# 1964
# FORD
# and
# MERCURY

# SHOP MANUAL

DAVE GRAHAM
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# 1964

# FORD-MERCURY

# SHOP MANUAL

Official Licensed Product
Ford Motor Company

SERVICE DEPARTMENT
FORD DIVISION
Ford MOTOR COMPANY

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# FOREWORD

*This shop manual provides the Service Technician with complete information for the proper servicing of the 1964 Ford and Mercury cars.*

*The information is grouped according to the type of work being performed, such as diagnosis and testing, frequently performed adjustments and repairs, in-vehicle adjustments, overhaul, etc. Specifications and recommended special tools are included.*

*Refer to the opposite page for important vehicle identification data.*

*The descriptions and specifications in this manual were in effect at the time this manual was approved for printing. The Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.*

**SERVICE DEPARTMENT**

**FORD MOTOR COMPANY**

# FORD IDENTIFICATION

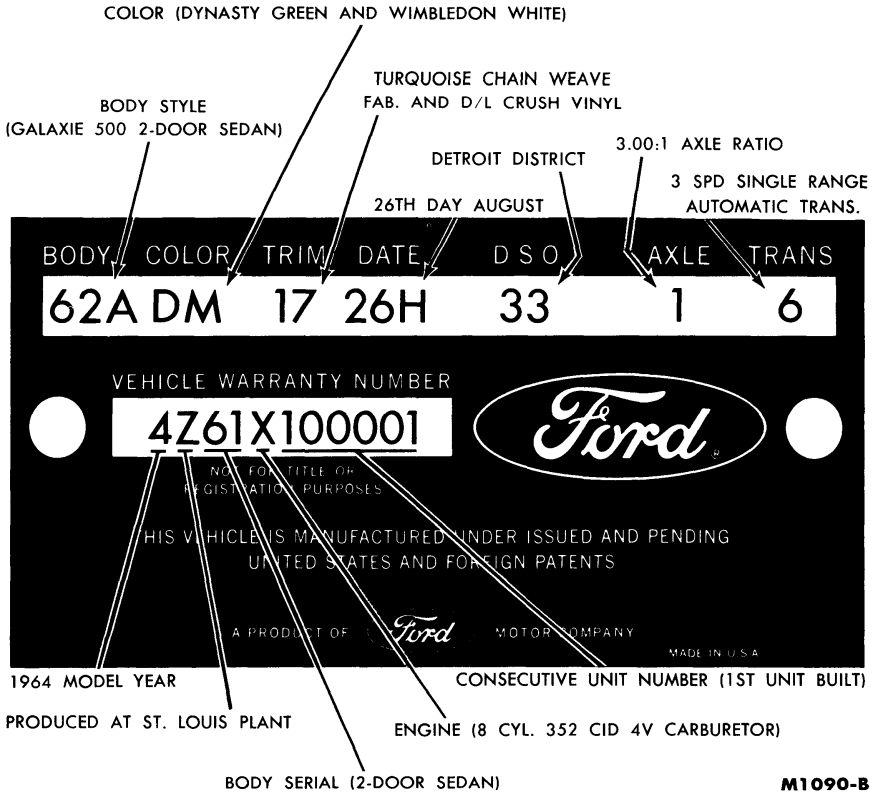



**FIG. 1—1964 Ford Warranty Plate**

Figure 1 illustrates the 1964 Galaxie Warranty Plate. The plate is located on the rear (lock) face of the left front door panel.

The official Vehicle Identification Number for title and registration purposes is stamped on a tab attached to the top right side (weld flange) of the dash panel in the engine compartment (Fig. 2). Do not use the "Vehicle Warranty Number" which appears on the Warranty plate for title or registration purposes.

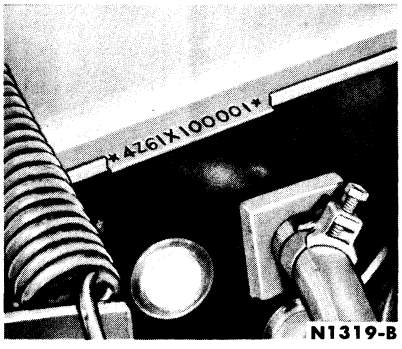



**FIG. 2—Ford Vehicle Identification Number Location**

## VEHICLE DATA

**Example (Fig. 1):**

(62A DM 17 26H 33 1 6)

62A.....2-Door Sedan
DM.....Dynasty Green and Wimbledon White
17.....Turquoise Chain Weave Fab. and Lt. Turquoise D/L Crush Vinyl
26H.....26th Day August
33.....Detroit District
1.....3.00:1 Ratio
6.....C-4 Automatic Dual Range

### BODY

**Ford Custom**

54E.....4-Door Sedan
62E.....2-Door Sedan

**Ford Custom 500**

54B.....4-Door Sedan
62B.....2-Door Sedan

**Galaxie 500**

54A.....4-Door Sedan
57B.....4-Door Fastback
62A.....2-Door Sedan
63B.....2-Door Fastback
76A.....2-Door Convertible

**Galaxie 500XL**

57C.....4-Door Fastback
63C.....2-Door Fastback
76B.....2-Door Convertible

**Station Wagons**

71A.....4-Door 9-Pass. Country Squire
71B.....4-Door 6-Pass. Country Sedan
71C.....4-Door 9-Pass. Country Sedan
71E.....4-Door 6-Pass. Country Squire

## COLOR

Two-tone paint codes use the same symbols as the single colors except that two symbols are used. The lower body color code will appear first in the warranty plate paint color space.

If a special paint is used, the paint color space will not be stamped.

| Code | *M-30-J Number | Color | Sales Name |
|---|---|---|---|
| A | 1724 | Black | Raven Black |
| B | 1638 | Peacock | Pagoda Green |
| D | 1625 | Med. Turquoise Met. | Dynasty Green |
| F | 1622 | Med. Blue Met. | Guardsman Blue |
| G | 1636 | Buff | Prairie Tan |
| J | 1515 | Red | Rangoon Red |
| K | 1621 | Silver Mink Met. | Silver Smoke Gray |
| M | 1619 | White | Wimbledon White |
| R | 1633 | Yellow | Phoenician Yellow |
| T | 1631 | Lt. Beige | Navaho Beige |
| X | 1632 | Maroon Met. | Vintage Burgundy |
| Y | 1623 | Lt. Blue | Skylight Blue |
| Z | 1630 | Med. Beige Met. | Chantilly Beige |

*"M-32-J" Acrylic Paint Alternate with "M-30-J"

## TRIM

Deviation trim sets will use existing trim codes plus a suffix. A trim code with a numerical suffix is not serviced, while a trim code with an alphabetical suffix is serviced.

| Code | Trim Schemes |
|---|---|
| | **Rib Vinyl and Crush Vinyl** |
| 03 | Med. Green and Med. Green |
| 04 | Med. Beige and Med. Beige |
| | **Chain Weave Fabric and Crush Vinyl** |
| 12 | Blue and Lt. Blue D/L* |
| 14 | Beige and Beige |
| 15 | Red and Red |
| 16 | Black and Black |
| 17 | Turquoise and Lt. Turquoise D/L* |
| | **Louvre Fabric and Crush Vinyl** |
| 22 | Blue and Lt. Blue Met. |
| 24 | Beige and Beige |
| 25 | Red and Red |
| 27 | Turquoise and Lt. Turquoise Met. |
| | **Bar Dot Fabric and Crush Vinyl** |
| 32 | Blue and Lt. Blue |
| 34 | Beige and Pale Beige |
| 35 | Red and Red |
| | **Mosaic Vinyl and Crush Vinyl** |
| 42 | Med. Blue Met. and Lt. Blue Met. |
| 44 | Med. Beige Met. and Beige |
| 45 | Red and Red |
| 47 | Med. Turquoise Met. and Lt. Turquoise Met. |
| | **Crush Vinyl (Bench Seat)** |
| 71 | Med. Silver Blue D/L and Lt. Silver Blue D/L* |
| 72 | Med. Blue D/L and Lt. Blue D/L* |
| 74 | Lt. Beige D/L and Beige |
| 75 | Red |
| 76 | Black |
| 77 | Med. Turquoise D/L and Turquoise D/L* |
| | **Crush Vinyl (Bucket Seat)** |
| 80 | White |
| 81 | Med. Silver Blue D/L and Silver Blue D/L* |
| 82 | Med. Blue D/L and Lt. Blue D/L |
| 84 | Lt. Beige D/L and Beige |
| 85 | Red |
| 86 | Black |
| 87 | Med. Turquoise D/L and Lt. Turquoise D/L* |
| 89 | Med. Palomino (Crinkle) |

*D/L—Diamond Lustre

## DATE

The code letters for the month are preceded by a numeral to show the day of the month when the car was completed. The second year code letters are to be used if 1964 model production exceeds 12 months.

| Month | First Model Year | Second Model Year |
|---|---|---|
| January | A | N |
| February | B | P |
| March | C | Q |
| April | D | R |
| May | E | S |
| June | F | T |
| July | G | U |
| August | H | V |
| September | J | W |
| October | K | X |
| November | L | Y |
| December | M | Z |

## DSO

Domestic Special Orders, Foreign Special Orders, and Pre-Approved Special Orders have the complete order number recorded in this space. Also to appear in this space is the two-digit code number of the District which ordered the unit. If the unit is regular production, only the District code number will appear.

## DISTRICT CODE

| Code | District | Code | District |
|---|---|---|---|
| 11 | Boston | 45 | Davenport |
| 12 | Buffalo | 51 | Denver |
| 13 | New York | 52 | Des Moines |
| 14 | Pittsburgh | 53 | Kansas City |
| 15 | Newark | 54 | Omaha |
| 21 | Atlanta | 55 | St. Louis |
| 22 | Charlotte | 61 | Dallas |
| 23 | Philadelphia | 62 | Houston |
| 24 | Jacksonville | 63 | Memphis |
| 25 | Richmond | 64 | New Orleans |
| 26 | Washington | 65 | Oklahoma City |
| 31 | Cincinanti | 71 | Los Angeles |
| 32 | Cleveland | 72 | San Jose |
| 33 | Detroit | 73 | Salt Lake City |
| 34 | Indianapolis | 74 | Seattle |
| 35 | Lansing | 81 | Ford of Canada |
| 36 | Louisville | 83 | Government |
| 41 | Chicago | 84 | Home Office Reserve |
| 42 | Fargo | 85 | American Red Cross |
| 43 | Rockford | 89 | Transportation Services |
| 44 | Twin Cities | 90 | Export |

## AXLE

A number designates a conventional axle, while a letter designates an Equa-Lock differential.

| Code | Ratio | Code | Ratio |
|---|---|---|---|
| 1 | 3.00:1 | A | 3.00:1 |
| 4 | 3.25:1 | E | 3.25:1 |
| 5 | 3.50:1 | F | 3.50:1 |
| 8 | 3.89:1 | H | 3.89:1 |
| 9 | 4.11:1 | I | 4.11:1 |

## TRANSMISSION

| Code | Type |
|---|---|
| 1 | 3-Speed Manual-Shift |
| 2 | Overdrive |
| 4 | Cruise-O-Matic |
| 5 | 4-Speed Manual-Shift |
| 6 | C-4 Automatic Dual Range |

## VEHICLE WARRANTY NUMBER

**Example (Fig. 1): 4Z61X100001**

| | |
|---|---|
| 4 | 1964 Year Model |
| Z | St. Louis Plant Assembly |
| 61 | 2-Door Sedan |
| X | 8-Cylinder 352 Cubic Inch Engine |
| 100001 | First Unit Built (Consecutive Unit Number) |

## MODEL YEAR

The numeral "4" designates 1964.

## ASSEMBLY PLANT

| Code Letter | Assembly Plant | Code Letter | Assembly Plant |
|---|---|---|---|
| A | Atlanta | P | Twin Cities |
| D | Dallas | S | Pilot Plant |
| E | Mahwah | U | Louisville |
| G | Chicago | W | Wayne |
| J | Los Angeles | Z | St. Louis |
| N | Norfolk | | |

## MODEL

The model code number identifies the product line series and the particular body style: the first of the two digits shows the product line, and the second digit shows a two-door style by an odd number or a four-door style by an even number.

**Ford Custom**
- 53 ..... 2-Door Sedan
- 54 ..... 4-Door Sedan

**Ford Custom 500**
- 51 ..... 2-Door Sedan
- 52 ..... 4-Door Sedan

**Galaxie 500**
- 61 ..... 2-Door Sedan
- 62 ..... 4-Door Sedan
- 64 ..... 4-Door Hardtop
- 65 ..... 2-Door Convertible
- 66 ..... 2-Door Fastback

**Galaxie 500XL**
- 60 ..... 4-Door Fastback
- 68 ..... 2-Door Fastback
- 69 ..... 2-Door Convertible

**Station Wagons**
- 72 ..... 4-Door 6-Passenger Country Sedan
- 74 ..... 4-Door 9-Passenger Country Sedan
- 76 ..... 4-Door 6-Passenger Country Squire
- 78 ..... 4-Door 9-Passenger Country Squire

## ENGINE

**Code**
- B ..... 6-Cylinder 223 Cubic Inch (Police)
- C ..... 8-Cylinder 289 Cubic Inch (2-barrel)
- E ..... 6-Cylinder 223 Cubic Inch (Taxi)
- P ..... 8-Cylinder 390 Cubic Inch (Police)
- Q ..... 8-Cylinder 427 Cubic Inch (4-barrel High Perf.)
- R ..... 8-Cylinder 427 Cubic Inch (8-barrel High Perf.)
- V ..... 6-Cylinder 223 Cubic Inch
- X ..... 8-Cylinder 352 Cubic Inch (4-barrel)
- Z ..... 8-Cylinder 390 Cubic Inch (4-barrel)

**Low Compression**
- 3 ..... 8-Cylinder 289 Cubic Inch
- 5 ..... 6-Cylinder 223 Cubic Inch
- 9 ..... 8-Cylinder 390 Cubic Inch

## CONSECUTIVE UNIT NUMBER

Each assembly plant, with each model year, begins with consecutive unit number 100001 and continues on for each car built.

# MERCURY IDENTIFICATION

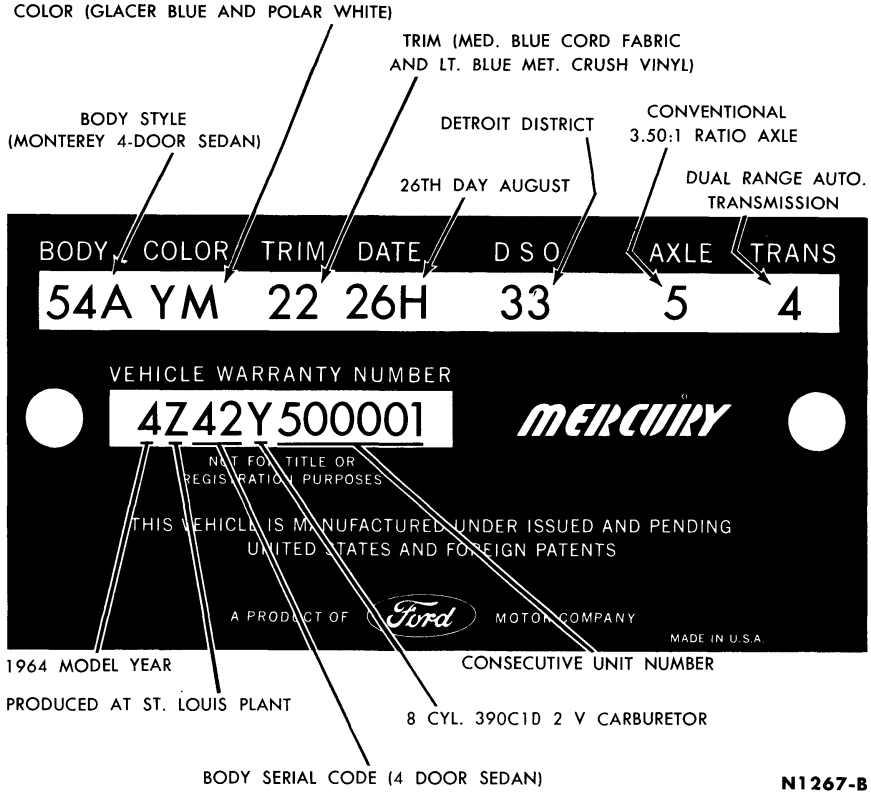



**FIG. 3—Mercury Warranty Plate**

Figure 3 illustrates the 1964 Monterey Warranty plate. The plate is located on the rear (lock) face of the left front door panel.

The official Vehicle Identification Number for title and registration purposes is stamped on a tab attached to the top right side (weld flange) of the dash panel in the engine compartment (Fig. 4). Do not use the "Vehicle Warranty Number" which appears on the Warranty plate for title or registration purposes.




**FIG. 4—Mercury Vehicle Identification Number Location**

## VEHICLE DATA

**Example (Fig. 3):**

(54A YM 22 26H 33 5 4)

54A....4-Door Sedan
YM....Glacier Blue and Polar White
22....Med. Blue Cord Fabric and Lt. Blue Met. Crush Vinyl
26H....26th Day of August
33....Detroit District
5....3.50:1 Ratio
4....Dual Range Automatic Transmission

### BODY

**Monterey**

54A....4-Door Sedan
62A....2-Door Sedan
63A....2-Door Hardtop Fastback
65A....2-Door Hardtop
76A....2-Door Convertible

**Montclair**

54B....4-Door Sedan
57D....4-Door Hardtop Fastback
63D....2-Door Hardtop Fastback
65B....2-Door Hardtop

**Parklane**

54F....4-Door Sedan
57C....4-Door Hardtop Fastback (Bucket Seats)
57F....4-Door Hardtop Fastback
63C....2-Door Hardtop Fastback (Bucket Seats)
65C....2-Door Hardtop (Bucket Seats)
65F....2-Door Hardtop
75F....4-Door Hardtop
76C....2-Door Convertible (Bucket Seats)
76F....2-Door Convertible

**Station Wagons**

71A....4-Door 6-Pass. Commuter
71B....4-Door 6-Pass. Colony Park
71C....4-Door 9-Pass. Commuter
71D....4-Door 9-Pass. Colony Park

### COLOR

Two-tone paint codes use the same symbols as the single colors except that two symbols are used. The lower body color code will appear first in the Warranty Plate Paint Color Space.

If a special paint is used, the paint color space will not be stamped.

| Code | *M-30-J Number | Color | Sales Name |
|---|---|---|---|
| A | 1724 | Black | Onyx |
| B | 1638 | Peacock | Peacock |
| D | 1625 | Med. Turquoise Met. | Silver Turquoise |
| F | 1622 | Med. Blue Met. | Pacific Blue |
| G | 1636 | Buff | Palomino |
| I | 1635 | Aztec Gold | Aztec Gold |
| J | 1515 | Red | Carnival Red |
| K | 1621 | Silver Blue Met. | Anniversary Silver |
| L | 1637 | Bittersweet | Bittersweet |
| M | 1619 | White | Polar White |
| R | 1633 | Yellow | Yellow Mist |
| T | 1631 | Lt. Beige | Fawn |
| W | 1555 | Lt. Pink Met. | Pink Frost |
| X | 1632 | Maroon Met. | Burgundy |
| Y | 1623 | Lt. Blue | Glacier Blue |
| Z | 1630 | Med. Beige Met. | Platinum Beige |

*"M-32-J" Acrylic Paint Alternate with "M-30-J".

### TRIM

Deviation trim sets will use existing trim codes plus a suffix. A trim code with a numeral suffix is not serviced, while a trim code with an alphabetical suffix is serviced.

| Code | Trim Schemes |
|---|---|
| | **Discus Fabric and Crush Vinyl (Bench-Pleated)** |
| 11 | Med. Silver Blue and Lt. Silver Blue Met. |
| 12 | Med. Blue and Lt. Blue Met. |
| 14 | Med. Beige and Lt. Beige Met. |
| 16 | Black and Black |
| | **Cord Fabric and Crush Vinyl (Bench-Plain)** |
| 22 | Med. Blue and Lt. Blue Met. |
| 24 | Med. Beige and Lt. Beige Met. |
| 26 | Black and Black |
| | **Stitch Rib Vinyl and Crush Vinyl (Crinkle) (Bench-Plain)** |
| 32 | Med. Blue Met. and Lt. Blue Met. |
| 35 | Red and Red |
| 36 | Black and Black |
| 39 | Med. Palomino and Med. Palomino (*) |
| | **Ostrich Vinyl and Crush Vinyl (Crinkle) (Bucket-Biscuit)** |
| 52 | Med. Blue Met. and Lt. Blue D/L* |
| 55 | Red and Red |
| 56 | Black and Black |
| 59 | Med. Palomino and Med. Palomino |
| 82 | White Pearl and White Pearl |
| 85 | (W/Red) White and White Pearl |
| 86 | (W/Black) White Pearl and White Pearl |
| 87 | (W/Turq.) White Pearl and White Pearl) |
| 89 | (W/Palomino) White Pearl and White Pearl |
| | **Caspian Fabric and Crush Vinyl (Bench-Biscuit)** |
| 61 | Med. Silver Blue and Lt. Silver Blue D/L* |
| 62 | Med. Blue and Lt. Blue D/L* |
| 64 | Med. Beige and Lt. Beige D/L* |
| 66 | Black and Black |
| 67 | Med. Turquoise and Med. Turquoise Met. |
| | **Crush Vinyl (Crinkle) (Bench-Pleated)** |
| 72 | Med. and Lt. Blue Met. |
| 75 | Red |
| 76 | Black |
| 79 | Medium Palomino |
| | **Ostrich Vinyl and Crush Vinyl (*Crinkle) (Bench-Biscuit)** |
| 92 | Lt. Blue Met. and Med. Blue Met. |
| 95 | Red and Red |
| 96 | Black and Black |
| 97 | Lt. Turquoise Met. and Med. Turquoise Met. |
| 99 | Med. Palomino and Med. Palomino (*) |

*D/L—Diamond Lustre

## DATE

The code letters for the month are preceded by a numeral to show the day of the month when the car was completed. The second year code letters are to be used if 1964 model production exceeds 12 months.

| Month | First Model Year | Second Model Year |
|---|---|---|
| January | A | N |
| February | B | P |
| March | C | Q |
| April | D | R |
| May | E | S |
| June | F | T |
| July | G | U |
| August | H | V |
| September | J | W |
| October | K | X |
| November | L | Y |
| December | M | Z |

## DSO

Domestic Special Orders, Foreign Special Orders, and Pre-Approved Special Orders have the complete order number recorded in this space. Also to appear in this space is the two-digit code number of the District which ordered the unit. If the unit is regular production, only the District code number appears.

## DISTRICT CODE

| Code | District | Code | District |
|---|---|---|---|
| 11 | Boston | 41 | Chicago |
| 12 | Philadelphia | 44 | St. Louis |
| 13 | New York | 45 | Twin Cities |
| 14 | Washington | 51 | Denver |
| 21 | Atlanta | 52 | Los Angeles |
| 22 | Dallas | 53 | Oakland |
| 24 | Jacksonville | 54 | Seattle |
| 25 | Memphis | 81 | Ford of Canada |
| 31 | Buffalo | 84 | Home Office Reserve |
| 32 | Cincinnati | 90-99 | Export |
| 33 | Cleveland | | |
| 34 | Detroit | | |

## AXLE

A number designates a Conventional axle, while a letter designates an Equa-Lock differential.

| Code | Ratio | Code | Ratio |
|---|---|---|---|
| 1 | 3.00:1 | A | 3.00:1 |
| 5 | 3.50:1 | F | 3.50:1 |
| 8 | 3.89:1 | H | 3.89:1 |
| 9 | 4.11:1 | I | 4.11:1 |

## TRANSMISSION

| Code | Type |
|---|---|
| 1 | 3-Speed Manual-Shift |
| 2 | Overdrive |
| 4 | Automatic (Multi-Drive) |
| 5 | 4-Speed Manual-Shift |

## VEHICLE WARRANTY NUMBER

**Example (Fig. 3): 4W42Y 500001**

| | |
|---|---|
| 4 | 1964 Model Year |
| W | Wayne Plant Assembly |
| 42 | Monterey 4-Door Sedan |
| Y | 8-Cylinder 390 Cubic Inch Engine |
| 500001 | First Unit Built |

## MODEL YEAR

The numeral "4" designates 1964.

## ASSEMBLY PLANT

| Code Letter | Assembly Plant |
|---|---|
| S | Pilot Plant |
| Z | St. Louis |
| W | Wayne |

## MODEL

The model code number identifies the product line series and the particular body style: the first of the two digits shows the product line, and the second digit shows a two-door style by an odd number or a four-door style by an even number.

| | |
|---|---|
| **Monterey** | |
| 41 | 2-Door Sedan |
| 42 | 4-Door Sedan |
| 43 | 2-Door Hardtop |
| 45 | 2-Door Convertible |
| 47 | 2-Door Hardtop Fastback |
| **Montclair** | |
| 52 | 4-Door Sedan |
| 53 | 2-Door Hardtop |
| 57 | 2-Door Hardtop Fastback |
| 58 | 4-Door Hardtop Fastback |
| **Parklane** | |
| 62 | 4-Door Sedan |
| 63 | 2-Door Hardtop |
| 64 | 4-Door Hardtop |
| 65 | 2-Door Convertible |
| 67 | 2-Door Hardtop Fastback |
| 68 | 4-Door Fastback |
| **Station Wagon** | |
| 72 | 4-Door 6-Pass. Commuter |
| 72 | 4-Door 9-Pass. Commuter |
| 76 | 4-Door 6-Pass. Colony Park |
| 76 | 4-Door 9-Pass. Colony Park |

## ENGINE

| Code | |
|---|---|
| H | 8-Cylinder 390 Cubic Inch (2-barrel Special) |
| P | 8-Cylinder 390 Cubic Inch (4-barrel Police) |
| Q | 8-Cylinder 427 Cubic Inch (4-barrel High Perf.) |
| R | 8-Cylinder 427 Cubic Inch (8-barrel High Perf.) |
| Y | 8-Cylinder 390 Cubic Inch (2-barrel) |
| Z | 8-Cylinder 390 Cubic Inch (4-barrel) |
| 9 | 8-Cylinder 390 Cubic Inch (4-barrel, Low Compression) |

## CONSECUTIVE UNIT NUMBER

Each assembly plant, with each model year, begins with consecutive unit number 500001 and continues on for each car built.

# BRAKES

# GROUP 2


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# PART 2-1 GENERAL BRAKE SERVICE


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| 2 Common Adjustments and Repairs | 2- 3 |
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## 1 DIAGNOSIS AND TESTING

### PRELIMINARY TESTS

**1.** Check the fluid level in the master cylinder, and add FoMoCo **heavy-duty** brake fluid if required.

**2.** With the engine running or enough vacuum in the system for power brakes, push the brake pedal down as far as it will go while the car is standing still. If the pedal travels more than halfway between the released position and the floor, check the brake adjustment and the automatic adjusters.

To check adjuster operation, check the shoes and the adjuster components for binding or improper installation. Follow the procedure described under "Brake Shoe Adjustments" in Part 2-2, Section 2.

Make several reverse brake stops to ensure uniform adjustment at all wheels.

**3.** On cars with power brakes, with the transmission in neutral, stop the engine and apply the parking brake. Depress the service brake pedal several times to exhaust all vacuum in the system. Then, depress the pedal and hold it in the applied position. Start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum booster system is not functioning. Follow the procedures in the "Booster Diagnosis Guide". With the engine shut off, exhaust all vacuum in the system. Depress the brake pedal and hold it in the applied position. If the pedal gradually falls away under this pressure, the hydraulic system is leaking. Check all tubing hoses, and connections for leaks.

If the brake pedal movement feels spongy, bleed the hydraulic system to remove air from the lines and cylinder. See Section 2, "Hydraulic System Bleeding". Also, check for leaks or insufficient fluid.

**4.** Should one of the brakes be locked and the car must be moved, open the brake cylinder bleeder screw long enough to let out a few drops of brake fluid. **This bleeding operation will release the brakes, but it will not correct the cause of the trouble.**

### ROAD TEST

**The car should be road tested only if the brakes will safely stop the car.** Apply the brakes at a speed of 25-30 mph to check for the existance of the trouble symptoms listed in Table 1, with the exception of those resolved in the preliminary tests and brake chatter. For each of the symptoms encountered, check and eliminate the causes which are also listed in Table 1. To check for brake chatter or surge, apply the brakes lightly at approximately 50 mph.

For booster removal and installation procedures, refer to Part 2-2, Section 3. For disassembly and assembly procedures, refer to Part 2-2, Section 4. For cleaning and inspection refer to Part 2-1, Section 3.

**TABLE 1—Brake Trouble Symptoms and Possible Causes**

| Possible Causes of Trouble Symptoms | Trouble Symptoms | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | One Brake Drags | All Brakes Drag | Hard Pedal | Spongy Pedal | Car Pulls to One Side | One Wheel Locks | Brakes Chatter | Excessive Pedal Travel | Pedal Gradually Goes to Floor | Brakes Uneven | Shoe Click After Release | Noisy or Grabbing Brakes | Brakes Do Not Apply |
| Mechanical Resistance at Pedal or Shoes | | x | x | | | | | | | | | | |
| Brake Line Restricted | x | x | x | | x | | | | | | | | |
| Leaks or Insufficient Fluid | | | | x | | | | x | x | | | | x |
| Improper Tire Pressure | | | | | x | | | | | x | | | |
| Improperly Adjusted or Worn Wheel Bearing | x | | | | x | | | | | | | | |
| Distorted or Improperly Adjusted Brake Shoe | x | x | x | | x | x | | x | | | x | x | |
| Faulty Retracting Spring | x | | | | x | | | | | | | | |
| Drum Out of Round | x | | | | x | | x | | | | | | |
| Linings Glazed or Worn | | | x | | x | x | x | x | | | x | x | x |
| Oil or Grease on Lining | | | x | | x | x | x | | | x | | x | x |
| Loose Carrier Plate | x | | | | | x | x | | | | | | |
| Loose Lining | | | | | | | x | | | | | | |
| Scored Drum | | | | | | | | | | x | | x | |
| Dirt on Drum-Lining Surface | | | | | | | | | | | | x | |
| Faulty Brake Cylinder | x | | | | x | x | | | | | | x | |
| Dirty Brake Fluid | x | x | | | | | | | | x | | | x |
| Faulty Master Cylinder | | x | | | | | | x | x | | | | x |
| Air in Hydraulic System | x | | | x | | | | x | | | | | x |
| Self Adjusters Not Operating | | | | | x | | | x | | | | | |
| Insufficient Shoe-to-Carrier Plate Lubrication | x | | | | | | | | | | x | | |
| Tire Tread Worn | | | | | | x | | | | | | | |
| Poor Lining to Drum Contact | | | | | | | x | | | | | | |
| Loose Front Suspension | | | | | | | x | | | | | | |
| "Threads" Left by Drum Turning Tool Pulls Shoes Sideways | | | | | | | | | | | x | | |
| Cracked Drum | | | | | | | | | | | | | |
| Sticking Booster Control Valve | | x | | | | | | x | | | | x | |

**BRAKE BOOSTER TROUBLE DIAGNOSIS GUIDE**

| | | |
|---|---|---|
| **BOOSTER INOPERATIVE—HARD PEDAL** | If the preliminary tests show that the booster is inoperative or if a hard pedal condition still exists after eliminating the causes of "Hard Pedal" listed in table 1, the trouble may be caused by vacuum leakage. Disconnect the vacuum line (two lines if equipped with an automatic transmission) at the booster, remove the vacuum manifold and check valve assembly, and look for a sticking or faulty check valve. Check all vacuum connections for leakage or obstruction. Check all hoses for a leaking or collapsed condition. Repair or replace parts as necessary.<br>If the foregoing procedure does not eliminate the trouble, remove the booster from the car. Separate the booster body from the end plate, and check the bellows, booster body, and diaphragm assembly for damage that would cause leaks. When assembling, be sure that the diaphragm assembly is properly positioned. Improper location could cause leakage between the vacuum and atmospheric sides of the diaphragm. |
| **BRAKES DRAG OR GRAB** | If the brakes still drag or grab after eliminating the causes listed in Table 1, the condition is probably caused by a sticking valve plunger assembly. | Remove and disassemble the booster. Clean, inspect, and replace parts as necessary. |
| **SELF APPLICATION OF BRAKES WHEN ENGINE STARTS** | Remove and disassemble the booster. Check the diaphragm for being out of locating radii in the housing. Check for a sticking or unseated | atmospheric valve. Clean, inspect, and replace parts as necessary. Be sure that the diaphragm is properly located when assembling. |

## 2 COMMON ADJUSTMENTS AND REPAIRS

### PARKING BRAKE LINKAGE ADJUSTMENT

Check the parking brake cables when the brakes are fully released. If the cables are loose, adjust them as follows.

1. Fully release the parking brake pedal by pushing down on the manual release lever.
2. Raise the car.
3. Adjust the pedal cable to the dimensions shown in Fig. 1.
4. Depress the parking brake pedal one notch from its normal released position.
5. Loosen the lock nut on the equalizer rod (Fig. 2), and then turn the nut in front of the equalizer several turns forward.
6. Turn the lock nut forward against the equalizer until a moderate drag is felt when turning the rear wheels.
7. When the cables are properly adjusted, tighten both nuts against the equalizer.
8. Release the parking brake, and make sure that the brake shoes return to the fully released position.

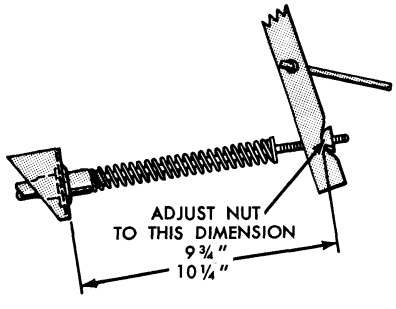



**FIG. 1—Pedal Cable Adjustment**

### POWER BRAKE MASTER CYLINDER PUSH ROD ADJUSTMENT

The push rod is provided with an adjustment screw to maintain the correct relationship between the booster control valve plunger and the master cylinder piston. Failure to maintain this relationship will prevent the master cylinder piston from completely releasing hydraulic pressure and can cause the brakes to drag.

To check the adjustment of the

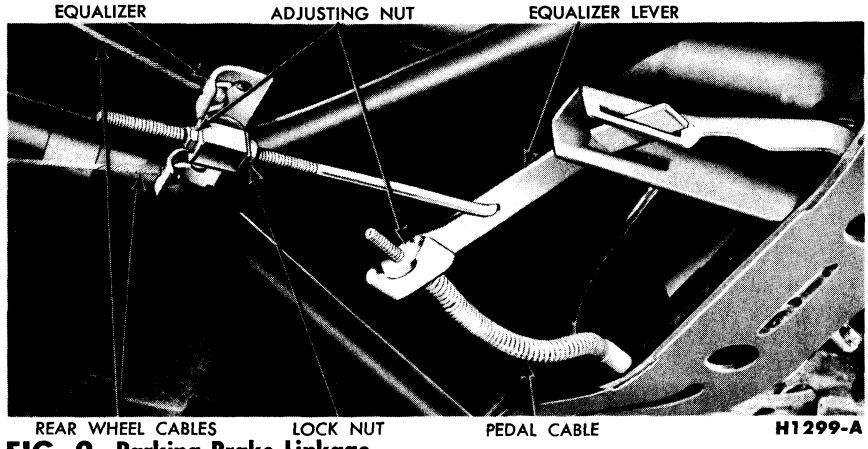



**FIG. 2—Parking Brake Linkage**

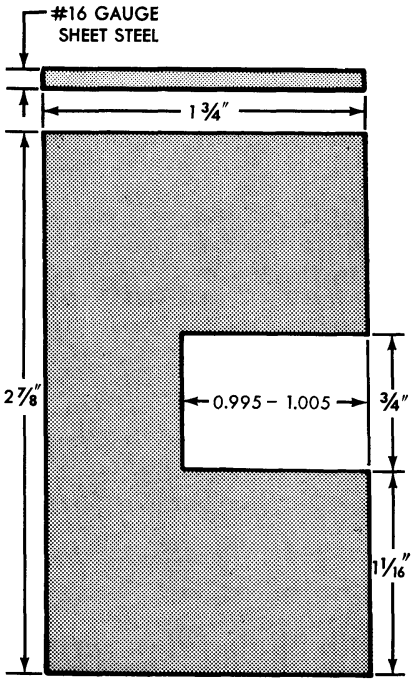



**FIG. 3—Push Rod Gauge Dimensions**

screw, fabricate a gauge of the dimensions shown in Fig. 3. Then place the gauge against the master cylinder mounting surface of the booster body as shown in Fig. 4. The push rod screw should be adjusted so that the end of the screw just touches the inner edge of the slot in the gauge. Do not set up side forces on the push rod as it may break the valve plunger.

**This is an approximate adjustment only.** To verify the adjustment, look through the make-up (rear) port when installing the master cylinder to the booster. The master cylinder piston should not move more than 0.015 inch as it contacts the push rod. No movement (exact contact) is ideal.

## HYDRAULIC SYSTEM BLEEDING

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action. Bleed the hydraulic system after it has been properly connected to be sure that all air is expelled from the brake cylinders and lines.

The hydraulic system can be bled manually or with pressure bleeding equipment.

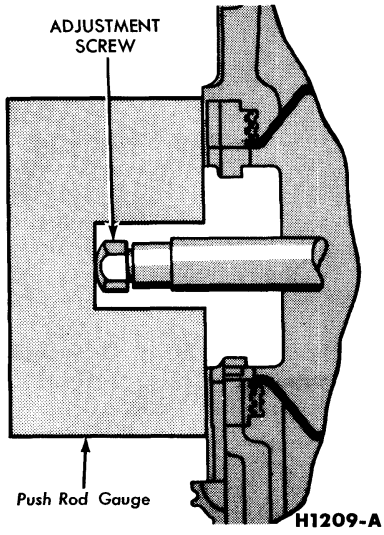



**FIG. 4—Push Rod Adjustment**

### MANUAL BLEEDING

Bleed the longest lines first. Keep the master cylinder reservoir filled with new heavy-duty brake fluid during the bleeding operation.

**Never use brake fluid which has been drained from the hydraulic system.**

**1.** Position a bent 3/8-inch box wrench on the bleeder fitting on the right rear brake wheel cylinder (Fig. 5). Attach a rubber drain tube to the bleeder fitting. **The end of the tube should fit snugly around the bleeder fitting.**

**2.** Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder fitting approximately 3/4 turn.

**3.** Push the brake pedal down slowly thru its full travel. Close the bleeder fitting, then return the pedal to the fully-released position. Repeat this operation until air bubbles cease to appear at the submerged end of the tube.

**4.** When the fluid is completely free of air bubbles, close the bleeder fitting and remove the drain tube.

**5.** Repeat this procedure at each brake wheel cylinder in order: left rear, right front, and left front. Refill the master cylinder reservoir after each brake cylinder is bled and when the bleeding operation is completed. The fluid level should be within 3/8 inch of the top of the reservoir.

### PRESSURE BLEEDING

Bleed the longest lines first. **Never use brake fluid which has been drained from the hydraulic system.**

The bleeder tank should contain enough new heavy-duty brake fluid to complete the bleeding operation, and it should be charged with 10-30 pounds of air pressure.

**1.** Clean all dirt from the master cylinder reservoir cap.

**2.** Remove the master cylinder reservoir cap, install an adapter cap on the reservoir, and attach the bleeder tank hose to the fitting on the adapter cap. Adapter cap 2162 can be used, or an adapter cap can be fabricated by cutting a hole in the center of a filler cap and soldering a fitting at the hole.

**3.** Position a 3/8-inch box wrench on the bleeder fitting on the right rear brake wheel cylinder (Fig. 5). Attach a rubber drain tube to the bleeder fitting. **The end of the tube should fit snugly around the bleeder fitting.**

**4.** Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.

**5.** Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder fitting.

**6.** When air bubbles cease to appear in the fluid at the submerged end of the drain tube, close the bleeder fitting and remove the tube.

**7.** Repeat this procedure at each brake wheel cylinder in order: left rear, right front, and left front.

**8.** When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the adapter fitting.

**9.** Remove the adapter cap, refill the master cylinder reservoir to within 3/8 inch from the top of the reservoir, and install the filler cap.

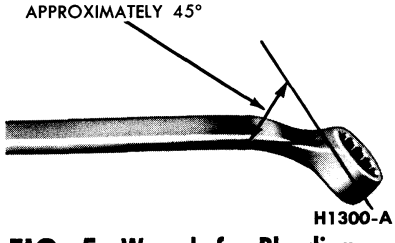



**FIG. 5—Wrench for Bleeding Brake**

## 3 CLEANING AND INSPECTION

### BRAKE ASSEMBLY

**1.** Remove the wheel from the drum, then remove the drum as outlined in Part 2-2, Section 2. Wash all the parts except the brake shoes in a cleaning fluid and dry with compressed air.

**2.** Brush all dust from the carrier plates and interior of the brake drums.

**3.** Inspect the brake shoes for excessive lining wear or shoe damage. If the lining is worn within 1/32 inch of the rivet heads or if the shoes are damaged, they must be replaced. Replace any lining that has been oil saturated. Replace lining in axle sets. Prior to replacement of lining, the drum diameter should be checked to determine if oversize linings must be installed.

**4.** Check the condition of brake shoes, retracting springs, and drum for signs of overheating. If the shoes have a slight blue coloring, indicating overheating, replacement of the retracting and hold down springs is strongly recommended. **Overheated springs lose their pull and could cause the new lining to wear prematurely, if they are not replaced.**

**5.** If the car has 24,000 or more miles of operation on the brake linings or signs of overheating are present when relining brakes, the wheel cylinders should be disassembled and inspected for wear and entrance of dirt into the cylinder. The cylinder cups should be replaced, thus avoiding future problems.

**6.** Inspect all other brake parts and replace any that are worn or damaged.

**7.** Inspect the brake drums and, if necessary, refinish. Refer to Part 2-2, Section 4 for refinishing.

### BOOSTER UNIT

A disassembled view of the brake booster is shown in Fig. 6.

After disassembly, immerse all metal parts in a suitable solvent. Use only alcohol on rubber parts or parts containing rubber. After the parts have been thoroughly cleaned and rinsed in cleaning solvent, the metal parts which come in contact with hydraulic brake fluid or rubber parts should be rewashed in clean alcohol before assembly. Use an air hose to blow dirt and cleaning fluid from the recesses and internal passages. When overhauling a power booster, use all parts furnished in the repair kit. **Discard all old rubber parts.**

Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts. If the inside of the booster body is rusted or corroded, polish it with steel wool or fine emery cloth. Replace the body shell when scored.

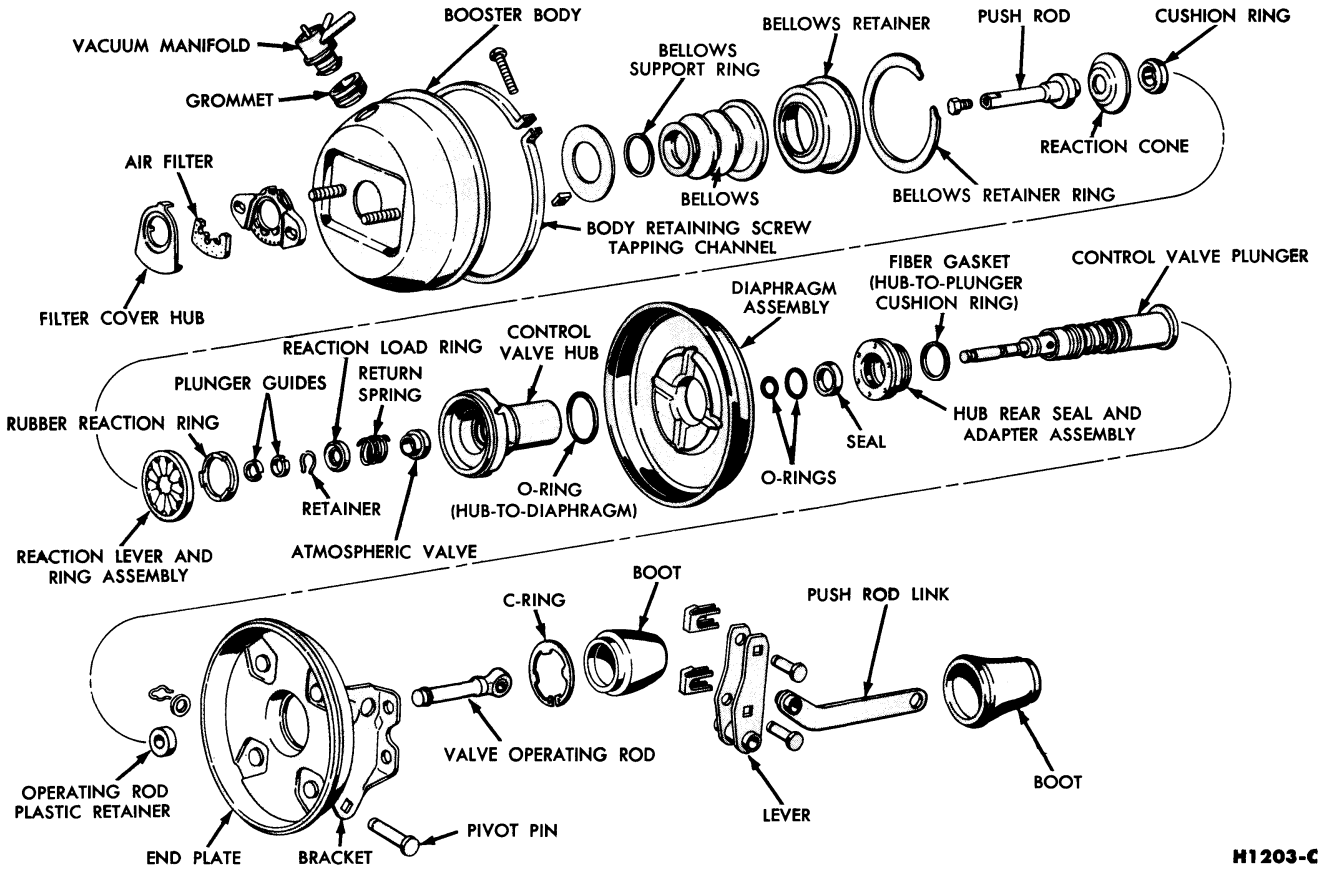



**FIG. 6—Booster Unit—Disassembled**

# PART 2-2 BRAKE SYSTEM


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 2- 6 | 3 Removal and Installation | 2-13 |
| 2 In-Car Adjustments and Repairs | 2- 8 | 4 Major Repair Operations | 2-16 |


## 1 DESCRIPTION AND OPERATION

### HYDRAULIC SELF ADJUSTING BRAKE SYSTEM

The hydraulic brake system employs single anchor, internal expanding and self adjusting brake assemblies.

The master cylinder converts physical force from the brake pedal and booster into hydraulic pressure against the pistons in the wheel cylinders. The wheel cylinder pistons, in turn, convert hydraulic pressure back into physical force at the brake shoes.

The self-adjusting brake mechanism consists of a cable, cable guide, adjusting lever, and adjuster spring (Fig. 1). The cable is hooked over the anchor pin at the top and is connected to the lever at the bottom. The cable is connected to the secondary brake shoe by means of the cable guide. The adjuster spring is hooked to the primary brake shoe and to the lever. The automatic adjuster operates only when the brakes are applied while the car is moving rearward and only when the secondary shoe is free to move toward the drum beyond a predetermined point.

With the car moving rearward and the brakes applied, the "wrap-around" action of the shoes following the drum forces the upper end of the primary shoe against the anchor pin. The action of the wheel cylinder moves the upper end of the secondary shoe away from the anchor pin. The movement of the secondary shoe causes the cable to pull the adjusting lever upward and against the end of a tooth on the adjusting screw star-wheel. The upward travel of the lever increases as lining wear increases. When the lever can move upward far enough, it passes over the end of the tooth and engages the tooth. When the brakes are released, the adjusting

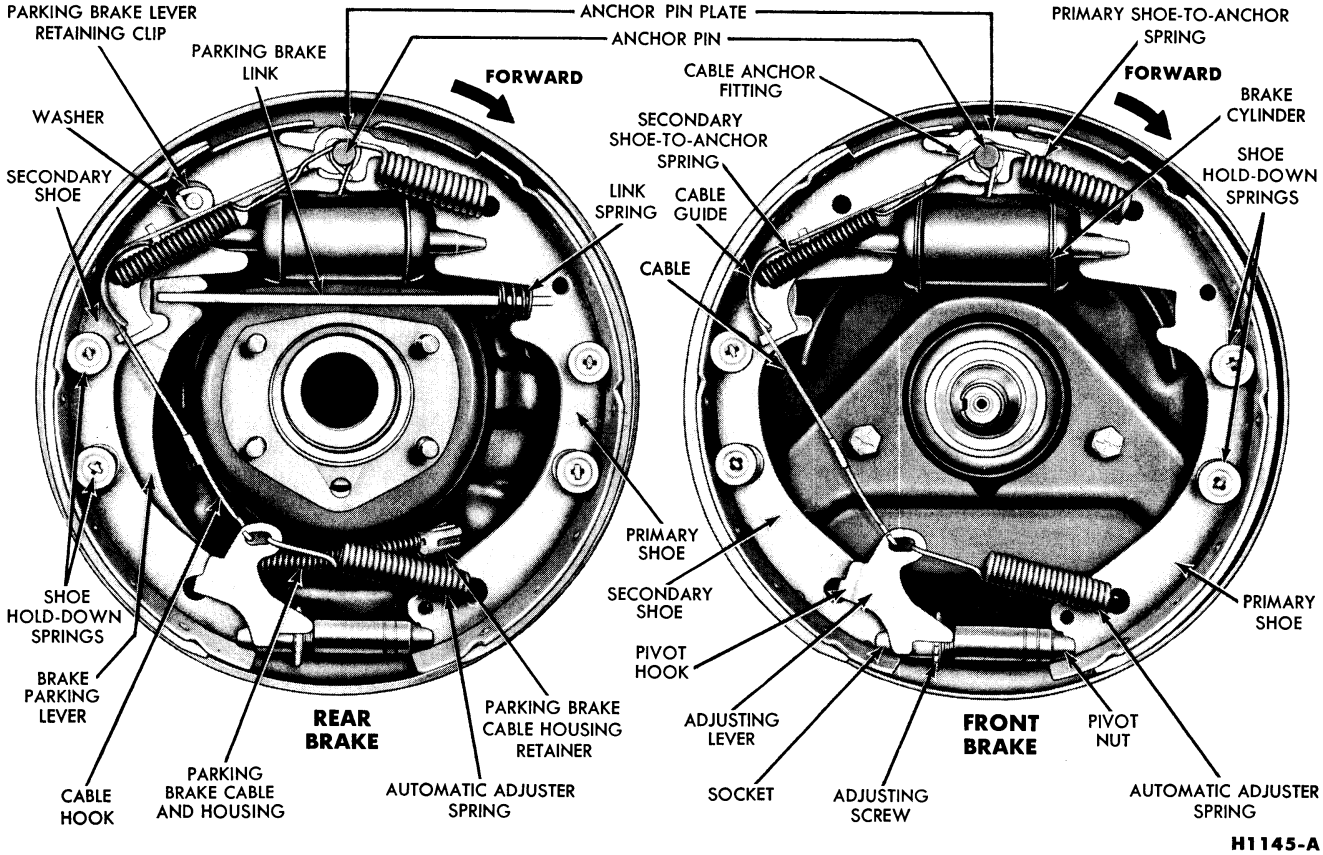



**FIG. 1—Self-Adjusting Brake Assemblies**

spring pulls the lever downward causing the starwheel to turn and expand the shoes. The star-wheel is turned one tooth at a time as the linings progressively wear.

With the car moving forward and the brakes applied, the secondary shoe is against the anchor pin and the primary shoe is moved toward the drum. Therefore, the adjuster does not operate.

The rear brake assembly is basically the same as the front brake. The conventional parking brake lever, link, and spring are used in the rear brake.

The anchor pins on all brakes are fixed and non-adjustable.

## BOOSTER SYSTEM

The optional power brake booster is installed on the engine side of the dash panel and is connected to the brake pedal through a lever assembly and push rod link.

The booster consists of a vacuum chamber, atmospheric valve, control valve plunger assembly, diaphragm, and an atmospheric chamber (Figs. 2, 3, and 4).

Atmospheric pressure is present at all times in the atmospheric chamber at the front side of the atmospheric valve. The air intake to the atmospheric chamber is protected by an air filter. The atmospheric chamber is separated from the vacuum chamber by the bellows assembly within the vacuum chamber.

Vacuum is present at all times in that area of the vacuum chamber forward of the diaphragm. Vacuum is supplied through a hose from the intake manifold to the vacuum manifold and check valve on the booster body. With this integral check valve and vacuum chamber, it is possible to obtain several power assisted brake applications with the engine shut off. This arrangement makes a vacuum reservoir unnecessary.

Either vacuum from the forward side of the diaphragm or air from the bellows (atmospheric chamber) can be connected to the rear side of the diaphragm through porting in the control valve hub and the plunger assembly.

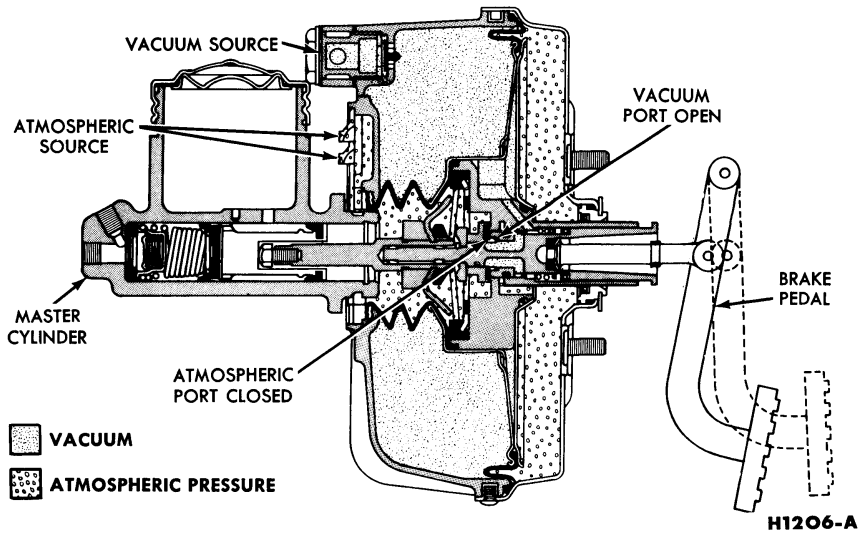



**FIG. 3—Booster in Holding Position**

## APPLYING POSITION

As the brake pedal is depressed, the valve operating rod and valve plunger assembly move forward compressing the plunger return spring (Fig. 2). The initial movement of the plunger closes the porting from the vacuum chamber preventing further evacuation of the area back of the diaphragm. Further movement of the plunger forces the atmospheric valve off its seat so that atmospheric pressure from the bellows can enter the hub porting that leads to the rear side of the diaphragm.

With vacuum on the front side of the diaphragm and atmospheric pressure on the back side of the diaphragm, a force is developed to move the diaphragm, push rod and master cylinder piston forward to close the compensating port and force hydraulic fluid under pressure through the residual pressure check valve and brake tubes to the wheel brakes. As hydraulic pressure is developed in the hydraulic system, a reaction counter-force acts against the reaction lever and ring assembly. This reaction lever and ring assembly is designed to transmit the reaction forces back through the actuating control valve assembly to the brake pedal and provide the driver with a resistance that is in proportion to the brake hydraulic apply forces. This is the means of providing the proper "driver feel" to the power brake unit.

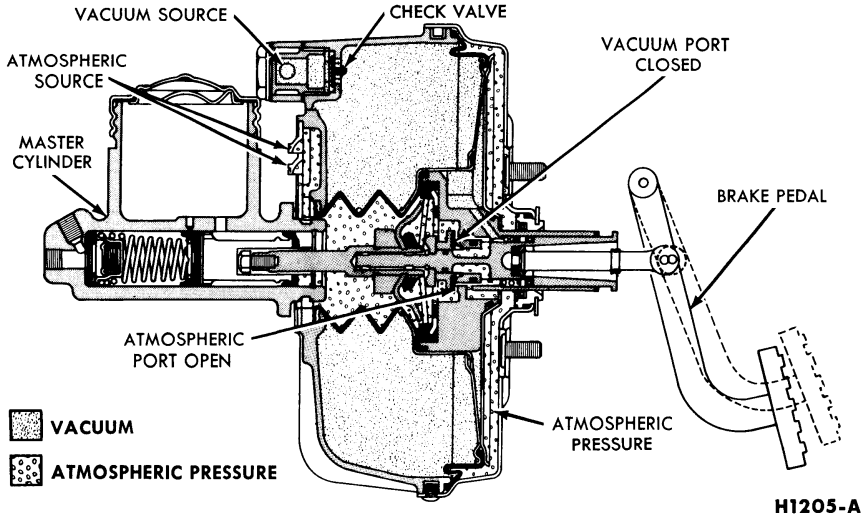



**FIG. 2—Booster in Applied Position**

## HOLDING POSITION

When the forward motion of the brake pedal is stopped and held, the valve operating rod ceases to move

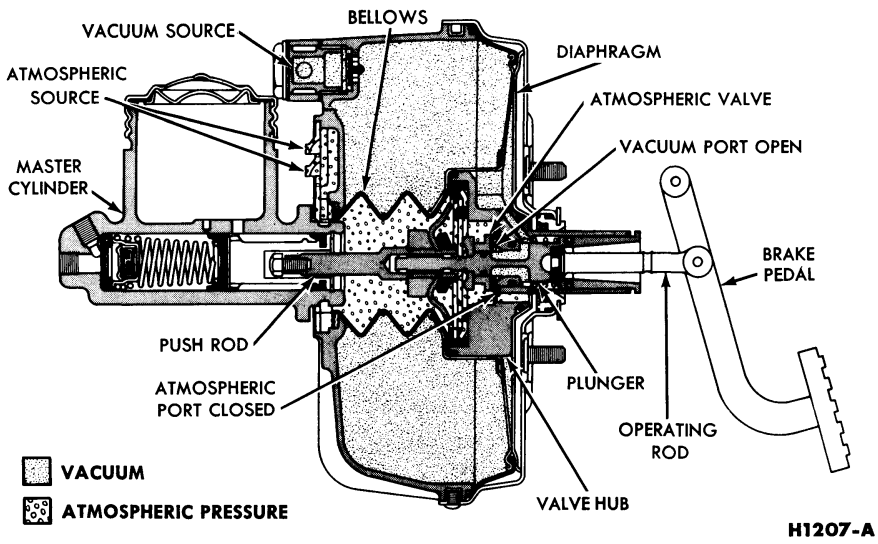



**FIG. 4—Booster in Released Position**

the control valve plunger forward. However, the unbalanced forces of atmospheric pressure and vacuum on each side of the diaphragm will continue to move the outer sleeve of the control valve plunger forward keeping the vacuum porting closed. At the same time, the reaction force acting through the reaction ring and lever assembly will tend to move the atmospheric valve to the closed position (Fig. 3). When these combined forces balance, the porting to the vacuum supply will remain closed and the atmospheric valve will cut off any further passage of atmospheric pressure to the area behind the diaphragm. Therefore, the power assist force acting on the master cylinder piston will stabilize and the hydraulic force applying the brakes will be maintained at a constant level.

### RELEASED POSITION

When the pedal pressure is released from the valve operating rod and plunger assembly, the plunger return spring moves the plunger away from the atmospheric valve allowing the valve to seat against the hub (Fig. 4). This seating of the valve closes off the bellows chamber from the hub porting that connects to the rear side of the diaphragm. At the same time, the rearward movement of the plunger opens the porting from the vacuum chamber and draws out the air from the rear side of the power diaphragm. With vacuum on both sides of the diaphragm, the assist force against the master cylinder push rod is eliminated. The brake shoe retracting springs will, therefore, cause the hydraulic fluid to return the master cylinder piston, push rod, control valve plunger assembly and the diaphragm to the released position.

With the piston and push rod in the released position, the hydraulic compensating port in the master cylinder is open. The open port permits fluid either to return from the brake system to the fluid reservoir, or enter the brake system from the reservoir.

### PARKING BRAKE

An independent foot-operated parking brake control actuates the rear wheel brake shoes through a cable linkage. The operating cable is routed from the parking brake control assembly to the equalizer lever which is attached to the equalizer assembly. The rear brake cables connect the equalizer assembly to the parking brake lever at each rear secondary shoe (Fig. 1).

When the pedal is depressed the secondary brake shoes are forced against the rear brake drums. The pedal is held in the applied position by the engagement of a spring loaded pawl with a ratchet. Pushing down on the release handle disengages the pawl from the ratchet to release the brakes.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### BRAKE SHOE ADJUSTMENTS

The car should be raised with the wheels off the floor. **If the car is raised on a frame-contact hoist, disconnect the parking brake cables to prevent the rear brakes from being partially applied due to rear axle and spring sag on the hoist.**

The hydraulic service brakes are self-adjusting and require a manual adjustment only after the brake shoes have been relined, replaced, or when the length of the adjusting screw has been changed while performing some other service operation.

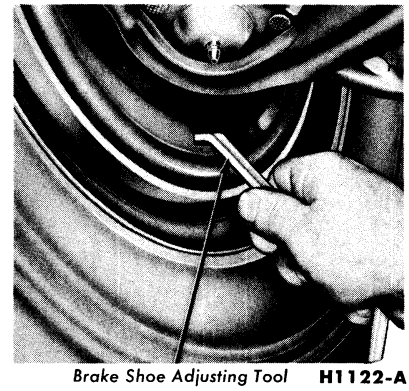
The brake drums should be at normal room temperature when adjusting the brake shoes. If the shoes are adjusted when the drums are hot and expanded, the shoes may drag when the drums are cool and contracted.

**1.** After the shoes have been installed or the adjusting screw has been turned, install the drum. Be sure that all excess grease, oil, and other foreign material are wiped off the carrier plate and drum.

Before installing the brake drum on the front wheel spindle, wipe the spindle completely free of grease. Install the drum carefully so that the grease seal retainers within the hub will not be damaged.

**2.** Remove the adjusting hole cover from the carrier plate and, from the carrier plate side, turn the adjusting screw upward to expand the shoes (Fig. 5). Expand the shoes until a drag is felt when the drum is rotated.

**3. Remove the drum.** Mark the tooth on the star wheel where the lever contacts the adjusting screw. While holding the adjusting lever



*Brake Shoe Adjusting Tool* H1122-A

**FIG. 5—Expanding Brake Shoes**

out of engagement with the adjusting screw, back off the adjusting screw ¾ of a turn with the fingers. If finger movement will not turn the screw, free it up; otherwise, the self-adjusting lever will not turn the screw. Lubricate the screw with a thin uniform coating of Stanolube–HD Moly Grease–Grade 2.

**Any other adjustment procedure may cause damage to the adjusting screw with consequent self adjuster problems.**

**4.** Apply a small quantity of high-temperature grease to the points where the shoes contact the carrier plate, being careful not to get the lubricant on the linings. Install the drum.

On a front wheel, install the wheel outer bearing, washer, and adjusting nut, then adjust the wheel bearings as outlined in Part 3-4, Section 2.

On rear wheels, install the three Tinnerman nuts and tighten securely.

**5.** Install the wheel on the drum and tighten the mounting nuts to specification.

**6.** Install the adjusting hole cover on the brake carrier plate.

**7.** When adjusting the rear brake shoes, check the parking brake cables for proper adjustment. Make sure that the equalizer lever operates freely.

**8.** After the brake shoes have been properly adjusted, check the operation of the brakes.

## FRONT BRAKE DRUM

### REMOVAL

**1.** Raise the car until the wheel and tire clear the floor. Remove the wheel cover or hub cap, and remove the wheel and tire assembly from the drum.

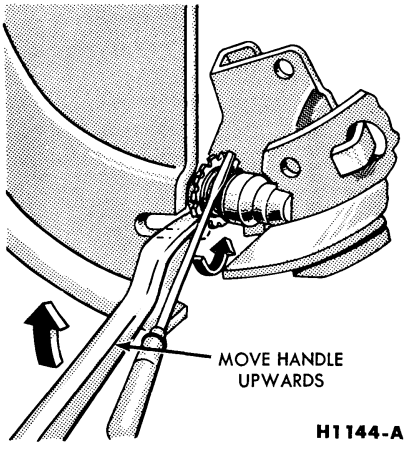



**FIG. 6—Backing Off Brake Adjustment**

**2.** Insert a narrow screwdriver through the brake adjusting hole at the inner side of the brake carrier plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the screw, back off the adjusting screw with the brake adjusting tool (Fig. 6). **Be very careful not to burr, chip, or damage the notches in the adjusting screw; otherwise the self-adjusting mechanism will not function properly.**

**3.** Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly.

**4.** Pull the hub and drum assembly of the wheel spindle.

### INSTALLATION

**1.** If the drum is being replaced, remove the protective coating from the new drum with carburetor degreaser. Install new bearings and grease retainer. Soak the new grease retainer in light engine oil at least 30 minutes before installation. Pack the wheel bearings, install the inner bearing cone and roller assembly in the inner cup, and install the new grease retainer. See Part 3-4, Section 4.

If the original drum is being installed, make sure that the grease in the hub is clean and adequate.

**2.** Install the drum assembly and adjust the brakes as outlined under "Brake Shoe Adjustments" in this section.

**3.** Install the outer wheel bearing, washer and adjusting nut.

**4.** Adjust the wheel bearing as outlined Part 3-4, Section 2, then install the grease cap. Install the wheel and hub cap.

## REAR BRAKE DRUM

### REMOVAL

**1.** Raise the car so that the wheel is clear of the floor.

**2.** Remove the hub cap and wheel. Remove the three Tinnerman nuts and remove the brake drum. Insert a narrow screwdriver through the brake adjusting hole in the carrier plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the adjusting screw, back off the adjusting screw with the brake adjusting tool (Fig 6). **Be very careful not to burr, chip, or damage the notches in the adjusting screw; otherwise, the self-adjusting mechanism will not function properly.**

### INSTALLATION

**1.** Remove the protective coating from a new drum with carburetor degreaser.

**2.** Place the drum over the brake assembly and into position. Adjust the brakes as outlined under "Brake Shoe Adjustments" in this section.

**3.** Install the three Tinnerman nuts and tighten securely. Install the wheel on the axle shaft flange studs against the drum, and tighten the retaining nuts to specifications.

## BRAKE SHOES AND ADJUSTING SCREW

### REMOVAL

**1.** With the wheel and drum removed, install a clamp over the ends of the brake cylinder as shown in Fig. 7.

**2.** Contract the shoes as follows:

**a.** Disengage the adjusting lever from the adjusting screw by pulling backward on the adjusting lever (Fig. 1).

**b.** Move the outboard side of the adjusting screw upward and back off the pivot nut as far as it will go.

**3.** Pull the adjusting lever, cable and automatic adjuster spring down and toward the rear to unhook the pivot hook from the large hole in the secondary shoe web. **Do not attempt to pry the pivot hook out of the hole.**

**4.** Remove the automatic adjuster spring and adjusting lever (Fig. 1).

**5.** Remove the primary shoe to anchor spring with the tool shown in Fig. 7. With the same tool, remove the secondary shoe to anchor spring and unhook the cable eye from the anchor pin.

**6.** Remove the anchor pin plate.

**7.** Remove the cable guide from the secondary shoe (Fig. 1).

**8.** Remove the shoe hold-down springs, shoes, adjusting screw, pivot nut, and socket.

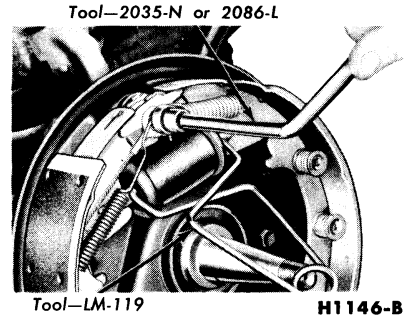



**FIG. 7—Retracting Spring Removal**

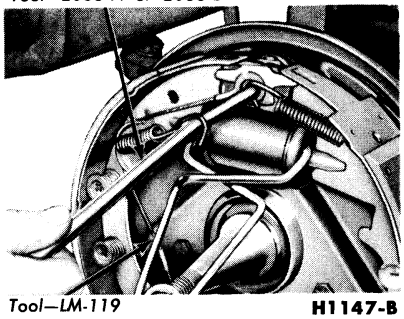



**FIG. 8–Retracting Spring Installation**

**9.** On rear brakes, remove the parking brake link and spring. Disconnect the parking brake cable from the parking brake lever.

**10.** After removing the rear brake secondary shoe, disassemble the parking brake lever from the shoe by removing the retaining clip and spring washer (Fig. 1).

### INSTALLATION

**1.** Before installing the rear brake shoes, assemble the parking brake lever to the secondary shoe and secure with the spring washer and retaining clip.

**2.** Apply a light coating of high-temperature grease at the points where the brake shoes contact the carrier plate.

**3.** Position the brake shoes on the carrier plate and secure the assembly with the hold down springs. On the rear brake, install the parking brake link and spring. Connect the parking brake cable to the parking brake lever (Fig. 1).

**4.** Install the anchor pin plate on the anchor pin.

**5.** Place the cable eye over the anchor pin with the crimped side toward the carrier plate.

**6.** Install the secondary shoe to anchor spring (Fig. 8).

**7.** Install the cable guide on the secondary shoe web with the flanged hole fitted into the hole in the secondary shoe web. Thread the cable around the cable guide groove (Fig. 1).

**It is imperative that the cable be positioned in this groove and not between the guide and the shoe web.**

**8.** Install the primary shoe to anchor spring with the tool shown in Fig. 8.

**Be certain that the cable eye is not cocked or binding on the anchor pin when installed. All parts should be flat on the anchor pin.** Remove the brake cylinder clamp.

**9.** Apply high-temperature grease to the threads and the socket end of the adjusting screw. Turn the adjusting screw into the adjusting pivot nut to the limit of the threads and then back off ½ turn.

**Interchanging the brake shoe adjusting screw assemblies from one side of the car to the other would cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism operated.** To prevent installation on the wrong side of the car, the socket end of the adjusting screw is stamped with an R or L (Fig. 9). The adjusting pivot nuts can be distinguished by the number of grooves machined around the body of the nut. Two grooves indicate a right hand nut; one groove indicates a left hand nut.

**10.** Place the adjusting socket on the screw and install this assembly between the shoe ends with the adjusting screw toothed wheel nearest the secondary shoe.

**11.** Hook the cable hook into the hole in the adjusting lever. The adjusting levers are stamped with an R or L to indicate their installation on a right or left hand brake assembly (Fig. 9).

**12.** Position the hooked end of the adjuster spring completely into the large hole in the primary shoe web. The last coil of the spring should be at the edge of the hole. Connect the loop end of the spring to the adjuster lever hole.

**13.** Pull the adjuster lever, cable and automatic adjuster spring down and toward the rear to engage the pivot hook in the large hole in the secondary shoe web (Fig. 1).

**14.** After installation, check the action of the adjuster by pulling the section of the cable between the cable guide and the adjusting lever toward the secondary shoe web far enough to lift the lever past a tooth on the adjusting screw wheel. The lever should snap into position behind the next tooth, and release of the cable should cause the adjuster spring to return the lever to its original position. This return action of the lever will turn the adjusting screw one tooth.

If pulling the cable does not produce the action described, or if the lever action is sluggish instead of positive and sharp, check the position of the lever on the adjusting screw toothed wheel. With the brake in a vertical position (anchor at the top), the lever should contact the adjusting wheel 3/16 inch plus or minus 1/32 inch) above the centerline of the screw. If the contact point is below this centerline, the lever will not lock on the teeth in the adjusting screw wheel, and the screw will not be turned as the lever is actuated by the cable.

To determine the cause of this condition:

**a.** Check the cable end fittings. The cable should completely fill or extend slightly beyond the crimped section of the fittings. If it does not meet this specification, possible damage is indicated and the cable assembly should be replaced.

**b.** Check the cable length. The cable should measure 11⅛ inches (plus or minus 1/64 inch) from the end of the cable anchor to the end of the cable hook.

**c.** Check the cable guide for damage. The cable groove should be parallel to the shoe web, and the body of the guide should lie flat against the web. Replace the guide if it shows damage.

**d.** Check the pivot hook on the lever. The hook surfaces should be square with the body of the lever for proper pivoting. Replace the lever if the hook shows damage.

**e.** See that the adjusting screw socket is properly seated in the notch in the shoe web.

### WHEEL CYLINDER REPAIR

It is not necessary to remove the brake cylinder from the carrier plate to disassemble, inspect, or hone and overhaul the cylinder. Removal is necessary only when the cylinder is damaged or scored beyond repair.

### DISASSEMBLY

**1.** Remove the links and the rubber boots from the ends of the brake cylinder. Remove the pistons, cups, and return spring from the cylinder bore (Fig. 10).

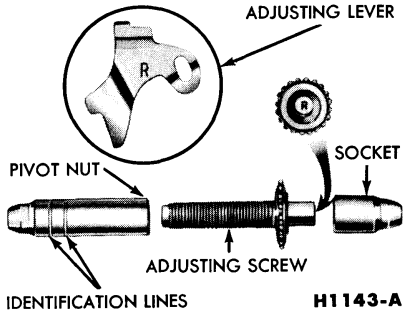



**FIG. 9–Adjusting Screw and Lever Identification**

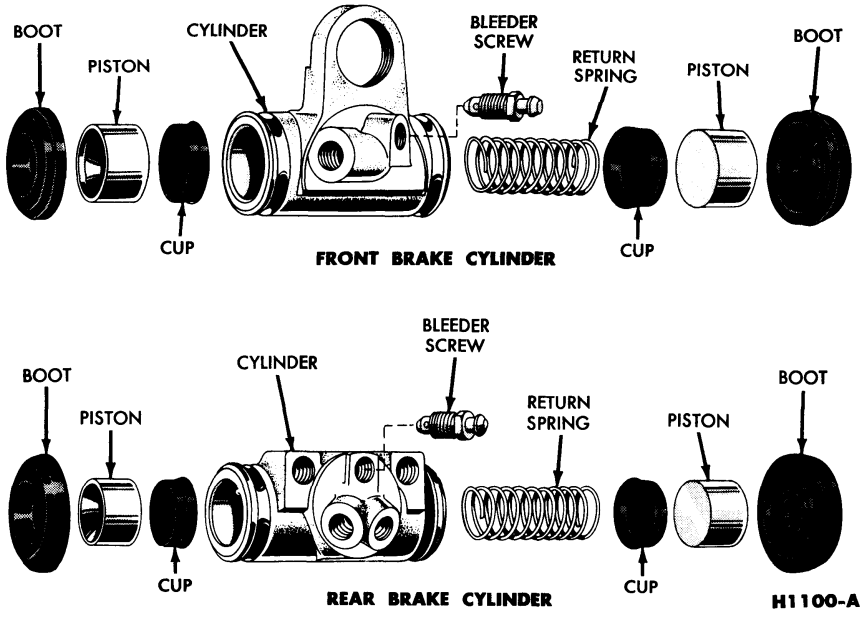



**FIG. 10—Front and Rear Wheel Cylinders**

2. Remove the bleeder screw from the cylinder.

### INSPECTION

1. Wash all parts in clean denatured alcohol. If alcohol is not available, use specified brake fluid. Dry with compressed air.

2. Check all internal parts for excessive wear or damage. **If any of the internal parts require replacing, all should be replaced.**

3. Inspect the cylinder bore for score marks or rust. If either condition is present, the cylinder bore must be honed. **However, the cylinder should not be honed more than 0.003 inch beyond its original diameter.**

4. Check the bleeder hole to be sure that it is open.

### ASSEMBLY

1. Apply a coating of heavy-duty brake fluid to all internal parts.

2. Thread the bleeder screw into the cylinder and tighten securely.

3. Insert the return spring, cups, and pistons into their respective positions in the cylinder bore (Fig. 10). Place a boot over each end of the cylinder. Bleed the brake system.

## WHEEL CYLINDER REPLACEMENT

### REMOVAL

1. With the wheel in a raised position, remove the wheel and the drum.

2. Place a clamp over the ends of the brake cylinder as shown in Fig. 7.

3. Remove the brake shoe assemblies, following procedures outlined in this section.

4. Disconnect the brake line from the brake cylinder. **On a car with a vacuum brake booster, be sure the engine is stopped and there is no vacuum in the booster system before disconnecting the hydraulic lines.**

To disconnect the hose at a front cylinder, loosen the tube fitting that connects the opposite end of the hose to the brake tube at a bracket on the frame. Remove the horseshoe-type retaining clip from the hose and bracket, disengage the hose from the bracket, then unscrew the entire hose assembly from the front wheel cylinder.

At a rear cylinder, unscrew the tube fitting that connects the tube to the cylinder. **Do not pull the metal tube away from the cylinder. Pulling the tube out of the cylinder connection will bend the metal tube and make installation difficult.** The tube will separate from the cylinder when the cylinder is removed from the carrier plate.

5. On the rear wheel, remove the wheel cylinder retaining bolts and lock washers and remove the cylinder. On the front wheel, remove the nut and washer that retains the cylinder to the anchor pin. Remove the cylinder from the anchor pin, and remove the clamp from the cylinder.

### INSTALLATION

Wipe the end(s) of the hydraulic line to remove any foreign matter before making connections.

**1. To install a front cylinder:**

a. Position the cylinder on the anchor pin against the carrier plate. Install the washer and cylinder retaining nut on the anchor pin, and torque to specification.

b. Install a new copper gasket over the hose fitting. Screw the hose assembly into the cylinder.

c. Engage the opposite end of the hose to the bracket on the frame, install the horseshoe-type retaining clip, and connect the brake tube to the hose with the tube fitting nut. Tighten the nut to specification with tool 1112-144.

**2. To install a rear cylinder:**

a. Place the rear wheel cylinder into position. Enter the tubing into the cylinder, and start the tube fitting nut into the threads of the cylinder.

b. Secure the cylinder to the carrier plate by installing the retaining bolts and lockwashers.

c. Tighten the tube fitting nut to specification with tool 1112-144.

3. Install the links in the ends of the wheel cylinder, install the shoe and adjuster assemblies, and adjust the shoes as outlined in this section.

4. Install the brake drum and wheel, adjust the brakes (Part 2-2, Section 2), and bleed the brakes as outlined in Part 2-1, Section 2.

## BRAKE CARRIER PLATE REPLACEMENT

### REMOVAL

1. Remove the wheel and brake drum. Disconnect the brake line from the brake cylinder.

2. Remove the brake shoe and adjuster assemblies and the wheel cylinder as outlined in this section. On the rear wheels, disconnect the parking brake lever from the cable.

3. If the rear carrier plate is being replaced, rotate the axle shaft so that the hole in the axle shaft flange lines up with the carrier plate retaining nuts and remove the nuts. Pull the axle shaft assembly out of the housing with tool-4235C and a slide hammer (Part 4-2), then remove the carrier plate.

If the front carrier plate is being replaced, remove the bolts and nuts that secure the plate to the front wheel spindle and remove the plate.

### INSTALLATION

**1.** Position a new **rear** carrier plate on the retaining bolts in the axle housing flange. Insert the axle shaft into the housing so that the splines engage the differential side gear with the bearing retainer sliding onto the retaining bolts and against the carrier plate. Install the retaining nuts through the access hole in the axle shaft flange.

Position a new **front** carrier plate to the wheel spindle and install the retaining bolts and nuts.

**2.** Install the wheel cylinder and connect the brake line as outlined in this section.

**3.** Install the brake shoe and adjuster assemblies as outlined in this section. On a rear brake, connect the parking brake cable to the lever. Install the brake drum and wheel.

**4.** Adjust the brake shoes (Section 2), and bleed the brake system as outlined in Part 2-1, Section 2.

### HYDRAULIC LINES

Steel tubing is used throughout the brake system with the exception of the flexible hoses at the front wheels and at the rear axle housing brake tube connector (Fig. 11).

**Always bleed the entire system after any hose or line replacement.**

### BRAKE TUBE REPLACEMENT

If a section of the brake tubing becomes damaged, the entire section should be replaced with tubing of the same type, size, shape, and length. **Copper tubing should not be used in a hydraulic system.** When bending brake tubing to fit underbody or rear axle contours, be careful not to kink or crack the tube.

All brake tubing should be flared properly to provide good leak-proof connections. Clean the brake tubing by flushing with clean denatured alcohol, before installation.

When connecting a tube to a hose, tube connector, or brake cylinder, tighten the tube fitting nut to specified torque with Milbar tool 1112-144 or equivalent.

### BRAKE HOSE REPLACEMENT

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. Place a new copper gasket over the hose fitting and screw the hose assembly into the front brake cylinder. Engage the opposite end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut. (Fig. 11).

A rear brake hose should be installed so that it does not touch the muffler outlet pipe or shock absorber.

Place a new gasket over the rear hose fitting and screw the hose assembly into the rear brake tube connector. Engage the front end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

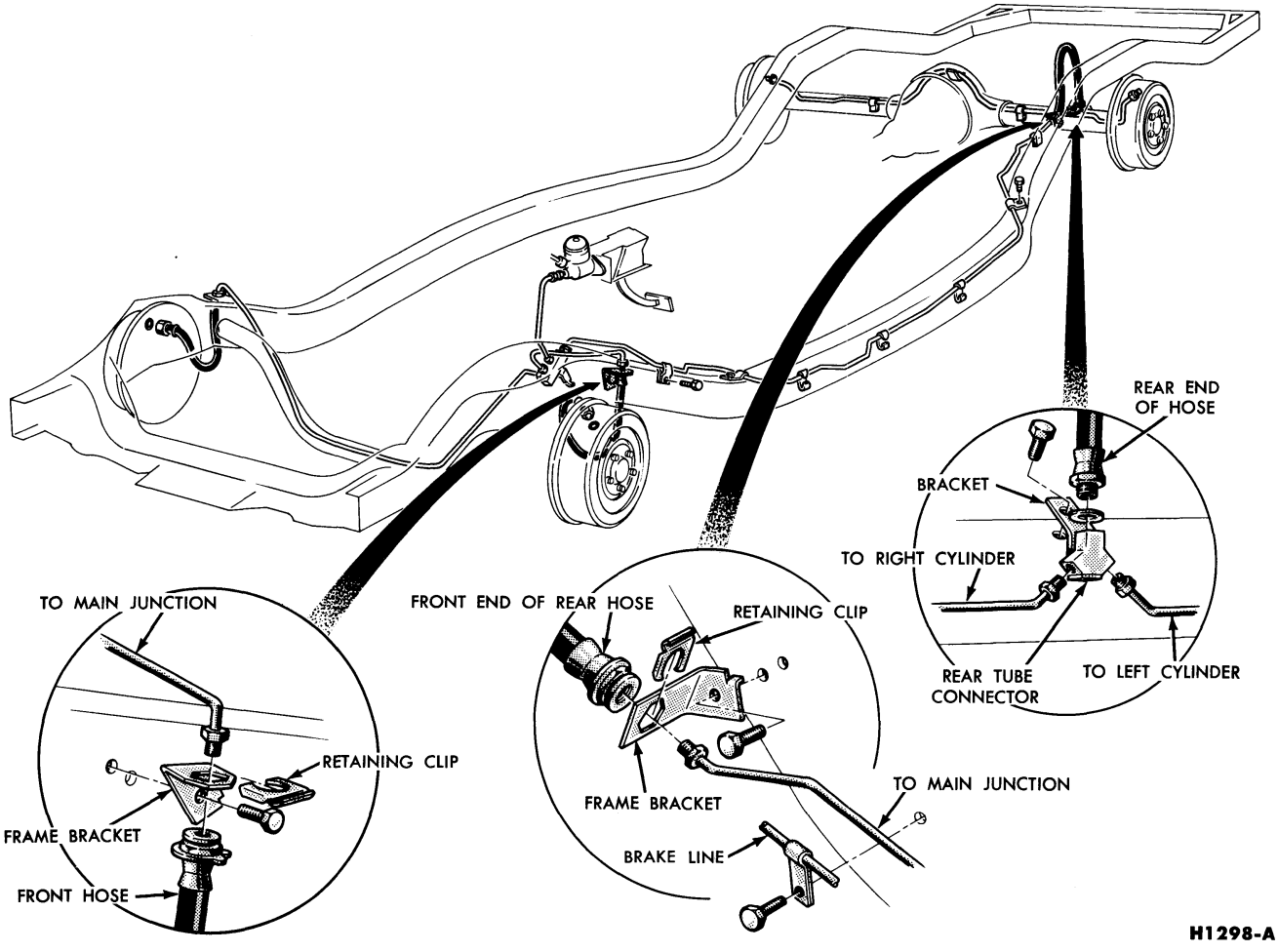



**FIG. 11—Service Brake System**

## 3 REMOVAL AND INSTALLATION

### MASTER CYLINDER— STANDARD BRAKES

#### REMOVAL

1. Disconnect the rubber boot from the rear end of the master cylinder in the passenger compartment.
2. Disconnect the brake line from the master cylinder. Disconnect the stop light switch wires from the switch (Fig. 12).
3. Remove the bolts that secure the master cylinder to the dash panel and lift the cylinder out and away from the push rod. Remove the rubber boot from the push rod.

#### INSTALLATION

1. With the rubber boot on the push rod, guide the master cylinder over the end of the push rod, and position the cylinder against the dash panel.
2. Install and torque the mounting bolts to specification.
3. Connect the brake line to the master cylinder fitting, but leave the brake line fitting loose.
4. Fill the master cylinder reservoir with heavy-duty brake fluid to within ¼ inch of the top. Install and tighten the filler cap.
5. Bleed the master cylinder to let air escape from the cylinder at the brake line fitting. Then tighten the fitting.
6. Remove the filler cap and fill the reservoir to the level specified. Install the cap and wipe off any fluid from the cylinder.

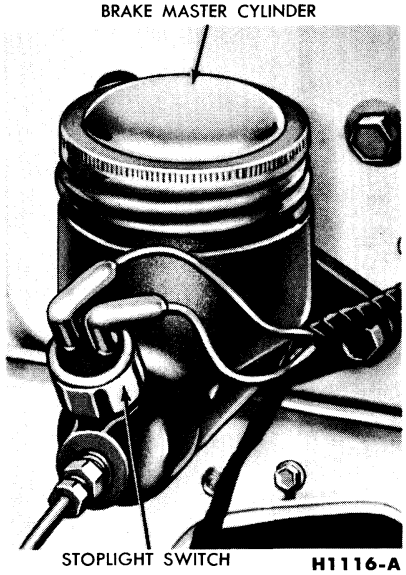



**FIG. 12—Brake Master Cylinder Installed**

7. Connect the wires to the stop light switch and the rubber boot to the master cylinder.

### MASTER CYLINDER— POWER BRAKES

#### REMOVAL

1. Remove the hydraulic line outlet fitting from the master cylinder.
2. Disconnect the stop light switch wires. **It is not necessary to remove the stop light switch.**
3. Remove the retaining nuts, lockwashers, and the master cylinder from the booster unit (Fig. 14).
4. Remove the rubber seal from the outer groove at the end of the master cylinder.

#### INSTALLATION

1. Before installing the master cylinder, check the distance from the outer end of the push rod to the master cylinder mounting surface at the end of the vacuum cylinder (Fig. 4, Part 2-1). If the push rod dimension is not correct, see "Master Cylinder Push Rod Adjustment," Part 2-1, Section 2.
2. When the push rod adjustment is correct, replace the rubber seal in the groove at the end of the master cylinder.
3. Position the master cylinder over the push rod onto the two studs that are integral with the booster body.
4. Install the attaching nuts and lockwashers and torque the nuts to specifications.
5. Replace the stop light switch wires.
6. Install the master cylinder hydraulic line outlet fitting.
7. Bleed the brake system. Fill the master cylinder within ¼ inch from the top of the filler opening. Install the filler cap and gasket.

### BOOSTER UNIT

#### REMOVAL

1. Working inside the car below the instrument panel, disconnect the booster push rod link from the brake pedal assembly. To do this, remove the C-washer (retaining clip) and slide the push rod link and bushings off the pin that is integral with the pedal (Fig. 13). Remove the push rod link boot.
2. Open the hood and disconnect the wires and retaining clip from the stop light switch at the brake master cylinder (Fig. 14).
3. Disconnect the brake line at

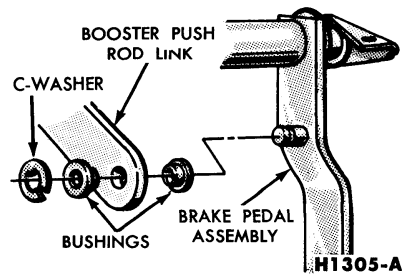



**FIG. 13—Booster-to-Pedal Connections**

the master cylinder outlet fitting.

4. Disconnect the manifold vacuum hose from the booster unit. Disconnect the transmission vacuum throttle valve hose, if the car is so equipped.
5. Remove the four bracket-to-dash panel retaining nuts and washers (Fig. 14). Remove the booster and bracket assembly from the dash panel, sliding the push rod link out from the engine side of the dash panel.

#### INSTALLATION

1. Mount the booster and bracket assembly to the dash panel by sliding the bracket holes on the mounting studs and the push rod link in through the hole in the dash panel. Install the bracket-to-dash panel retaining nuts and washers (Fig. 14).
2. Connect the manifold vacuum hose to the booster. Connect the transmission vacuum throttle valve hose, if so equipped.
3. Connect the brake line to the master cylinder outlet fitting and connect the wires and retaining clip to the stop light switch and brake booster.
4. Working inside the car below the instrument panel, install push rod

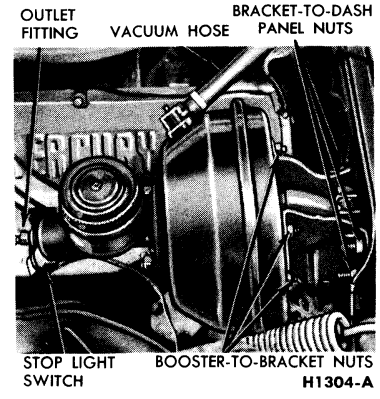



**FIG. 14—Master Cylinder and Booster Installation**

link boot, and connect the booster push rod link to the brake pedal assembly. To do this, lubricate the bushings with specified lubricant and install the bushings and the push rod link onto the pin that is integral with the pedal (Fig. 13). Secure the link to the pin with a C-washer.

5. Bleed the brake system.

## BRAKE PEDAL—MANUAL SHIFT TRANSMISSION

### REMOVAL

1. Back off the clutch pedal assist spring adjusting nut to the last few threads (Fig. 15).

2. Disconnect the clutch pedal-to-equalizer rod at the clutch pedal by removing the hairpin type retainer and bushing.

3. Remove the clutch pedal bumper bracket from the pedal support bracket. Remove the assist spring adjusting nut, and disconnect the retainer and spring from the pedal support bracket.

4. Remove the C-washer and nylon bushings (Fig. 16), and disconnect the master cylinder push rod from the brake pedal assembly.

5. Remove the hairpin type retainer and spring washer from the clutch and brake pedal shaft, then remove the clutch pedal and shaft assembly, the brake pedal assembly, and the bushings from the pedal support bracket (Fig. 16).

### INSTALLATION

1. Apply a coating of Lubriplate to the bushings and locate all bushings in their proper places on the clutch and brake pedal assemblies.

2. Position the brake pedal to the support bracket, then install the clutch pedal and shaft assembly through the support bracket and brake pedal assembly. Install the spring washer and retainer (Fig. 16).

3. Hook the clutch assist spring to its retainer, and connect the retainer to the pedal support bracket with the adjusting nut (Fig. 15).

4. Mount the clutch pedal bumper bracket to the pedal support bracket (Fig. 15). Adjust the bumper for clutch total travel.

5. Connect the clutch pedal-to-equalizer rod to the clutch pedal assembly with the bushing and hairpin retainer. Apply Lubriplate to the bushing. Adjust clutch pedal free play to specification by lengthening or shortening the rod at the equalizer.

6. Adjust the clutch lever assist spring to the dimension shown in Fig. 15 by loosening or tightening the adjusting nut on the retainer at the pedal support bracket.

7. Connect the master cylinder push rod to the brake pedal assembly with a C-washer and nylon bushings (Fig. 16). Apply Lubriplate to the bushings.

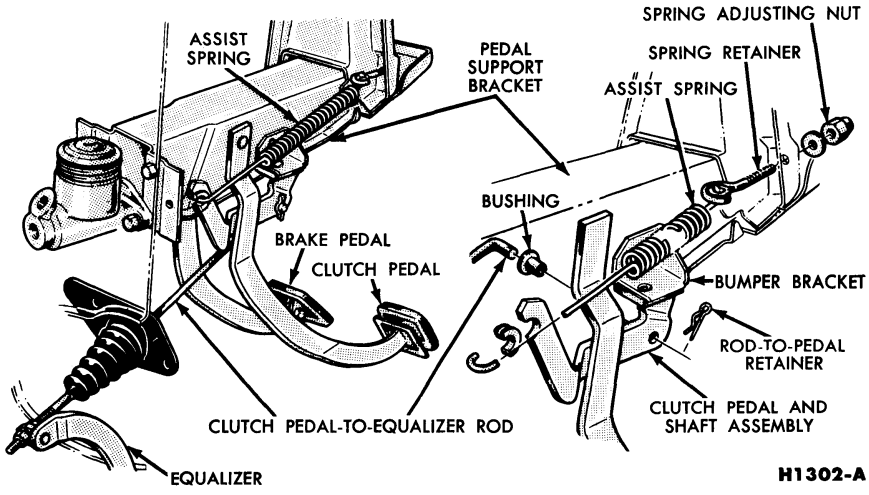



**FIG. 15—Clutch and Brake Pedal Assembly**

## BRAKE PEDAL—AUTOMATIC TRANSMISSION

### REMOVAL

1. Remove the C-washer and nylon bushings, and disconnect the master cylinder push rod from the brake pedal assembly (Fig. 16).

2. Remove the hairpin type retainer and spring washer from the brake pedal shaft, then remove the shaft, the brake pedal assembly and the bushings from the pedal support bracket.

### INSTALLATION

1. Apply a coating of Lubriplate to the bushings and locate all the bushings in their proper places on the pedal assembly and pedal support bracket (Fig. 16).

2. Position the brake pedal assembly to the support bracket, then install the pedal shaft through the support bracket and brake pedal assembly. Install the spring washer and retainer.

3. Connect the master cylinder push rod to the brake pedal assembly with a C-washer and nylon bushings (Fig. 16).

## PARKING BRAKE PEDAL ASSEMBLY

### REMOVAL

1. Remove the bolts that retain the parking brake control assembly to the dash side panel.

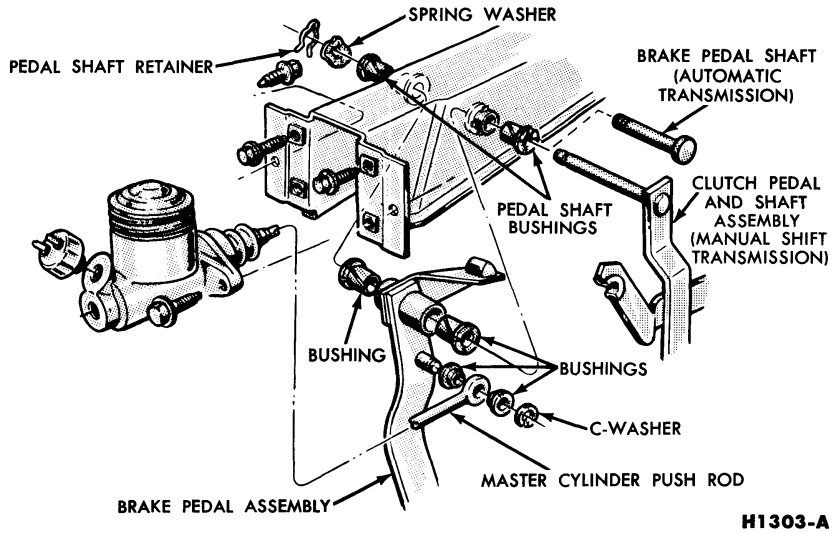



**FIG. 16—Brake Pedal Removal and Installation**

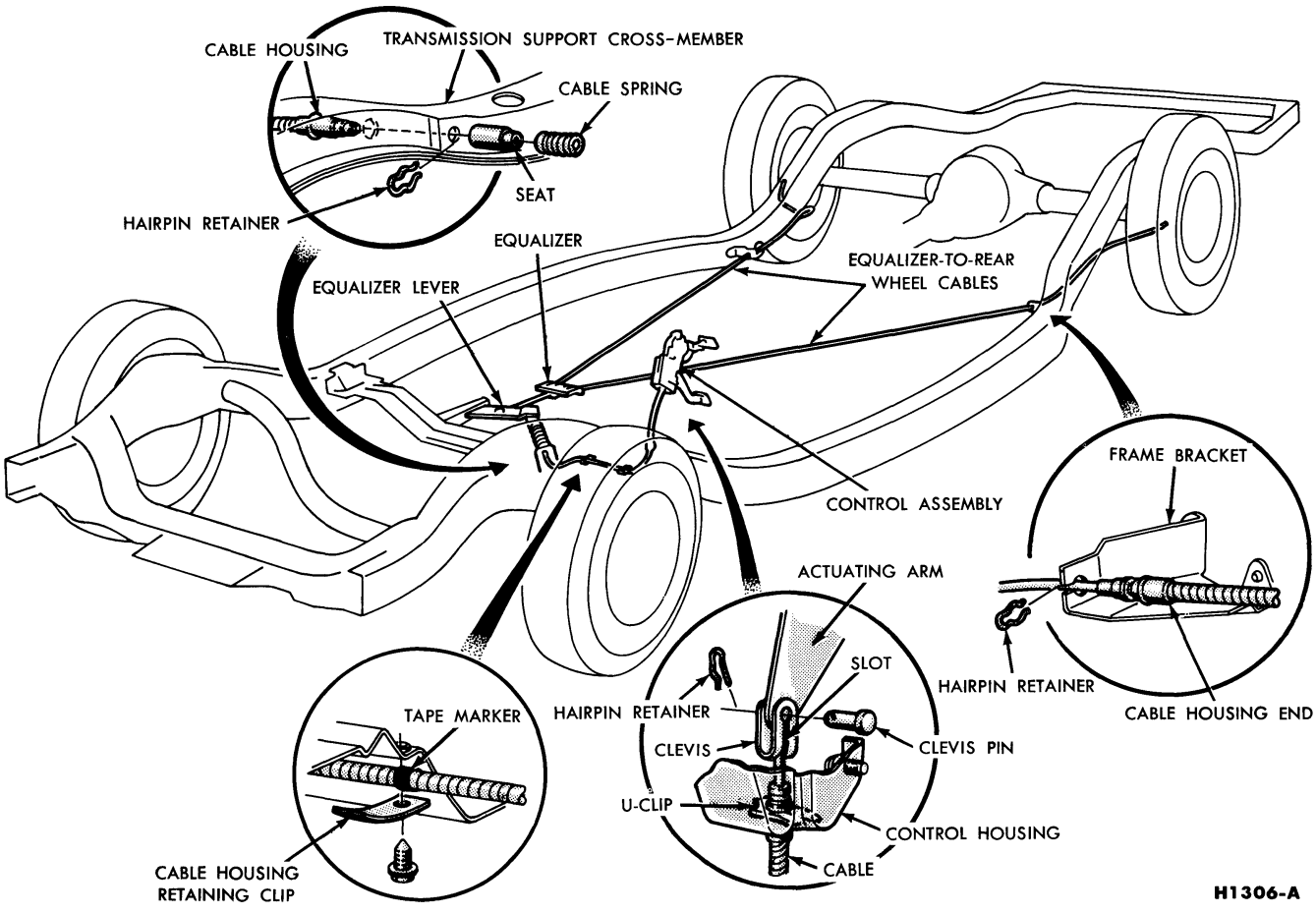



**FIG. 17—Parking Brake System**

2. Remove the U-clip that retains the cable housing to the parking brake control housing (Fig. 17).

3. Remove the hairpin retainer and clevis pin from the clevis. Disengage the clevis from the ball end of the cable, then remove the control assembly from the cable and housing.

### INSTALLATION

1. Insert the parking brake cable and housing through the hole in the control housing and install the U-clip (Fig. 17).

2. Install the clevis over the ball on the end of the cable, and attach the clevis to the actuating arm by inserting the clevis pin. The head of the clevis pin must be assembled on the slotted side of the clevis as shown in Fig. 17. Secure the clevis by installing the hair pin retainer.

3. Position the parking brake control assembly to the dash side panel and secure with retaining bolts.

4. Check the adjustment and operation of the parking brake system.

## PARKING BRAKE EQUALIZER TO CONTROL CABLE

### REMOVAL

1. Raise the car on a hoist. Move the parking brake equalizer lever forward far enough to permit removal of the half moon-type adjusting nut, then remove the adjusting nut from the end of the cable (Fig. 2, Part 2-1).

2. Remove the hairpin retainer from the cable housing at the transmission rear support crossmember. Remove the cable spring and seat (Fig. 17).

3. Remove the attaching screws and the two cable housing retaining clips at the underside of the floor pan (one retaining clip at each side of the frame side rail).

4. Pull the cable through the cross member and over the frame side rail, then lower the car.

5. Working inside the car, pull back the upper left hand corner of the floor mat. Remove the retaining bolts and the parking brake control assembly from the dash side panel.

6. Remove the U-clip that retains the cable housing to the parking brake control housing (Fig. 17).

7. Remove the hairpin retainer and clevis pin from the clevis. Rotate and remove the clevis, then remove the cable and housing from the control assembly.

8. Push the parking brake cable and grommet down through the floor pan.

### INSTALLATION

1. Guide the lower end of the replacement cable and grommet down through the floor pan.

2. Position the upper end of the cable into the control housing assembly, and secure the cable housing with the U-clip (Fig. 17).

3. Install the clevis over the ball on the end of the cable, and attach the clevis to the actuating arm by inserting the clevis pin. The head of the clevis pin must be assembled on the slotted side of the clevis as shown. Secure the clevis by installing the hair pin retainer.

4. Position the parking brake

control assembly to the dash side panel and secure with the retaining bolts.

**5.** Raise the car on a hoist. Route the cable over the frame side rail and through the cross member.

**6.** Secure the cable housing to the frame side rail by installing two retaining clips, one on each side of the side rail. Position the cable assembly so that the tape marker is located at the in-board clip.

**7.** Secure the cable housing to the rear side of the transmission rear support cross member by installing the hairpin retainer (Fig. 17). Install the spring seat and cable spring on the cable.

**8.** Assemble the rear end of the cable to the equalizer lever, and install the half moon-type adjusting nut on the end of the cable.

**9.** Adjust the parking brake linkage as outlined in Part 2-1, Section 2, and check the operation.

### PARKING BRAKE EQUALIZER TO REAR WHEEL CABLE

#### REMOVAL

**1.** Raise the car and remove the hub cap and wheel.

**2.** Remove the three Tinnerman nuts that hold the brake drum in place, back off the brake shoes, and remove the drum.

**3.** Loosen the lock nut on the equalizer rod, and disconnect the cable from the equalizer (Fig. 2, Part 2-1).

**4.** Remove the hair pin retainer that holds the cable housing to the frame bracket and pull the cable and housing out of the bracket (Fig. 17).

**5.** Working on the wheel side (Fig. 1), compress the prongs on the cable retainer so that they can pass through the hole in the carrier plate. Draw the cable retainer out of the hole.

**6.** With the spring tension off the parking brake lever, lift the cable out of the slot in the lever and remove through the carrier plate hole.

#### INSTALLATION

**1.** Pull enough of the cable through the housing so that the end of the cable may be inserted over the slot in the parking brake lever (Fig. 1).

**2.** Pulling the excess slack from the cable, insert the cable housing into the carrier plate access hole so that the retainer prongs expand.

**3.** Thread the front end of the cable housing through the frame bracket and install the hair pin retainer (Fig. 17).

**4.** Insert the ball end of the cable into the equalizer and tighten the lock nut on the equalizer end slightly (Fig. 2, Part 2-1).

**5.** Install the rear drum. Tighten the three Tinnerman nuts that retain the drum, and install the wheel and hub cap.

**6.** Adjust the rear brake shoes as outlined in Section 2. Adjust the parking brake linkage as outlined in Part 2-1, Section 2.

## 4 MAJOR REPAIR OPERATIONS

### BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with a fine emery cloth. A drum that is excessively scored or shows a total indicator runout of over 0.007 inch should be turned down. Remove only enough stock to eliminate the scores and true up the drum. The refinished diameter must not exceed 0.060 inch oversize (11.090 inches).

If the drum diameter is less than 0.030 inch oversize (11.060 inches) after refinishing, standard lining may be installed. If the drum diameter is 11.060-11.090 inches, oversize linings must be installed.

After a drum is turned down, wipe the refinished surface with a cloth soaked in clean denatured alcohol. If one drum is turned down, the opposite drum on the same axle should also be cut down to the same size.

### BRAKE SHOE RELINING

Brake linings that are worn to within 1/32 inch of the rivet or have been saturated with grease or oil should be replaced. Failure to replace worn linings will result in a scored drum. **When it is necessary to replace linings, they must also be replaced on the wheel on the opposide of the car.**

Inspect brake shoes for distortion, cracks, or looseness. If this condition exists, the shoe should be discarded. **Do not repair a defective brake shoe.**

**1.** Wash the brake shoes thoroughly in a clean solvent. Remove all burrs or rough spots from the shoes.

**2.** Check the inside diameter of the brake drum. If the diameter is less than 11.060 inches, standard lining may be installed. If the diameter is 11.060-11.090 inches, oversize lining should be installed.

**3.** Position the new lining on the shoe. Starting in the center, insert and secure the rivets, working alternately towards each end. Install all parts supplied in the kit. **Replacement linings are ground and no further grinding is required.**

**4.** Check the clearance between the shoe and lining. The lining must seat tightly against the shoe with not more than 0.005-inch clearance between any two rivets.

### MASTER CYLINDER

#### DISASSEMBLY

**1.** Clean the outside of the cylinder, and remove the filler cap and gasket. Pour out any brake fluid that may remain in the cylinder or reservoir.

**2.** Remove the stop light switch and the brake line fitting from the forward end of the cylinder (Figs. 18 and 19).

**3.** Remove the snap ring from the bore at the rear of the cylinder with tool 33621 (Fig. 20).

**4.** When disassembling a master cylinder used with the standard brake system, remove the piston assembly, cup, spring, check valve, and valve seat from the cylinder bore (Fig. 18).

When disassembling a master cylinder used with a booster, remove the piston assembly, cup, and the spring and check valve assembly from the cylinder bore. Remove the O-ring from the piston (Fig. 19).

#### CLEANING, INSPECTION, AND REPAIR

**1.** Clean all master cylinder parts in clean denatured alcohol, and inspect the parts for wear or damage, replacing them as required. **When using a master cylinder repair kit, install all of the parts supplied.**

**2.** Check the ports and vents in the master cylinder to make sure that all are open and free of foreign matter.

**3.** A leaf-type valve is riveted to the front end of the piston in a master cylinder used with the standard brake system (Fig. 18). If this valve is loose or has moved so that the piston ports are open, replace the piston.

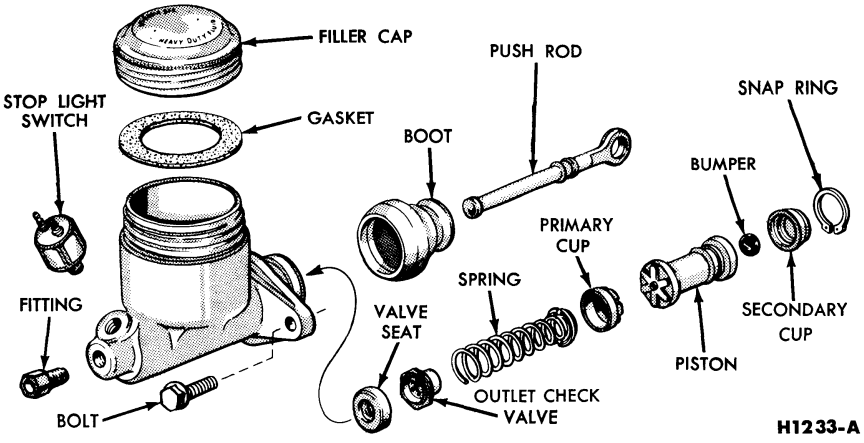



**FIG. 18—Master Cylinder with Standard Brake System**

When inspecting a master cylinder used with a booster, check the ports in the piston to make sure that they are open and free of foreign material (Fig. 19).

**4.** Inspect the cylinder walls for scores or rust, and recondition them if necessary. **Hone the cylinder walls no more than necessary (0.003 inch maximum). Oversize pistons and cups are not available for excessively honed cylinders.**

**5.** Remove any burrs or loose metal that may have resulted from the honing operation, and clean the cylinder with denatured alcohol.

### ASSEMBLY

**1.** Dip all parts except the master cylinder body in clean FoMoCo **heavy-duty brake fluid.**

**2.** Install the brake line fitting and the stop light switch on the cylinder and tighten them securely.

**3.** When assembling a master cylinder used with the standard brake system, install the valve seat, check valve, spring, cup, and piston assembly in the cylinder bore (Fig. 18).

When assembling a master cylinder used with a booster, install the O-ring on the piston. Install the spring and check valve assembly, cup, and piston in the cylinder bore (Fig. 19).

**4.** Install the snap ring in the back of the bore (Fig. 20).

### DISASSEMBLY OF BOOSTER REMOVAL OF EXTERNAL PARTS

**1.** Remove the two attaching nuts and lockwashers, and separate the master cylinder from the booster body.

**2.** Remove the filter cover and hub and the air filter from the booster body (Fig. 6, Part 2-1).

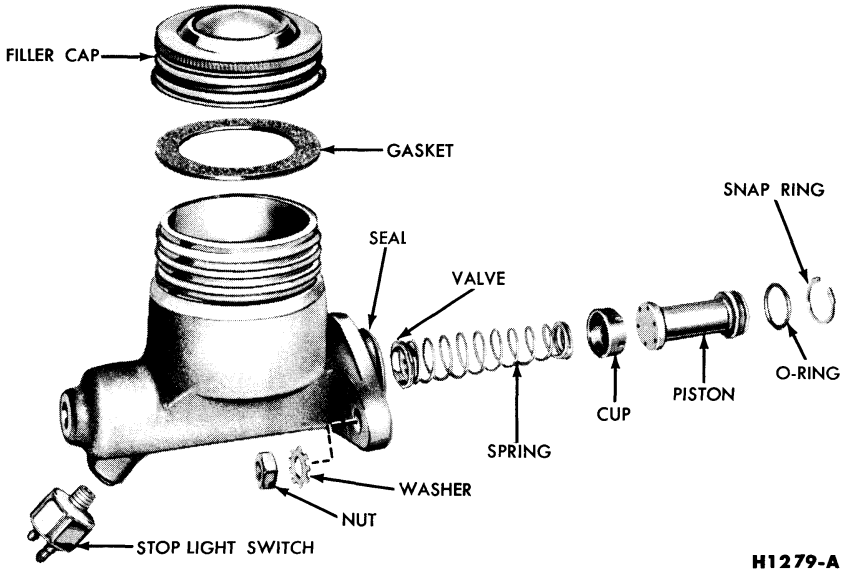



**FIG. 19—Master Cylinder with Booster**

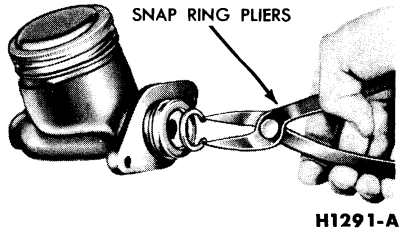



**FIG. 20—Removing Snap Ring from Master Cylinder**

**3.** Remove the vacuum manifold and check valve assembly and the rubber grommet from the booster body (Fig. 6, Part 2-1).

**4.** Disconnect the valve operating rod from the lever assembly by removing the retainer clip and connecting pin (Fig. 6, Part 2-1).

**5.** Disconnect the lever assembly from the end plate brackets by removing the retainer clip and pivot pin.

**6.** Remove the retaining nuts, and disassemble the brackets from the end plate.

**7.** Remove the rubber boot from the valve operating rod.

### SEPARATION OF MAJOR COMPONENTS

**1.** Remove the large C-ring that retains the rear seal adapter assembly to the booster end plate (Fig. 6, Part 2-1).

**2.** Scribe a line across the booster body and end plate to facilitate proper alignment at reassembly. Remove the booster body-to-end plate retaining screws, tap the outside of the end plate with a fibre hammer, and separate the end plate from the booster body, leaving the rear seal and adapter assembly on the control valve hub.

**3.** Push the bellows assembly into the vacuum chamber (Fig. 21), and separate the bellows, control valve, and diaphragm assembly from the booster body.

**4.** Remove the outer O-ring from the rear seal adapter assembly (Fig. 6, Part 2-1).

### DISASSEMBLY OF BELLOWS, PUSH ROD AND VALVE ASSEMBLY FROM DIAPHRAGM

**1.** Remove the large bellows retaining ring, bellows, bellows retainer and support ring from the diaphragm and valve assembly (Fig. 22).

**2.** Remove the retainer and support ring from the bellows (Fig. 6, Part 2-1).

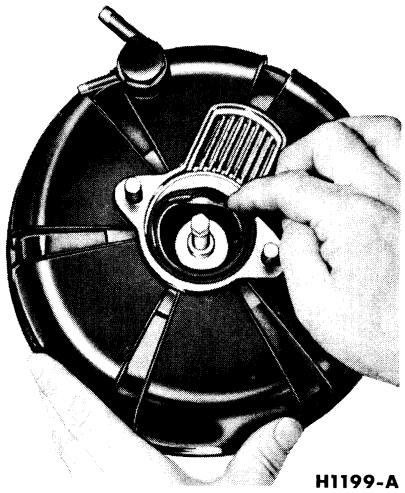

H1199-A

**FIG. 21—Separation of Bellows, Control Valve, and Diaphragm Assembly from Booster Body**

**3.** Remove the push rod assembly, the reaction lever and ring from the control valve hub (Fig. 23).

**4.** Remove the retainer, the cushion ring and the reaction cone from the push rod assembly, and disassemble the reaction levers from the rings (Fig. 23). Also see Fig. 6, Part 2-1.

**5.** Remove the 2 plastic plunger guides from the control valve plunger, then remove the retainer that holds the reaction load ring, return spring, and atmospheric valve to the control valve hub (Fig. 23).

**6.** Slide the reaction load ring, the return spring and the atmospheric valve from the control valve hub (Figs. 23 and 24).

**7.** Separate the control valve hub and the control valve plunger assembly from the diaphragm by sliding the valve plunger and rear seal adapter from the rear of the valve hub (Fig. 24). Remove the hub outer O-ring from the front side of the diaphragm.

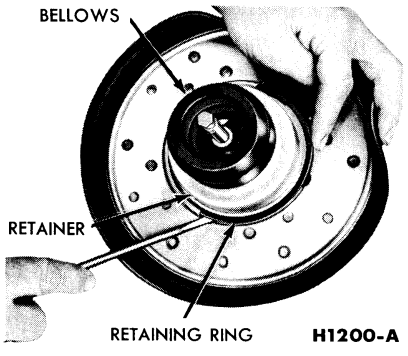



**FIG. 22—Bellows Removal or Installation**

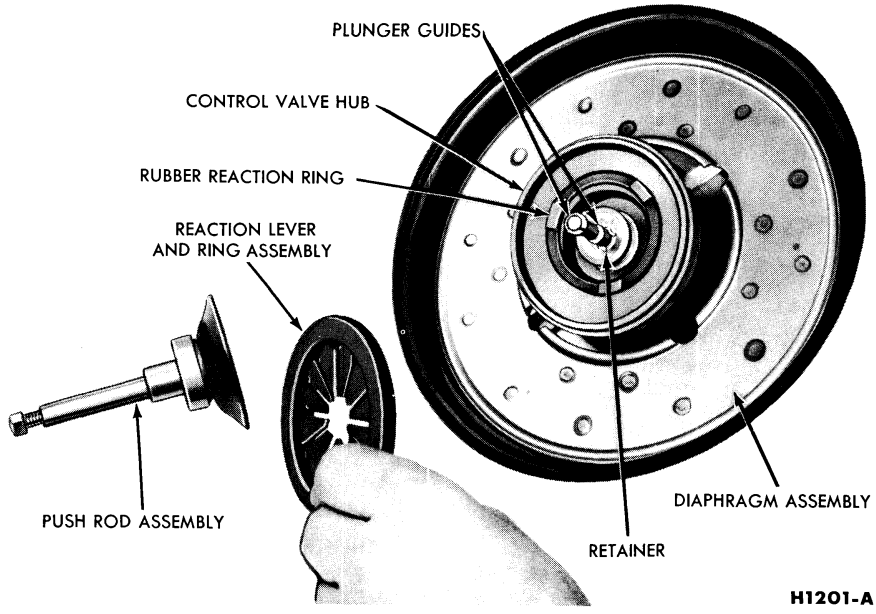



**FIG. 23—Assembly of Reaction Components and Push Rod to Valve Hub**

### DISASSEMBLY OF CONTROL VALVE PLUNGER

**1.** Remove the hub rear seal adapter from the valve plunger assembly, and remove the seal from the adapter.

**2.** Remove the O-rings, the seal, and the fibre gasket from the valve plunger (Fig. 25).

**3. Do not remove the valve operating rod from the control valve plunger unless the plunger assembly or the rod is to be replaced.** To remove, hold the rod firmly and force the plunger off the rod, breaking the plastic retainer. Remove all the broken pieces of the plastic retainer from the groove in the plunger, if the plunger is to be used again with a replacement rod.

## ASSEMBLY OF BOOSTER

### ASSEMBLY OF CONTROL VALVE PLUNGER

**1.** If the valve operating rod was removed from the plunger, assemble a new plastic retainer to the end of the rod (Fig. 6, Part 2-1). Insert the rod into the plunger so that the retainer engages the groove in the

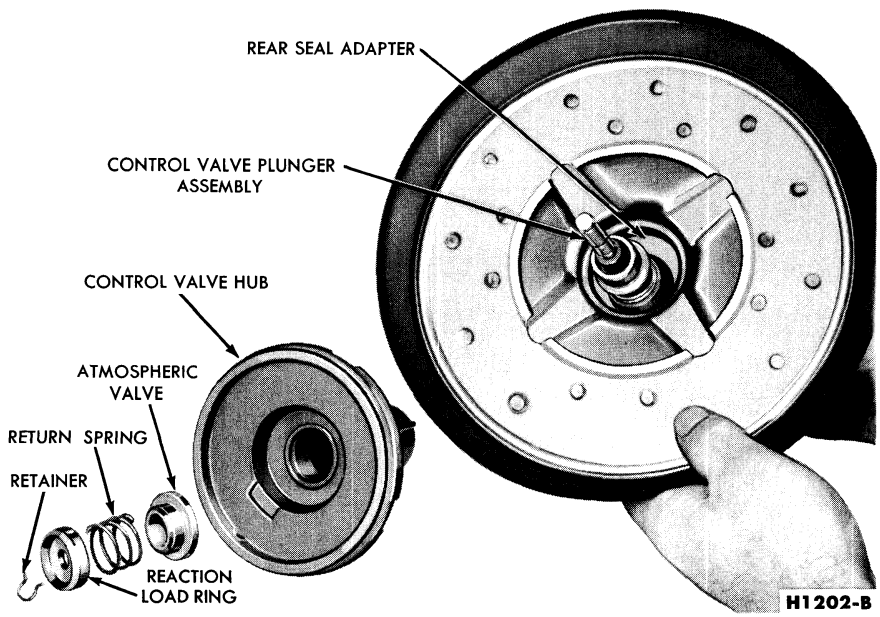



**FIG. 24—Disassembly of Control Valve Components from Diaphragm**

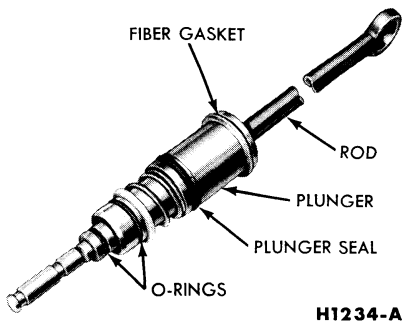



**FIG. 25—Valve Operating Rod and Plunger Assembly**

plunger.

**2.** Install the fibre gasket, the plunger seal, and the O-rings to the valve plunger assembly (Fig. 25).

### ASSEMBLY OF VALVE ASSEMBLY, PUSH ROD, AND BELLOWS TO DIAPHRAGM

**1.** Insert the control valve plunger into the control valve hub from the rear of the hub (Fig. 26).

**2.** Assemble the atmospheric valve, the return spring and the reaction load ring to the valve plunger and hub.

**3.** Push the control valve plunger assembly forward and the reaction load ring backward against the return spring in order to install the retainer in the groove of the plunger.

**4.** Install the O-ring in the groove on the outer circumference of the valve hub. Assemble the valve plunger and hub assembly to the diaphragm so that the operating rod and the small-diameter end of the hub enter the front side of the diaphragm and protrude from the rear side.

**5.** Install the two plastic plunger guides in their grooves on the valve plunger assembly (Fig. 23).

**6.** Install the rubber reaction ring in the valve hub so that the ring locating knob indexes in the notch in the hub (Fig. 26), with the ring tips toward the front (Fig. 23).

**7.** Assemble the reaction lever and ring assembly, then install the assembly in the valve hub (Fig. 23).

**8.** Assemble the reaction cone and cushion ring to the push rod, and secure to the rod with the retainer (Fig. 6, Part 2-1). Install the push rod assembly to the valve hub so that the valve plunger indexes in the push rod (Fig. 23).

**9.** Assemble the bellows, retainer, and support ring (Fig. 6, Part 2-1). The support ring is positioned on the middle fold of the bellows.

**10.** Position the bellows assembly and secure it to the diaphragm by installing the retaining ring (Fig. 22). **Make sure that the retaining ring is fully seated.**

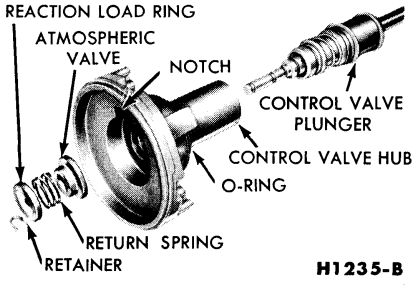



**FIG. 26—Assembly of Control Valve Components to Valve Hub**

### ASSEMBLY OF MAJOR COMPONENTS

**1.** With a screw driver, slightly move the booster body retaining screw tapping channel in order to provide a new surface for the self-tapping attaching screws (Fig. 6, Part 2-1).

**2.** Install the diaphragm, the control valve components, and the bellows as an assembly to the booster body. **Make sure that the lip of the diaphragm is evenly positioned on the retaining radius of the booster body.**

**3.** Install the O-ring in the front side of the end plate.

**4.** Install the valve hub rear seal in the adapter assembly with the sealing lip toward the rear, then install the adapter assembly into the front side of the end plate with the small diameter end of the adapter protruding from the rear side of the end plate (Fig. 27).

**5.** Install the large C-ring to the rear seal adapter at the rear side of the end plate (Fig. 27).

**6.** Position the end plate to the booster body. Align the scribe lines, compress the two assemblies together with a clamp, then install the attaching screws.

**7.** Pull the front lip of the bellows through the booster body, and position it around the outer groove of the booster body (Fig. 27).

**8.** Adjust the push rod as outlined in Part 2-1, Section 2.

### INSTALLATION OF EXTERNAL PARTS

**1.** Install the rubber boot to the valve operating rod (Fig. 6, Part 2-1).

**2.** Position the mounting brackets to the end plate, and install the retaining nuts.

**3.** Connect the lever assembly to the lower end of the mounting brackets with the pivot pin. Install the retainer clip.

**4.** Connect the valve operating rod to the upper end of the lever with the connecting pin and clip.

**5.** Install the rubber grommet in the vacuum port in the booster body. The large diameter side of the grommet should be to the outside of the booster. Force the vacuum manifold and check valve assembly through the grommet. **Do not push the grommet into the vacuum chamber.**

**6.** Install the following parts to the booster body in the order indicated: first the air filter; then the filter cover and hub; and finally the brake master cylinder. Torque the master cylinder mounting nuts to specification.

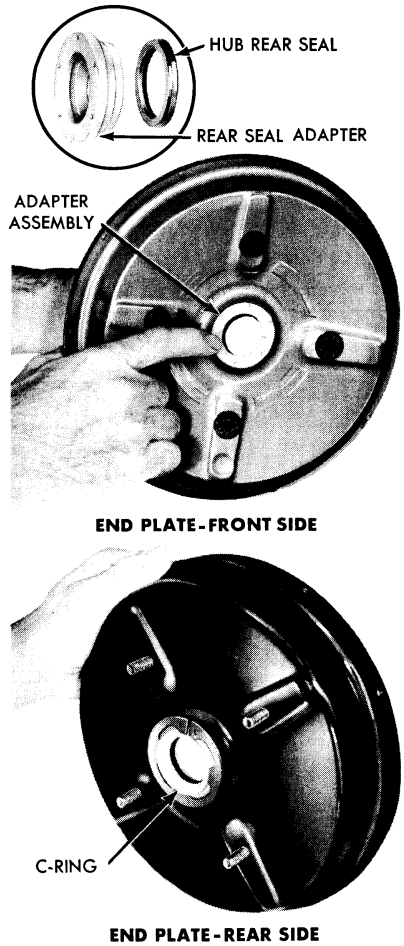



**FIG. 27—Installation of Hub Rear Seal and Adapter Assembly**

# PART 2-3 SPECIFICATIONS

## DIMENSIONS—INCHES

| Model | | Drum Inside Diameter | Drum Maximum Boring Limit | Lining Length | | Lining Width | | Wheel Cylinder Bore Diameter | Master Cylinder Bore Diameter | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Primary | Secondary | Primary | Secondary | | | |
| Sedan | Front | 11.030 | 11.090 | 9.34 | 12.12 | 2½ | 2½ | 1 3/32 | Standard | 1.000 |
| | Rear | | | | | | | ⅞* | | |
| Station Wagon, Police Interceptor, and Taxi | Front | | | | | 3 | 3 | 1 3/32 | Power | 0.875 |
| | Rear | | | | | 2½ | 2½ | 15/16 ⅞* | | |

*For Taxi, (Max. Wear) only

## BRAKE CHECKS AND ADJUSTMENTS

| Type of Check or Adjustment | Specification | |
|---|---|---|
| Brake Shoe Repair | Drum Diameter | Brake Lining Required |
| | 11.030-11.060 inch | Standard |
| | 11.060-11.090 inch | Oversize |
| | Maximum Brake Lining Clearance (Midway between Rivets)—0.005 inch | |
| | Maximum Lining Wear Limit (From Top of Rivets)—1/32 inch | |
| Master Cylinder | Hydraulic Master Cylinder Bore Maximum Honed Diameter (1.003 inch stand.) (0.878 Power) | |
| Power Unit | Push-Rod Adjustment—0.995-1.005 inch | |
| Drum Out of Round | Refinish if Total Indicator Run-Out Exceeds 0.007 inch | |
| Self Adjustment Cable Length | End of Cable Anchor to End of Cable Hook—11⅛ inch ± 1/64 | |

## TORQUE LIMITS

| Description | Foot-Pounds |
|---|---|
| Master Cylinder-To-Pedal Support Bracket | 20-25 |
| Pedal Pad to Brake Pedal Nut | 12-16 |
| Control Assembly—Parking Brake to Cowl Side Bolt | 15-19 |
| Master Cylinder Fitting | 6-12 |
| Left Hand Brake Hose—Front to Connector Bolt | 12-18 |
| Wheel Cylinder Bleeder Screw | 120 in-lbs Maximum |
| Master Cylinder Stop Light Switch | 6-12 |
| Vacuum Connector at Engine Manifold | 20-28 |

### FRONT BRAKES

| | |
|---|---|
| Carrier Plate and Cylinder Assembly Brake Shoe Anchor Pin Nut | 20-30 |
| Anchor Pin to Spindle Bolt | 80-106 |
| Wheel Assembly to Hub and Drum Assembly Nuts | 75-110 |
| Front Brake Carrier Plate to Spindle Nut | 25-45 |

## TORQUE LIMITS (Cont.)

### REAR BRAKES

| Description | Foot-Pounds |
|---|---|
| Drum Assembly to Axle Shaft Assembly Speednut | Hand Push Fit |
| Wheel Assembly to Axle Shaft to Drum Assembly Nuts | 75-110 |
| Brake Cylinder to Brake Carrier Plate Bolt | 10-20 |
| Brake Carrier Plate to Axle Housing | 30-40* |

### POWER BRAKES

| | |
|---|---|
| Master Cylinder to Booster Body | 10-13 |
| Brake Booster to Pedal Support Bracket | 15-25 |

*Models 59, 71 RPO Heavy Duty—55-65 Foot Pounds

# SUSPENSION, STEERING WHEELS AND TIRES — GROUP 3


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# PART 3-1 SUSPENSION, STEERING, WHEELS AND TIRES GENERAL SERVICE


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| 2 Common Adjustments and Repairs | 3-4 |
| 3 Cleaning and Inspection | 3-7 |


## 1 DIAGNOSIS AND TESTING

### MANUAL STEERING

Table 1 lists various steering trouble symptoms and possible causes. Several of these symptoms are also common to suspension, frame, and wheel and tire troubles. For this reason, be sure that the cause of the trouble is in the steering gear or linkage before adjusting, repairing, or replacing any of the steering parts.

### POWER STEERING

#### PRELIMINARY TESTS

The following preliminary checks should always be made before performing any trouble-shooting operations.

**Check Pump Belt.** If the pump belt is broken, glazed, or worn, replace it with a new belt. **Use only the specified type of belt.**

Check the belt tension. If the belt is too loose or too tight, it should be adjusted to the proper tension. The following procedure is for necessary adjustment.

Do not try to increase belt tension pulling on the reservoir.

**In the following procedure, a "used belt" is one that has run ten minutes or longer.**

**1.** Check the power steering belt tension, using tool T62L-8620-A. See Part 3-6 for specified tension on new and on used belts.

**2.** If necessary, loosen the power steering pump bracket adjusting bolt and the pivot bolt.

**3.** Increase or decrease tension as required by adjusting the pump position.

**4.** Torque the adjusting bolt and the pivot bolt to specification, and check the power steering belt tension.

**Check Fluid Level.** Start the engine, turn the steering wheel all the way to the left and right several times, and shut off the engine.

Check the fluid level in the reservoir. If the level is low, add enough fluid (Part 3-4) to raise the level to a point ¼ inch from the top or to the F mark on the dip stick. **Do not overfill the reservoir.**

**Check for Fluid Leaks**

**1.** If the power steering fluid does not already include yellowish green dye, pre-mix one teaspoonful of oil-soluble aniline dye with 2 pints of automatic transmission fluid. Then refill the reservoir with the dye solution.

**2.** With the engine running at idle speed, turn the steering wheel from stop to stop several times to distribute the dye solution throughout the hydraulic system. Do not hold the wheel against each wheel stop more than 3 seconds.

**3.** Shut off the engine, and check for leaks.

**FITTING AND TUBE SEAT LEAK INSPECTION.** Since most fluid leaks occur at the fittings and connections in a power steering hydraulic system, these parts should be checked before any other part is replaced.

**1.** With the engine running at idle speed, raise the car on a hoist.

**2.** Clean the outside of the control valve and the power cylinder, the bottom surfaces of the pump, and all lines and fittings. Dirt, oil, and grease should be removed from all areas where leaks may exist.

**3.** Tighten all fittings, using a special 5-flat tube wrench. **Do not tighten the fittings with a standard open end wrench.** If a properly tightened fitting leaks, replace the seat.

**PUMP, CONTROL VALVE, AND POWER CYLINDER LEAK INSPECTION.** If the fittings and

**TABLE 1—Trouble Symptoms and Possible Causes**

| Possible Causes of Trouble Symptoms | Trouble Symptoms | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jerky Steering | Loose Steering | Hard Steering and/or Loss of Power Assist | Hard Turning When Stationary | Steering and Suspension Noises | Shimmy or Wheel Tramp | Pull to One Side | Side-to-Side Wander | Body Sway or Roll | Tire Squeal on Turns | Binding or Poor Recovery | Normal or Irregular Tire Wear | Sag at One Wheel | Hard or Rough Ride | Rear Suspension Misalignment (Dog Tracking) |
| Incorrect Tire Pressure | | | x | x | x | x | x | x | x | x | | x | x | x | |
| Tire Sizes Not Uniform | | | x | x | | x | x | x | | | | x | x | | |
| Overloaded or Unevenly Loaded Vehicle | | | | | | | | x | | | | x | x | x | |
| Power Steering Fluid Level Low-Leak | x | | x | x | x | | | | | | | | | | |
| Sagging or Broken Spring | | | | | x | x | x | x | x | | | x | x | x | |
| Glazed, Loose or Broken Power Steering Pump Belt | x | | x | x | x | | | | | | | | | | |
| Rear Spring Tie Bolt Off Center | | | | | | | x | | | | | x | | | x |
| Broken Rear Spring Tie Bolts | | | | | x | x | x | x | x | | | x | | | x |
| Rear Spring Front Hanger Mislocated | | | | | | | x | | | | | x | | | x |
| Bent Spindle Arm | | | | | | | x | x | | x | | x | | | |
| Bent Spindle | | | | | | | x | x | | x | | x | | | |
| Lack of Lubrication | | | x | x | x | | | | | | x | | | x | |
| Air in Power Steering System | x | | | | x | x | | | | | | | | | |
| Obstruction in Power Steering Lines | | | x | | x | | | | | | | | | | |
| Loose or Weak Shock Absorber | | | | | x | x | | | x | | | x | | x | |
| Loose or Worn Suspension Arm Bushings | | | | | x | x | | | | | | x | | x | |
| Binding Front Suspension Ball Joints or Steering Linkage | | | | x | x | | | | | | x | | | x | |
| Loose, Worn, or Damaged Steering Linkage or Connections | x | | | | x | x | | x | | x | | x | | | |
| Loose Steering Gear Mountings | x | x | | | x | x | | x | x | | | | | | |
| Insufficient Steering Pump Pressure | | | x | x | | | | | | | x | | | | |
| Incorrect Steering Gear Adjustment | x | x | x | x | x | x | | x | x | | x | x | | | |
| Incorrect Brake Adjustment | x | | | | x | | x | | | | | x | | | |
| Incorrect Front Wheel Bearing Adjustment | x | x | | | x | x | x | x | | | | x | | | |
| Wheel Out of Balance | x | | | | x | x | | | | | | x | | x | |
| Incorrect Front Wheel Alignment | | | x | | x | x | x | x | | x | x | x | | | |
| Out-of-Round Wheel or Brake Drum | | | | | | x | | | | | | x | | x | |
| Frame or Underbody Out of Alignment | | | | | | | x | | | | | x | | | x |
| Bent Rear Axle Housing | | | | | x | | x | | | | | x | | | x |
| Excessive Wear of Steering Pump Internal Parts | | | | | x | | | | | | | | | | |
| Steering Gear Valve Spool Binding or Out of Adjustment | | | x | x | | | | | | | x | | | | |
| Obstruction Within Steering Gear | | | x | x | | | | | | | x | | | | |

connections do not leak, check the other parts of the system.

**PUMP RESERVOIR LEAKS.** Leak points at the pump reservoir may be caused by an improperly installed cover or a defective cover gasket. A worn or damaged stud gasket on the stud at the center of the cover may also cause leakage.

Check the hose connection at the reservoir for leaks, and tighten the hose clamp if necessary.

**PUMP LEAKS.** Leakage may occur at the O-rings in the orifices at the top of the pump body. The reservoir or adapter must be removed from the pump to replace these O-rings.

Other pump leak points are the

shaft seal at the front of the pump, the pump housing O-ring and the other O-ring between the two halves of the pump, and the relief valve retainer O-ring. Replace only the defective parts as required.

**CONTROL VALVE LEAKS.** If the control valve is leaking (somewhere other than the tube seats), replace all the seals, using a control valve seal kit. Use all applicable parts in the kit, and be sure they are correctly installed. When assembling the new seals in the valve, an application of silicone grease to the internal parts will help to provide a better seal against future leakage. Apply grease to the centering spring area, especially on the cap and spacer mating surfaces. Coat the threads of the cap retaining bolts with grease. The rubber boot seals, the actuator assembly, and the metal cup seals in the control valve should also be coated with silicone grease.

Some oil remaining from the manufacturing processes may be found in the sleeve near the ball stud. Do not confuse this oil with leaking fluid from the hydraulic system.

**POWER CYLINDER LEAKS.** The power cylinder may leak at the piston rod seals. A power cylinder seal kit should be used to correct leakage. **Do not replace the power cylinder assembly unless the piston rod is scored or has a dull gray finish instead of a high luster chrome finish.**

**Check Turning Effort.** With the front wheels properly aligned and tire pressures correct, check the effort required to turn the steering wheel.

1. With the car on dry concrete, set the parking brakes.

2. With the engine warmed up and running at idle speed, turn the steering wheel to the left and right several times to warm the fluid.

3. Attach a torque wrench to the steering wheel hub (Fig. 1). Note the torque required to turn the wheel at least one complete revolution in both directions. See Part 3-6 for the specified torque which should be approximately equal in both directions.

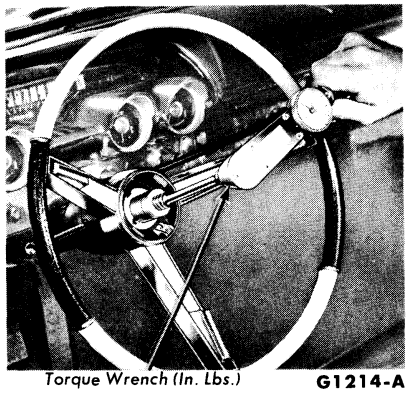



**FIG. 1—Checking Turning Effort**

**SECONDARY TESTS**

| | | |
|---|---|---|
| **BINDING OR POOR RECOVERY** | If the steering wheel binds or sticks when turned, or if poor recovery to the straight-ahead position occurs, check the Pitman arm ball stud in the control valve sleeve. If the ball stud is rubbing against the edge of the sleeve slot, the roll pin may be missing.<br>If either of the idler arm bushings is worn or damaged, replace both bushings.<br>Check the steering gear adjustments (Parts 3-1 and 3-3).<br>Check the operation of the control valve spool in the valve housing. If the spool is binding in the housing, | check the spool adjustment. If the adjustment is correct, overhaul or replace the control valve.<br>Check the control valve travel regulator stop adjustment. If the stop is drawn up too tightly, the ball stud will bind in the seats. Adjust the stop as required.<br>Check the control valve sleeve and the socket tube for damage. Replace parts that show signs of damage, and adjust the travel regulator stop.<br>Check for possible interference between the steering wheel and the steering column. |
| **HARD STEERING** | If the effort required to turn the steering wheel is greater than normal for the entire travel of the front wheels, check the tire pressure, then test the fluid pressure. Be sure that there are no leaks, that the reservoir is properly filled, and that the belt is properly adjusted. If the pump output pressure is low, the pump may be defective and should be overhauled or replaced.<br>If the pressure test shows that the trouble is in the control valve or power cylinder, remove and inspect these units. Repair or replace any damaged parts.<br>If the pressure test indicates that the pressures throughout the system are within specifications, check the following items in the order given:<br>Check the control valve spool centering | tering spring adjustment. Adjust if required (Part 3-4).<br>Check the control valve spool for movement. If the spool does not move freely, check for, and eliminate, interference between the socket tube and the valve sleeve. If the spool is sticking in the housing, remove the spool and check the spool lands for burrs. Small burrs may be removed with crocus cloth if the edges of the valve lands are not rounded in the process. If the spool cannot be repaired, replace the control valve.<br>Check the control valve ball stud for free movement in the ball stud seats. If the stud is binding in the seats, adjust the travel regulator stop. If the hard steer condition still exists, check the front wheel alignment. |

CONTINUED ON NEXT PAGE

**SECONDARY TESTS (Continued)**

| | | |
|---|---|---|
| **EXCESSIVE FREE PLAY** | If excessive free play or lost motion is noticed when steering, check the steering gear worm and ball nut mesh adjustment.<br>Check for excessive clearance between the steering arm ball stud and the ball stud seats. If the ball stud is | loose in the seats, adjust the control valve travel regulator stop.<br>Check the control valve centering spring adjustment, if the spring adjusting nut is loose, tighten the nut until it is snug, and then back off the nut not more than ¼ turn. **Excessive tightening may damage the stop pin.** |
| **NOISE** | Check the pump belt tension. A loose or glazed belt can cause belt squeal. A glazed belt, even when properly adjusted, may slip.<br>Excessive torque at the pressure line joints may distort the tube seats and cause leaks. | Noise may result if the specified hose is not used or if it is improperly routed. If noise still exists with the specified hose installed, the pump should be removed from the car and inspected. |
| **STEERING CHATTER** | A loose pump belt can cause chatter against the wheel stops during an extremely sharp turn. Check the belt tension, and adjust it to specifications if necessary.<br>Check for looseness in the idler arm rod connection. Looseness at this point may be due to worn mounting bushings or improper | mounting nut torque. Replace the bushings if worn. Torque the nut to specification.<br>Check the power cylinder piston rod insulators for looseness. If the insulators are worn, replace them. If the mounting nut is loose, torque it to specification, and torque the locknut to specification. |
| **RATTLES** | Check the control valve spool centering spring adjustment. If the adjustment is loose, tighten the nut until snug, and then back off the nut not more than ¼ turn. **Excessive** | **tightening may damage the stop pin.**<br>Check for looseness between the control valve ball stud and the ball stud seats. If the stud is loose in the seats, adjust the travel regulator stop. |
| **LOSS OF POWER ASSIST** | Check the entire system for damage, replacing parts as necessary. Replace or tighten a broken or loose pump belt.<br>Test the fluid pressure to determine whether the trouble is in the pump, the control valve, or the power cylinder.<br>If the pressure test indicates that the pump is at fault, remove and overhaul the pump.<br>If the pressure test indicates that the control valve or power cylinder is at fault, check as follows:<br>Disconnect the power cylinder piston rod from the idler arm bracket. | Operate the piston by hand to check for resistance to movement. If the piston moves easily with little or no resistance, the internal parts of the power cylinder are broken or damaged. Replace the power cylinder.<br>Maladjustment of the control valve spool centering spring can cause a loss of left turn power assist. Check the adjustment, and readjust if necessary. Replace all defective parts.<br>Check the operation of the control valve check valve. If the check valve does not operate freely, replace the check valve assembly. |

## 2 COMMON ADJUSTMENTS AND REPAIRS

### FLUID PRESSURE TEST

A fluid pressure test will show whether the pump or some other unit in the power steering system is causing trouble in the system.

**1.** Disconnect the pressure line hose from the pump outlet, and install the pressure testing tool between the hose and the pump outlet (Fig. 2). **Be sure that the pressure gauge is between the pump and the shut-off valve on the tool.**

**2.** Open the shut-off valve on the testing tool, and run the engine at idle speed. **If the pump normally operates quietly, ignore the louder pump noise when the pressure testing tool is connected to the system.** Allow at least two minutes for the fluid to warm up before starting the pressure tests.

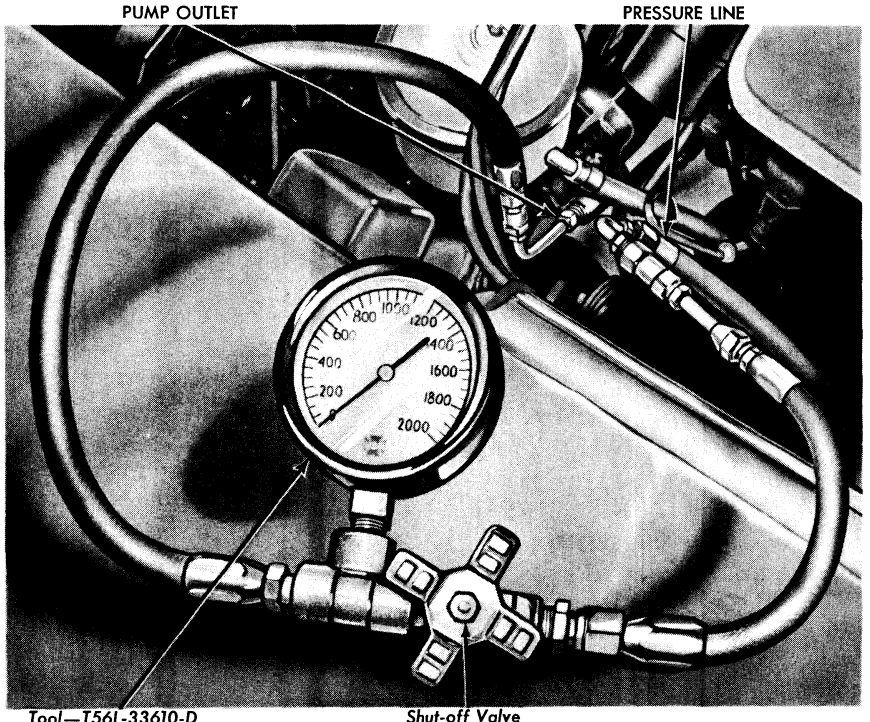



**FIG. 2—Pressure Testing Tool Installed**

**3.** Turn the front wheels all the way to the right and then to the left, noting the fluid pressure reading on the gauge when each wheel is against its stop. Normal fluid pressure at both positions for a car with a 352 or 390 C.I.D. V-8 engine is 950-1100 psi. Normal pressure for a car with the Mileage Maker six or the 289 C.I.D. engine is 750-900 psi. **Do not hold a wheel against its stop for more than 3 seconds at a time because the fluid may overheat.**

**4.** If the fluid pressure, with a wheel against its stop, is less than 950 psi (or 750 psi) turn the wheel off the stop. Slowly close the testing tool shut-off valve, and watch the gauge for an increase in pressure. **Do not leave the valve closed for more than 3 seconds.**

**5.** If the fluid pressure, with the shut-off valve fully closed, still shows less than 950 psi (or 750 psi), the pump is causing the trouble. If the pressure increases to normal pressure range, the trouble is in either the control valve or power cylinder.

**6.** After the fluid pressure test is complete, shut off the engine and remove the pressure testing tool. Make the necessary repairs or replacements to eliminate the trouble in the system.

## FRONT WHEEL ALIGNMENT CHECKS

**Do not attempt to check and adjust front wheel alignment without first making a preliminary inspection of the front-end parts.**

Check all the factors of front wheel alignment except toe-out on turns before making any adjustments. Toe-out on turns should be checked only after caster, camber, and toe-in have been adjusted to specifications.

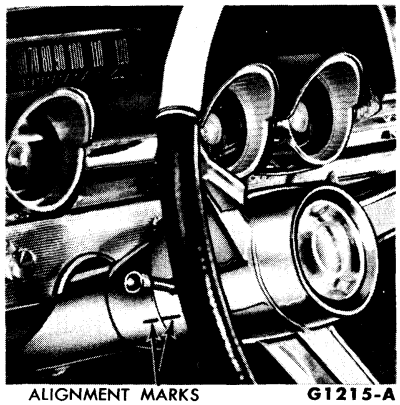



**FIG. 3—Straight Ahead Position Marks**

## EQUIPMENT INSTALLATION

Equipment used for front wheel alignment inspection must be accurate. If portable equipment is being used, perform all inspection operations on a level floor.

**1.** Drive the car in a straight line far enough to establish the straight-ahead position of the front wheels, and then mark the steefing wheel hub and the steering column collar (Fig. 3). **Do not adjust the steering wheel spoke position at this time.** If the front wheels are turned at any time during the inspection, align the marks to bring the wheels back to the straight-ahead position.

**2.** Install the wheel alignment equipment on the car. Whichever type of equipment is used, follow the installation and inspection instructions provided by the equipment manufacturer.

## CASTER

Check the caster angle at each front wheel.

The caster is the forward or rearward tilt of the top of the wheel spindle. If the spindle tilts to the rear, caster is positive. If the spindle tilts to the front, caster is negative. The correct caster angle, or tilt, is $-\frac{1}{2}°$ to $+\frac{1}{2}°$. The maximum difference between both front wheel caster angles should not exceed $\frac{1}{2}°$. However, a difference of not more than $\frac{1}{4}°$ is preferred.

## CAMBER

Check the camber angle at each front wheel.

Camber is the amount the front wheels are tilted at the top. If a wheel tilts outward, camber is positive. If a wheel tilts inward, camber is negative. The correct camber angle, or outward (positive) tilt, is $+\frac{1}{4}°$ to $+1°$. The maximum difference between both front wheel camber angles should not exceed $+\frac{1}{2}°$. However, a difference of not more than $\frac{1}{4}°$ is preferred.

## TOE-IN

Check the toe-in with the front wheels in the straight-ahead position. **Run the engine so that the power steering control valve will be in the center (neutral) position.** Measure the distance between the extreme front and also between the extreme rear of both front wheels. The difference between these two distances is the toe-in.

Correct toe-in, or inward pointing of both front wheels at the front, is ⅛ to ¼ inch.

### FRONT WHEEL TURNING ANGLE

After caster, camber, and toe-in have been adjusted to specifications, check the turning angle.

The turning angle of an outside wheel should be 17° 30′ with Power Steering and 17° 21′ with manual steering when the inside wheel is turned 20°. If this angle is not correct, the spindle arm is probably bent and should be replaced.

After front wheel alignment factors have been checked, make the necessary adjustments. **Do not attempt to adjust front wheel alignment by bending the suspension or steering parts.**

### CASTER AND CAMBER ADJUSTMENTS

Caster and camber can be adjusted by removing or installing shims between the inner shaft of the front suspension upper arm and the mounting bracket on the frame in the engine compartment. The adjusting shims (Fig. 4) are located on the fender side of the bracket.

Both caster and camber adjustments can be made at the same time by loosening the nuts on the two bolts that fasten the inner shaft to the mounting bracket. Use the tool shown in Fig. 5. After the required shims have been removed or installed, torque the nuts to specifications, using the tool shown in Fig. 5. To obtain this torque, turn the nut until 50 ft-lbs is shown. **The wrench and the tool must stay in line (as shown) during the tightening operation.** Caster and camber adjusting shims are available in 1/32-inch and ⅛-inch thicknesses.

#### CASTER

To adjust caster, remove or install shims at either the front bolt or the rear bolt (Fig. 4).

The removal of shims at the front bolt or the installation of shims at the rear bolt will cause the upper ball joint to move forward. The removal of shims at the rear bolt or the installation of shims at the front bolt will cause the ball joint to move rearward. A 1/16-inch change of shim thickness at either bolt will change the caster angle ½°. The difference between the shim stack thicknesses at the two bolts should not exceed ⅛ inch.

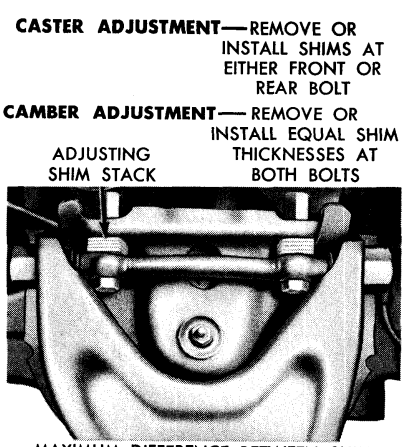



**FIG. 4—Caster and Camber Adjustments**

#### CAMBER

To adjust camber, remove or install equal shim thicknesses at both bolts (Fig. 4).

The removal of equal shims at both bolts will move the upper ball joint inward. The installation of equal shims at both bolts will move the ball joint outward. A 1/16 inch change of shim thickness at both bolts will change the camber angle ¼°. The total shim stack thickness at each bolt should not exceed ⅝ inch (Fig. 4).

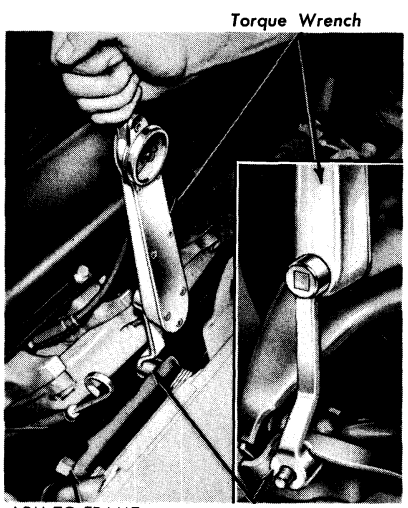



**FIG. 5—Inner Shaft Retaining Nut**

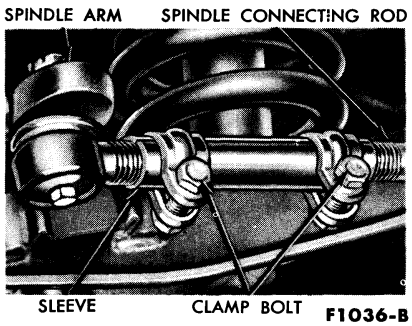



**FIG. 6—Spindle Connecting Rod Sleeve**

### TOE-IN AND STEERING WHEEL SPOKE POSITION ADJUSTMENTS

Check the steering wheel spoke position when the front wheels are in the straight-ahead position. If the spokes are not in their normal position, they can be properly adjusted while toe-in is being adjusted.

1. Loosen the two clamp bolts on each spindle connecting rod sleeve (Fig. 6).

2. Adjust toe-in. If the steering wheels spokes are in their normal position, lengthen or shorten both rods equally to obtain correct toe-in (Fig. 7). If the steering wheel spokes are not in their normal position, make the necessary rod adjustments to obtain correct toe-in and steering wheel spoke alignment (Fig. 8).

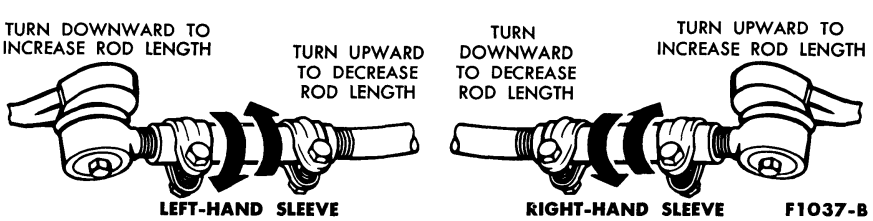



**FIG. 7—Spindle Connecting Rod Adjustments**

3. Recheck toe-in and the steering wheel spoke position. If toe-in is correct and the steering wheel spokes are still not in their normal position, turn both connecting rod sleeves upward or downward the same number of turns to move the steering wheel spokes (Fig. 7).

4. When toe-in and the steering wheel spoke position are both correct, torque the clamp bolts on both connecting rod sleeves to 11-14 ft-lbs. If the car is equipped with power steering, both bolts on the left sleeve should be in a vertical position on the forward side of the sleeve to prevent interference with the control valve. **The sleeve position should not be changed when the clamp bolts are tightened.**

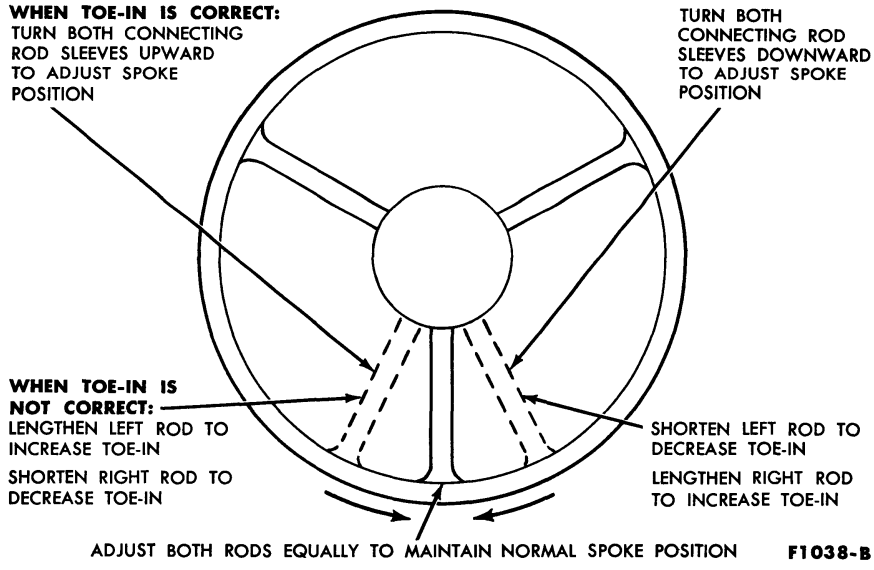



**FIG. 8—Toe-in and Steering Wheel Spoke Adjustments**

## 3 CLEANING AND INSPECTION

### FRONT END GENERAL INSPECTION

**Do not check and adjust front wheel alignment without first making the following inspection for front-end maladjustment, damage, or wear.**

1. Check for specified air pressures in all four tires.

2. Raise the front of the car off the floor. Shake each front wheel grasping the upper and lower surfaces of the tire. Check the front suspension ball joints and mountings for looseness, wear, and damage. Check the brake backing plate mountings. Torque all loose nuts and bolts to specifications. Replace all worn parts as outlined in Part 3-2.

3. Check the steering gear mountings and all steering linkage connections for looseness. Torque all mountings to specifications. If any of the linkage is worn or bent, replace the parts as outlined in Part 3-3.

4. Check the front wheel bearings. If any in-and-out free play is noticed, adjust the bearings to specifications. Replace worn or damaged bearings as outlined in Part 3-5.

5. Spin each front wheel with a wheel spinner, and check and balance each wheel as required.

6. Check the action of the shock absorbers. If the shock absorbers are not in good condition, the car may not settle in a normal, level position, and front wheel alignment may be affected.

### WHEEL INSPECTION

Wheel hub nuts should be inspected and tightened to specification at pre-delivery. Loose wheel hub nuts may cause shimmy and vibration. Elongated stud holes in the wheels may also result from loose hub nuts.

Keep the wheels and hubs clean. Stones wedged between the wheel and drum and lumps of mud or grease can unbalance a wheel and tire.

Check for damage that would affect the runout of the wheels. Wobble or shimmy caused by a damaged wheel will eventually damage the wheel bearings. Inspect the wheel rims for dents that could permit air to leak from the tires.

# PART 3-2 SUSPENSION


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 3-8 | 3 Removal and Installation | 3-11 |
| 2 In-Car Adjustments and Repairs | 3-10 | 4 Major Repair Operations | 3-13 |


## 1 DESCRIPTION AND OPERATION

### FRONT SUSPENSION

Each front wheels rotates on a spindle. The upper and lower ends of the spindle are attached to upper and lower ball joints which are mounted to an upper and lower arm respectively. The upper arm pivots on a bushing and shaft assembly which is bolted to the frame. The lower arm pivots on two studs, one being located in the front crossmember and the other in the No. 2 crossmember (Fig. 1). A coil spring seats between the lower arm and the top of the spring housing. A double acting shock absorber is bolted to the arm and the top of the spring housing.

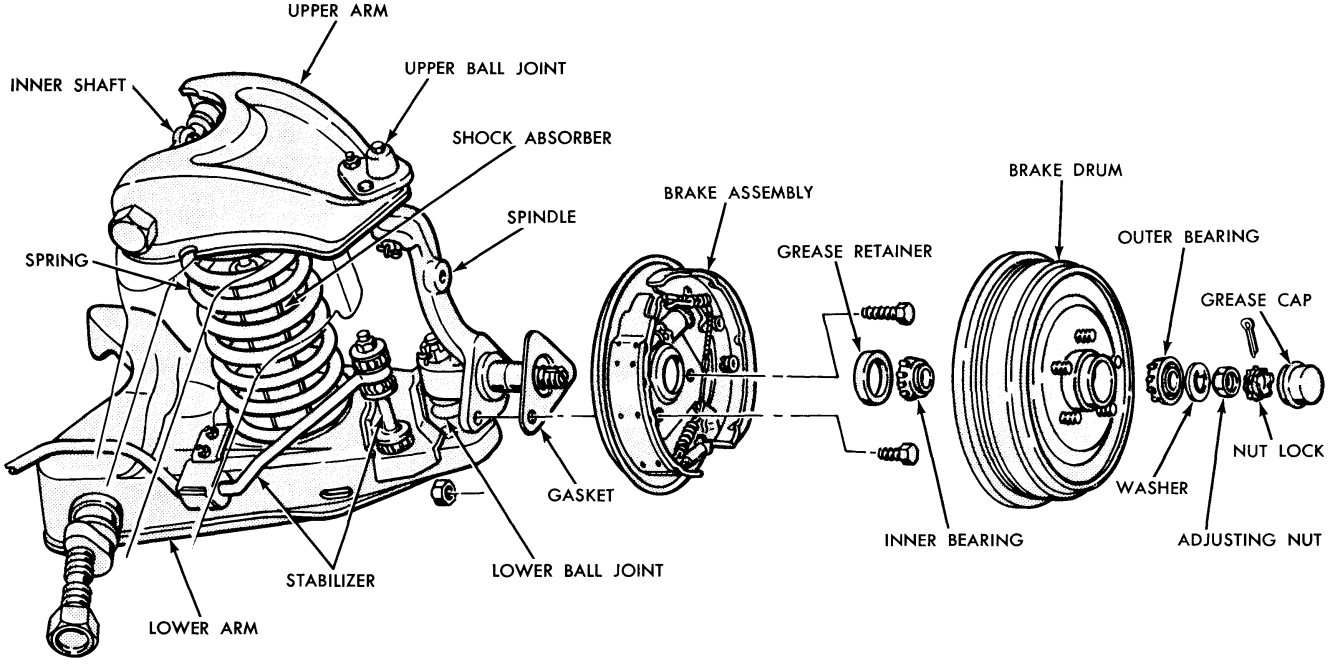
The swiveling action of the ball joints allows the wheel and spindle assemblies to move up and down with changes in road surface. The swiveling ball joints also permit the spindles and wheels to be turned to the left or right by the steering gear and linkage.

The pivoting action of the suspension arms provides an **up and down** movement for the spindles and wheels as required by bumps or depressions in the road surface. The coil springs and shock absorbers control this up and down movement. The stabilizer bar (Fig. 1) is attached to each lower arm to dampen road shocks and minimize road sway.

### REAR SUSPENSION

Each rear wheel, hub and brake drum assembly is bolted to the rear axle shaft flange. The wheel and axle shaft assembly rotates in the rear axle housing. Two spring pads, integral with the axle housing, rest on two leaf-type springs. The axle housing is fastened to the springs by spring clips (U-bolts), spring clip plates, and nuts (Fig. 2). Each spring is suspended from a frame side rail by a hanger at the front and a shackle at the rear. The upper end of each shock absorber is mounted to a frame crossmember the lower end is mounted to the spring pad at the axle housing.

The springs and shock absorbers provide for up and down movement of the rear axle and wheels as required by changes in the road surface. They also cushion road shocks.




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**FIG. 1—Front Suspension**

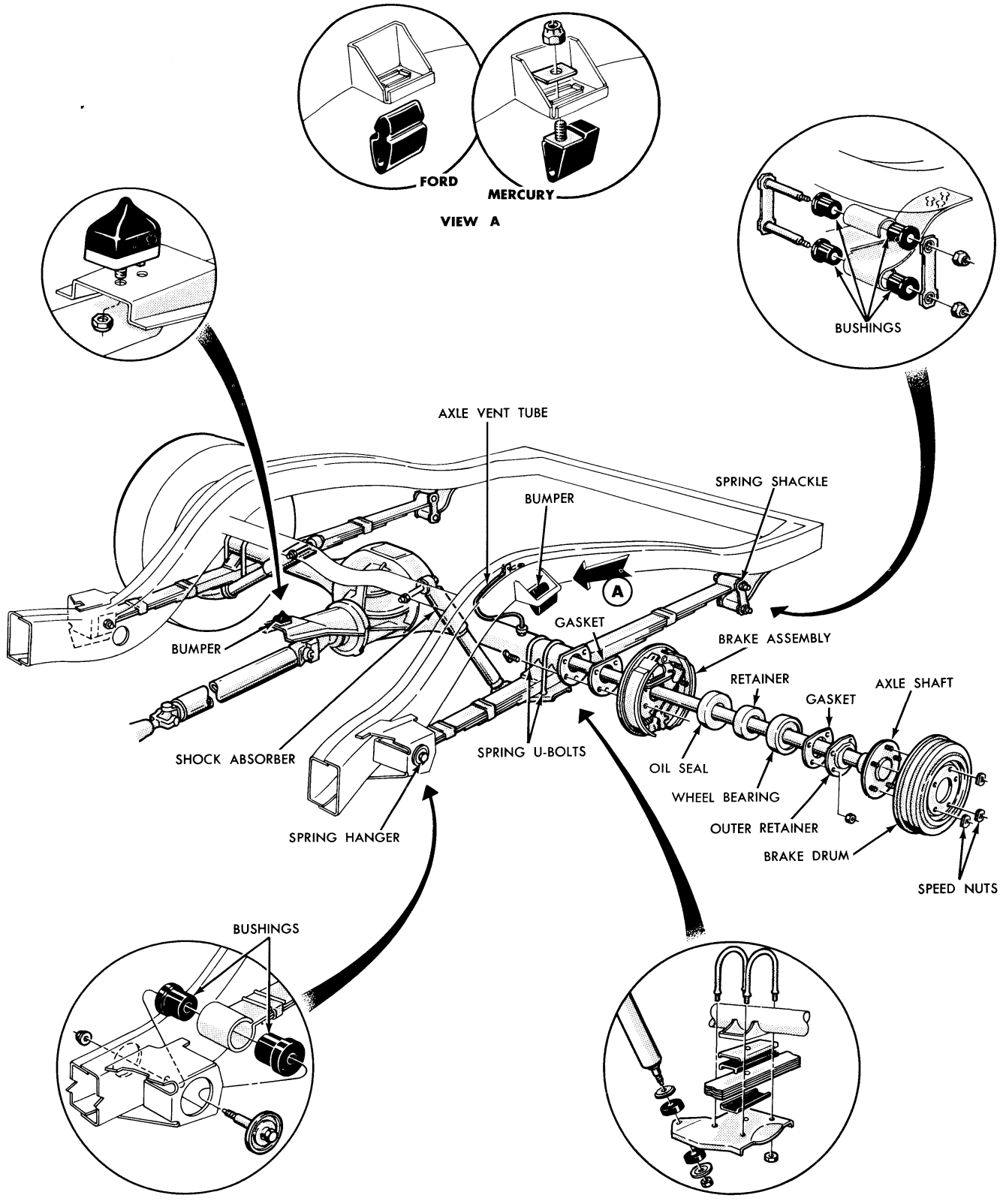



**FIG. 2—Rear Suspension**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### UPPER BALL JOINT REPLACEMENT—ARM IN CAR

**1.** Raise the car high enough to provide working space, and place a support under the lower arm. If a chain hoist or a jack that has a narrow contact pad is to be used on the bumper to raise the car, distribute the load along the bumper by using a steel plate 3 or 4 inches long as a contact pad to prevent damaging the bumper.

**2.** Remove the wheel and tire.

**3.** Drill a ⅛-inch hole through each upper ball joint retaining rivet. Using a large chisel, cut off the rivets.

**4.** Remove the upper arm suspension bumper.

**5.** Remove the cotter pin and nut from the upper ball joint stud.

**6.** Place a box wrench over the lower end of the ball joint remover tool, and position the tool as in Fig. 3. The tool should seat firmly against the ends of both studs, and not against the lower stud nut.

**7.** Turn the wrench until both studs are under tension, and then, with a hammer, tap the spindle near the upper stud to loosen the stud from the spindle. **Do not loosen the stud with tool pressure alone.** Remove the ball joint.

**8.** Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.

**9.** Attach the new ball joint to the upper arm. **Use only the specified bolts, nuts, and washers. Do not rivet the new ball joints to the arm.** Torque the nuts to specification.

**10.** Install the upper arm suspension bumper. Torque the nut to specification.

**11.** Position the ball joint stud in the spindle bore, and torque the retaining nut to specification. Install a new cotter pin.

**12.** Install the wheel and tire.

**13.** Remove the safety stands, and lower the car.

**14.** Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

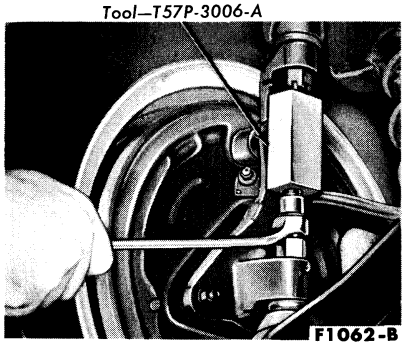



**FIG. 3—Disconnecting Upper Ball Joint**

### INNER SHAFT AND/OR BUSHING REPLACEMENT—ARM IN CAR

**1.** Raise the car to provide working space, and remove the wheel and tire as a unit.

**2.** After noting the number and location of the adjusting shims, use the tool shown in Fig. 4, to remove the inner shaft retaining nuts, bolts, washers, and shims.

**3.** Swing the upper arm upward and outward to provide working space.

**4.** Remove the 2 bushings and the inner shaft.

**5.** Install the new inner shaft. Lubricate the bushings.

**6.** Swing the arm back to its normal position, and partially install the inner shaft retaining bolts, shims, washers, and nuts.

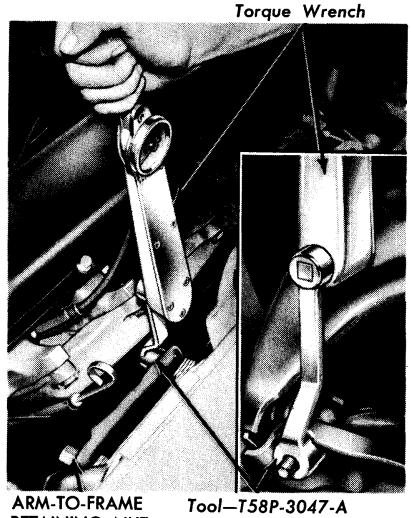



**FIG. 4—Installing Inner Shaft Attaching Nut**

**7.** Using the tool shown in Fig. 4, torque the nuts to specification. To attain this torque with the special tool, turn the nut until 50 ft-lbs is shown. **The wrench and the tool must stay in line (as shown) during the tightening operation.**

**8.** Install the wheel and tire, and lower the car.

**9.** Check and, if necessary, adjust caster, camber, and toe-in.

### LOWER BALL JOINT REPLACEMENT—ARM IN CAR

**1.** Raise the car high enough to provide working space, leaving the lower arm free to drop as coil spring tension is eased. If a chain hoist or a jack that has a narrow contact pad is to be used on the bumper to raise the car, distribute the load along the bumper by using a steel plate 3 or 4 inches long as a contact pad to prevent damaging the bumper.

**2.** If the ball joint is riveted to the arm, drill a ⅛-inch pilot hole completely through each rivet. Then drill off the rivet head through the pilot hole with a ⅜-inch drill, and drive out both rivets.

**3.** Position a jack or safety stand under the lower arm, and lower the car about 6 inches to offset the coil spring tension.

**4.** Remove the cotter pin from the ball joint stud, and remove the nut.

**5.** Place a box wrench over the lower end of the tool shown in Fig. 3, and position the tool. **The tool should seat firmly against the end of both studs, and not against the upper stud nut.**

**6.** Turn the wrench until both studs are under tension, and then, with a hammer, tap the spindle near the lower stud to loosen the stud from the spindle. **Do not loosen the stud with tool pressure alone.** Remove the ball joint.

**7.** Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.

**8.** Position the stud of the ball joint to the spindle bore, and install the retaining nut finger-tight.

**9.** Attach the ball joint to the lower arm. **Use only the specified bolts, nuts, and washers. Do not rivet**

**the new ball joint to the arm.** Torque the nuts to specification.

**10.** Torque the ball joint stud nut to specification, and install a new cotter pin.

**11.** Remove the jack.

**12.** Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

### STABILIZER REPAIR

To replace the end bushings on each stabilizer link, use the following procedure.

**1.** Raise the car on a hoist.

**2.** Remove the link-to-stabilizer bar retaining nut, washers, and insulators, and disconnect the link from the bar (Fig. 1).

**3.** Remove the link-to-lower arm retaining nut, washers, and insulators, and disconnect the link from the bar (Fig. 1).

**4.** Remove the link-to-lower arm retaining nut, washers, and insulators, and remove the link from the arm.

**5.** Assemble the link and new washers and insulators to the lower arm, then install the link-to-lower arm retaining nut.

**6.** Connect the link to the bar with new washers and insulators and secure with the retaining nut.

**7.** Lower the car.

## 3 REMOVAL AND INSTALLATION

### INNER SHAFT AND/OR BUSHING REPLACEMENT—ARM REMOVED

**Always replace both upper arm bushings if either bushing is worn or damaged,** and install only new bushings when replacing the shaft.

**1.** Remove the bushings from the shaft and arm.

**2.** Install the new bushings, using the tool shown in Fig. 5. Lubricate the bushings. **The arm must be exactly centered, and the tool should be left in place until after the bushings have been torqued to specification. Position the bushings carefully to avoid damaging the O-rings inside the bushings.**

### LOWER ARM AND COIL SPRING REPLACEMENT

**1.** Raise the car so that the front wheels are about 8 inches off the floor, and place supports under both frame side members just back of the lower arms.

**2.** Remove the wheel and tire assembly.

**3.** Disconnect the stabilizer assembly.

**4.** Disconnect the lower end of the shock absorber, and push it up to the retracted position.

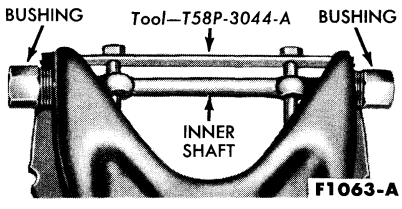



**FIG. 5—Installing Upper Arm Inner Shaft Bushing**

**5.** Remove the cotter pin from the nut on the lower ball joint stud, and loosen the nut one or two turns. **Do not remove the nut from the stud at this time.**

**6.** Straighten the cotter pin on the upper ball joint stud nut, place a box wrench over the lower end of the ball joint remover tool, and install the tool between the upper and lower ball joint studs (Fig. 1). **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

**7.** Turn the wrench until the tool places the studs under tension, and tap the spindle near the lower stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud in the spindle with tool pressure only.** If both arms are being removed, loosen the upper stud in the same manner as the lower stud.

**8.** Place a jack under the lower arm at approximately a 60° angle away from the wheel and toward the center of the car. Hook the saddle of the jack over the outer edge of the spring seat (Fig. 6).

**9.** Remove the nut from the lower ball joint stud, and slowly lower the arm until the spring is fully extended (Fig. 7).

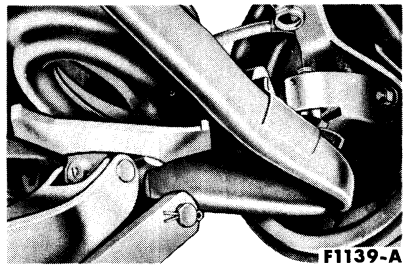



**FIG. 6—Supporting Lower Arm**

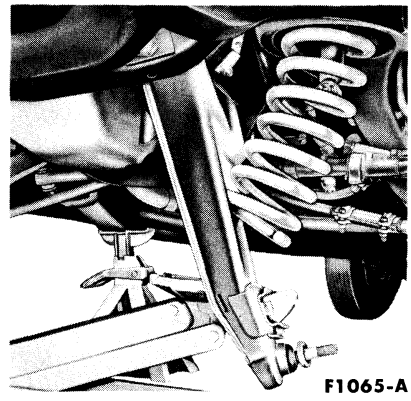



**FIG. 7—Lowering or Raising Lower Arm**

**10.** Apply foot pressure to the lower suspension arm to push the arm inward so that the spring and insulator assembly may be lifted from the car (Fig. 8).

**11.** Remove the lower arm retaining bolts, washers, and shims, and remove the arm from the car. **Note**

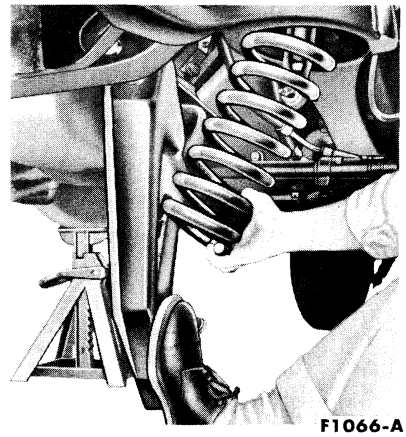



**FIG. 8—Removing or Installing Coil Spring**

**the respective front and rear positions of the 2 different retaining bolts.**

**12.** Mount the lower arm to the frame crossmembers. Insert the large diameter bolt from the rear side of the rear crossmember and through the arm. Position the insulator and washers on the small retaining bolt and turn the small bolt into the internal threads of the large diameter bolt. Do not tighten.

Install the forward bolt from the front side of the front crossmember with sufficient shims between the crossmember and arm to prevent forward and backward movement of the arm. Install the insulator, washer, and retaining nut on the bolt but do not tighten.

**13.** Tape the insulator (and shim assembly if so equipped) to the top of the coil spring. Position the insulator and spring in the upper suspension arm spring pocket, and hook the lower end over the edge of the lower arm pocket by applying foot pressure inward on the lower arm (Fig. 8). **The spring coil end must be seated correctly in the lower pocket.**

**14.** Position the jack directly behind the lower arm at approximately a 60° angle away from the wheel and toward the center of the car. Push the jack outboard as the arm is raised to align the ball stud with the spindle bore (Fig. 9).

**15.** Apply downward pressure on the top of the wheel to permit the ball joint shoulder to slip over the edge of the bore into position.

**16.** Torque the lower ball joint nut to specification, and remove the jack.

**17.** Install the lower ball joint retaining nut cotter pin, and bend the upper ball joint retaining nut cotter pin.

**18.** Torque the lower arm retaining bolts and nut to specification. **The lower arm should be in a normal load position when the retaining bolts and nut are tightened.**

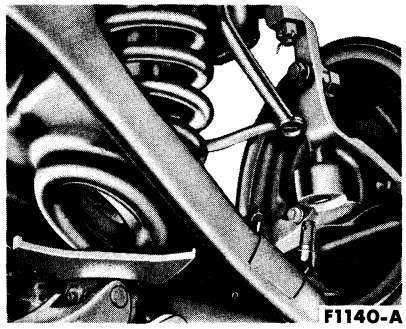



**FIG. 9—Aligning Ball Stud with Spindle Bore**

**19.** Expand the shock absorber, and connect it to the arm.

**20.** Connect the stabilizer assembly with the car weight on the wheel to insure correct seating of the rubber insulator.

**21.** Install the wheel and tire assembly.

**22.** Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

## LOWER ARM BUSHING REPLACEMENT

**Always replace both lower arm bushings if either bushing is worn or damaged.**

**1.** Position the bushing remover tools (Fig. 10) and press both bushings out of the arm.

**2.** Press new bushings into the arm with the tools shown in Fig. 11. **The bushing flanges must be at the inner sides of the lower arm.**

## LOWER BALL JOINT REPLACEMENT—ARM REMOVED

**1.** Remove the ball joint from the arm. If the ball joint is riveted to the arm, drill a ⅛-inch pilot hole completely through each rivet, and then drill off the rivet head through the pilot hole with a ⅜-inch drill. Drive all rivets out of the holes.

**2.** Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.

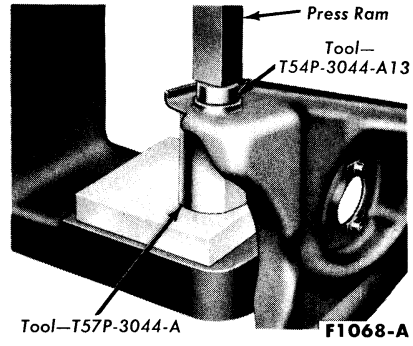



**FIG. 10—Removing Lower Arm Bushing**

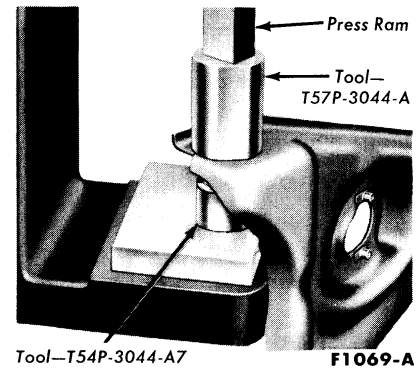



**FIG. 11—Installing Lower Arm Bushing**

**3.** Install the ball joint on the arm. **Use only the specified bolts, nuts and washers. Do not attempt to rivet the new ball joint to the arm.**

**4.** Torque the nut on the suspension arm bumper to specification. Torque the ball joint retaining nuts and bolts to specification.

## FRONT WHEEL SPINDLE REPLACEMENT

**1.** Raise the car until the front wheel clears the floor, and place a support under the lower arm. Mark the steering wheel straight ahead position.

**2.** Back off the brake adjustment, and remove the wheel, hub, and drum as an assembly.

**3.** Remove the mounting bolt at the anchor pin and the two lower mounting bolts and nuts, then dismount the brake backing plate assembly from the spindle. Support the plate to prevent damage to the brake hose.

**4.** Disconnect the spindle connecting rod end from the spindle arm with tool CJ 89-1.

**5.** Remove the cotter pins from both ball joint stud nuts, and loosen the nuts one or two turns. **Do not remove the nuts from the studs at this time.**

**6.** Place a box wrench over the lower end of the ball joint remover tool, and install the tool between the upper and lower ball joint studs (Fig. 3). **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

**7.** Turn the wrench until the tool places the studs under tension, and, with a hammer, tap the spindle near the studs to loosen them in the spindle. **Do not loosen the studs in the spindle with tool pressure only.**

**8.** Remove both ball joint stud nuts, raise the upper suspension arm, and remove the spindle from both studs.

**9.** Position the spindle on both ball joint studs and install both stud nuts.

**10.** Torque the stud nuts to specification. Continue to tighten both nuts until the cotter pin holes and slots line up. Install new cotter pins.

**11.** Connect the spindle connecting rod end to the spindle arm. Install the retaining nut, torque to specification, and install the cotter pin.

**12.** Install the brake backing plate on the spindle, and torque the brake shoe anchor pin bolt to specifications. Torque the lower bolts to specifications.

**13.** Install the wheel, hub, and drum assembly, and adjust the wheel bearings and brakes.

**14.** Check and, if necessary, adjust caster, camber, and toe-in.

## 4 MAJOR REPAIR OPERATIONS

### SHOCK ABSORBERS

Passenger cars and station wagons are equipped with hydraulic shock absorbers of the direct-acting type and are nonadjustable and nonrefillable, and cannot be repaired.

Before replacing a shock absorber, check the action of the shock absorbers by grasping the bumper and jouncing the car up and down. If the shock absorbers are in good condition the car will immediately settle to a normal position after the bumper is released. If the car continues to jounce, or remains displaced, remove the shock absorbers for further testing. If the shock absorber shows signs of oil leakage, replace it.

### TESTING

To check a shock absorber removed from a car proceed as follows:

**1.** Hold the shock absorber in the vertical position with the piston (lower end) up, and pull out the piston and rod until the shock is extended to its full length.

**2.** With the shock absorber held in the same position, push in the piston and rod until the shock is compressed to its shortest length.

**3.** Repeat steps 1 and 2 several times until all the air is expelled.

**4.** Clamp the lower end (small diameter) in a vise in a vertical position.

**5.** Extend the shock to its full length and then compress it to its shortest length. There should be a constant drag during the complete cycle. Any sudden loss of drag indicates air in the system or faulty internal valve operation. Replace defective shock absorbers.

### SHOCK ABSORBER REPLACEMENT

The front and rear shock absorbers are nonadjustable and nonrefillable, and cannot be repaired.

### FRONT SHOCK ABSORBER REPLACEMENT

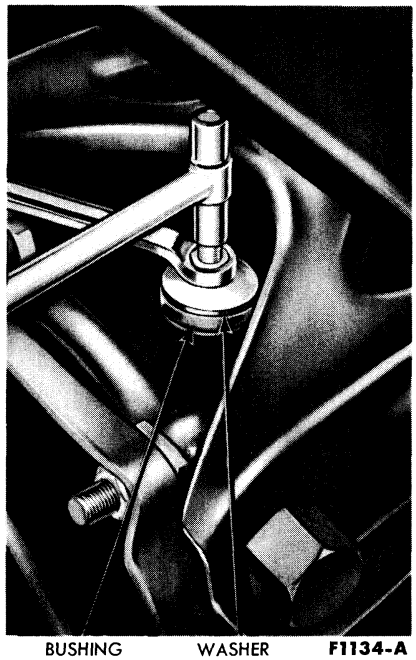
**1.** Raise the front of the car and place supports under both suspension lower arms. **Be sure that the lower end of the shock absorber remains accessible for servicing.**

**2.** Remove the retaining nut, washer, and rubber bushing from the upper end of the shock absorber shaft (Fig. 12).

**3.** Remove one lower bushing mounting bolt and loosen the other (Fig. 13). Slide the bushing assembly off the loosened bolt, then lower the shock absorber through the hole in the suspension arm.

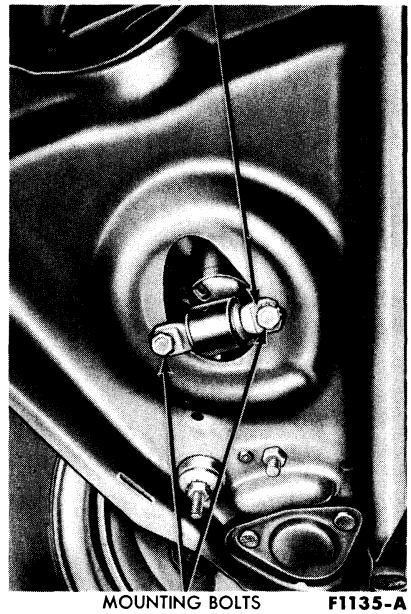
**4.** If the shock absorber is serviceable and the bushing requires replacing, remove the old bushing from the lower end of the shock absorber (Fig. 14).

**5.** Apply RUGLYDE or a comparable lubricant to the replacement bushing, and install the bushing on the shock absorber (Fig. 15) with one quick drive of the press ram.



BUSHING WASHER F1134-A

**FIG. 12—Front Shock Absorber Upper Mounting**



LOWER MOUNTING BUSHING

MOUNTING BOLTS F1135-A

**FIG. 13—Front Shock Absorber Lower Mounting**

**6.** Place the inner washer and bushing on the shock absorber shaft. Expel all air by performing steps 1 and 2 under "Testing." Extend the shock absorber and install it through the hole in the lower arm and through the coil spring so that the shaft will go through the hole in the upper mounting bracket. **Be sure the mounting bracket is free of burrs.**

**7.** Install the upper bushing and the outer washer on the shaft, and torque the nut to specification (Fig. 12).

**8.** Torque the lower mounting bolts to specification (Fig. 13).

For information on frames, refer to Part 13-1.

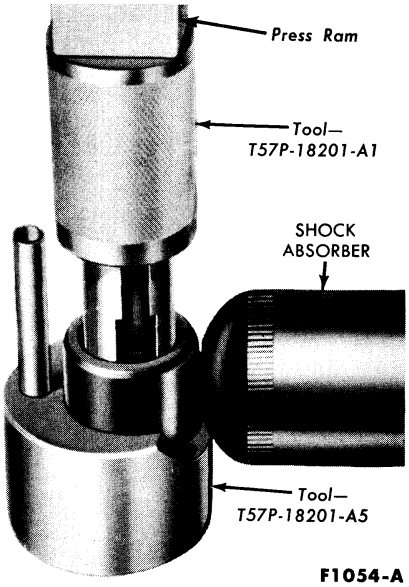



**FIG. 14—Removing Front Shock Absorber Bushing**

## REAR SUSPENSION ALIGNMENT CHECK

Suspected misalignment or "dog tracking" of front and rear wheel treads should be checked. Drive the car straight ahead on a section of pavement, part of which is wet, and stop about ten feet beyond the wet area. If alignment is correct, the rear tire imprints will appear an equal distance inside the front tire tracks (Fig. 16).

### TIE BOLT OFF CENTER

Misalignment may result from a rear spring tie bolt head which is not centered in the locating hole of the spring mounting pad on the axle housing (Fig. 17). To determine whether or not this bolt is off-center, measure the distance "A" (Fig 18) between a locating hole common to both frame side rails and the forward edge of the axle housing. This hole is in the outboard side of the rails and to the rear of the rear spring front hanger bracket. Dimension "A" should be the same, within ⅛ inch, on both sides of the car.

To center the tie bolt, take the following steps:

1. Loosen the four spring clip nuts.
2. With a jack, push or pull the housing into position.
3. While there is jack pressure, move the spring clip into line, with the new position of the housing.
4. Torque the spring clip nuts to specifications.
5. Recheck the distance between front and rear tire imprints, and adjust further if necessary.

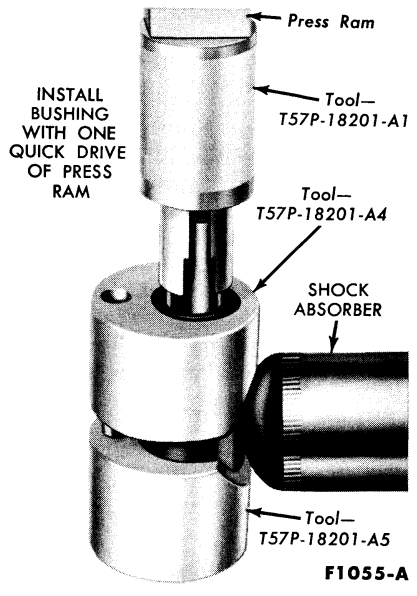



**FIG. 15—Installing Front Shock Absorber Bushing**

### REAR SPRING FRONT HANGER REPLACEMENT

To determine if the rear spring front hanger should be replaced, measure the distance "B" (Fig. 18) between a locating hole common to both frame side rails and the leading edge of the rear spring front stud. This hole is in the outboard side of the rail to the rear of the rear spring front hanger bracket. Dimension "B" should be the same, within ⅛ inch, on both sides of the car.

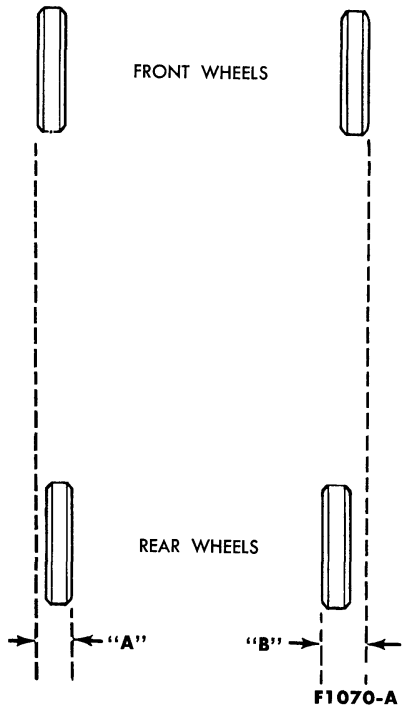



**FIG. 16—Suspension Alignment Check**

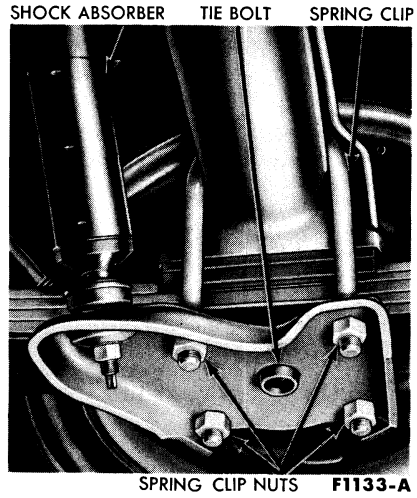



**FIG. 17—Rear Spring and Spring Clips**

If necessary, replace the hanger bracket as follows:

1. Raise the car on a frame hoist or a jack so that the axle assembly can be lowered.
2. Disconnect the lower end of the rear shock absorber from the spring clip plate.
3. Disconnect the parking brake cable at the equalizer, and disconnect the cable rear retaining clip from the frame crossmember on the side being reworked.
4. Remove the rear spring front hanger stud, and lower the forward end of the spring to allow removal of the hanger bracket.
5. Remove the hanger bracket by cutting the top and bottom flange loose from the center portion with a cutting torch. Bend the center section until free of the frame welds, and then remove. Bend the top and bottom flanges up and down until they break free of the welds.
6. Burn the old welds off the

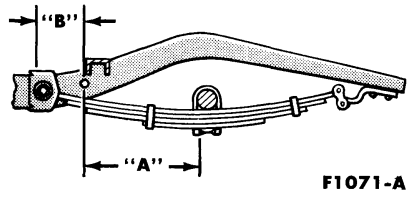



**FIG. 18—Rear Spring Hanger Alignment Check**

frame at the lower flange, and grind the weld areas smooth.

**7.** Cut off approximately ⅛ inch from the edge of the upper flange on the new spring hanger to allow clearance for the original weld on the top of the frame.

**8.** Elongate the rear spring front hanger bracket center bolt hole in the frame (both sides of frame channel) with a rotary file to provide clearance for positioning of the new bracket.

**9.** Locate and tack-weld the new bracket on the frame. **Use the same hole in the frame side rail that was used to check alignment originally. The bracket must be plumb and in proper position before final welding. Use mild steel rod and arc welding equipment.**

**10.** Reposition the rear spring in the bracket.

**11.** Install the rear spring front hanger stud and nut, and torque to specifications.

**12.** Recheck the rear axle alignment, using the frame holes.

**13.** Connect the lower end of the shock absorber.

**14.** Connect the parking brake cable and lower the car.

## REAR SPRING REPLACEMENT

**1.** Raise the car until the rear wheels clear the floor, and place supports under the car frame and the rear axle.

**2.** Disconnect the parking brake cable spring from the inner spring clip.

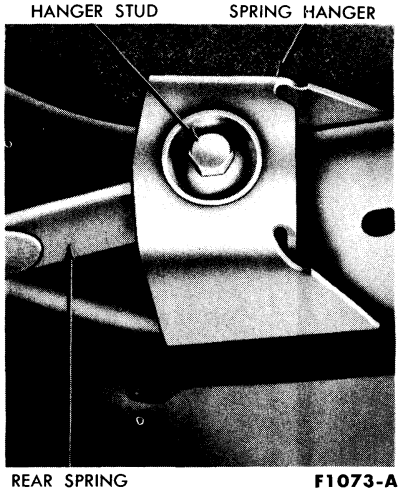



**FIG. 19—Rear Spring Front Hanger**

**3.** Disconnect the lower end of the shock absorber from the spring clip plate (Fig. 17).

**4.** Remove the spring clip nuts, the clips, and the spring clip plate.

**5.** Remove the front hanger stud from the forward end of the spring (Fig. 19).

**6.** Remove the shackle from the shackle hanger and spring, and remove the spring from the car.

**7.** Position the new spring under the rear axle. **The shorter end of the spring between the center tie bolt and the spring eye should be toward the front of the car.**

**8.** Install the shackle and shackle hanger, leaving the lock nuts finger-tight.

**9.** Install the front hanger stud in the spring and hanger, and torque the lock nut to specifications.

**10.** Torque the shackle lock nuts to specifications.

**11.** Install the spring clips, plate and clip nuts. **Be sure that all parts are properly seated on the spring and rear axle.**

**12.** Torque the clip nuts to specification. **Do not exceed the maximum torque because the rear wheel camber may be affected.**

**13.** Connect the lower end of the shock absorber to the rear spring clip plate.

**14.** Connect the parking brake cable spring to the inner spring clip.

## REAR SPRING INSPECTION AND REPAIR

Inspect the rubber bushings, shackle and studs, and hanger and stud, for wear or damage. Replace parts where necessary.

Check for broken spring leaves. Inspect the anti-squeak inserts between the leaves, and replace them if they are worn. **The spring leaves must be dry and free of oil and dirt before new inserts are installed.**

Inspect the spring clips for worn or damaged threads. Check the spring clip plates for distortion.

## REAR SHOCK ABSORBER REPLACEMENT

**1.** Remove the nut that retains the shock absorber assembly to the spring clip plate, and remove the lower washer and rubber bushing (Fig. 20).

**2.** Remove the self-locking nut and washer that retains the upper end of the shock absorber to the mounting stud on the crossmember. Compress the shock absorber to clear the hole in the spring clip plate, and remove the assembly from the mounting stud.

**3.** If the shock absorber is serviceable, replace the rubber bushings in the eye of the shock absorber.

**4.** Expel all air by performing steps 1 and 2 under "Testing."

**5.** Place the inner washer and the shock absorber on the mounting stud, then install the outer washer and self-locking nut (snug).

**6.** Extend the shock absorber, and locate the lower stud in the hole in the spring clip plate with washers and new rubber bushings. Install the lower retaining nut and torque to specification.

**7.** Torque the self-locking nut on the upper mounting stud to specification.

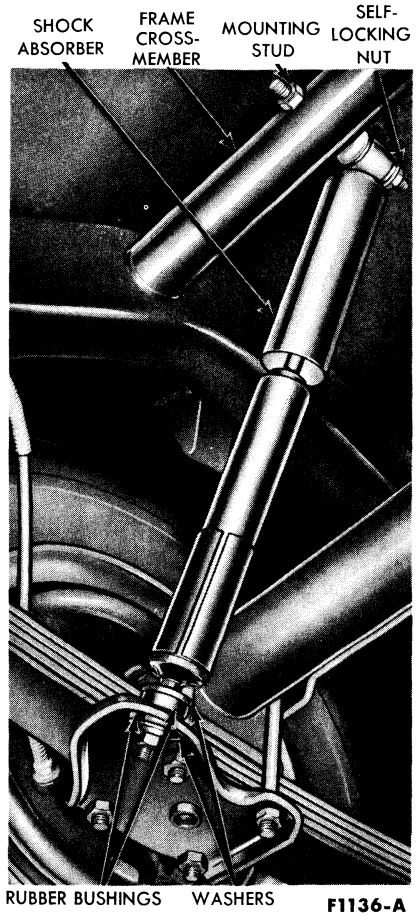



**FIG. 20—Rear Shock Absorber**

# PART 3-3 MANUAL STEERING


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| 2 | In-Car Adjustments and Repairs | 3-16 |
| 3 | Removal and Installation | 3-21 |
| 4 | Major Repair Operations | 3-22 |
| 5 | Steering Linkage Repair | 3-23 |


## 1 DESCRIPTION

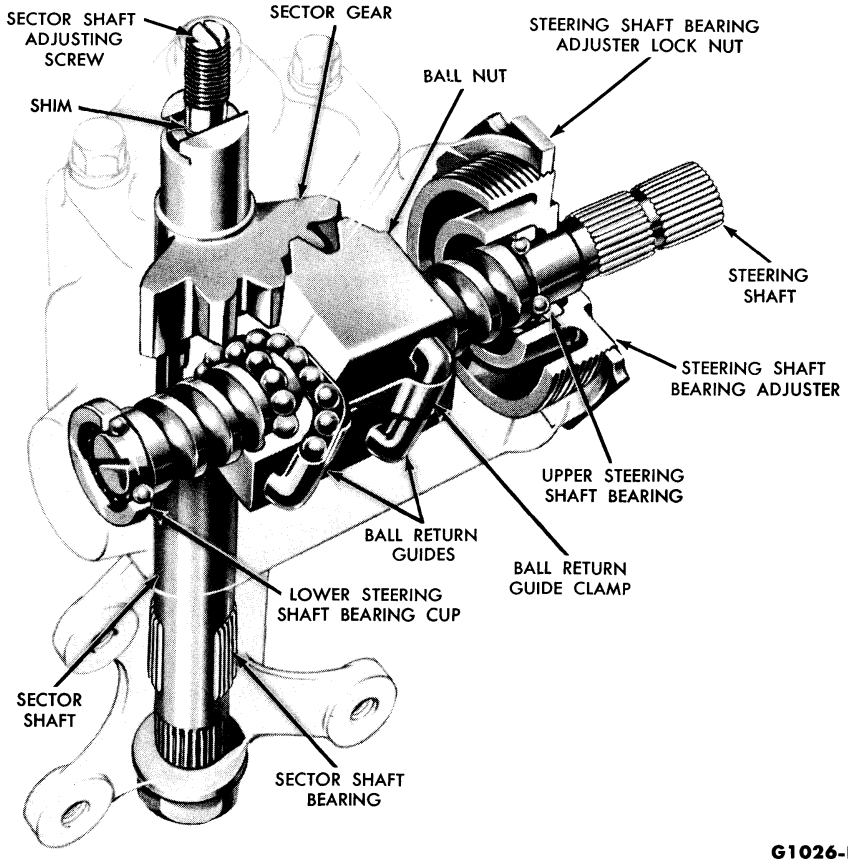



**FIG. 1—Recirculating Ball Type Steering Gear**

The steering gear (Fig. 1) is of the worm and recirculating ball type. The sector shaft rotates in needle bearings that are pressed into the gear housing.

The worm bearing preload is controlled by the large adjusting nut which is threaded into the housing. The sector shaft mesh load is controlled by an adjusting screw located in the housing cover.

The steering linkage consists of the Pitman arm, steering-arm-to-idler arm rod, idler arm and the spindle connecting rods (tie rods).

A steering gear identification tag is provided under one of the cover attaching bolts (Fig. 2).

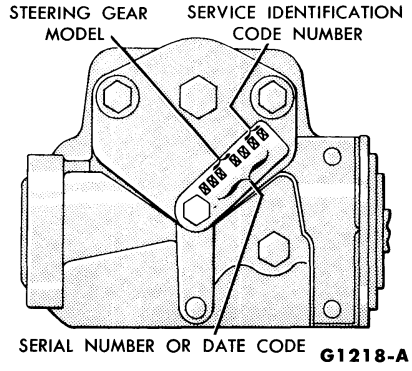



**FIG. 2—Steering Gear Identification Tag**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### STEERING WORM AND SECTOR GEAR ADJUSTMENTS

The ball nut assembly and the sector gear must be adjusted properly to maintain minimum steering shaft end play (a factor of preload adjustment) and minimum backlash between sector gear and ball nut. There are only two possible adjustments within the recirculating ball-type steering gear, and **these should be made in the following order to avoid damage or gear failure.**

**1.** Disconnect the Pitman arm from the steering arm-to-idler arm rod. On a car with power steering, disconnect the arm from the control valve ball stud (Fig. 19).

**2.** Loosen the nut which locks the sector adjusting screw (Fig. 3), and turn the adjusting screw counterclockwise.

**3.** Measure the worm bearing preload by attaching an inch-pound torque wrench to the steering wheel nut (Fig. 4). With the steering wheel off center, read the pull required to

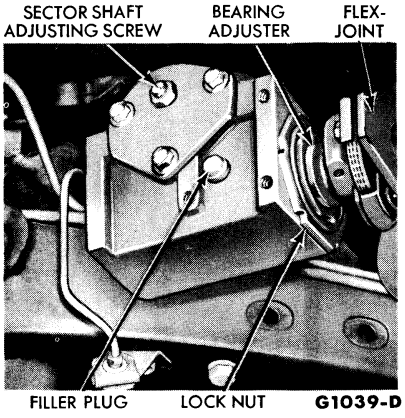



**FIG. 3—Steering Gear Adjustment**

rotate the input shaft approximately 1½ turns either side of center. If the torque or preload is not within specification (Part 5-1), adjust as explained in the next step.

**4.** Loosen the steering shaft bearing adjuster lock nut, and tighten or back off the bearing adjuster (Fig. 3) to bring the preload within the specified limits.

**5.** Tighten the steering shaft bearing adjuster lock nut, and recheck the preload.

**6.** Turn the steering wheel slowly to either stop. **Turn gently against the stop to avoid possible damage to the ball return guides.** Then rotate the wheel 2¾ turns to center the ball nut.

**7.** Turn the sector adjusting screw clockwise until the specified pull (Part 5-1) is necessary to rotate the worm past its center (high spot) (Fig. 4). **No perceptible backlash is permissible at 30° on either side of center.**

**8.** While holding the sector adjusting screw, tighten the sector adjusting screw locknut to specification, and recheck the backlash adjustment.

**9.** Connect the Pitman arm to the steering arm-to-idler arm rod. On a car with power steering, connect the arm to the control valve ball stud.

## STEERING WHEEL SPOKE POSITION ADJUSTMENT

When the steering gear is on the high point, the front wheels should be in the straight-ahead position and the steering wheel spokes should be in their normal position with the Pitman arm pointing directly forward. If the spokes are not in their normal position, they can be adjusted without disturbing the toe-in adjustment (Part 3-1).

## STEERING WHEEL REPLACEMENT

**1.** Remove the horn ring (or button) assembly and related parts.

**2.** Remove the nut from the end of the steering shaft, and remove the steering wheel from the shaft, using the tool shown in (Fig. 5).

**3.** With the front wheels straight forward, position the steering wheel on the steering shaft with the spokes properly centered and the alignment marks on both parts properly aligned.

**4.** Install the steering wheel nut on the shaft, torque to specifications, and stake the nut.

**5.** Install the horn ring (or button) assembly and related parts.

## STEERING COLUMN REMOVAL

### STATIONARY COLUMN

**1.** Working from the engine compartment, remove the two bolts, lock washers, guides, and bushings that attach the flex coupling to the steering shaft flange. (Fig. 6).

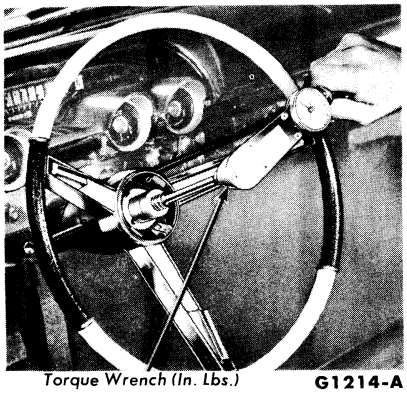



**FIG. 4—Checking Preload**

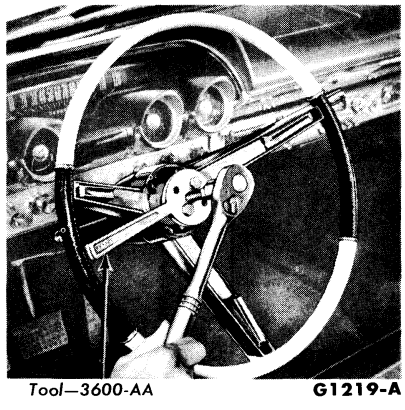



**FIG. 5—Removing Steering Wheel**

**2.** Disconnect the transmission control (shift) rods from the column shift levers. This does not apply to Ford 500XL Models.

**3.** Disconnect the turn signal wires and the shift quadrant wires (automatic transmission only) at their connectors.

**4.** Remove the steering wheel. Install the nut back on the shaft to prevent the shaft from slipping out of the column.

**5.** Slide the rubber grommet (Fig. 6) up the tube approximately three inches.

**6.** Remove the escutcheon plate-to-dash attaching screws. Remove the two screws that attach the two halves of the escutcheon plate and remove them from the column.

**7.** Remove the two bolts, lock washers and flat washers that secure the column to the instrument panel.

**8.** Lift the column from the car.

### MOVABLE COLUMN

**1.** Remove the bolt that secures the flex coupling to the upper steering shaft (Fig. 7).

**2.** Remove the three bolts that attach the column mounting plate to the steering gear.

**3.** Disconnect the selector lever from the rod. This does not apply to XL500 Models.

**4.** Remove the steering wheel. Install the steering wheel nut to prevent the shaft from slipping out.

**5.** Disconnect the turn signal, shift quadrant and neutral safety switch wires at the connectors.

**6.** Remove the screws that attach the escutcheon plate to the dash panel.

**7.** Unhook the cover retaining spring from the instrument panel cover (Fig. 7).

**8.** Remove the two bolts that attach the steering column to the track. Support the column while removing these bolts.

**9.** Lift the steering column from the car.

## STEERING COLUMN INSTALLATION

### STATIONARY COLUMN

**1.** Hold the column in place aligning the flex coupling dowls with the flange on the upper steering shaft. Install, but do not tighten, the bolts, lock washers, and flat washers that attach the column to the instrument panel. (Fig. 6).

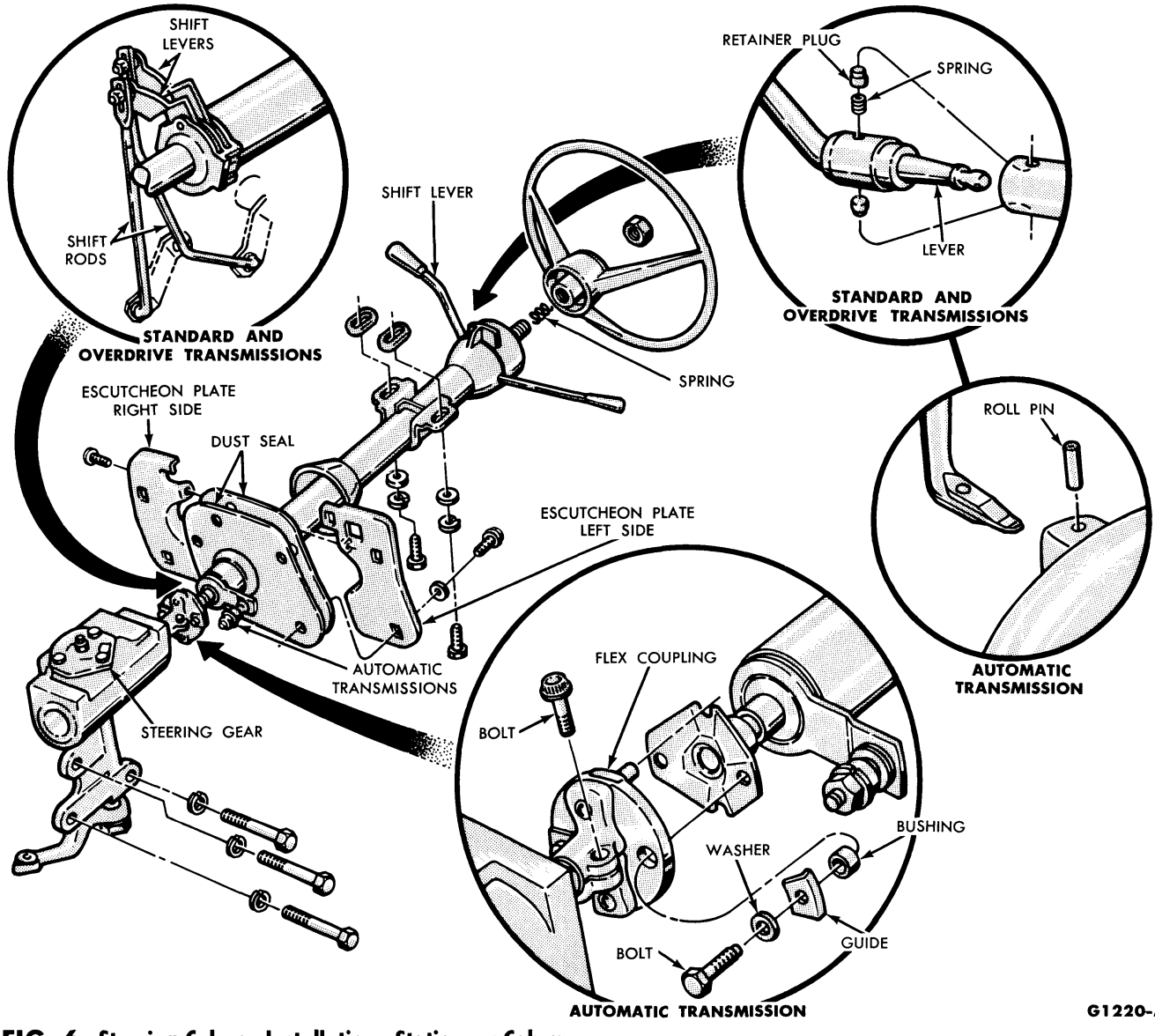



**FIG. 6—Steering Column Installation—Stationary Column**

2. Position the dust seal and escutcheon plate on the dash panel. Install the attaching screws. Install the two screws that secure the escutcheon plates together.

3. Slide the rubber grommet down the column until it contacts the escutcheon plates.

4. Connect the turn signal wires and the shift quadrant wires (automatic transmission only) at their connectors.

5. Secure the flex joint with the bushings, guides, washers, and bolts.

6. Connect and adjust the shift linkage.

7. Tighten the steering column-to-instrument panel attaching bolts.

8. Install the steering wheel.

### MOVABLE COLUMN

1. Install the locating spacer on the sliding track as shown in Fig. 8.

2. Hold the column in position with the column mounting plate resting on the steering gear and the upper steering shaft entered in the flex coupling gear. Install, but, do not tighten the steering column-to-track attaching bolts (Fig. 7).

3. Secure the dust seal and the escutcheon plate to the dash panel with the attaching screws.

4. Connect the turn signal, neutral safety switch, and the shift quadrant wires to their respective connectors.

5. Install and torque the three column mounting plate-to-steering gear attaching bolts to specifications.

6. Install the flex coupling-to-upper steering shaft bolt.

7. Connect and adjust the transmission control rod.

8. Tighten the track-to-column attaching bolts being careful not to create a bind in the track.

9. Remove the locating spacer (Fig. 8), from the track.

10. Install the cover-to-steering column retaining spring (Fig. 7).

11. Install the steering wheel.

## STEERING COLUMN UPPER BEARING REPLACEMENT

### STATIONARY COLUMN

1. Remove the steering column from the car as detailed on page 3-17.

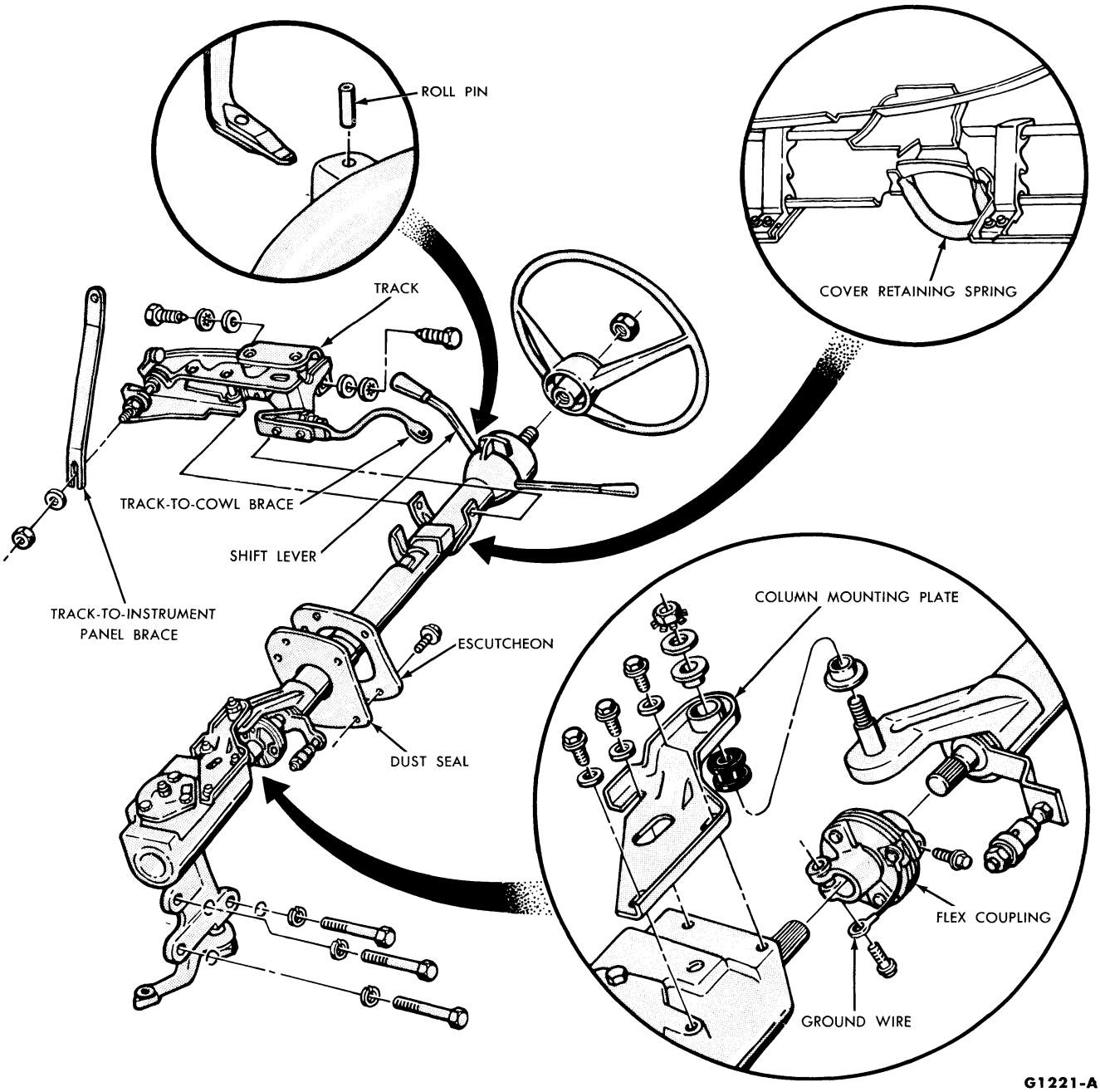



**FIG. 7—Steering Column Installaton—Movable Column**

**2.** Remove the three screws that attach the upper bearing retainer to the hub (Fig. 9) and remove the retainer.

**3.** Remove the screw that secures the quadrant light to the hub (automatic transmission only).

**4.** Remove the turn signal switch lever, then lift the turn signal switch and the quadrant lamp from hub.

**5.** Remove the steering wheel nut and upper bearing spring. Tap on the top of the shaft with a soft hammer to remove it from the bearing. Slide the shaft out the lower end of the column.

**6.** Remove the bearing from the hub as shown in Fig. 10.

**7.** Remove the rubber insulator from the bearing.

**8.** Install the insulator on the new bearing.

**9.** Press the bearing into place in the hub.

**10.** Install the turn signal switch and retainer. Install the turn signal switch lever. Secure the retainer to the hub with three screws. Install the quadrant light if so equipped.

**11.** Slide the upper steering shaft into the steering column until the C-washer on the shaft seats against the bearing.

**12.** Install the column in the car as detailed on page 3-17.

### MOVABLE COLUMN

**1.** Remove the bolt that secures the upper shaft to the flex coupling (Fig. 11).

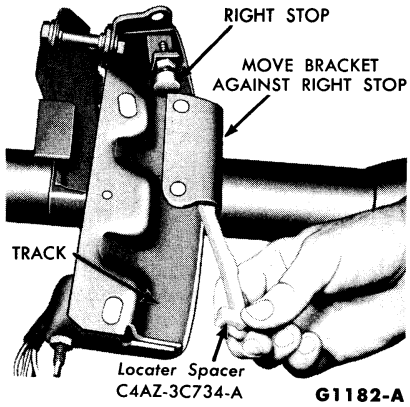



**FIG. 8—Removing or Installing Locating Spacer**

**2.** Remove the steering wheel and spring.

**3.** Remove the three attaching screws from the turn signal switch and upper bearing retainer. Remove the retainer.

**4.** Remove the screw that secures the shift quadrant light to the column and remove the light.

**5.** Remove the turn signal switch lever, then carefully lift the turn signal switch off the shaft.

**6.** Thread the steering wheel attaching nut on the shaft. Grasp the nut and pull the shaft and bearing out of the column.

**7.** Remove the bearing from the shaft. Separate the insulator from the bearing.

**8.** Install the insulator on the new bearing. Seat the new bearing against the C-washer on the shaft.

**9.** Install the shaft and bearing in the column, making sure that the flat on the shaft is in alignment with the bolt hole in the flex coupling.

**10.** With the shaft entered in the coupling and the bearing seated in the hub, position the shift quadrant light in the hub and secure it with the attaching screw.

**11.** Position the turn signal switch and retainer in place and secure them with the three attaching screws. Install the turn signal switch lever.

**12.** Install the spring and steering wheel on the column.

**13.** Secure the upper shaft to the flex coupling with the attaching bolt.

**14.** Check the operation of the turn signals.

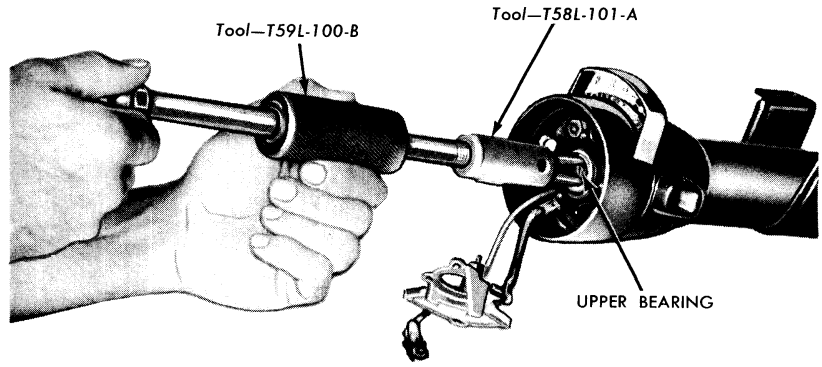



**FIG. 10—Removing Steering Column Upper Bearing**

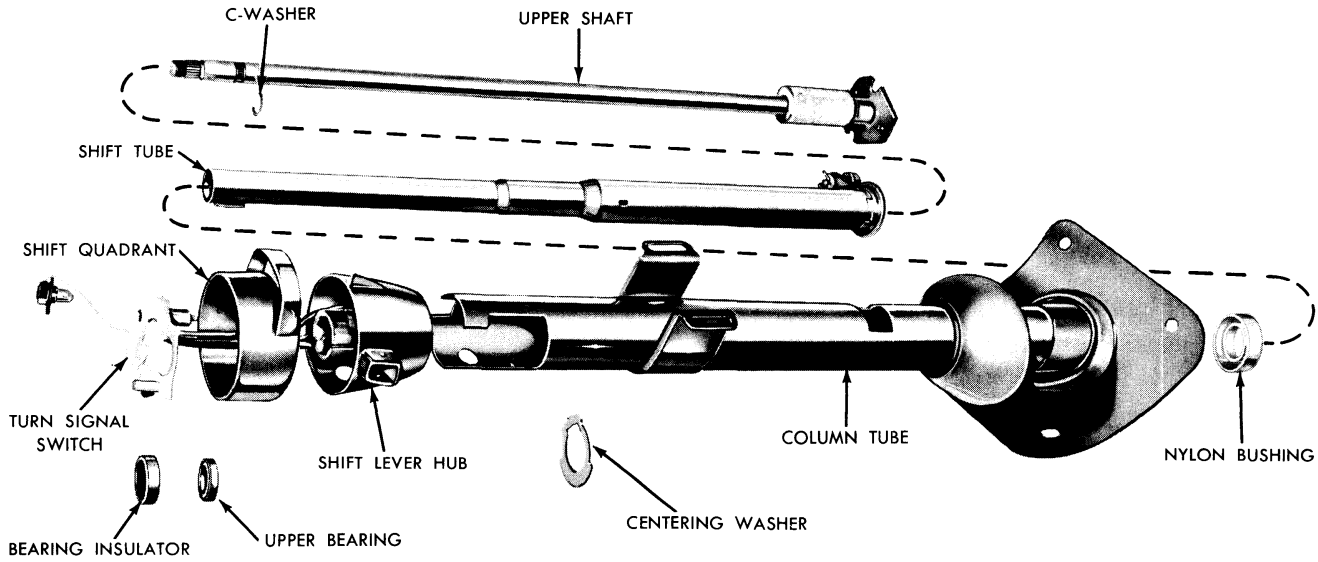



**FIG. 9—Steering Column Disassembled (Stationary)**

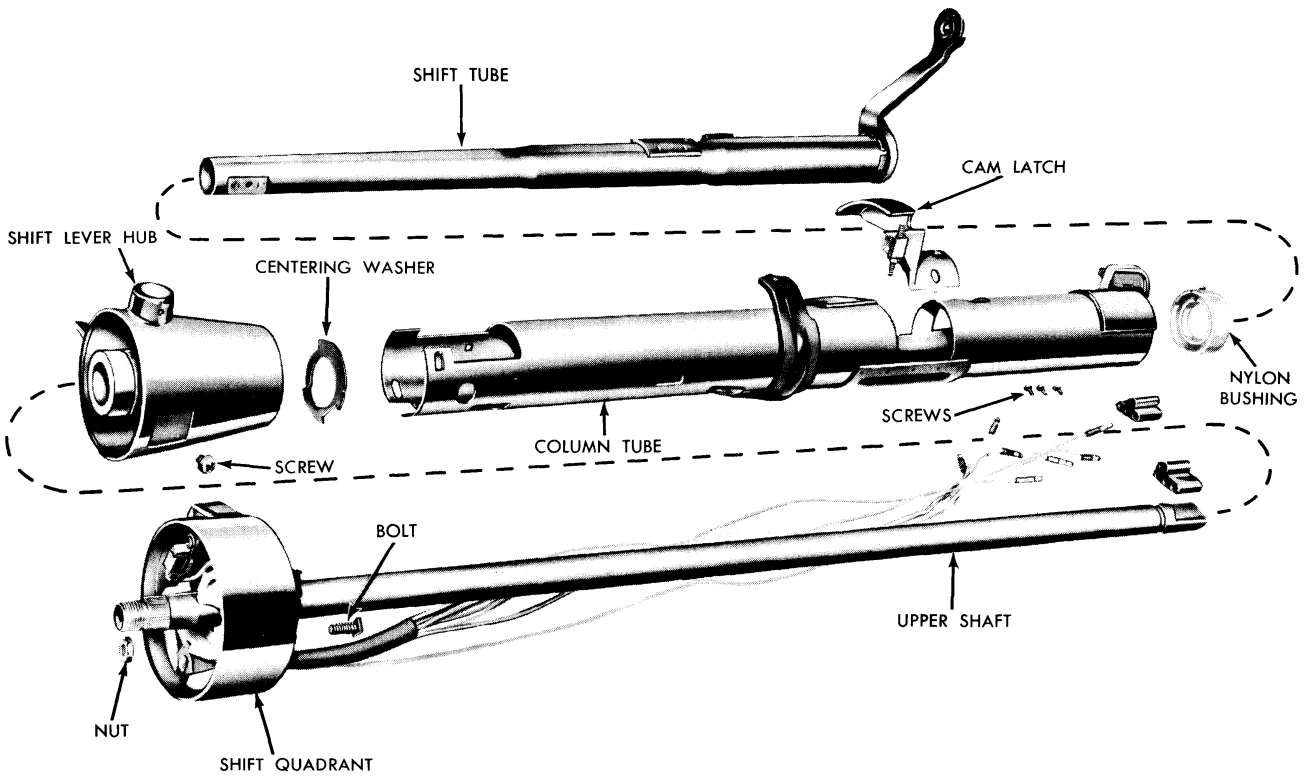



**FIG. 11—Steering Column Disassembled (Movable)**

## 3 REMOVAL AND INSTALLATION

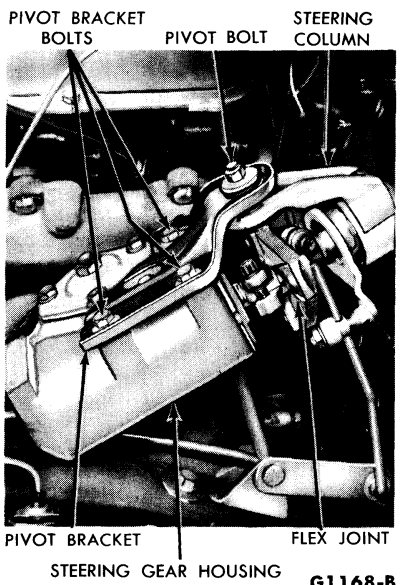



**FIG. 12—Movable Column-to-Steering Gear Connector**

### STEERING GEAR

#### REMOVAL

1. Remove the steering column bracket bolts (Fig. 12) if the car is equipped with a movable column.

2. Remove the bolt that attaches the flex joint to the steering gear.

3. Raise the front of the car and install safety stands.

4. Disconnect the Pitman arm from the sector shaft.

5. If necessary, disconnect the muffler inlet pipe.

6. Remove the steering gear housing attaching bolts, and remove the steering gear.

#### INSTALLATION

1. With the steering wheel spokes aligned and the sector shaft in the center position, install the steering gear. Torque the mounting bolts to specification.

2. With the wheels straight ahead, connect the Pitman arm to the sector shaft.

3. If necessary, connect the muffler inlet pipe.

4. Install the steering column bracket bolts, and torque to specifications.

5. Remove the steering gear filler plug and housing lower cover bolt. After turning the steering wheel to the left to move the ball nut away from the filler hole, fill the steering gear with the correct lubricant. Fill the gear until lubrication comes out of the housing cover lower bolt hole. Install the filler plug and the cover bolt. Torque the bolt to specification.

## 4 MAJOR REPAIR OPERATIONS

### STEERING GEAR DISASSEMBLY

**1.** Rotate the steering shaft 2¾ turns from either stop.

**2.** After removing the sector adjusting screw locknut and the housing cover bolts, remove the sector shaft with the cover. Remove the cover from the shaft by turning the screw clockwise. **Keep the shim with the screw.**

**3.** Loosen the worm bearing adjuster nut, and remove the adjuster assembly and the steering shaft upper bearing.

**4.** Carefully pull the steering shaft and ball nut from the housing, and remove the steering shaft lower bearing. **To avoid possible damage to the ball return guides, keep the ball nut from running down to either end of the worm.**

**Disassemble the ball nut only if there is indication of binding or tightness.**

**5.** Remove the ball return guide clamp and the ball return guides from the ball nut. **Keep the ball nut clampside up until ready to remove the balls.**

**6.** Turn the ball nut over, and rotate the worm shaft from side to side until all 54 balls have dropped out of the nut into a clean pan. With the balls removed, the ball nut will slide off the worm.

Remove the caged needle bearings only if preliminary inspection shows damage.

**7.** Remove the upper bearing cup from the bearing adjuster and the lower cup from the housing. It may be necessary to tap the housing or the adjuster on a block of wood (Fig. 13).

**8.** Press out both sector shaft needle bearing assemblies and oil seal from the housing (Fig. 14).

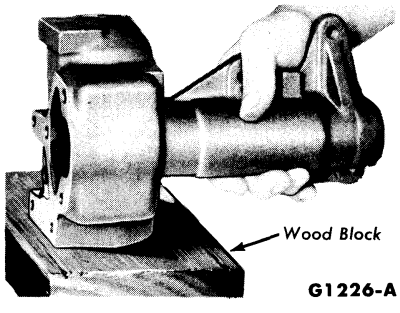



**FIG. 13—Removing Bearing Cup from Housing**

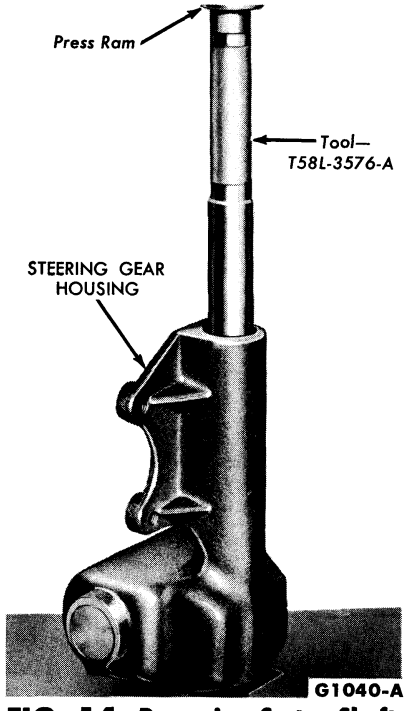



**FIG. 14—Removing Sector Shaft Bearing**

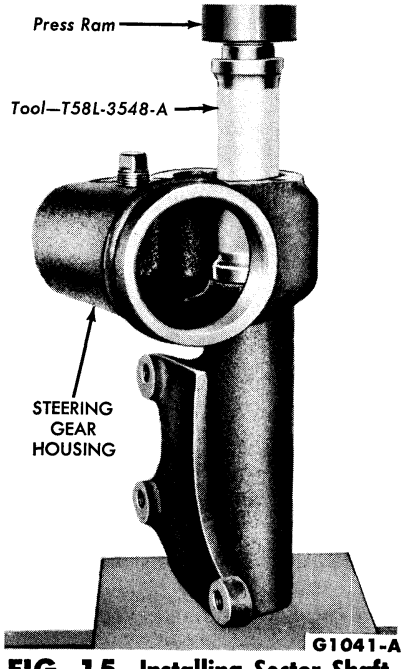



**FIG. 15—Installing Sector Shaft Bearing**

### STEERING GEAR ASSEMBLY

**1.** If the sector shaft bearings and oil seal have been removed, press new bearing assemblies into the housing (Fig. 15). **Apply the recommended steering gear lubricant to the bearings.**

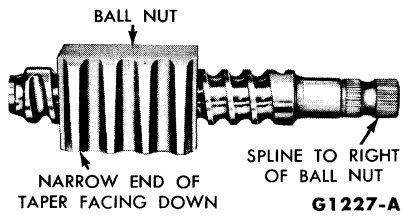



**FIG. 16—Ball Nut Position on Shaft**

**2.** Install a bearing cup in the lower end of the housing and in the adjuster.

**3.** If the seal in the bearing adjuster was removed, install a new seal.

**4.** Lay the steering shaft on a bench, with the splined end to the right. Slide the ball nut on the shaft as shown in Fig. 16. Align the grooves in the worm and in the ball nut by sighting through the ball guide holes.

**5.** Divide the balls into two groups of 27 each. Pack 2 ball return guides with lubricant and place 9 balls into each guide. Place the other 2 guide halves on the ones that are loaded with balls.

**6.** Drop 18 balls into one circuit. It will be necessary to oscillate the worm shaft slightly to circulate the balls.

**7.** Push the guide into the guide holes of the ball nut, tapping lightly with the wooden handle of a screwdriver if necessary.

**8.** Load the second circuit in the ball nut in the same manner and install the ball return guide clamp and screw. Torque the screw to specification. Check the worm shaft to make sure that it rotates freely.

**9.** Coat the threads of the steering shaft bearing adjuster, the housing cover bolts, and the sector adjusting screw with a suitable oil-resistant sealing compound. **Do not apply sealer to female threads, and especially avoid getting any sealer on the steering shaft bearings.**

**10.** Coat the worm bearings, sector shaft bearings, and gear teeth with steering gear lubricant.

**11.** Clamp the housing in a vise, with the sector shaft axis horizontal, and position the steering shaft lower bearing in its cup.

**12.** Position the steering shaft and ball nut assemblies in the housing.

**13.** Position the steering shaft upper bearing on the top of the worm, and install the steering shaft bearing adjuster and the adjuster nut and bearing cup. Leave the nut loose.

**14.** Adjust the worm bearing preload, using an inch-pound torque wrench. See Part 3-6 for the specified preload.

**15.** Position the sector adjusting screw and adjuster shim, and check the end clearance which should not exceed 0.002 inch between the screw head and the end of the sector shaft. If clearance is greater than 0.002 inch, add enough shims to reduce the end play to within the 0.002 tolerance.

**16.** Start the sector shaft adjusting screw into the housing cover.

**17.** Install a new gasket on the housing cover.

**18.** Apply enough gear lubricant to fill the pocket in the housing between the sector shaft bearings (approximately 30% full). Rotate the steering shaft until the ball nut teeth are in position to mesh with the sector gear, tilting the housing so that the ball nut will tip toward the housing cover opening.

**19.** With the housing cover turned out of the way fill the gear with 0.7 lbs. ± .07 of gear lubricant. Push the housing cover and sector shaft assemblies into place, and install the two top housing cover bolts. **Do not tighten the cover bolts until it is certain that there is some lash between ball nut and sector gear teeth.** Torque the bolts to specification.

**20.** After loosely installing the sector shaft adjusting screw lock nut, adjust the sector shaft mesh load. See Part 3-6 for the specified mesh load, then tighten the adjusting screw lock nut.

## 5 STEERING LINKAGE REPAIR

The manual steering linkage (Fig. 17) consists of the Pitman arm, the steering arm-to-idler arm rod, the steering idler arm, and the spindle connecting rods (tie rods).

### SPINDLE CONNECTING ROD END REPLACEMENT

The spindle connecting rod ends, which are threaded into the outer ends of the rod sleeves, have non-adjustable ball studs. A rod end should be replaced when excessive looseness at the ball stud is noticed.

**1.** Raise the end and install safety stands. Remove the cotter pin and nut from the rod end ball (Fig. 18).

**2.** Loosen the connecting rod sleeve clamp bolts, and remove the rod end from the spindle arm, using the tool shown in Fig. 19.

**3.** Remove the rod end from the sleeve. Discard all rod end parts that were removed from the sleeve. **All new parts should be used when a spindle connecting rod end is replaced.**

**4.** Thread a new end into the sleeve, but do not tighten the sleeve clamp bolts at this time.

**5.** Install the seal on the rod end ball stud, insert the stud in the spindle arm hole, and install the stud nut. Torque the nut to specification and install the cotter pin.

**6.** Check and, if necessary, adjust toe-in. **Be sure to tighten the sleeve clamp bolts after toe-in is checked and adjusted.** If the car has power steering, be sure that there is no interference between the sleeve bolts and the control valve.

### SPINDLE CONNECTING ROD REPLACEMENT

A spindle connecting rod should be replaced if it becomes worn or damaged. **Do not attempt to straighten a bent rod.**

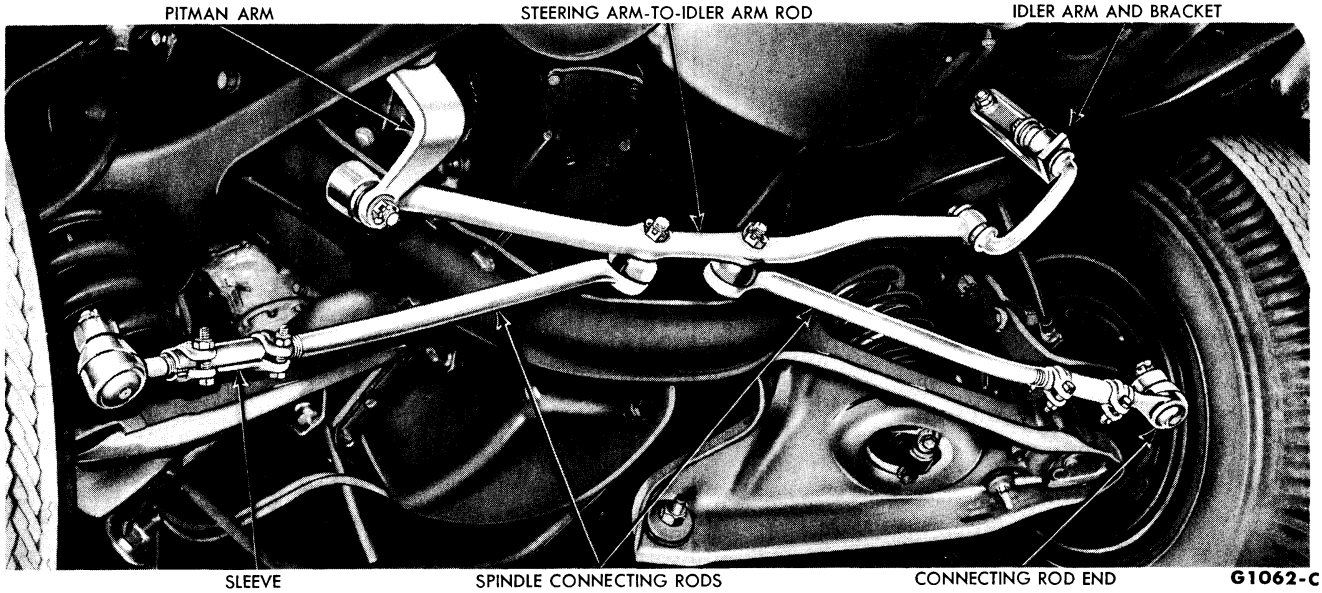



**FIG. 17—Steering Linkage Installed**

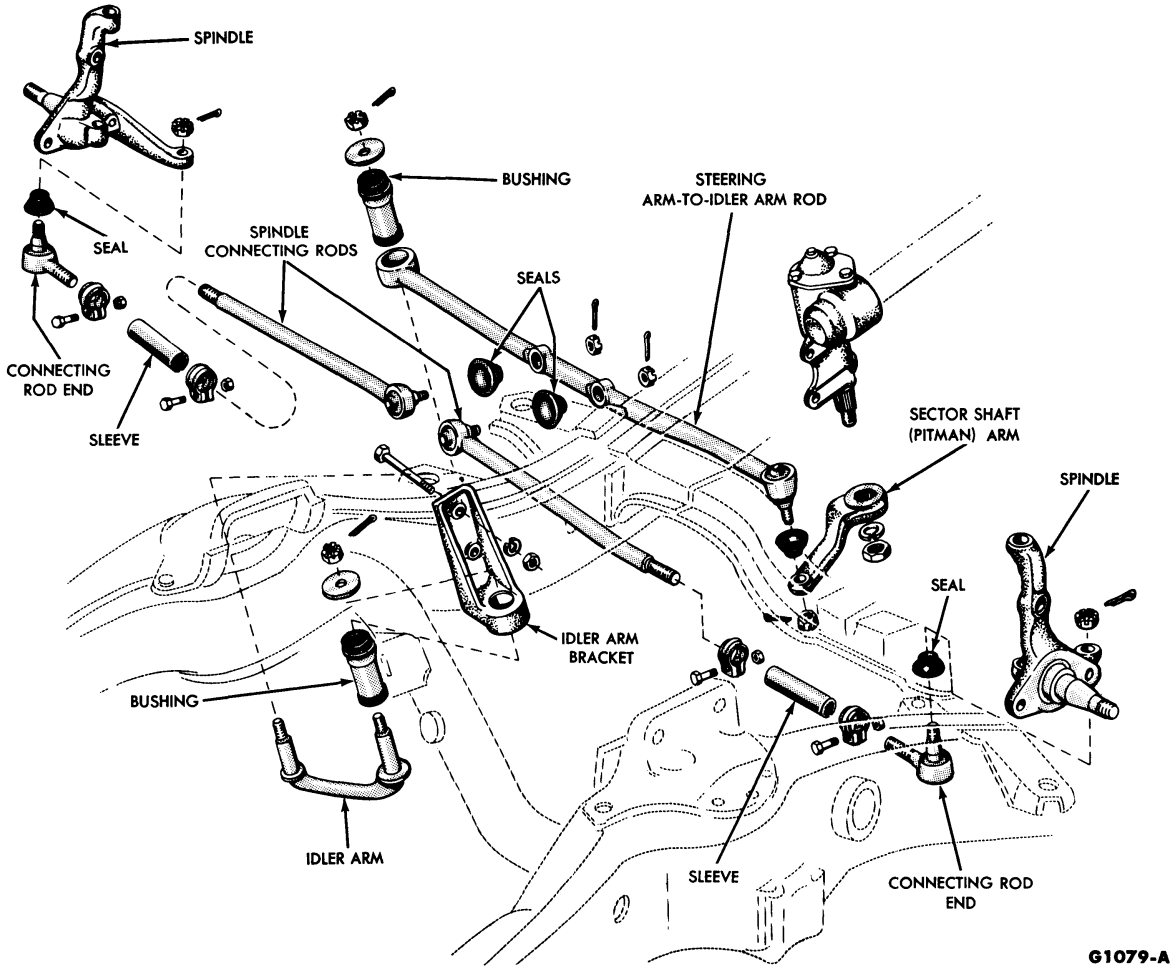



**FIG. 18—Steering Linkage Disassembled**

**1.** Remove the cotter pin and nut which attach the spindle connecting rod ball stud to the steering arm to idler arm rod (Fig. 18). Remove the ball stud from the rod, using the tool shown in Fig. 3. **Be careful not to loosen or bend any other parts on the steering arm to idler arm rod.**

**2.** Loosen the connecting rod sleeve clamp bolts, and remove the rod from the sleeve.

**3.** Thread a new connecting rod into the sleeve, but do not tighten the sleeve clamp bolts at this time.

**4.** With the seal properly positioned install the connecting rod ball stud in the steering arm-to-idler arm rod, and install the nut on the ball stud. Torque the nut to specification. Install a new cotter pin.

**5.** Check and, if necessary, adjust toe-in. **Be sure to tighten the sleeve clamp bolts after toe-in is checked and adjusted.** If the car has power steering, be sure that there is no interference between the sleeve bolts and the control valve.

## STEERING ARM-TO-IDLER ARM ROD REPLACEMENT

Replace the steering arm-to-idler arm rod if it is bent or if the ball joint is worn. Do not try to straighten a bent rod.

**1.** Remove the nuts from the ball stud at the Pitman arm and from the idler arm.

**2.** Remove the nuts from the spindle connecting rod ball studs.

**3.** Remove the ball stud from the Pitman arm, using the tool shown in Fig. 19. Remove the connecting rod ball studs from the rod, using the same tool. Remove the rod.

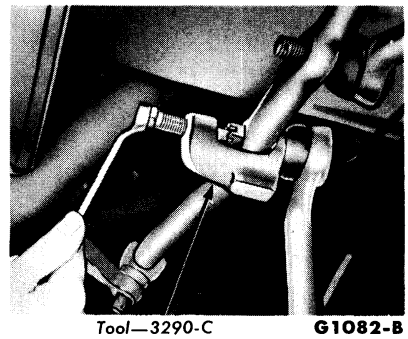



**FIG. 19—Removing Ball Stud**

**4.** Install a **new** bushing in the replacement steering arm-to-idler arm rod, using tool T61P-3355-A. Properly position the three ball stud seals.

**5.** Position the rod on the idler arm and the Pitman arm. Torque the idler arm nut and the ball stud nut

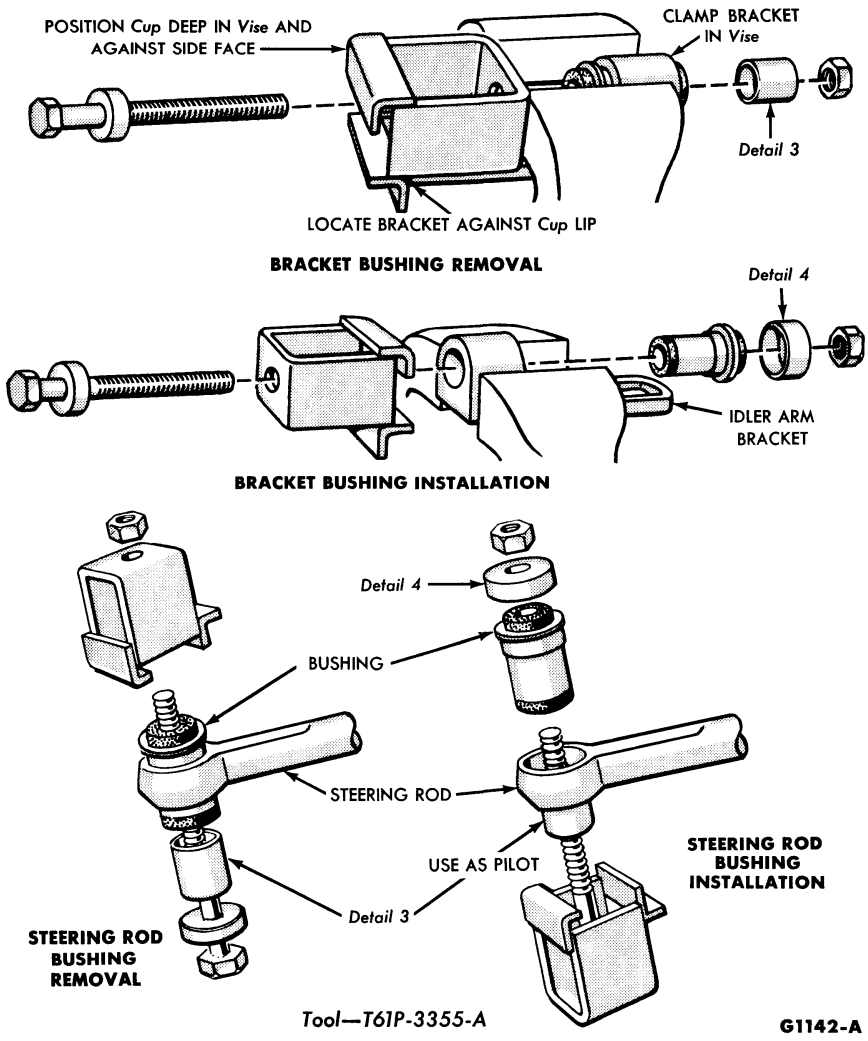



**FIG. 20—Replacing Idler Arm Bushing**

to specifications. Install new cotter pins.

**6.** Install the spindle connecting rod ball studs, and torque the stud nuts to specification. Install new cotter pins.

**7.** Check and, if necessary, adjust the toe-in.

## STEERING IDLER ARM BUSHING REPLACEMENT

**If an idler arm bushing is worn, replace both idler arm bushings.**

**1.** Remove the bushing retaining nuts from the idler arm.

**2.** Remove the idler arm bracket.

**3.** Remove the bushing from the bracket, using tool T61P-3355-A (Fig. 20).

**4.** Remove the bushing from the steering arm-to-idler arm rod, using tool T61P-3355-A.

**5.** Install new bushings in the rod and in the bracket, using tool T61P-3355-A.

**6.** Position the idler arm, and torque the retaining nuts to specification. Install new cotter pins. **When installing the idler arm, be sure that the linkage is in the straight-ahead position.**

# PART 3-4 POWER STEERING


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| 2 | In-Car Adjustments and Repairs | 3-28 |
| 3 | Removal and Installation | 3-28 |
| 4 | Major Repair Operations | 3-30 |


## 1 DESCRIPTION

Master - Guide Power Steering (Fig. 1) is a hydraulically controlled linkage-type steering system which includes a fluid reservoir and pump, a control valve, a power cylinder, the connecting fluid lines, and the steering linkage. The roll-type hydraulic pump, belt-driven from the engine crankshaft, draws fluid from the reservoir and provides fluid pressure for the system. Within the pump itself is a pressure-relief valve which governs the pressures within the steering system according to the varying conditions of operation. After fluid has passed from the pump to the control valve and the power cylinder, it returns to the reservoir.

The control valve, operated by steering wheel movement, directs the pressure developed by the pump. When the front wheels are in the straight-ahead position, the control valve spool is held in the center (neutral) position by its centering spring. Fluid then flows around the valve lands and returns to the reservoir (Fig. 2). Within the control valve body there is a reaction limiting valve which reduces parking effort.

When a force of about 4 pounds is exerted on the steering wheel for a left turn, the valve spool overcomes the force of the centering spring and moves toward the right-hand end of the valve. As a result, pressure is exerted on the right side of the power cylinder piston, and fluid in the left end of the cylinder returns to the reservoir (Fig. 2).

If the direction of the force on the steering wheel is reversed, the front wheels will return to the straight forward position. Or as force on the steering wheel falls below about 4 pounds, the valve spool centering spring forces the spool back to the center position where the pressure on both sides of the power cylinder piston is equal. With normal forward driving movement of the car and in the absence of operative pressure within the power cylinder, the front wheels will seek to return to the straight ahead position. This is a normal effect of the front wheel alignment and action of the torsion type bushings in the idler arm. For a right turn, the directional forces explained above are reversed (Fig. 2).

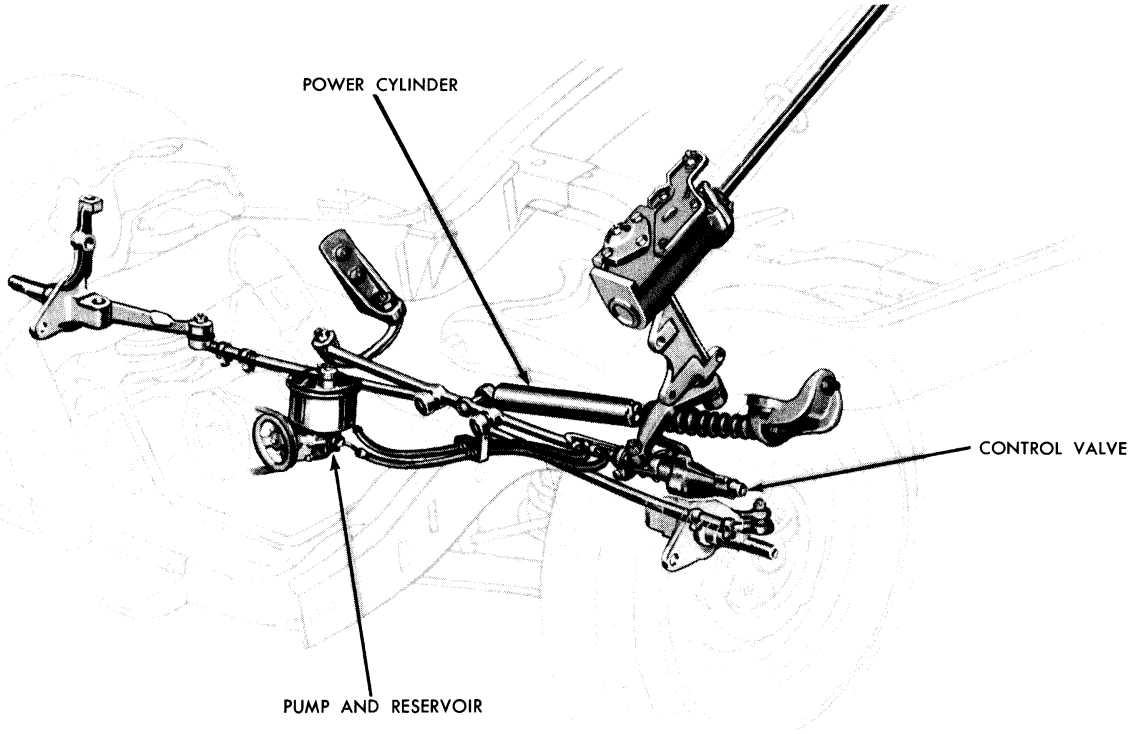



**FIG. 1—Power Steering System**

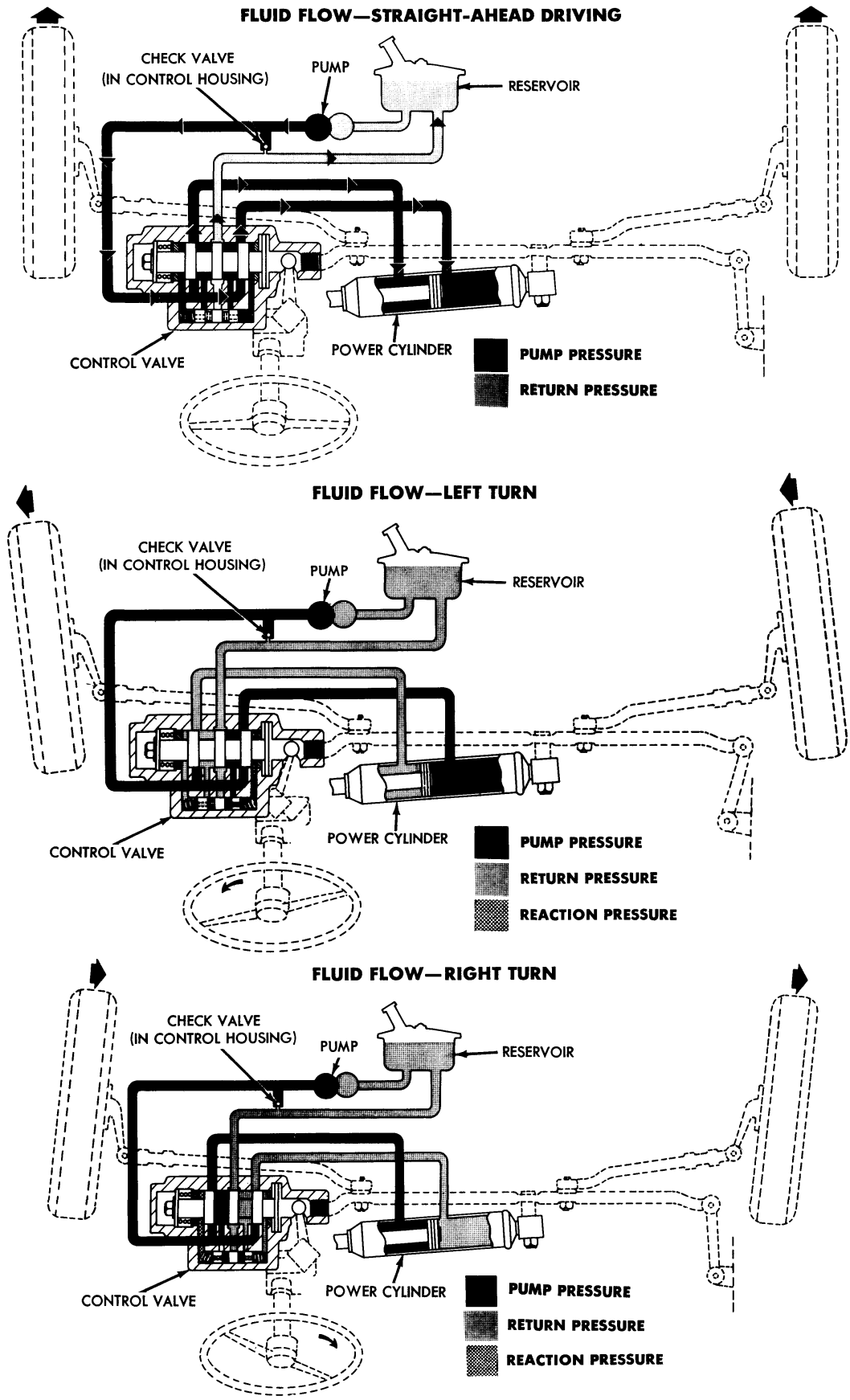



**FIG. 2—Fluid Flow Diagram**

If, for any reason, the pump fails to deliver fluid pressure, the car may be steered without pump pressure.

An idle speed control valve (Fig. 3) eliminates the problem of the engine stalling when the driver parks the car. (Ford **only** with 289 cu. in. engines and air conditioning.) When the steering linkage stops are contacted, the output of the pump becomes maximum and the maximum pressure is directed to the control valve.

The maximum pressure causes the plunger of the control valve to move the bellcrank linkage; thus, the proper engine idle speed is maintained. Refer to the engine specification section of this manual for the proper engine idle speeds.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### PUMP BELT TENSION ADJUSTMENT

Pump drive belt tension cannot be checked accurately using the thumb pressure or belt deflection methods. Correct belt adjustment is assured only with the use of a belt tension gauge of the type similar to the one shown in Fig. 3.

**1.** Check the belt tension with a gauge as shown in Fig. 3. With a new belt, or one that has been run for less than ten minutes, the tension should be within 120-150 lbs. With a belt that has been run for more than ten minutes, the tension should be within 90-120 lbs.

**2.** To adjust the belt, loosen the pump pivot and adjusting bolts to allow movement of the bracket in its adjusting slot. Move the pump as required, and snugly tighten the bolts. **Do not move the pump by lifting or pulling on the reservoir.**

**3.** Recheck the belt tension. When the tension has been correctly adjusted, tighten the bolts to 20-25 ft. lbs. torque.

### FILTER REPLACEMENT

**1.** Remove the cover from the power steering reservoir.

**2.** Remove the fluid with a suction gun.

**3.** On a remote mounted reservoir, lift the hold-down spring, washers and the filter element from the reservoir. The hold-down spring and washers are removed with the cover on pump mounted reservoir.

**4.** Wipe the reservoir clean with a lint-free cloth.

**5.** Position a new filter unit on the seat (Fig. 4).

**6.** Cement (M2G14-A cement) a new cover gasket around the inside of the cover.

**7.** On a remote mounted reservoir, position the retaining washer and the hold-down spring on the filter element. Place the cover and washer over the stud and install the wing nut until flush with the top of the stud.

Install the cover, pump mounted reservoir spring and hold-down washer assembly.

**8.** Fill the reservoir and check for leaks.

**9.** Start the engine and turn the vehicle right and left several times.

**10.** Recheck the fluid level and replenish the fluid as required.

**11.** Install the cover.

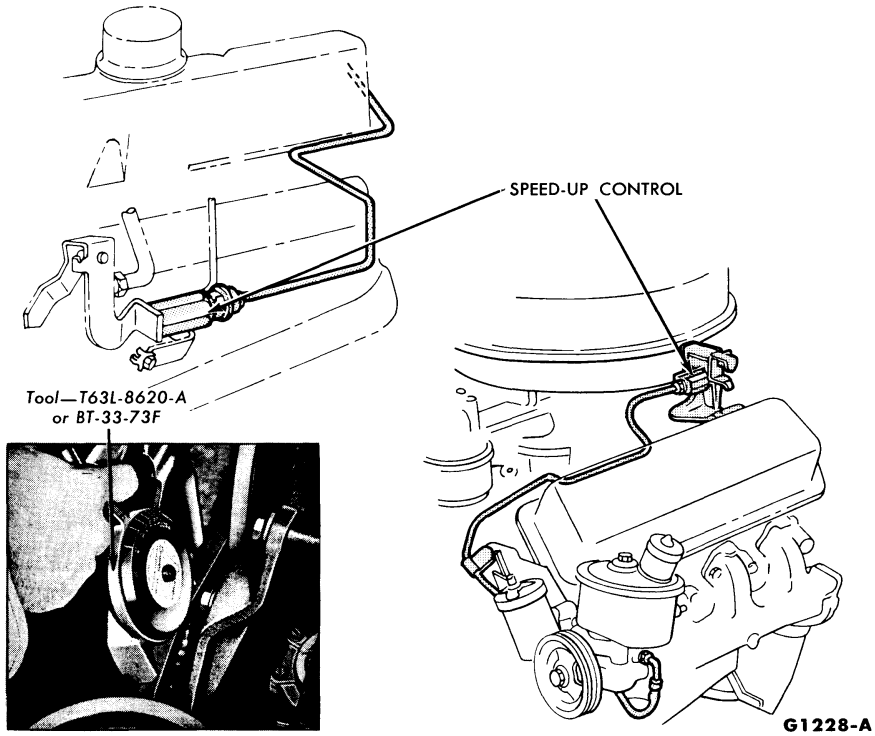



**FIG. 3—Power Steering Idle Speed Control Valve**

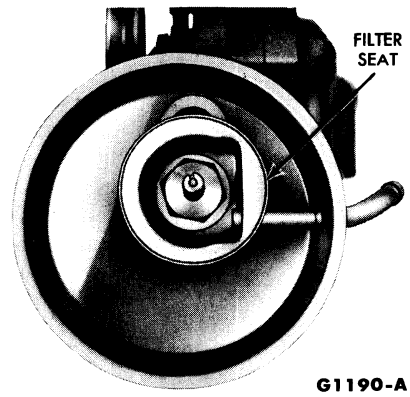



**FIG. 4—Fluid Reservoir**

## 3 REMOVAL AND INSTALLATION

### STEERING GEAR

Refer to Part 3-3, Section 3 for detailed Removal and Installation instructions.

### POWER STEERING PUMP

#### REMOVAL

**1.** Remove the reservoir cover. With a suction gun, remove as much fluid as possible from the reservoir.

**2.** Disconnect the two hoses at the pump, and fasten them in a raised position to prevent fluid from draining out.

3. Loosen and remove the pump belt.

4. Remove the pivot bolt and the adjusting bolt, and lift out the pump, reservoir, and bracket or pump bracket or adapter on cars equipped with air conditioning.

### INSTALLATION

1. Position the pump, reservoir and bracket or pump bracket and adapter assembly in the engine compartment, and install the mounting bolts finger tight.

2. Position the pump belt, and check the alignment of the crankshaft and pump pulleys. If the pulleys are not aligned, the pump may be incorrectly installed, or spacers may be necessary.

3. Adjust the belt tension (Section 2).

4. Connect the two hoses at the pump.

5. Fill the reservoir with automatic transmission fluid to a point ¼ inch from the top or to the F mark on the dipstick.

Install the non-dipstick type cover at this time. **The cover must be seated evenly and tightly around the edge of the reservoir. Tighten the wing nut securely.**

6. Start the engine and run it at idle speed for about two minutes to warm the fluid in the power steering system.

7. After turning the steering wheel all the way to the left and right several times, check the system for leaks.

8. Increase the engine speed to about 1000 rpm, and turn the steering wheel all the way to the left and right several times. Do not hold the wheel against the stops more than three seconds.

9. Stop the engine, and check the pump, reservoir, and hose connections for fluid leaks. Correct the cause of any leaks.

10. Check the fluid level, and refill the reservoir if necessary.

To check the fluid in the remote mounted reservoir, turn the wing nut to the top of the stud, then, rotate the cover clockwise until the fluid is visible. Add fluid as required, then secure the cover in place.

## CONTROL VALVE

### REMOVAL

1. Disconnect the four fluid line fittings at the control valve, and drain the fluid from the lines. Turn the front wheels to the left and right several times to force the fluid from the system.

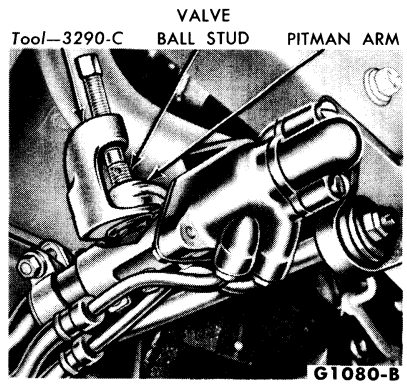



**FIG. 5—Removing Control Valve Ball Stud**

2. Loosen the clamping nut and bolt at the right end of the sleeve.

3. Remove the roll pin from the steering arm to idler arm rod through the slot in the sleeve.

4. Remove the control valve ball stud nut.

5. Using the tool shown in Fig. 5, remove the ball stud from the sector shaft arm.

6. After turning the front wheels fully to the left, unthread the control valve from the steering arm to idler arm rod.

### INSTALLATION

1. Thread the valve onto the steering arm-to-idler arm rod until about four threads are still visible on the rod.

2. Position the ball stud in the sector shaft arm.

3. Measure the distance between the center of the grease plug in the sleeve and the center of the stud at the inner end of the left-hand spindle connecting rod (Fig. 6). **Be sure that the measurement is taken parallel to the centerline of the control valve.** The distance should be $11\frac{15}{16}$ inches. If the distance is not correct, disconnect the ball stud from the sector shaft arm and turn the valve on the steering arm-to-idler arm rod to increase or decrease the distance.

4. When the correct distance is obtained and the ball stud is positioned in the sector shaft arm, align the hole in the steering arm to idler arm rod with the slot near the end of the valve sleeve. Install the roll pin in the rod hole to lock the valve in position on the rod.

5. Torque the valve sleeve clamp bolt to specification.

6. Install the nut on the ball stud, and torque the nut to specification. Install a new cotter pin.

7. Connect the fluid lines to the control valve, and tighten all fittings securely. **Do not over-tighten.**

8. Fill the fluid reservoir with the specified fluid to a point ¼ inch from the top or to the F mark on the dipstick.

9. Start the engine and run it at idle speed for about two minutes to warm the fluid in the power steering system.

10. Turn the steering wheel all the way to the left and right several times, and check the system for fluid leaks.

11. Increase the engine speed to

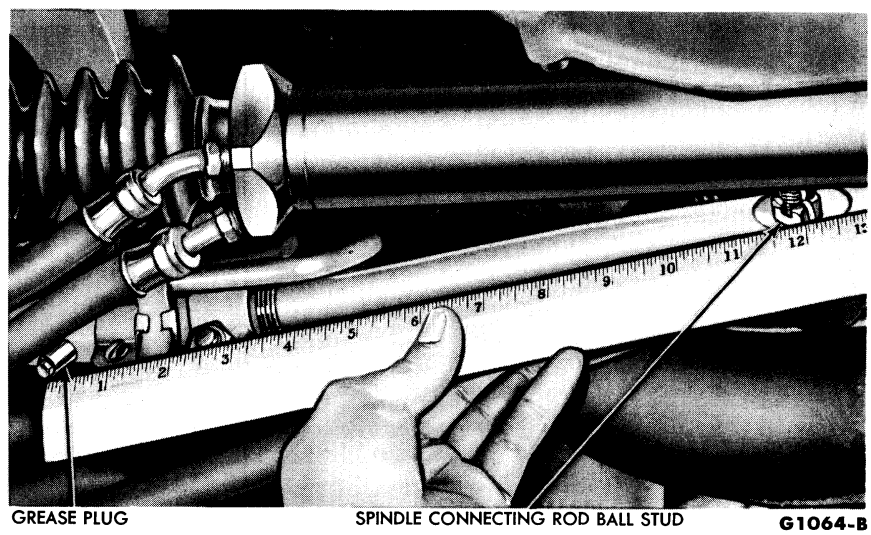



**FIG. 6—Measuring Control Valve Length for Installation**

about 1000 rpm, and turn the steering wheel all the way to the left and right several times.

**12.** Stop the engine, and check the control valve and hose connections for fluid leaks. Correct the cause of any leaks.

**13.** Check the fluid level, and refill the reservoir if necessary.

**14.** With the engine running, check the position of the steering wheel when the front wheels are in the straight-ahead position. **Do not make any adjustments until toe-in is checked.**

**15.** Keep the engine running, and check toe-in. If either toe-in or steering wheel position is not correct make all necessary adjustments (Part 3-1) at the spindle connecting rod sleeves.

**16.** Connect a torque wrench to the steering wheel hub (Fig. 7), and note the torque required to turn the wheel in both directions with the engine idling. The pull should not exceed 56 inch-pounds and should be about equal in both directions. After making this check, torque the steering wheel attaching nut to specification and stake the nut.

### POWER CYLINDER

### REMOVAL

**1.** Remove the two lines from between the power steering valve and the power cylinder. Move the front wheels to the left and right several times to force all the fluid from the power cylinder.

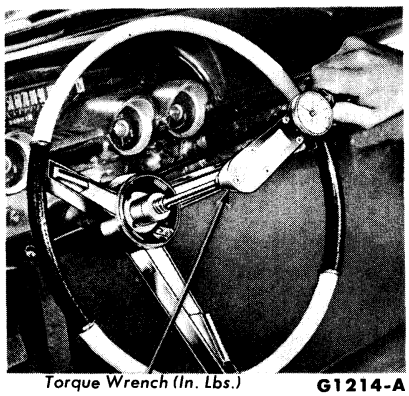



**FIG. 7—Checking Preload**

**2.** Remove the lock nut, nut, washer, and insulator from the outer end of the piston rod. Do not remove the rod from the bracket at this time.

**3.** Remove the cotter pin and nut which holds the cylinder on the steering arm-to-idler arm rod. Then remove the power cylinder ball stud from the steering arm-to-idler arm rod using tool 3290-C. Remove the piston rod from the bracket and remove the sleeve, inner bushing and washer from the piston rod.

### INSTALLATION

**1.** Install the washer, inner insulator sleeve and boot on the power cylinder piston rod. Then position the cylinder ball stud in the steering arm-to-idler arm with the piston rod in its bracket.

**2.** Install the nut on the cylinder ball stud. Torque the nut to specification and install a new cotter pin.

**3.** Install the outer insulator, washer, and nut on the piston rod, and torque the nut to specification. Install the piston rod lock nut.

**4.** Install the two lines between the control valve and cylinder. Tighten the fittings.

**5.** Fill the fluid reservoir with fluid (Group 21) to ¼ inch from the top or to the F mark on the dipstick.

**6.** Start the engine and run it at idle speed for about two minutes to warm the fluid.

**7.** Turn the steering wheel all the way to the left and right several times, and check the system for fluid leaks.

**8.** Increase the engine speed to about 1000 rpm and turn the steering wheel all the way to the left and right several times. **Do not** hold against the stops longer than three seconds at a time.

**9.** Stop the engine, and check the power cylinder and hose connections for fluid leaks. Correct the cause of any leaks.

**10.** Check the fluid level, and refill the reservoir if necessary.

## 4 MAJOR REPAIR OPERATIONS

### POWER STEERING PUMP

### DISASSEMBLY

**Handle all parts very carefully to avoid nicks, burrs, scratches, and dirt which could make the parts unfit for use.**

**1.** Drain as much as possible of the remaining fluid from the pump and reservoir, and clamp the pump adjusting bracket in a vise.

**2.** On a car without air conditioning, remove the reservoir cover. Remove the reservoir retaining nut and reinforcement from inside the reservoir and lift the reservoir off the pump. On cars equipped with air conditioning, it may be necessary to remove the adapter.

**3.** Remove the two orifice O-rings from the top of the pump.

**4.** Remove the pulley and the pulley key from the carrier shaft.

**5.** Remove all the bolts from the pump, and separate the bracket, pump housing, and housing cover. If the parts do not pull apart easily, tap them gently with a soft hammer to loosen them. **Lift the cover vertically from the housing to prevent internal parts from falling out.**

**6.** Remove the O-rings from the flow director and the carrier insert (Fig. 8).

**7.** Using a feeler gauge and a straight-edge, check the end clearance of the carrier and the rollers in the pump housing (Fig. 9). If the clearance exceeds 0.0015-inch, replace the worn parts. **A damaged roller, carrier, or insert should not be replaced by itself; these parts are serviced in a kit, and all parts of the kit should be used.**

**8.** Remove the six rollers, and then pull out the carrier and shaft very carefully to avoid damage to these parts or the oil seal. **Remove the cam insert only for replacement.**

**9.** Slide the carrier off the shaft and remove the carrier shaft pin (Fig. 8).

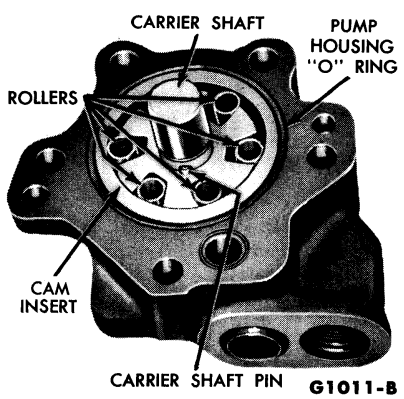



**FIG. 8—Pump Housing Carrier and Shaft**

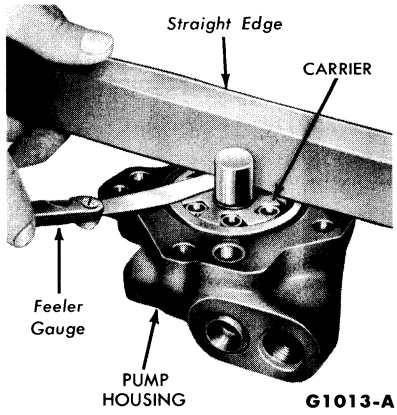



**FIG. 9—End Clearance Check**

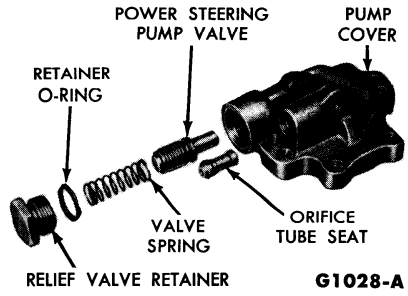



**FIG. 10—Pump Cover**

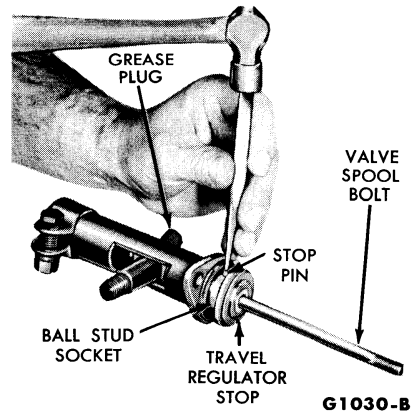



**FIG. 12—Removing Stop Pin**

**10.** Remove the relief valve retainer (Fig. 10) from the housing cover, and remove the O-ring from the retainer.

**11.** Remove the valve spring from the bore in the housing cover, and slide the valve out of the bore. If the valve does not slide out easily, tap the cover with a soft hammer. **Do not scratch or nick the valve when removing it from the cover.**

## CONTROL VALVE

### DISASSEMBLY

**1.** Wipe all fluid and loose dirt from the outside of the control valve.

**2.** Remove the centering spring cap from the valve housing (Fig. 11). **When holding the control valve for disassembly, use a soft-jawed vise, and clamp the valve only around the sleeve flange to prevent damage to the housing, spool, or sleeve.**

**3.** Remove the nut from the end of the valve spool bolt. Remove the washers, spacer, centering spring, adapter, and bushing from the bolt and the valve housing.

**4.** Remove the two bolts that hold the valve housing and the sleeve together, and separate the housing from the sleeve.

**5.** Remove the plug from the valve sleeve.

**6.** Push the valve spool out of the centering spring end of the valve housing, and remove the seal from the spool.

**7.** Remove the spacer, bushing, and seal from the sleeve end of the valve housing.

**8.** Drive the stop pin out of the travel regulator stop with a punch and hammer (Fig. 12). **Pull the head of the valve spool bolt tightly against the travel regulator stop before driving the pin out of the stop.**

**9.** Turn the travel regulator stop counterclockwise in the valve sleeve to remove the stop from the sleeve.

**10.** Remove the valve spool bolt,

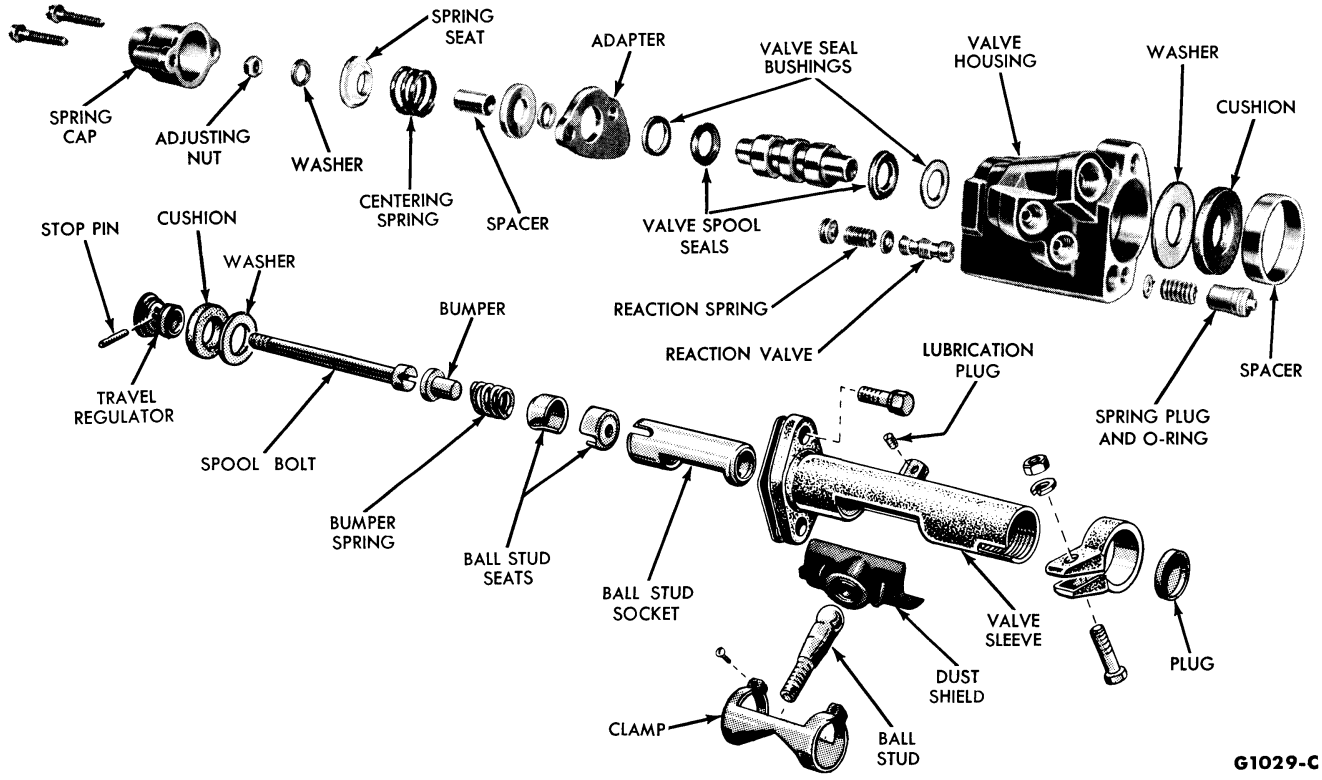



**FIG. 11—Control Valve Disassembled**

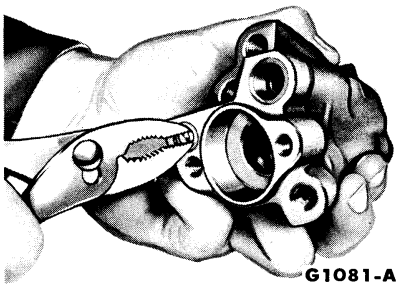



**FIG. 13—Removing Reaction Valve Plug**

spacer, and rubber washer from the travel regulator stop.

**11.** Remove the rubber boot and clamp from the valve sleeve.

**12.** Slide the bumper, spring, and ball stud seat out of the valve sleeve, and remove the ball stud socket from the sleeve.

**13.** After removing the return port hose seal, remove the return port relief valve.

**14.** After removing the spring plug and O-ring, remove the reaction limiting valve (Fig. 13).

## POWER CYLINDER

### SEAL REMOVAL

**1.** Clamp the power cylinder in a vise, and remove the snap ring from the end of the cylinder. **Be careful not to distort or crack the cylinder in the vise.**

**2.** Pull the piston rod out all the way to remove the scraper, bushing, and seals. If the seals cannot be removed in this manner, remove them from the cylinder with a sharp pick.

## PARTS REPAIR AND REPLACEMENT

### PUMP

**Orifice Tube Seat Replacement.** If damage, wear, or leakage makes replacement of this seat necessary, use the following procedure:

**1.** Tap the existing hole in the seat, using a starting tap of suitable size. **Be sure to remove all metal chips from the seat port after tapping.**

**2.** Place a nut and large flat washer on a bolt of the same size as the tapped hole. The washer must be large enough to cover the seat port.

**3.** Insert the bolt in the tapped hole and, using it as a puller remove the seat.

**4.** Place a new seat in the port, and thread a bolt of suitable size into the port. Tighten the bolt enough to bottom the seat in the port.

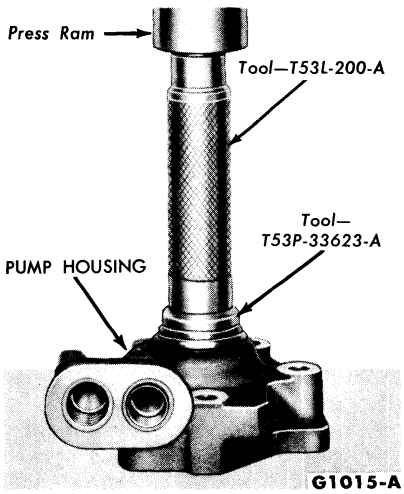



**FIG. 14—Installing Carrier Shaft Seal**

**Carrier Shaft Seal Replacement.** If the shaft seal was removed from the pump housing, install a new seal. **Do not install the old seal.**

**1.** Coat the lip of a new seal with Lubriplate or an equivalent lubricant.

**2.** Position the seal in the bore of the housing. **The lip of the seal must face toward the pump housing carrier chamber.**

**3.** Press the seal into the housing (Fig. 14) until it seats firmly and evenly against the shoulder in the bore.

## CONTROL VALVE

### TUBE SEAT REPLACEMENT

If a hose seat is worn or damaged, it should be replaced. It can be removed with an Easy-Out tool, or by using a bolt of appropriate size as a puller.

**1.** Tap the existing hole in the tube seat, using a starting tap of suitable size. **Be sure to remove all metal chips from the hose seat port after tapping.**

**2.** Place a nut and large flat washer on a bolt of the same size as the tapped hole. The washer must be large enough to cover the hose seat port.

**3.** Insert the bolt in the tapped hole, and using the nut as a puller, remove the tube seat.

**4.** Place a new tube seat in the port, and thread a bolt of suitable size into the port. Tighten the bolt enough to bottom the seat in the port.

## POWER STEERING PUMP

### ASSEMBLY

Before assembling the pump and reservoir, coat all parts with automatic transmission fluid. **If the cam insert is to be replaced, the new insert must be installed so that the slot in the edge of the insert engages the small pin in the pump housing.**

**1.** If the carrier and related parts seem to be in good condition, install the pin and the carrier on the shaft. Make sure that the carrier teeth are pointed in a counterclockwise direction of rotation when the carrier is installed in the housing.

**2.** Carefully insert the shaft through the housing, taking care not to damage the seal. Install the rollers. **To avoid damage to the seal, be sure the shaft does not move back and forth in the housing.**

**3.** Position the valve assembly and spring in the bore, install a new O-ring on the pump valve retainer, and install the retainer in the pump housing cover. Torque the retainer to specifications.

**4.** Place a new O-ring in the groove around the insert in the pump housing, and install a new flow-ring in the face of the housing (Fig. 10).

**5.** Fasten the pump housing and cover together.

**6.** Clamp the adjusting bracket in a vise, and install the pump on the bracket. Torque all bolts to specifications.

**7.** Install the key, pulley washer, and retaining bolt on the carrier shaft.

**8.** Torque the pulley retaining bolt to specification. **The carrier shaft should turn freely when the bolt is properly tightened.**

**9.** Place the new O-rings in the grooves on the top of the pump housing on pump mounted reservoirs. Only one O-ring is required at the outlet when the adapter is used.

**10.** Hold the reservoir on the pump housing, and install the reinforcement in the reservoir. Install and torque the retaining bolt to specifications. **The ears on the reinforcement should be facing upward over the outer hole in the reservoir.** On cars equipped with air conditioning, properly position the adap-

ter. Then, install and torque the retaining bolt to specifications.

**11.** Cement (M2G14-A cement) a new cover gasket around the inside of the cover. Install only the dipstick-type cover, washer, and retaining bolt at this time. **The cover must be seated evenly and tightly on the reservoir.**

## CONTROL VALVE

### ASSEMBLY

Before assembling the control valve, coat all parts except the seals with Ford Automatic Transmission Fluid. Coat the seals with lubricant COAZ-19553-A.

**1.** Install the reaction limiting valve, the spring, and the plug.

**2.** Install the return port relief valve and the hose seat.

**3.** Insert one of the ball stud seats (flat end first) into the ball stud socket, and insert the threaded end of the ball stud into the socket.

**4.** Place the socket in the control valve sleeve so that the threaded end of the ball stud can be pulled out through the slot in the sleeve (Fig. 15).

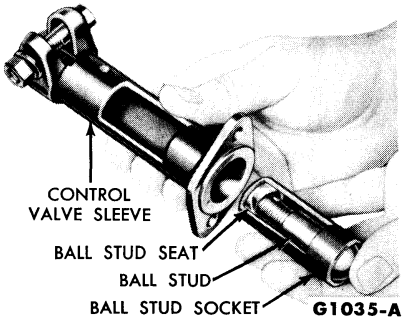



**FIG. 15—Installing Ball Stud Seal and Socket**

**5.** Place the other ball stud seat, the spring, and the bumper (Fig. 11) in the socket, and install and securely tighten the travel regulator stop.

**6.** Loosen the stop just enough to align the nearest hole in the stop with the slot in the ball stud socket, and install the stop pin in the ball stud socket, travel regulator stop, and valve spool bolt (Fig. 12).

**7.** Install the rubber boot, clamp, and the plug on the control valve sleeve. **Make sure that the lubrication fitting is turned on tightly and does not bind on the ball stud socket.**

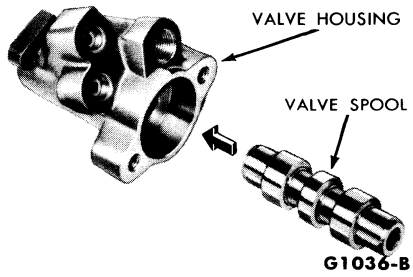



**FIG. 16—Inserting Valve Spool**

**8.** Insert the valve spool in the valve housing (Fig. 16). **Rotate the spool while inserting it in the housing.**

**9.** Move the spool toward the centering spring end of the housing, and place the small seal, bushing, and spacer in the sleeve end of the housing.

**10.** Press the valve spool against the inner lip of the seal and, at the same time, guide the lip of the seal over the spool with a small screwdriver. **Do not nick or scratch the seal or the spool during installation.**

**11.** Place the sleeve end of the housing on a flat surface so that the seal, bushing, and spacer are at the bottom end and push down on the valve spool until it stops.

**12.** Carefully install the spool seal and bushing in the centering spring end of the housing around the large end of the spool. Press the seal against the end of the spool, guiding the seal over the spool with a small screwdriver. **Do not nick or scratch the seal or the spool during installation.**

**13.** Pick up the housing, and slide the spool back and forth in the housing to check for free movement.

**14.** Place the valve sleeve on the housing so that the ball stud is on the same side of the housing as the ports for the two power cylinder lines. Install the two bolts in the sleeve, and torque them to specifications.

**15.** Place the adapter on the centering spring end of the housing, and install the bushing, washers, spacers, and centering spring on the valve spool bolt.

**16.** Compress the centering spring, and install the nut on the bolt. After tightening the nut securely, loosen it not more than ¼ turn (Fig. 17). **Excessive tightening of the nut may break the stop pin at the travel regulator stop.**

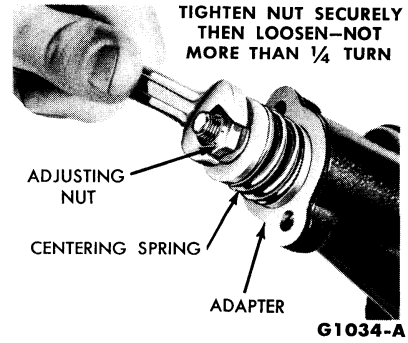



**FIG. 17—Adjusting Centering Spring**

**17.** Move the ball stud back and forth in the sleeve slot to check the spool for free movement. See Part 9-3 for the specified travel. Apply silicone grease at the sealing areas.

**18.** Install the centering spring cap on the valve housing, and torque the two cap bolts to specification.

**19.** Install the nut on the ball stud so that the valve can be positioned in a vise as shown in Fig. 18. Then push forward on the cap end of the valve to check the valve spool for free movement.

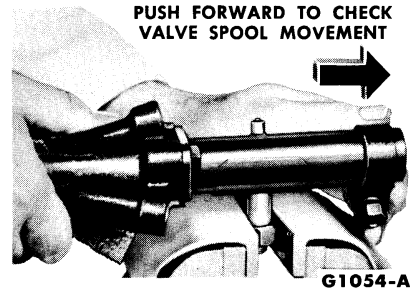



**FIG. 18—Inspecting Valve Spool Movement**

**20.** Turn the valve around in the vise, and push forward on the sleeve end to check the spool for free movement.

## POWER CYLINDER

### ASSEMBLY

When replacing the power cylinder seals, install all of the parts supplied in the repair kit.

**1.** Coat the new seals with silicone lubricant, and place the parts (Fig. 19) on the piston rod which has been coated with the same grease.

**2.** Push the rod in all the way, and install the parts in the cylinder with a deep socket slightly smaller

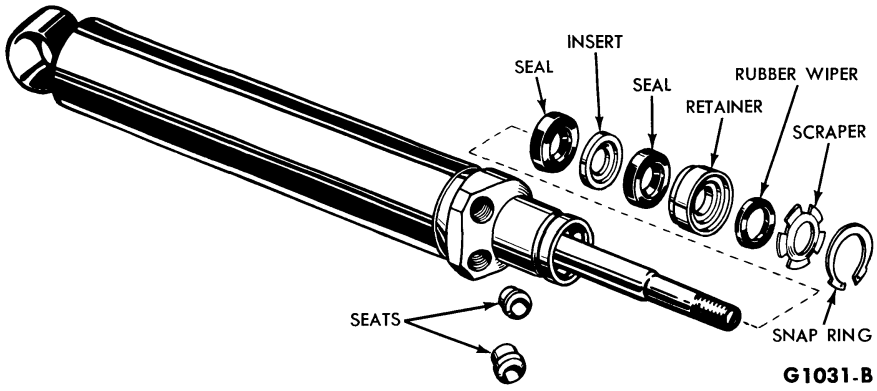



**FIG. 19—Power Cylinder**

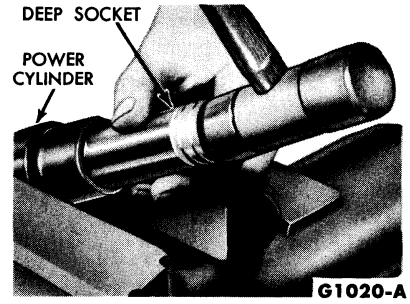



**FIG. 20—Installing Power Cylinder Seals**

than the cylinder opening (Fig. 20). Install the snap ring.

# PART 3-5 WHEELS AND TIRES


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 3-35 | 3 Removal and Installation | 3-36 |
| 2 In-Car Adjustments and Repairs | 3-35 | 4 Major Repair Operations | 3-37 |


## 1 DESCRIPTION AND OPERATION

### FRONT WHEEL ASSEMBLY

Each front wheel and tire assembly is bolted to its respective front hub and brake drum assembly. Two opposed tapered roller bearings are installed in each hub. A grease retainer is installed at the inner end of the hub to prevent lubricant from leaking into the drum. The entire assembly is retained to its spindle by the adjusting nut, nut lock and cotter pin (Fig. 1). The front wheel assemblies rotate freely on their respective spindles and are driven by the motion of the car.

### REAR WHEEL ASSEMBLY

The rear wheel hub and brake drum assembly is retained to studs on the rear axle shaft flange by three speed nuts (Part 3-2, Fig. 2). The wheel and tire assembly mounts on the same rear axle shaft flange studs and is held against the hub and drum by the wheel nuts. The rear wheel bearing is pressed onto the axle shaft just inside the shaft flange, and the entire assembly is retained to the rear axle housing by the bearing retainer plate which is bolted to the housing flange.

The inner end of each axle shaft is splined to the engine powered differential. The rear wheels are, therefore, driven by the engine.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### FRONT WHEEL BEARING ADJUSTMENT

The front wheel bearings should be adjusted if the wheel is loose on the spindle or if the wheel does not rotate freely. The following procedure will bring the bearing adjustment to specification.

**1.** Raise the car until the wheel and tire clear the floor.

**2.** Pry off the hub cap or wheel cover and remove the grease cap (Fig. 1) from the hub.

**3.** Wipe the excess grease from the end of the spindle, and remove the cotter pin and nut lock.

**4.** While rotating the wheel, hub, and drum assembly, torque the adjusting nut to 15-20 ft-lbs to seat the bearings (Fig. 2).

**5.** Locate the nut lock on the adjusting nut so that the castellations on the lock are aligned with the cotter pin hole in the spindle.

**6.** Using a 1⅛-inch box wrench, back off both the adjusting nut and the nut lock together until the next

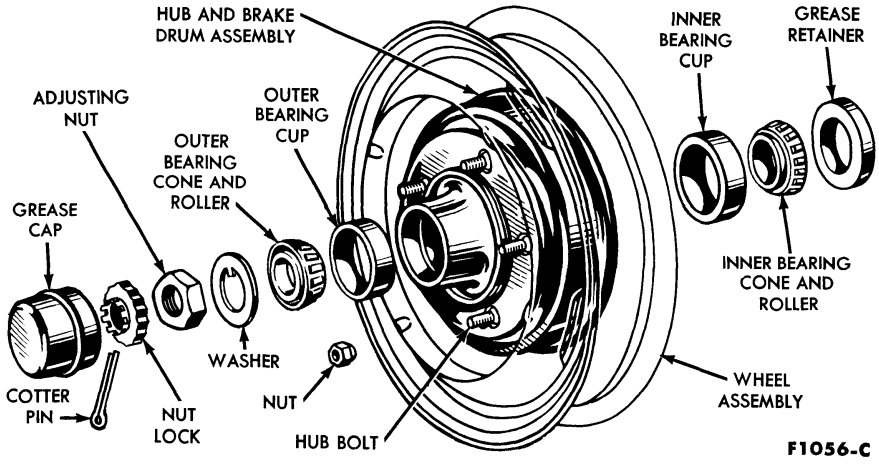



**FIG. 1—Front Hub, Bearings and Grease Retainer**

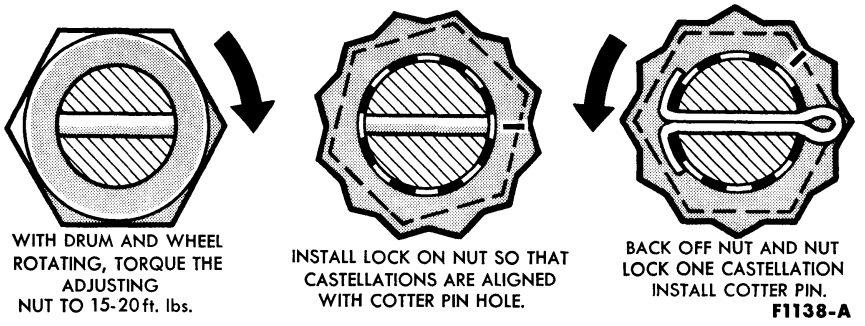



**FIG. 2—Front Wheel Bearing Adjustment**

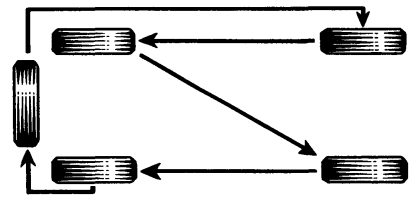
castellation on the nut lock aligns with the cotter pin hole in the spindle.

**7.** Install a new cotter pin, and bend the ends of the cotter pin around the castellated flange of the nut lock.

**8.** Check the front wheel rotation. If the wheel rotates properly, install the grease cap and the hub cap or wheel cover. If the wheel still rotates roughly or noisily, clean, inspect or replace the bearings and cups as required.

### TIRE ROTATION

For longer tire life, all five tires should be cross-switched as shown in Fig. 3. See Group 19 for the specified interval.



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**FIG. 3—Tire Cross-Switching Diagram**

## 3 REMOVAL AND INSTALLATION

### WHEEL AND TIRE ASSEMBLY

#### REMOVAL

**1.** Pry off the wheel hub cap or cover. Loosen but do not remove the wheel hub nuts.

**2.** Raise the car until the wheel and tire clear the floor.

**3.** Remove the wheel hub nuts from the bolts, and pull the wheel and tire assembly from the hub and drum.

#### DEMOUNTING TIRE FROM WHEEL

The tire can be demounted on a mounting machine. **Be sure that the outer side of the wheel is positioned downward.** If tire irons are used follow the procedure given here.

**1.** Remove the valve cap and core, and deflate the tire completely.

**2.** With a bead loosening tool, break loose the tire side walls from the wheel (Fig. 4).

**3. Position the outer side of the wheel downward,** and insert two tire irons about eight inches apart between the tire inner bead and the back side of the wheel rim. **Use only tire irons with rounded edges or irons designed for demounting tubeless tires.**



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**FIG. 4—Bead Loosening Tool**

**4.** Leave one tire iron in position, and pry the rest of the bead over the rim with the other iron. Take small "bites" with the iron around the tire in order to avoid damaging the sealing surface of the tire bead.

**5.** Stand the wheel and tire upright with the tire outer bead in the drop center well at the bottom of the wheel. Insert the tire iron between the bead and the edge of the wheel rim, and pry the wheel out of the tire.

#### MOUNTING TIRE TO WHEEL

**1.** If a used tire is being installed remove all dirt from the tire.

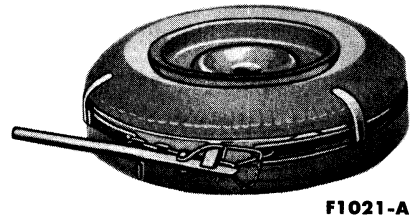
If a tire is being mounted to the original wheel, clean the rim with emery cloth or fine steel wool. Check the rim for dents.

If a new wheel is being installed, coat a new valve with RUGLYDE or similar rubber lubricant and position the valve to the new wheel. Use a rubber hammer or a valve replacing tool to seat the valve firmly against the inside of the rim.

**2.** Apply RUGLYDE or a similar rubber lubricant to the sealing surface on both tire beads. With the outer side of the wheel down, pry the beads over the wheel rim with two tire irons. **Do not use a hammer or mallet to force the beads over the rim.**

**3.** Align the balance mark on the tire with the valve on the wheel.

**4.** Hold the beads against the rim flanges by positioning a tire mounting band over the tire (Fig. 5). If a mounting band is not available, tie a tourniquet of heavy cord around the circumference of the tire. Tighten the cord with a tire iron. Center the tire on the wheel with a rubber mallet.



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**FIG. 5—Tubeless Tire Mounting Band**

**5.** Give the tire a few quick bursts of air to seat the beads properly, then inflate the tire to 40 psi pressure. Check to see that the bead positioning rings (outer rings near the side walls) are evenly visible just above the rim flanges all the way around the tire. If the rings are not even, deflate the tire completely and inflate it again.

**6.** When the rings are properly positioned, deflate the tire to the recommended pressure.

#### INSTALLATION

**1.** Clean all dirt from the hub and drum.

**2.** Position the wheel and tire assembly on the hub and drum. Install the wheel hub nuts and tighten them alternately in order to draw the wheel evenly against the hub and drum.

**3.** Lower the car to the floor, and torque the hub nuts to specification.

## 4 MAJOR REPAIR OPERATIONS

### FRONT WHEEL GREASE SEAL AND BEARING REPLACEMENT AND/OR REPACKING

If bearing adjustment will not eliminate looseness or rough and noisy operation, the hub and bearings should be cleaned, inspected, and repacked. If the bearing cups or the cone and roller assemblies are worn or damaged, they should be replaced.

**1.** Raise the car until the wheel and tire clear the floor.

**2.** Insert a narrow screwdriver through the brake adjusting hole at the inner side of the brake backing plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the screw, back off the adjusting screw with the brake adjusting tool (Fig. 6). **Be very careful not to burr, chip, or damage the notches in the adjusting screw; otherwise the self adjusting mechanism will not function properly.**

**3.** Remove the wheel cover or hub cap. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly (Fig. 1).

**4.** Pull the wheel, hub, and drum assembly off the wheel spindle.

**5.** Remove the grease retainer and the inner bearing cone and roller assembly from the hub with tool 1175AE.

**6.** Clean the lubricant off the inner and outer bearing cups with solvent and inspect the cups for scratches, pits, excessive wear, and other damage. If the cups are worn or damaged, remove them with a drift.

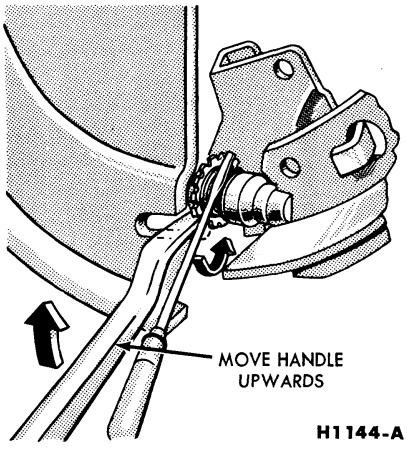



**FIG. 6—Backing Off Brake Adjustment**

**7.** Soak a new grease retainer in light engine oil at least 30 minutes before installation. Thoroughly clean the inner and outer bearing cones and rollers with solvent, and dry them thoroughly. **Do not spin the bearings with compressed air.**

Inspect the cone and roller assemblies for wear or damage, and replace them if necessary. **The cone and roller assemblies and the bearing cups should be replaced as a unit if damage to either is encountered.**

**8.** Thoroughly clean the spindle and the inside of the hub with solvent to remove all old lubricant.

Cover the spindle with a clean cloth, and brush all loose dust and dirt from the brake assembly. **To prevent getting dirt on the spindle, carefully remove the cloth from the spindle.**

**9.** If the inner and/or outer bearing cup(s) were removed, install the replacement cup(s) in the hub with the tool shown in Fig. 7. **Be sure to seat the cups properly in the hub.**

**10.** Pack the inside of the hub with specified wheel bearing grease. Add lubricant to the hub only until the grease is flush with the inside diameter of both bearing cups (Fig. 8).

**11.** All old grease should be completely cleaned from the bearings before repacking them with new grease. Pack the bearing cone and roller assemblies with wheel bearing grease. A bearing packer is desirable for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.

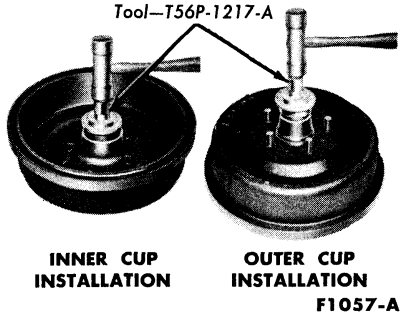



**FIG. 7—Installing Front Wheel Bearing Cup**

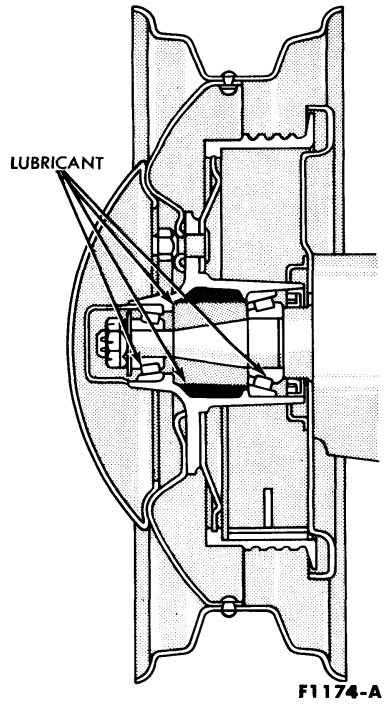



**FIG. 8—Front Wheel Hub Lubrication**

**12.** Place the inner bearing cone and roller assembly in the inner cup, and install the new grease retainer with the reverse end of the tool shown in Fig. 7. **Be sure that the retainer is properly seated.**

**13.** Install the wheel, hub, and drum assembly on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.**

**14.** Install the outer bearing cone and roller assembly and the flat washer on the spindle, then install the adjusting nut (Fig. 1).

**15.** Adjust the wheel bearings as outlined in Section 2, and install a new cotter pin. Bend the ends of the cotter pin around the castellations of the nut lock to prevent interference with the radio static collector in the grease cap. Install the grease cap.

**16.** Adjust the brake shoes as outlined in Part 2-2, Section 2.

**17.** Install the hub cap or wheel cover.

## FRONT HUB AND DRUM ASSEMBLY REPLACEMENT

When the hub and drum assembly is replaced, new bearings, cups, and grease retainer must be installed in the new assembly. The new grease retainer should be soaked in light engine oil at least 30 minutes before installation.

**1.** Raise the car until the wheel and tire clears the floor. Pry off the hub cap or wheel cover, and remove the wheel and tire assembly from the hub and drum assembly.

**2.** Back off the brake adjuster and remove the old hub and drum assembly from the wheel spindle as outlined in steps 2 and 3 of the foregoing procedure.

**3.** Remove the protective coating from the new hub and drum with carburetor degreaser. Install new inner and outer bearing cups in the new hub with the tool shown in Fig. 7. **Be sure to seat the cups properly in the hub.**

**4.** Grease and install the new parts as outlined in steps 10 through 12 of the foregoing procedure.

**5.** Install the new hub and drum assembly on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer.**

**6.** Install the outer bearing cone and roller assembly and the flat washer on the spindle, then install the adjusting nut (Fig. 1).

**7.** Position the wheel and tire assembly on the new hub and drum assembly. Install the wheel hub nuts and tighten them alternately in order to draw the wheel evenly against the hub and drum.

**8.** Adjust the wheel bearings as outlined in Section 2, and install a new cotter pin. Bend the ends of the cotter pin around the castellations of the nut lock to prevent interference with the radio static collector in the grease cap. Install the grease cap.

**9.** Adjust the brake shoes as outlined in Part 2-2, Section 2.

**10.** Install the hub cap or wheel cover.

# PART 3-6 SPECIFICATIONS

## TORQUE LIMITS—MANUAL STEERING

| Description | Ft.-Lbs. |
|---|---|
| Steering Pitman Rod Assembly | 35-55 |
| Steering Spindle Arm Connecting Rod and End Assy. to Control Rod | 35-55 |
| Steering Spindle Arm Connecting Rod and End Assy. to Spindle Arm | 35-55 |
| Steering Spindle Connecting Rod Clamp to Adjusting Sleeve | 8-13 |
| Steering Idler Arm Mounting Bracket to Frame Assembly | 25-35 |
| Idler Arm to Frame Mtg. Brkt. Assy. | 60-70 |
| Idler Arm to Rod Assy. | 60-70 |
| Steering Wheel to Steering Gear Assembly | 25-35 |
| Trans. Manual Shift Rod (Locking Rod) to Ball Joint (Movable Column) | 7-11 |
| Steering Pitman Arm to Sector Shaft Assy. | 110-150 |
| Steering Gear Assy. to Frame Assy. | 28-43 |
| Steering Column Bracket to Instrument Panel | 12-16 |
| Steering Gear & Lower Flange Assy. to Upper Shaft & Flange | 15-20 |
| Selector Assy. to Track Assy. (Movable Col.) | 6-9 |
| Track Assy. to Brake Pedal Supt. (Movable Col.) | 13-21 |
| Steering Col. to Pivot Bracket | 7-11 |
| Pivot Bracket to Steering Gear | 7-11 |
| Brace to Track Assy. | 7-11 |
| Brace to Brake Pedal Supt. | 7-11 |
| Track Assy. to Track Bracket | 7-11 |
| Outer Brace to Track Bracket | 7-11 |
| Sector Shaft Cover Bolts | 20-30 |
| Meshload Adjusting Screw Lock Nut | 32-40 |
| Ball Return Guide Clamp Screw | 3½-5 |
| Adjuster Lock Nut | 60-80 |

## TORQUE LIMITS—POWER STEERING

| Description | Ft.-Lbs. |
|---|---|
| Steering Pitman Arm to Sector Shaft Assembly | 110-150 |
| Steering Pitman Arm to Idler Arm Rod Assembly (Power Steering Valve) | 35-55 |
| Power Cylinder Assy. to Crosslink | 50-65 |
| Idler Arm to Bracket and Idler Arm to Rod Assy. | 60-70 |
| Steering Spindle Arm Connecting Rod & End Assy. to Control Rod Assy. | 35-55 |
| Steering Spindle Arm Connecting Rod & End Assy. to Spindle Arm | 35-55 |
| Steering Spindle Connecting Rod Clamp to Adjusting Sleeve | 8-13 |
| Hydraulic Control Valve Clamp to Control Rod Assy. | 15-20 |
| Steering Idler Arm Mounting Bracket to Frame Assy. (Side Holes) | 25-35 |
| Cylinder Mounting Bracket to Frame Assy. (Bottom Holes) | 35-43 |
| Hydraulic Cylinder to Bracket | 18-24 |
| Hydraulic Cylinder to Mounting Bracket Jam-Nut | 3-5 |
| Cylinder Mounting Bracket to Frame (Side Hole) | 50-65 |
| Pressure Hose to Power Steering Pump | 18-25 |
| Pressure Hose to Power Steering Valve | 6-9 |
| Return Line Tube to Power Steering Valve | 10-20 |
| Hoses (Valve to Cylinder) to Power Steering Valve and to the Power Cylinder | 14-18 |

## FRONT SUSPENSION
## FRONT WHEEL ALIGNMENT

### CASTER

| | |
|---|---|
| Caster Angle | – ½° to + ½° |
| Maximum Caster Angle Difference Between Wheels | ½° |

### CAMBER

| | |
|---|---|
| Camber Angle | ¼° to + 1° |
| Maximum Camber Angle Difference Between Wheels | ½° |
| Maximum Allowable Thickness of Shim Stack at Each Bolt | ⅝ inch |
| Amount of Camber Angle Change with 1/16-inch Change of Shim Thickness at Both Bolts | ¼° |

### TOE-IN AND TOE-OUT

| | |
|---|---|
| Toe-In | ⅛-¼ inch |
| Toe-Out on Turn (Angle of Inside Wheel When Outside Wheel is Turned 20°) | 20½° |

## TORQUE LIMITS—FRONT SUSPENSION

| Description | Ft.-Lbs. |
|---|---|
| Joint Assy.—Frt. Suspension Lower Arm Ball to Frt. Spindle | 70-90 |
| Joint Assy.—Frt. Suspension Upper Arm Ball to Frt. Spindle | 60-80 |
| Bumper Assy.—Frt. Suspension Upper Arm to Arm & Inner Shaft Assy. | 15-25 |
| Arm & Inner Shaft Assy.—Front Suspension Upper to Bracket—Suspension Arm & Shock Mounting Upper | 65-85 |
| Arm & Bushing Assy.—Frt. Suspension Lower to Frame Frt. Crossmember | 40-60 |
| Arm & Bushing Assy.—Frt. Suspension Lower to Frame #2 Crossmember | 40-60 |
| Frt. Shock Absorber Pin & Bushing Assy. to Frt. Suspension Lower Arm Assy. | 10-15 |
| Frt. Shock Absorber to Upper Mounting Bracket in Frame | 15-25 |
| Bushing—Frt. Suspension Upper Arm to Frt. Suspension Upper Arm Shaft | 160 to 190 |
| Frt. Stabilizer Bar to Lower Arm | 8-13 |
| Frt. Stabilizer Bar Frame Mounting Bracket to Frame | 20-35 |
| Bumper Assy.—Lower Arm to Arm & Bushing Assy.—Front Suspension Lower | 15-25 |
| Bushing Assy.—Lower Arm Front Shaft Mounting | 160-240 |

## TORQUE LIMITS—REAR SUSPENSION

| Description | Ft.-Lbs. |
|---|---|
| Rear Shock Absorber to Rear Spring Plate Assy. | 15-25 |
| Rear Suspension Spring Assy. to Rear Spring Front Hanger (in Frame Assy.) | 30-40 |
| Rear Suspension Spring Shackle Bars to Frame Assy. | 15-22 |
| Rear Suspension Spring Shackle Bar to Rear Spring Assy. | 15-22 |
| Rear Suspension Spring Assy. to Rear Axle | 30-45 |
| Rear Brake Assy. & Bearing Retainer to Rear Axle Housing | 30-40 |
| Universal Joint Flange Axle End to Universal Joint Bearing Assy. | 12-15 |
| Rear Shock Absorber Upper Mounting to Stud and Stud to Frame | 30-40 |
| Rear Brake Assy. & Bearing Retainer to Rear Axle Housing | 55-65 |
| Bumper Assy.—Rear Axle Differential Carrier to Differential Carrier Bracket | 15-22 |

## REAR LEAF SPRING

| Body Style | Number of Leaves | Capacity at Normal Load Height | Spring Length at Normal Load |
|---|---|---|---|
| Hardtop | 4 | 880-920 pounds | 60 inches |
| Convertible | 4 | 980-1020 pounds | 60 inches |

## SUSPENSION LUBRICATION

| | |
|---|---|
| Steering Arm Stop | M-1C31 |
| Rear Spring Bushings And Center Mounting Insulator | M-99C45-A |

## WHEELS AND TIRES

| Model Application | | Tire Size | Inflation Pressure (psi)* Front | Inflation Pressure (psi)* Rear | Wheel Type | Rim Type | Bolt Circle Diameter (inches) | Number of Bolts | Wheel Nut Torque (Foot-Pounds) | Front Wheel Bearing End Play |
|---|---|---|---|---|---|---|---|---|---|---|
| Ford | 300 | 7.00 x 14⊕ | 24 | 24 | Disc | 5.5J | 4.5 | 5 | 75-110 | .005 to .0065 with torque at 17-25 ft-lbs |
| Sedan | 500 | 7.50 x 14△ | | | | | | | | |
| Mercury Sedan | | 8.00 x 14 | | | | | | | | |
| Convertible | Six | 7.50 x 14 | | | | | | | | |
| | V-8 | 8.00 x 14 | | | | | | | | |
| Station Wagon | | 8.00 x 14 | | 28 | | 6.0J | | | | |
| Police & Taxi | | 6.70 x 15 | | 24 | | 5.5J | | | | |

*For Sustained High Speed Driving or for Hauling Heavy Loads, add 4 lbs. to recommended pressures.
⊕ Use 7.50 x 14 with Air Conditioning; or with Power Brakes and Power Steering; or with 352 CID Engine.
△ Use 8.00 x 14 with Air Conditioning.

## TREAD WIDTH AND WHEELBASE

| | |
|---|---|
| Front Tread Width | 61 inches |
| Rear Tread Width | 60 inches |
| Wheelbase | 119 inches |

## LUBRICATION

| | |
|---|---|
| Front Wheel Bearings | Pack with ESA-M1C60-A |
| Front Wheel Bearing Seal | Soak in Oil M-4629 |

## SERVICE SPECIFICATIONS, ADJUSTMENTS AND TOLERANCES

### VEHICLE

| Model | HCA-AX | HCA-BL |
|---|---|---|
| Gear Type | Manual | Power |
| Gear Ratio | 22:1 | 20:1 |
| Turns of Steering Wheel (Stop to Stop) # | 5½ | 5 |
| Lube Capacity | 11 Oz. | 11 Oz. |
| Worm Bearing Preload @ | 4-5 Lbs. In. | 3-4 Lbs. In. |
| Total Preload (Worm Bearing Plus Sector Mesh) $ | 9-10 Lbs. In. | *8-9 Lbs. In. |

### ADJUSTMENTS

Adjusting screw clearance at bottom of sector shaft T-slot—.000″-.002″.
Backlash at 30° on either side of straight ahead steering position—None
Sector shaft end play—Steering linkage disconnected—None

### NOTES

# Gear Only—Not attached to Pitman arm

@ Torque required to rotate input shaft at approx. 1½ turns either side of center. (Gear out of car or steering wheel removed and Pitman arm disconnected)

$ Required to rotate input shaft and worm assembly past center high point

* Total preload must be a minimum of 2 lbs. in greater than bearing preload

# REAR AXLE

# GROUP 4


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**PART 4-2**
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# PART 4-1 GENERAL AXLE SERVICE


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2 Common Adjustments and Repairs ..... 4-4
3 Cleaning and Inspection ..... 4-6


## 1 DIAGNOSIS AND TESTING

### DIAGNOSIS GUIDE

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, tires, and other parts of the car. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing, or replacing any of the axle parts.

Also, certain trouble symptoms are common to both the conventional and locking differential axles, while still other symptoms are found only in the locking differential.

To determine whether the car is equipped with a conventional or a locking differential, check the car warranty plate and the axle ratio tag. Refer to CAR IDENTIFICATION at the front of this manual.

### LOCKING DIFFERENTIAL

The locking differential can be checked for proper operation without removing the carrier from the axle housing.

Jack up one rear wheel and remove the wheel cover. On a Ford model install tool T59L-4204-A on the axle shaft flange studs as shown in Fig. 1. On a Mercury model, insert tool 44211-A into the two holes in the end of the axle shaft as shown in Fig. 2.

Using a torque wrench of at least 200 foot-pounds capacity, rotate the axle shaft. **Be sure that the transmission is in neutral gear, one rear wheel is on the floor, and the other rear wheel is raised off the floor.** The torque required to continuously rotate the shaft should be more than 100 foot-pounds. The initial breakaway torque may be higher than the continuous turning torque, but this is normal. The axle shaft should turn

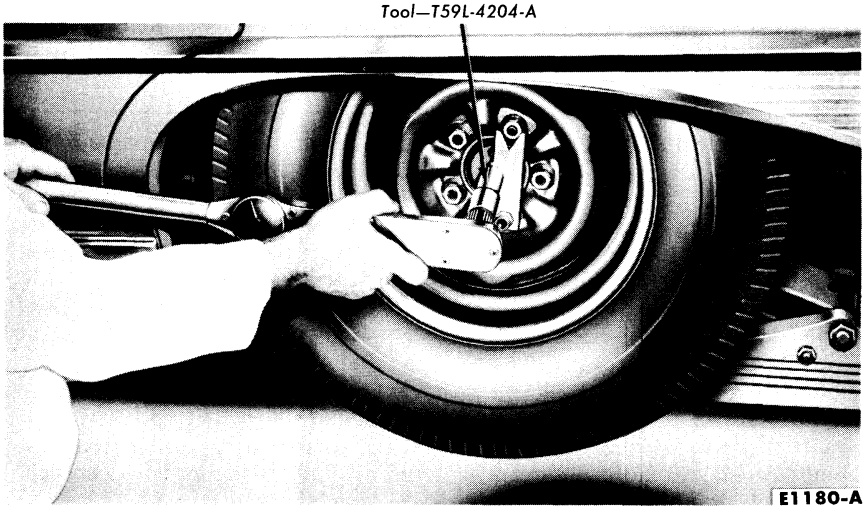



**FIG. 1—Locking Differential Check—Ford**

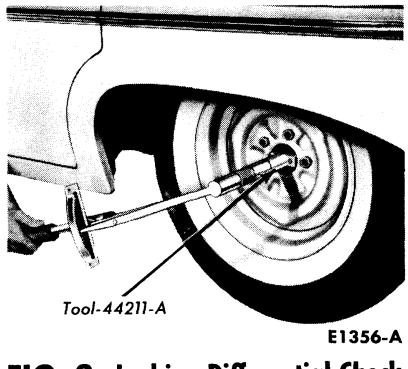



**FIG. 2—Locking Differential Check —Mercury**

with even pressure throughout the check without slipping or binding.

If the torque reading does not exceed 100 foot-pounds, check the differential for improper assembly.

**A car equipped with a locking differential will always have both wheels driving. If, while the car is being serviced, only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor will drive the car off the stand or jack.**

**REAR AXLE TROUBLE SYMPTOMS AND POSSIBLE CAUSES**

| | | |
|---|---|---|
| **EXCESSIVE REAR AXLE NOISE (ALL REAR AXLES)** | Since gears are in mesh, some rear axle noise is normal. However, excessive noise often indicates the beginning of other troubles in the axle.<br>A road test can help determine whether the noise is being caused by trouble in the rear axle or in other parts of the car. **Before road-testing the car, make sure that the tire pressures and the rear axle lubricant level are normal. Then drive the car far enough to warm the axle lubricant to its normal operating temperature.**<br>With the car stopped and the transmission in neutral, run the engine at various speeds. If the noise still exists during this test, it probably comes from the engine or the exhaust system.<br>To determine if the noise is being caused by the rear axle or the tires, drive the car over several different types of road surfaces. Smooth asphalt or black-top roads minimize tire noises. Tire noises may be eliminated by cross-switching the tires. Snow tires often cause noises not heard with conventional tires. | Noise caused by a worn or damaged wheel bearing is often loudest when the car is coasting at low speeds, and it usually stops when the brakes are gently applied. To find the noisy bearing, jack up each wheel and check each bearing for roughness while the wheel is rotating, provided that the car is equipped with a conventional differential.<br>If all possible external sources of noise have been checked and eliminated, and the noise still exists, road-test the rear axle under all four driving conditions–drive, cruise, float, and coast. Any noise produced by the sidegears and pinions in the differential case will be most pronounced on turns. A continuous whine under a light load between 20 and 35 miles per hour indicates rough or brinnelled pinion bearings. If the tone of drive, coast and float noise differs with speed and if the noise is very rough and irregular; worn, rough or loose differential or pinion shaft bearings are indicated. Remove, disassemble, and inspect the axle. |
| **EXCESSIVE REAR AXLE BACKLASH (ALL REAR AXLES)** | Excessive backlash in the axle driving parts may be caused by worn axle shaft splines, loose axle shaft flange nuts, loose U-joint flange mountings, excessive backlash between the drive | pinion and drive gear, excessive backlash in the differential gears, or bearings which are worn or out of adjustment. |
| **ONE WHEEL SPINS EXCESSIVELY (LOCKING DIFFERENTIAL ONLY)** | Use the procedure given under "Locking Differential" for checking the locking differential while the carrier assembly is in the car. If the torque required to rotate one rear | wheel is less than 100 foot-pounds, the differential is not functioning properly. To repair the unit, the carrier assembly must be removed from the axle housing. |
| **AXLE HAS A HIGH-PITCHED, CHATTERING NOISE ON TURNS (LOCKING DIFFERENTIAL ONLY)** | Drive the car in a fairly tight circle, making five circles clockwise and five counterclockwise. This will permit the lubricant to work in between the clutch plates. If the noise does not disappear during this driving test, it is probable that the axle does not have the approved Ford lubricant.<br>The lubricant may be checked by draining two tablespoonfuls from the axle and mixing it with an equal amount of white alcohol, such as rubbing alcohol. Mix the lubricant and alcohol thoroughly and let it | stand for at least two minutes. If the sample now has a blue tint, the lubricant is approved Ford lubricant. If it has a yellow tint, it is not the correct lubricant. Drain and refill the axle with the approved lubricant. It is not necessary to flush the axle housing.<br>After refilling the axle drive the car in fairly tight circles clockwise and counterclockwise. The chattering noise should disappear as soon as the new lubricant works in between the clutch plates. |

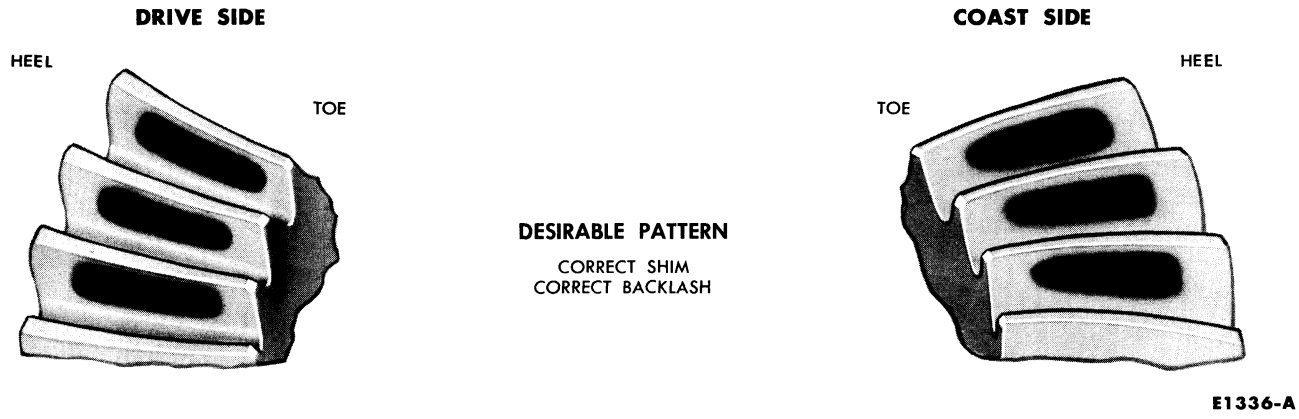



**FIG. 3—Ideal Tooth Pattern**

## GEAR TOOTH CONTACT PATTERN CHECK

Paint the gear teeth and roll a pattern as described in Section 3. After diagnosing the tooth pattern as explained here, make the appropriate adjustments as outlined in Section 2.

In making a final gear tooth contact pattern check, it is necessary to recognize the fact that there are three different types of gear set, hunting, non-hunting and partial non-hunting. Each type is determined by the ratio and the number of teeth in the gears. The non-hunting and partial non-hunting types can be identified by the paint "timing" marks on the pinion and drive gear teeth (Part 4-2, Fig. 43). See Part 4-3 for complete identification specifications.

### THE IDEAL TOOTH PATTERN

Fig. 3 shows the ideal tooth pattern. **This pattern is not a rigid standard but merely a general norm.**

In general, desirable tooth patterns should have the following characteristics:

(a) The drive pattern should be fairly well centered on the tooth.

(b) The coast pattern should be centered on the tooth but may be slightly toward the toe.

(c) Some clearance between the pattern and the top of the tooth is desirable.

(d) There should be no hard lines where the pressure is high.

The individual gear set need not conform exactly to the "ideal" pattern in order to be acceptable. Characteristic differences between the three types of gear sets as well as differences between individual gear sets of the same type will result in patterns that are acceptable yet different from those shown in Fig. 3.

### HUNTING GEAR SET

In a hunting-type gear set, any one pinion gear tooth comes into contact with all drive gear teeth. In this type, several revolutions of the drive gear are required to make all possible gear combinations.

**Acceptable Pattern.** The drive pattern shown in Fig. 4 was rolled on a hunting-type gear set. Since each pinion tooth came into contact with each drive gear tooth, the pattern is a result of the **combined** tooth contacts. Therefore, the pattern is uniform from tooth to tooth.

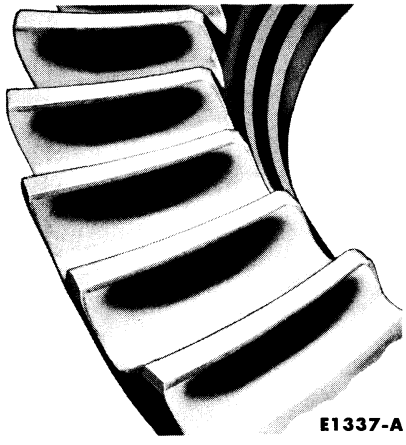



**FIG. 4—Acceptable Hunting Gear Pattern**

**Unacceptable Pattern.** An erratic tooth pattern on a hunting gear set indicates gear runout and possible need for gear replacement.

A pattern that is uniform, but off center indicates a change in shim or backlash (Fig. 9).

### NON-HUNTING GEAR SET

In a non-hunting type gear set, any one pinion gear tooth comes into contact with only a few drive gear teeth. In this type, only one revolution of the drive gear is required to make all possible tooth contact combinations.

**Acceptable Patterns.** The drive patterns shown in Figs. 5 and 6 were rolled on two different non-hunting

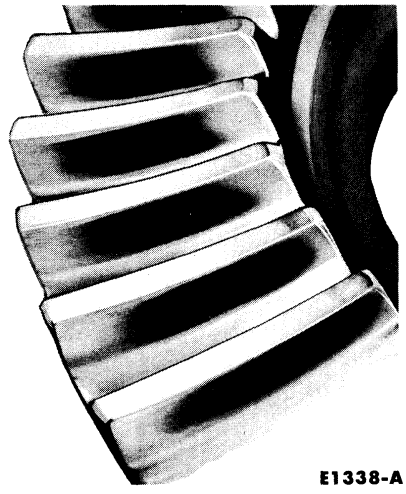



**FIG. 5—Acceptable Non-Hunting Pattern—Center-Toe-Center**

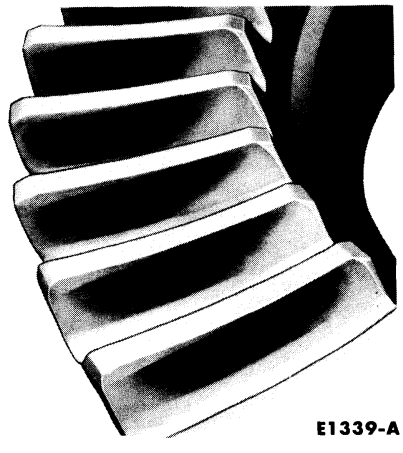
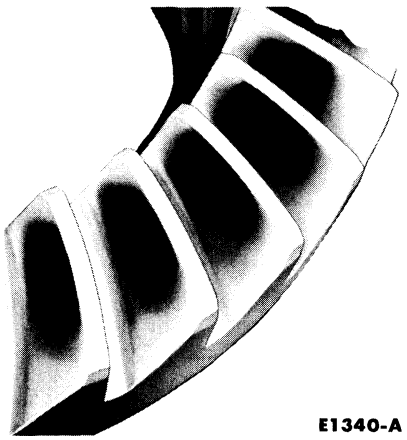



**FIG. 6—Acceptable Non-Hunting Pattern—Center-Heel-Center**



E1340-A

**FIG. 7—Acceptable Non-Hunting Gear Set—Coast Pattern**

type gear sets. The pattern in Fig. 5 runs from the tooth center toward the toe and then back to center. The pattern in Fig. 6 runs from the tooth center toward the heel and then back to center. These patterns are not unusual for non-hunting gear sets and are acceptable. The pattern on any one drive gear tooth was formed by only **one** pinion tooth coming into contact with it. Because of this limited tooth contact, the non-hunting pattern can be more erratic than the hunting pattern and still be acceptable. Likewise, the coast pattern on a non-hunting gear set is usually less uniform tooth to tooth than it would be on a hunting gear set (Fig. 7).

Fig. 8 shows a pattern rolled on another gear set. In this case, the pattern is fairly uniform from tooth to tooth.

**Unacceptable Patterns.** A non-hunting gear set should be checked for runout and possible replacement if the pattern runs from the tooth center toward the toe and back to center on some gear teeth (Fig. 5) while on other teeth of the same gear, the pattern runs from the tooth center toward the heel and back to center (Fig. 6).

A non-hunting gear set requires a change in shimming or backlash when its pattern tends to concentrate toward the heel or toe, top or bottom of **most** teeth (Fig. 9).

### PARTIAL NON-HUNTING GEAR SET

In a partial non-hunting type gear set, any one pinion tooth comes into contact with only part of the drive gear teeth, but more than one revolution of the drive gear is required to make all possible gear tooth combinations.

Tooth to tooth pattern uniformity will usually be in between the hunting and the non-hunting patterns. Partial non-hunting gear set patterns will usually be less uniform than hunting gear set patterns, but more uniform than non-hunting gear set patterns.

### SHIM AND BACKLASH CHANGES

The patterns shown in Fig. 9 are typical of gear sets that have either an incorrect backlash or an incorrect shim adjustment. Since each gear set rolls a characteristic pattern, the patterns in Fig. 9 should be considered as typical only and should be used as a guide rather than a rigid standard. The drive pattern is rolled on the convex side of the tooth, and the coast pattern is rolled on the concave side.

The movement of tooth contact patterns with changes in backlash and shimming can be summarized as follows:

**1.** Thicker shim with the backlash constant moves the pinion further from the ring gear:

a. Drive pattern moves toward the top of the tooth (face contact) and toward the heel.

b. Coast pattern moves toward the top of the tooth and slightly toward the toe.

**2.** Thinner shim with the backlash constant moves the pinion closer to the ring gear:

a. Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

b. Coast pattern moves deeper on the tooth and toward the heel.

**3.** Decreasing backlash moves the drive gear closer to the pinion:

a. Drive pattern moves slightly lower and toward the toe.

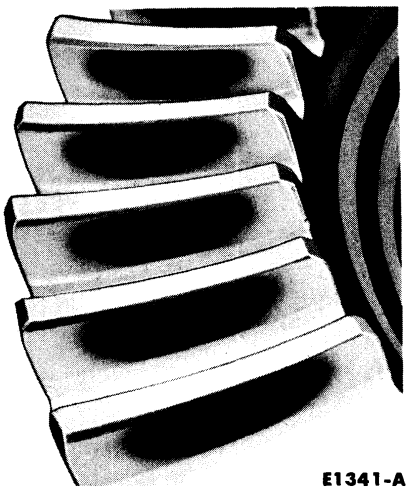
b. Coast pattern moves lower and toward the toe.

**4.** Increasing backlash moves the drive gear away from the pinion:

a. Drive pattern moves slightly higher and toward the heel.

b. Coast pattern moves higher and toward the heel.

If the patterns are not correct, make the changes as indicated. The pinion need not be disassembled to change a shim. All that is required is to remove the pinion, bearing, and retainer assembly and install a different shim. When reinstalling the pinion and retainer assembly of a non-hunting or partial non-hunting gear set, be sure that the marked tooth on the pinion indexes between the marked teeth on the drive gear (Fig. 45, Part 4-2). Refer to "Pinion and Drive Gear Tooth Contact Adjustment," Section 2.



E1341-A

**FIG. 8—Acceptable Non-Hunting Pattern—Uniform**

## 2 COMMON ADJUSTMENTS AND REPAIRS

### PINION AND DRIVE GEAR TOOTH CONTACT ADJUSTMENT

Two separate adjustments affect pinion and drive gear tooth contact. They are pinion location and backlash (Fig. 10).

Individual differences in machining the carrier housing and the gear set require a shim between the pinion retainer and the carrier housing to locate the pinion for correct contact with the drive gear. The original factory installed shim is of the correct thickness for a given original carrier and gear set assembly. In service, shims should be added or removed from the original pack only as indicated by the tooth pattern check. Adding shims moves the pinion away from the drive gear; removing shims moves the pinion toward the drive gear (Fig. 10).

The tooth pattern check also indicates whether the drive gear should be adjusted away from or toward the pinion to increase or decrease backlash between the gears.

If the tooth pattern check indicates a change in backlash only, follow the procedure under "Backlash

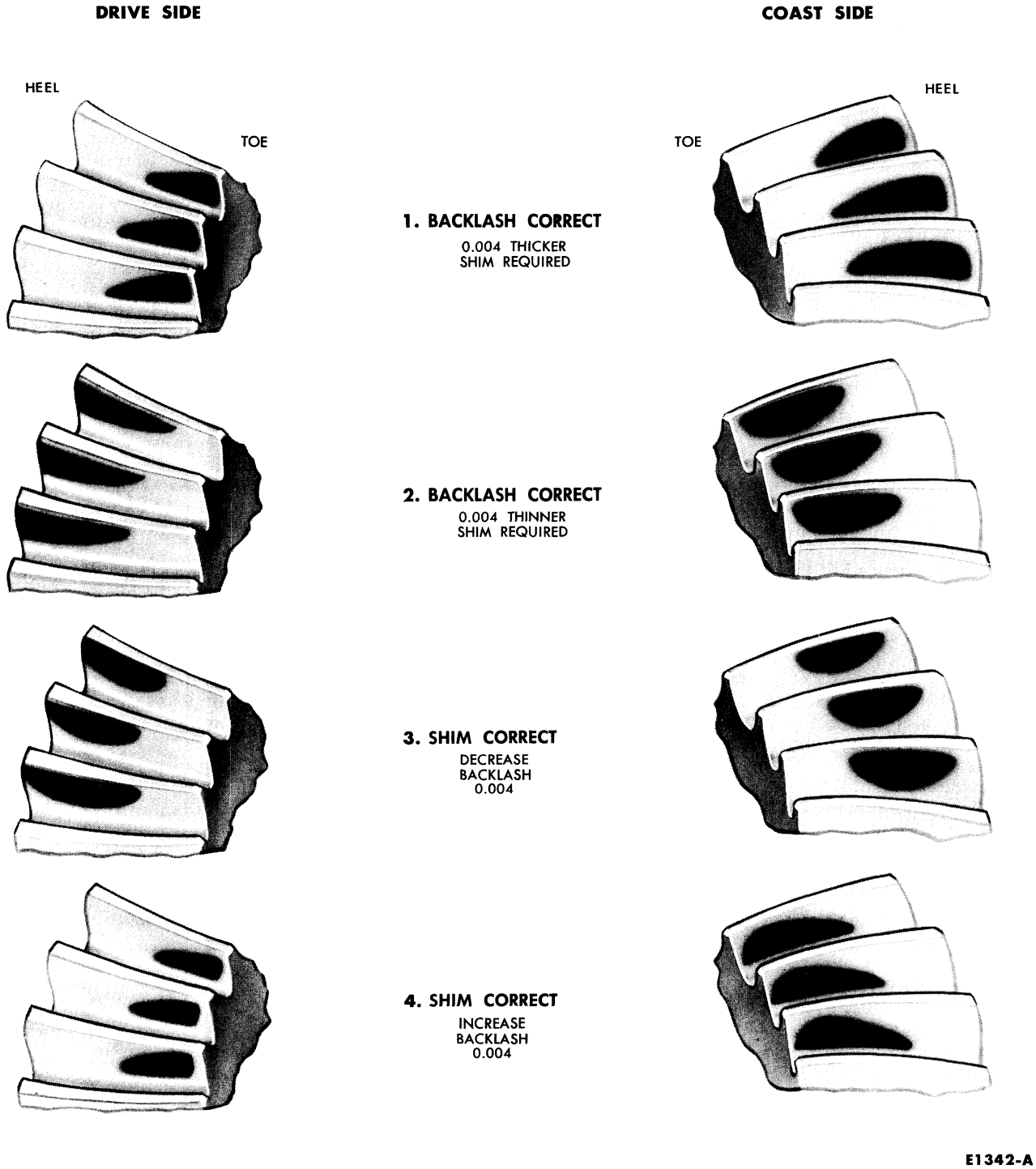



**FIG. 9—Typical Gear Tooth Contact Patterns Indicating Shim or Backlash Change**

Between Drive Gear and Pinion." If the tooth pattern indicates a change in shim thickness follow the procedure under "Pinion Location."

### BACKLASH BETWEEN DRIVE GEAR AND PINION

**1.** Remove the adjusting nut locks, loosen the differential bearing cap bolts, and then torque the bolts to 25 ft-lbs.

**2. The left-hand adjusting nut is on the drive gear side of the carrier. The right-hand nut is on the pinion side.** Loosen the right-hand nut until it is away from the cup. Tighten the left-hand nut until the drive gear is just forced into the pinion with no backlash. (Recheck the right-hand nut at this time to be sure that it is still loose.) **Tightening the left-hand nut moves the drive gear into the pinion to decrease backlash, and tightening the right-hand nut moves the drive gear away.**

**3.** Tighten the right-hand nut two notches beyond the position where it first contacts the bearing cup. Rotate the drive gear several revolutions in

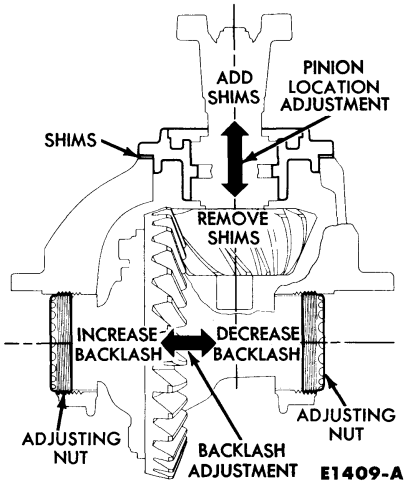



**FIG. 10—Pinion and Drive Gear Tooth Contact Adjustment**

each direction while the bearings are loaded to seat the bearings in their cups. **This step is important.**

**4.** Again loosen the right-hand nut to release the preload. If there is any backlash between the gears, tighten the left-hand nut just enough to remove this backlash. Carefully tighten the right-hand nut until it just contacts the cup. Set preload of 2½ to 3 notches tight by the right-hand nut. As preload is applied from the right-hand side, the drive gear is forced away from the pinion and usually results in the correct backlash.

**5.** Torque the differential cap bolts to specification.

**6.** Measure the backlash as shown in Fig. 12. Measure the backlash on several teeth around the drive gear. If the measurements vary more than 0.003 inch, there is excessive runout in the gears or their mountings, which must be corrected to obtain a satisfactory unit. If the backlash is out of specification, loosen one adjusting nut and tighten the opposite nut an equal amount, to move the drive gear away from or toward the pinion. **When moving the adjusting nuts, the final movement should always be made in a tightening direction. For example, if the left-hand nut had to be loosened one notch, loosen the nut two notches, then tighten it one. This procedure makes it certain that the nut is contacting the bearing cup, and that the cup cannot shift after being put in service.**

**7.** Again check the tooth contact pattern. If the pattern is still incorrect, a change in pinion location (shim thickness) is indicated.

### PINION LOCATION

**1.** Remove the retaining bolts and the pinion and bearing retainer assembly from the carrier.

**2.** Measure the original shim thickness with a micrometer. Increase or decrease the shim thickness as indicated by the tooth pattern check described in Section 1.

**3.** Replace the pinion retainer O-ring (Fig. 34, Part 4-2). Coat the O-ring with axle lubricant before installing. **Do not roll the O-ring into the groove. Snap it into position.**

**4.** Being careful not to pinch the O-ring, install the pinion and bearing retainer assembly in the carrier with the corrected shim pack.

Before installing the pinion and bearing retainer assembly, determine which type of gear set is being used. The **non-hunting** and **partial non-hunting** types can be identified by the paint "timing" marks on the gear teeth (Fig. 43, Part 4-2). Part 4-3 can also be referred to for identification.

If the gear set is of the **non-hunting** or **partial non-hunting** type, clean the teeth on both the pinion and drive gear so that the timing marks are visible. Rotate the differential case and drive gear assembly in the carrier until the marked teeth on the drive gear are opposite the pinion entry hole. Place the assembly in the carrier so that the marked tooth on the pinion indexes between the marked teeth on the drive gear (Fig. 43, Part 4-2).

**In almost every case of improper assembly (gear assembled out of time), the noise level and probability of failure will be higher than they would be with properly assembled gears.**

When installing the **hunting** type gear set (no "timing marks"), assemble the pinion and retainer assembly into the carrier without regard to the matching of any particular gear teeth.

**5.** Install the retainer-to-carrier mounting bolts and torque to specifications.

**6.** Adjust the backlash between the drive gear and pinion as outlined in the foregoing procedure.

**7.** Make a tooth pattern check. If the pattern is still unsatisfactory, repeat this procedure changing the shim thickness each time until a satisfactory tooth pattern is obtained.

## 3 CLEANING AND INSPECTION

### INSPECTION BEFORE DISASSEMBLY OF CARRIER

The differential carrier should be inspected before any parts are removed from it, and it should also be inspected as it is disassembled. These inspections can help to find the cause of the trouble and to determine the corrections needed.

Mount the carrier in the holding fixture shown in Fig. 11. Wipe the lubricant from the internal working parts, and visually inspect the parts for wear or damage.

Rotate the gears to see if there is any roughness which would indicate defective bearings or chipped gears. Check the gear teeth for scoring or signs of abnormal wear.

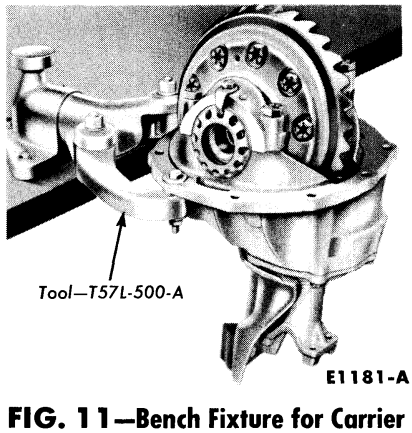



**FIG. 11—Bench Fixture for Carrier Overhaul**

Set up a dial indicator (Fig. 12) and check the backlash at several points around the drive gear. Backlash should be within specifications.

If no obvious defect is noted, check the gear tooth contact. Paint the gear teeth with suitable gear marking compound, such as a paste made with dry red lead and oil. A mixture that is too wet will run and smear. Too dry a mixture cannot be pressed out from between the teeth. As shown in Fig. 13, wrap a cloth or rope around the drive pinion flange to act as a brake. Rotate the drive gear back and forth (use a box wrench on the drive gear attaching bolts for a lever) until a clear tooth contact pattern is obtained.

Certain types of gear tooth contact patterns on the drive gear indicate incorrect adjustment. Noise caused

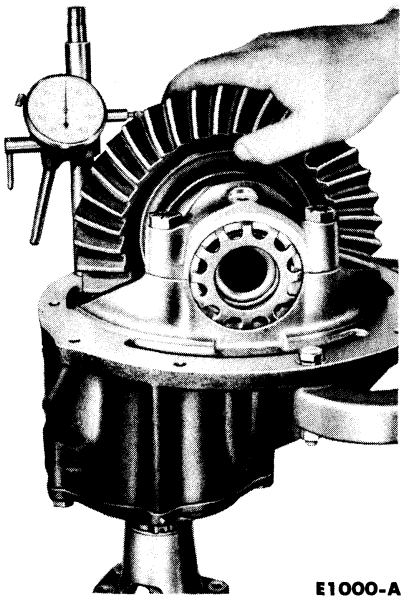



**FIG. 12—Backlash Check**

by incorrect adjustment can often be corrected by readjusting the gears. Typical patterns and the necessary corrections are explained under "Tooth Contact Pattern Check" in Section 1.

Gear tooth runout can sometimes be detected by an erratic pattern on

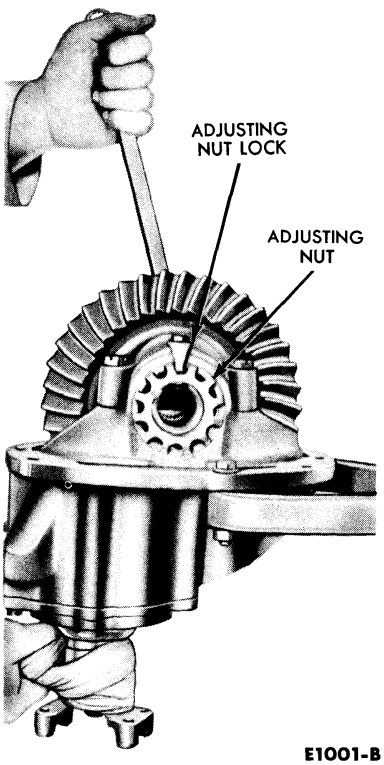



**FIG. 13—Gear Tooth Contact Check**

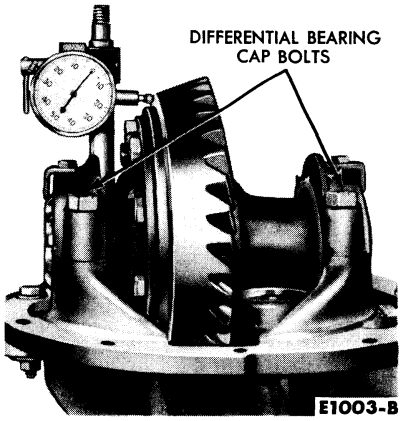



**FIG. 14—Drive Gear Runout Check**

the teeth. However, a dial indicator should be used to measure the runout of the back face of the drive gear, as shown in Fig. 14. If this runout exceeds specifications, disassemble the carrier and replace necessary parts as indicated in Part 4-2, Section 4.

Loosen the differential bearing cap bolts, and then torque to 25 ft-lbs. Remove the adjusting nut locks. Carefully loosen one of the adjusting nuts to determine if any differential bearing preload remains. If at least one notch of preload remains, the

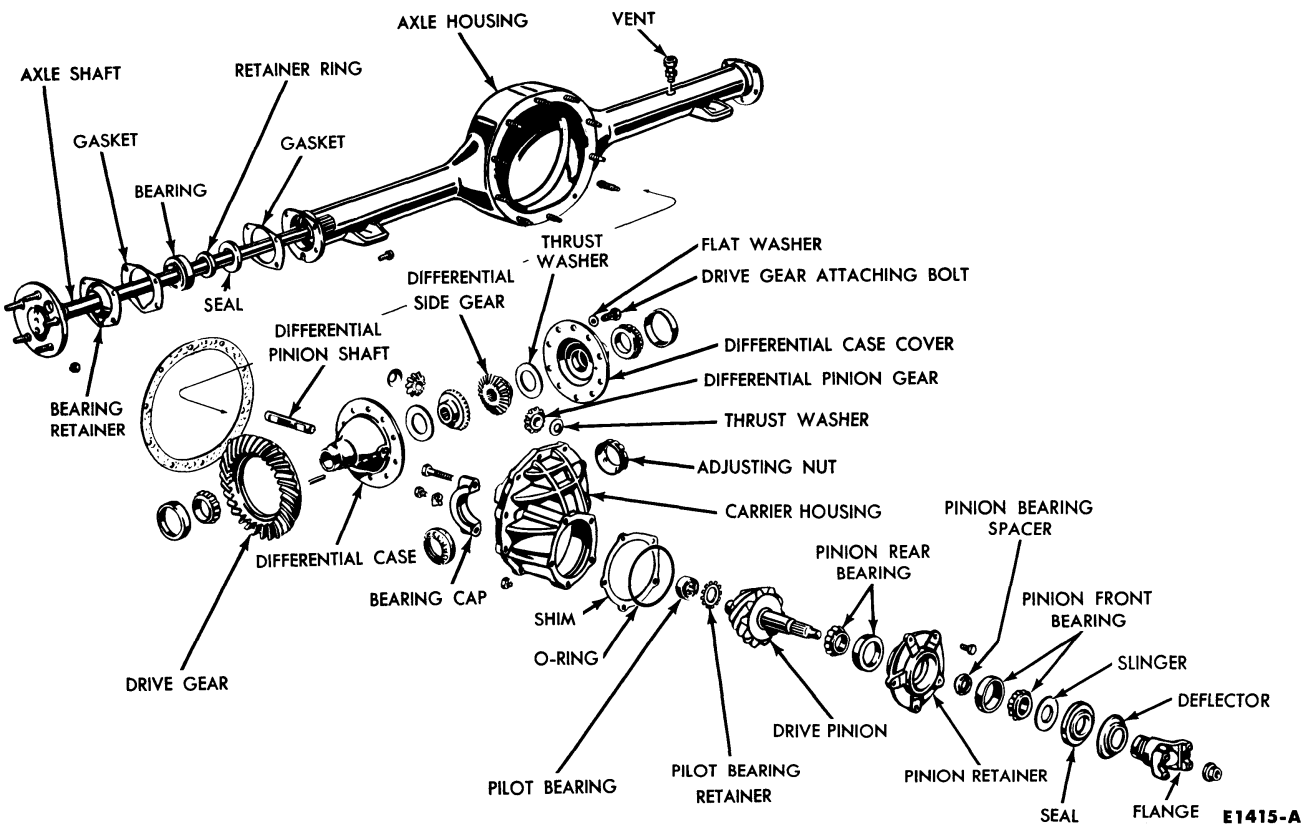



**FIG. 15—Rear Axle Disassembled**

differential bearings may be re-used, provided they are not pitted or damaged.

### INSPECTION AFTER DISASSEMBLY

Thoroughly clean all parts (Fig. 15). **Always use clean solvent when cleaning bearings.** Oil the bearings immediately after cleaning to prevent rusting. Inspect the parts for defects. Clean the inside of the carrier before rebuilding it. **When a scored gear set is replaced, the axle housing should be washed thoroughly and steam cleaned.** This can only be done effectively if the axle shafts and shaft seals are removed from the housing. Inspect individual parts as outlined below.

### GEARS

Examine the pinion and drive gear teeth for scoring or excessive wear. **Extreme care must be taken not to damage the pilot bearing surface of the pinion.**

The pattern taken during disassembly should be helpful in judging if gears can be re-used. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring is the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be re-used.

Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of the differential gear can cause a "chucking" noise known as "chuckle" when the car is driven at low speeds. Wear of splines, thrust surfaces, or thrust washers can contribute to excessive drive line backlash.

### BEARING CUPS AND CONE AND ROLLER ASSEMBLIES

Check bearing cups for rings, scores, galling, or excessively worn wear patterns. Pinion cups must be solidly seated. Check by attempting to insert a 0.0015-inch feeler between these cups and the bottoms of their bores.

When operated in the cups, cone and roller assemblies must turn without roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates the bearings were not preloaded properly or the rollers were slightly misaligned.

If inspection reveals either a defective cup or a defective cone and roller assembly **both parts** should be replaced to avoid early failure.

### DIFFERENTIAL BEARING ADJUSTING NUTS

Temporarily install the bearing caps and test the fit of the adjusting nuts in their threads. The nuts should turn easily when the caps are tightened to 25 ft-lbs. The faces of the nuts that contact the bearing cups must be smooth and square. Replace the nuts or examine the threads in the carrier if their fit is not proper. Be sure that the bearing caps and adjusting nuts are on the side they were machined to fit. Observe the punch marks and scribe marks made during disassembly.

### U-JOINT FLANGE

Be sure that the ears of the flange have not been damaged in removing the drive shaft or in removing the flange from the axle. The end of the flange that contacts the oil slinger as well as the flat surface of the pinion nut counterbore must be smooth. Polish these surfaces if necessary. Roughness aggravates backlash noises, and causes wear of the slinger and pinion nut with a resultant loss in pinion bearing preload.

### PINION RETAINER

Be sure that the pinion bearing cups are seated. Remove any chips or burrs from the mounting flange. Clean the groove for the O-ring seal and all lubricant passages. If the cups were removed, examine the bores carefully. Any nicks or burrs in these bores must be removed to permit proper seating of the cups.

### CARRIER HOUSING

Make sure that the differential bearing bores are smooth and the threads are not damaged. Remove any nicks or burrs from the mounting surfaces of the carrier housing.

### DIFFERENTIAL CASE

Make sure that the hubs where the bearings mount are smooth. Carefully examine the differential case bearing shoulders, which may have been damaged when the bearings were removed. The bearing assemblies will fail if they do not seat firmly against the shoulders. Check the fit (free rotation) of the differential side gears in their counterbores. Be sure that the mating surfaces of the two parts of the case are smooth and free from nicks or burrs.

### LOCKING DIFFERENTIAL PARTS

Inspect the clutch plates for uneven or extreme wear. The dog-eared clutch plates must be free from burrs, nicks, or scratches which could cause excessive or erratic wear to the bonding material of the internally splined clutch plates. The internally splined clutch plates should be inspected for condition of the bond, bonding material, and wear. Replace the bonded plates if their thickness is less than 0.085 inch or if the bonded material is scored or badly worn. Inspect the bonded plate internal teeth for wear. Replace them, if excessive wear is evident.

Examine all thrust surfaces and hubs for wear. Abnormal wear on these surfaces can contribute to a noisy axle.

Inspect the Belleville springs for proper free height of ¼ inch.

# PART 4-2 REAR AXLE


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| 2 | In-Car Adjustment and Repair | 4-10 |
| 3 | Removal and Installation | 4-13 |
| 4 | Major Repair Operations | 4-14 |


## 1 DESCRIPTION AND OPERATION

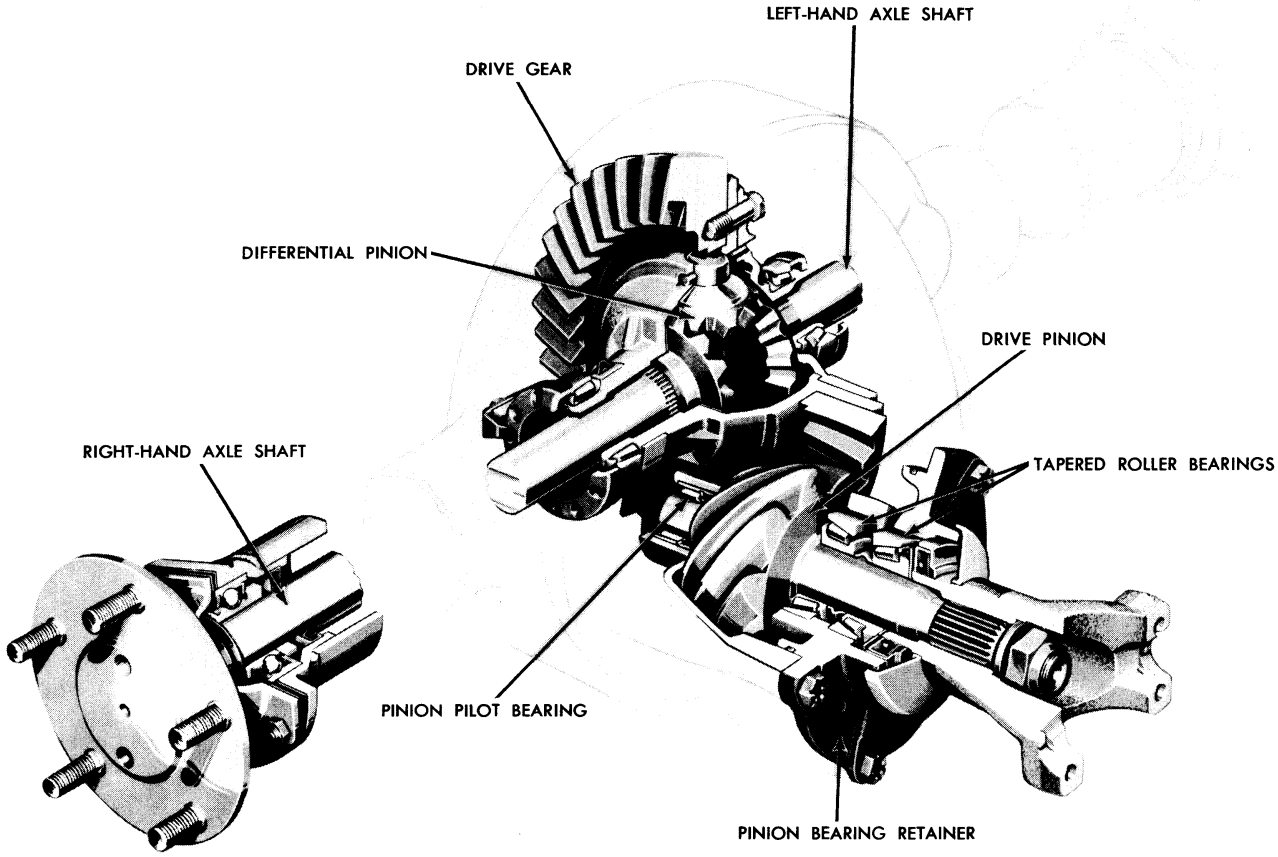



**FIG. 1—Rear Axle Assembly**

### CONVENTIONAL AXLE

#### DESCRIPTION

The rear axle is of the banjo-housing, hypoid gear type, in which the centerline of the pinion is mounted below the centerline of the drive gear (Fig. 1).

The integral pinion gear and shaft and the pinion bearings are assembled in a pinion retainer, which is bolted to the carrier. The pinion is straddle mounted; that is, it is supported by bearings both in front of and to the rear of the pinion gear. Two opposed tapered roller bearings support the pinion shaft in front of the pinion gear. A straight roller (pilot) bearing supports the pinion shaft at the rear of the pinion gear.

The differential assembly is mounted on two opposed tapered roller bearings, which are retained in the carrier by removable caps. The entire carrier assembly is bolted to the axle housing.

Ball bearing assemblies (rear wheel bearings) are pressed onto the outer ends of the axle shafts and set in the outer ends of the axle housing. These bearings support the semi-floating axle shafts at the outer ends. The inner ends of the shafts spline to the differential side gears. Bearing retainer plates hold the shafts in the housing. The left and right axle shafts are not interchangeable, the left shaft being shorter than the right.

A metal tag stamped with the model designation and gear ratio is secured to all Ford-produced axles under one of the carrier-to-housing bolts. The first five spaces on the top line are reserved for the model designation letters such as WBS-AG, WBT-Z, or WBV-BC. These letters indicate a specific combination of

the following factors: conventional or locking axle; two or four-pinion differential; diameter of drive gear; small or large wheel bearings; and the gear ratio. It is important, therefore, to use the model designation for obtaining the correct replacement parts.

### OPERATION

The rear axle drive pinion receives its power from the engine through the transmission and drive shaft. The pinion gear rotates the differential case through engagement with the drive gear, which is bolted to the case outer flange. Inside the case, two differential pinion gears are mounted on the differential pinion shaft which is pinned to the case. These pinion gears are engaged with the side gears, to which the axle shafts are splined. Therefore, as the differential case turns, it rotates the axle shafts and rear wheels. When it is necessary for one wheel and axle shaft to rotate faster than the other, the faster turning side gear causes the pinions to roll on the slower turning side gear to allow differential action between the two axle shafts.

## LOCKING DIFFERENTIAL AXLE

### DESCRIPTION

The axle assembly, except for the differential case and its internal components, is identical to the conventional axle.

A constant-friction locking differential, which employs automatic transmission-type clutch plates to control differential action, is available as optional equipment (Fig. 2).

Three dog-eared steel clutch plates are locked into the differential cover. Two bronze, bonded clutch plates are splined to a clutch hub which, in turn, is splined to the left-hand axle shaft. Two Belleville spring washers maintain a constant pressure between the steel and bonded clutch plates so that the clutch is always engaged.

### OPERATION

The pressure between clutch plates opposes differential action at all times. When the car turns a corner the clutch "slips" allowing normal differential action to take place. Under adverse weather conditions, where one or both wheels may be on a low-traction surface such as snow, ice or mud, the friction between the clutch plates will transfer a portion of the usable torque to the wheel with the most traction. Thus, the wheel that is on ice or snow will not spin, but will have a tendency to operate with the opposite wheel in a combined driving effort.

When performing the following procedures, refer to Part 4-1, Section 3 for cleaning and inspection procedures.

## 2 IN-CAR ADJUSTMENT AND REPAIR

### REAR AXLE SHAFT, WHEEL BEARING AND OIL SEAL REPLACEMENT

The rear axle shafts, wheel bearings, and oil seal can be replaced without removing the differential assembly from the axle housing.

1. Remove the wheel and tire from the brake drum.
2. Remove the nuts that secure the brake drum to the axle flange, and then remove the drum from the flange.
3. Working through the hole provided in each axle shaft flange, remove the nuts that secure the wheel bearing retainer plate. Then pull the axle shaft assembly out of the axle housing (Fig. 3). **The brake carrier plate must not be dislodged. Install one nut to hold the plate in place after the axle shaft is removed.**
4. If the rear wheel bearing is to be replaced, loosen the inner retainer ring by nicking it deeply with a cold chisel in several places (Fig. 4). It will then slide off easily.
5. On a Ford model, remove the bearing from the axle shaft with the tool shown in Fig. 5. If the "push-puller" operation is used, be sure that the puller arms contact **the flat surface** of the axle shaft flange rather than the bolt heads. Also with this method, be careful not to damage or burr the oil seal journal as the bearing breaks loose.

On a Mercury, remove the bearing from the axle shaft with the tool shown in Fig. 6.

6. **Whenever a rear axle shaft is removed, the oil seal must be replaced.** Remove the seal with tool 1175-AB and a slide hammer (Fig. 7). Soak new oil seals in SAE 10 oil for ½ hour before installing.
7. Inspect the machined surface of the axle shaft and the axle housing for rough spots or other irregularities which would affect the sealing action of the oil seal. Check the axle shaft splines for burrs, wear or damage. Carefully remove any burrs or rough spots. Replace worn or damaged parts.
8. Lightly coat wheel bearing bores with ball joint grease (C1AZ-19590-A).

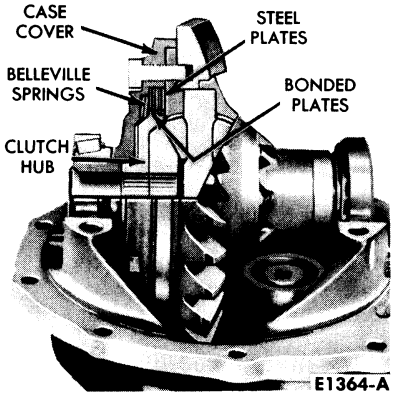



**FIG. 2—Locking Differential**

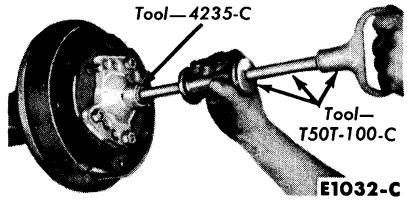



**FIG. 3—Axle Shaft Removal**

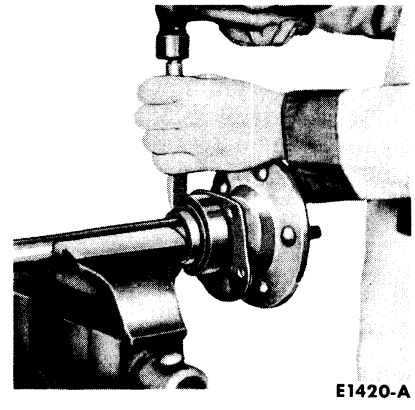
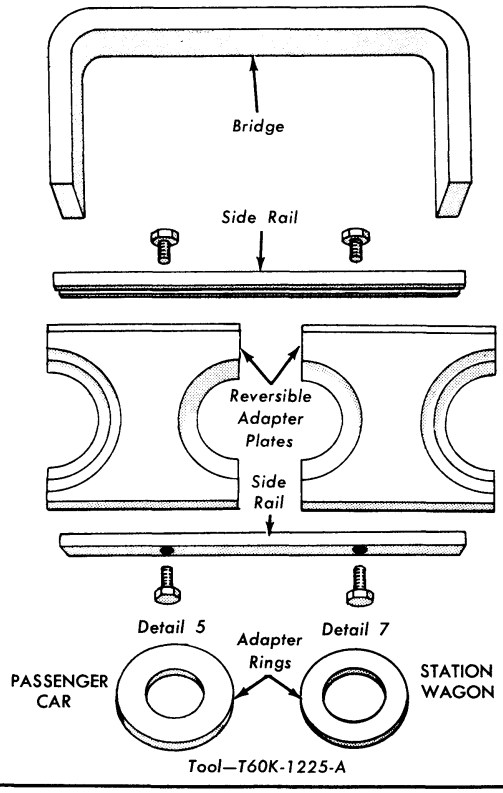
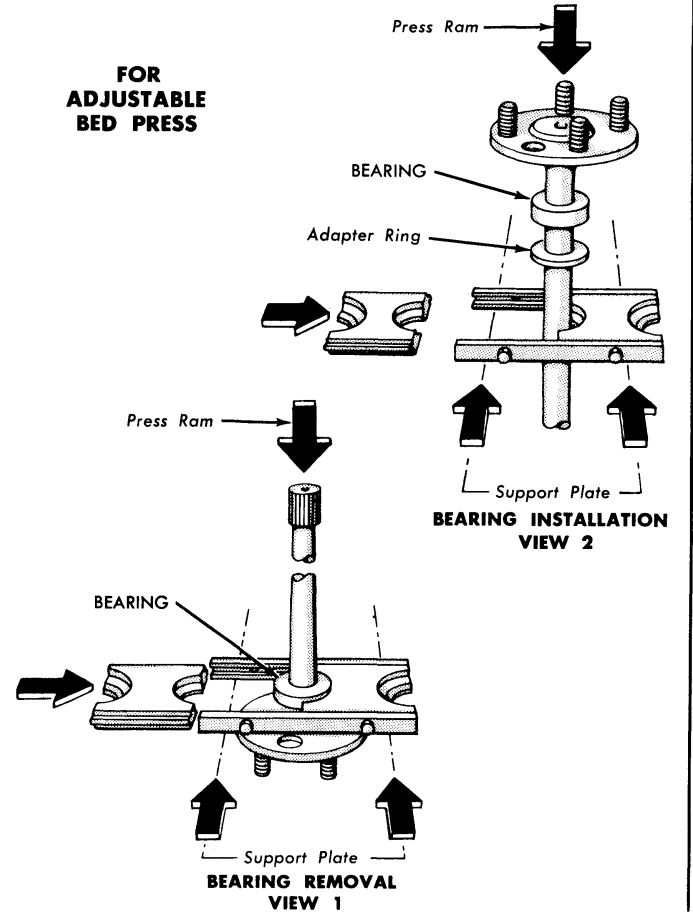
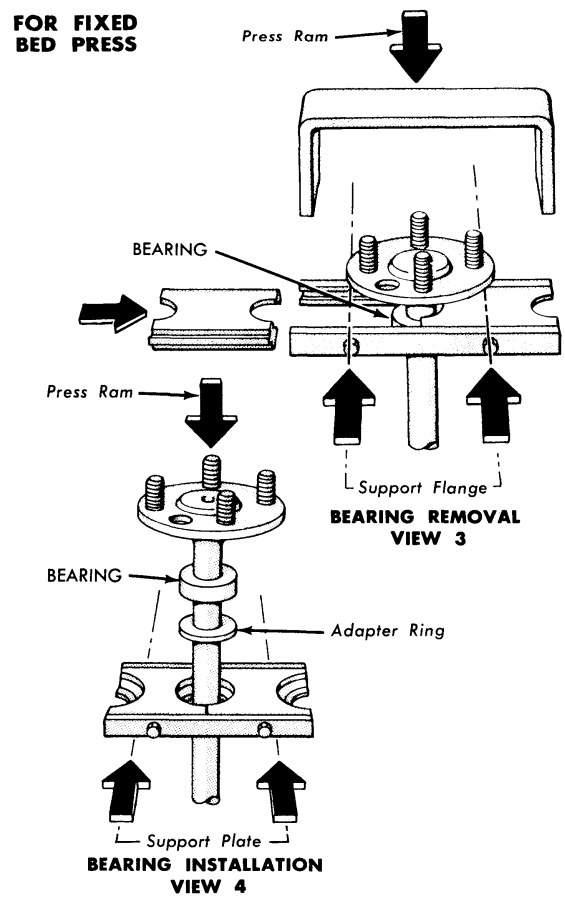



**FIG. 4—Rear Wheel Bearing Retainer Ring Removal**



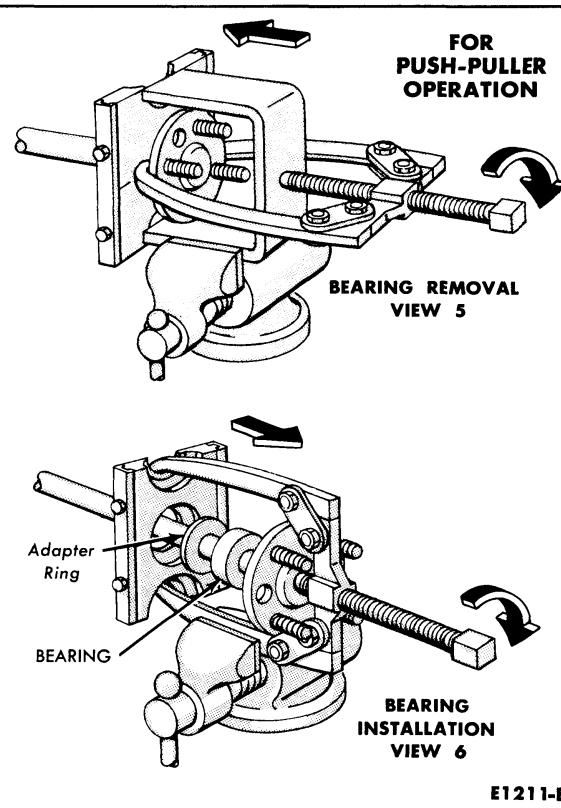




**FIG. 5—Wheel Bearing Removal and Installation—Ford**

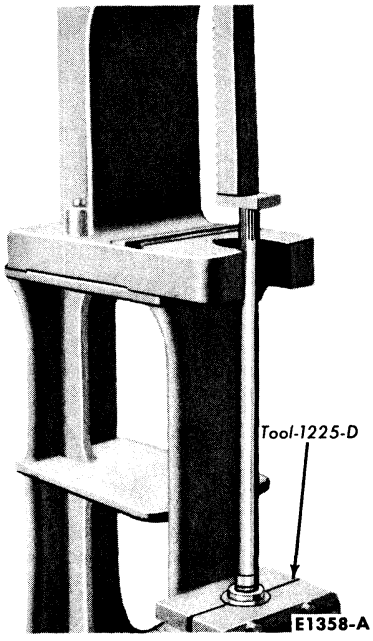



**FIG. 6—Wheel Bearing Removal —Mercury**

**9.** Place the retainer plate on the axle shaft, and press the new wheel bearing on the shaft with the tool shown in Fig. 5 (Ford model) or Fig. 8 (Mercury model). **Do not attempt to press on both the bearing and the inner retainer ring at the same time.**

**10.** Using the bearing installation tool (Ford–T60K-1225-A or Mercury–4234-4), press the bearing inner retainer ring on the shaft until the retainer seats firmly against the bearing.

**11.** Install the new oil seal with the tools shown in Fig. 9. **Be sure the new seal has been soaked in SAE 10 oil for ½ hour.** Wipe a small amount of oil resistant sealer on the outer edge of the seal before it is installed. **Do not put sealer on the sealing lip.**

**12.** Place a new gasket on each side of the brake carrier plate, and then carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the side gear, and push the shaft in until the bearing bottoms in the housing.

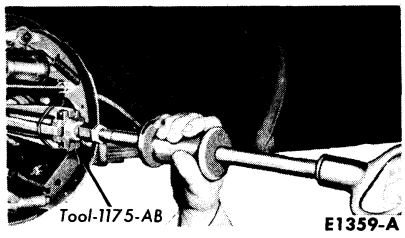



**FIG. 7—Rear Wheel Bearing Oil Seal Removal**

**13.** Install the bearing retainer plate and the nuts that secure it. Torque the nuts to specifications.

**14.** Install the brake drum and the drum retaining nuts.

**15.** Install the wheel and tire on the drum.

## DRIVE PINION OIL SEAL REPLACEMENT

The drive pinion oil seal can be replaced without removing the differential carrier assembly from the axle housing. Soak new seals in SAE 10 oil for ½ hour before use.

**1.** Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly (Fig. 10). Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the transmission group for the appropriate tool.

**2.** Make punch marks on the end of the pinion shaft, the pinion shaft nut, and the U-joint flange inner surface for realignment. While holding the flange with the tool shown in Fig. 16 (Ford) or Fig. 17 (Mercury), remove the integral pinion nut and washer.

**3.** Clean the pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the car higher than the rear.

**4.** Using the tool shown in Fig. 18 (Ford) or Fig. 19 (Mercury), remove the U-joint flange.

**5.** Using the tool shown in Fig. 20, remove the drive pinion oil seal.

**6.** Clean the oil seal seat.

**7.** Coat the outer edge of the new seal with a small amount of oil resistant sealer. **Do not put any of the sealer on the sealing lip.** Install the seal in the retainer, using the applicable tool shown in Fig. 37.

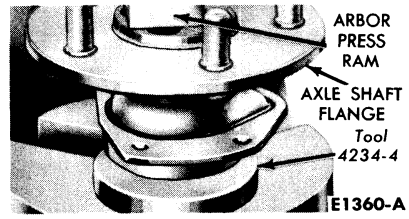



**FIG. 8—Wheel Bearing Installation—Mercury**

**8.** Install the U-joint flange using the tool shown in Fig. 38.

**9.** Install the integral retaining nut and washer on the pinion shaft. Tighten the nut until the punch mark on the nut is aligned with the punch marks on the end of the pinion shaft and on the inner surface of the U-joint flange.

**10.** Tighten the nut an additional ¼ turn beyond the alignment marks. Hold the flange with the tool shown in Fig. 16 (Ford) or Fig. 17 (Mercury) while the nut is being tightened.

**11.** Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.

**12.** Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange (Fig. 10).

**13.** Check the lubricant level, and add whatever amount of specified lubricant is necessary.

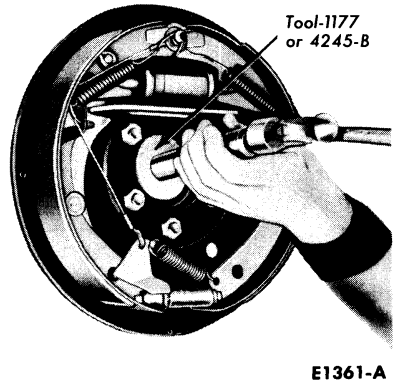



**FIG. 9—Rear Wheel Bearing Oil Seal Installation**

## 3 REMOVAL AND INSTALLATION

### CARRIER ASSEMBLY

#### REMOVAL

1. Raise the car on a hoist and remove the two rear wheel and tire assemblies.
2. Remove the two brake drums (3 Tinnerman nuts at each drum) from the axle shaft flange studs. If difficulty is experienced in removing the drums, back off the brake shoes as explained in Part 2-2.
3. Working through the hole provided in each axle shaft flange, remove the nuts that secure the rear wheel bearing retainer plate. Pull each axle shaft assembly out of the axle housing (Fig. 3). Install a nut on one of the brake carrier plate retaining bolts to hold the plate to the axle housing after the shaft has been removed. **Whenever a rear axle shaft is removed the wheel bearing oil seal must be replaced.** Remove both seals with tool 1175AB.
4. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position at assembly. Disconnect the drive shaft at the rear axle U-joint, remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the housing to prevent transmission leakage. Refer to the transmission group for the appropriate tool.
5. Place a drain pan under the carrier and housing, remove the carrier retaining nuts, and drain the axle. Remove the carrier assembly from the axle housing.

#### INSTALLATION

1. Clean the axle housing and shafts using kerosene and swabs. To avoid contamination of the grease in the sealed ball bearings, do not allow any quantity of solvent directly on the wheel bearings. Clean the mating surfaces of the axle housing and carrier.
2. Position the differential carrier on the studs in the axle housing using a new gasket between carrier and housing. Install the carrier-to-housing retaining nuts, and torque to specifications.
3. Remove the oil seal replacer tool from the transmission extension housing. Position the drive shaft so that the front U-joint slip yoke splines to the transmission output shaft.
4. Connect the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange during the removal procedure (Fig. 10). Install the U-bolts and nuts and torque to specifications.

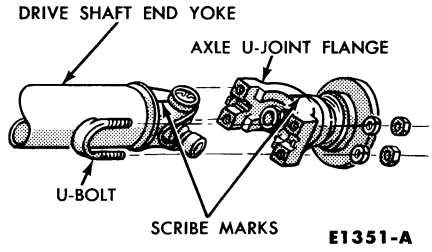



**FIG. 10—Drive Shaft-to-Axle U-Joint Connection**

5. Soak two new rear wheel bearing oil seals in SAE 10 oil for ½ hour before installation. Wipe a small amount of an oil resistant sealer on the outer edge of each seal before it is installed. **Do not put any of the sealer on the sealing lip.** Install the oil seals in the ends of the rear axle housing with tool 1177 or 1177-N.
6. Install the two axle shaft assemblies in the axle housing. The shorter shaft goes into the left side of the housing.

When installing an axle shaft, place a new gasket on each side of the brake carrier plate and carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the differential side gear, and push the shaft in until the bearing bottoms in the housing.

7. Install the bearing retainers on the attaching bolts on the axle housing flanges. Install the nuts on the bolts and torque to specifications.
8. Install the two rear brake drums and the drum retaining nuts.
9. Install the rear weel and tire assemblies.
10. If the rear brake shoes were backed off, adjust the brakes as outlined in Part 2-1.
11. Fill the rear axle with specified lubricant.

### AXLE HOUSING

#### REMOVAL

1. Remove the carrier assembly from the axle housing as outlined in the foregoing procedure.
2. Position safety stands under the rear frame members.
3. Disengage the brake line from the clips that retain the line to the axle housing.
4. Disconnect the vent tube from the rear axle housing.
5. Remove the brake carrier plate assemblies from the axle housing, and support them with wire. Do not disconnect the brake line.
6. Disconnect each rear shock absorber from the spring clip plate and position out of the way.
7. Lower the rear axle slightly to reduce some of the spring tension. At each rear spring, remove the spring clip (U-bolt) nuts, spring clips, and spring clip plate. Remove the spring lower insulator and retainer. See Part 3-2.
8. Remove the rear axle housing from under the car.

#### INSTALLATION

1. Install new rear wheel bearing oil seals in the ends of the rear axle housing with tool 1177 or 1179N. New seals should be soaked in SAE 10 oil for ½ hour before use.
2. Position the rear axle housing on the rear springs. Position the spring upper insulators and retainers between the axle housing and springs with the retainer flange forward.
3. Install the lower insulators and insulator retainers (Flange to the rear), and then install the spring clips (U-bolts), spring clip plate, and nuts. **Torque the spring clip nuts evenly to specifications. Make sure that the lower insulator retainer contacts the upper retainer.**
4. If a new axle housing is being installed, remove the bolts that retain the carrier plate and bearing retainer from the old housing flanges. Position the bolts in the new housing flanges to hold the brake carrier plates in position. Install the carrier plates with new gaskets to the axle housing flanges.
5. Connect the vent tube to the axle housing.
6. Position the brake line to the axle housing, and secure with the retaining clips.
7. Raise the rear axle housing and springs enough to allow connecting the rear shock absorbers to the spring clip plates. Connect the lower stud of

each shock absorber to its spring clip plate, and install the bushing, washer, and nut on the stud. **Be sure the spring clip plate is free of burrs. Tighten the nut to specified torque.**

8. Install the carrier assembly and the two axle shaft assemblies in the axle housing as outlined in this section.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

After mounting the carrier in a holding fixture, perform the "Inspection Before Disassembly of Carrier" as explained in Part 4-1, Section 3. Then disassemble the carrier as outlined in the following procedures.

### REMOVAL AND DISASSEMBLY OF CONVENTIONAL DIFFERENTIAL CASE

1. Mark one differential bearing cap and the mating bearing support with punch marks to help position the parts properly during assembly of the carrier. Also, mark one of the bearing adjusting nuts and the carrier with scribe marks for proper location during assembly.

2. Remove the adjusting nut locks, bearing caps, and adjusting nuts. Then lift the differential assembly out of the carrier.

3. Remove the differential bearings with the tool shown in Fig. 11 for a Ford model, or the tools shown in Fig. 12 for removing the differential bearings from a Mercury.

4. Mark the differential case, cover, and drive gear for assembly in the original position.

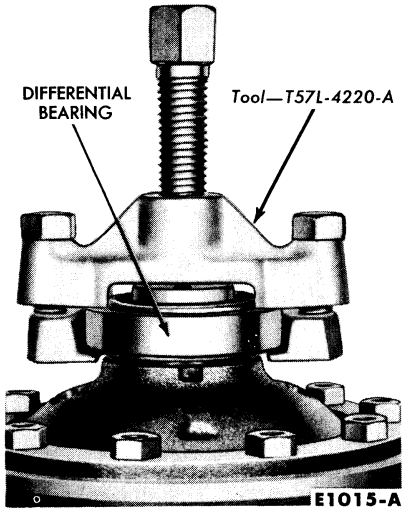



**FIG. 11—Differential Bearing Removal—Ford**

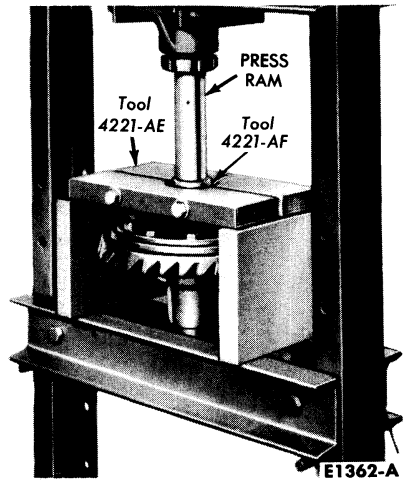



**FIG. 12—Differential Bearing Removal—Mercury**

5. Remove the bolts that attach the drive gear to the differential case. Press the gear from the case or tap it off with a soft-faced hammer.

6. With a drift, drive out the differential pinion shaft lock pin (Fig. 13), and separate the 2-piece differential case.

7. Drive out the pinion shaft with a brass drift (Fig. 14).

8. Remove the gears and thrust washers (Fig. 40).

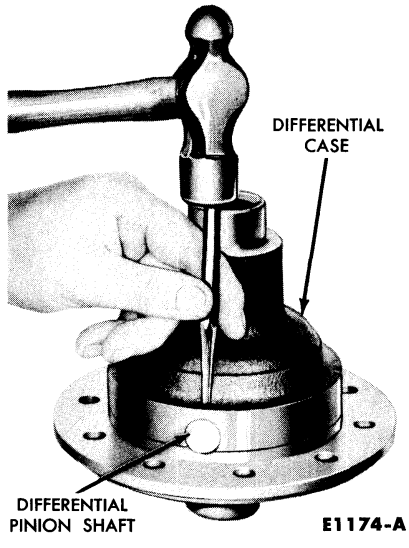



**FIG. 13—Differential Pinion Shaft Lock Pin Removal**

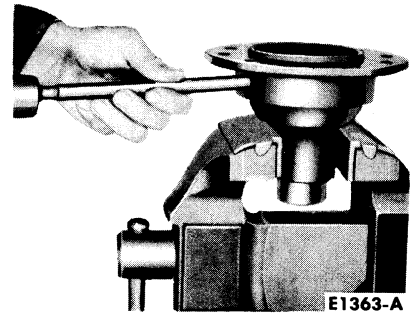



**FIG. 14—Driving Out Differential Pinion Shaft**

### REMOVAL AND DISASSEMBLY OF LOCKING DIFFERENTIAL CASE

1. Remove the differential case from the carrier and remove the bearings from the differential as outlined in steps 1 through 4 in the foregoing procedure.

2. Loosen **alternate** drive gear attaching bolts **evenly** to release the spring pressure between the differential case and cover. A hydraulic press can be used to contain the spring pressure while the bolts are removed. Apply about one ton pressure across the case bearing hubs while the drive gear bolts are removed. This will pre-

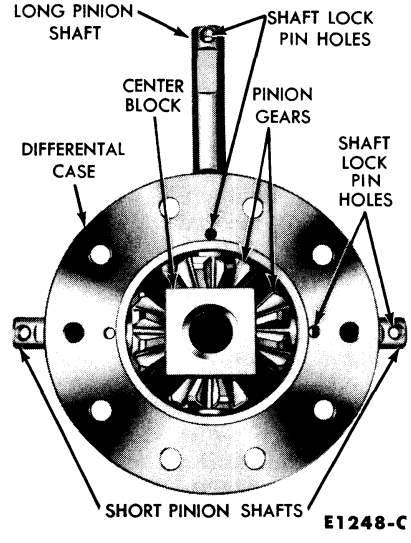



**FIG. 15—Four Pinion Differential**

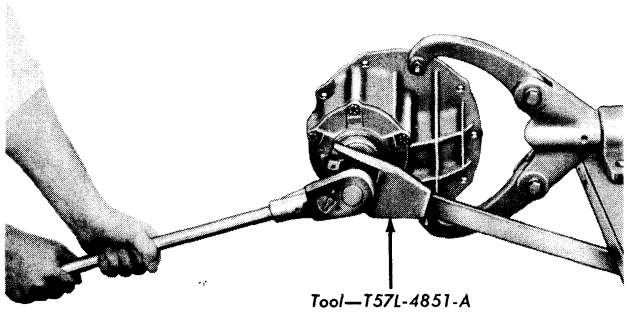



FIG. 16—Pinion Shaft Nut Removal—Ford

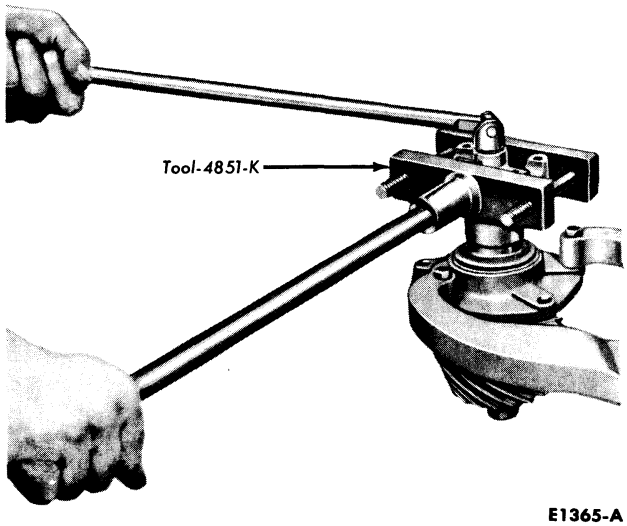



FIG. 17—U-Joint Flange Holding Tool—Mercury

vent stripping the bolt threads.

3. Release the hydraulic press ram, and remove the differential case cover.

4. Remove the two Belleville springs (Fig. 44).

5. Remove the steel and the bonded clutch plates.

6. Remove the differential clutch hub, side gear, and thrust washer.

7. Remove the drive gear from the differential case.

8. Drive out the differential pinion shaft lock pin.

9. With a brass drift, drive out the differential pinion shaft. Then remove the pinion gears and thrust washers.

## REMOVAL AND DISASSEMBLY OF 4-PINION DIFFERENTIAL CASE

1. Remove the differential case from the carrier, and remove the side bearings and drive gear from the case as outlined in steps 1 through 5 under "Removal and Disassembly of Conventional Differential Case."

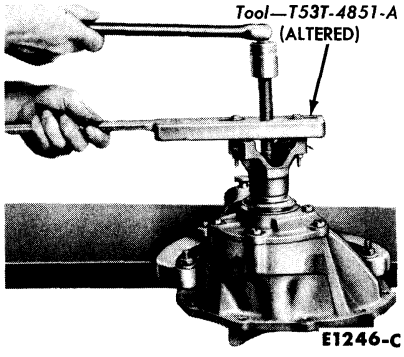



FIG. 18—U-Joint Flange Removal

2. Drive out the three differential pinion shaft lock pins with a drift, and separate the 2-piece differential case.

3. With a brass drift, drive out the long pinion shaft. Drive from the end opposite the retainer hole (Fig. 15).

4. Remove the two short pinion shafts. Using a drift, drive each shaft from the center outward.

5. Lift out the center block, and remove the gears and thrust washers.

## REMOVAL AND DISASSEMBLY OF DRIVE PINION AND BEARING RETAINER

1. Turn the carrier assembly upright and remove the pinion shaft nut (Fig. 16). On a Ford model, use the tool shown in Fig. 16. On a Mercury, leave the carrier mounted in the fixture as shown in Fig. 16, but use the tool shown in Fig. 17.

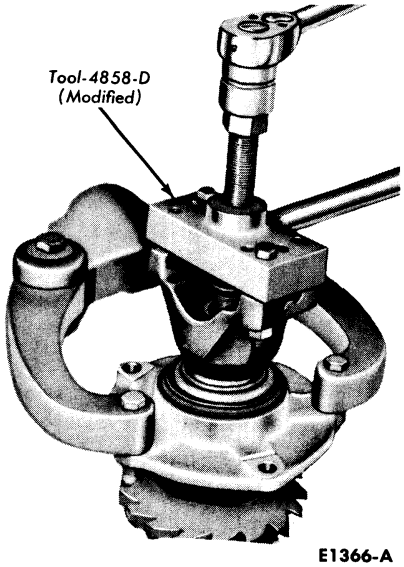



FIG. 19—Flange Removal Tool —Mercury

2. Remove the U-joint flange from the pinion shaft (Fig. 18). On a Ford model, use the tool shown in Fig 18. On a Mercury, leave the case mounted in the fixture as shown in Fig. 18, but use the tool shown in Fig. 19.

3. Remove the pinion seal (Fig. 20) and the slinger.

4. Remove the pinion, bearing, and retainer assembly from the carrier housing (Fig. 36). Measure the shim thickness with a micrometer. Record this original shim thickness. If a new gear set is installed during assembly, a new shim will have to be installed. The original shim thickness is one of the factors necessary in calculating the new shim thickness. **Extreme care must be taken not to damage the mounting surfaces of the retainer and carrier.**

5. Place a protective sleeve (hose) on the pinion pilot bearing surface.

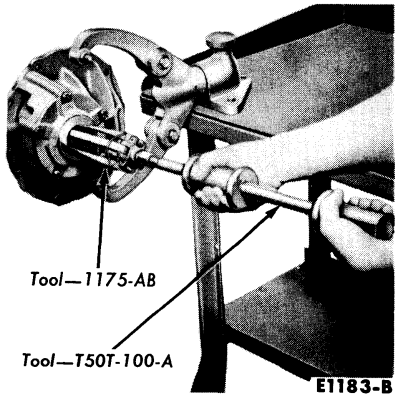



FIG. 20—Pinion Seal Removal

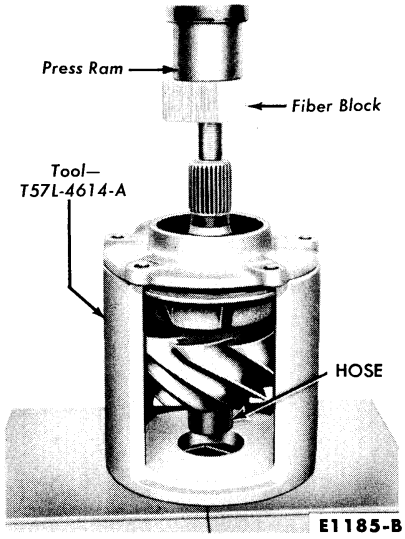



**FIG. 21—Pinion Front Bearing Cone Removal—Ford**

Press the pinion shaft out of the pinion front bearing cone. On a Ford model, use the tool shown in Fig. 21. On a Mercury, use the press and blocks as shown in Fig. 22.

**6.** Press the pinion shaft out of the pinion rear bearing cone (Fig. 23 or Fig. 24).

### PARTS REPAIR OR REPLACEMENT

Clean and inspect all the parts as outlined in Part 4-1, Section 3. Before assembling the carrier, repair or replace all parts as indicated by the inspection.

The principal replacement operations are covered in the following procedures. All other repair or replacement operations are performed during "Cleaning and Inspection" Part 4-1, Section 3, or during the "Assembly of the Carrier" in this section.

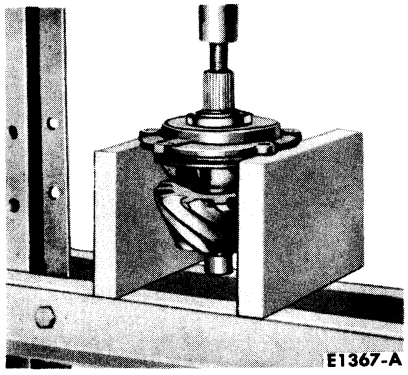



**FIG. 22—Pinion Front Bearing Cone Removal—Mercury**

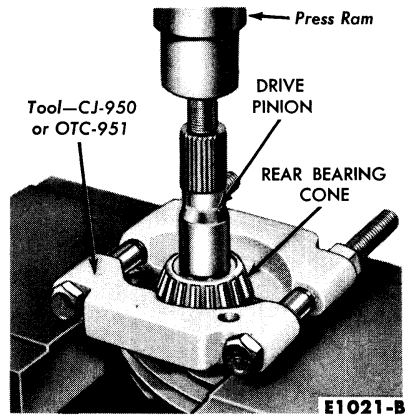



**FIG. 23—Pinion Rear Bearing Cone Removal—Ford**

### PILOT BEARING

**1.** Remove the pilot bearing as shown in Fig. 25. Drive out the pilot bearing and the bearing retainer together.

**2.** Drive the new bearing in until it bottoms as shown in Fig. 26.

**3.** Using the same tool, install a **new** pilot bearing retainer with the concave side up.

### PINION BEARING CUPS

**Do not remove the pinion bearing cups from the retainer unless the cups are worn or damaged.** The flange and pilot of the retainer are machined during manufacture by locating on these cups after they are installed in their bores. If the cups are worn or damaged, they should be removed and replaced as shown in Figs. 27, 28, 29, and 30.

After the new cups are installed,

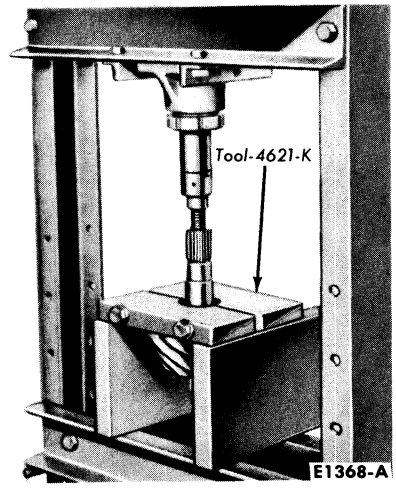



**FIG. 24—Pinion Rear Bearing Cone Removal—Mercury**

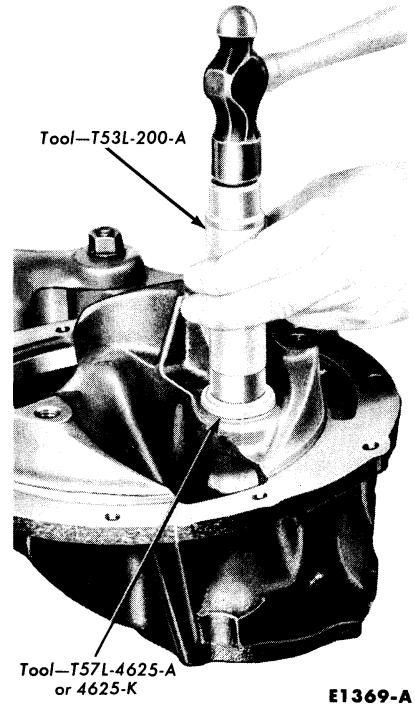



**FIG. 25—Pilot Bearing Removal**

make sure they are seated in the retainer by trying to insert a 0.0015-inch feeler gauge between the cup and the bottom of the bore.

Whenever the cups are replaced, the cone and roller assemblies should also be replaced.

### DRIVE PINION AND GEAR SET

When replacing a drive gear and pinion, note that the orginal factory installed shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the orginal gear set dimension. Therefore, to select the

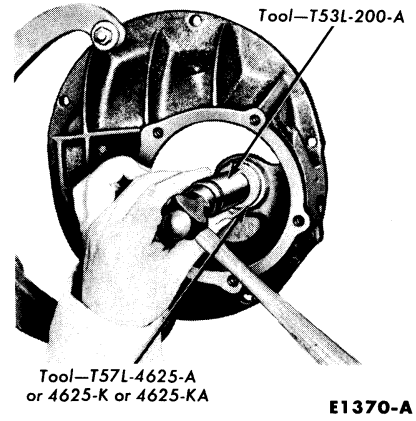



**FIG. 26—Pilot Bearing Installation**

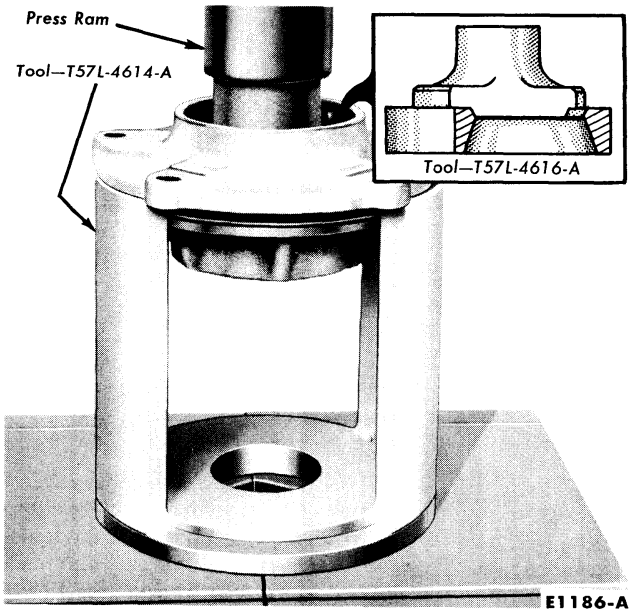



FIG. 27—Pinion Bearing Cup Removal—Ford

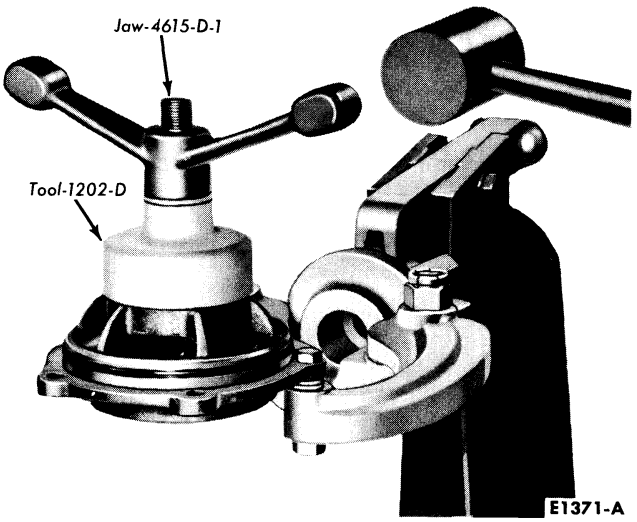



FIG. 28—Pinion Bearing Cup Removal—Mercury

correct shim thickness for the new gear set to be installed, follow these steps:

1. Measure the thickness of the **original shim** with a micrometer.

2. Note the shim adjustment number on both the old pinion and the new pinion. Each pinion gear is marked with an adjustment number such as the +1 marking in Fig. 31.

3. Refer to Part 4-3 to determine the correct amount of shim thickness change. The amount shown in the table under the old pinion shim adjustment number and in line with the new pinion number is the amount of **change** that should be made to the **original** shim thickness.

If the old pinion is marked +4, for example, and the new pinion is marked −2, the table indicates that 0.006 inch of shim stock should be removed from the **original** shim pack.

If the **original** shim pack was lost or if a new carrier housing is being installed, substitute a **nominal** 0.020-inch shim for the **original,** and follow the foregoing procedure for a trial build-up. If any further shim change is necessary, it will be indicated in the tooth pattern check.

A new drive gear and pinion should always be installed in an axle as a matched set (never separately). **Be sure that the same matching number appears on both the drive pinion and the drive gear.** Note the number "170" in Fig. 31.

4. After determining the correct shim thickness as explained in the foregoing steps, install the new pinion and drive gear as outlined under "Assembly".

## DIFFERENTIAL CASE, BEARINGS AND DRIVE GEAR

If the drive gear runout check (be-

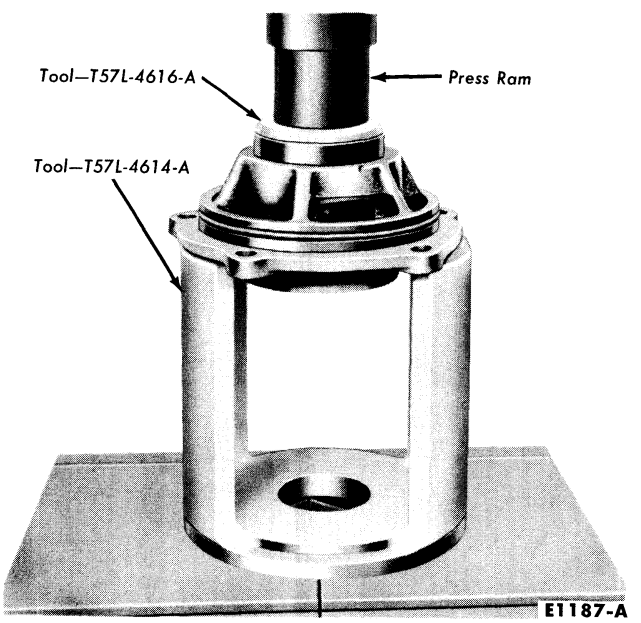



FIG. 29—Pinion Bearing Cup Installation—Ford

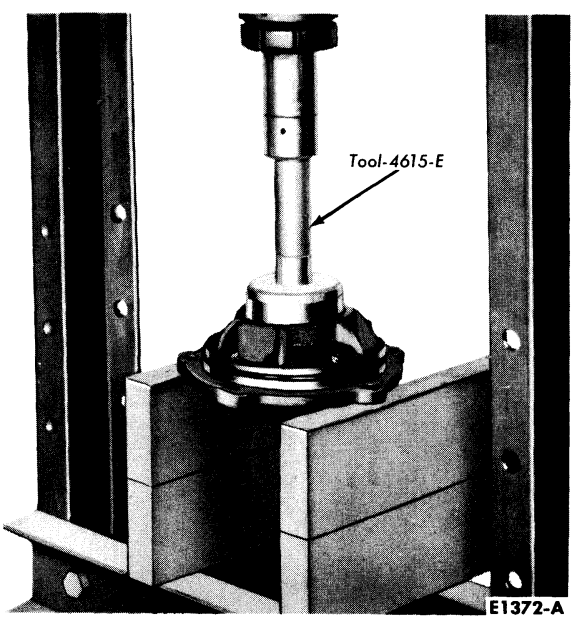



FIG. 30—Pinion Bearing Cup Installation—Mercury

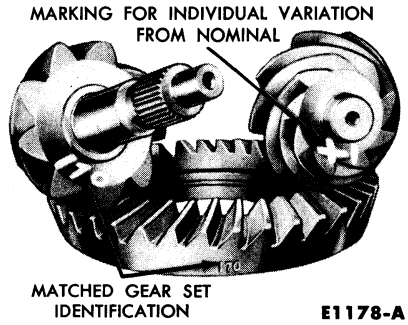



**FIG. 31—Pinion and Drive Gear Markings**

fore disassembly) exceeded specifications, the condition may be caused by a warped gear, a defective case, or excessively worn differential bearings.

To determine the cause of excessive runout proceed as follows:

**1.** Assemble the two halves of the differential case together **without** the drive gear, and press the two differential side bearings on the case hubs.

**2.** Place the cups on the bearings and set the differential case in the carrier.

**3.** Install the bearing caps and adjusting nuts as outlined in steps 11 thru 14 under "Assembly and Installation of Conventional Differential Case" in this section.

**4.** Tighten the right-hand nut two notches beyond the position where it first contacts the bearing cup. Rotate the differential case several revolutions in each direction while the bearings are loaded to seat the bearings in their cups. **This step is important.**

**5.** Again loosen the right hand nut to release the preload. Check to see that the left hand nut contacts the bearing cup. Then set a preload of 2½ to 3 notches tight at the right hand nut.

**6.** Check the runout of the differential case flange with a dial indicator. If the runout does **not now** exceed specifications, install a new drive gear. If the runout still exceeds specifications, the drive gear is true and the trouble is due to either a defective case or worn bearings.

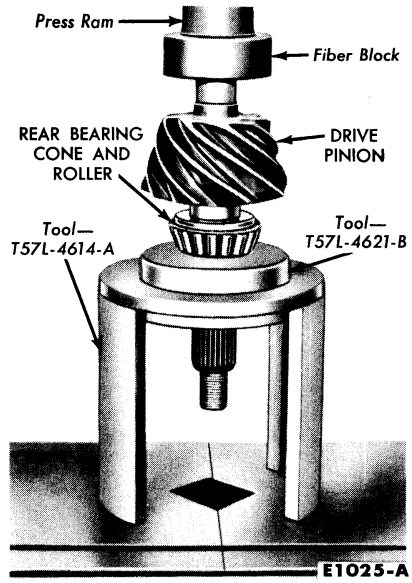



**FIG. 32—Pinion Rear Bearing Cone Installation—Ford**

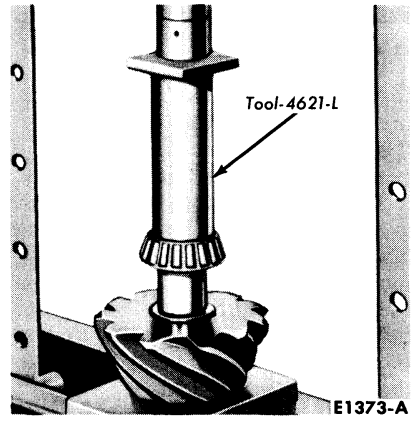



**FIG. 33—Pinion Rear Bearing Cone Installation—Mercury**

**7.** Remove the differential case from the carrier and remove the side bearings from the case.

**8.** Install **new** bearings on the case hubs, and again install the differential assembly in the carrier **without** the drive gear.

**9.** Check the case runout again with the new bearings. If the runout is **now** within limits, the old bearings were excessively worn. Use the new bearings for assembly. If the runout is still excessive, the case is defective and should be replaced.

## ASSEMBLY

### ASSEMBLY AND INSTALLATION OF DRIVE PINION AND BEARING RETAINER

**1.** Install the drive pinion rear bearing cone and roller on the pinion shaft. On a Ford model, use the tools shown in Fig. 32. On a Mercury, use the tool shown in Fig. 33. Place a new spacer on the pinion shaft (Fig. 34).

**2.** Place the bearing retainer on the pinion shaft, and install the front bearing cone and roller. Press the

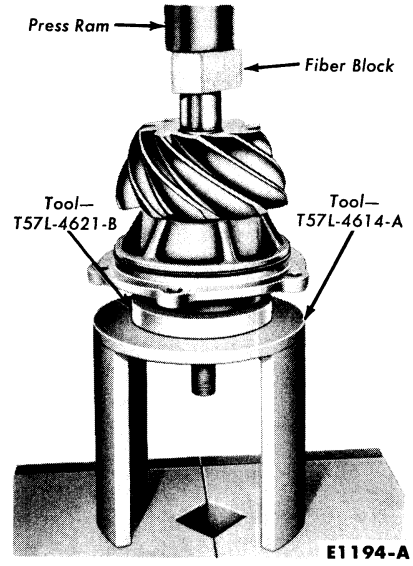



**FIG. 35—Pinion Front Bearing Installation**

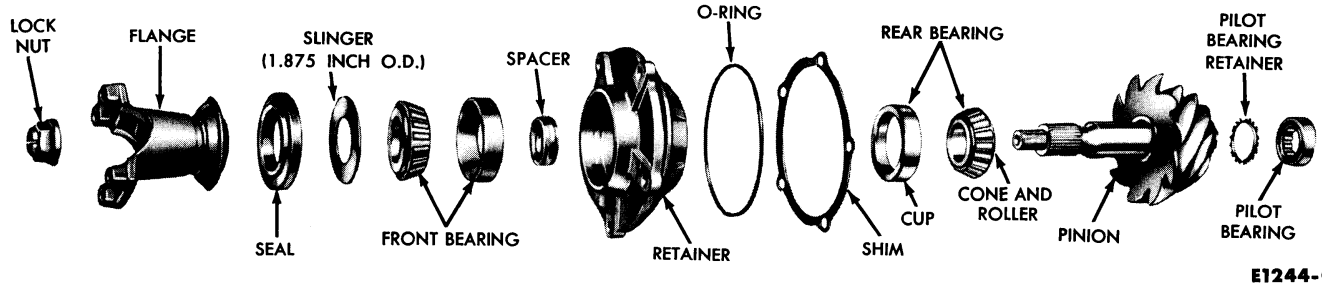



**FIG. 34—Pinion and Bearing Retainer**

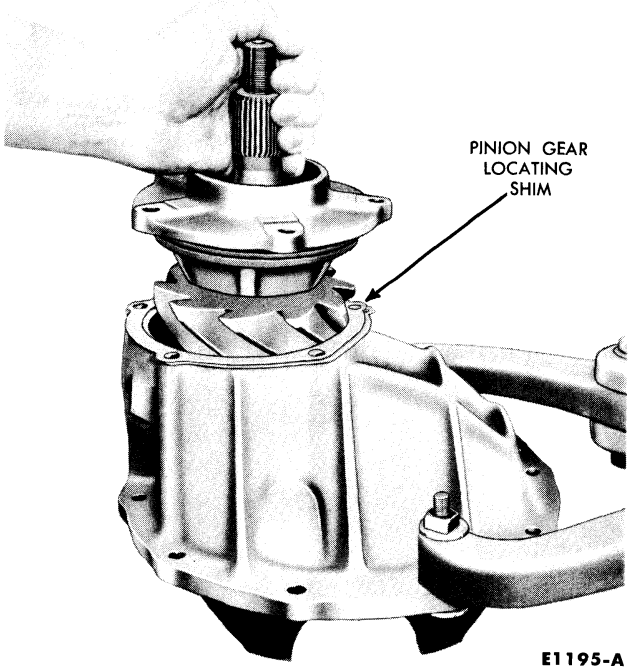



**FIG. 36—Pinion and Retainer Assembly Removal or Installation**

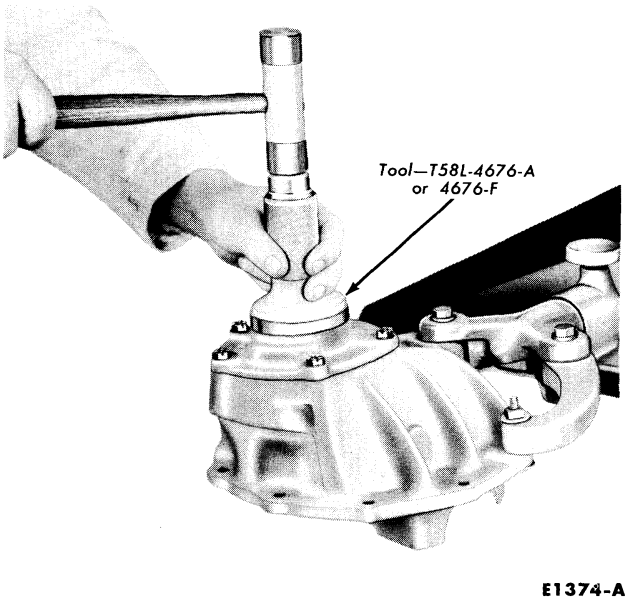



**FIG. 37—Oil Seal Installation**

front bearing cone and roller into position as shown in Fig 35. Be careful not to crush the bearing spacer.

**3.** Lubricate the O-ring with axle lubricant and install it in its groove in the pinion retainer. Be careful not to twist it. Snap the O-ring into position.

**4.** Place the proper shim on the carrier housing and install the pinion and retainer assembly, being careful not to pinch the O-ring (Fig. 36).

**5.** Install the pinion retainer bolts. Torque the bolts to specification.

**6.** Place the slinger over the pinion shaft and against the front bearing.

**7.** Coat the outside edge of a new oil seal with a small amount of an oil resistant sealer. **Do not put any of the sealer on the sealing lip.** Install the seal in the bearing retainer (Fig. 37). New seals should be soaked in SAE 10 oil for ½ hour before use.

**8.** Install the U-joint flange (Fig. 38).

**9.** Start a new integral nut and washer on the pinion shaft.

**10.** Hold the flange with the tool shown in Fig. 16 (Ford) or Fig. 17 (Mercury), and torque the pinion shaft nut to 175 ft-lbs. **Do not exceed 175 ft-lbs at this time.**

**11.** Check the pinion bearing preload as shown in Fig 39. If an inch-pound torque wrench is not available, tool 4209-C may be used in combination with tool 4209-C12. Correct preload will be obtained when the torque required to rotate the pinion in the retainer is as specified in Part 4-3. If the torque required to rotate the pinion is less than specified, tighten the pinion shaft nut a little at a time until the proper preload is established. **Do not overtighten the nut.** If excessive preload is obtained as a result of overtightening, replace the collapsible bearing spacer.

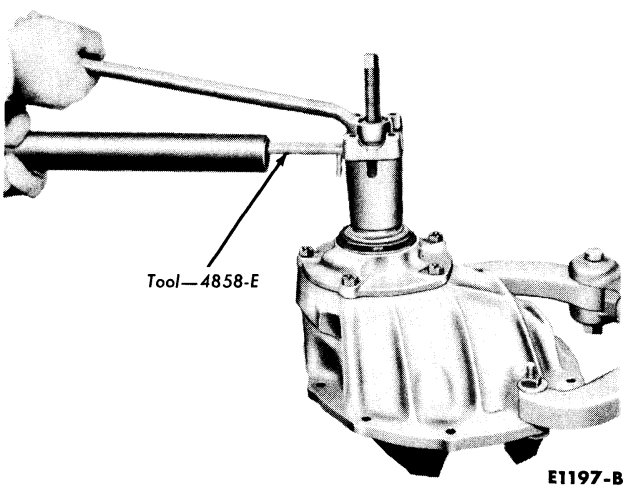



**FIG. 38—U-Joint Flange Installation**

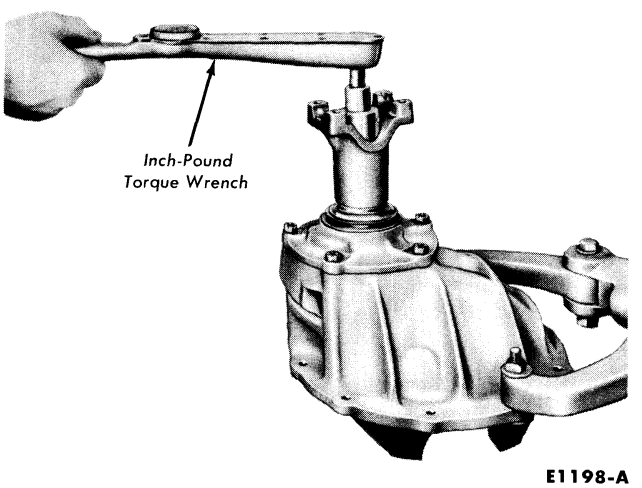



**FIG. 39—Pinion Bearing Preload Check**

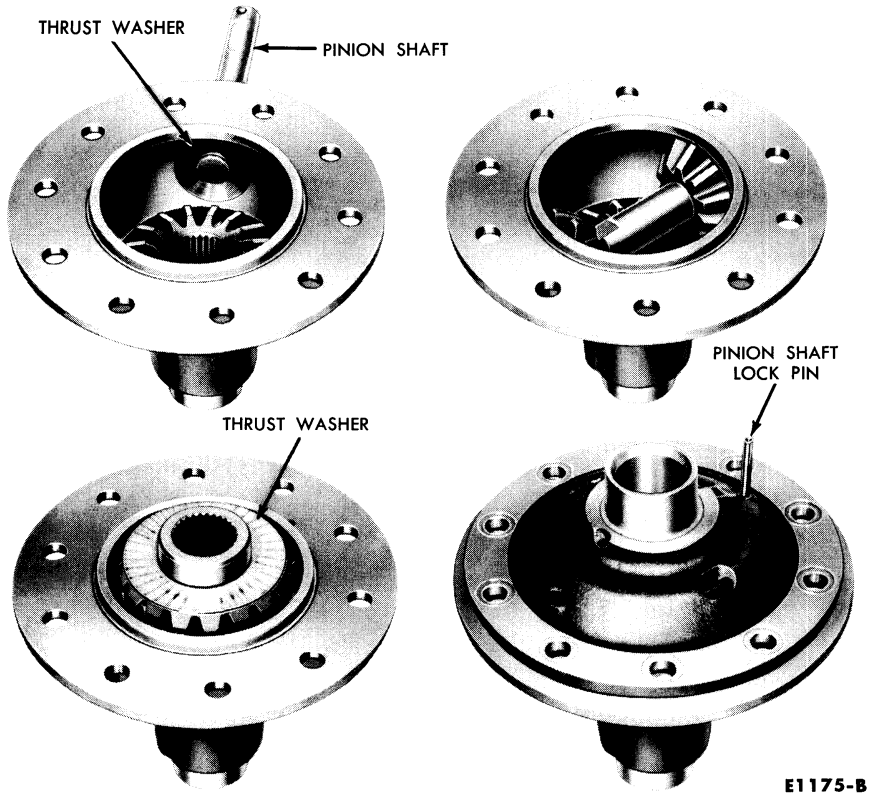



**FIG. 40—Assembly of Differential Case**

**Do not back off the pinion shaft nut to establish pinion bearing preload.** If the torque on the pinion shaft nut is less than 175 ft-lbs. after bearing preload is established, a new collapsible spacer must be used.

### ASSEMBLY AND INSTALLATION OF CONVENTIONAL DIFFERENTIAL CASE

**1.** Place a side gear and thrust washer in the differential case bore (Fig. 40). **Lubricate all differential parts liberally with axle lubricant during assembly.**

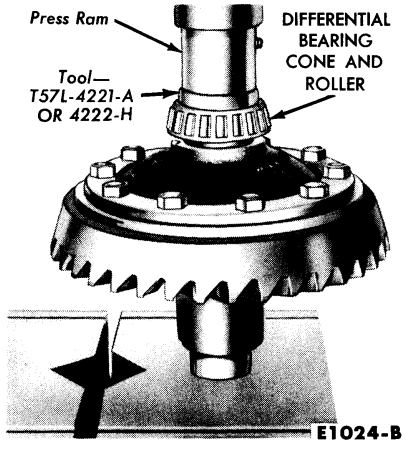



**FIG. 41—Differential Bearing Installation—Ford**

**2.** With a soft-faced hammer, drive the pinion shaft into the case only far enough to retain a pinion thrust washer and pinion gear.

**3.** Place the second pinion and thrust washer in position, and drive the pinion shaft into place. **Carefully line up the pinion shaft lock pin holes.**

**4.** Place the second side gear and thrust washer in position (Fig. 40), and install the cover on the differential case. Install the pinion shaft lock pin. A pinion or axle shaft spline can be inserted in the side gear spline to check for free rotation of the differential gears.

**5.** Insert two 7/16 (N. F.) bolts two inches long through the differential case flange, and thread them three or four turns into the drive gear as a guide in aligning the drive gear bolt holes. Press or tap the drive gear into position.

**6.** Install and tighten the drive gear bolts and washers evenly, and torque them alternately across the gear to specification.

**7.** If the differential bearings have been removed, press them on as shown in Fig. 41 (Ford) or 42 (Mercury).

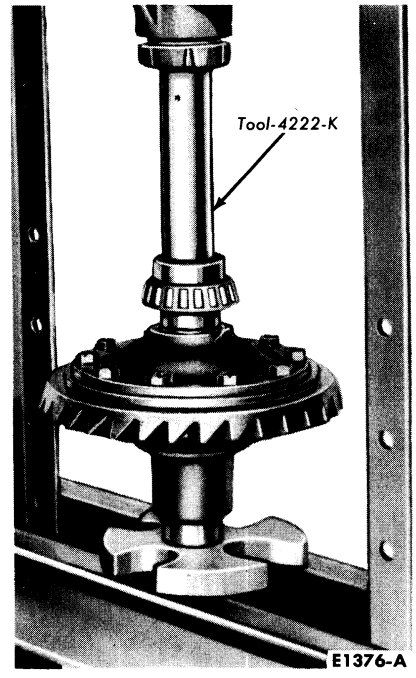



**FIG. 42—Differential Bearing Installation—Mercury**

**8.** Wipe a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.

**9.** Place the cups on the bearings. If the gear set is of the **non-hunting** or **partial non-hunting** type, assemble the differential case and drive gear assembly in the carrier so that the marked tooth on the pinion indexes between the marked teeth on the drive gear as shown in Fig. 43.

**In almost every case of improper assembly (gears assembled out of time), the noise level and probability of failure will be higher than they would be with properly assembled gears.**

When installing the **hunting** type gear set (no "timing marks"), assemble the differential case and drive gear assembly in the carrier without regard to the matching of any particular gear teeth.

**10.** Slide the assembly along the bores until a slight amount of backlash is felt between the gear teeth.

**11.** Set the adjusting nuts in the bores so that they just contact the bearing cups. The nuts should be engaged about the same number of threads on each side.

**12.** Carefully position the bearing caps on the carrier. Match the marks made when the caps were removed.

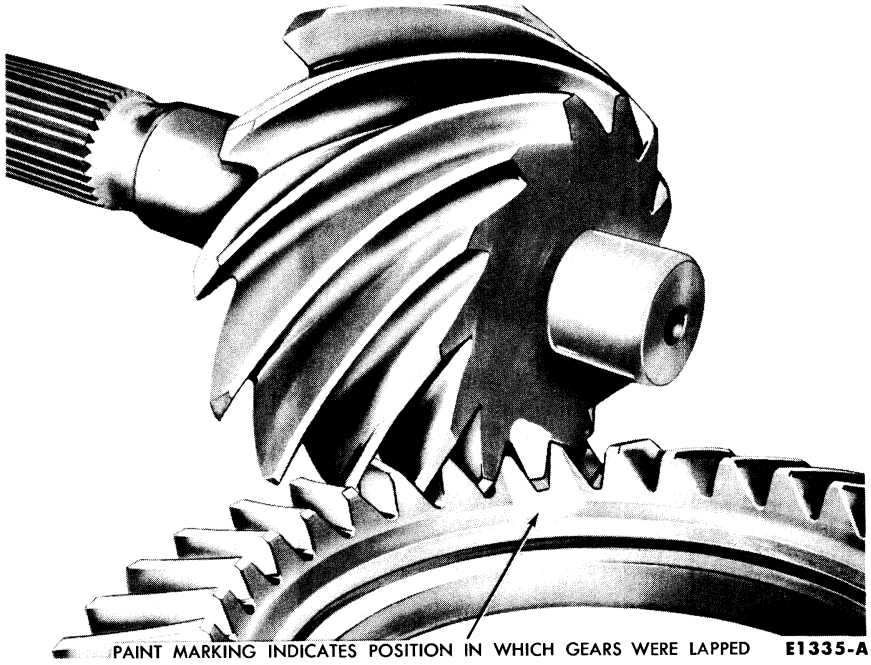



**FIG. 43—Gear Set Timing Marks**

**13.** Install the bearing cap bolts and alternately torque them to 70-80 ft-lbs.

**14.** If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and again inspect for damaged threads or incorrectly positioned caps. Tightening the bolts to the specified torque is done to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 25 ft-lbs. before making adjustments.

**15.** Adjust the backlash between the drive gear and pinion as outlined in Part 4-1, Section 2.

**16.** Be sure to make a final tooth pattern check before installing the carrier assembly in the axle housing.

## ASSEMBLY AND INSTALLATION OF LOCKING DIFFERENTIAL CASE

**1.** Place the side gear and thrust washer in the differential case (Fig. 44). **Lubricate all parts liberally with axle lubricant during assembly.**

**2.** With a soft-faced hammer, drive the pinion shaft into the case only far enough to retain a pinion thrust washer and pinion gear.

**3.** Place the second pinion and thrust washer in position, and drive the pinion shaft into place. **Carefully line up the pinion shaft lock pin holes.**

**4.** Install the pinion shaft lock pin. **The lock pin must not extend beyond the surface of the case.**

**5.** Insert two 2-inch 7/16 (N. F.) bolts through the differential case flange, and thread them three or four turns into the drive gear as a guide in aligning the drive gear bolt holes. Press or tap the drive gear into position.

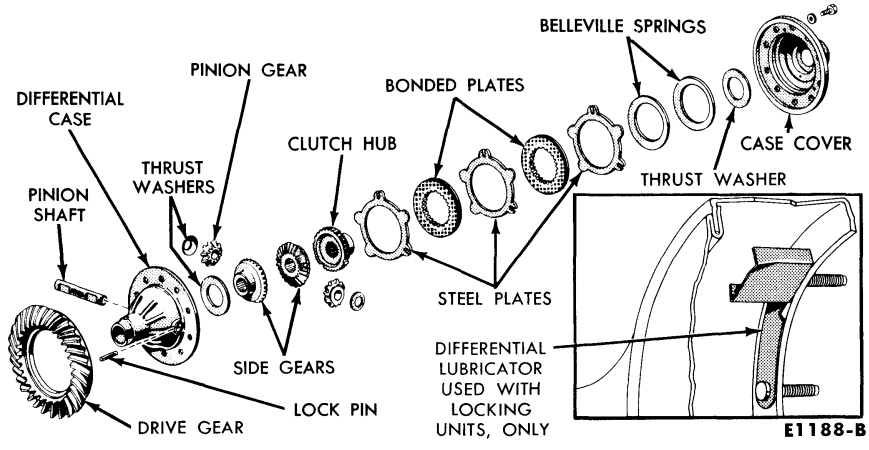



**FIG. 44—Locking Differential Assembly**

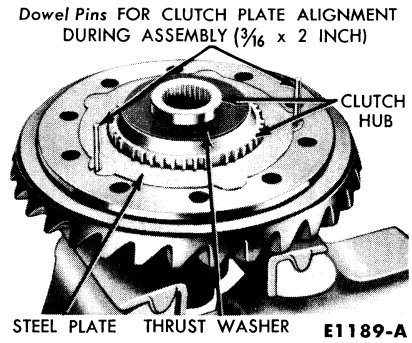



**FIG. 45—Clutch Plate Installation**

**6.** Clamp the differential case in a soft-jawed vise. Install the differential side gear on the differential pinion gears. Place the clutch hub on the side gear. Place the thrust washer on the hub (Fig. 45).

**7.** To align the clutch plates during assembly, insert two 3/16 x 2 dowel pins into the differential case. Place a steel plate on the differential case so that the slots in the dog ears straddle the dowel pin (Fig. 45). **Lubricate all the locking differential parts with axle lubricant so that an accurate torque check can be made.**

**8.** Place a bonded plate on the steel plate. Make sure the bonded plate inner spline teeth properly engage the hub spline. Assemble the remaining plates: a steel plate, a bonded plate, and lastly a steel plate.

**9.** Place the two Belleville springs on the top steel plate. Both Belleville springs are assembled with their concave sides down (Fig. 46). Carefully center the Belleville springs so that they will fit into the cover.

**10.** Place the differential case cover

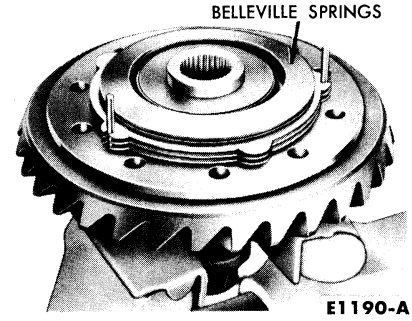



**FIG. 46—Belleville Spring Installation**

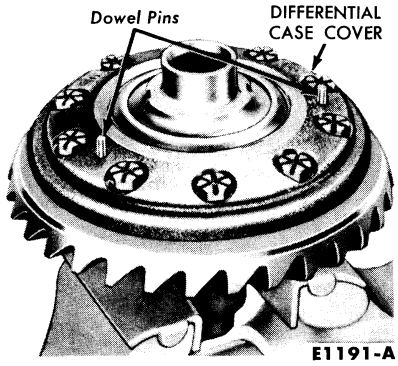



**FIG. 47—Differential Cover Installation**

on the case (Fig. 49). Start the drive gear bolts.

**11.** Tighten the bolts evenly and alternately across the diameter of the drive gear. As the bolts are tightened the Belleville springs are compressed and the differential case and cover are pulled together.

**12.** Remove the dowel pins.

**13.** Torque the case to drive gear bolts to specifications.

**14.** Check the torque required to rotate one side gear while the other side gear is held (Fig. 48). Ignore the torque required to start the side gear turning. The torque required to keep it moving steadily should be between 155 and 195 ft-lbs, if new clutch plates were installed. The torque should be over 100 ft-lbs, if the original clutch plates were installed. If the required torque is not within these limits, check for improper assembly.

**15.** Install the side bearings on the differential case, and install the case in the carrier as described in steps 7 through 16 under "Assembly and Installation of Conventional Differential Case".

### ASSEMBLY AND INSTALLATION OF 4-PINION DIFFERENTIAL CASE

**Lubricate all parts thoroughly with axle lubricant during assembly.**

**1.** Place a thrust washer and side gear in the differential case bore.

**2.** Install the four thrust washers, and place the pinion gears on the side gear. Align the washers and pinion gears with the pinion shaft holes in the case (Fig. 15).

**3.** Install the center block so that its four small diameter holes are aligned with the holes in the pinion gears and in the case.

**4.** With a brass drift, drive in the two short pinion shafts from the outside of the case (Fig. 15). **Be sure to align the shaft lock pin holes as each shaft is being driven into place.**

**5.** Drive the long pinion shaft into place from the lock pin hole end of the case, being sure to align the lock pin hole in the shaft with that in the case.

**6.** Place the second side gear and thrust washer on top of the four pinion gears, then install the differential case cover so that the three shaft lock pin holes in the cover are aligned with their corresponding holes in the case.

**7.** Install the three shaft lock pins with a drift. A pinion or axle shaft spline can be inserted in the side gear spline to check for free rotation of the differential gears.

**8. Fill differential case with axle lubricant.**

**9.** Install the drive gear and side bearings on the differential case, and install the case in the carrier as described in steps 5 through 16 under "Assembly and Installation of Conventional Differential Case".

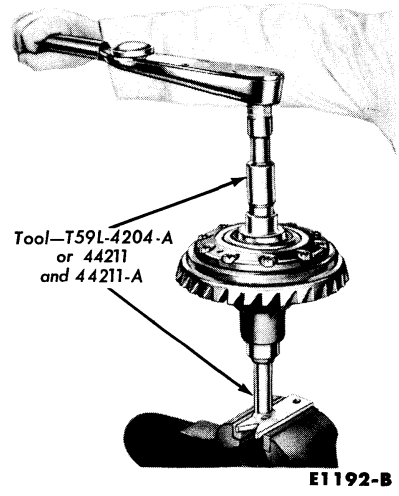



**FIG. 48—Differential Torque Check**

# PART 4-3 SPECIFICATIONS

## REAR AXLE

### ADJUSTMENTS

| Description | Inches |
|---|---|
| Backlash Between Drive Gear and Pinion | 0.004-0.009 |
| Maximum Backlash Variation Between Teeth | 0.003 |
| Maximum Runout of Backface of Drive Gear as Assembled | 0.003 |
| Differential Side Gear Thrust Washer Thickness | 0.030-0.032 |
| Differential Pinion Gear Thrust Washer Thickness | 0.030-0.032 |
| Nominal Pinion Locating Shim | 0.020 |
| Available Pinion Shims (In steps of 0.001 inch) | 0.008-0.029 |

### PINION AND DRIVE GEAR IDENTIFICATION

| Ratio | Number of Teeth | | Type of Gear Set |
|---|---|---|---|
| | Drive Gear | Pinion | |
| 3.00:1 | 39 | 13 | Non-Hunting |
| 3.25:1 | 39 | 25 | Partial Non-Hunting |
| 3.50:1 | 35 | 10 | Partial Non-Hunting |
| 3.56:1 | 32 | 9 | Hunting |
| 3.89:1 | 35 | 9 | Partial Non-Hunting |
| 4.11:1 | 37 | 9 | Hunting |

### LUBRICANT—REAR AXLE

| Refill Capacity | (All Models) | 5 Pints |
|---|---|---|
| **Engine Size** | **Ford Specification** | **Ford Part No.** |
| 223, 260, 352 | M-2C28-B* | C2AZ-19580-A |
| 390 | M-2C50-B | C1AZ-19580-E or F |
| 289, 427 | M-2C57-A* | C2AZ-19580-D |

*If the specified lubricants are unavailable, M-2C50-B may be used for "adding to," not exceeding one pint in quantity, in all except Equa-Lock axles.

For all cars equipped with Equa-Lock axles, regardless of engine size, use M-2C50-B, plus (1) ounce of M-2C58 additive per pint of M-2C50-B (4 oz. for complete refill).

SAE 90 grade lubricants are recommended for all temperatures above —25° F. For temperatures below —25° F, the same type of lubricant, but of a SAE 80 grade, should be used.

### DRIVE PINION ADJUSTING SHIM THICKNESS CHANGES (Inches)

| New Pinion Marking | Old Pinion Marking | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | −4 | −3 | −2 | −1 | 0 | +1 | +2 | +3 | +4 |
| +4 | +0.008 | +0.007 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 |
| +3 | +0.007 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | −0.001 |
| +2 | +0.006 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | −0.001 | −0.002 |
| +1 | +0.005 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | −0.001 | −0.002 | −0.003 |
| 0 | +0.004 | +0.003 | +0.002 | +0.001 | 0 | −0.001 | −0.002 | −0.003 | −0.004 |
| −1 | +0.003 | +0.002 | +0.001 | 0 | −0.001 | −0.002 | −0.003 | −0.004 | −0.005 |
| −2 | +0.002 | +0.001 | 0 | −0.001 | −0.002 | −0.003 | −0.004 | −0.005 | −0.006 |
| −3 | +0.001 | 0 | −0.001 | −0.002 | −0.003 | −0.004 | −0.005 | −0.006 | −0.007 |
| −4 | 0 | −0.001 | −0.002 | −0.003 | −0.004 | −0.005 | −0.006 | −0.007 | −0.008 |

### TORQUE LIMITS (Ft-lbs)

| | |
|---|---|
| Differential Bearing Cap Bolts | 70-85 |
| Differential Bearing Adjusting Nut Lock Bolts | 12-25 |
| Carrier to Housing Stud Nuts | 30-40 |
| Pinion Retainer to Carrier Bolts | 30-45 |
| Drive Gear Attaching Bolts* | 65-80 |
| Rear Axle Shaft Bearing Retainer Bolts | 30-40† |
| Rear Shock Absorber to Rear Spring Clip Plate Assembly Nuts | 15-25 |

### TORQUE LIMITS (Ft-lbs)—Continued

| | | |
|---|---|---|
| Pinion Flange U-Bolt Nuts | | 15-20 |
| Spring Clip Nuts (Rear Springs to Axle Housing) | | 30-45 |
| Minimum Torque Required to Tighten Pinion Nut to Obtain Correct Pinion Bearing Preload | | 175 |
| **Pinion Bearing Preload** | New Bearings | 17-27 inch-pounds |
| | Used Bearings | 8-12 inch-pounds |
| **Differential Bearing Preload** | | 2½-3 notches tight |

*High Performance 427 CID Engine 105-125 †Models 59-71 RPO Heavy Duty. . . . . 55-65

# DRIVE LINE AND CLUTCH

# GROUP 5


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**PART 5-3** PAGE
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# PART 5-1 DRIVE LINE


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2 Description and Operation ..... 5- 1
3 Replacement ..... 5- 1


## 1 TROUBLE DIAGNOSIS

**DRIVE SHAFT TROUBLE DIAGNOSIS AND POSSIBLE CAUSES**

| | | |
|---|---|---|
| **DRIVE SHAFT VIBRATION** | Undercoating or other foreign material on shaft.<br>Universal joint U-bolts loose.<br>Universal joints worn, or lack of lubricant.<br>Drive shaft mis-aligned (drive line angle). | Drive shaft and universal joints 180° out of phase.<br>Broken rear spring center bolt.<br>Broken rear spring.<br>Rear springs not matched (sagged to one side).<br>Drive shaft damaged (bent) or out of balance (missing balance weights). |
| **U-JOINT NOISE** | Universal joint U-bolts loose.<br>Lack of lubrication. | Worn U-joints. |

## 2 DESCRIPTION AND OPERATION

The drive shaft is the means of transfering power from the engine to the differential in the rear axle and then to the rear wheels. The drive shaft incorporates two universal joints and a slip yoke. The universal joints are provided with a threaded plug which can be removed to lubricate the universal joints when necessary. The splines in the yoke and on the transmission output shaft permit the drive shaft to move forward and rearward as the axle moves up and down.

All drive shafts are balanced. If the car is to be undercoated, cover the drive shaft to prevent application of the undercoating material.

## 3 REPLACEMENT

### REMOVAL

**1.** To maintain drive line balance, mark the relation of the slip yoke and the drive flange on the axle with the shaft so that they may be installed in their original positions.

**2.** Disconnect the rear U-joint from the drive pinion flange. Pull the drive shaft toward the rear of the car until the front U-joint yoke clears the transmission extension housing and the seal.

**3.** Remove the snap rings that retain the bearings in the yoke and drive shaft (Fig. 1).

**4.** Place the U-joint in a vise or a press.

**5.** Select a socket wrench with an outside diameter slightly smaller than the U-joint bearings. Select another socket wrench with an inside diameter slightly larger than the bearing outside diameter.

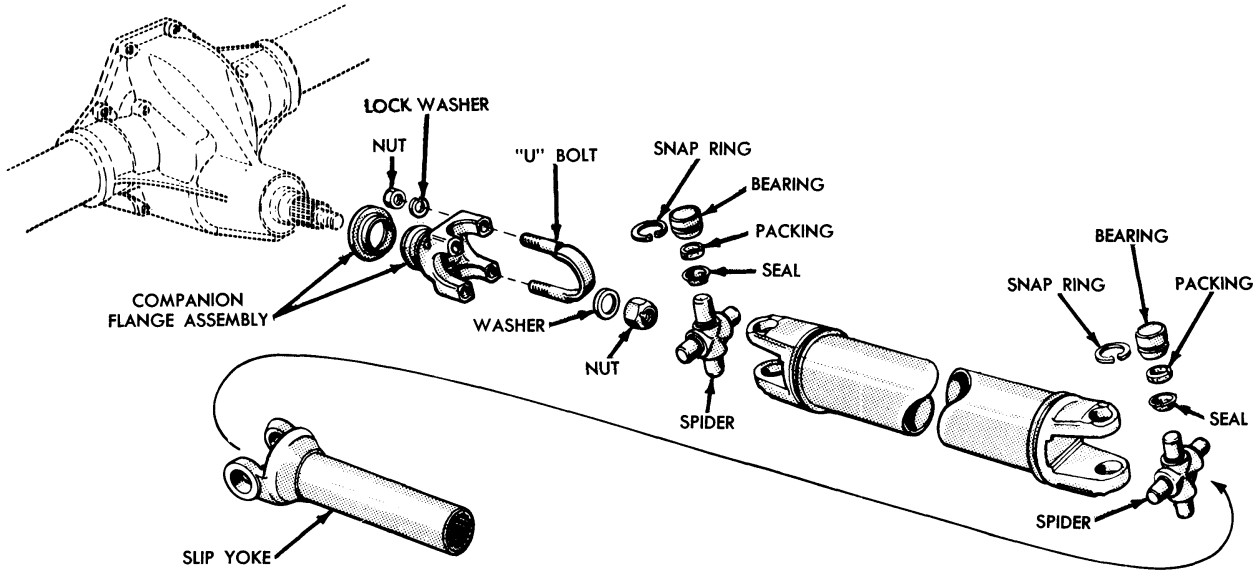



**FIG. 1—Drive Shaft Disassembled**

**6.** Place the socket wrenches at opposite bearings so that the smaller socket becomes a bearing driver and the larger socket becomes a bearing receiver when the vise jaws come together (Fig. 2).

**7.** Close the vise jaws until the spider contacts the yoke or drive shaft. Remove the driveshaft from the vise. Remove the one bearing with channel lock pliers.

**8.** Reverse the sockets and press the opposite bearing outward until the spider contacts the yoke or drive shaft. Remove the bearing with channel lock pliers.

**9.** Remove the spider from the shaft or yoke. Remove the remaining two bearings in the same manner.

**10.** If new U-joint bearings are being installed, **check the new bearings for adequate grease.**

**11.** Position the spider in the yoke. Press a bearing into the bore and onto the spider. Press another in the opposite bore of the yoke and onto the spider.

**12.** Install the snap ring on each bearing.

**13.** Install the spider and bearings in the drive shaft in the same manner as in the yoke.

**14.** Use the same procedure to remove and replace the rear U-joint spider and bearings.

Check the joint for freedom of movement. If a bind has resulted from misalignment during the foregoing procedures, tap the ears of the driveshaft sharply to relieve the bind. Do not install the driveshaft unless the universal joints are free of bind.

**15.** If the rubber seal installed on the end of the transmission extension housing is damaged in any manner, install a new seal.

**16.** On a manual-shift transmission, lubricate the yoke spline with conventional transmission lubricant (Group 21). On an automatic transmission, lubricate the yoke spline with special spline lubricant (Group 21). This spline is sealed so that the transmission fluid does not "wash" away the spline lubricant (Fig. 3). Install the yoke on the transmission output shaft.

**17.** Install the U-bolts and nuts which attach the U-joint to the drive pinion flange.

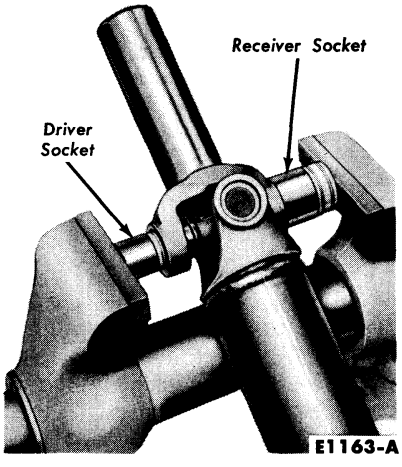



**FIG. 2—Removing Universal Joint**

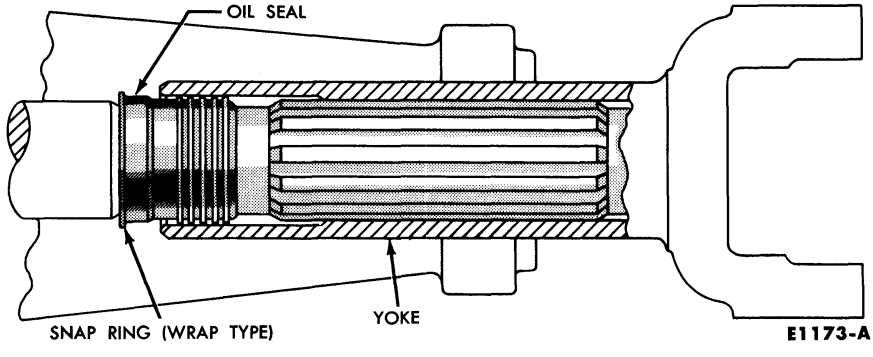



**FIG. 3—Output Shaft Spline Seal**

# PART 5-2 GENERAL CLUTCH SERVICE


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Diagnosis and Testing | 5- 3 | 2 Cleaning and Inspection | 5- 5 |


## 1 DIAGNOSIS AND TESTING

### TROUBLE SYMPTOMS AND POSSIBLE CAUSES

| | | |
|---|---|---|
| **CLUTCH NOISY WITH ENGINE STOPPED** | Pressure plate lugs rubbing against cover.<br>Clutch linkage improperly adjusted or inadequately lubricated. | Clutch assist spring clunking.<br>Release bearing hub burred and dragging on transmission bearing retainer. |
| **CLUTCH NOISY WHEN PEDAL FREE TRAVEL IS TAKEN OUT, ENGINE RUNNING** | Release bearing failure due to:<br>Improper travel adjustment.<br>Bearing cocked on hub. | Release lever out of plane.<br>Flywheel housing misalignment.<br>Excessive crankshaft end play. |
| **CLUTCH NOISY WHEN PEDAL IS THREE-QUARTERS TO FULLY DEPRESSED, ENGINE RUNNING** | Pressure plate lugs rubbing against window openings in cover. | Release bearing failure.<br>Loose and worn pilot bearing. |
| **CLUTCH SLIPS OR CHATTERS** | Incorrect pedal travel.<br>Grease or oil on clutch facings from:<br>Release bearing. | Release lever.<br>Pilot bearing.<br>Transmission.<br>Pressure plate fingers binding. |
| **CLUTCH VIBRATION** | Improper or defective clutch disc.<br>Release bearing out of plane. | Flywheel housing misalignment.<br>Pressure plate fingers binding. |
| **THUD** | Excessive engine crankshaft end play. | |
| **GEAR CLASH OR POOR RELEASE** | Incorrect pedal free travel.<br>Disc binding on transmission input shaft. | Excessive disc runout.<br>Flywheel housing misalignment.<br>Excessive engine idle speed. |
| **CLUTCH PEDAL SCRUBBING** | Release lever cocked.<br>Pedal push rod rubbing on firewall felt and insulator.<br>Release lever pivot knife edge rough.<br>Pedal shaft binding at support bracket. | Pressure plate finger rubbing internally.<br>Burrs on clutch pedal arm or clutch assist spring retainer.<br>Release bearing hub scrubbing on input shaft bearing retainer. |

### FLYWHEEL HOUSING ALIGNMENT

Alignment of the flywheel housing bore and rear face with the engine should be checked as a possible cause when any of the following occur: excessive transmission gear wear, transmission jumping out of gear, especially third gear, drive line vibration, excessive pilot bushing wear, noisy release bearing, or excessive clutch spin time.

### INSPECTION

With the clutch release bearing removed, install the indicator pilot

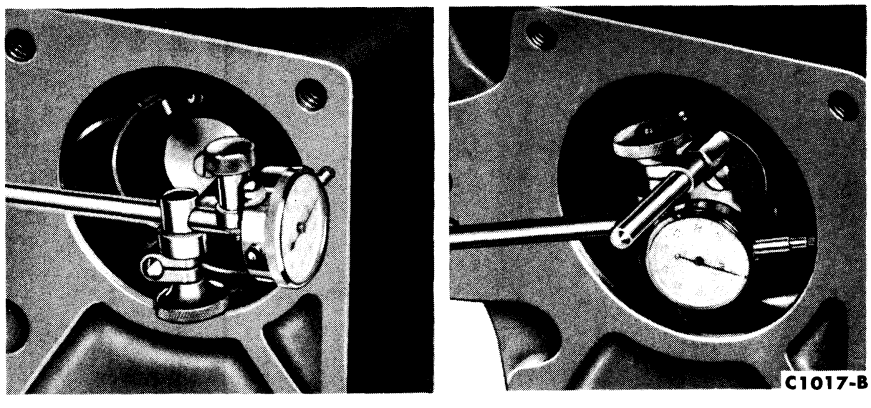
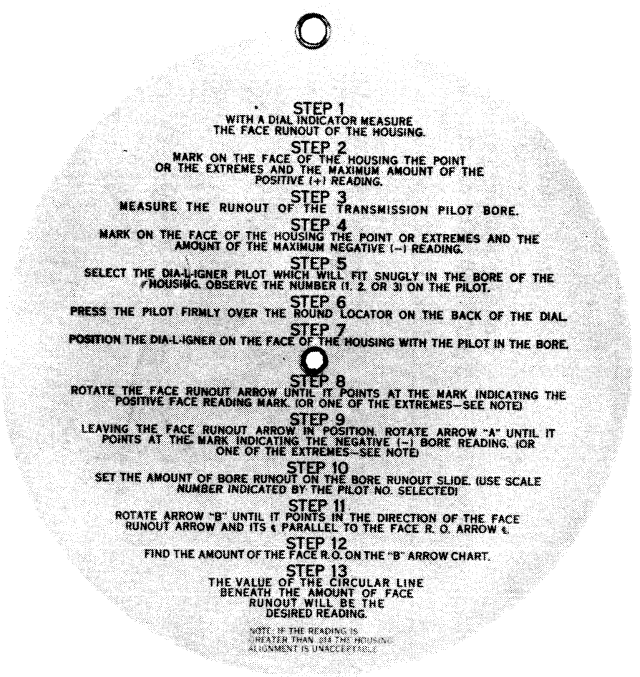
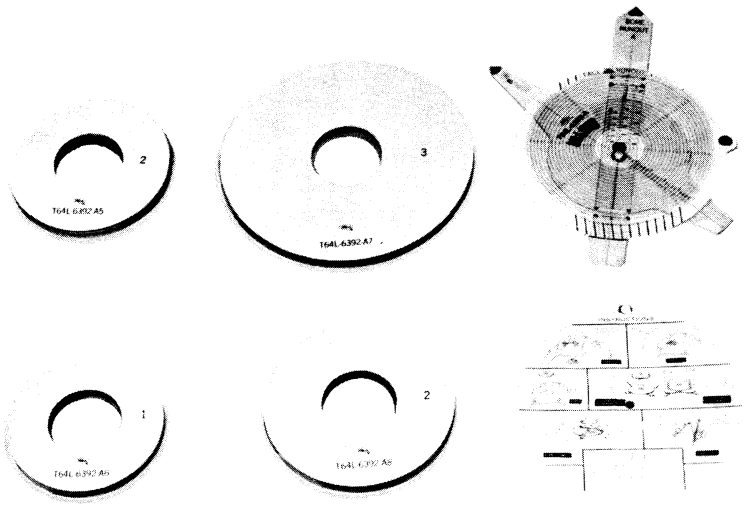



**FIG. 1—Flywheel Housing Alignment Check**



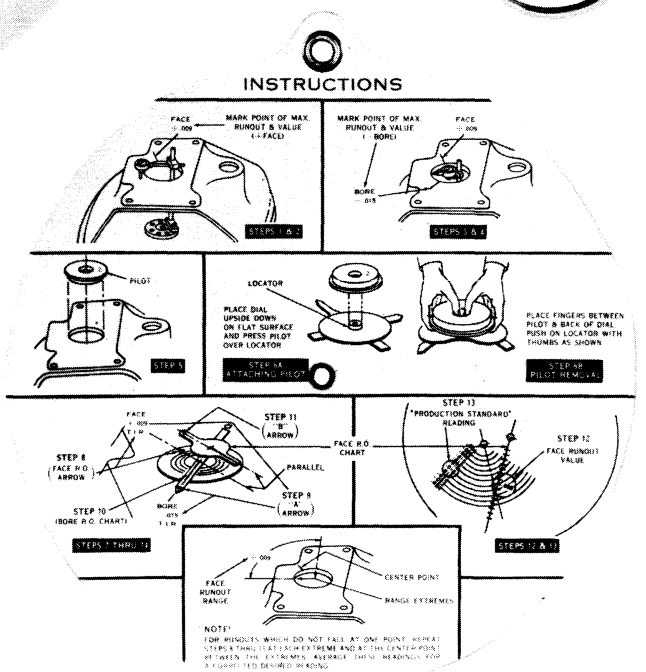




**FIG. 2—Dia-A-Ligner Gauge**

C1467-A

tool shown in Fig. 1. Clean the faces of the flywheel housing bolt bosses, and remove all burrs, nicks, and paint from the mounting face of the housing.

Install the dial indicator on the pilot and adjust the holder so the button will contact a circumference just inside of the transmission mounting holes. Remove the flywheel housing cover and pull the flywheel outward or push it inward to remove crankshaft end play. Set the dial indicator face to read zero.

Remove the spark plugs to alleviate compression. Pull the engine crankshaft through one revolution. The crankshaft must be held all the way out or all the way in. Note the indicator reading and mark the maximum point of runout on the face of the housing as detailed in Steps 1 and 2 of the Dia-L-Igner instructions (Fig. 2).

Position the dial indicator to check bore alignment (Fig. 1). The bore must be clean and free of burrs, nicks and paint.

Pull the crankshaft through one revolution. Note the indicator reading and mark the maximum point of runout on the face of the housing as detailed in Steps 3 and 4 of the Dia-L-Igner instructions (Fig. 2).

After completing the above inspection, install the spark plugs and the flywheel housing cover.

### CORRECTION

### ENGINE IN CAR

Since any change in face alignment will change bore alignment, it may be possible to correct bore alignment by changing face alignment. Face alignment can be changed by shimming between the flywheel housing and engine. Figure 3 shows the type of shim which can be fabricated.

**Not more than 0.010 inch in shim thickness may be used between the flywheel housing and the engine.** If a 0.010-inch shim will not bring face and bore alignment within limits, replace the flywheel housing.

The shim required is one half the maximum minus (–) indicator reading, and should be located at the point of maximum minus (–) indicator reading.

If both the bore and face alignment are out of limits, shim between the flywheel housing and engine to bring face alignment within limits. Check the bore alignment.

If bore alignment is out of limits and face alignment is within limits, shim the flywheel housing to the limit of face misalignment and check the bore alignment. If it is not within limits, replace the housing.

### ENGINE OUT OF CAR

The same procedure to correct alignment may be used with the engine out of the car or in the car, up to the point of replacing the flywheel housing. If the bore alignment cannot be brought within limits by shimming, follow this procedure:

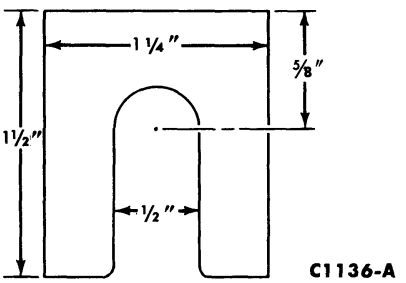



**FIG. 3—Fabricated Flywheel Housing Shim**

Remove the flywheel housing from the engine and remove the dowel pins. Install the flywheel housing and tighten the attaching bolts.

Install the dial indicator (Fig. 1). Check the face alignment, and shim as required to bring face alignment within limits.

Position the indicator to check bore alignment. If bore alignment is not within limits, reduce the tension on the flywheel housing attaching bolts so that the housing can be moved by striking it with a lead hammer or a block of wood and a steel hammer.

The lateral alignment should be within limits so that an indicator reading is within limits between the 9 o'clock and 3 o'clock positions on the bore circle. When the lateral alignment is within limits, the housing usually can be moved straight up or down without disturbing the lateral alignment. When alignment is within limits, torque the housing bolts and recheck bore alignment.

If the flywheel housing cannot be moved enough to bring the alignment within limits, mark the holes restricting movement, and then remove the housing and drill the marked bolt holes 1/32 inch larger. Remove the dowel pins from the cylinder block.

When the flywheel housing bore alignment is within limits and the attaching bolts are at normal torque, hand ream the dowel pin holes 1/32 inch larger. Use a straight reamer and ream from the flywheel housing side. Oversize dowel pins can be made from drill rod stock.

Remove the flywheel housing and then install the oversize dowel pins in the cylinder block. Complete the assembly in the usual way.

## 2 CLEANING AND INSPECTION

### RELEASE BEARING

Wipe all oil and dirt off the release bearing. **The bearing is prelubricated and should not be cleaned with solvent.**

Inspect the bearing retainer for loose spring clips and rivets.

Inspect the release bearing assembly for burrs which may cause the assembly to drag on the transmission bearing retainer. Any such burrs should be cleaned up with fine crocus cloth. If burrs are found, inspect the transmission input shaft bearing retainer for evidence of scoring. Any scoring should be polished out with crocus cloth. Coat the bearing retainer with a thin film of lithium-base grease (COAZ-19584-A).

Hold the bearing inner race and rotate the outer race while applying pressure to it. If the bearing rotation is rough or noisy, replace the bearing.

Most release bearing failures are caused by improper clutch pedal adjustments. If the clutch linkage does

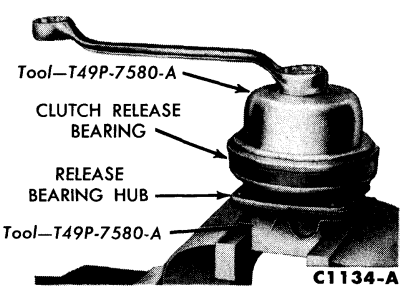



**FIG. 4—Installing Clutch Release Bearing**

not have enough free travel, the release bearing will constantly touch the release fingers and will spin whenever the engine is running.

When installing a release bearing, use the tool shown in Fig. 4.

Release bearing failure can be caused by the release lever contact points being out of plane. Check the wear on the release bearing assembly where the release lever contacts it.

If one side of the assembly shows more wear than the other, the release lever is bent out of plane, or is not centering on the bracket on the flywheel housing.

Misalignment between the engine and transmission can cause release bearing failure. Other symptoms of misalignment are: transmission jumping out of gear, especially third gear, drive line vibration; excessive wear in the pilot bushing, excessive clutch disc spin time resulting in gear clash, and excessive transmission gear wear.

## PRESSURE PLATE AND COVER

Inspect the surface of the pressure plate for burn marks, scores, or ridges. Generally, pressure plate resurfacing is not recommended. However, minor burn marks, scores, or ridges may be removed. During the resurfacing process, the flatness of the pressure plate must be maintained. If the pressure plate is badly heat-checked or deeply scored, replace the pressure plate and cover assembly. Clean pressure plate and

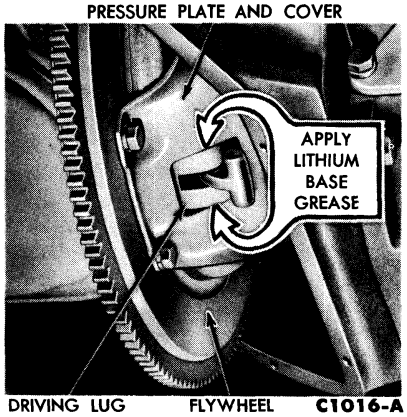



**FIG. 5—Pressure Plate Lubrication Point**

flywheel surfaces with a suitable solvent, such as carbon tetrachloride, to be sure the surfaces are free from any oil film. **Do not use cleaners with petroleum base, and do not immerse the pressure plate in the solvent.**

Place the plate on the floor, being careful not to score or scratch the surface. Force each individual finger down, then release quickly. If the finger does not return quickly, a binding condition is indicated, and the pressure plate should be replaced.

The pressure plate should be lubricated with a lithium-base grease between the driving lugs and the edges of the pressure plate openings as shown in Fig. 5. Depress the pressure plate fingers fully, apply the lubricant, and then move the fingers up and down until the lubricant is worked in. **Do not apply excessive lubricant.**

## CLUTCH DISC

Inspect the clutch disc facings for oil or grease. **Eliminate the source of any oil or grease before replacing the disc.** An excessive amount of grease in the pilot bushing or release bearing hub will find its way to the disc facings. Too much lubricant in the transmission or a plugged transmission vent will force the transmission lubricant out the input shaft and onto the disc facings.

Inspect the clutch disc for worn or loose facings. Check the disc for distortion and for loose rivets at the hub. Check for broken springs. **Springs loose enough to rattle will not cause noise when the car is operating.** Replace the disc assembly if any of these defects are present. **Be especially careful when installing a new disc to avoid dropping it or contaminating it with oil or grease.**

## PILOT BUSHING

Check the fit of the clutch pilot bushing in the bore of the crankshaft.

The bushing is pressed into the crankshaft and should not be loose. Inspect the inner surface of the bushing for wear or a bell-mouthed condition. If the bushing is worn or damaged, replace the bushing with a new service bearing. Refer to the applicable engine for the replacement procedure.

# PART 5-3 CLUTCH


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 5- 7 | 3 Removal and Installation | 5-10 |
| 2 In-Car Adjustments and Repairs | 5- 7 | | |


## 1 DESCRIPTION AND OPERATION

The clutch is of the centrifugal single dry disc type and consists of the clutch disc, pressure plate and the clutch release bearing (Fig. 1).

### OPERATION

The clutch is actuated by a clutch pedal and a series of mechanical linkage.

When the clutch pedal is in the engaged position, the clutch disc facings are clamped between the friction surface of the engine flywheel and the face of the clutch pressure plate, thereby connecting engine power to the transmission. Depressing the clutch pedal actuates the clutch release shaft fork which moves the clutch release bearing against the clutch fingers. This, in turn, moves the pressure plate away from the clutch disc. Since the disc is splined to the transmission input shaft, the clutch disc and transmission input shaft will stop when the clutch is disengaged, thereby disconnecting engine power from the transmission.

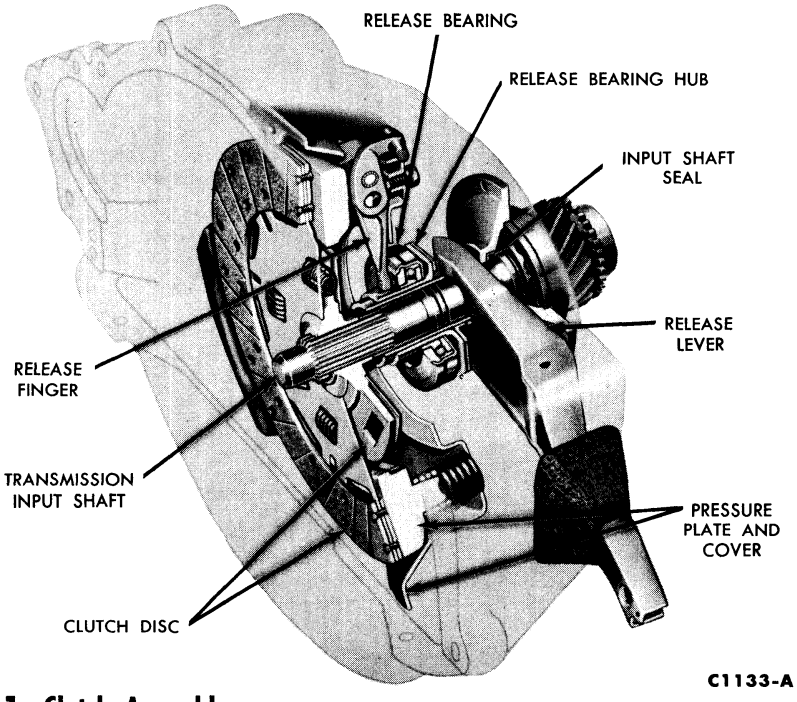



**FIG. 1—Clutch Assembly**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### CLUTCH PEDAL ADJUSTMENT

Adjust the clutch pedal whenever the clutch does not disengage or engage properly, or when new clutch parts are installed. Both the total travel and the free travel of the pedal should be adjusted. **Improper adjustment of the clutch pedal is one of the most frequent causes of clutch failure and can be a contributing factor in some transmission failures.**

**1.** Disconnect the interlock shift rod at the interlock shift lever (Fig. 4). This step applies only to cars equipped with an overdrive transmission.

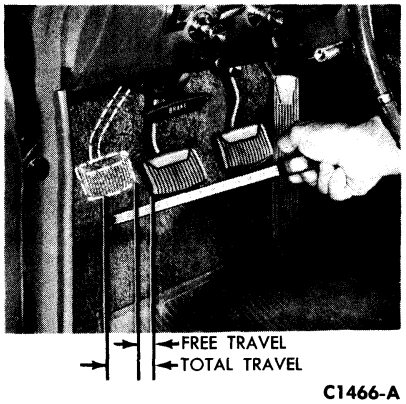
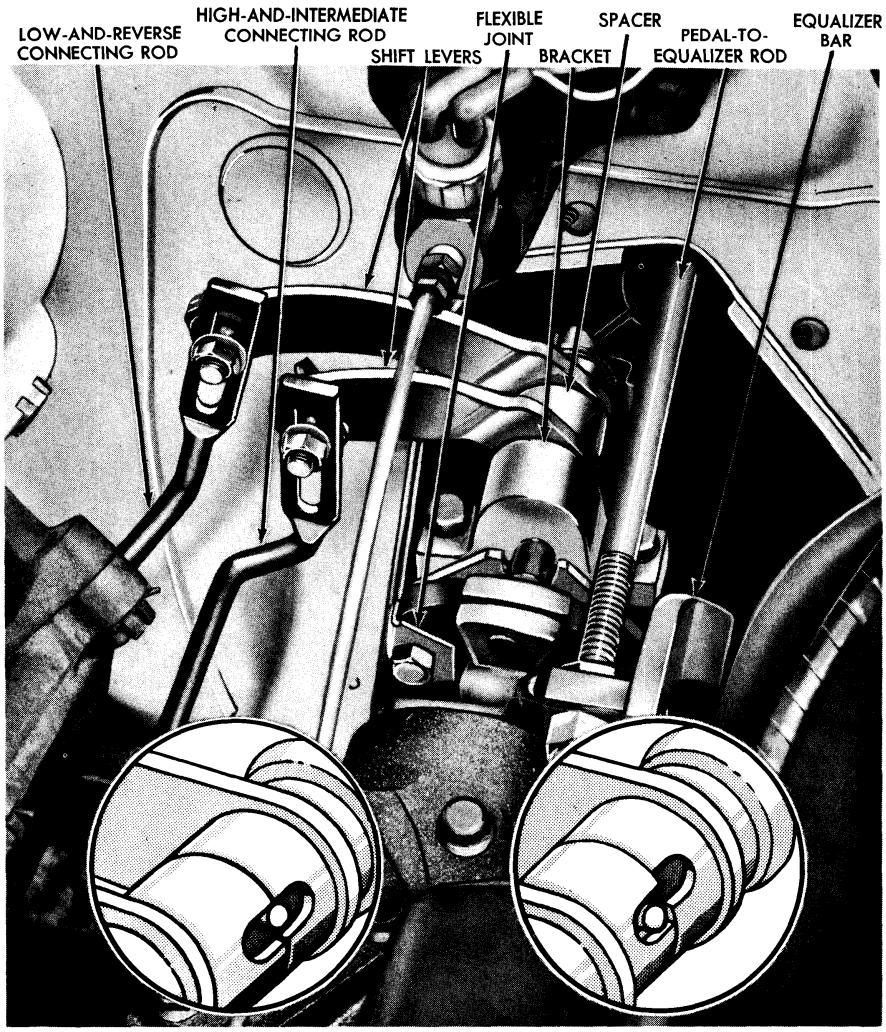



**FIG. 2—Clutch Pedal Travel**

**2.** Measure the total travel of the pedal (Fig. 2). If the travel is not within specification, move the clutch pedal bumper and the bracket (Fig. 5) up or down until the travel is within specified limits. **Always check and adjust total travel before checking free travel.**

**3.** With the clutch pedal against its bumper (pedal released), measure the overall length of the spring. The overall length should be 10¾ inches.




C1150-B

**FIG. 3—Clutch Pedal Travel Adjustments (Typical)**

4. With the engine idling, depress the pedal just enough to take up the free travel and note the reading on the tape (Fig. 2). The difference between this reading and the reading where the pedal is released is the clutch pedal free travel. If the free travel is not within specification, adjust the clutch pedal to equalizer rod (Fig. 3). To increase the free travel, loosen the rearward adjusting nut and tighten the forward nut. To reduce the free travel, loosen the forward nut and tighten the rearward nut. **Both nuts must be tightened against the trunnion after making the adjustment.**

5. With the transmission in neutral and the interlock pawl snugly engaged (overdrive only) connect the interlock shift rod.

6. As a final check, measure the pedal free travel with the transmission in neutral and the engine running at about 3000 rpm. If the free travel at this speed is not ½ inch, readjust the clutch pedal to equalizer rod to obtain specified free travel. Otherwise, the release fingers may contact the release bearing continuously, resulting in premature bearing and clutch failure. **Free travel must be exactly to specification.**

## INTERLOCK (OVERDRIVE MODELS ONLY)

**Be sure that the clutch linkage and pedal height are correctly adjusted before adjusting the interlock (Fig. 4).**

Adjust the interlock as follows:

1. With the interlock shift rod disconnected at the interlock shift lever and the transmission in neutral, adjust the position of the pawl or the plate so that the two interlock parts fit snugly.

Tighten the pawl or the plate attaching bolts.

2. Shift the transmission into low and into neutral to check operation of the interlock. Adjust the length of the interlock shift rod so that the low and reverse shift lever is engaged by the pawl or the plate until the clutch pedal enters the overtravel or reserve area. Readjust the pawl for snug fit, if necessary.

3. With the transmission in neutral, connect the interlock rod to the shift lever and check the shift linkage operation.

4. Use COAZ-19584-A lubricant as required for the interlock linkage.

## CLUTCH PEDAL AND/OR BUSHING REPLACEMENT

### REMOVAL

1. Remove the nut from the retainer on the upper end of the assist spring. Then remove the spring, nylon bushings and retainer from the pedal and pedal support (Fig. 5).

2. Disconnect the clutch pedal to equalizer rod from the pedal.

3. Remove the retaining clip, spring washer, and flat washer from the clutch pedal shaft. Then remove the shaft, bushings, and pedal from the support.

4. Remove the bushings from the pedal shaft, and transfer the pedal pad.

### INSTALLATION

1. After lubricating the clutch pedal shaft bushings, position them on the shaft. Then position the shaft and pedal in the pedal support.

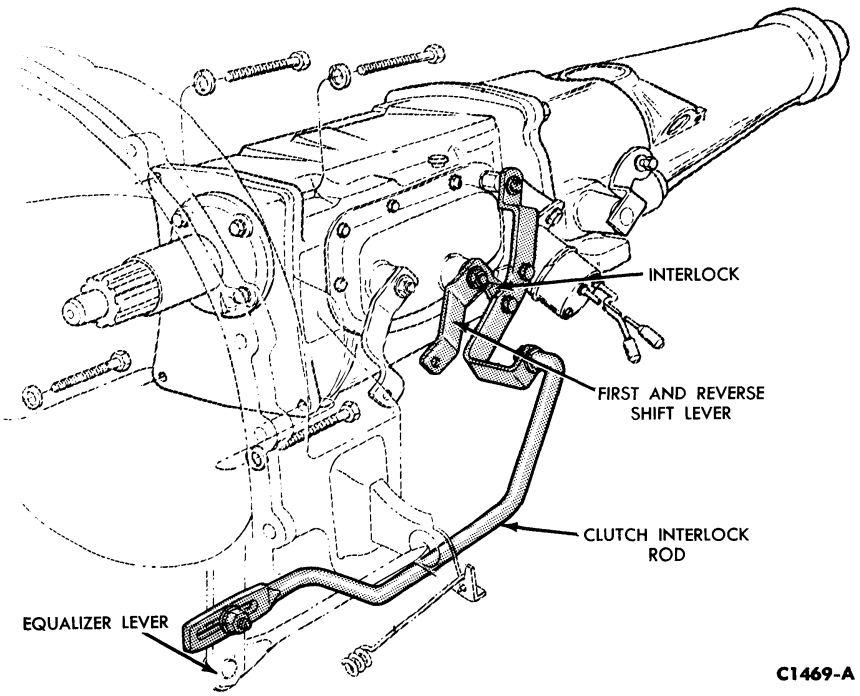



**FIG. 4—Clutch Interlock Mechanism (Used with 352 and 390 Cu. In. Engines)**

2. Install the flat washer, spring washer, and retaining clip on the pedal shaft.

3. Connect the clutch pedal to equalizer rod to the pedal.

4. After lubricating the assist spring eyes with Lubriplate, depress the clutch pedal and install the assist spring and nylon bushings and retainer.

5. Adjust the clutch pedal travel.

## EQUALIZER BAR AND/OR BUSHING REPLACEMENT

1. Disconnect the pedal to equalizer rod at the pedal, and then disconnect the rod from the equalizer bar (Fig. 5).

2. Raise the car and disconnect the release lever retracting spring at the lever.

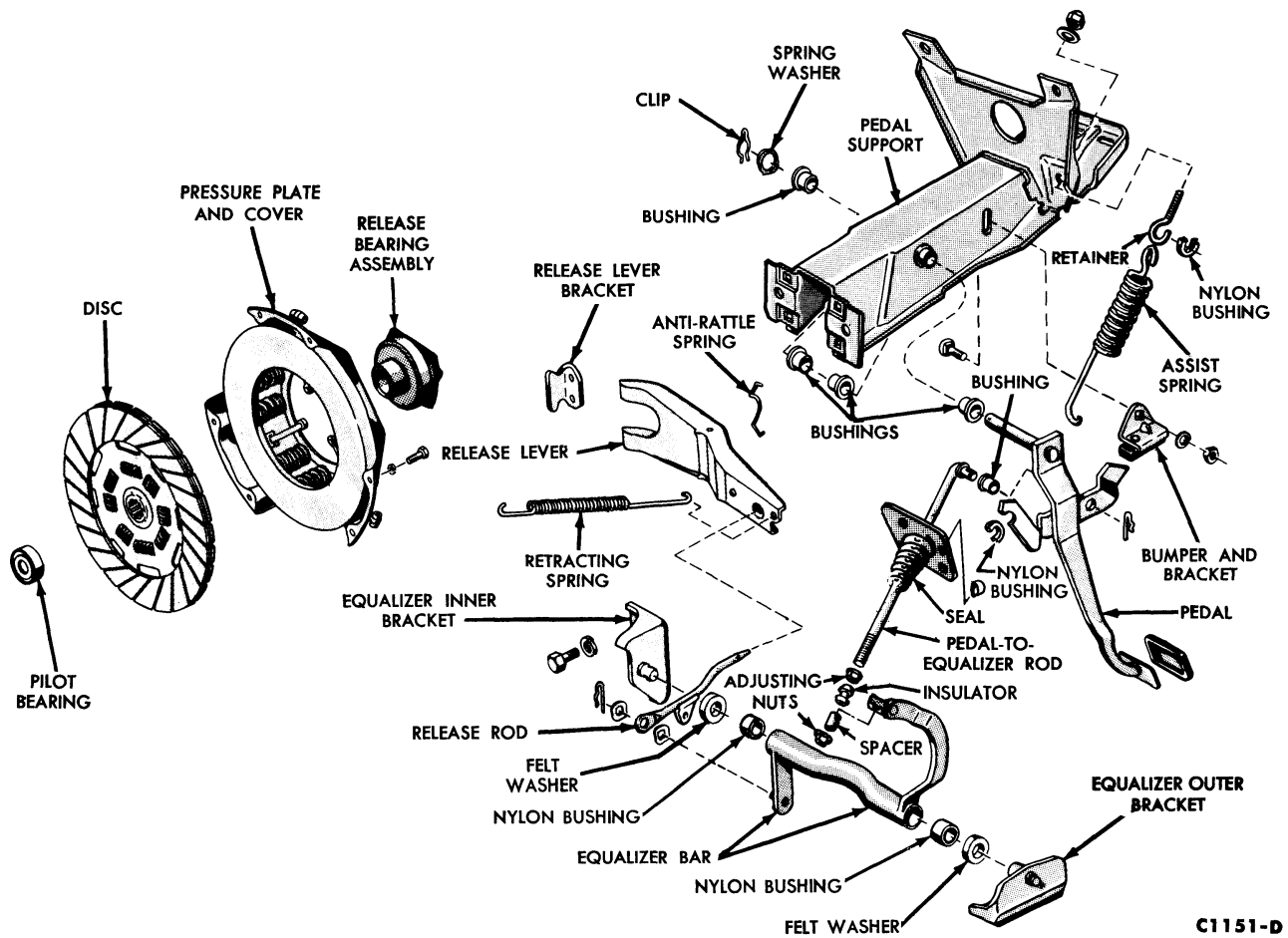



**FIG. 5—Clutch and Linkage Disassembled**

3. Remove the equalizer bar inner bracket and the bushing.

4. Remove the release rod from the equalizer bar, and then remove the equalizer bar. Remove the bushing from the outer bracket.

5. Position the equalizer bar and outer bushing on the outer bracket. Hold the bushing in place with grease.

6. After positioning the inner bushing, install the inner bracket (with the equalizer bar in place).

7. Connect the release rod and the release lever retracting spring.

8. After lowering the car, install the pedal to equalizer rod.

9. Adjust the clutch and the interlock. The clutch interlock is used only on cars equipped with an overdrive transmission.

## 3 REMOVAL AND INSTALLATION

### CLUTCH REMOVAL

1. Raise the car on a hoist.

2. Disconnect the drive shaft from the rear U-joint flange. Then slide the drive shaft off the transmission output shaft. Insert tool T57L-7657-A (Ford) or 7657-D (Mercury) over the output shaft and into the extension housing oil seal.

3. Disconnect the speedometer cable from the extension housing.

4. Disconnect the gear shift rods from the transmission levers. If equipped with an overdrive transmission, disconnect the interlock rod from the overdrive.

5. If the car is equipped with overdrive, disconnect the solenoid and governor wires at their connectors, disconnect the overdrive control cable, and then remove the wiring harness and the solenoid from the transmission.

6. Disconnect the parking brake cable, and support the rear of the engine with a transmission jack.

7. Remove the bolts that attach the extension housing to the engine rear support.

8. Remove the bolts that attach the transmission to the flywheel housing.

9. Move the transmission rearward until the input shaft clears the flywheel housing.

10. If removing a clutch from a car with an aluminum flywheel housing, remove the starter and the housing from the engine.

11. Remove the flywheel housing cover (cast iron housings only).

12. Remove the release lever retracting spring. Then slide the release bearing and hub off the release lever. This applies only to cast iron flywheel housings.

13. Loosen the six pressure plate cover attaching bolts evenly to release the spring tension. **If the same pressure plate and cover is to be installed after the clutch is overhauled, mark the cover and flywheel so that the pressure plate can be installed in the same position.**

14. Remove the pressure plate and the clutch disc from the flywheel.

### CLUTCH INSTALLATION

1. Install the clutch release lever if it was removed.

2. Place the clutch disc, and pressure plate assembly in position on the flywheel. Start the cover attaching bolts to hold the pieces in place but do not tighten them. **Avoid dropping the parts or contaminating them with oil or grease.**

3. Align the clutch disc with the tool shown in Fig. 6, and torque the six pressure plate cover attaching bolts evenly to specification. Then remove the tool.

4. Place the release bearing and hub on the release lever. Coat the bearing retainer inside diameter with a light film of lithium-soap type grease. **Do not lubricate the bearing hub.**

If working on an engine with an aluminum flywheel housing, install it and the starter at this time. Make sure that the mounting surfaces are clean.

5. The mounting surfaces of the transmission and the flywheel housing must be free of dirt, paint, and burrs. Install two guide pins in the flywheel housing lower mounting bolt holes. Move the transmission forward on the guide pins until it is

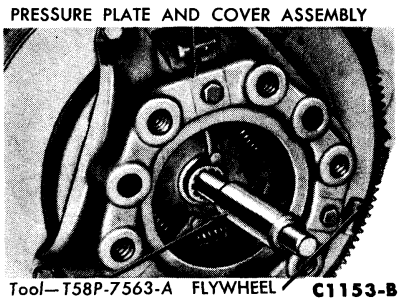



**FIG. 6—Installing Clutch Disc**

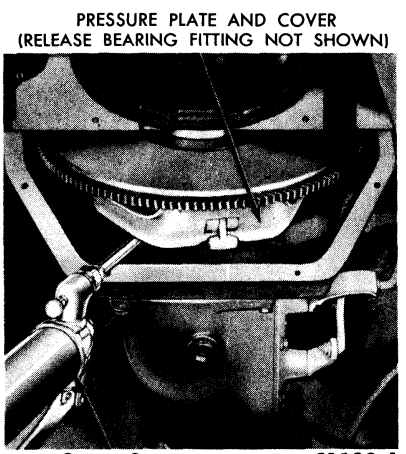



**FIG. 7—Lubricating Clutch Release Bearing (Heavy Duty Clutch Only)**

tightly positioned against the flywheel housing.

**6.** Install the two upper mounting bolts. Then remove the guide pins and install the two lower mounting bolts. Torque all bolts to specification.

**7.** Install the bolts that attach the extension housing to the engine rear support.

**8.** Remove the transmission jack and connect the parking brake cable.

**9.** If the car is equipped with overdrive, install the solenoid and the wiring harness on the transmission, connect the overdrive control cable, and connect the solenoid and governor wires at their connectors.

**10.** Connect the gear shift rods to the transmission levers, and adjust the linkage. If the car is equipped with overdrive, connect the clutch interlock rod to the overdrive shift lever.

**12. If a heavy duty clutch has been installed, lubricate the release bearing as shown in Fig. 7.** Install the flywheel housing cover.

**13.** Connect the release lever retracting spring. Install the flywheel housing cover (cast iron housing only).

**14.** Remove the tool from the transmission output shaft, and install the drive shaft.

**15.** Adjust the clutch pedal travel.

# PART 5-4 SPECIFICATIONS

## CLUTCH AND MANUAL-SHIFT TRANSMISSIONS

### CLUTCH ADJUSTMENTS

| | Inches |
|---|---|
| Clutch Pedal Free Travel (Engine Idling) ±1/16 | 1 |
| Clutch Pedal Total Travel ± 1/8 | 6¾ |
| Assist Spring Length Installed (Clutch Pedal Up) | 10-10⅛ |
| Maximum Indicator Reading of Concentricity —Flywheel Housing Bore to Crankshaft Centerline | 0.010 |
| Maximum Indicator Reading of Face Squareness —Flywheel Housing Mounting Face to Crankshaft Centerline* | 0.007 |

*Using Tool No. 6392-N

### TORQUE SPECIFICATIONS

| | Foot Pounds |
|---|---|
| Lower Access Clutch Cover Plate to Flywheel Housing Bolts | 17-20 |
| Flywheel Housing to Block Bolts | 40-50 |
| Pressure Plate and Cover Plate Assembly Retaining Bolts | 23-28 |
| Transmission Extension Housing to Case Bolts | 37-42 |
| Clutch Release Equalizer Frame Bracket Bolts | 25-30 |
| Input Shaft Bearing Retainer to Transmission Case Bolts | 12-15 |
| Overdrive Assembly to Transmission Case Nuts | 37-42 |
| Transmission Assembly to Flywheel Housing Bolts | 37-42 |
| Gear Shift Housing Assembly to Transmission Case Bolts | 12-15 |
| Gear Shift Control Levers to Cam and Shaft Assembly Nuts | 12-15 |
| #3 Crossmember to Support Bracket Bolts | 45-50 |
| Engine Rear Support to Transmission Case Bolts | 40-45 |

### CLUTCH IDENTIFICATION

| Engine Cubic Inch Displacement | Pressure Plate | | | Disc | |
|---|---|---|---|---|---|
| | Diameter (Inches) | Number of Springs | Color Identification Paint Daub | Number of Springs | Spring Color |
| Mileage Maker Six | 9½ | 6 | Aluminum | 3<br>3 | Pink<br>Aluminum |
| | 11* | 9* | Pressure Plate—Bronze*<br>Cover Plate—Bronze* | 4<br>4 | Aluminum*<br>Pink* |
| 289 V-8 | 10.4 | 9 | Pressure Plate—White<br>Cover Plate—Pink | 4<br>6 | Orange—Small<br>Orange—Large |
| 352 V-8 | 11 | 9 | Pressure Plate—Aluminum<br>Cover Plate—Pink and Orange | 6<br>6 | Blue—Small<br>Yellow—Large |
| 390 V-8 | 11 | 4 | Pressure Plate—Purple<br>Cover Plate—Green and Yellow | 8 | Aluminum |
| 427-V-8 | 11.5 | 12 | Pressure Plate—Bronze and White<br>Cover Plate—White | 5<br>5 | No<br>Color |

*Heavy-Duty Clutch

# MANUAL SHIFT TRANSMISSIONS

# GROUP 6


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# PART 6-1 GENERAL TRANSMISSION SERVICE


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| 2 Common Adjustments and Repairs | 6-2 | | |


## 1 DIAGNOSIS AND TESTING

**DIAGNOSIS GUIDE**

| | | |
|---|---|---|
| **NOISY IN FIRST THROUGH THIRD SPEEDS—FOUR-SPEED ONLY** | Gear relative to pertinent speed involved, worn or damaged.<br>Countershaft gear worn or damaged. | Countershaft gear bearings worn or damaged.<br>Synchronizers worn or damaged. |
| **NOISY IN ALL SPEEDS** | Low lubricant level.<br>Incorrect lubricant.<br>Countershaft gear or bearings, worn or damaged. | Input shaft bearing worn or damaged.<br>Transmission misaligned or loose. |
| **NOISY IN HIGH GEAR —DIRECT** | Synchronizers worn or broken.<br>Input shaft bearing or gear, worn or damaged. | Output shaft bearing worn or damaged. |
| **NOISY IN REVERSE** | Reverse idler or shaft, worn or damaged.<br>Reverse sliding gear worn or broken. | Shift linkage improperly adjusted.<br>Bent, damaged, or loose shift linkage.<br>Shift levers, shafts, or forks worn. |
| **HARD SHIFTING** | Clutch improperly adjusted.<br>Clutch parts worn or damaged.<br>Shift linkage out of adjustment.<br>Bent, damaged, or loose shift link- | age.<br>Shift levers, shafts, or forks worn.<br>Incorrect lubricant.<br>Synchronizers worn or broken. |
| **JUMPING OUT OF GEAR** | Shift linkage out of adjustment, worn or loose.<br>Insufficient spring tension of rail detent springs.<br>Misalignment or loose transmis- | sion case and/or clutch housing.<br>Worn input shaft pilot bearing.<br>Bent output shaft.<br>Worn or broken high gear synchronizer. |

**Continued on next page**

## DIAGNOSIS GUIDE (Continued)

| | | |
|---|---|---|
| **JUMPING OUT OF GEAR (Continued)** | Worn clutch teeth on input shaft and/or worn clutch teeth on synchronizer sleeve.<br>Bent or worn shift fork, lever, and/or shaft.<br>End play in input shaft (bearing retainer loose or broken, loose or | worn bearings on input and output shafts).<br>Clutch teeth not engaging completely.<br>Not enough over-shift travel in column.<br>Shift cover loose or gasket damaged (four-speed only). |
| **STICKING IN GEAR** | Clutch not releasing fully.<br>Burred or battered teeth on synchronizer sleeve and/or input shaft.<br>Frozen synchronizing blocking ring on input shaft gear cone.<br>Stuck shift plug. | Lack of lubrication.<br>Improper lubrication.<br>Corroded transmission levers (shaft).<br>Defective (tight) input shaft pilot bearing. |
| **GEARS SPINNING WHEN SHIFTING INTO GEAR FROM NEUTRAL** | Clutch not fully releasing.<br>Binding input shaft pilot bearing. | Synchronizers not functioning. |
| **REVERSE GEAR CLASH** | Transmission gears can be made to clash by shifting into reverse gear too quickly after the clutch pedal is depressed, even though the clutch is in perfect working order. Sufficient time **MUST** be allowed before shifting into reverse gear. If gear clash continues after allowing proper | time for the clutch driven plate to stop, check the clutch adjustments to specified limits. Also, make sure that the engine idle speed is to specification. Gear clash also may be caused by a dragging clutch plate (plate distorted, or input shaft pilot bearing tight). |
| **LUBRICANT LEAKS** | Excessive lubricant.<br>Incorrect lubricant.<br>Vent plugged .<br>Input shaft bearing retainer loose, cracked or gasket damaged.<br>Shift cover loose or gasket damaged (four-speed only). | Worn shift shaft seals.<br>Shift cover bolts not sealed (four-speed only).<br>Worn or damaged extension housing seal.<br>Countershaft loose in case bores. |

## 2 COMMON ADJUSTMENTS AND REPAIRS

### REAR SEAL REPLACEMENT

1. Remove the drive shaft.

2. Remove the seal from the extension housing with the tool shown in Fig. 1.

3. Install the new seal in the extension housing with the tool shown in Fig. 2.

4. Install the drive shaft.

### REAR BUSHING AND SEAL REPLACEMENT

1. Remove the drive shaft from the car.

2. Insert the tool shown in Fig. 3, into the extension housing until it grips on the front side of the bushing.

3. Turn the screw clockwise until the seal and the bushing are free of the housing.

4. Drive a new bushing into the extension housing with the tool shown in Fig. 4.

5. Install a new seal in the housing as shown in Fig. 2.

6. Install the drive shaft.

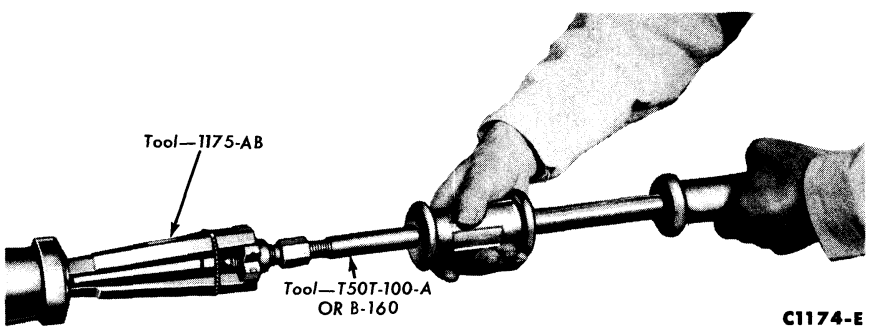



**FIG. 1—Removing Extension Housing Seal**

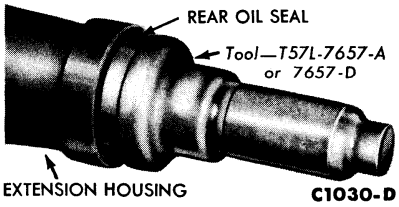



**FIG. 2—Installing Extension Housing Seal**

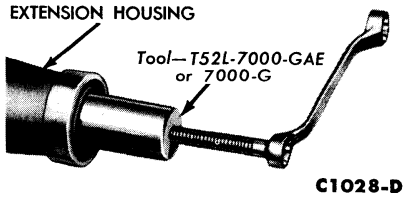



**FIG. 3—Removing Extension Housing Bushing and Seal**

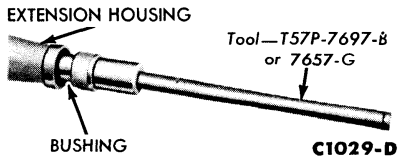



**FIG. 4—Installing Extension Housing Bushing**

## 3 CLEANING AND INSPECTION

### CLEANING

1. Wash all parts, except the ball bearings, in a suitable cleaning solvent. Brush or scrape all foreign matter from the parts. Be careful not to damage any parts with the scraper. Dry all parts with compressed air.

2. Rotate the ball bearings in a cleaning solvent until all lubricant is removed. Hold the bearing assembly to prevent it from rotating, and dry it with compressed air.

3. Lubricate the bearings with approved transmission lubricant and wrap them in a clean, lint-free cloth or paper until ready for use.

### INSPECTION

1. Replace a case that is cracked, or has worn or damaged bearing bores. Repair all damaged threads.

2. Remove any burrs from the front and rear mounting surfaces which could cause transmission misalignment.

3. Inspect all gears for excessive wear or tooth damage. If either condition is present, replace the defective parts.

4. If the bushing in the reverse idler gear is worn, a new gear and bushing must be installed.

5. Inspect the input and the output shaft for excessive wear, spline, or tooth damage. If one of these conditions is present, replace the shaft.

6. Inspect the bearings for cracked races, and the balls and rollers for looseness, wear, end play or other damage. Replace the bearings if these conditions exist.

7. Install the countershaft gear in the transmission case. Check the end play between the countershaft gear and the thrust washers of the transmission case with a feeler gauge (Fig. 5). If the end play exceeds specification, replace the thrust washers. If the end play is within specifications, the countershaft should be removed and the countershaft gear and the dummy shaft be left in the bottom of the case until the transmission is assembled.

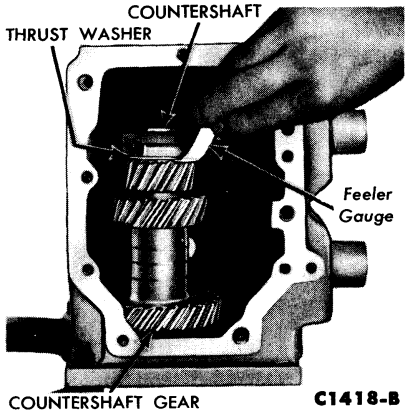



**FIG. 5—Checking Countershaft Gear End Play (Typical)**

8. Inspect the bushing and seal in the extension housing. If required, they may be removed and installed as detailed in Section 2.

# PART 6-2 THREE-SPEED TRANSMISSION


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 6-4 | 3 Removal and Installation | 6-5 |
| 2 In-Car Adjustments and Repairs | 6-5 | 4 Major Repair Operations | 6-6 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

The three-speed transmission (Fig. 1) is available in all Ford and Mercury models. The following table gives the transmission model and the car model in which it is used:

**TABLE 1**

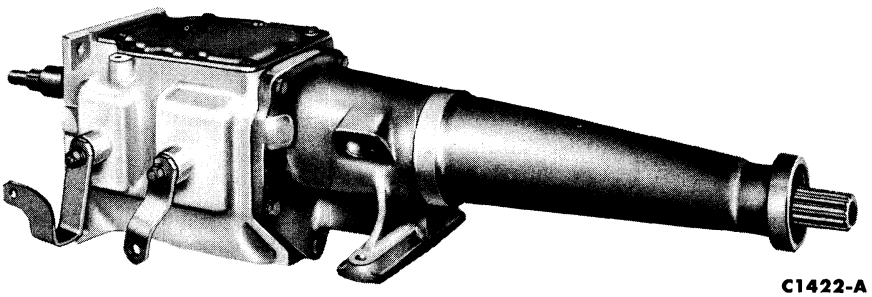
| Trans. Model | Engine C.I.D. | Car Model |
|---|---|---|
| HEE-D | 223 | Ford |
| HEF-AE | 223 | Ford Taxi |
| HEF-AF | 289 | Ford |
| HEG-A | 352-390 | Ford & Mercury |
| HEG-C | 427 | Ford & Mercury |

This transmission is of the fully synchronized type, with all gears except the reverse gear and sleeve being in constant mesh. All forward-speed changes are accomplished with synchronizer sleeves (Fig. 2). The synchronizers permit quicker shifts, greatly reduce gear clash, and permit down-shifting from high to intermediate between 40-20 mph and from intermediate to low below 20 mph.

Synchronizers and blocking rings are the conventional tapered ring and straight clutch gear type (Figs. 16 and 17).

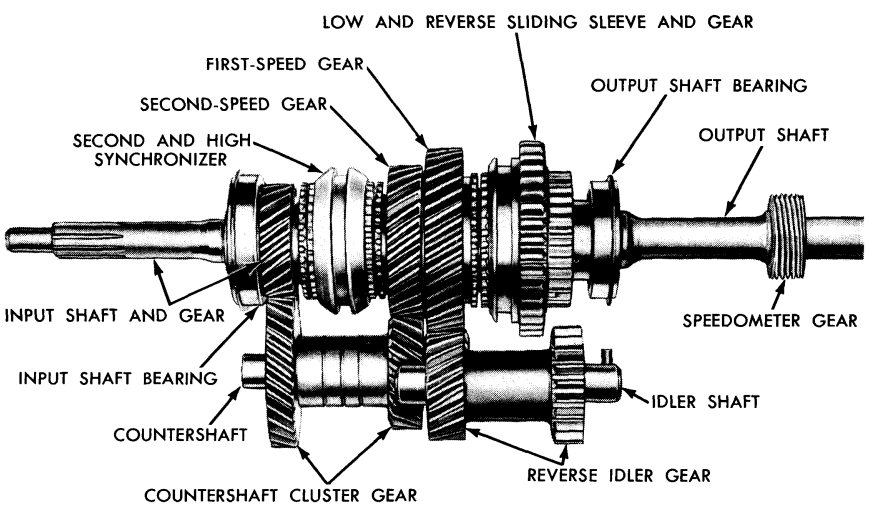
Ball bearings support the input shaft and gear and the center of the output shaft (Figs. 12 and 14). Roller bearings in the input shaft bore support the front of the output shaft. The countershaft gear (cluster) runs on two rows of roller bearings. Two bronze bushings are used in the reverse idler gear (Fig. 11). A bushing located at the rear of the extension housing supports the rear of the output shaft.

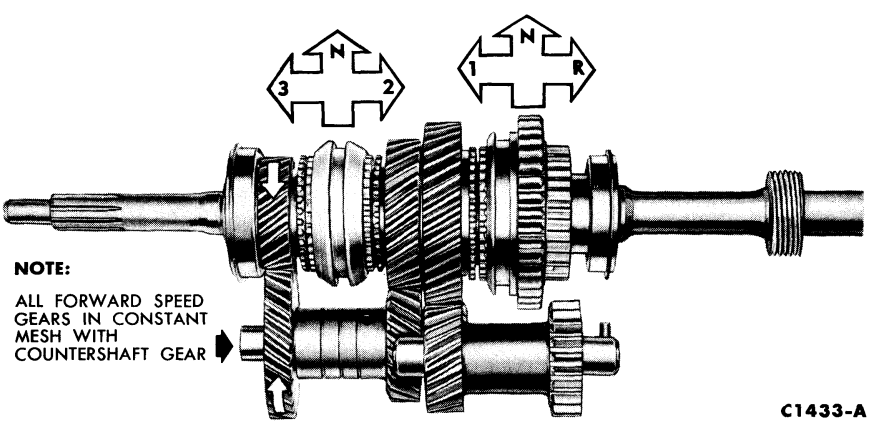
The shift forks, shift rails, detent mechanism and related parts are provided in the transmission case (Fig. 8).



C1422-A

**FIG. 1—Three-Speed Transmission**




C1433-A

**FIG. 2—Power Flow—Three-Speed Transmission**

### OPERATION

When the first-speed gear is selected, the shift lever moves the reverse gear and sleeve forward and forces the synchronizer blocking ring conical surface against the matching cone on the constant mesh first gear located on the output shaft. If the car is moving, the internal teeth of the reverse gear and sleeve and blocking ring will not index until the constant-mesh first gear is brought up or down to the speed of the reverse gear and sleeve which is rotating at output shaft speed.

The reverse gear and sleeve has internal splines that, with further movement, will slide over the blocking ring and engage external clutch teeth on the constant mesh first gear. Since first gear is now locked to the output shaft and is always meshed with the countershaft (cluster) gear, the power flow is from the input gear, through the countershaft gear, to the constant mesh first gear, through the reverse gear and sleeve to the output shaft and out the rear of the transmission.

Engagement of second and third gears is the same as first except for ratio. In third gear, the input gear and shaft is locked directly to the output shaft by the second and third-speed synchronizer to provide a ratio of 1:1.

Spur teeth are cut on the outside of the reverse gear and sleeve which, like the hub, are always locked to the output shaft. Reverse gear is engaged by sliding the reverse gear and sleeve into mesh with the spur gear at the rear of the idler gear. The drive is then from the input gear, through the countershaft gear, to and through the reverse idler gear to the output shaft reverse gear and sleeve. The gears in this position will rotate the output shaft in a reverse direction.

A system of interlocks and detents in the transmission case prevents the selection of more than one gear speed at a time and helps to hold any gear in the selected position.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### GEAR SHIFT LINKAGE ADJUSTMENT

**1.** Place the gear shift lever in the neutral position.

**2.** Loosen the two gearshift rod adjustment nuts (Fig. 3).

**3.** Insert a 3/16-inch diameter alignment pin through the first and reverse gearshift lever and the second and third gearshift lever. It may be necessary to align the levers to insert the pin.

**4.** Tighten the two gearshift rod adjustment nuts.

**5.** Remove the alignment pin from the levers.

**6.** Start the engine and shift the selector lever to each position to make sure it operates freely.

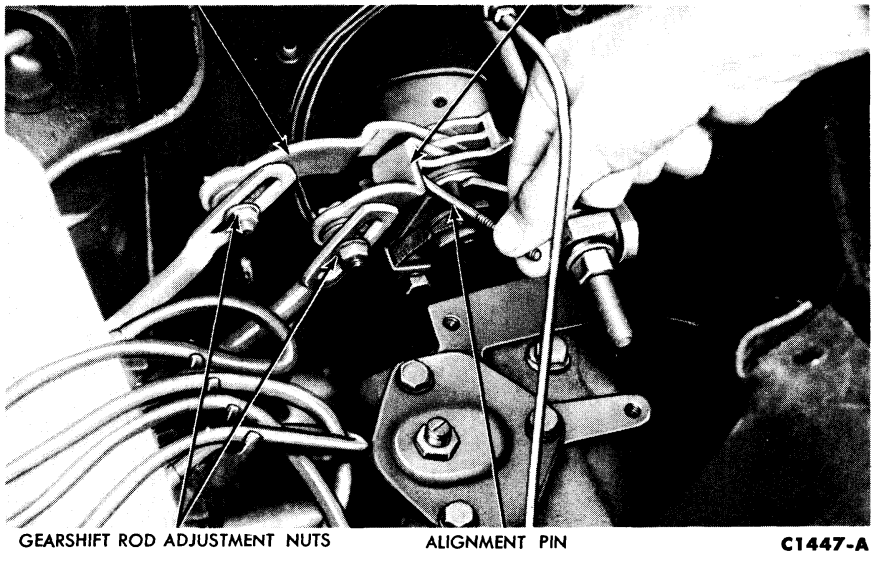



**FIG. 3—Gearshift Linkage Adjustment**

## 3 REMOVAL AND INSTALLATION

### REMOVAL

**1.** Raise the car on a hoist and drain the lubricant from the transmission.

**2.** Mark the drive shaft so that it may be installed in the same relative position. Disconnect the drive shaft from the rear U-joint flange.

**3.** Slide the front of the drive shaft out of the extension housing and off the output shaft. Insert the tool shown in Fig. 2, Part 6-1, into the extension housing to prevent the lubricant from leaking out of the transmission.

**4.** Remove the cap screw and lock washer that secures the speedometer cable retainer to the extension housing. Pull the speedometer cable out of the extension housing.

**5.** Remove the cotter pin, flat washer, and spring washer that secures the shift rods to the shift levers on the transmission.

**6.** Disconnect the parking brake cable from the equalizer.

**7.** Remove the two cap screws and lock washers that secure the extension housing to the engine rear support.

**8.** Raise the rear of the engine high enough to remove the weight from the frame crossmember. Remove the crossmember attaching bolts. Remove the crossmember and the rear support.

**9.** Support the transmission with a transmission jack and remove the four flywheel housing-to-transmission case attaching bolts and lock washers.

**10.** Move the transmission and jack rearward until the input shaft is clear of the flywheel housing.

**11.** Remove the transmission from the jack and mount it in a holding fixture.

### INSTALLATION

**1.** Make certain that the machined surfaces of the transmission case and the flywheel housing are free of dirt, paint, and burrs.

**2.** Install a guide pin in each lower mounting bolt hole.

**3.** Start the input shaft through the release bearing. Align the splines on the input shaft with the splines in the clutch disc. Move the transmission forward on the guide pins until the input shaft pilot enters the bearing or bushing in the crankshaft. If the transmission front bearing retainer binds up on the clutch release bearing hub, work the release bearing lever until the hub slides onto the transmission front bearing retainer. Install the two transmission-to-flywheel housing upper mounting bolts and lock washers. Remove the two guide pins and install the lower mounting bolts and lock washers. Torque the four mounting bolts to specifications.

**4.** Raise the rear of the engine high enough to provide clearance for installing the crossmember and the engine rear support. Bolt the crossmember and support assembly to the frame.

**5.** Lower the engine until the extension housing just contacts the rear support. Align the bolt holes in the extension housing with those in the support. Then lower the engine and remove the jack. Install the two extension housing-to-support attaching bolts and lock washers.

**6.** Insert the parking brake front cable in the equalizer and install the equalizer in the bracket on the crossmember. Secure the parking brake rear cable to the equalizer with a cotter pin.

**7.** Connect each shift rod to its respective shift lever on the transmission with a spring washer, flat washer, and cotter pin.

**8.** Insert the speedometer cable and driven gear in the extension housing and secure it with a cap screw and lock washer.

**9.** Remove the tool shown in Fig. 2, Part 6-1, from the extension housing. Align the reference marks and slide the front universal joint yoke onto the output shaft and into the extension housing. Connect the rear universal joint to the axle pinion flange and torque the nuts to specifications.

**10.** Fill the transmission to the proper level with the approved lubricant.

**11.** Adjust the clutch pedal free travel and the shift linkage as required.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

**1.** Mount the transmission in a holding fixture.

**2.** Remove the cap screws that attach the cover to the case. Remove the cover and the gasket (Fig. 4) from the case. Remove the plug, detent spring and the detent plug from the top of the case (Fig. 8).

**3.** Remove the cap screws and lock washers that attach the extension housing to the case. Remove the extension and gasket from the case.

**4.** Remove the cap screws and lock washers that attach the front bearing retainer to the case. Remove the retainer and gasket from the case.

**5.** Remove the lubricant filler plug from the right side of the case. Working through the plug opening, drive the roll pin out of the case and countershaft with a ¼-inch punch (Fig. 5).

**6.** Hold the countershaft gear with a hook and with the tool shown in Fig 6, push the countershaft out the rear of the case.

The countershaft (cluster) gear and thrust washers (Fig. 10) can be lowered to the bottom of the case. Remove the counter shaft from the rear of the case.

**7.** Pull the input gear and shaft forward until the gear contacts the case, and then remove the large snap ring. It is necessary to move the gear forward to provide clearance when removing the output shaft assembly transmissions. On all other models, from HEG-A and HEG-C model the input shaft and gear is removed from the front of the case at this time.

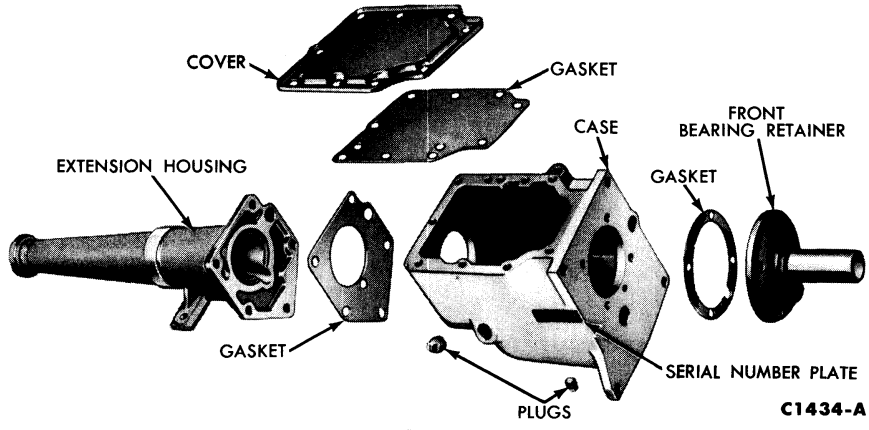



**FIG. 4—Transmission Case and Related Parts**

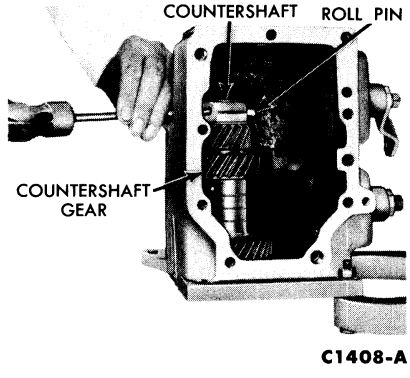


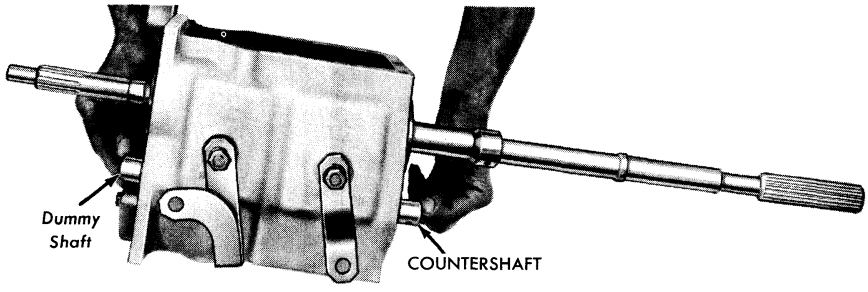

**FIG. 5—Removing Countershaft Roll Pin**

**8.** Remove the snap ring that secures the speedometer drive gear on the output shaft. Slide the speedometer drive gear off the shaft. Remove the speedometer drive gear lock ball from the shaft.

**9.** Remove the snap ring that retains the output shaft bearing on the shaft. Remove the bearing from the case and shaft as shown in Figure 7.

**10.** Place both shift levers in the neutral (center) position.

**11.** Remove the set screw (Fig. 8) that retains the detent springs and plugs in the case. Remove the detent spring and plug from the case.




*Tool—T63P-7111-A (352, 390 AND 427 V-8)*
*Tool—T63P-7111-B (223 SIX TAXI AND 289 V-8)*
*Tool—T63P-7111-C (MILEAGE MAKER SIX)*

C1436-B

**FIG. 6—Removing Countershaft**

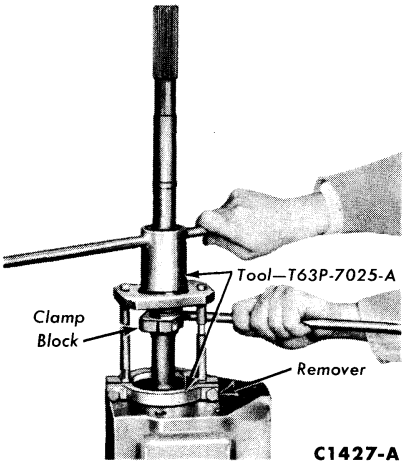



**FIG. 7—Removing Output Shaft Bearing**

**12.** Remove the set screw that secures the first and reverse shift fork to the shift rail. Slide the first and reverse shift rail out through the rear of the case.

**13.** Slide the first and reverse synchronizer forward as far as possible, and rotate the first and reverse shift fork upward. Then lift it from the case.

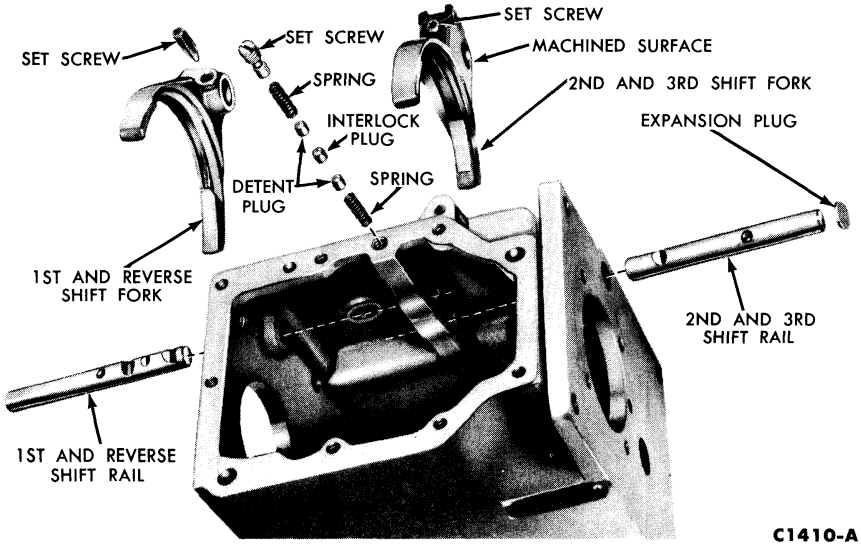



**FIG. 8—Shift Rails and Forks Disassembled**

**14.** Move the second and third-speed shift fork to the second-speed position to gain access to the set screw. Remove the set screw from the fork. Rotate the shift rail 90° as shown in Fig. 9.

**15.** Lift the interlock plug (Fig. 8) from the case with a magnet.

**16.** Tap on the inner end of the second and third-speed shift rail to remove the expansion plug (Fig. 8) from the front of the case. Remove the shift rail.

**17.** Remove the second and third-speed shift rail detent plug and spring from the detent bore.

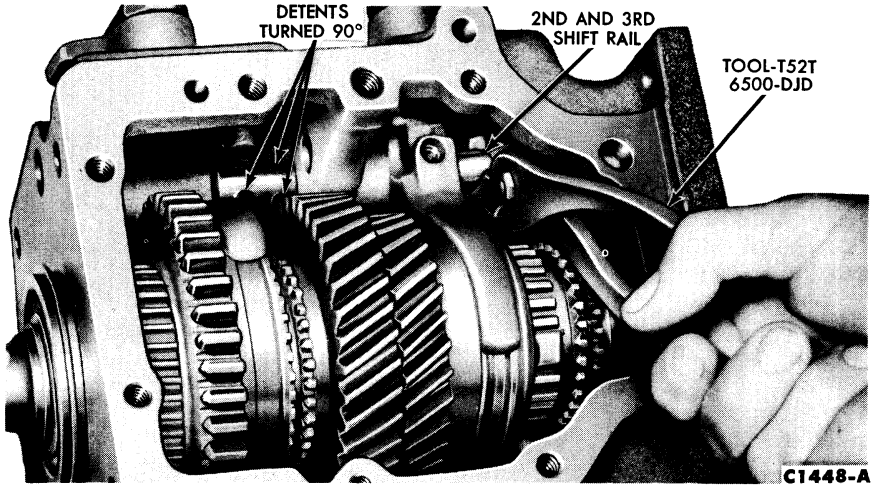



**FIG. 9—Rotating Second and Third-Speed Shift Rail**

**18.** Rotate the second and third-speed shift fork upward, and lift it from the case.

**19.** Carefully lift the output shaft assembly out through the top of the case.

**20.** On an HEG-A or C model, work the input shaft bearing and gear back through the bore in the case and out through the top.

**21.** Lift the reverse idler gear and two thrust washers (Fig. 11) from the case. Lift the countershaft gear, thrust washers, and dummy shaft from the case.

**22.** Remove the snap ring from the front of the output shaft, and slide the synchronizer and the second-speed gear (Fig. 12) off the shaft.

**23.** Remove the next snap ring and tabbed thrust washer from the output shaft. Then slide the first gear and blocking ring off the shaft.

**24.** Remove the next snap ring from the output shaft. Then slide the reverse gear and sleeve off the shaft.

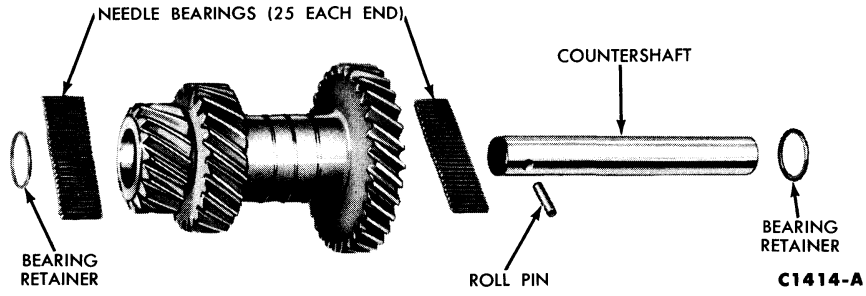



**FIG. 10—Countershaft Gear Disassembled**

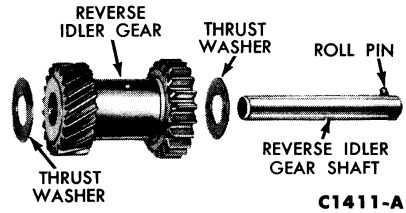



**FIG. 11—Reverse Idler Shaft Disassembled**

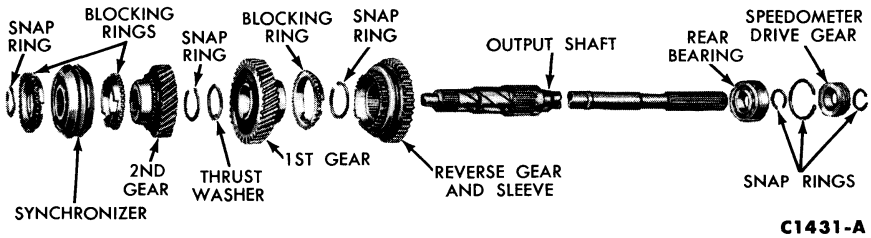



**FIG. 12—Output Shaft Disassembled**

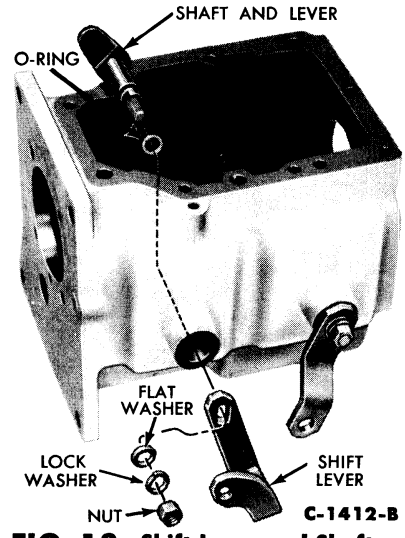



**FIG. 13—Shift Lever and Shaft Disassembled**

## PARTS REPAIR OR REPLACEMENT

### SHIFT LEVERS AND SEALS

**1.** Remove the nut, lock washer, and flat washer that secure each shift lever (Fig. 13) to the lever and shaft in the transmission case. Lift the levers off the shaft. Slide each lever and shaft out of the case. Discard the "O" ring from each shaft.

**2.** Lubricate the new seals with transmission lubricant and install them on the shafts.

**3.** Install the lever and shafts in the case.

**4.** Position a shift lever on each shaft and secure them with a flat washer, lock washer, and nut.

### INPUT SHAFT BEARING

**1.** Remove the snap ring securing the input shaft bearing (Fig. 14), and press the input shaft out of the bearing.

**2.** Press the input shaft bearing onto the input shaft with the tool shown in Fig 15, and install the snap ring on the shaft.

### SYNCHRONIZERS

**1.** Push the synchronizer hub from each synchronizer sleeve.

**2.** Separate the inserts and insert springs from the hubs. Do not mix the parts from the second and third-speed synchronizer with the first and reverse synchronizer Figs. 16 and 17.

**3.** If the tip of the first and reverse synchronizer rear insert spring is less than 0.120 inch in length (Fig. 16) replace it.

**4.** Install the rear insert spring (Fig. 18) in the groove of the first and reverse synchronizer hub. Make sure that the spring covers all insert grooves. Start the hub in the sleeve making sure that the alignment marks are properly indexed. Position the three inserts in the hub making sure that the small end is over the spring and that the shoulder is on the inside of the hub. Slide the sleeve and reverse gear onto the hub until the detent is engaged. Install the front insert spring in the hub to hold the inserts against the hub.

**5.** Install one insert spring (Fig. 17) into a groove of the second and third speed synchronizer hub, making sure that all three insert slots are fully covered. With the alignment marks on the hub and sleeve aligned, start the hub into the sleeve. Place the three inserts on top of the retaining spring and push the assembly together. Install the remaining insert spring so that the spring ends cover the same slots as does the other spring. Do not stagger the springs. Place a synchronizer blocking ring on each end of the synchronizer sleeve.

### COUNTERSHAFT GEAR BEARINGS

**1.** Remove the dummy shaft, fifty roller bearings, and the two bearing retainer washers from the countershaft gear (Fig. 10).

**2.** Coat the bore in each end of the countershaft gear with grease.

**3.** Hold the dummy shaft in the gear and install the twenty-five roller bearings and a retainer washer in each end of the gear.

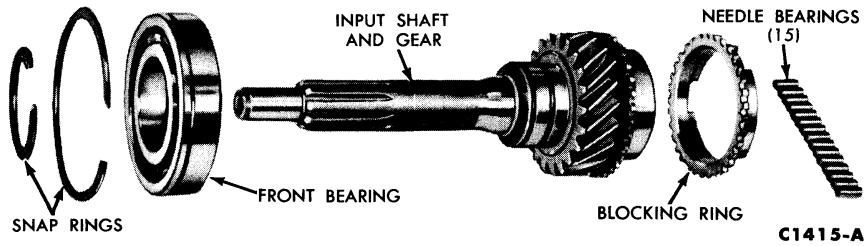



**FIG. 14—Input Shaft Gear Disassembled**

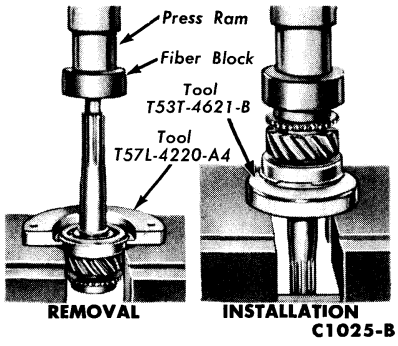



**FIG. 15—Replacing Input Shaft Bearing**

### ASSEMBLY

**1.** If the countershaft has not already been installed, position the countershaft, dummy shaft, roller bearings and thrust washers in the transmission case. The countershaft will remain in the bottom of the case until the output and the input shafts have been installed.

**2.** Lubricate the output shaft splines and machined surfaces with transmission lubricant.

**3.** Slide the first and reverse gear and sleeve (Fig. 12) onto the output shaft with the teeth end of the gear facing toward the rear of the shaft. Secure it in place with the snap ring.

**4.** Coat the tapered machined surface on the first gear with grease. Place the blocking ring on the greased surface.

**5.** Slide the first gear onto the output shaft with the blocking ring toward the rear of the shaft. Rotate the gear as necessary to engage the three notches in the blocking ring with the synchronizer inserts. Secure the first gear with the thrust washer and snap ring.

**6.** Coat the tapered machined surface of the second gear with grease and slide the blocking ring onto it. Slide the second gear with blocking ring and the second and third gear synchronizer onto the mainshaft. The tapered machined surface of the second gear must be toward the front of the shaft. Make sure that the notches in the blocking ring engage the synchronizer inserts. Secure the synchronizer with a snap ring.

**7.** Coat the bore of the input shaft and gear with a **thin** film of grease. **A thick film of grease will plug the lubricant holes and prevent lubrication to the bearings.** Install the 15 bearings (Fig. 14) in the bore.

**8.** If working on an HEG model transmission, install the input gear and bearing through the top of the case and through the bore in front of the case. Install the snap ring in the bearing groove.

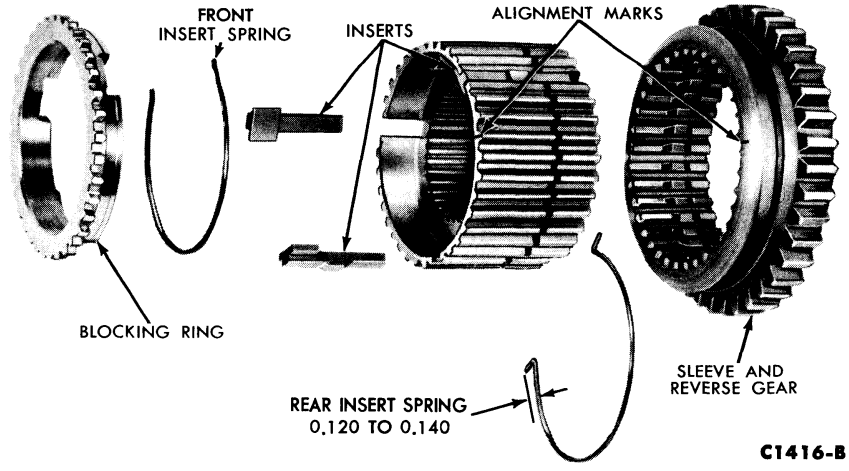



**FIG. 16—First and Reverse Synchronizer Disassembled**

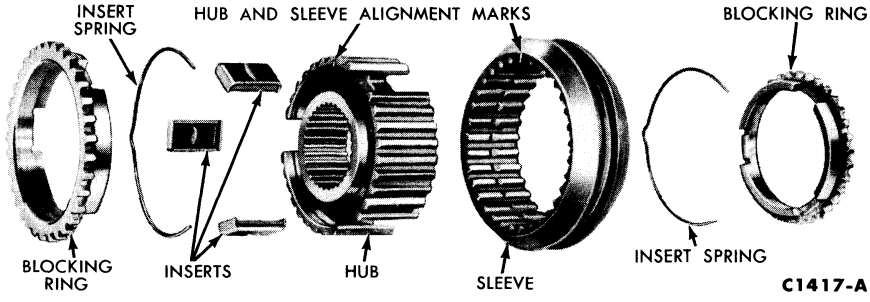



**FIG. 17—Second and Third Synchronizer Disassembled**

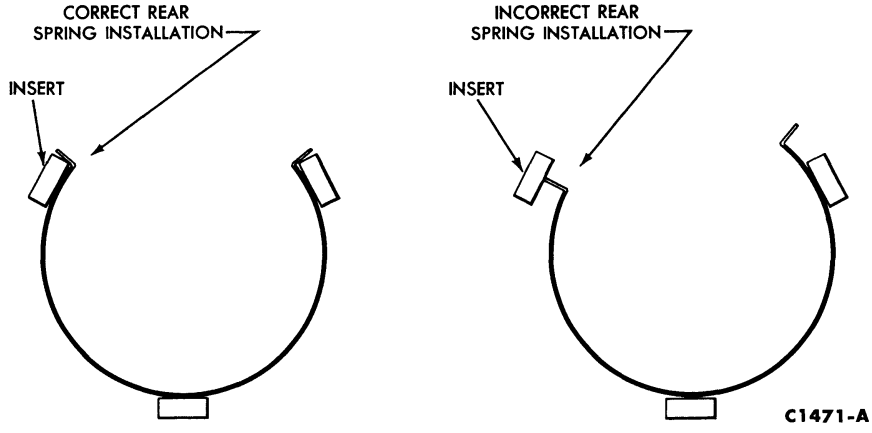



**FIG. 18—First and Reverse Speed Synchronizer Insert Spring Installation**

**9.** Position the output shaft assembly in the case. Position the second and third-speed shift fork on the second and third-speed synchronizer.

**10.** Place a detent plug spring and a plug in the case (Fig. 8). Place the second and third-speed synchronizer in the second speed position (toward rear of transmission). Align the fork and install the second and third-speed shift rail. It will be necessary to depress the detent plug to enter the rail in the bore. Move the rail inward until the detent plug engages the forward notch (second-speed position).

**11.** Secure the fork to the shaft with the set screw. Move the syn-

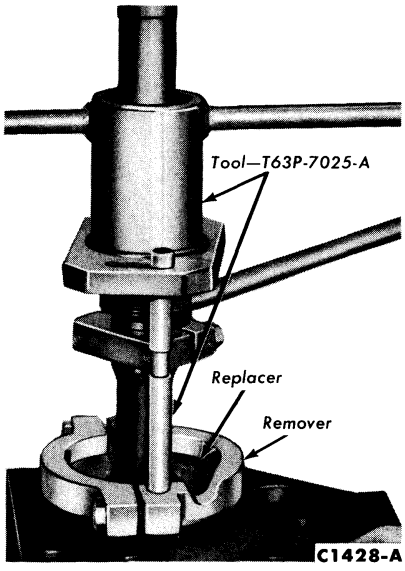



**FIG. 19—Installing Output Shaft Rear Bearing**

chronizer to the neutral position.

**12.** Install the interlock plug in the case. If the second and third-speed shift rail is in the neutral position, the top of the interlock will be slightly lower than the surface of the first and reverse shift rail bore.

**13.** Move the first and reverse synchronizer forward to the first-speed position. Place the first and reverse shift fork in the groove of the first and reverse synchronizer. Rotate the fork into position and install the first and reverse shift rail. Move the rail inward until the center notch (neutral) is aligned with the detent bore. Secure the fork to the shaft with the set screw. Install the remaining detent plug and spring. Secure the detent spring with the slotted head set screw. Turn the set screw in until the head is flush with the case.

**14.** Install a new shift rail expansion plug in the front of the case.

**15.** Hold the input shaft and blocking ring in position. Then move the output shaft forward to seat the pilot in the roller bearings of the input gear.

**16.** Tap the input gear bearing into place in the case while holding the output shaft to prevent the roller bearings from dropping. Install the front bearing retainer and new gasket making sure that the oil return slot is at the bottom of the case. Install and torque the attaching screws to 19-25 ft-lbs.

**17.** Install the large snap ring on the rear bearing. Place the bearing on the output shaft with the snap ring end toward the rear of the shaft. Press the bearing into place with the tool shown in Fig. 19. Secure the bearing to the shaft with a snap ring.

**18.** Hold the speedometer drive gear lock ball in the detent and slide the speedometer drive gear into place. Secure the gear with a snap ring.

**19.** Place the transmission in the vertical position. Working through the drain hole in the bottom of the case, align the bore of the countershaft gear and the thrust washers with the bore of the case with a screwdriver.

**20.** Working from the rear of the case, push the dummy shaft out of the countershaft gear with the countershaft. Before the countershaft is completely inserted in the bore, make sure that the hole that accommodates the roll pin is aligned with the hole in the case. Drive the shaft into place and install the roll pin.

**21.** Coat a new extension housing gasket with sealer and position it on the case.

**22.** Install lock washers on the five attaching screws. Dip the threads of the cap screws in sealer. Secure the housing to the case and torque the cap screws to 42-50 ft-lbs.

**23.** Install the filler and drain plugs in the case. Make sure that the magnetic plug is installed in the bottom of the case.

**24.** Place the transmission in gear. Pour lubricant over the entire gear train while rotating the input or output shaft.

**25.** Coat a new cover gasket (Fig. 4) with sealer. Secure the cover with cap screws. Torque the screws to 14-19 ft-lbs.

**26.** Check the operation of the transmission in all of the gear positions.

# PART 6-3 FOUR-SPEED TRANSMISSION


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| 2 In-Car Adjustments and Repairs | 6-12 | 4 Major Repair Operations | 6-14 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

The four-speed transmission (Fig. 1) is of the fully synchronized type with all gears except the reverse sliding gear being in constant mesh. All forward-speed changes are accomplished with synchronizer sleeves (Fig. 2). The synchronizers permit quicker shifts, greatly reduce gear clash, and permit down-shifting into any forward speed gear while the car is moving.

The shift linkage is mounted directly on the transmission extension housing (Fig. 1) and enters the driver's compartment through an opening in the floor pan. A flexible rubber boot is provided to seal the driver's compartment (Fig. 3) from the exterior.

The shift pattern is engraved in the top of the gear shift lever knob. A finger-operated release lever is provided on the shift lever to prevent the transmission from being accidentally shifted into reverse gear.

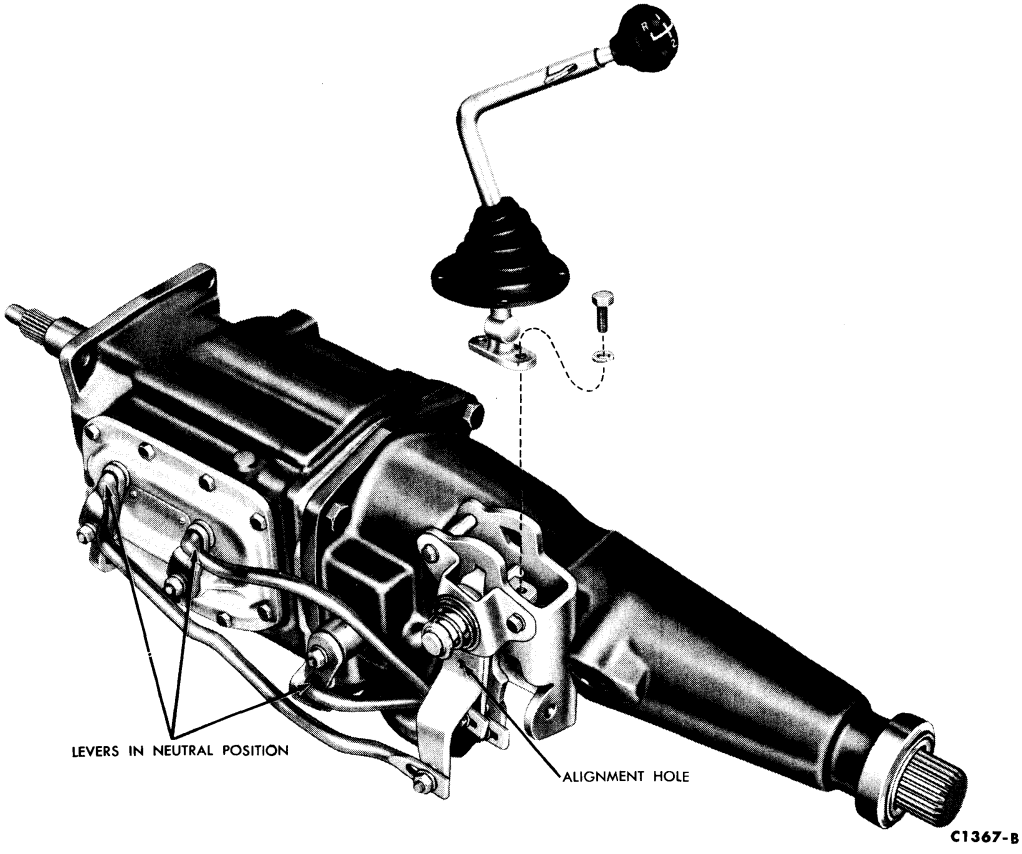



**FIG. 1—Four-Speed Floor Shift Transmission**

### OPERATION

In first speed, the first-and-second speed synchronizer sleeve is moved rearward by the shift fork. The sleeve engages the first speed blocking ring, which acts as a cone clutch applied to the free-wheeling first speed gear. This action speeds up or slows down the first speed gear to match the speed of the output shaft. Further movement of the sleeve locks the first-and-second speed synchronizer hub to the first-speed gear by means of internal splines. On engagement of the clutch, power flows through the input shaft and gear to the meshed

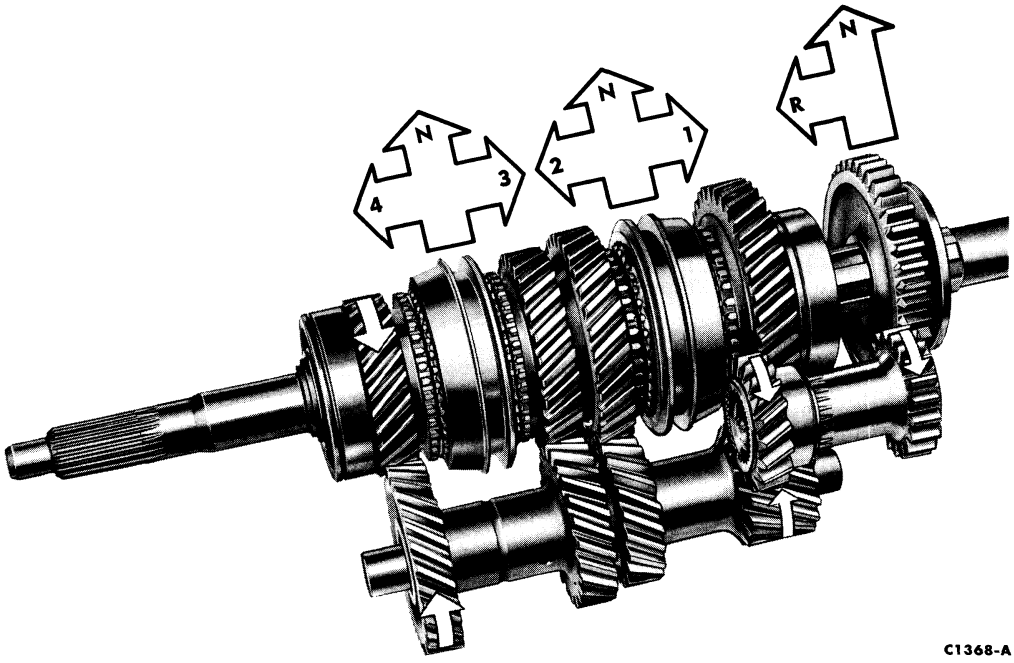



**FIG. 2—Power Flow—Four-Speed Transmission**

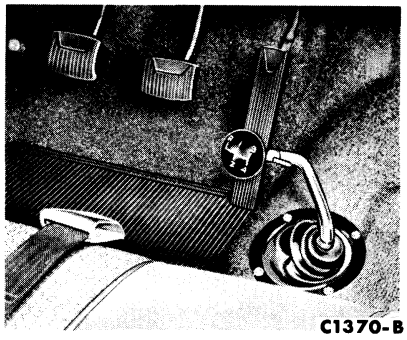



**FIG. 3—Shift Lever Installation**

countershaft gear and thence to the first-speed gear. This gear transmits the power through the locked synchronizer hub to the transmission output shaft. All the other forward-speed gears are in idler motion, as they are all driven by the countershaft (cluster) gear, but they do not transmit power because they are not locked to the output shaft. All the forward-speed shifts are made in the same manner as the first-speed shift, due to the constant-mesh features.

Reverse gear is engaged by moving the reverse sliding gear forward on the output shaft until it meshes with the reverse rear idler gear. Movement of the sliding gear is accomplished by a separate shift fork mounted in the extension housing. With all forward-speed synchronizer sleeves in neutral, power flow in reverse is through the input shaft to the constant-mesh countershaft (cluster) gear, thence to the constant mesh reverse gear front idler. Splines then carry the power through the adapter plate to the reverse gear rear idler in the extension housing. As the sliding reverse gear is meshed with the reverse gear rear idler, power is transmitted to the output shaft, rotating it in a reverse direction.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### GEAR SHIFT LINKAGE ADJUSTMENT

To adjust the gear shift linkage, place the shift lever in neutral position and raise the car on a hoist. Insert a ¼-inch drill or drill rod into the alignment hole as shown in (Fig. 4.) If the rod will not enter, check for bellied or bent shift rods. If the shift rods are the correct shape, check for loose lever lock nuts at the rod ends. Reset the linkage by loosening the three rod retaining lock nuts (Fig. 5) and moving the levers until the ¼-inch gauge rod or drill will enter the alignment holes. Make sure the transmission shift levers are in neutral and the reverse shift lever is in the neutral detent. If there is any doubt about location of the neutral position, disconnect the shift rods at the retaining lock nuts and rotate each forward-speed shift lever through its three positions until the center (neutral) detent is positively located. Move the reverse shift lever forward until positive engagement of the detent is felt. Install the shift rods

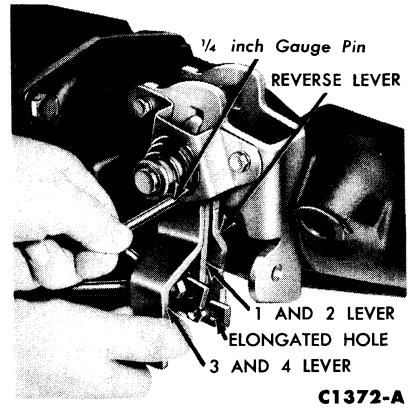



**FIG. 4—Shift Linkage Adjustment**

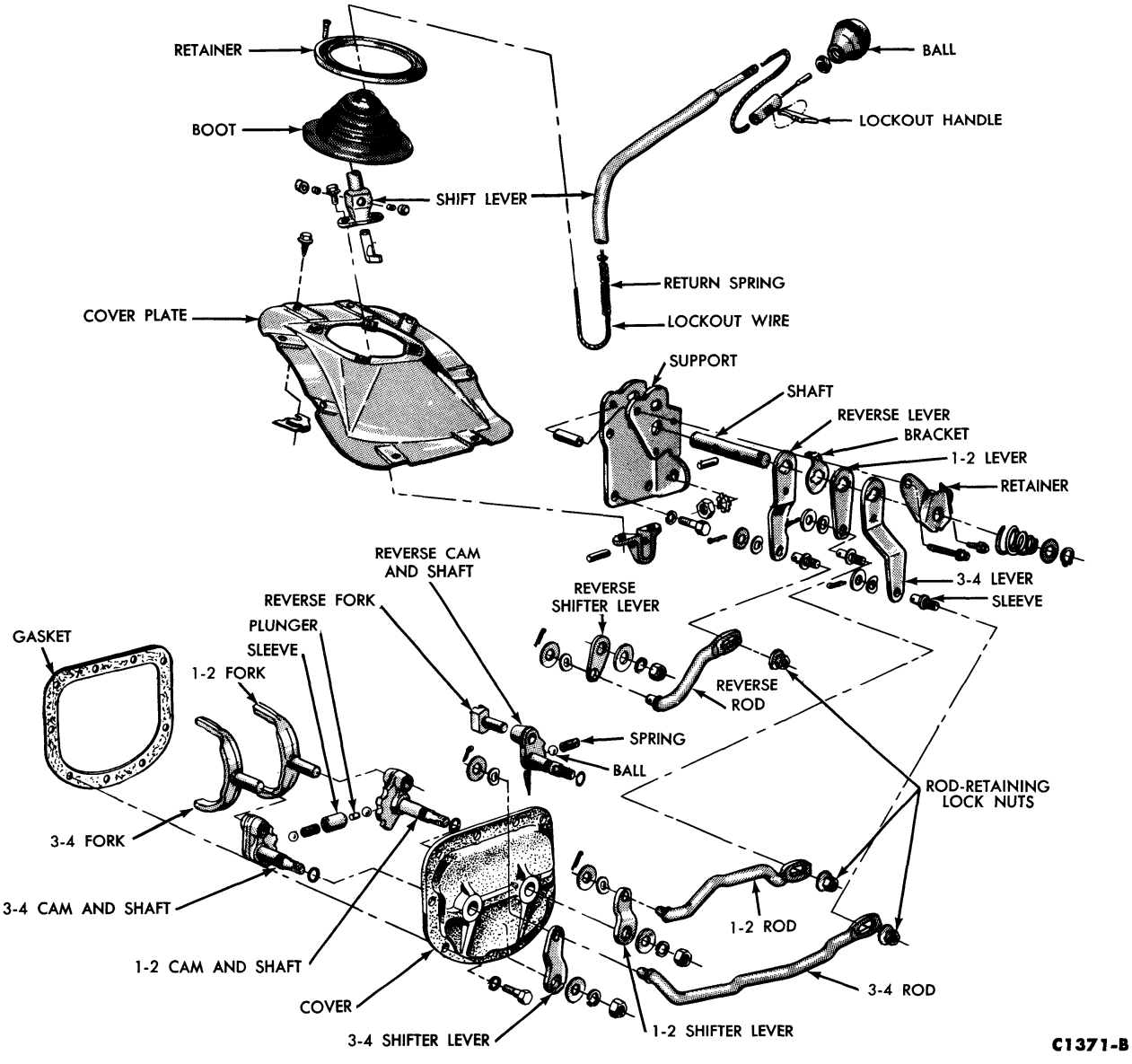



**FIG. 5—Shift Linkage and Cover Disassembled**

and tighten the lock nuts to specifications. Remove the ¼-inch gauge rod. Operate the shift levers to make sure that the detents are engaging. Lower the car and check for smooth cross-over operation.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

**1.** Before raising the car, remove the transmission gear shift selector lever boot retainer (Fig. 5). Working under the boot **remove the shift selector lever retaining bolts** and remove the selector lever from the shift assembly. The remaining shift linkage may be left on the transmission during removal.

**2.** Mark the drive shaft so that it may be installed in the same relative position. Disconnect the drive shaft from the rear U-joint flange. Slide the drive shaft off the transmission output shaft and install the tool shown in Fig. 2, Part 6-1, in the extension housing to prevent lubricant leakage.

**3.** Disconnect the speedometer cable from the extension housing.

**4.** Disconnect the parking brake at the equalizer bar, and support the engine with a transmission jack.

**5.** Remove the extension housing-to-engine rear support attaching bolts.

**6.** Raise the rear of the engine with the transmission jack. Disconnect the frame crossmember at the frame and remove the crossmember and engine rear support.

**7.** Move the jack from under the engine to support the transmission. Then remove the bolts that attach

the transmission to the flywheel housing.

**8.** Move the transmission and jack rearward until the transmission input shaft clears the flywheel housing. If necessary, lower the engine enough to obtain clearance for transmission removal.

**Do not depress the clutch pedal while the transmission is removed.**

### INSTALLATION

**1.** Make sure that the mounting surfaces of the transmission and the flywheel housing are free of dirt, paint, and burrs. Install two guide pins in the flywheel housing lower mounting bolt holes. Move the transmission forward on the guide pins until the input shaft splines enter the clutch hub splines and the case is positioned against the flywheel housing.

**2.** Install the two upper mounting bolts snug and then remove the two guide pins. Install the two lower mounting bolts. Torque all mounting bolts to specifications.

**3.** Raise the rear of the engine, and install the crossmember and the engine rear support. Then lower the engine. Torque the crossmember-to-frame attaching bolts to specifications.

**4.** With the transmission extension housing resting on the engine rear support, install the transmission extension housing attaching bolts. Torque to specifications.

**5.** Connect the speedometer cable to the extension housing, and connect the parking brake cable to the equalizer.

**6.** Remove the tool shown in Fig. 2, Part 6-1. Align the reference marks and slide the forward end of the drive shaft assembly over the transmission output shaft. Connect the drive shaft to the rear U-joint flange.

**7.** Place the shift cover levers and the reverse shift lever in neutral position and insert a ¼-inch rod in the shaft linkage alignment hole. Adjust the linkage as necessary and tighten the linkage lever lock nuts to specifications. Remove the ¼-inch rod.

**8.** Fill the transmission to the proper level with the specified lubricant.

**9.** Lower the car and install the shift selector lever and boot.

**10.** Check the shift and cross-over motion for full shift engagement and smooth cross-over operation.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

**1.** Mount the transmission in a holding fixture and drain the lubricant.

**2.** Disconnect the shift linkage rods at the shift levers. Remove the shift linkage from the extension housing as a unit.

**3.** Remove the transmission shift cover, gasket, and shift forks as an assembly.

**4.** Drive the reverse shift shaft pin (Fig. 6) out of the extension housing. Move the reverse shift shaft out of the extension housing about ⅛ inch. This operation frees the reverse shift fork from the reverse sliding gear located in the extension housing.

**5.** Remove the extension-to-case attaching bolts (Fig. 7). Tap the extension housing with a soft hammer to free it from the case. Slide the extension housing rearward until the reverse idler shaft (Fig. 8) is clear of the reverse rear idler gear. Rotate the extension housing to the left to clear the reverse shift fork and remove the extension housing.

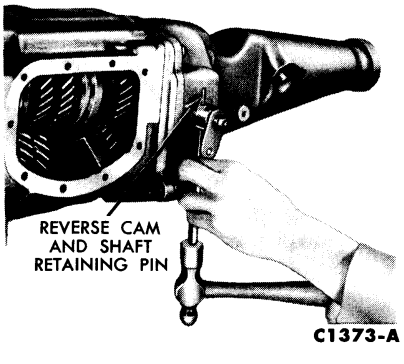



**FIG. 6—Removing Reverse Cam and Shaft Retaining Pin**

**6.** Lift the reverse rear idler (Fig. 9) from the case.

**7.** Remove the self-locking bolt that attaches the adapter plate to the transmission case. Remove the transmission output shaft assembly along with the adapter plate (Fig. 10). Catch any of the input shaft pilot rollers that may stick to the output shaft. Remove the remaining rollers from the input shaft bore.

**8.** Remove the fourth-speed gear synchronizer blocking ring which will be stuck on the input shaft gear or will have fallen into the case.

**9.** Remove the reverse gear front idler and thrust washer from the case (Fig. 11).

**10.** Working from the front of the case, use a drift to start the countershaft rearward. Insert the tool (dummy shaft) shown in Fig. 12 and push out the countershaft, allowing the countershaft (cluster) gear to settle to the bottom of the case. Remove the Woodruff key from the rear of the countershaft.

**11.** Remove the input shaft bearing retainer and discard the gasket. Remove the input shaft bearing retaining snap ring and push the input shaft and bearing assembly inward and out of the bearing bore. Remove the input shaft assembly from inside the case.

**12.** Remove the countershaft (cluster) gear from the case (including dummy shaft and thrust washers). Note the arrangement of the spacers.

**13.** Remove the input shaft bearing retainer oil seal as shown in Fig. 13.

**14.** Install the input shaft bearing retainer oil seal using the tool shown in Fig. 14.

**15.** To disassemble the output shaft, remove the small snap ring at the front of the shaft and slide the third and fourth-speed gear synchronizer assembly (Fig. 15), third-speed gear synchronizer blocking ring, third-speed gear (Fig. 16), thrust washer, second-speed gear, and second-speed synchronizer blocking ring (Fig. 17) off the shaft.

**16.** Remove the output shaft rear oil seal from the shaft. Position the output shaft in a press and remove the speedometer drive gear (Fig. 18). Slide the reverse sliding gear off the output shaft.

**17.** Spread the retaining snap ring (Fig. 19) and press or tap the adapter plate off the output shaft rear bearing. Remove the snap ring retaining the output shaft bearing to

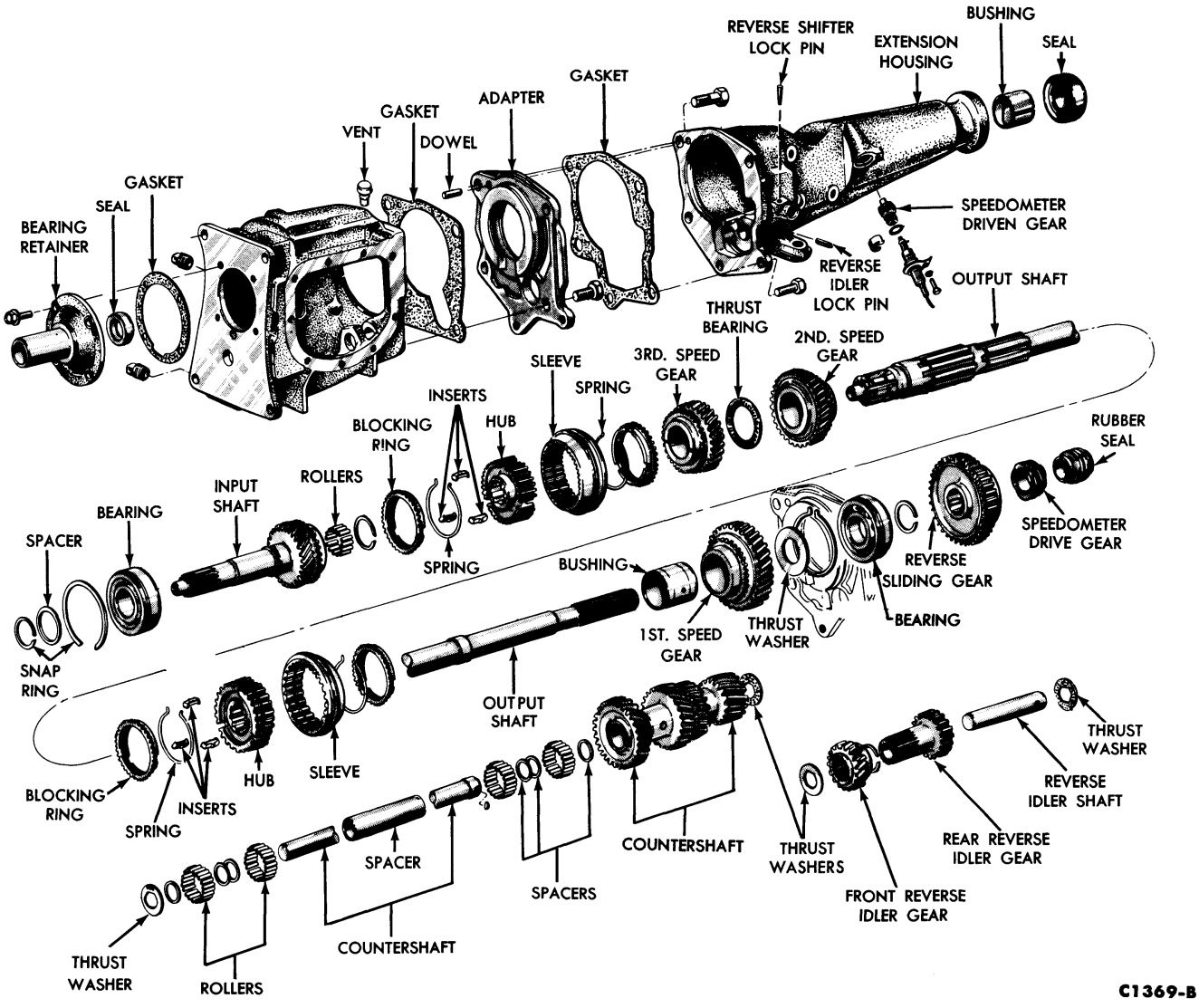



**FIG. 7—Four-Speed Transmission Disassembled**

the output shaft and press the bearing off the shaft (Fig. 20).

**18.** Complete the disassembly of the output shaft by sliding off the first-speed gear thrust washer (plain), first-speed gear, first-speed gear bushing, first-speed synchronizer blocking ring, and first and second-speed synchronizer assembly (Fig. 20).

**19.** To disassemble the extension housing, first remove the oil seal as shown in Fig. 1, Part 6-1. If necessary to replace the extension housing bushing, do so after reinstalling the extension housing, so that the tool shown in Fig. 2, Part 6-1, will be supported by the output shaft.

**20.** Pull the reverse shift fork from the reverse shift shaft and cam. Remove the reverse shift lever and carefully tap the shaft and cam into the housing, allowing detent ball and spring to drop out of the detent bore. Remove the "O" ring seal from the shift shaft.

**21.** Remove the reverse idler shaft by driving the retaining pin inward until it bottoms. Pull the shaft from the extension housing. Tap the shaft with a soft hammer to loosen it if necessary.

## PARTS REPAIR OR REPLACEMENT

### SYNCHRONIZERS

**1.** Scribe an index mark across the sleeve and the hub so that they may be installed in their original position when assembling them.

**2.** Disassemble the first and second-speed and third and fourth-speed synchronizers (Fig. 7) by sliding the clutch sleeves off the hubs and removing the three inserts and two insert springs from each assembly.

**3.** In both units, the synchronizer is assembled by installing two insert springs and three inserts on the synchronizer hub.

**4.** The springs should be assembled with one tang of each spring in the same insert, but with the springs turned in opposite directions so that the openings do not line up.

**5.** Line up the etched marks on the sleeve and hub and slide the sleeve onto the hub.

### SHIFT COVER

**1.** Remove the shift levers (Fig. 21) from the cam and shaft assemblies.

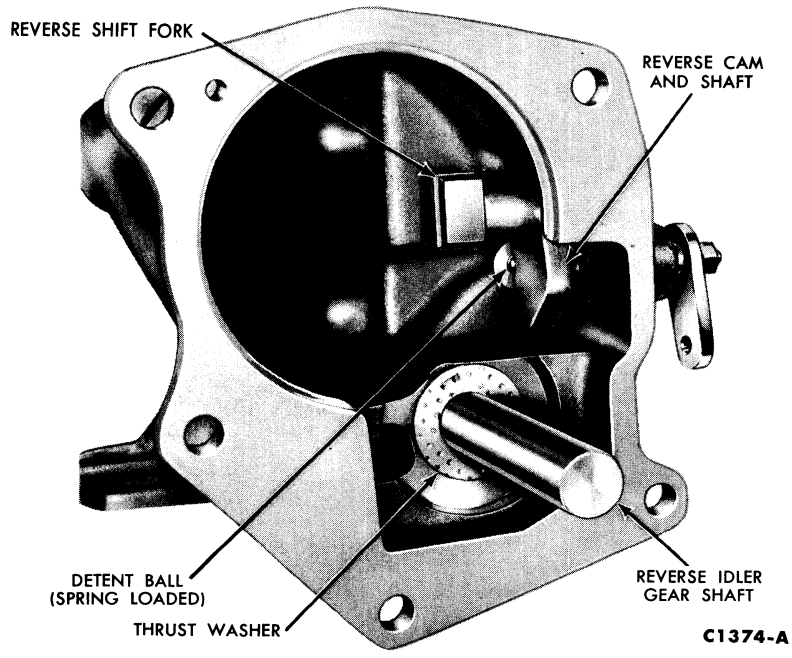



**FIG. 8—Reverse Idler Shaft and Shift Mechanism**

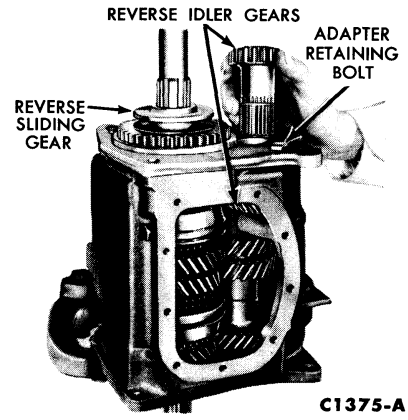



**FIG. 9—Reverse Gear Rear Idler Removal**

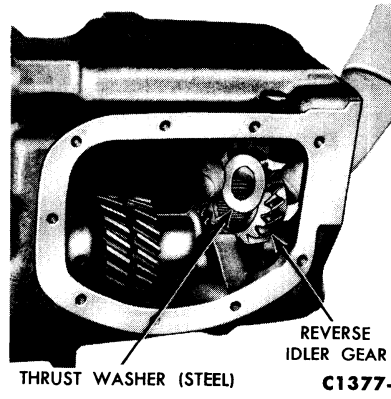



**FIG. 11—Reverse Gear Front Idler Removal**

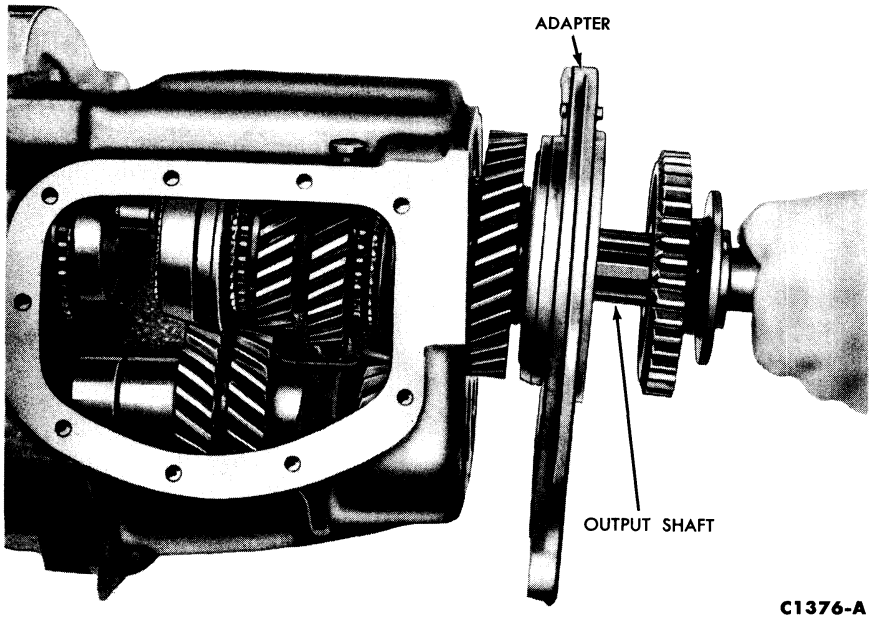



**FIG. 10—Output Shaft Removal**

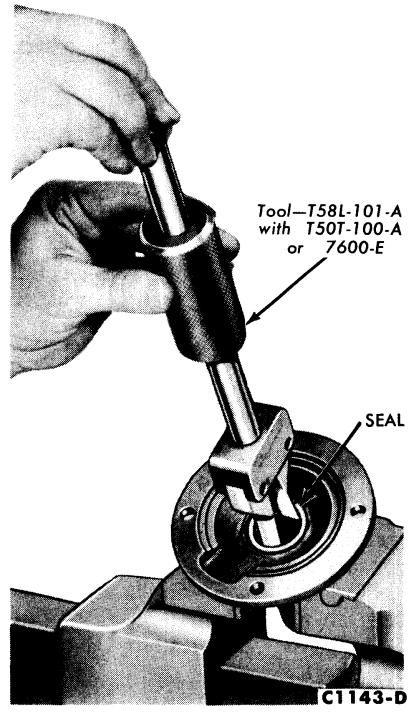



**FIG. 13—Input Shaft Oil Seal Removal**

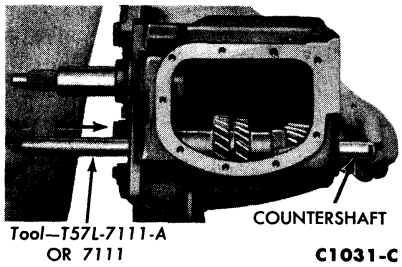



**FIG. 12—Countershaft Removal**

2. Pull the shift forks and shafts out of the gear shift cover. With the shafts removed, the detent balls, retainer, and spring will fall out of the gear shift cover.
3. Pull the shift forks out of the cams.
4. Remove the seal rings from the cam shafts.
5. Install new seal rings on the shift lever cam shafts. Lubricate the seal rings and shaft bores.

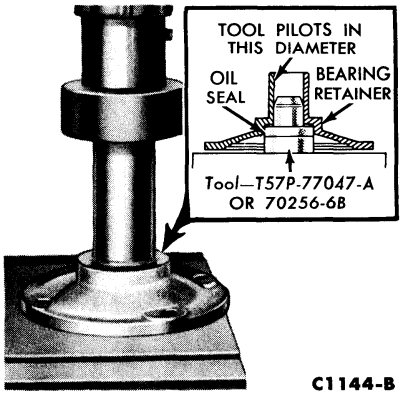



**FIG. 14—Input Shaft Oil Seal Installation**

**6.** Position one cam and shaft in the cover and place it in the neutral position.

**7.** Install the interlock spring, sleeve, pin, and one detent ball in the shift cover detent bore (Fig. 21).

**8.** Position the remaining detent ball and second cam and shaft in the cover. Install the gear shift levers and forks on the shafts. Check operation of the assembly.

### COUNTERSHAFT GEAR BEARINGS

**1.** Disassemble the countershaft gear as shown in Fig. 22. The six steel spacer washers are interchangeable.

**2.** Position the long countershaft roller spacer on the remover tool (dummy shaft) and install it in the countershaft (cluster) gear.

**3.** Install 20 roller bearings, two spacer washers, 20 more roller bearings, one spacer and one thrust washer in each end of the countershaft gear (Fig. 22).

**4.** Install the thrust washers with the flat bronze sides toward the countershaft gear faces.

### INPUT SHAFT BEARING

**1.** To disassemble the input shaft (Ford), remove the bearing retainer snap ring, and spacer washer. Reinstall the bearing outer snap ring that was removed previously. Then press the bearing off the shaft as shown in Fig. 23, using the tool indicated. To disassemble the input shaft (Mercury), remove the bearing retainer snap ring, and spacer washer. Insert the lip of the tool in the bearing snap ring groove and press the shaft out of the bearing.

**2.** Assemble the input shaft bearing on the shaft as shown in Fig. 23. Retain the bearing on the shaft with a spacer and snap ring.

**3.** Position the input shaft pilot rollers in the input shaft bore using a light film of heavy grease.

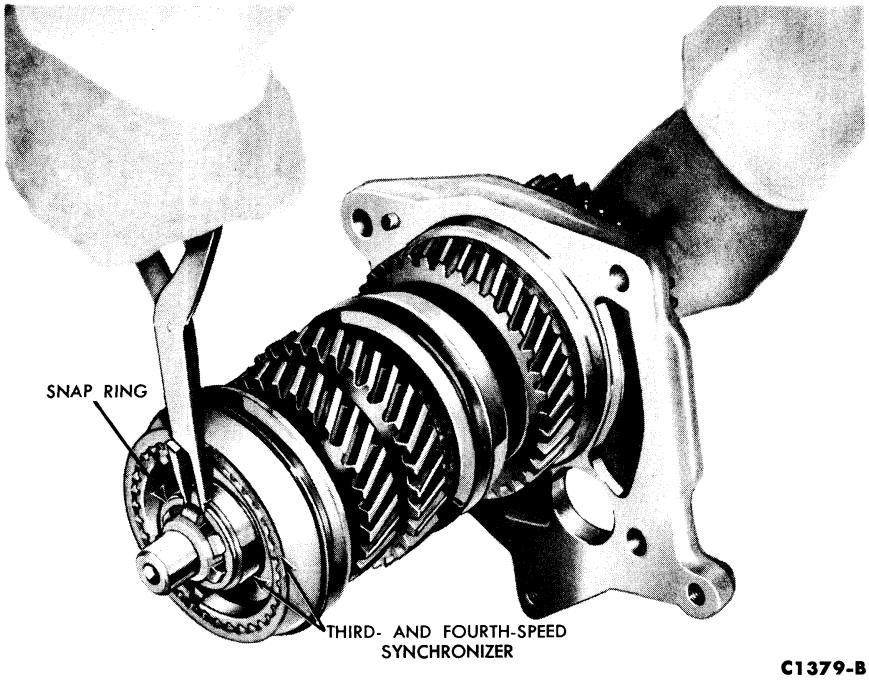



**FIG. 15—Third- and Fourth-Speed Synchronizer Removal**

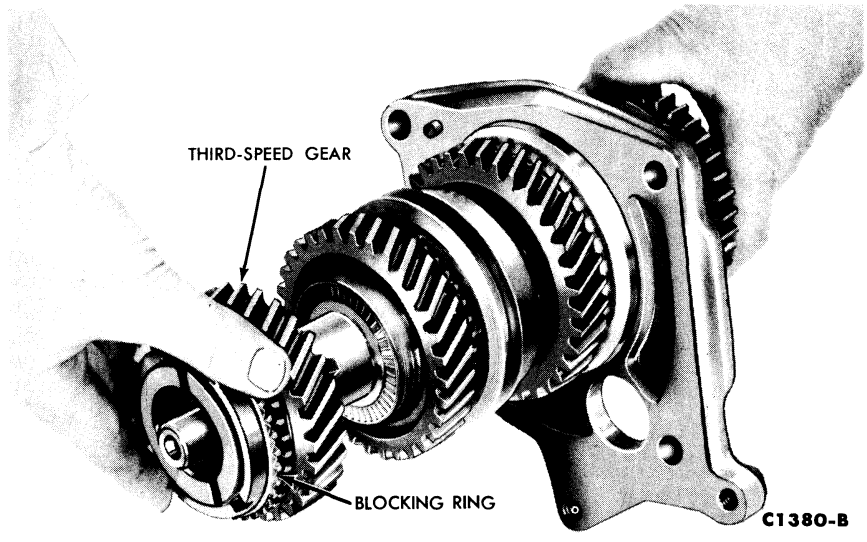



**FIG. 16—Third-Speed Gear Removal**

### ASSEMBLY

**1.** Place the countershaft gear in the case, aligning the thrust washer tangs with the slots in the case. Install the countershaft and check the countershaft gear end play (Fig. 24). Replace the thrust washers as required so that end play does not exceed 0.025 inch. Insert the remover tool (dummy shaft) in place of the countershaft and allow the countershaft gear to rest on the bottom of the case.

**2.** Install the input shaft assembly in the case, working thru the shift cover opening. Install the input shaft retaining snap ring in the front bearing groove.

**3.** Raise the countershaft gear into mesh with the input shaft gear and install the countershaft. Line up the countershaft Woodruff key slot with the counterbore provided in the case and install the Wood-

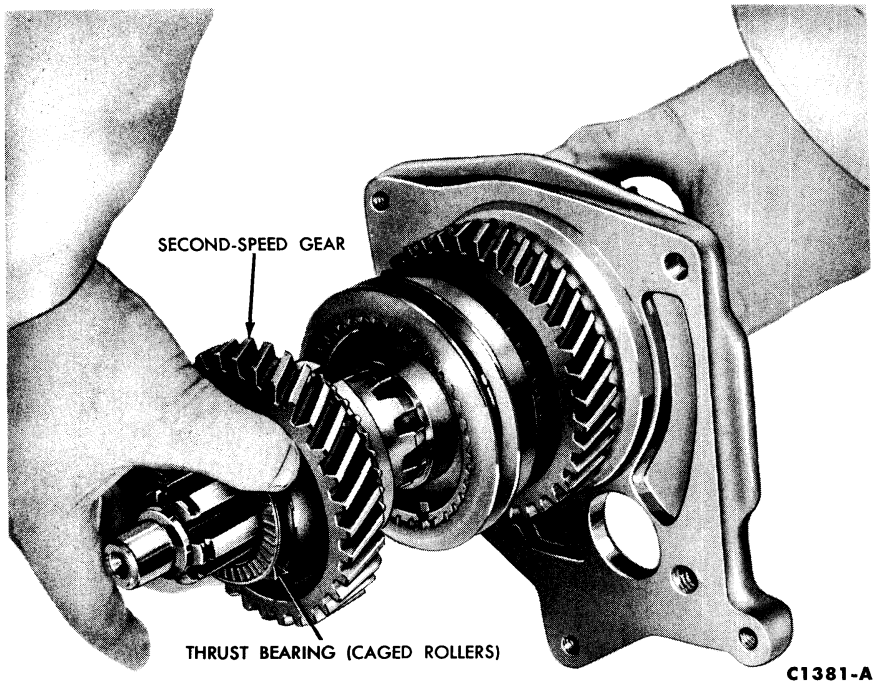



**FIG. 17—Second-Speed Gear Removal**

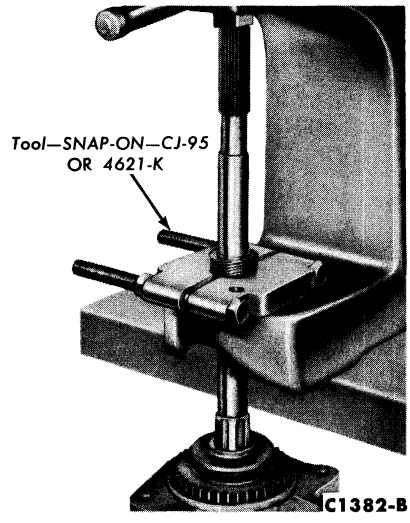



**FIG. 18—Speedometer Drive Gear Removal**

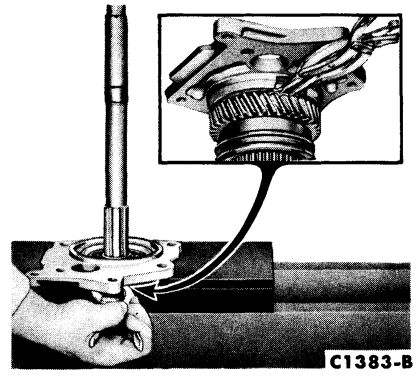



**FIG. 19—Adapter Plate Removal**

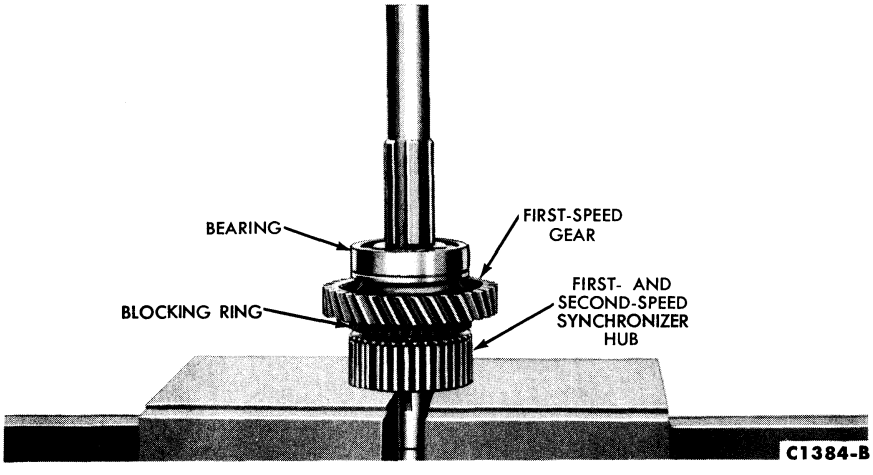



**FIG. 20—Output Shaft Bearing Removal**

ruff key. Tap the countershaft into position flush with the rear face of the case.

**4.** Position the fourth-speed synchronizer blocking ring on the input shaft gear taper with heavy grease.

**5.** Working from the rear of the output shaft, slide the first and second-speed synchronizer onto the shaft. The sliding clutch sleeve long taper should face the rear (Fig. 19).

**6.** Slide the first-speed bushing onto the output shaft. Position the first-speed gear synchronizer blocking ring on the first and second-speed gear synchronizer, aligning the notches in the blocking ring with the inserts in the synchronizer. Install the first-speed gear on the first-speed gear bushing, tapered hub facing forward. Install the first-speed gear thrust washer, with the grooved side to the gear (Fig. 7).

**7.** Position the output shaft rear bearing on the output shaft with the snap ring groove in the bearing race facing forward. Press the bearing on the shaft. Seat the bearing firmly against the shaft shoulder and install the snap ring.

**8.** Install the adapter plate on the output shaft rear bearing by spreading the snap ring in the adapter plate and tapping or pressing the plate over the bearing (Fig. 19). Release the snap ring.

**9.** Position the reverse sliding gear on the output shaft, with the shift collar toward the rear. Press the speedometer drive gear on the output shaft until the measurement from the rear end of the output shaft to the rear face of the speedometer gear is 9¼ inches.

**10.** Working from the front of the output shaft (Fig. 17), position the second-speed gear synchronizer blocking ring on the previously installed first and second-speed synchronizer. Line up the notches in the blocking ring with the inserts in the synchronizer.

**11.** Slide the second-speed gear onto the output shaft, with the tapered hub facing toward the rear. Position the radial roller thrust bearing against the front hub face of the second-speed gear (Fig. 17).

**12.** Install the third-speed gear on the output shaft, with the tapered hub facing forward. Position the third-speed gear synchronizer blocking ring on the taper of the third-

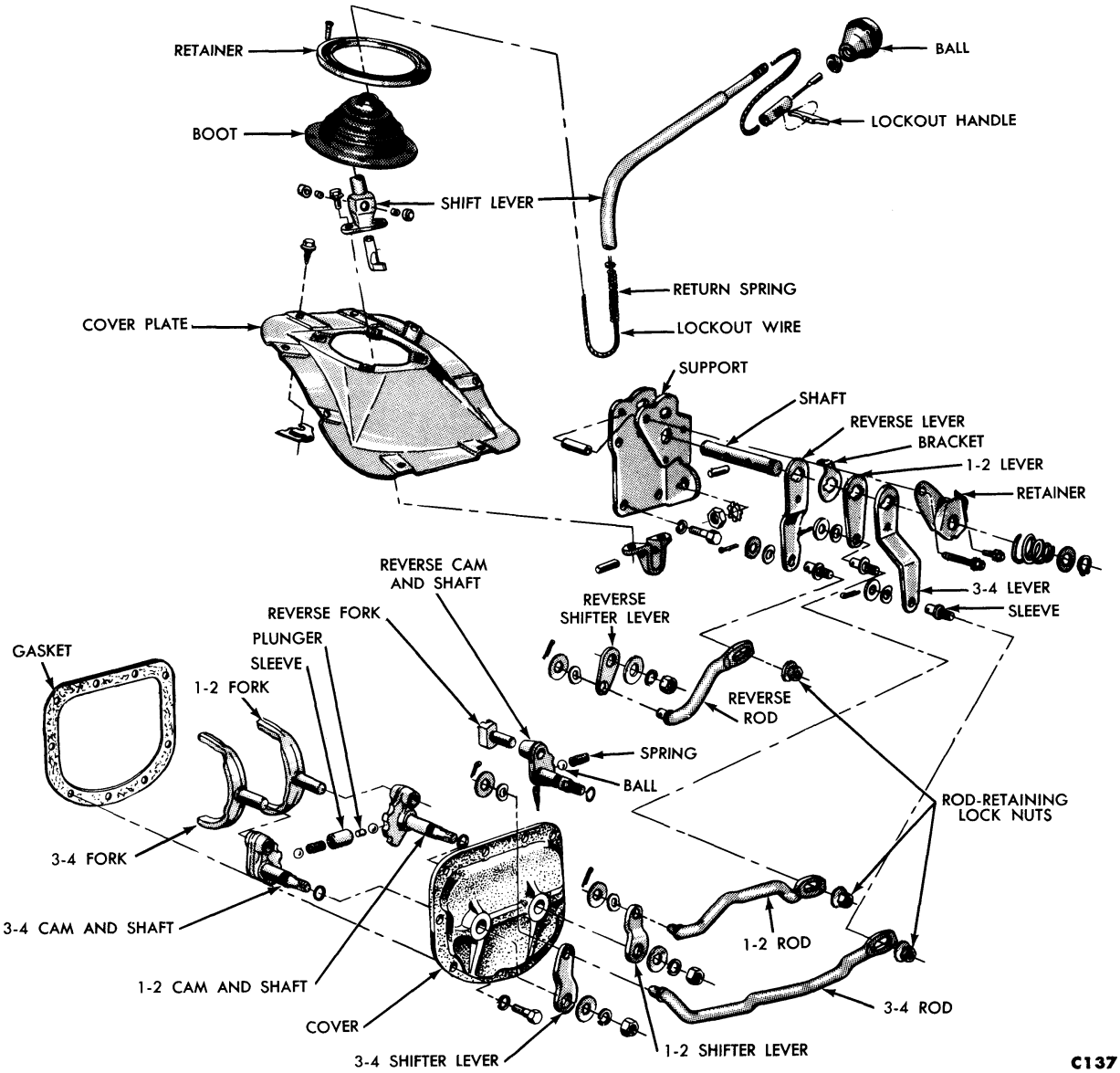



**FIG. 21—Shift Cover and Linkage Disassembled**

speed gear, with the notches in the blocking ring facing forward (Fig. 16).

**13.** Position the third and fourth-speed gear synchronizer assembly on the output shaft, lining up the synchronizer insert with the notches in the third-speed gear blocking ring. Install the output shaft front snap ring (Fig. 15).

**14.** Position the output shaft seal on the output shaft.

**15.** Working through the output shaft opening, install the reverse gear front idler and thrust washer in the case as shown in Fig. 11.

**16.** Make sure that the fourth-speed synchronizer blocking ring is in place on the input shaft gear and that the input shaft pilot rollers are installed. Apply a gasket to the rear of the case. Position the output shaft in the transmission case and move it forward, lining up the notches in the fourth-speed blocking ring with the inserts in the third and fourth-speed synchronizer. Line up the dowel pin in the adapter with the locating hole in the main case and push or tap the output shaft and adapter into position. Install the self-locking bolt retaining the adapter plate to the transmission case and torque it to specifications.

**17.** Install the reverse gear rear idler gear (Fig. 9).

**18.** Line up the retaining pin holes in the idler shaft and housing and tap the reverse idler shaft into the extension housing with a soft hammer. Coat the retaining pin with oil resistant sealer and install the pin flush with the outside of the housing.

**19.** Position the O-ring seal on the reverse shifter shaft. Install the detent ball and spring in the detent bore. Working from inside the extension housing, hold the detent ball down with a suitable tool and insert the shift shaft and cam from the inside. Install the reverse shift lever. Position the reverse shift fork on the reverse shift shaft (Fig. 8).

**20.** Install reverse idler gear tanged thrust washer on the idler shaft with the tang facing rearward (Fig. 8). Apply heavy grease to retain the washer against the extension housing.

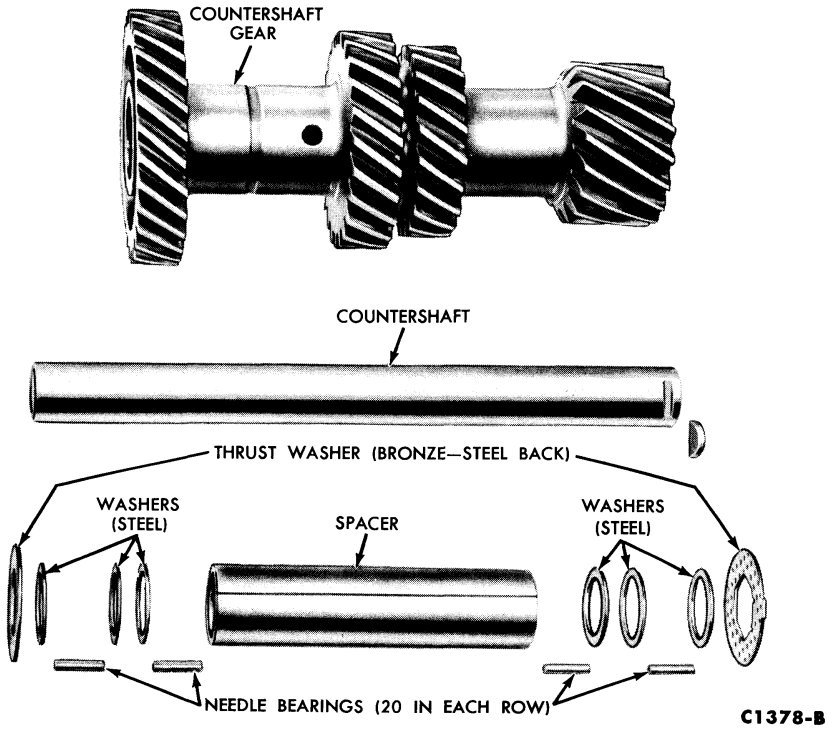



**FIG. 22—Countershaft Gear Disassembled**

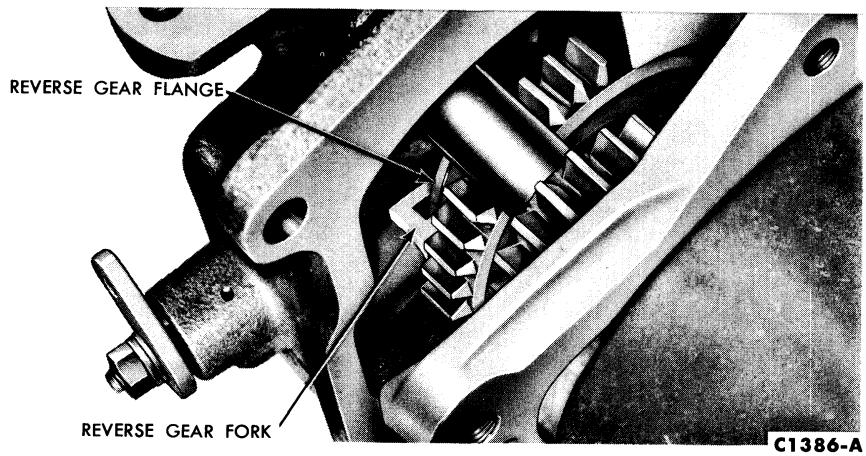



**FIG. 25—Extension Housing Installation**

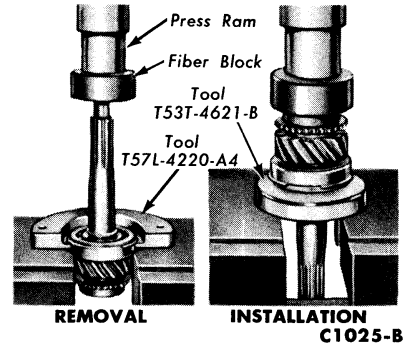



**FIG. 23—Input Shaft Bearing Replacement**

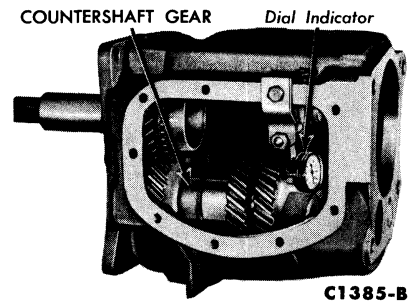



**FIG. 24—Checking Countershaft Gear End Play**

**21.** Position a new gasket on the adapter, using sealer to hold the gasket in place.

**22.** Move the reverse shift lever to bring the shift fork to the extreme forward position (Fig. 8). Pull the lever outward so that the reverse fork will clear the reverse gear on assembly. Slide the reverse gear forward on the output shaft until it engages the reverse idler gear.

**23.** Position the extension housing over the output shaft and carefully push the housing forward. Insert the reverse idler shaft into the reverse idler gears. When the reverse shift fork seats in the reverse gear shift collar groove (Fig. 25), push the reverse shift shaft into position. Move the reverse gear rearward with the shift lever, and seat the extension housing against the adapter plate.

**24.** Place the first and second-speed and the third and fourth-speed synchronizer in neutral and the reverse idler gear in reverse (forward) position. Set the reverse shift lever in the reverse position. Install a new shift cover gasket on the case, using sealer. Install the shift cover. Use sealer on the bolts and torque them to specifications.

**25.** Check operation of the reverse shift lever. If satisfactory, install the extension housing to the adapter plate and transmission case. Apply sealer to the lower right bolt to prevent lubricant leaks. Torque to specifications.

**26.** Install reverse shift cam and shaft retainer pin (Fig. 6).

**27.** Install the extension housing bushing and oil seal as shown in Figs. 4 and 2, Part 6-1.

# PART 6-4 OVERDRIVE TRANSMISSION


| Section | | Page |
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| 1 | Diagnosis and Testing | 6-21 |
| 2 | Cleaning and Inspection | 6-23 |
| 3 | Description and Operation | 6-23 |
| 4 | In-Car Adjustments and Repairs | 6-25 |
| 5 | Transmission Removal and Installation | 6-25 |
| 6 | Major Repair Operations | 6-26 |


## 1 DIAGNOSIS AND TESTING

When trouble occurs in the overdrive unit, check the mechanical operation of the unit before checking the operation of the overdrive electrical control system.

### MECHANICAL CHECKS

#### OVERDRIVE CONTROL HANDLE CLEARANCE CHECK

Check the specified clearance between the overdrive control handle shank and the bezel on the instrument panel.

#### OVERDRIVE CONTROL LEVER POSITION CHECK

Raise the car and check the position of the overdrive control lever at the overdrive unit housing. The lever should rest firmly against its stop at the rear. If the lever is not all the way back the overdrive shift rail may be locking the pawl and preventing it from engaging the balk ring gear.

With the engine stopped and the clutch engaged, shift the transmission to third or second gear and shift the overdrive control lever to the automatic (rearward) position. The drive shaft should then turn freely in a clockwise direction (when viewed from the front), but should lock up when turned counterclockwise.

With the transmission remaining in third or second gear, shift the overdrive control lever to the locked-out (forward) position. The drive shaft should lock up when turned either clockwise or counterclockwise.

#### PAWL ENGAGEMENT CHECK

Check the mechanical engagement of the pawl with the balk ring gear, using the following procedure:

**1.** Turn the ignition switch to the ON position and raise the car.

**2.** Shift the overdrive control lever to the locked-out (forward) position, and shift the transmission to neutral.

**3.** Turn the drive shaft clockwise and, at the same time ground the governor white wire with a jumper. The solenoid will click, indicating that it is energized.

**4.** Keep the solenoid energized, and shift the transmission to third or second gear to lock the transmission output shaft against rotation. Shift the overdrive control lever to the automatic (rearward) position.

**5.** Turn the drive shaft clockwise. At less than ¼ turn of the driveshaft, the pawl will engage the balk ring gear and lock the drive shaft against rotation in both directions.

If the pawl does not engage the balk ring gear, replace the solenoid and repeat the test. If the pawl still does not engage, remove the overdrive unit from the car for inspection and repair.

### ELECTRICAL CHECKS

#### GOVERNOR CIRCUIT CHECK

**1.** Turn the ignition switch ON and OFF, and listen for the relay or solenoid to click. If either clicks as soon as the ignition switch is turned ON, the governor circuit (Fig. 1) is grounded or the relay is defective.

**2.** To determine which condition is present, remove the wire from the TH-SW terminal on the relay and turn the ignition switch ON. If the relay clicks, the relay is defective. If it does not click, the governor circuit is grounded.

**3.** To check the governor operation when the relay does not click as the ignition switch is turned ON, disconnect the wire at the TH-SW terminal.

**4.** Raise the rear wheels off the floor.

**5.** Connect a test lamp between the battery and the wire removed from the TH-SW terminal.

**6.** Start the engine and, with the transmission in third-speed, bring the speedometer reading up through 28 mph. The lamp should light at or about this speed.

**7.** Throttle the engine down through 22 mph and at or about this speed the lamp should go out. If the lamp lights, and goes out at or about these speeds, the governor and governor circuit are working properly.

**8.** Turn the ignition switch ON and raise the car. Disconnect the yellow wire from the white wire at the governor connector.

**9.** Ground the white wire on the transmission case. If the relay and solenoid click, the governor circuit is working properly from the TH-SW terminal to the connector (Fig. 1), and the trouble is in the yellow wire or the governor. If the relay and solenoid do not click when the white wire is grounded, the trouble is between the TH-SW terminal and the connector (Fig. 1).

#### SOLENOID CIRCUIT CHECK

**1.** With the engine stopped and the ignition switch ON, ground the TH-SW terminal on the relay. If the relay and solenoid click as the ground is made and broken, the

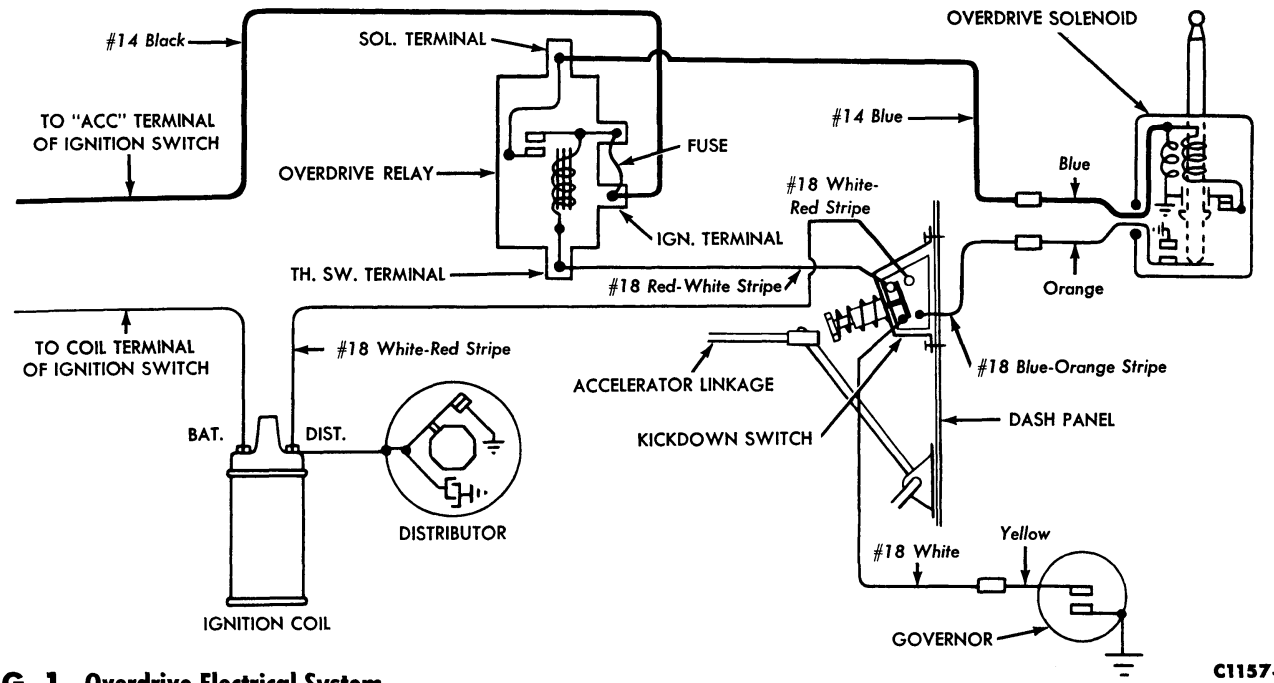



**FIG. 1—Overdrive Electrical System**

solenoid circuit is working properly. If the relay does not click as the TH-SW terminal is grounded, check the relay IGN terminal with a test lamp.

**2.** With the ignition switch ON, the test lamp should light when it is connected between the IGN terminal on the relay and at a ground. If it does not, the trouble is between the ignition switch and the IGN terminal.

**3.** Connect the test lamp at the other end of the fuse and at a ground. If the lamp lit at the IGN end and not at the other, replace the fuse. **Sometimes the fuse will "open" under the fuse end caps where the "open" cannot be seen.**

**4.** With current at both ends of the fuse, connect the test lamp between the solenoid terminal and at a ground. Ground the TH-SW terminal. The lamp should light. If it does not, replace the relay.

**5.** With the relay working properly, the solenoid should click when the TH-SW terminal is grounded. If it does not, connect a jumper from the SOLENOID relay terminal to the short blue wire separated from its connector near the solenoid. If the solenoid does not click when the relay closes with the jumper wire connected, replace the solenoid. If it does click, replace the wire from the SOLENOID relay terminal to the connector.

### INTERRUPTER CIRCUIT CHECK

If the interruptor circuit does not ground the engine ignition momentarily when the driver depresses the accelerator pedal to the floor, the overdrive unit cannot shift from overdrive to direct.

**1.** The first check of the ignition interruptor circuit is at the ignition coil. The black wire which runs from the ignition coil to the kickdown switch must be connected to the DIST terminal on the coil. Sometimes this wire is improperly connected to the BAT terminal during ignition work.

**2.** Disconnect the blue wire with an orange band (Fig. 1) from its connector near the solenoid, and ground it to the transmission case with a jumper.

**3.** With the engine running at fast idle, push the kickdown switch stem in until it bottoms (Fig. 2). When the stem bottoms, the engine should stop.

If it does not stop, the circuit is open between the DIST terminal and the connector.

**4.** To check the ignition grounding contacts inside the solenoid, disconnect the jumper and remove the solenoid from the overdrive unit.

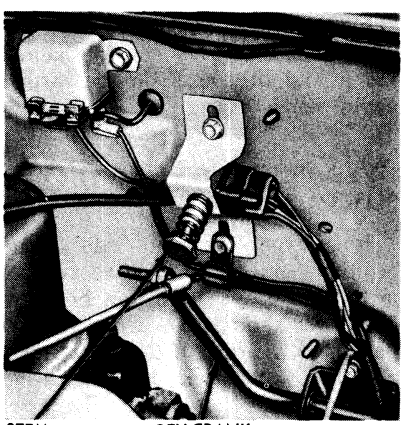



**FIG. 2—Kickdown Switch Installation**

**5.** Attach the solenoid to an adapter so that the stem can extend fully when the solenoid is energized. Make sure the solenoid is grounded.

**6.** Connect both solenoid wires at their connectors.

**7.** Ground the governor wire with a jumper.

**8.** With the engine running at fast idle, press in on the kickdown switch stem until it bottoms. The engine should stop. If it does not, replace the solenoid.

## 2 CLEANING AND INSPECTION

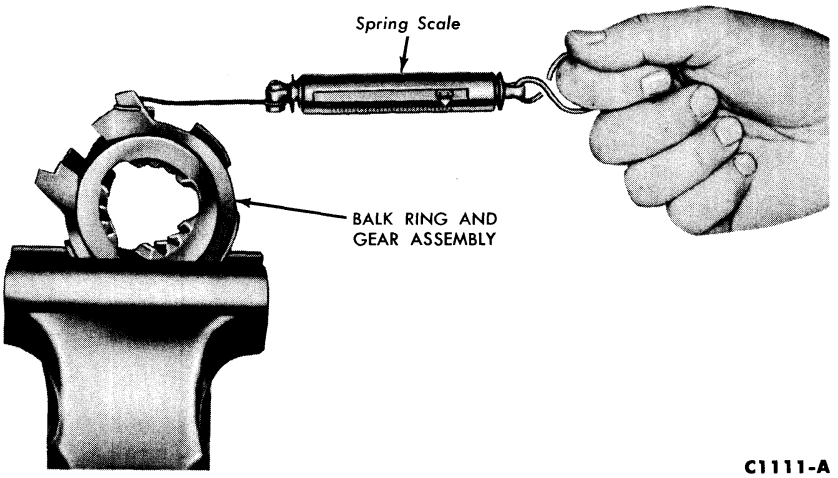
### CLEANING

Clean and inspect the transmission unit parts in the same manner as for the conventional transmission. Clean all overdrive parts thoroughly.

### INSPECTION

Check the balk ring tension, as shown in Fig. 3 for a pull of 3½-5½ pounds. Read the spring scale while the balk ring is turning, because the initial effort required to start the ring turning may be considerably higher than the specified pull. Replace the assembly if the tension is not within specifications.

Check the inner surface of the free-wheel clutch outer race. If the surface is worn or "chattered," the overdrive output shaft must be replaced.




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**FIG. 3—Checking Balk Ring Tension**

Check the clutch rollers for cracks and wear. Replace the complete set of 12 rollers if any are cracked or worn.

## 3 DESCRIPTION AND OPERATION

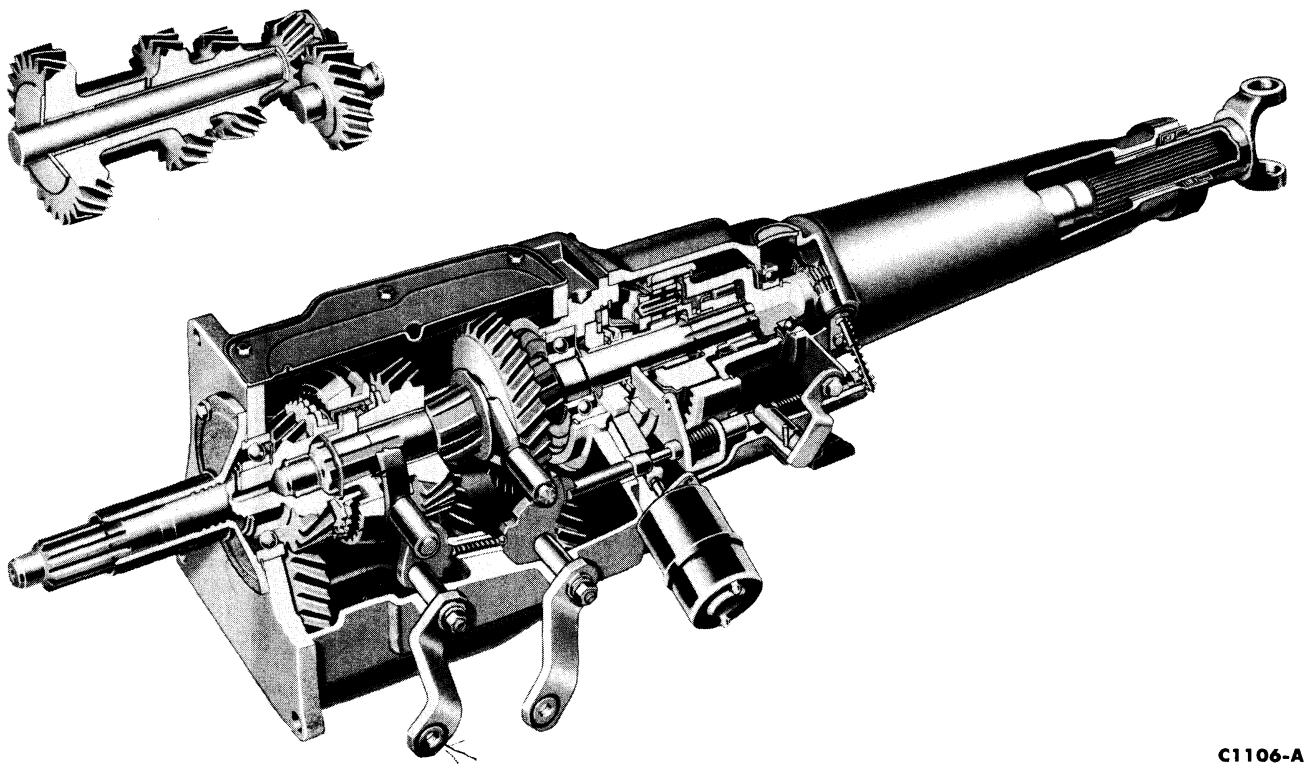
### DESCRIPTION

The overdrive unit is basically an automatic planetary transmission attached to the rear of a conventional three-speed transmission (Fig. 4) to provide four forward speeds instead of three. The overdrive can be mechanically locked out by a control cable located on the instrument panel.

The electrical system which controls the operation of the overdrive when the control cable is pushed in, consists of a relay, a manual kick-down switch, solenoid, governor, and the circuit wiring.

### MECHANICAL OPERATION

**Direct, Free-Wheeling Drive.** When the control handle is pushed in, the drive through the overdrive



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**FIG. 4—Overdrive Transmission**

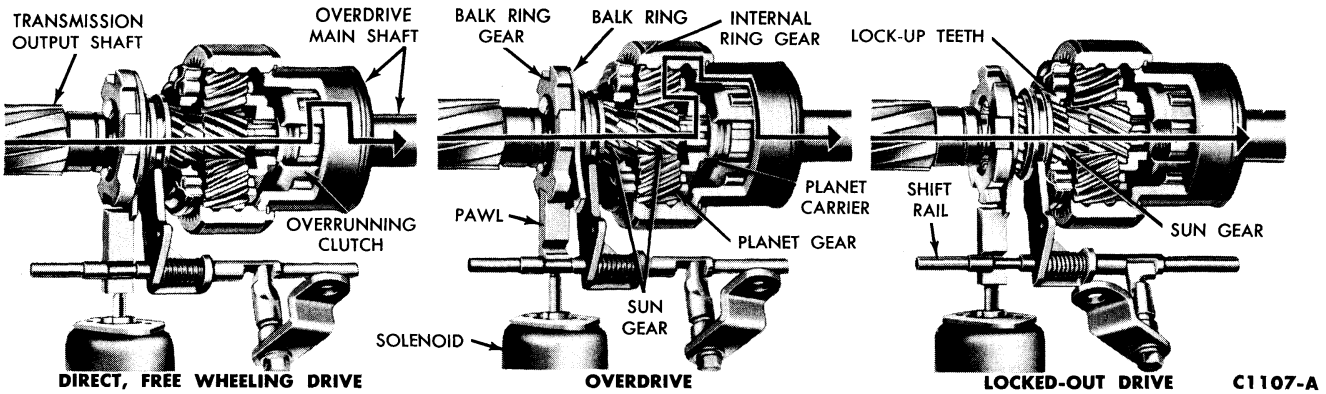



**FIG. 5—Overdrive Power Flow**

unit from start to approximately 28 mph is direct (1.00:1) and free-wheeling.

The power flow is from the transmission output shaft, through the overrunning clutch (free-wheel unit), to the overdrive main shaft (Fig. 5).

This drive is said to be free-wheeling because the overrunning clutch permits the transmission output shaft to drive the overdrive main shaft, but it does not permit the drive to reverse. **In a free-wheeling drive, the engine can drive the rear wheels, but the rear wheels cannot drive the engine.**

In direct, free-wheeling drive, the planetary gearing is in neutral, because the sun gear can run free. It can rotate clockwise (from the front), counterclockwise, or stand still, depending on the relative speeds of the planet carrier (transmission output shaft), and the internal ring gear (overdrive main shaft). At a 0.70:1 ratio, the sun gear will stand still. At a higher ratio, the sun gear will turn clockwise (from the front). At a lower ratio than 0.70:1, it will turn counterclockwise.

**Overdrive.** To shift the overdrive unit from direct (1.00:1) to overdrive (0.70:1) the sun gear is held against rotation (Fig. 5).

This is accomplished by engaging a pawl in the balk ring gear which is splined to the sun gear.

In overdrive, the power flow is from the transmission output shaft to the planet carrier splined to it, through the planet gears and then to the sun gear. With the sun gear held against rotation, the planet gears are forced to "walk around" the sun gear and drive the internal ring gear. The transmission output shaft will then drive the overdrive main shaft at a ratio of 0.70:1.

In overdrive, the overrunning clutch is uncoupled because the outer race (overdrive main shaft) is turning faster than the clutch cam (transmission output shaft). Overdrive is a two-way drive; the engine can drive the rear wheels and the rear wheels can drive the engine.

To shift from overdrive back to direct, the pawl is disengaged from the balk ring gear, permitting the sun gear to run free. The overdrive gearing is now in neutral. As soon as the speed of the transmission output shaft comes up to the speed of the overdrive main shaft, the overrunning clutch automatically locks up and direct drive is restored.

**Locked-Out Drive.** When the control handle is pulled out, the overdrive unit cannot function at any car speed. This lockout is accomplished by the shift rail moving the sun gear into engagement with the lock-up teeth on the planet carrier (Fig. 5).

When the sun gear is locked to the planet carrier, the planetary gearing is locked as one mechanical unit and the transmission output shaft is locked to the overdrive main shaft. This lock-up is necessary in reverse, because the transmission output shaft reverses its rotation and therefore cannot drive the overdrive main shaft through the overrunning (one-way) clutch. The lock-up in reverse is accomplished by the low and reverse position. This locked-up drive is also necessary when the car is pushed to start the engine, since the overrunning clutch will not transmit power from the overdrive main shaft to the transmission output shaft.

## ELECTRICAL SYSTEM

The overdrive electrical system, which engages and disengages the pawl, consists of a relay, a manual kick-down switch, a solenoid, a centrifugal governor and the circuit wiring.

There are three separate circuits (Section 1, Fig. 1) in the electrical system: a governor circuit which opens and closes the relay, a solenoid circuit which supplies current through the relay to energize the solenoid, and an ignition interrupter circuit, which momentarily grounds the engine ignition for full-throttle downshift (kickdown).

**Pawl Engagement.** The electrical system does not operate until car speed reaches approximately 28 mph. At this speed, the governor contacts close, permitting current to flow from the battery through the relay to the solenoid.

There are two coils in the solenoid, usually referred to as the "pull-in" and "hold-in" coils. The pull-in coil is energized only while the solenoid plunger is being pulled in. As soon as the plunger is in, a set of points inside the solenoid opens the pull-in circuit.

As the plunger is pulled in, an engaging spring and a return spring are engaged.

Under pressure from the pawl engaging spring, the pawl is pushed in until it strikes the balk ring.

The usual position of the balk ring when the solenoid engaging spring pushes the pawl against it is shown in the left view of Fig. 6. When the transmission output shaft is driving the overdrive main shaft through the overrunning clutch, all elements of the planetary gearing are revolving as a unit, and in a counterclockwise (from the rear) direction. This rotates the balk ring against the pawl.

When the driver releases the throttle, the overdrive main shaft

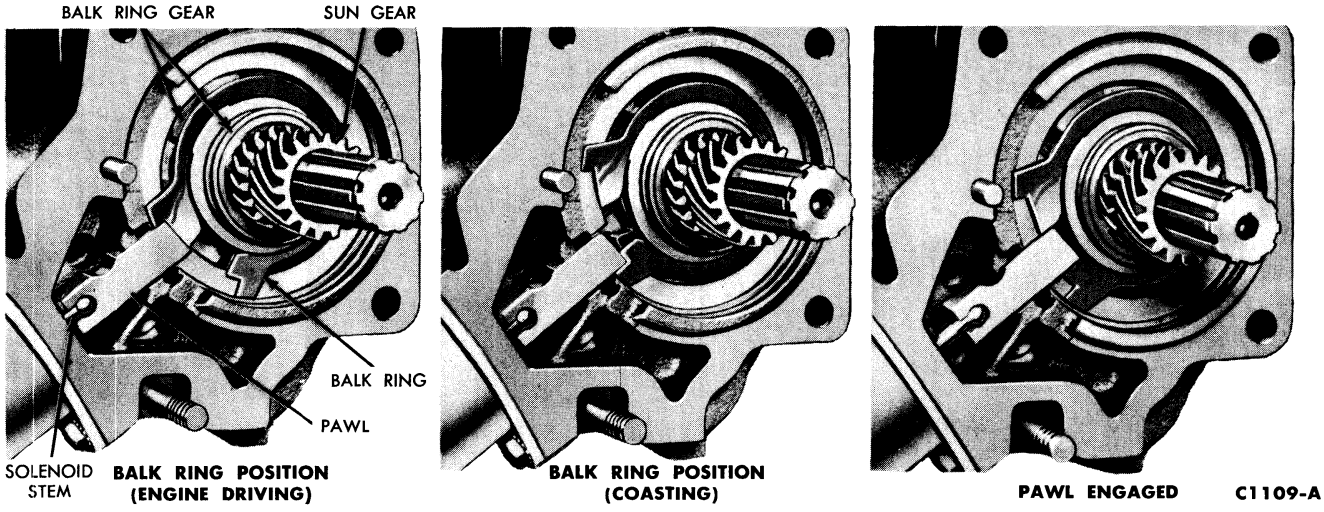



**FIG. 6—Pawl and Balk Ring Positions**

overruns the transmission output shaft. When this overrun exceeds the ratio of 0.70:1, the sun gear and balk ring reverse, releasing the pawl to engage the balk ring gear.

The position of the balk ring, should the solenoid be energized when the car is coasting (engine idling) up through 28 mph, is shown in the right view of Fig. 6. Under this condition the sun gear will be rotating clockwise (from the rear) and the pawl will be blocked.

The pawl engages when the engine speeds up, and brings the transmission output shaft up through the 0.70:1 ratio with the overdrive main shaft. This action will cause the sun gear to reverse its clockwise (from the rear) rotation and release the pawl to engage the balk ring gear.

**Pawl Disengagement.** The pawl disengages under two conditions. First, when the car speed drops below approximately 22 mph, the governor opens the circuit through the relay and de-energizes the solenoid, permitting the return spring to pull out the pawl. Second, the driver may shift the overdrive back to direct drive at any road speed, by pressing the accelerator pedal to the floor so that it depresses the kickdown switch stem.

When this happens, the kickdown switch opens the governor circuit through the relay, and de-energizes the solenoid, permitting the return spring to try to pull out the pawl.

Also, it closes the interrupter circuit and grounds the ignition long enough for the return spring to pull out the pawl.

Normal ignition is restored as soon as the pawl comes out, and the solenoid stem opens the ignition grounding contacts. The actual time of ignition interruption is equal to that required for one revolution of the crankshaft.

## 4 IN-CAR ADJUSTMENTS AND REPAIRS

### OVERDRIVE CONTROL CABLE ADJUSTMENT

**1.** Loosen the overdrive cable lock nut at the overdrive control lever.

**2.** Position the overdrive cable until there is ¼ inch clearance between the cable control handle and bezel.

**3.** Move the overdrive control lever to the rear against the stop. When moving the lever, be careful not to move the cable out of position.

**4.** Tighten the control cable lock nut on the overdrive.

## 5 TRANSMISSION REMOVAL AND INSTALLATION

### REMOVAL

**The overdrive unit cannot be removed from the car as a separate assembly.** Remove the transmission and overdrive unit together, following the steps detailed below:

**1.** Disconnect the solenoid and governor wires from the connectors near the solenoid.

**2.** Remove the overdrive wiring harness from its clip on the transmission.

**3.** Disconnect the overdrive control cable from the lever on the side of the overdrive unit and from the clamp at the solenoid.

**4.** Remove the overdrive transmission from the car, following the procedure given in Part 6-2 for removing the 3-speed Conventional Drive transmission.

### INSTALLATION

The overdrive unit must be assembled and installed on the transmission before the transmission is installed in the car.

**1.** Install the overdrive transmission in the car, following the procedure given in Part 6-2 for installing the 3-speed Conventional Drive transmission.

**2.** Connect the overdrive control cable to the lever on the side of the overdrive unit. With the cable connected, there must be ¼ inch clearance between the control handle shank and the bezel when the lever at the overdrive housing is against its rear stop.

**3.** Connect the solenoid and governor to the connectors near the solenoid.

**4.** Install the overdrive wiring harness in its clip on the transmission.

# 6 MAJOR REPAIR OPERATIONS

## DISASSEMBLY (OVERDRIVE USED WITH 223 and 289 CID ENGINES)

**1.** Mount the transmission in a holding fixture. Then drain the transmission and the overdrive unit.

**2.** Remove the solenoid retaining screw, and then rotate the solenoid about ¼ turn to remove it.

**3.** Remove the governor.

**4.** Remove the transmission cover and gasket.

**5.** With a sharp punch, pierce the snap ring hole cover (Fig. 7), and remove the cover.

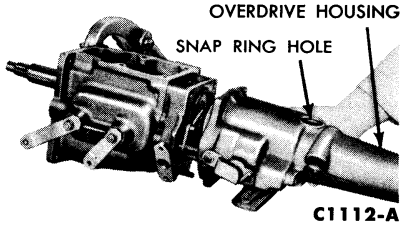



**FIG. 7—Removing Overdrive Housing**

**6.** Remove the three overdrive housing to transmission case bolts, the stud nut, and the overdrive control shaft pin.

**7.** Pull the overdrive control lever and shaft out as far as possible. Spread the snap ring that retains the overdrive output shaft bearing and then remove the overdrive housing (Fig. 7).

**It may be necessary to tap the overdrive output shaft with a soft-faced hammer to free the output shaft bearing from the housing.**

**8.** Remove the overdrive output shaft from the assembly. Catch any of the free-wheel unit rollers that drop out. Remove the rest of the rollers.

**9.** Remove the speedometer gear retaining snap ring. Remove the gear and drive ball.

**10.** If the overdrive output shaft bearing is to be replaced use the tools shown in Fig. 8.

**11.** Remove the free-wheel unit retainers (Fig. 9). Then remove the clutch, planet carrier, sun gear, and shift rail.

**12.** Remove the snap ring from the adapter, and then remove the plate and trough, balk ring gear and pawl.

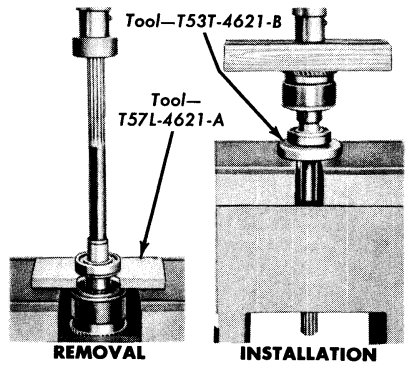



**FIG. 8—Replacing Output Shaft Bearing**

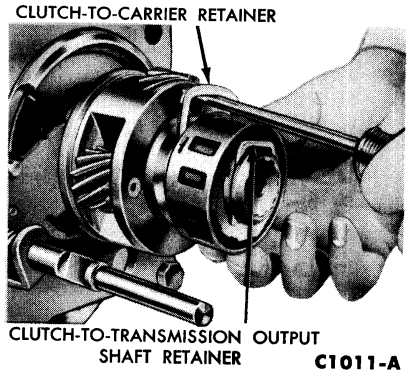



**FIG. 9—Removing Free Wheel Unit Retainer**

**13.** Remove the input shaft bearing retainer and gasket (Fig. 10).

If the input shaft seal is to be replaced, use the same tools which are used on the conventional 3-speed transmission.

**14.** Remove the stud from the rear of the case. Rotate the overdrive adapter to expose the countershaft lock, and remove the lock.

**15.** With a drift, drive the countershaft toward the rear until it just clears the hole at the front of the case, and then push the countershaft out of the rear with the bearing retainer tool shown in Fig. 11.

**16.** The countershaft gear will now drop to the bottom of the case to provide clearance for removal of the input shaft and bearing. Tap the input shaft and bearing out of the front of the case.

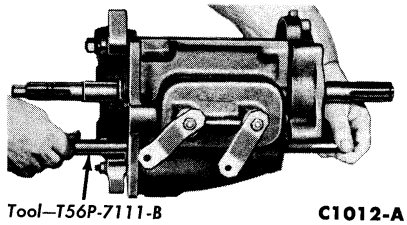



**FIG. 11—Removing Countershaft**

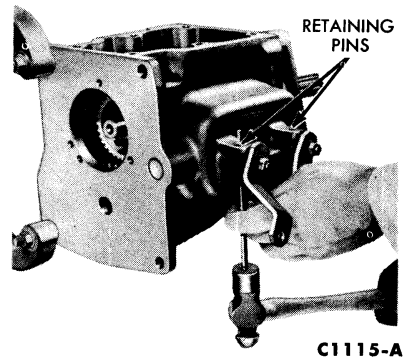



**FIG. 12—Removing Shift Lever Shaft Retaining Pin**

**17.** Remove the shift lever shaft retaining pins (Fig. 12).

**18.** Pull the low and reverse shift lever out as far as it will go; then remove the low and reverse fork.

**19.** Remove the overdrive adapter and transmission output shaft as an assembly (Fig. 13).

**20.** Remove the snap ring at the front of the transmission output shaft, and then slide the synchronizer intermediate gear, and the sliding low and reverse gear off the shaft.

**21.** While holding the washers and bearing retainer tool at the small end of the countershaft gear to prevent the roller bearings and bearing retainer tool from falling out, lift the gear from the case.

**22.** Drive the reverse idler gear shaft out of the rear of the case with a brass drift and a hammer, and remove the idler gear from the case.

**23.** Remove the lock plunger, spring, pin, and detent balls from the case (Fig. 14).

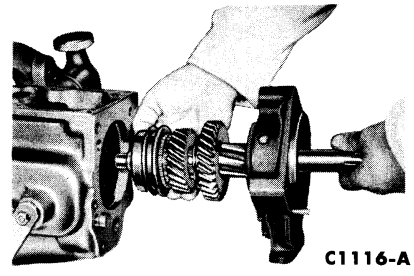



**FIG. 13—Removing Output Shaft and Adapter**

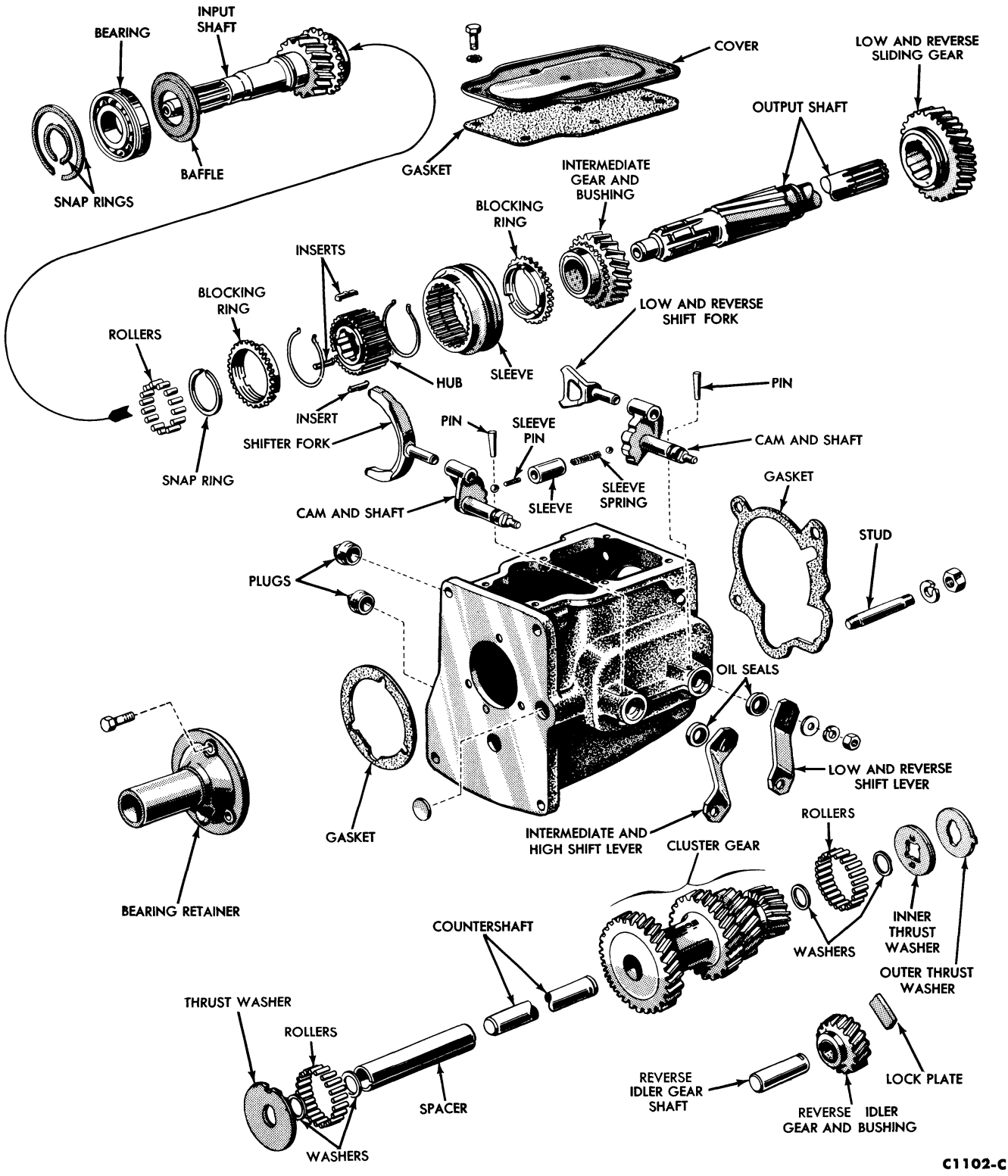



**FIG. 10—Overdrive Transmission Disassembled**

## PARTS REPAIR OR REPLACEMENT

### INPUT SHAFT

**1.** If the input shaft bearing is to be replaced, remove the snap ring that retains the bearing, and press the bearing and baffle off the shaft (Fig. 15).

**2.** Position the baffle on the input shaft with the dished side toward the gear (Fig. 10).

**3.** Press a new bearing into place on the gear and shaft.

### SYNCHRONIZER

**1.** Disassemble the synchronizer unit (Fig. 10) by sliding the inter-

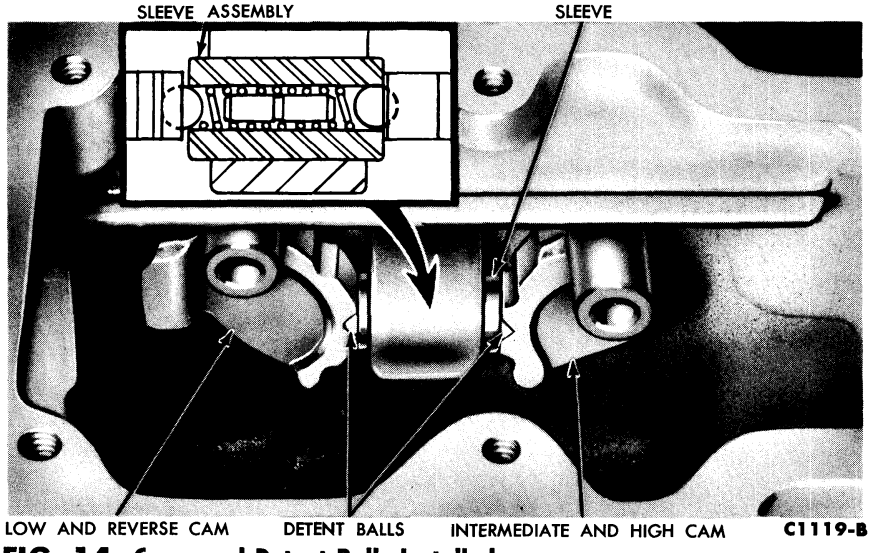



**FIG. 14—Cams and Detent Balls Installed**

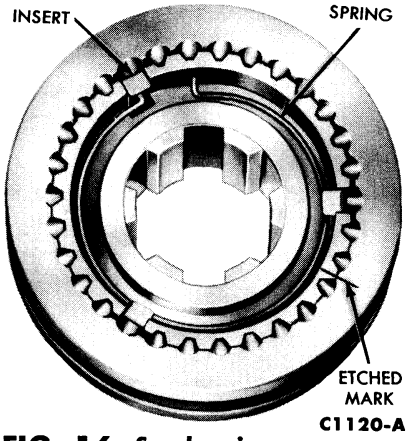



**FIG. 16—Synchronizer**

mediate and high sleeve off the hub. Remove the three inserts and two springs from the hub.

**2.** Assemble the synchronizer unit by installing the two springs on the hub and placing the three inserts in the hub. Hook one spring end in an insert as shown in Fig. 16.

**3.** After lining up the etched marks on the sleeve and hub splines, slide the sleeve into place on the hub.

### OUTPUT SHAFT BEARING

**1.** Remove the snap ring which retains the output shaft in the adapter (Fig. 17), and tap the bearing out of the adapter. Remove the baffle from the adapter.

**2.** Remove the snap ring and press the old bearing off and the new bearing on with the tools shown in Fig. 18.

Install the snap ring to retain the bearing.

**3.** Position the baffle in the adapter (Fig. 17). Tap the bearing and shaft into place in the adapter.

**4.** Install the snap ring to retain the bearing.

### CAM AND SHAFT SEALS

**1.** Remove the nuts and lock washers that secure the levers on the cam and shaft units, and remove the levers from the shafts and cams.

**2.** Remove the cams and shafts, detent balls, pin, spring, and sleeve (Fig. 10) from the case.

**3.** Remove the seals with a suitable puller.

**4.** Install the new seals with a suitable driver.

**5.** Install the intermediate and high shift fork and shaft in the case.

**6.** Insert a detent ball, sleeve, spring, and pin in the bore of the case. Move the cam and shaft so that the detent ball seats in the neutral (center) notch.

**7.** Install the low and reverse cam and shaft assembly, and then install the levers on the shafts with nuts and lock washers.

**8.** Install a detent ball in the sleeve at the low and reverse end. Then push the low and reverse cam toward the detent ball far enough to hold the ball in place in the neutral notch. The ball must seat in the notch of the cam.

**9.** Install the shift lever shaft retaining pins (Fig. 12).

**10.** In order to assure positive shifting, and eliminate the possibility of engaging more than one set of gears at the same time, the clearance between the ramp of one cam and the sleeve must be checked.

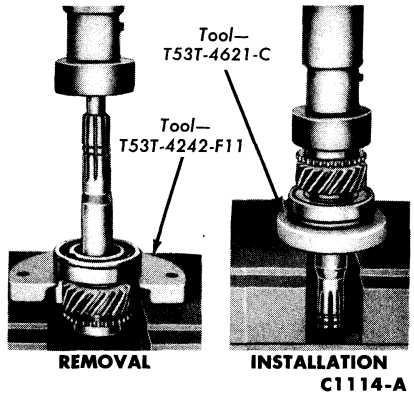



**FIG. 15—Replacing Input Shaft Bearing**

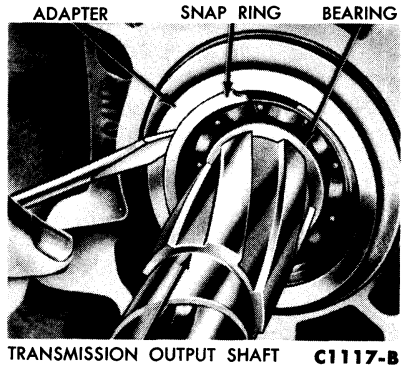



**FIG. 17—Removing Output Shaft Bearing Snap Ring**

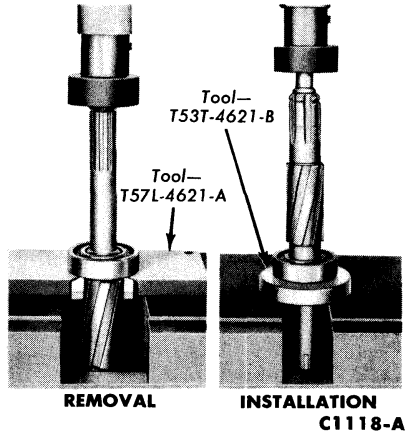



**FIG. 18—Replacing Output Shaft Bearing**

### COUNTERSHAFT ROLLERS

**1.** Remove the thrust washers from each end of the countershaft.

**2.** Remove the dummy shaft, retainer washers, rollers, and spacer from the countershaft gear.

**3.** Position the spacer and the dummy shaft in the countershaft.

**4.** Place a retainer washer in each end of the countershaft gear.

5. Apply grease to all of the rollers and place them in each end of the countershaft gear.

6. Apply grease to the two remaining retainer washers and to the contact surface of the thrust washers. Install the retainer washers and the thrust washers on each end of the gear.

## ASSEMBLY

**Always use new gaskets and gasket sealer during assembly.** To provide initial lubrication, apply a thin coating of lubricant on all parts before installation.

1. Install the countershaft gear in the transmission case.

2. Install the reverse idler gear in the case, with the chamfered gear teeth ends toward the front.

3. Drive the reverse idler shaft into the case, with the locking notch aligned with the countershaft hole.

4. Install the low and reverse sliding gear on the output shaft, with the shifter fork groove toward the front.

5. Install the intermediate gear on the output shaft, with the clutch teeth toward the front.

6. Place a blocking ring on the intermediate gear, and install the synchronizer assembly on the transmission output shaft, with the hub thrust surface toward the rear (Fig. 16). Install the snap ring that retains the synchronizer.

7. Install the shift forks in the cams inside the transmission case. **The offset in the low and reverse fork goes toward the front.**

8. Place a new gasket on the overdrive adapter and hold it in place with gasket sealer.

9. Install the overdrive adapter and transmission output shaft assembly in the transmission.

10. Engage the shift forks with the high and intermediate sleeve, and with the low and reverse sliding gear.

11. Seat the overdrive adapter squarely against the transmission case, and secure with a cap screw.

12. Insert the pilot roller bearings in the input shaft and retain with grease.

13. Place the blocking ring on the input shaft gear.

14. Tap the input shaft and bearing into the case with a soft hammer, and at the same time line up the slots in the blocking ring with the synchronizer inserts.

15. Place a new gasket on the input shaft bearing retainer, and hold it in place with gasket sealer.

16. Install the input shaft bearing retainer on the transmission case.

17. Swing the transmission to an inverted position in the fixture.

18. Remove the cap screw holding the adapter in place. Pull the adapter outward approximately ¼ inch, and rotate it to expose the countershaft hole.

19. Work the countershaft gear into normal position by rotating the input and output shafts.

20. Push the countershaft into the case from the rear.

21. Align the slots in the countershaft with the slot in the reverse idler shaft and install the lock plate.

22. Rotate the adapter to its normal position and set it squarely against the transmission case. Check the blocking rings to make sure the slots are aligned with the synchronizer inserts.

23. Swing the transmission so that the input shaft is pointing down.

24. Install the stud in the transmission case.

25. Place the balk ring gear assembly and pawl in the adapter (Fig. 19).

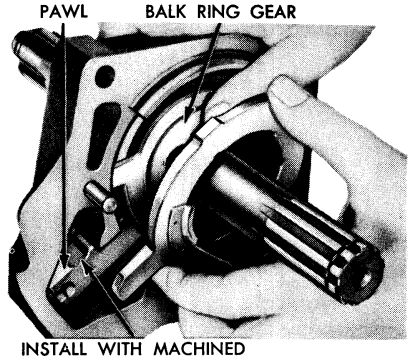



**FIG. 19—Plate and Trough Installed**

26. Place the plate and trough assembly in the adapter and install its snap ring.

27. Install the sun gear and shift rail (Fig. 20).

28. Install the planet carrier and the clutch cam. Install the retainers.

29. Install the 12 clutch rollers and hold them in position with a strong rubber band.

30. Rotate the roller cage counterclockwise (from the rear) until the rollers are off the cam surfaces. The rubber band will hold them there.

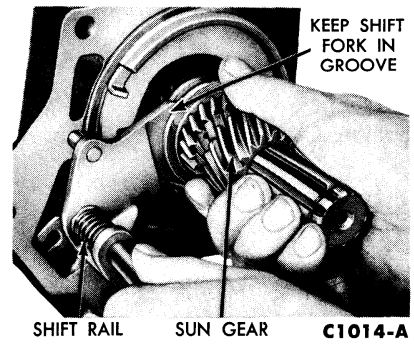



**FIG. 20—Sun Gear and Shift Rail Installation**

31. Slide the overdrive output shaft carefully over the clutch rollers. The rubber band will not affect operation of the overdrive.

32. Align the shift rail spring with the holes in the overdrive housing.

33. Place a new gasket on the overdrive adapter, and hold it in place with gasket sealer.

34. Install the overdrive housing, over the overdrive output shaft and shift rail. Install the three bolts and one nut.

35. If the overdrive output shaft bearing snap ring does not drop into its groove when the housing is seated squarely on the adapter, pry the overdrive output shaft bearing toward the rear, working through the snap ring hole. Install the three bolts and one nut.

36. Engage the overdrive shaft lever by pushing it inward. The lever is correctly engaged when a spring load is apparent as the lever is pushed forward.

37. Install the retaining pin in the overdrive housing to hold the control shaft in place.

38. If the overdrive housing bushing and seal are to be replaced, use the same tools which are used on conventional transmissions.

39. Thread the governor into the overdrive housing.

40. Rotate the solenoid ¼ turn from normal position so that the half ball on the solenoid stem can engage the pawl. Install the two solenoid attaching screws.

If the solenoid stem is properly engaged, the solenoid cannot be removed from the overdrive in its normal position. Any attempt to pull it out will merely compress the engaging spring in the solenoid.

41. Install the drain plugs in the transmission case and in the overdrive housing.

### DISASSEMBLY (OVERDRIVE USED WITH 352 and 390 C.I.D. ENGINES)

**1.** Mount the transmission in a holding fixture. Then drain the transmission and the overdrive unit.

**2.** Remove the gear shift cover and the shift forks from the transmission case. Discard the gear shift cover gasket.

**3.** Remove the solenoid retaining screw, and then rotate the solenoid about ¼ turn to remove it.

**4.** Remove the governor.

**5.** With a sharp punch, pierce the snap ring hole cover, and remove the cover from the top of the overdrive housing.

**6.** From the bottom, drive out the overdrive manual control shaft lock pin. Pull the manual control lever and shaft out as far as possible.

**7.** Remove the overdrive housing attaching bolts.

**8.** Insert snap ring pliers in the overdrive housing snap ring hole, and spread the snap ring that retains the main shaft bearing.

**9.** Remove the overdrive housing. To free the output shaft bearing from the housing, it may be necessary to tap on the shaft with a soft-faced hammer.

**10.** Remove the overdrive main shaft from the assembly. Catch any of the clutch rollers that drop out. Remove the rest of the rollers.

**11.** After removing the snap ring from the end of the transmission output shaft, remove the overrunning clutch and planet carrier. Remove the snap ring at the rear of the sun gear.

**12.** Remove the sun gear and the shift rail and fork assembly together.

**13.** Remove the snap ring that retains the plate and trough assembly in the adapter. Lift the plate and trough, balk ring gear, and pawl from the adapter.

**14.** Remove the input shaft bearing retainer and gasket. Discard the gasket.

**15.** If the input shaft seal is to be replaced, use the tools which are used for conventional transmission.

**16.** Tap the input shaft forward as far as it will go.

**17.** Remove the overdrive adapter and transmission output shaft assembly from the case (Fig. 21).

**18.** With a drift, drive the countershaft from the front of the case and toward the rear until the countershaft clears the front hole. Remove the Woodruff key from the rear of the countershaft as soon as the key clears the case.

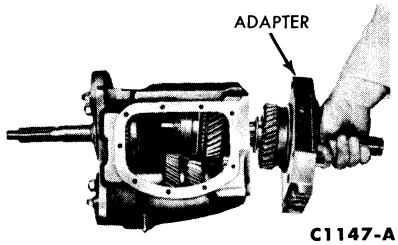



**FIG. 21—Removing Adapter and Output Shaft**

**19.** Push the countershaft from the countershaft gear with the dummy shaft (Fig. 22). **Make sure the gear drops to the bottom of the case.** Remove the countershaft from the case.

**20.** Remove the snap ring from the input shaft bearing outer race. With a soft-faced hammer, drive the input shaft and bearing toward the rear until the bearing clears the case.

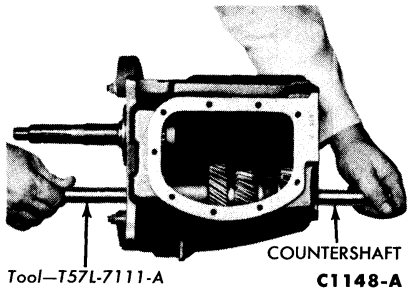



**FIG. 22—Removing Countershaft**

**21.** Remove the input shaft and bearing through the gear shift cover opening.

**22.** Remove the countershaft (cluster) gear from the case.

**23.** Drive the reverse idler shaft out through the rear of the case. Remove the Woodruff key from the shaft as soon as it clears the case.

**24.** Remove the snap ring that retains the synchronizer assembly to the transmission output shaft. Slide the synchronizer, blocking ring, intermediate gear, and low and reverse sliding gear from the transmission output shaft.

**25.** Remove the snap ring that retains the output shaft bearing in the adapter. Tap the bearing and shaft out of the adapter. Remove the oil baffle from the adapter.

**26.** If the transmission output shaft or overdrive output shaft bearings are to be replaced, use the tools shown in Fig. 23.

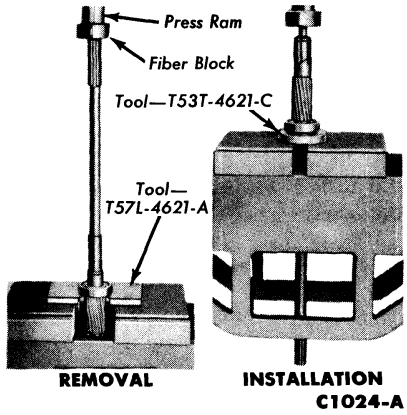



**FIG. 23—Output Shaft Bearing Replacement**

**27.** The input shaft bearing should be replaced with the tools shown in Fig. 15.

**28.** The synchronizer can be disassembled by sliding the high and intermediate sleeve from the hub.

### ASSEMBLY

**Always use new gaskets and gasket sealer during assembly.** To provide initial lubrication, apply a thin coating of lubricant on all parts before installation.

**1.** Place the bearing retainer tool (Fig. 22) in the countershaft (cluster) gear. Slide the spacer over the bearing retainer tool. Install a row of needle bearings, a flat washer, a second row of needle bearings, and a second flat washer at each end of the countershaft gear. Place the thrust washers (front and rear) on the gear, and keep them in place with heavy lubricant (Fig. 24).

**2.** Place the countershaft gear in the case. The tab on the front thrust washer must enter the slot in the case. The tab on the steel washer at the rear must be at the top.

**3.** Place the reverse idler gear in position in the case, with the chamfered gear teeth ends toward the

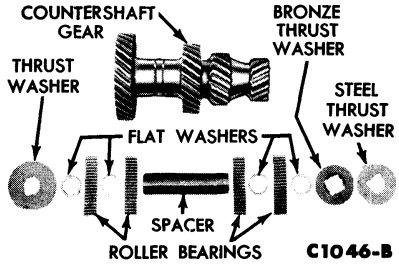
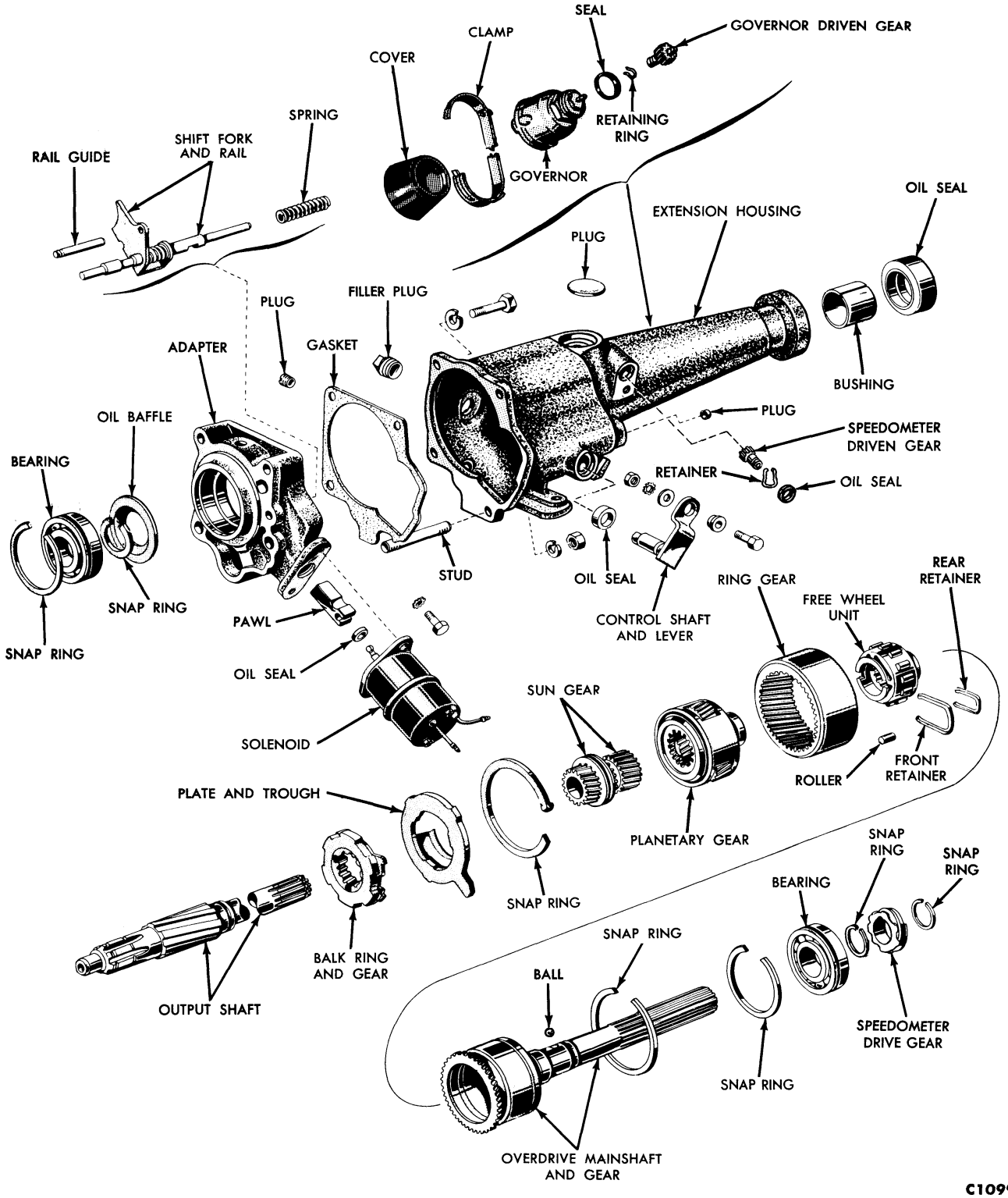



**FIG. 24—Countershaft Gear Disassembled**




C1099-B

**FIG. 25—Overdrive Unit Disassembled**

front. Install the reverse idler shaft and Woodruff key.

4. Assemble the pilot rollers in the input shaft. Install the input shaft and bearing through the side of the case and tap into place with a soft-faced hammer. Install the snap ring on the input shaft bearing outer race. Place a new gasket on the bearing retainer and install it.

5. Turn the transmission upside down and work the countershaft (cluster) gear into position. Start the countershaft from the rear of the case, and push the dummy shaft out

the front of the case. Install the Woodruff key and drive the countershaft until flush with the rear face of the transmission case.

**6.** Slide the oil baffle onto the transmission output shaft, with the dished side next to the bearing.

**7.** Install the transmission output shaft and bearing in the overdrive adapter. Install the selective-fit snap ring which secures the bearing in the adapter (Fig. 25).

**8.** Install the low and reverse sliding gear on the output shaft with the shift fork groove toward the front.

**9.** Install the intermediate and high gear on the output shaft, with the clutch teeth toward the front.

**10.** Assemble the synchronizer by placing the three inserts in position. Place a spring at each end of the hub, and hook one spring end in an insert (Fig. 16). Align the etched marks on the sleeve and hub splines, and slide the sleeve over the hub with the shifter fork groove toward the rear.

**11.** Slide the synchronizer onto the output shaft, with the rear blocking ring in place, and install the snap ring.

**12.** Place the pilot roller bearing flat washer on the output shaft journal, and retain with grease.

**13.** Place a new gasket on the front side of the adapter and retain with gasket sealer.

**14.** Install the output shaft assembly and adapter in the case (Fig. 21). Secure the adapter in place with a bolt.

**15.** Place the balk ring in the adapter with the balk ring side out.

**16.** Install the pawl with the machined recess in line with the shift rail hole, and then install the plate and trough assembly. Install the snap ring.

**17.** Install the overdrive shift rail and fork assembly and sun gear at the same time (Fig. 20). Install the snap ring in the transmission output shaft groove at the rear of the sun gear.

**18.** Slide the planet carrier and clutch cam onto the output shaft, and install the snap ring.

**19.** Install the clutch rollers and hold in place with a strong rubber band. Slide the overdrive main shaft carefully over the clutch rollers.

**20.** Align the overdrive shift rail spring with the holes in the housing.

**21.** Place a new gasket (Fig. 25) on the adapter and retain in place with gasket sealer.

**22.** Install the overdrive housing over the main shaft and shift rail, and start the bolts. Install the overdrive main shaft bearing snap ring. Install a new cover.

**23.** Tighten the overdrive housing attaching bolts.

**24.** Engage the overdrive shaft lever by pushing it inward. Install the retaining pin.

**25.** If replacement of the overdrive housing bushing and/or seal is necessary, use the tools shown in Part 6-1.

**26.** Install the governor.

**27.** Rotate the solenoid ¼ turn from normal position so that the half ball on the solenoid stem can engage the pawl. Install the lower cap screw.

**28.** Install the drain plugs in the transmission case and overdrive housing.

# PART 6-5 SPECIFICATIONS

## THREE-SPEED TRANSMISSION

### GEAR RATIOS

| Car Usage | Transmission Model | Engine C.I.D. | Ratio | | | |
|---|---|---|---|---|---|---|
| | | | First Speed | Second Speed | Third Speed | Reverse |
| Ford | HEE-A | 223-1V | 3.26 | 1.84 | 1.00:1 | 3.35 |
| Ford Taxi | HEF-A | 223-1V | 2.79 | 1.70 | 1.00:1 | 2.87 |
| Ford—Mercury | HEF-B | 260-2V | 2.79 | 1.70 | 1.00:1 | 2.87 |
| Ford Taxi | HEF-C | 260-2V | 2.79 | 1.70 | 1.00:1 | 2.87 |
| Ford—Mercury | HEG-A | 352-2V 390-4V | 2.42 | 1.61 | 1.00:1 | 2.33 |

### TORQUE LIMITS

| Description | Foot Pounds |
|---|---|
| Input shaft bearing retainer to transmission case | 19-25 |
| Extension housing to transmission case | 42-50 |
| Access cover to transmission case | 14-19 |
| Gear shift control levers to cam and shaft | 18-23 |
| Shift fork to shift rail | 12-17 |
| Filler plug to case | 10-15 |
| Drain plug to case | 20-30 |

### CLEARANCES

| Description | Inches |
|---|---|
| Countershaft Gear End Play | 0.004-0.018 |
| Reverse Idler Gear End Play | 0.004-0.018 |

### LUBRICANT

| Type Lubricant | Mild E P Gear Oil M-568-0 |
|---|---|
| Capacity | 3½ pints |

## WARNER FOUR-SPEED TRANSMISSION

### TORQUE LIMITS

| Description | Foot Pounds |
|---|---|
| Adapter Plate to Extension Housing Bolts | 20-30 |
| Engine Rear Support to Extension Housing Bolts | 35-40 |
| Gear Shift Control Levers to Cam and Shaft assembly | 12-15 |
| Gear Shift Housing to Transmission Case Bolts | 15-20 |
| Gear Shift Linkage to Transmission Extension Housing Bolts | 12-15 |
| Input Shaft Bearing Retainer Bolt | 15-20 |
| Third Crossmember to Support Bracket Bolts | 45-50 |
| Transmission to Extension Housing Bolts | 35-45 |

### CLEARANCES

| Description | Inches |
|---|---|
| Countershaft Gear End Play | 0.025 |

### LUBRICANT

| Type Lubricant | Mild EP Gear Oil M-568-D |
|---|---|
| Capacity (Dry) | 3½ pints |

# OVERDRIVE TRANSMISSION

## GEAR RATIOS

| Engine | 1st Gear | | 2nd Gear | | 3rd Gear | | Reverse Gear | |
|---|---|---|---|---|---|---|---|---|
| | Conventional Drive | Overdrive | Conventional Drive | Overdrive | Conventional Drive | Overdrive | Conventional Drive | Overdrive |
| Mileage Maker Six and V-8 | 3.20 | 2.80 | 1.86 | 1.69 | 1.00:1 | 0.70 | 3.83 | 3.80 |
| 352 and 390 V-8 | 2.37 | 2.49 | 1.51 | 1.59 | 1.00:1 | 0.72 | 2.81 | 3.15 |

## TORQUE LIMITS

| Description | Foot Pounds |
|---|---|
| Lower Access Clutch Cover Plate to Flywheel Housing Bolts | 17-20 |
| Flywheel Housing to Block Bolts | 40-50 |
| Pressure Plate and Cover Plate Assembly Retaining Bolts | 23-28 |
| Transmission Extension Housing to Case Bolts | 37-42 |
| Clutch Release Equalizer Frame Bracket Bolts | 25-30 |
| Input Shaft Bearing Retainer to Transmission Case Bolts | 12-15 |
| Overdrive Assembly to Transmission Case Nuts | 37-42 |
| Transmission to Flywheel Housing Bolts | 37-42 |
| Gear Shift Housing to Transmission Case Bolts | 12-15 |
| Gear Shift Control Levers to Cam and Shaft Assembly Nuts | 12-15 |
| 3 Crossmember to Support Bracket Bolts | 45-50 |
| Engine Rear Support to Transmission Case Bolts | 40-45 |

## LUBRICANT

| Type Lubricant | Mild EP Gear Oil M-568-D |
|---|---|
| 223 and 229 C.I.D. Engines | 3 pints |
| 352 and 390 C.I.D. Engines | 4 pints |

# AUTOMATIC TRANSMISSION

# GROUP 7


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**PART 7-2**
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**PART 7-4**
SPECIFICATIONS . . . . . 7-82


# PART 7-1 GENERAL TRANSMISSION SERVICE


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|---|---|
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| 2 Common Adjustments and Repairs | 7-14 |
| 3 Cleaning and Inspection | 7-14 |


Two different Dual Range three-speed transmissions — the new C4 Automatic and the earlier model Cruise-O-Matic—used on Ford cars or Merc-O-Matic used on Mercury cars are used in 1964. Part 7-1 covers diagnosis and testing, common adjustments and repairs, and cleaning and inspection for both types of transmissions. Where there are differences in procedures or specifications, the type of transmission affected will be designated.

## 1 DIAGNOSIS AND TESTING

The following preliminary checks should be made on the transmission before proceeding with any other diagnosis checks.

### TRANSMISSION FLUID LEVEL CHECK

Check the transmission fluid level. Low fluid level can affect the operation of the transmission, and may indicate fluid leaks that could cause transmission damage.

A fluid level that is too high will cause the fluid to become aerated. Aerated fluid will cause low control pressures, and the aerated fluid may be forced out the vent.

### TRANSMISSION FLUID LEAKAGE CHECKS

Check the speedometer cable connection at the transmission. Replace the rubber seal if necessary.

On a Cruise-O-Matic or Merc-O-Matic transmission, inspect the governor inspection plate for leakage. Install a new gasket if needed.

Leakage at the oil pan gasket often can be stopped by tightening the attaching bolts to the proper torque. If necessary, replace the gasket.

Check the fluid filler tube connection at the transmission. If leakage is found here, tighten the fitting (Cruise-O-Matic or Merc-O-Matic) or replace the filler tube O-ring (C4 Automatic).

Check the fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fitting, replace the leaking parts.

Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator tank is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines from the cooler fittings and applying 5 psi air pressure to the fittings. If the cooler is leaking and will not hold this pressure, the radiator must be replaced. **The cooler cannot be replaced separately.**

If leakage is found at either the downshift control lever shaft or the manual lever shaft, replace either or both seals.

Inspect the pipe plug on the left side of the transmission case at the front. If the plug shows leakage, torque the plug to specification. If tightening does not stop the leaks, replace the plug.

When converter drain plugs leak, remove two drain plugs with a six-point wrench. Coat the threads with FoMoCo Perfect Seal Sealing Compound or its equivalent, and install the plugs. Torque the drain plugs to specification. **Fluid leakage from the converter housing may be caused by engine oil leaking past the rear main bearing or from oil gallery plugs, or power steering oil leakage from steering system. Be sure to determine the exact cause of the leak before repair procedures are started.**

Oil-soluble aniline or fluorescent dyes premixed at the rate of ½ teaspoon of dye powder to ½ pint of

transmission fluid have proved helpful in locating the source of the fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the oil cooler leaks into the engine coolant system. A black light, however, must be used with the fluorescent dye solution.

## FLUID LEAKAGE IN CONVERTER AREA

In diagnosing and correcting fluid leaks in the front pump and converter area, use the following procedures to facilitate locating the exact cause of the leakage. Leakage at the front of the transmission, as evidenced by fluid around the converter housing, may have several sources. By careful observation, it is possible, in many instances, to pinpoint the source of the leak before removing the transmission from the car. The paths which the fluid takes to reach the bottom of the converter housing are shown in Fig. 1.

**1.** Fluid leaking by the seal lip will tend to move along the drive hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the converter housing only, near the outside diameter of the housing.

**2.** Fluid leakage by the outside diameter of the seal and front pump body will follow the same path which leaks by the front pump seal.

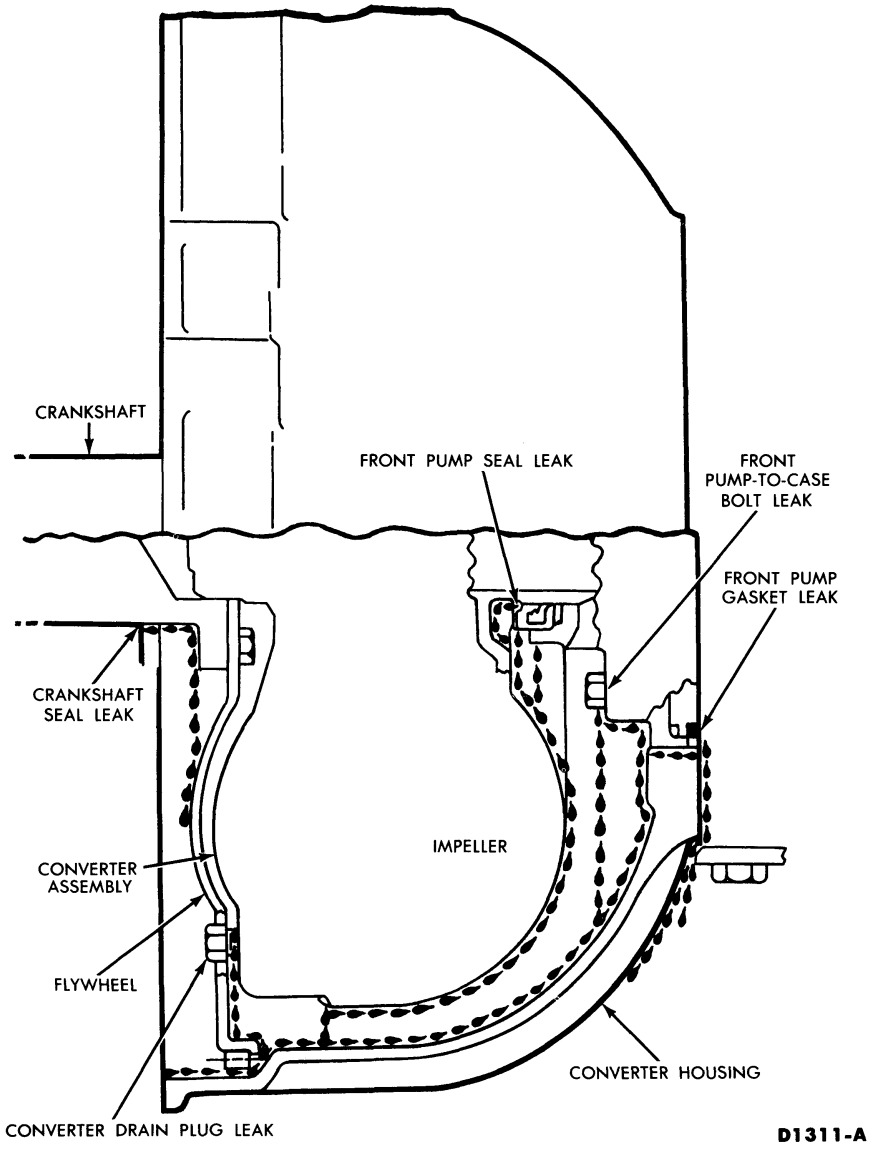



**FIG. 1—Typical Converter Area Oil Leakage Check**

**3.** Fluid that leaks by a front pump to case bolt will be deposited on the inside of the converter housing only. Fluid will not be deposited on the back of the converter.

**4.** Leakage by the front pump to case gasket may cause fluid to be deposited inside the converter housing, or it may seep down between the front of the case and converter housing. Fluid on the front of the case, above the pan gasket, is evidence that the front pump to case gasket or seal could be leaking.

**5.** Fluid leakage from the converter drain plugs will appear at the outside diameter of the converter on the back face of the flywheel, and in the converter housing only near the flywheel.

Engine oil leaks are sometimes improperly diagnosed as front pump seal leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the problem.

**1.** Leakage at the rocker arm cover (valley cover) may allow oil to flow over the converter housing or seep down between the converter housing and engine block causing oil to be present in or at the bottom of the converter housing.

**2.** Oil gallery plug leaks will allow oil to flow down the rear face of the block to the bottom of the converter housing.

**3.** Leakage by the crankshaft seal will work back to the flywheel, and then into the converter housing.

Fluid leakage from other areas, such as the power steering system forward of the transmission, could cause fluid to be present around the converter housing due to blow back or road draft.

The following procedures should be used to determine the cause of the leakage before any repairs are made.

**1.** Remove the transmission dipstick and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of "make-up" fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak. Fluid used in the power steering system is also dyed red. Since road draft may cause leaking power steering fluid to be present on the transmission, this leakage, if present, should be eliminated before performing work on the transmission.

2. Remove the lower converter housing cover. Clean off any fluid from the top and bottom of the converter housing, front of the transmission case, and rear face of the engine and engine oil pan. Clean the converter area by washing with carbon tetrachloride or other suitable non-flammable solvent, and blow dry with compressed air.

3. Wash out the converter housing, the front of the flywheel, and the converter drain plugs. The converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the block and top of the converter housing for evidence of fluid leakage. Raise the car on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the drive and reverse ranges to increase pressures within the transmission. Observe the front of the flywheel, back of the block (in as far as possible), and inside the converter housing and front of the transmission case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

### CONVERTER LEAKAGE CHECK

During the above fluid leakage checks, if there are indications that the welds on the torque converter housing are leaking, the converter will have to be removed and the following check made before the unit is replaced.

A leak checking tool (Fig. 2) can be made from standard parts. The tool can be used to check Cruise-O-Matic or Merc-O-Matic and C4 Automatic converters.

1. Install the plug in the converter (Fig. 3) and expand it by tightening the wing nut. Attach the safety chains.

2. Install the air valve in one of the drain plug threads.

3. Introduce air pressure into the converter housing. Check the pressure with a tire gauge and adjust it to 20 psi.

4. Place the converter in a tank of water. Observe the weld areas for bubbles. If no bubbles are observed, it may be assumed that the welds are not leaking.

### ENGINE IDLE SPEED CHECK

Check and, if necessary, adjust the engine idle speed, using the procedure given in Group 8.

If the idle speed is too low, the engine will run roughly. An idle speed that is too high will cause the car to creep when the transmission is shifted into gear and will cause rough transmission engagement.

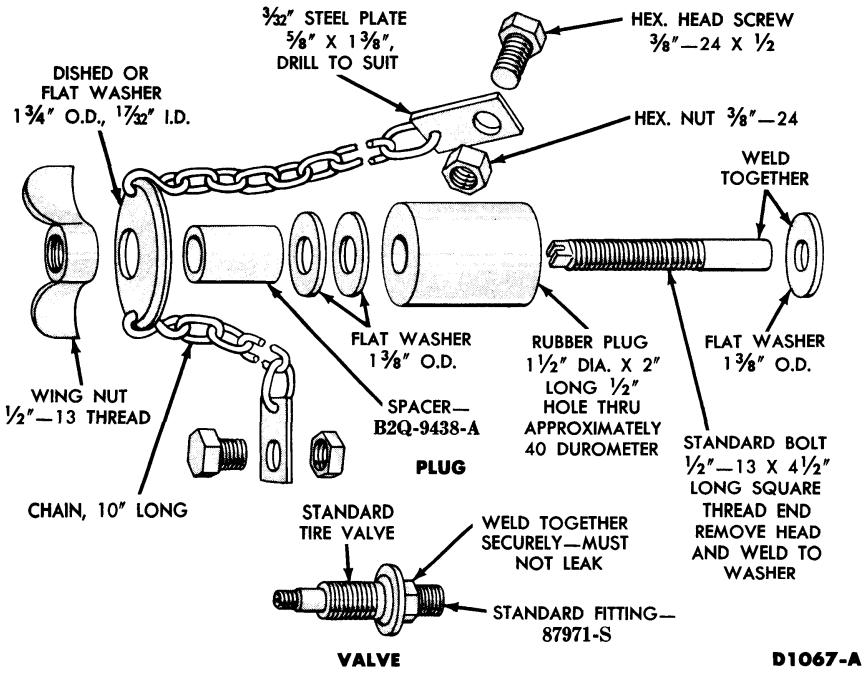



**FIG. 2—Converter Leak Checking Tool**

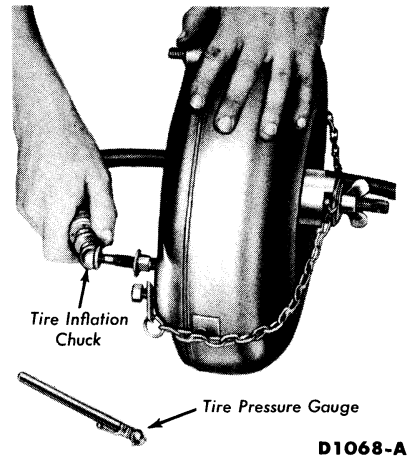



**FIG. 3—Converter Leak Checking Tool Installation**

### ANTI-STALL DASHPOT CLEARANCE CHECK

After the engine idle speed has been properly adjusted, check the anti-stall dashpot clearance. Follow the procedure given in Group 8 for checking and adjusting this clearance.

### MANUAL LINKAGE CHECKS

Correct manual linkage adjustment is necessary to position the manual valve for proper fluid pressure direction to the different transmission components. Improperly adjusted manual linkage may cause cross-leakage and subsequent transmission failure. Refer to Linkage Adjustments in Part 7-2 or 7-3 for detailed manual linkage adjustment procedures.

### CONTROL PRESSURE AND VACUUM DIAPHRAGM UNIT CHECK

When the vacuum diaphragm unit (Fig. 4) is operating properly and the downshift linkage is adjusted properly, all the transmission shifts (automatic and kickdown) should occur within the road speed limits specified in Part 7-4.

If the automatic shifts do not occur within limits or the transmission slips during shift points, the following procedure is suggested to separate engine, transmission, linkage, and diaphragm unit or valve body problems.

1. Attach a tachometer to the engine and a vacuum gauge to the transmission vacuum line at the vacuum unit (Fig. 5).

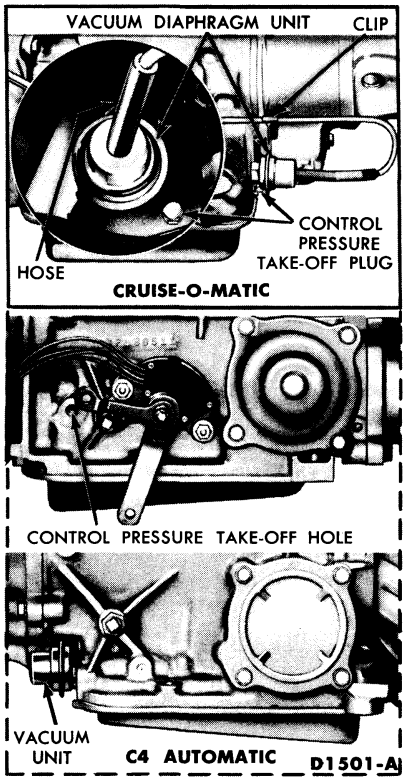



**FIG. 4—Vacuum Diaphragm and Control Pressure Connecting Point**

2. Attach a pressure gauge to the control pressure outlet at the transmission.

3. Firmly apply the parking brake and start the engine.

4. Adjust the engine idle speed to the specified rpm. If the engine idle speed cannot be brought within limits by adjustment at the carburetor idle adjustment screw, check the throttle and downshift linkage for a binding condition. If the linkage is satisfactory, check for vacuum leaks in the transmission diaphragm unit (Fig. 6) and its connecting tubes and hoses. Check all other vacuum operated units (such as the power brake) for vacuum leaks.

### VACUUM UNIT CHECK

To check the vacuum unit for diaphragm leakage, remove the unit from the transmission. Use a distributor tester equipped with a vacuum pump (Fig. 6). Set the regulator knob so that the vacuum gauge reads 18 inches with the end of the vacuum hose blocked off.

Then connect the vacuum hose to the transmission vacuum unit. If the gauge still reads 18 inches, the vacuum unit diaphragm **is not leaking.** As the hose is removed from the transmission vacuum unit, hold a finger over the end of the control rod. When the hose is removed, the internal spring of the vacuum unit should push the control rod outward.

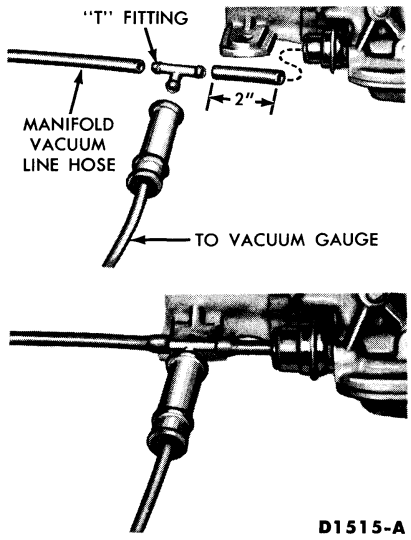



**FIG. 5—Vacuum Test Line Connections**

### TESTING—C4 AUTOMATIC TRANSMISSION

The test results of the following checks should agree with the specifications given in Table 1.

### CONTROL PRESSURE CHECK—AT ENGINE IDLE

1. With the transmission in neutral, and the engine at the correct idle speed, the vacuum gauge should show a minimum of 18 inches. If the vacuum reading is lower than 18 inches, an engine problem is indicated or there is leakage in the vacuum line. Make necessary repairs to obtain a minimum vacuum reading of 18 inches.




**FIG. 6—Testing Transmission Vacuum Unit for Leakage**

2. At engine idle, depress and release the accelerator pedal quickly and observe the vacuum gauge. The amount of vacuum should decrease and increase with the changes in throttle openings. If the vacuum response to changes in throttle opening is too slow the vacuum line to the diaphragm unit could be restricted. **Make the necessary repairs before completing the test.**

3. At engine idle, check the transmission control pressure gauge at all selector lever positions. Transmission control pressures should agree with the specifications as outlined in Table 1.

At different altitudes above sea level, it may not be possible to ob-

**TABLE 1—C4 Automatic Transmission**

**CONTROL PRESSURE AT ZERO OUTPUT SHAFT SPEED**

| Engine Speed or Manifold Vacuum | Throttle Position | Shift Selector Lever Position | *Control (Line) Pressure (psi) |
|---|---|---|---|
| Idle—Above 18 Inches of Vacuum | Closed | P,N,D1,D2,L | 55-62 |
| | | R | 55-96 |
| 17.5 to 16.5 Inches of Vacuum | As Required | D1,D2,L,R | Line Pressure Increase |
| 10 Inches of Vacuum | As Required | D1,D2,L | 95-110 |
| 3 Inches of Vacuum | As Required | D1,D2,L | 138-148 |
| | | R | 213-227 |

*Transmission oil at normal operating temperature.

tain 18 inches vacuum at engine idle. At these altitudes, with idle vacuum of less than 18 inches, refer to the following specifications to determine idle speed control pressure in forward driving ranges D1, D2, D, or L.

| Engine Vacuum (At Idle) | Control Pressure (psi) |
|---|---|
| 17 Inches | 55-65 |
| 16 Inches | 55-71 |
| 15 Inches | 55-77 |
| 14 Inches | 55-83 |
| 13 Inches | 55-89 |
| 12 Inches | 55-95 |
| 11 Inches | 55-101 |

## CONTROL PRESSURE INCREASE CHECK

The control pressure increase should be checked in all ranges except Park and Neutral. Shift the transmission into D1, D2, L and R and check control pressure increase in each range. With the correct control pressure at engine idle, advance the throttle until the engine vacuum reading falls between 17.5-16.5 inches. As the vacuum gauge reading decreases into these specifications, **the control pressure should start to increase.**

Control pressure increase may be noted immediately when the throttle is opened due to the increased pump output, resulting from increased engine rpm. When this happens, the pressure increase point can be checked by using a distributor vacuum tester. Install the distributor tester vacuum line on the diaphragm assembly. Adjust the tester to provide over 18 inches of vacuum. Increase the engine to 600-700 rpm. Reduce the tester vacuum reading through the 17.5-16.5 inch range and observe the transmission pressure gauge for the pressure increase.

## CONTROL PRESSURE CHECK AT 10 INCHES OF VACUUM

A control pressure check should be made at 10 inches of vacuum in D1, D2, and L. Advance the throttle until the engine vacuum reading is 10 inches and check the control pressure regulation. Control pressure should be 95-110 psi, as shown in Table 1.

## CONTROL PRESSURE CHECK AT 3 INCHES OF VACUUM

Check control pressure at 3 inches of vacuum in D1, D2, and L. The control pressure should be 138-148 psi. Then move the selector lever to R. With the vacuum at 3 inches, the control pressure should be 213-227 psi, as shown in Table 1.

**While making this pressure test, do not hold the throttle open for more than five seconds in each detent position.** Between each test move the selector lever to neutral and run the engine at 1000 rpm for fifteen seconds to cool the converter.

**If the vacuum and pressure gauge readings are within specifications, the diaphragm unit and transmission control pressure regulating system are operating properly.**

If transmission control pressure is too low, too high, fails to increase with throttle opening, or is extremely erratic, use the procedure given under the following appropriate heading to resolve the problem.

**Control Pressure is Low at Engine Idle.** If control pressure at engine idle is low in all selector lever positions, trouble other than the diaphragm unit is indicated. When control pressure at engine idle is low in all ranges, check for excessive leakage in the front oil pump, case, and control valve body, or a sticking control pressure regulator valve.

**Control Pressure is High at Engine Idle**. If transmission control pressure at engine idle is too high in all ranges, the trouble may be in the diaphragm unit or its connecting vacuum tubes and hoses, throttle valve, or control rod.

With the engine idling, disconnect the hose from the diaphragm unit and check the engine manifold vacuum. Hold a thumb over the end of the hose and check for vacuum. If the engine speeds up when the hose is disconnected and slows down as the thumb is held against the end of the hose, the vacuum source is satisfactory.

Stop the engine, and remove the diaphragm unit and the diaphragm unit control rod. Inspect the control rod for a **bent** condition and for corrosion. Check the diaphragm unit for leakage with the distributor tester (Fig. 6).

**Control Pressure Does Not Increase With Vacuum at 17.5 to 16.5 Inches.** When the control pressure is within specification at engine idle, but does not increase, as the vacuum is decreased to the specified limits, first check the control rod between the vacuum unit and throttle valve for proper engagement. If the control rod is not assembled into the end of the throttle valve or vacuum unit, the valve cannot regulate throttle pressure to increase control pressure. Next check for a stuck secondary or primary throttle valve, pressure booster valve, or a stuck control pressure regulator valve.

If control pressure increases before or after vacuum is decreased to 17.5 to 16.5 inches, check for a leaking diaphragm assembly, bent diaphragm can, or worn or bent control rod to the throttle valve.

**Control Pressure Not Within Limits at 10 or 3 Inches of Vacuum.** If idle pressure and pressure point increase are within specifications but pressures at 10 or 3 inches of vacuum are not within specifications in all ranges, excessive leakage, low pump capacity, or a restricted oil pan screen is indicated.

If pressures are not within specifications for specific selector lever positions only, this indicates excessive leakage in the clutch or servo circuits used in those ranges.

When the control pressure is within specifications at engine idle, **but not within specifications** at the pressure rise point of 17.5 to 16.5 inches of vacuum, at 10 inches of vacuum, or at 3 inches of vacuum, the vacuum diaphragm unit may need adjustment.

The vacuum diaphragm assembly has an adjusting screw in the vacuum hose connecting tube (Fig. 7). The inner end of the screw bears against a plate which in turn bears against the vacuum diaphragm spring (Fig. 7).

All readings slightly high or all readings slightly low may indicate the vacuum unit needs adjustment to correct a particular shift condition.

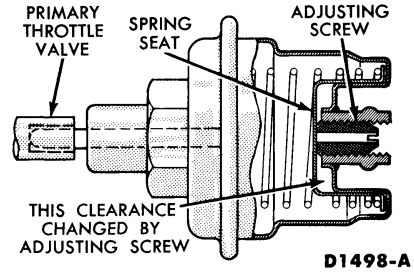



**FIG. 7–Vacuum Diaphragm Unit**

For example, if the pressure at 10 inches of vacuum was 120 psi and the pressure at 3 inches of vacuum was 170 psi, and upshifts and downshifts were harsh, a diaphragm adjustment to reduce the diaphragm assembly spring force would be required.

If the pressure readings are low, and control pressure does not start to build up until vacuum drops to 15 inches, an adjustment to increase diaphragm spring force is required.

To increase control pressure, turn the adjusting screw in clockwise. To reduce control pressure, back the adjusting screw out by turning it counterclockwise. **One complete turn** of the adjusting screw (360°) will change idle line control pressure approximately 2-3 psi. After the adjustment is made, install the vacuum line and make all the pressure checks as outlined in Table 1.

**The diaphragm should not be adjusted to provide pressures below the ranges in Table 1, in order to change shift feel. To do so could result in soft or slipping shift points and damage to the transmission.**

### STALL TEST

Start the engine to allow it to reach its normal temperature. Apply both the parking and service brakes while making tests.

The stall test is made in D2, D1, L, or R, at full throttle to check engine performance, converter clutch operation or installation, and the holding ability of the forward clutch, reverse-high clutch and low-reverse band and the gear train one-way clutch. **While making this test, do not hold the throttle open for more than five seconds at a time.** Then move the selector lever to Neutral and run the engine at 1000 rpm for about 15 seconds to cool the converter before making the next test. If the engine speed as recorded by the tachometer exceeds the maximum limits specified in Table 2, release the accelerator immediately because clutch or band slippage is indicated.

### STALL SPEED TOO HIGH

If stall speed exceeds specifications, band or clutch slippage is indicated, depending on transmission selector lever position. Excessive engine rpm only in D1, D2, and L indicates forward clutch slippage. Excessive engine rpm only in R indicates either reverse-high clutch or low-reverse band slippage. Excessive engine rpm only in D1 indicates gear train one-way clutch slippage.

### STALL SPEED TOO LOW

When the stall test speeds are low and the engine is properly tuned, converter stator clutch problems are indicated. A road test must be performed to determine the exact cause of the trouble.

If the stall test speeds are 300 to 400 rpm below the specifications shown in Table 2, and the car cruises properly but has very poor acceleration, the converter stator clutch is slipping.

If the stall test speeds are 300 to 400 rpm below the specified values, and the car drags at cruising speeds and acceleration is poor, the stator clutch could be installed backwards. Remove the converter and check the stator clutch as described in "Cleaning and Inspection."

When the stall test shows normal speeds, the acceleration is good, but the car drags at cruising speeds, the difficulty is due to a seized stator assembly. If the stator is defective, replace the converter.

### INITIAL ENGAGEMENT CHECKS

Initial engagement checks are made to determine if initial band and clutch engagements are smooth.

Run the engine until its normal operating temperature is reached. With the engine at the correct idle speed, shift the selector lever from N to D2, D1, L, and R. Observe the initial band and clutch engagements. Band and clutch engagements should be smooth in all positions. Rough band and clutch engagements in D1, D2, L, or R are caused by high engine idle speed or high control pressures.

### SHIFT POINT CHECKS

Check the light throttle upshifts in D1. The transmission should start in first gear, shift to second, and then shift to third, within the shift points specified in Table 3.

While the transmission is in third gear, depress the accelerator pedal through the detent (to the floor). The transmission should shift from third to second or third to first, depending on the car speed.

Check the closed throttle downshift from third to first by coasting down from about 30 mph in third gear. The shift should occur within the limits specified in Table 3.

When the selector lever is at D2, the transmission can operate only in second and third gears. Shift points for second to third and third to second are the same in both D2 and D1.

With the transmission in third gear and road speed over 30 mph, the transmission should shift to second gear when the selector lever is moved from D2 or D1 to L. When the same manual shift is made below about 20 mph, the transmission will shift from second or third to first. **This check will determine if the governor pressure and shift control valves are functioning properly.**

During the shift check operation, if the transmission does not shift within specifications or certain gear ratios cannot be obtained, refer to the diagnosis guide to resolve the problem.

### AIR PRESSURE CHECKS

A "NO DRIVE" condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.

**TABLE 2—Stall Speeds—C4 Automatic Transmission**

| Selector Lever Position | Clutch Applied | Band Applied | Engine Speed (rpm) | |
|---|---|---|---|---|
| | | | 223-Six | 289-V-8 |
| D2 | Forward | Intermediate | 1500-1700 | 1750-1950 |
| D1 | Forward | One-Way Clutch | | |
| L | Forward | Low-Reverse | | |
| R | Reverse-High | Low-Reverse | | |

When the selector lever is at D2, a "NO DRIVE" condition may be caused by an inoperative forward clutch. A "NO DRIVE" condition at D1 may be caused by an inoperative forward clutch or one-way clutch. When there is no drive in L, the difficulty could be caused by improper functioning of the forward clutch or low-reverse band and the one-way clutch. Failure to drive in reverse range could be caused by a malfunction of the reverse-high clutch or low-reverse band. Erratic shifts could be caused by a stuck governor valve.

To make the air pressure checks, loosen the oil pan bolts and lower one edge of the oil pan to drain the transmission fluid. Remove the oil pan and the control valve body assembly. The inoperative units can be located by introducing air pressure into the transmission case passages leading to the clutches, servos, and governor (Fig. 8)

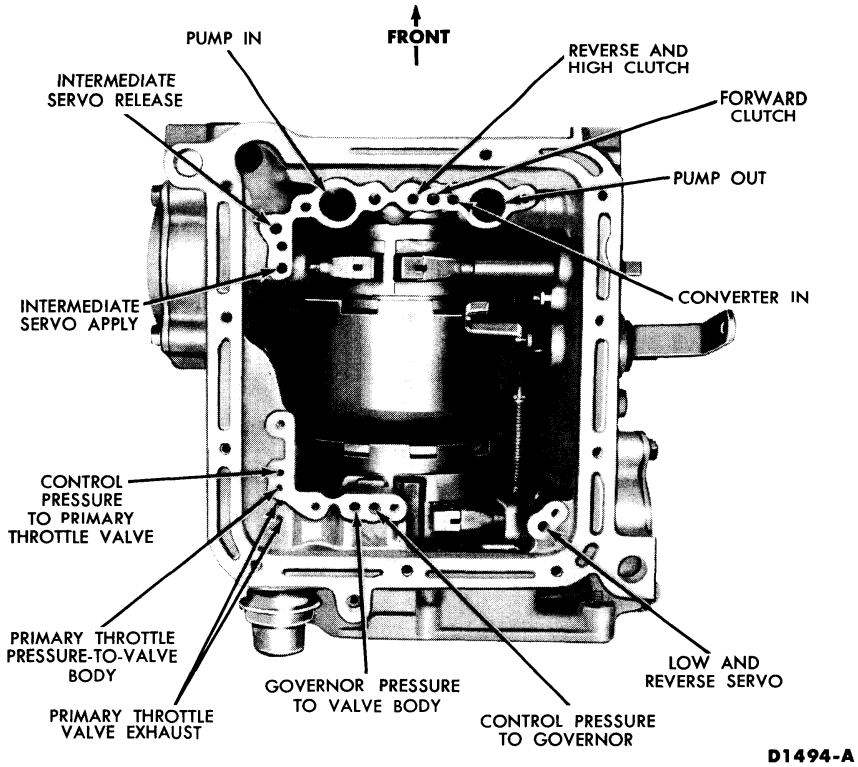



**FIG. 8—Case Oil Passage Hole Identification—C4 Automatic**

### FORWARD CLUTCH

Apply air pressure to the transmission case forward clutch passage (Fig. 8). A dull thud can be heard when the clutch piston is applied. If no noise is heard, place the finger tips on the input shell and again apply air pressure to the forward clutch passage. Movement of the piston can be felt as the clutch is applied.

### GOVERNOR

Apply air pressure to the control pressure to governor passage and listen for a sharp clicking or whistling noise. The noise indicates governor valve movement.

### REVERSE-HIGH CLUTCH

Apply air pressure to the reverse-high clutch passage (Fig. 8). A dull thud indicates that the reverse-high clutch piston has moved to the applied position. If no noise is heard, place the finger tips on the clutch drum and again apply air pressure to detect movement of the piston.

### INTERMEDIATE SERVO

Hold the air nozzle in the intermediate servo apply passage (Fig. 8). Operation of the servo is indicated by a tightening of the intermediate band around the drum. Continue to apply air pressure to the intermediate servo apply passage, and introduce air pressure into the intermediate servo release passage. The intermediate servo should release the band against the apply pressure.

### LOW-REVERSE

Apply air pressure to the low-reverse apply passage (Fig. 8). The low-reverse band should tighten around the drum if the servo is operating properly.

## TABLE 3—C4 Automatic Transmission

### SHIFT SPEEDS (APPROXIMATE)

| Axle Ratio | Automatic Shift Speeds (mph) | | | | | | | | Manual Shift Speeds (mph) |
|---|---|---|---|---|---|---|---|---|---|
| | D1 | | D1 or D2 | | D1 | D1 or D2 | D1 | D2 | L |
| | 1-2 Minimum Throttle | 1-2 Maximum Throttle | 2-3 Minimum Throttle | 2-3 Maximum Throttle | 3-1 Minimum Throttle | 3-2 Maximum Throttle | 2-1 or 3-1 Maximum Throttle | 3-2 Minimum Throttle | 2-1 Minimum Throttle |
| 3.25:1 3.50:1 | 8-10 | 31-41 | 12-24 | 54-71 | 10 (max.) | 64 (max.) | 33 (max.) | 10 (max.) | 22 (max.) |
| 3.00:1 | 9-11 | 36-44 | 14-25 | 64-76 | 11 (max.) | 69 (max.) | 35 (max.) | 11 (max.) | 23 (max.) |

## TABLE 4—Cruise-O-Matic or Merc-O-Matic Transmission

### CONTROL PRESSURE AT ZERO OUTPUT SHAFT SPEED

| Engine Speed or Manifold Vacuum | Throttle Position | Selector Lever Position | *Control Line Pressure | |
|---|---|---|---|---|
| | | | All Except Police Interceptor | Police Interceptor |
| Engine Idle–Vacuum above 16 inches | Closed | P, N, D2, D1, L | 57-77 | 70-95 |
| Engine Idle–Vacuum above 16 inches | Closed | R | 71-106 | 81-144 |
| Engine rpm as required for 16-13.7 inches of manifold vacuum | As Required | L, D2, D1 | Line Pressure Increase | Line Pressure Increase |
| Engine rpm–STALL Vacuum below 1.5 inches | To and thru Detent | L, D2, D1 | 151-176 | 170-200 |
| Engine rpm–STALL Vacuum below 1.5 inches | To and thru Detent | R | 201-213 | 212-228 |

*Transmission Oil at Normal Operating Temperature

If the servos do not operate, disassemble, clean, and inspect them to locate the source of the trouble.

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove and, with air pressure, check the fluid passages in the case and front pump to detect obstructions.

If the passages are clear, remove the clutch assemblies, and clean and inspect the malfunctioning clutch to locate the trouble.

### TESTING—CRUISE-O-MATIC OR MERC-O-MATIC TRANSMISSION

The test results of the following checks should agree with the specifications given in Table 4.

### CONTROL PRESSURE CHECK–AT ENGINE IDLE

**1.** With the transmission in neutral, and the engine at the correct idle speed, the vacuum gauge should show a minimum of 18 inches. If the vacuum reading is lower than 18 inches, an engine problem is indicated or there is leakage in the vacuum line. Make necessary repairs to obtain a minimum vacuum reading of 18 inches.

**2.** At engine idle, depress and release the accelerator pedal quickly and observe the vacuum gauge. The amount of vacuum should decrease and increase with the changes in throttle openings. If the vacuum response to changes in throttle opening is too slow, the vacuum line to the diaphragm unit could be restricted. **Make the necessary repairs before completing the test.**

**3.** At engine idle, check the transmission control pressure gauge at all selector lever positions. The transmission control pressure test should agree with Table 4, for control pressure at engine idle.

### CONTROL PRESSURE INCREASE CHECK

Control pressure increase should be checked in all ranges except Park and Neutral.

Shift the transmission into D1, D2, L, and R and check control pressure rise in each range. Advance the throttle until the engine vacuum reading falls between 16-13.7 inches. As the vacuum gauge reading decreases into these specifications, **the control pressure should start to rise as outlined in Table 4.**

### CONTROL PRESSURE CHECK AT STALL SPEED

Check control pressure at stall speed (throttle advanced to and through detent) in R, D1, D2, L. Pressures at stall in the various ranges should agree with the control pressures as outlined in Table 4. If the engine speed exceeds the maximum limits, release the accelerator immediately bcause band or clutch slippage is indicated. **While making the stall pressure test, do not hold the throttle open for more than five seconds in each detent position.** Between each test move the selector lever to neutral and run engine at 1000 rpm for fifteen seconds, to cool the converter.

If the vacuum and pressure gauge readings are within specifications, the diaphragm unit and transmission control pressure regulating system are operating properly.

If transmission control pressure is too low, too high, fails to rise with throttle opening, or is extremely erratic, use the procedure given under the following appropriate heading to resolve the problem.

**Control Pressure is Low at Engine Idle.** If control pressure at engine idle is low in all selector lever positions, trouble other than the diaphragm unit is indicated. When control pressure at engine idle is low in all ranges, check for excessive leakage in the front oil pump, case, and control valve body, or a sticking control pressure regulator valve.

**Control Pressure is High at Engine Idle.** If transmission control pressure at engine idle is too high in all ranges, the trouble may be in the diaphragm unit or its connecting vacuum tubes and hoses, throttle valve, or control rod.

With the engine idling, disconnect the hose from the diaphragm unit and check the engine manifold vacuum. Hold a thumb over the end of the hose and check for vacuum. If the engine speeds up when the hose is disconnected and slows down as the thumb is held against the end of the hose, the vacuum source is satisfactory.

Stop the engine, and remove the diaphragm unit and the diaphragm unit push rod. Inspect the control rod for a **bent** condition and for corrosion. Install the diaphragm unit in the case to prevent fluid loss, but

leave the push rod out. With the push rod removed, the diaphragm unit cannot affect transmission control pressure.

Start the engine and check control pressure at engine idle in all selector lever positions. If control pressure is still too high, the trouble is in the transmission pressure regulating control system. If the pressure is now within limits, the diaphragm unit was not operating properly and should be checked with the distributor tester (Fig. 6).

**Control Pressure Does Not Increase With Throttle Opening.** When the control pressure is within specification at engine idle, but does not rise, as the vacuum is decreased to the specified limits, first check the control rod between the vacuum unit and throttle valve for proper engagement. If the control rod is not assembled into the end of the throttle valve or vacuum unit, the valve cannot regulate throttle pressure to increase control pressure. Next check for a stuck throttle valve, compensator valve or control pressure regulator valve.

If control pressure increases before or after vacuum is decreased to the specified limits check for the proper operation of the diaphragm assembly, bent diaphragm cam, or worn or bent control rod.

**Control Pressure Not Within Limits—Stall Test.** If idle pressure and pressure point increase are within specifications but stall pressures are not within specification in all ranges, excessive leakage, low pump capacity or restricted oil pan screen is indicated.

If stall pressures are not within specifications for specific ranges only, this indicates excessive leakage in the clutch or servo circuits used in those ranges.

## STALL TEST

Start the engine to allow it to reach its normal temperature. Apply both the parking and service brakes while making these tests.

The stall test is made in D2, D1, L, or R, at full throttle to check engine performance, converter clutch operation or installation, and front clutch, rear clutch and rear band operation.

**While making this test, do not hold the throttle open for more than five seconds at a time.** Then move the selector lever to Neutral and run the engine at 1000 rpm for about 15 seconds to cool the converter before making the next test. If the engine speed, as recorded by the tachometer, exceeds the maximum limits specified in Table 5, release the accelerator immediately because clutch or band slippage is indicated.

### STALL SPEED TOO HIGH

If stall speed exceeds specifications, band or clutch slippage is indicated, depending on transmission selector lever position. Excessive engine rpm in D1, D2, and L indicates front clutch slippage. Excessive rpm in D1 only indicates one-way clutch slippage. Excessive engine rpm in R indicates either rear clutch or rear band slippage.

### STALL SPEED TOO LOW

When the stall test speeds are low and the engine is properly tuned, converter stator clutch problems are indicated. A road test must be performed to determine the exact cause of the trouble.

If the stall test speeds are 300 to 400 rpm below the specifications shown in Table 5, and the car cruises properly but has very poor acceleration, the converter stator clutch is slipping.

Remove the converter and check the stator clutch as described in "Cleaning and Inspection".

If the stall test speeds are 300 to 400 rpm below the specified values, and the car drags at cruising speeds and acceleration is poor, the stator clutch is installed backwards.

When the stall test shows normal speeds, the acceleration is good, but the car drags at cruising speeds, the difficulty is due to a seized stator assembly. If the stator is defective, replace the converter.

## INITIAL ENGAGEMENT CHECKS

Initial engagement checks are made to determine if initial band and clutch engagements are smooth.

Run the engine until its normal operating temperature is reached. With the engine at the correct idle speed, shift the selector lever from N to D2, D1, L, and R. Observe the initial band and clutch engagements. Band and clutch engagements should be smooth in all positions. Rough initial engagements in D1, D2, L, or R are caused by high engine idle speed or high control pressures.

## SHIFT POINT CHECKS

Check the light throttle upshifts in D1. The transmission should start in first gear, shift to second and then shift to third, within the shift points specified in Table 6.

While the transmission is in third gear, depress the accelerator pedal through the detent (to the floor). The transmission should shift from third to second or third to first, depending on the car speed.

Check the closed throttle downshift from third to first by coasting down from about 30 mph in third gear. The shift should occur within the limits specified in Table 6.

**TABLE 5—Stall Speeds—Cruise-O-Matic or Merc-O-Matic Transmissions**

| Selector Lever Position | Clutch Applied | Band Applied | Engine Speed (rpm) | | |
|---|---|---|---|---|---|
| | | | 289-2V | 352 V-8 | 390 V-8 |
| D2 | Front | Front | 1750-1950 | 1550-1750 | 390-4V 1800-2000 |
| D1 | Front | One-Way Clutch | | | 390-2V 1700-1900 |
| L | Front | Rear | | | Police Interceptor 1750-1950 |
| R | Rear | Rear | | | |

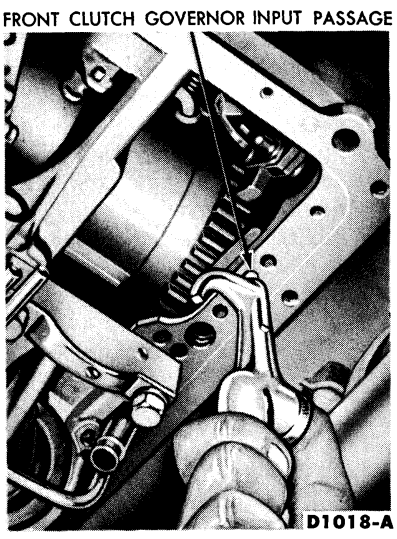



**FIG. 9—Typical Front Clutch Air Check**

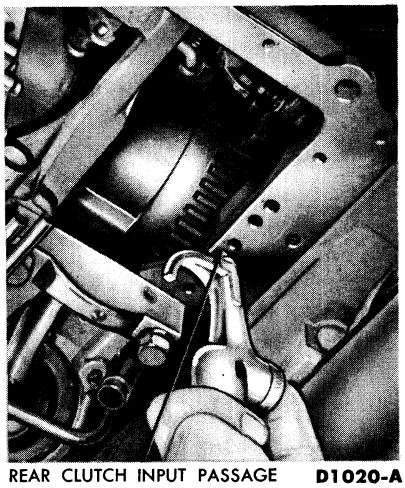



**FIG. 11—Typical Rear Clutch Air Check**




**FIG. 12—Typical Rear Servo Air Check—Cruise-O-Matic**

When the selector lever is at D2, the transmission can operate only in second and third gears. Shift points for second to third and third to second are the same in both D2 and D1.

With the transmission in third gear and road speed over 30 mph, the transmission should shift to second gear when the selector lever is moved from D2 or D1 to L. When the same manual shift is made below about 25 mph, the transmission will shift from second or third to first. **This check will determine if the governor pressure and shift control valves are functioning properly.**

During the shift check operation, if the transmission does not shift within specifications or certain gear ratios cannot be obtained, refer to the diagnosis guide to resolve the problem.

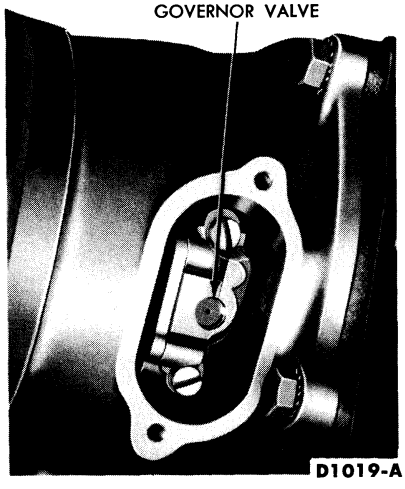



**FIG. 10—Governor Valve**

## AIR PRESSURE CHECKS

A "NO DRIVE" condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.

When the selector lever is at D2 and D1 and L, a "NO DRIVE" condition may be caused by an inoperative front clutch. A "NO DRIVE" condition at D1 may be caused by an inoperative one-way clutch. When there is no drive in L, the difficulty could be caused by improper functioning of the front clutch, the rear band or the one-way clutch. Failure to drive in reverse range could be caused by a malfunction of the rear clutch or rear band. Erratic shifts could be caused by a stuck governor valve.

To make the air pressure checks, drain the transmission fluid, and then remove the oil pan and the control valve assembly. The inoperative units can be located by introducing air pressure into the transmission case passages leading to the clutches, servos, and governor.

### FRONT CLUTCH

Apply air pressure to the transmission case front clutch passage (Fig. 9). A dull thud can be heard when the clutch piston is applied. If no noise is heard, place the finger tips on the drum and again apply air pressure to the front clutch passage. Movement of the piston can be felt as the clutch is applied.

### GOVERNOR

Remove the governor inspection cover from the extension housing.

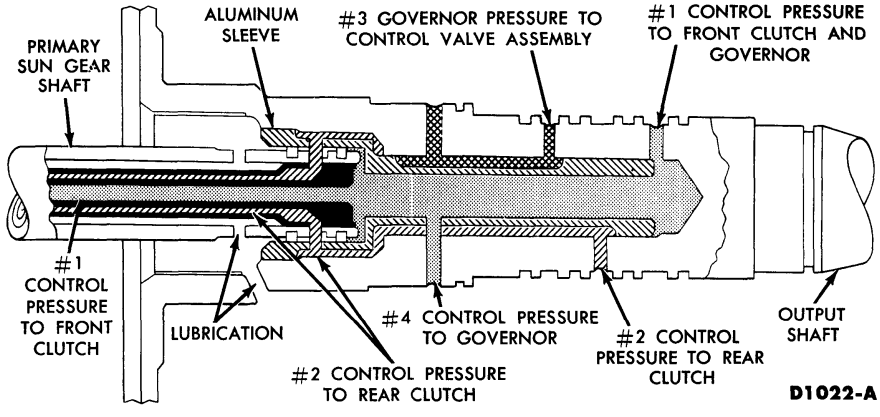



**FIG. 13—Output and Primary Sun Gear Fluid Passages—Cruise-O-Matic**

Apply air pressure to the front clutch passage, listen for a sharp click, and watch to see if the governor weight snaps inward (Fig. 10). Inward weight movement indicates correct governor valve operation.

### REAR CLUTCH

Apply air pressure to the rear clutch passage (Fig. 11). A dull thud indicates that the rear clutch piston has moved to the applied position. If no noise is heard, place the finger tips on the rear drum and again apply air pressure to detect movement of the piston.

### FRONT SERVO

Hold the air nozzle in the front servo apply tube. Operation of the front servo is indicated by a tightening of the front band around the drum. Continue to apply air pressure to the front servo apply tube and introduce air pressure into the front servo release tube. **Hold a cloth over the release tube while applying the servo to catch the spray from the release tube.** The front servo should release the band against the apply pressure.

### REAR SERVO

Apply air pressure to the rear servo apply passage (Fig. 12). The rear band should tighten around the drum if the rear servo is operating properly.

If either servo is inoperative, remove the inoperative unit and apply air pressure directly to its passages. Proper operation of the servos indicates that the trouble is in the case passages. If the servo does not operate, disassemble, clean, and inspect it to locate the source of trouble.

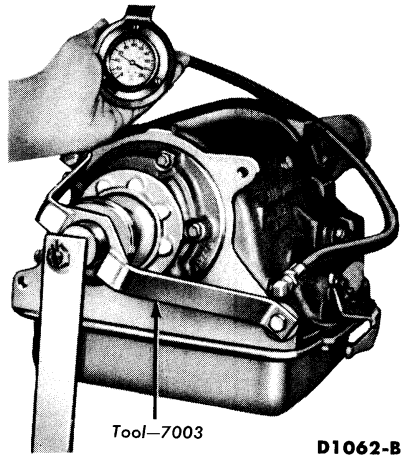



**FIG. 14—Typical Bench Testing Tool Installation**

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove and, with air pressure, check the fluid passages at the output shaft aluminum sleeve for correct indexing with the shaft holes. Check the primary sun gear shaft assembly passages with air pressure to detect obstructions (Fig. 13).

If the output shaft and primary sun gear shaft passages are clear, remove the clutch assemblies, and clean and inspect the malfunctioning clutch to locate the trouble.

### HYDRAULIC SYSTEM BENCH TESTS (CRUISE-O-MATIC OR MERC-O-MATIC)

After the transmission has been assembled and is ready for installation in the car, check the hydraulic system to make sure it is operating properly. These hydraulic tests can be made on the bench so that most malfunctions of the system can be corrected before the transmission is installed in the car.

### TESTING TOOL INSTALLATION

**1.** Install a plug in the filler tube hole in the oil pan, and pour about four quarts of transmission fluid into the transmission through the speedometer gear opening.

**2.** Remove the vacuum diaphragm unit and the diaphragm unit control rod, and install the vacuum unit if these parts had been previously installed.

**3.** Install the bench testing tool on the transmission.

**4.** Remove the ⅛-inch pipe plug at the transmission case. Turn the front pump in a clockwise direction at 75-100 rpm until a regular flow of transmission fluid leaves the hole in the transmission case. This operation "bleeds" the air from the pump.

**5.** Install the pressure gauge (77820 or T57L-77820-A) as shown in Fig. 14.

### PRESSURE TESTS

Turn the front pump at 75-100 rpm and note the gauge readings. The pressure readings on the bench test must be within the limits as outlined in Table 3, for the engine idle check.

If pressure gauge readings are within limits in all selector lever positions, install the vacuum diaphragm control rod unit.

## TABLE 6—Cruise-O-Matic Transmission

### SHIFT SPEEDS (APPROXIMATE)

| Transmission Model | Automatic Shift Speeds (mph) | | | | | | | | Manual Shift Speeds (mph) |
|---|---|---|---|---|---|---|---|---|---|
| | D1 | | D1 or D2 | | D1 | D1 or D2 | D1 | D2 | L |
| | 1-2 Minimum Throttle | 1-2 Maximum Throttle | 2-3 Minimum Throttle | 2-3 Maximum Throttle | 3-1 Minimum Throttle | 3-2 Maximum Throttle | 2-1 or 3-1 Maximum Throttle | 3-2 Minimum Throttle | 2-1 Minimum Throttle |
| PCT | 7-9 | 35-42 | 10-21 | 6 | 6 | 6 | 25-33 | 6-10 | 17-24 |
| PCD | 10-13 | 40-48 | 14-24 | 63-73 | 9-10 | 58-68 | 27-36 | 7-10 | 16-28 |
| PCE | 8-11 | 41-49 | 14-24 | 63-75 | 8-10 | 58-69 | 27-36 | 7-10 | 19-26 |
| PCE Police Interceptor | 6-11 | 47-56 | 14-27 | 79-90 | 6-8 | 73-81 | 37-46 | 4-11 | 25-39 |

## DIAGNOSIS GUIDE

The Diagnosis Guide lists the most common trouble symptoms that may be found and gives the items that should be checked to find the cause of the trouble. There are two diagnosis guides, one for each type transmission.

The items to check are arranged in a logical sequence which should be followed for quickest results. The letter symbols for each item are explained in the key. If items A, B, C, K, and the stall tests have already been checked during preliminary checks and adjustments, they need not be repeated.

### C4 AUTOMATIC DUAL RANGE DIAGNOSIS GUIDE

| Trouble Symptom | Items to Check | | Probable Trouble Sources |
|---|---|---|---|
| | Transmission in Car | Transmission Out of Car | |
| Rough Initial Engagement in D1 or D2 | K B W F E | | A. Fluid Level |
| Rough Initial Engagement D2 Only | G J | | B. Vacuum Diaphragm Unit or Tubes |
| 1-2 or 2-3 Shift Points Incorrect | A B C D W E L | | C. Manual Linkage |
| Rough 2-3 Shift | B F E | | D. Governor |
| Engine Overspeeds on 2-3 Shift | B G W E F | r | E. Valve Body |
| No Shift Points | C D E J | | F. Control Pressure Regulator Valve |
| No 2-3 Shift | C R D E | b r | G. Intermediate Band |
| No 3-1 Shift in D1 | B E | | H. Low-Reverse Band |
| No Forced Downshifts | L W E | | I. Low-Reverse Servo |
| Runaway Engine on Forced Downshift | G F E J B | c | J. Intermediate Servo |
| Rough 3-2 or 3-1 Shift at Closed Throttle | K B E | | K. Engine Idle Speed |
| Shifts 1-3 in D1 and D2 | G J | | L. Downshift Linkage |
| No Engine Braking in First Gear—Manual Low Range | H I | | M. Converter Drain Plugs |
| Creeps Excessively in D1 or D2 | K | | N. Oil Pan Gasket, or Filler Tube |
| Slips or Chatters in First Gear, D1 | A B W F E | a c i | O. Oil Cooler and Connections |
| Slips or Chatters in Second Gear | A B G W F E J | a c | P. Manual or Downshift Lever Shaft Seal |
| Slips or Chatters in R | A H W F E I | b c | Q. ⅛-inch Pipe Plug in Side of Case |
| No Drive in D1 Only | C E | i | R. Perform Air-Pressure Check |
| No Drive in D2 Only | C | | S. Extension Housing to Case Gaskets and Lockwashers |
| No Drive in R Only | C H I E R | b c | U. Extension Housing Rear Oil Seal |
| No Drive in D1, D2, or L | D W R | a | W. Perform Control Pressure Check |
| No Drive in Any Selector Lever Position | A C W F E R | c h | X. Speedometer Driven Gear Adapter Seal |
| Lockup in D2 Only | H I | i | a. Forward Clutch |
| Lockup in R Only | | a g | b. Reverse-High Clutch |
| Parking Lock Binds or Does Not Hold | C | g | c. Leakage in Hydraulic System |
| Transmission Overheats | A O F | n | d. Front Pump |
| Maximum Speed Too Low, Poor Acceleration | | n | g. Parking Linkage |
| Transmission Noisy in N | F | d | h. Planetary Assembly |
| Transmission Noisy in First, Second, and Reverse Gear | F | h d | i. Planetary One-Way Clutch |
| Transmission Noisy in P | F | d | j. Engine Rear Oil Seal |
| Fluid Leak | M N O P Q S U X | j m p | m. Front Pump Oil Seal |
| | | | n. Converter One-Way Clutch |
| | | | p. Front Pump to Case Gasket or Seal |
| | | | r. Reverse-High Clutch Piston Air Bleed Valve |

**CRUISE-O-MATIC OR MERC-O-MATIC DUAL RANGE DIAGNOSIS GUIDE**

| Trouble Symptom | Items to Check | | Probable Trouble Sources |
|---|---|---|---|
| | Transmission in Car | Transmission Out of Car | |
| Rough Initial Engagement in D1 or D2 | K B W F E G | | A. Fluid Level |
| 1-2 or 2-3 Shift Points Incorrect | A B C D W E L | | B. Vacuum Diaphragm Unit or Tubes |
| Rough 2-3 Shift | B G F E J | | C. Manual Linkage |
| Engine Overspeeds on 2-3 Shift | B G E F | r | D. Governor |
| No 1-2 or 2-3 Shift | D E C G J | b c f | E. Valve Body |
| No 3-1 Shift | K B E | | F. Pressure Regulator |
| No Forced Downshifts | L W E | | G. Front Band |
| Runaway Engine Forced Downshift | G F E J B | c | H. Rear Band |
| Rough 3-2 or 3-1 Shift at Closed Throttle | K B E | | I. Rear Servo |
| Creeps Excessively in D1 or D2 | K | | J. Front Servo |
| Slips or Chatters in First Gear, D1 | A B W F E | a c f i | K. Engine Idle Speed |
| Slips or Chatters in Second Gear | A B G W F E J | a c | L. Downshift Linkage |
| Slips or Chatters in R | A H W F E I B | b c f | M. Converter Drain Plugs |
| No Drive in D1 | C E | i | N. Oil Pan Gasket, Drain Plug or Tube |
| No Drive in D2 | E R C | a c f | O. Oil Cooler and Connections |
| No Drive in L | C E R | a c f | P. Manual or Throttle Lever Shaft Seal |
| No Drive in R | H I E R C | b c f | Q. ⅛-inch Pipe Plug in Side of Case |
| No Drive in Any Selector Lever Position | A C W F E R | c | R. Perform Air-Pressure Check |
| Lockup in D1 | C I J | b g c | S. Extension Housing to Case Gaskets and Lockwashers |
| Lockup in D2 | C H I | b g c i | T. Center Support Bolt Lockwashers |
| Lockup in L | G J E | b g c | U. Extension Housing Rear Oil Seal |
| Lockup in R | G J | a g c | V. Governor Inspection Cover Gasket |
| Parking Lock Binds or Does Not Hold | C | g | W. Perform Control Pressure Check |
| Engine Does Not Start by Pushing Car | A C F E | e c | X. Speedometer Driven Gear Adapter Seal |
| Transmission Overheats | O F | n | a. Front Clutch |
| Maximum Speed Too Low, Poor Acceleration | | n | b. Rear Clutch |
| Transmission Noisy in N | F | a d | c. Leakage in Hydraulic System |
| Transmission Noisy in First, Second, Third, or Reverse Gear | F | h a b d | d. Front Pump |
| Transmission Noisy in P | F | d | e. Rear Pump |
| Transmission Noisy During Coast at 30-20 mph in N, Engine Stopped | | e | f. Fluid Distributor Sleeve in Output Shaft |
| Fluid Leak | M N O P Q S T U V X | j m p | g. Parking Linkage |
| | | | h. Planetary Assembly |
| | | | i. Planetary One-Way Clutch |
| | | | j. Engine Rear Oil Seal |
| | | | m. Front Pump Oil Seal |
| | | | n. Converter One-Way Clutch |
| | | | p. Front Pump to Case Gasket |
| | | | r. Rear Clutch Piston Air Bleed Valve |

## 2 COMMON ADJUSTMENTS AND REPAIRS

### TRANSMISSION FLUID LEVEL CHECK

The transmission fluid level should be checked using the following procedure.

**1.** Make sure that the car is standing level; then firmly apply the parking brake.

**2.** Run the engine at normal idle speed. If the transmission fluid is cold, run the engine at fast idle speed (about 1200 rpm) until the fluid reaches its normal operating temperature. When the fluid is warm, slow the engine down to normal idle speed.

**3.** Shift the selector lever through all positions, and place the lever at P. **Do not turn off the engine during the fluid level checks.**

**4.** Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.

**5.** Pull the dipstick out of the tube, wipe it clean, and push it all the way back into the tube.

**6.** Pull the dipstick out of the tube again, and check the fluid level. If necessary, add enough fluid to the transmission through the filler tube to raise the fluid level to the F (full) mark on the dipstick. **Do not overfill the transmission.**

### TRANSMISSION FLUID DRAIN AND REFILL

Normal maintenance and lubrication requirements do not necessitate periodic automatic transmission fluid changes.

If a major failure, such as a clutch, band, bearing, etc., has occurred in the transmission, it will have to be removed for service. At this time the converter must be thoroughly flushed to remove any dirt.

When filling a dry transmission and converter, install five quarts of fluid. Start the engine, shift the selector lever as in step 7 below, and check and add fluid as necessary.

Following is the procedure for partial drain and refill due to in-car repair operation.

**1.** On a Cruise-O-Matic or Merc-O-Matic transmission, disconnect the fluid filler tube from the transmission oil pan. On a C4 Automatic transmission, remove all but two of the oil pan bolts. Loosen the two bolts and carefully lower one edge of the oil pan to drain the fluid.

**2.** When the fluid has stopped draining from the transmission, remove and thoroughly clean the oil pan. Discard the oil pan gasket.

**3.** Place a new gasket on the oil pan, and install the pan on the transmission.

**4.** On a Cruise-O-Matic or Merc-O-Matic model, connect the filler tube to the oil pan, and tighten the fitting securely.

**5.** Add three quarts of fluid to the transmission through the filler tube.

**6.** Run the engine at idle speed for about two minutes, and then run it at fast idle speed (about 1200 rpm) until it reaches its normal operating temperature. **Do not race the engine.**

**7.** Shift the selector lever through all the positions, place it at P, and check the fluid level. If necessary, add enough fluid to the transmission to raise the level to the F (full) mark on the dipstick. **Do not overfill the transmission.**

### THROTTLE AND DOWNSHIFT LINKAGE

Lubricate the throttle linkage with 10W engine oil. Lubricate the lower pivot point of the downshift rod with CIAZ-19590-A moly lube (ball joint grease).

### OIL COOLER FLUSHING PROCEDURE

When a clutch or band failure or other internal trouble has occurred in the transmission, any metal particles or clutch plate or band material that may have been carried into the cooler should be removed from the system by flushing the cooler before the transmission is put back into service.

**1.** Disconnect the fluid return line from the rear of the transmission.

**2.** Start the engine and drain about two quarts of fluid from the cooler into a pan. Discard the drained fluid. If there is no fluid flow or the fluid does not flow freely from the return line, shut off the engine and disconnect both lines at the cooler and transmission.

**3.** Use an air hose (with not more than 100 psi air pressure) to reverse flush the lines and the cooler.

**4.** Connect both lines at the cooler, and the pressure line at the transmission.

**5.** Start the engine and check the fluid flow. If the fluid flows freely, connect the return line at the transmission and fill the transmission with new fluid to the specified level. If there is no fluid flow or if the flow is restricted, replace the radiator. **Do not attempt to correct cooler or cooling line leaks by closing off the lines.**

When fluid leakage is found at the oil cooler, the entire radiator must be replaced. **The oil cooler cannot be removed from the radiator for replacement.**

## 3 CLEANING AND INSPECTION

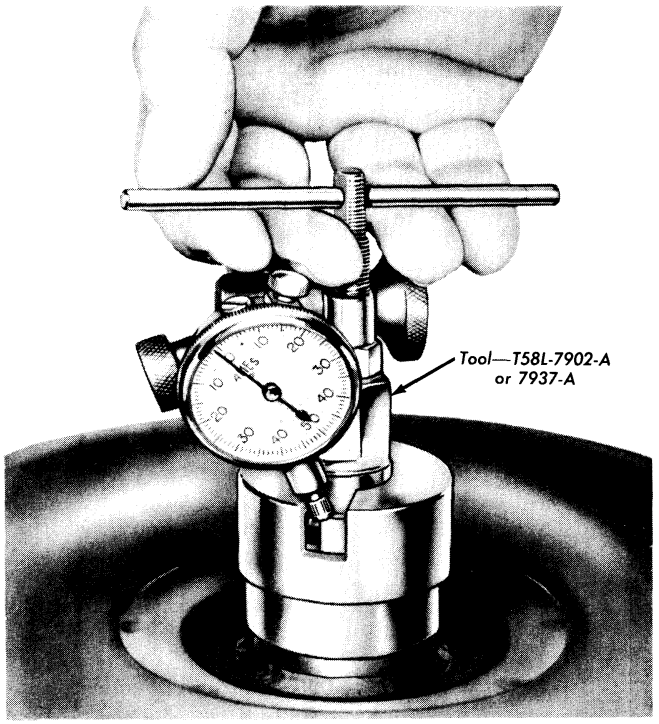
Clean the parts with suitable solvent and use moisture-free air to dry off all the parts and clean out oil passages.

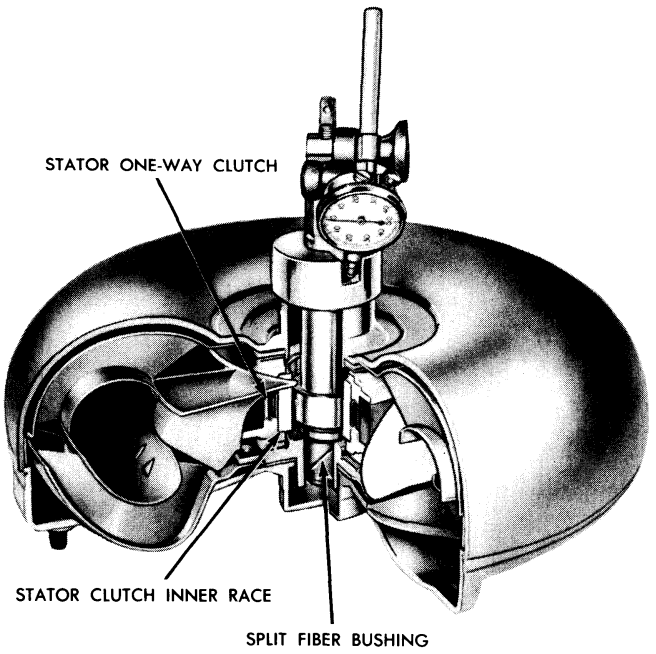
**The composition clutch plates and bands should not be cleaned in a vapor degreaser or with any type of detergent solution. To clean these parts, wipe them off with a lint-free cloth. New clutch plates or bands should be soaked in transmission oil for fifteen minutes before the plates or bands are assembled.**

### CONVERTER CLEANING

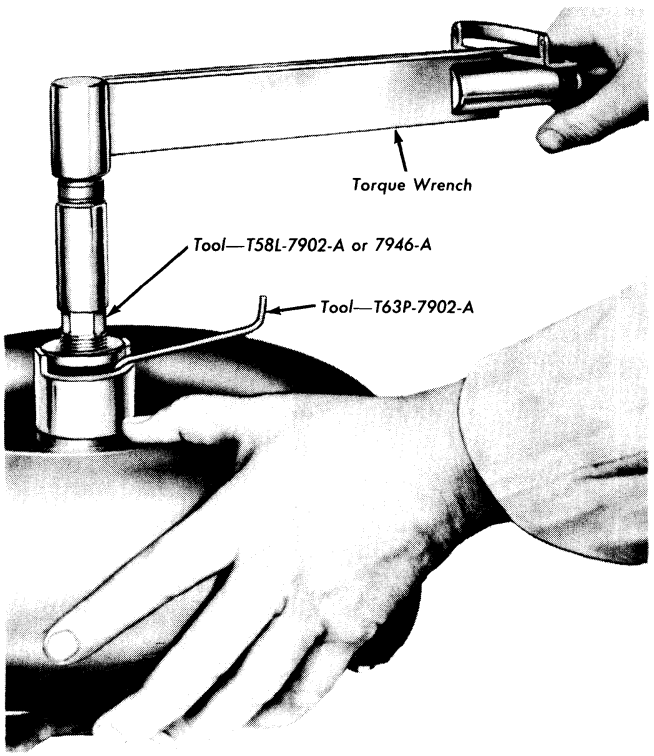
The converter cannot be disassembled for cleaning. If there is reason to believe that the converter has an excessive amount of foreign material in it, the following cleaning procedure should be used:

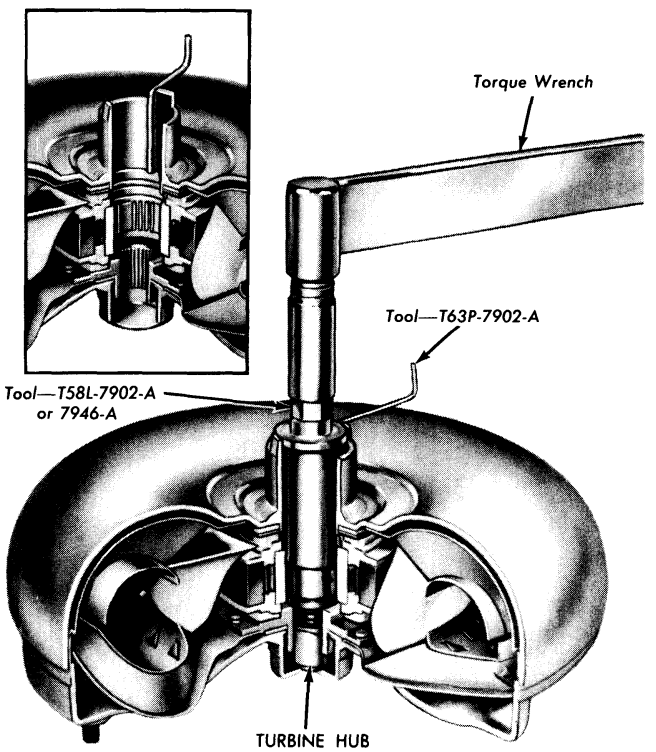
**1.** With the converter on the bench, remove both drain plugs and tilt the converter in all directions to drain as much fluid as possible.




**END PLAY CHECK**




**STATOR CLUTCH CHECK**

D1064-B

**FIG. 16—Typical Converter Checking Tool—Cruise-O-Matic**

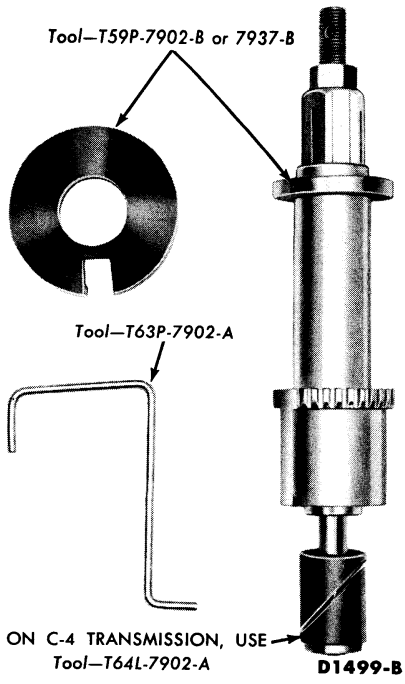



**FIG. 15—Converter Checking Tool**

2. Install the drain plugs and fill the converter through the pump drive hub with a light-body oil such as kerosene, or a cleaning solvent suitable for transmission cleaning.

3. Install the tool shown in Fig. 15 in the converter. Expand the bushing in the turbine spline. Rotate the tool to circulate the fluid in the converter.

4. Remove both drain plugs and thoroughly drain the converter. Remove the tool and install the drain plugs. Torque the plugs to specification.

### TURBINE AND STATOR END PLAY CHECK

1. Insert the tool into the converter pump drive hub until it bottoms.

2. Install the guide over the converter pump drive hub.

3. Expand the split fiber bushing in the turbine spline by tightening the adjusting nut. Tighten the adjusting nut until the tool is securely locked into the spline.

4. Attach a dial indicator to the tool (Fig. 16 or Fig. 17). Position the indicator button on a converter pump drive hub, and set the dial face at 0 (zero).

5. Lift the tool upward as far as it will go and note the indicator reading. The indicator reading is the total end play which the turbine and stator share. If the total end play exceeds the limits specified in Part 7-4, replace the converter unit.

### STATOR ONE-WAY CLUTCH CHECK

1. Loosen the adjusting nut to free the split bushing, and then remove the tool from the converter.

2. Install the stator outer race holding tool in one of the four holes provided in the stator (Fig. 16 or Fig. 17).

3. Insert the tool in the converter pump drive hub. As the tool enters the converter, the pins will engage the stator clutch inner race spline.

4. Place a torque wrench on the tool (Fig. 16 or Fig. 17). The tool (and stator inner race) should turn freely clockwise (from the pump drive hub side of the converter). It should lock up and hold a 10 ft-lb pull when the wrench is turned counterclockwise. Try the clutch for lockup and hold in at least five different locations around the converter. On the C4 Automatic, the metal ring holding the locking tool will have to be held by hand during this check.

5. If the clutch fails to lock up and hold a 10 ft-lb torque, replace the converter unit.

### STATOR TO IMPELLER INTERFERENCE CHECK

1. Position the front pump assembly on a bench with the spline end of the stator shaft pointing up (Fig. 18).

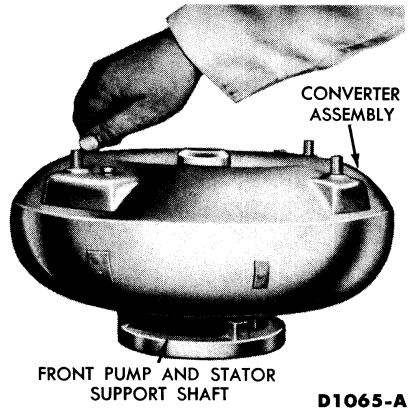



**FIG. 18—Stator to Impeller Interference Check**

2. Mount a converter on the pump so that the splines on the one-way clutch inner race engage the mating splines of the stator support, and the converter hub engages the pump drive gear.

3. While holding the pump stationary, try to rotate the converter counterclockwise. The converter should rotate freely without any signs of interference or scraping within the converter assembly.

4. If there is an indication of scraping, the trailing edges of the stator blades may be interfering with the leading edges of the impeller blades. In such cases, replace the converter.

### STATOR TO TURBINE INTERFERENCE CHECK

1. Position the converter on the bench front side down.

2. Install a front pump assembly to engage the mating splines of the stator support and stator, and pump drive gear lugs.

3. Install the input shaft, engaging the splines with the turbine hub (Fig. 19).

4. While holding the pump stationary, attempt to rotate the turbine with the input shaft. The turbine should rotate freely in both directions without any signs of interference or scraping noise.

5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, the converter must be replaced.

The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause inter-

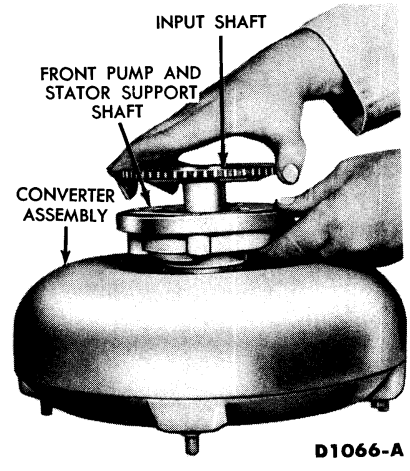
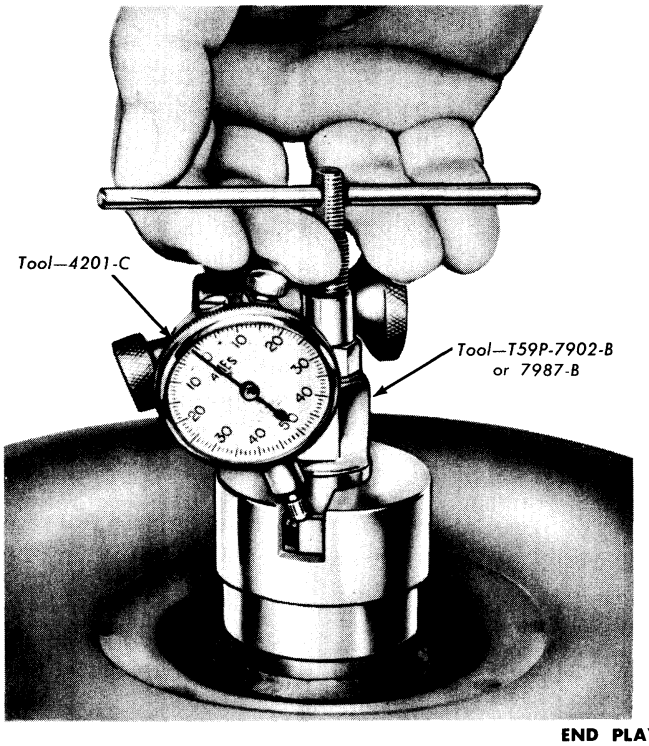
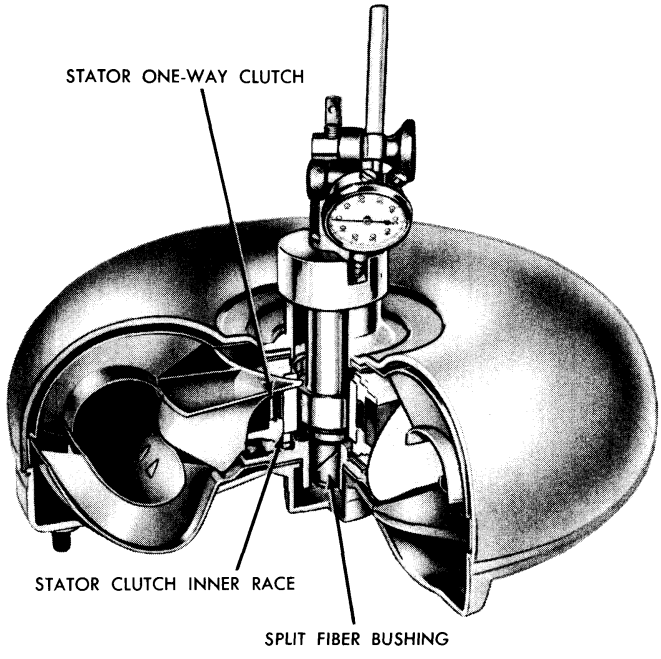
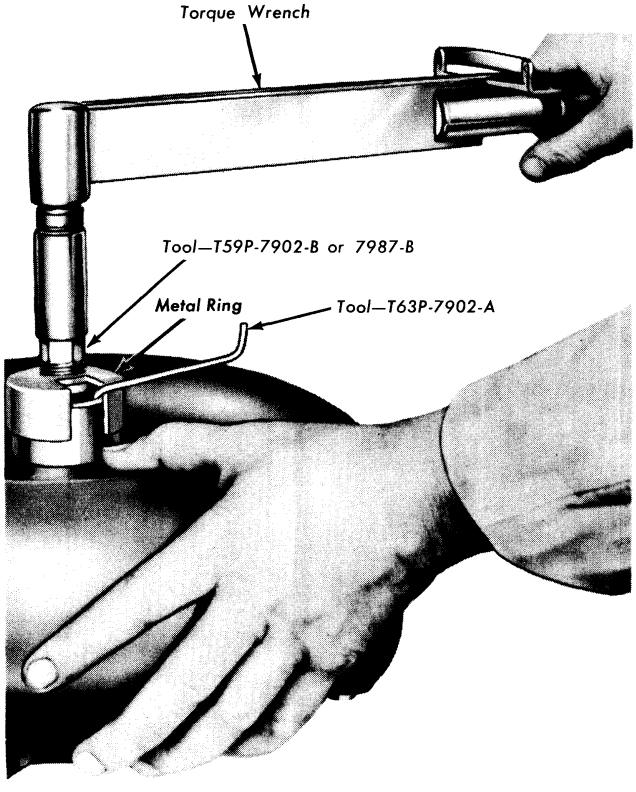


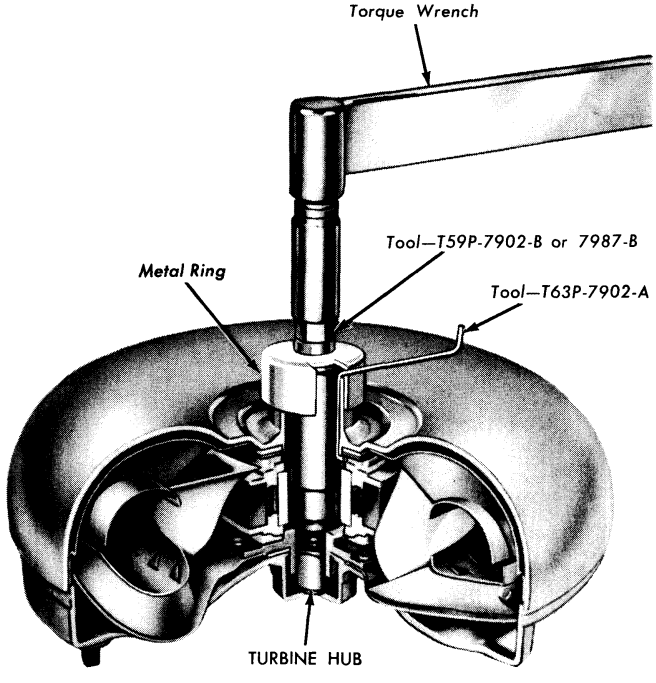

**FIG. 19—Stator to Turbine Interference Check**




END PLAY CHECK




STATOR CLUTCH CHECK

D1516-A

**FIG. 17—Typical Converter Checking Tool—C4 Automatic**

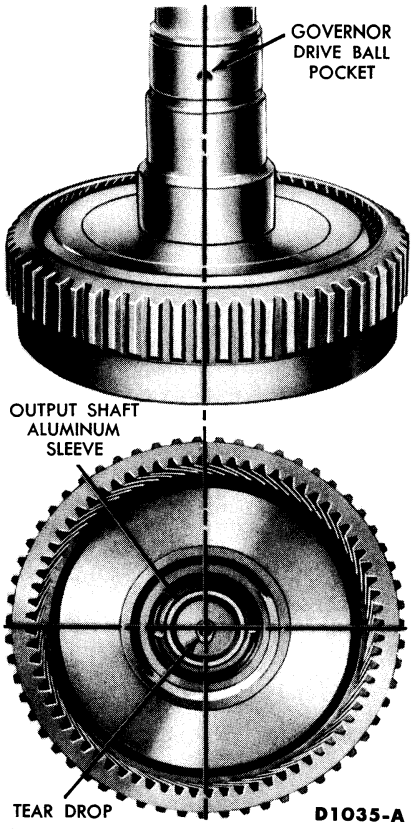



**FIG. 20—Correct Position of Output Shaft Aluminum Sleeve**

ference when installing the converter into the crankshaft. Check the converter front pump drive hub for nicks or sharp edges that would damage pump seal.

### OUTPUT SHAFT AND PRIMARY SUN GEAR SHAFT (CRUISE-O-MATIC OR MERC-O-MATIC)

**1.** Inspect the thrust surfaces and journals for scores. Inspect the internal gear for broken or worn teeth.

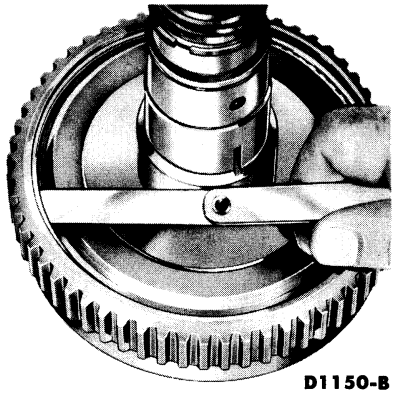



**FIG. 21—Checking Output Shaft Snap Ring Clearance**

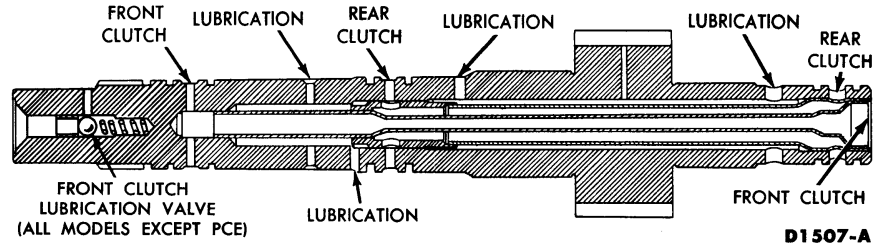



**FIG. 22—Cross-Section of Primary Sun Gear Shaft**

**2.** Inspect the aluminum sleeve for scores or leakage. Inspect the ring grooves for burrs.

**3.** Inspect the keyway and drive ball pocket for wear, and inspect the splines for burrs or wear.

**4.** Inspect the output shaft sleeve for alignment with the governor drive ball (Fig. 20).

**5.** Inspect the external parking gear teeth for damage and the speedometer drive gear teeth for burrs.

**6.** If either the output shaft or ring gear has been replaced, place the assembled unit with the gear face down on the bench, push the shaft downward, and check the clearance between the top of the snap ring and its groove (Fig. 21). If this clearance exceeds 0.002 inch, replace the snap ring with a thicker ring to reduce the clearance to less than 0.002 inch. Selective snap rings are available in several thicknesses for this purpose.

**7.** Inspect the rubber seal and stop ring at the front of the output shaft spline. If wear or damage is evident, replace the parts.

**8.** Inspect the primary sun gear for broken or worn teeth. Inspect all thrust surfaces and journals for scores. Check all fluid passages (Fig. 22) for obstructions and leakage. Inspect the seal ring grooves for burrs.

**9.** Inspect the sun gear shaft splines for burrs and wear. Check the front clutch lubrication valve for free movement.

**10.** Check the fit of the seal rings in the grooves of the shaft. The rings should enter the grooves freely without bind.

**11.** Check the fit of the seal rings in their respective bores. A clearance of 0.002-0.009 inch should exist between the ends of the rings.

**12.** Install the seal rings on the shaft, and check for free movement in the grooves.

### DISTRIBUTOR SLEEVE (CRUISE-O-MATIC OR MERC-O-MATIC)

**1.** Inspect the distributor sleeve for scores or excessive ring wear. Inspect the distributor sleeve passages for obstructions.

**2.** Check the fit of the fluid tubes in the distributor.

### PINION CARRIER, ONE WAY CLUTCH AND CENTER SUPPORT (CRUISE-O-MATIC OR MERC-O-MATIC)

**1.** Inspect the clutch outer race, inner race, band surface, pinion gears, bearings, and thrust washer (Fig. 23) for roughness.

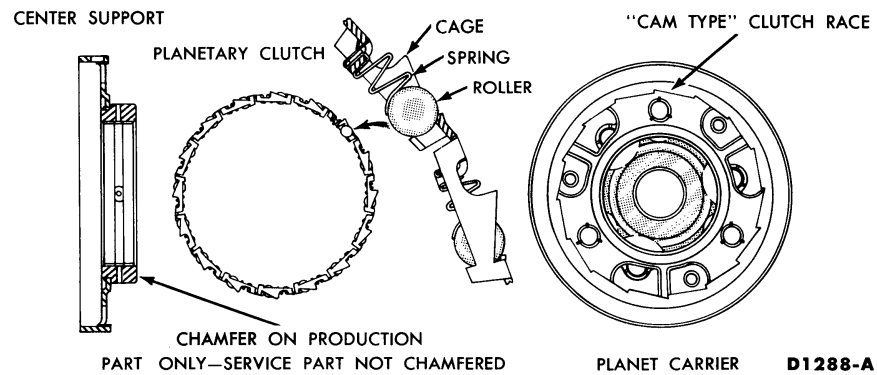



**FIG. 23—Roller Type Planetary Clutch, Carrier and Center Support**

2. Inspect the center support bushing for roughness.

3. Inspect the one-way clutch cage rollers and springs for excessive wear or damage.

## EXTENSION HOUSING

1. Inspect the housing for cracks. Inspect the gasket surface for burrs or warpage. Check for leakage around the governor inspection cover and gasket on a Cruise-O-Matic or Merc-O-Matic transmission. If leakage is found, install a new gasket.

2. Inspect the bushing for scores or wear.

3. Inspect the rear seal for hardness, cracks, or wear. If the seal shows wear or deterioration, replace the seal.

4. Inspect the seal counterbore and remove all burrs and scores with crocus cloth.

## REAR CLUTCH (MERC-O-MATIC OR CRUISE-O-MATIC) AND REVERSE-HIGH CLUTCH

1. Inspect the drum band surface, the bushing, and thrust surfaces for scores. Minor scores may be removed with crocus cloth. **Badly scored parts must be replaced.**

Inspect the clutch piston bore and the piston inner and outer bearing surfaces for scores. Check the air bleed ball valve in the clutch piston for free movement. Check the orifice to make sure it is not plugged.

2. Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.

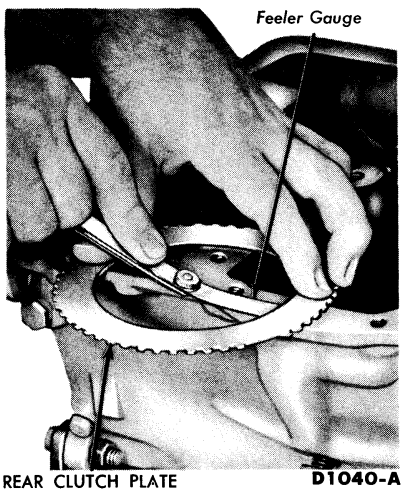



**FIG. 24—Check Rear Clutch Steel Plate Coning**

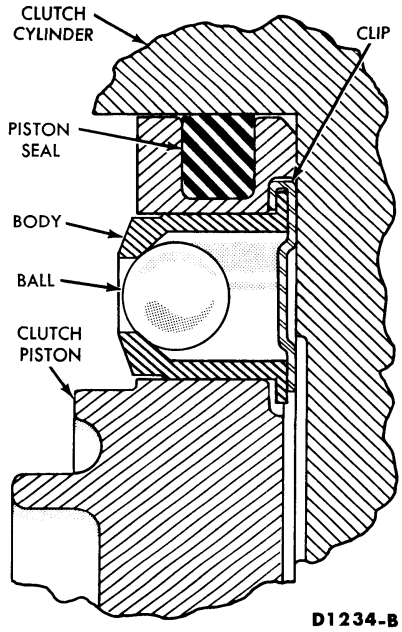



**FIG. 25—Clutch Piston Check Valve**

3. Inspect the clutch plates for scores, and check the plates for fit on the clutch hub serrations. Replace all plates that are badly scored or do not fit freely in the hub serrations.

4. Inspect the clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release spring(s) for distortion.

5. On a Cruise-O-Matic or Merc-O-Matic transmission, inspect the needle bearing for worn rollers, on the PCE model, position the steel plates on a flat surface. Check the coning with a feeler gauge (Fig. 24). The plates are coned 0.010 inch.

## FRONT CLUTCH (MERC-O-MATIC OR CRUISE-O-MATIC) AND FORWARD CLUTCH (C4 AUTOMATIC)

1. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if it is badly scored or damaged.

2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect the piston check ball for freedom of movement and proper seating (Fig. 25).

3. Check the clutch release spring for distortion and cracks. Replace the spring if it is distorted or cracked.

4. Inspect the bronze composition and the steel clutch plates and the clutch pressure plate for scored bearing surfaces. Replace all parts that are deeply scored.

5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.

6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.

7. On a Cruise-O-Matic or Merc-O-Matic transmission, inspect the turbine shaft bearing surfaces for scores. If excessive clearance or scores are found, discard the unit.

Check the splines on the turbine shaft for wear and replace the shaft if the splines are excessively worn. Inspect the bushing in the turbine shaft for scores. On C4 Automatic transmission, check the input shaft for damaged or worn splines.

## FRONT PUMP

1. Inspect the mating surfaces of the pump body and cover for burrs.

2. Inspect the drive and driven gear bearing surface for scores, and check the gear teeth for burrs. Inspect the stator support splines for burrs and wear.

3. Check the fluid passages for obstructions.

4. If any parts other than the stator support are found defective, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth. The stator support is serviced separately.

5. On a C4 Automatic transmission, check the oil ring grooves in the stator support or nicks, burrs or damaged edges. Check the large O-ring groove of the pump body for damage. Check the gasket mating surface of the pump body for damaged surface.

## REAR PUMP (CRUISE-O-MATIC OR MERC-O-MATIC)

1. Remove the drive and driven gears from the pump body.

2. Inspect the gear pockets and

the crescent of the pump body for scores or pitting.

3. Inspect the inner bushing and the drive and driven gear bearing surfaces for scores.

4. Check all fluid passages for obstructions, and check mating surfaces and gasket surfaces of the pump body and cover for burrs.

5. Inspect the pump cover bearing surface for scores. Minor burrs or scores may be removed with crocus cloth.

6. If any pump parts, other than the pump cover, are defective, replace the pump as a unit. The pump cover can be replaced separately.

### PRESSURE REGULATOR (CRUISE-O-MATIC OR MERC-O-MATIC)

1. Inspect the regulator body and cover mating surface for burrs.

2. Check all fluid passages for obstructions.

3. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth.

4. Check free movement of the valves in their bores. The valves should fall freely into the bores when both the valve and bore are dry.

5. Inspect the valve springs and spacers for distortion.

### VALVE BODY

1. Clean all parts thoroughly in clean solvent, and then blow them dry with moisture-free compressed air.

2. Inspect all valve and plug bores for scores. Check all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs or distortion. Inspect all plugs and valves for burrs and scores. **Crocus cloth can be used to polish valves and plugs if care is taken to avoid rounding the sharp edges of the valves and plugs.**

3. Inspect all springs for distortion. Check all valves and plugs for free movement in their respective bores. Valves and plugs, when dry, must fall from their own weight in their respective bores.

4. Roll the manual valve on a flat surface to check it for a bent condition.

### GOVERNOR

1. Inspect the governor valve and bore for scores. Minor scores may be removed with crocus cloth. Replace the governor if the valve or body is deeply scored.

2. Check for free movement of the valve in the bore. Inspect fluid passages in the valve body and counterweight for obstructions. **All fluid passages must be clean.**

3. Inspect the mating surfaces of the governor body and counterweight (Cruise-O-Matic or Merc-O-Matic) governor distributor (C4 Automatic) for burrs and distortion. Mating surfaces must be smooth and flat.

### FRONT SERVO (MERC-O-MATIC OR CRUISE-O-MATIC) AND INTERMEDIATE SERVO (C4 AUTOMATIC)

1. Inspect the servo bore for cracks and the piston bore and the servo piston stem for scores. Check fluid passages for obstructions.

2. On Cruise-O-Matic or Merc-O-Matic transmissions, check the actuating lever for free movement, and inspect it for wear. If necessary to replace the actuating lever or shaft, remove the retaining pin and push the shaft out of the bracket.

Inspect the adjusting screw threads and the threads in the lever.

3. Check the servo spring and servo band strut(s) for distortion.

### REAR SERVO (MERC-O-MATIC OR CRUISE-O-MATIC) AND LOW-REVERSE SERVO (C4 AUTOMATIC)

1. Inspect the servo bore for cracks and the piston bore for scores.
2. Check the fluid passages for obstructions.
3. Inspect the band and the struts for distortion. Inspect the band ends for cracks.
4. Inspect the servo spring for distortion.
5. Inspect the servo band lining for excessive wear and bonding to the metal band.
6. On a Cruise-O-Matic or Merc-O-Matic transmission, check the servo body to case mating surface for burrs. Check the accumulator piston and check valve for freedom of movement. Check the actuating lever socket for scores.

### CASE

Inspect the case for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the vent for obstructions, and check all fluid passages for obstructions and leakage (Fig. 26 and Fig. 8).

Inspect the case bushing for scores. Check all parking linkage parts for wear or damage.

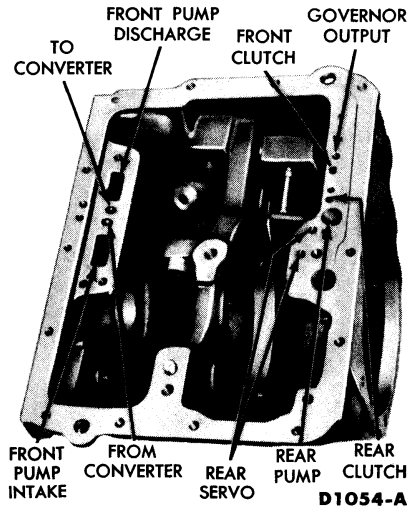



**FIG. 26—Cruise-O-Matic Transmission Case Fluid Passages**

# PART 7-2 C4 AUTOMATIC DUAL RANGE TRANSMISSION


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 7-21 | 3 Removal and Installation | 7-35 |
| 2 In-Car Adjustment and Repairs | 7-31 | 4 Major Repair Operations | 7-36 |


## 1 DESCRIPTION AND OPERATION

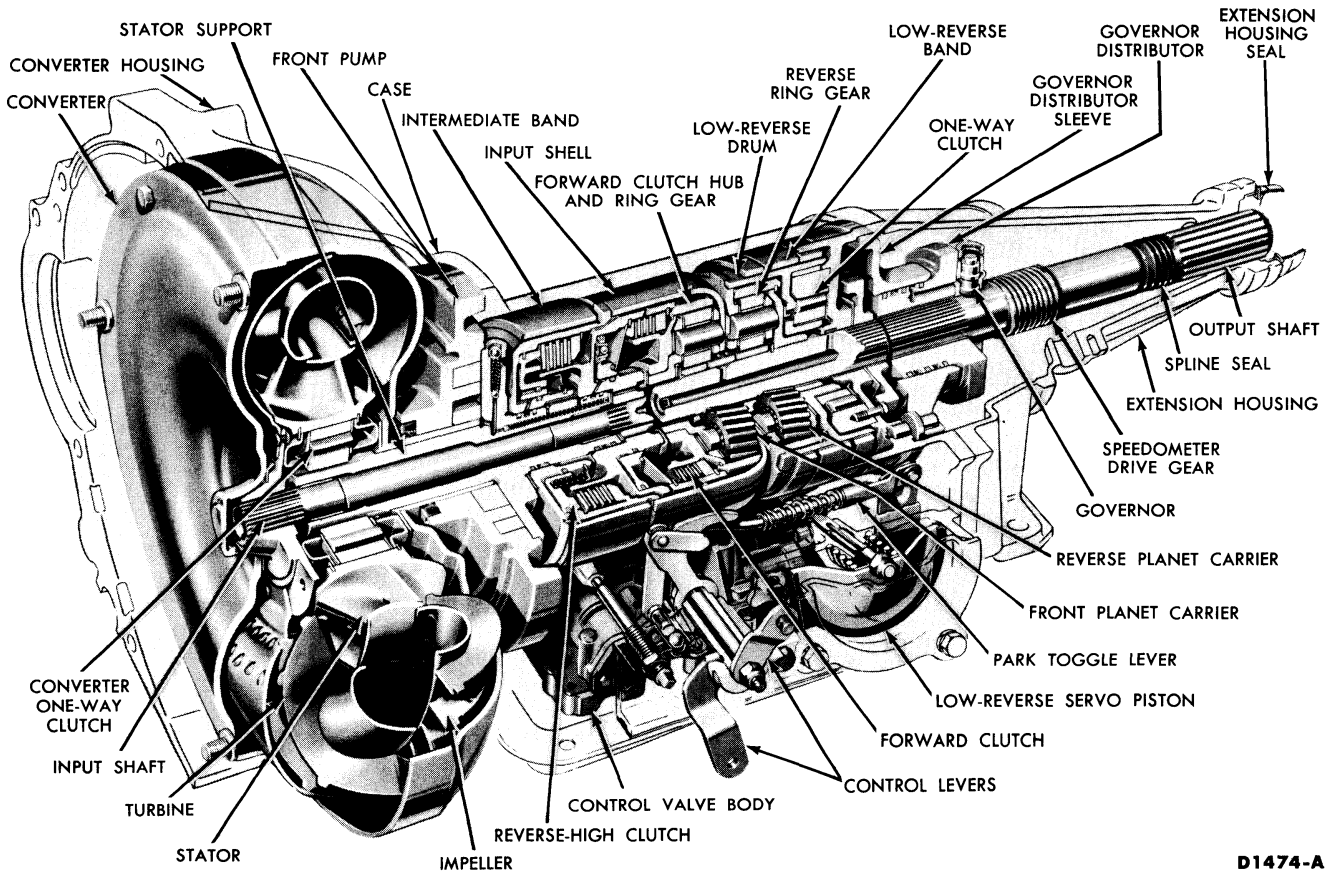



**FIG. 1—C4 Automatic Transmission**

### IDENTIFICATION

Figure 1 identifies the type of automatic transmission. The identification tag (Fig. 2), attached by the low-reverse servo cover bolt, includes the model prefix and suffix, a service identification number, and a build date code. The service identification number indicates changes to service details which affect interchangeability **when the transmission model is not changed.** For interpretation of this number, see the Master Parts Catalog. Table 1 shows the engine and transmission model application.

### TORQUE CONVERTER

The hydraulic torque converter (Fig. 3) consists of an impeller (pump), a turbine, and a stator. All these parts are enclosed and operate in a fluid-filled housing.

When the engine is running, the fluid in the torque converter flows from the impeller to the turbine and back to the impeller through the stator. This flow produces a maximum torque increase of about 2 to 1 when the turbine is stalled. When enough torque is developed by the impeller, the turbine begins to rotate, turning the turbine shaft (input shaft).

The converter torque multiplication gradually tapers off as turbine speed approaches impeller speed, and it becomes 1 to 1 when the turbine is being driven at 9/10 impeller speed. This is known as the "coupling point."

When the turbine is rotating at less than 9/16 impeller speed the converter is multiplying torque. The fluid leaving the turbine blades strikes the front face of the stator blades. These blades are held stationary by the action of a one-way clutch (Fig. 3) as long as the fluid is directed against the front face of the blades.

When the turbine rotates faster than 9/10 impeller speed the converter no longer multiplies torque. The fluid is directed against the back face

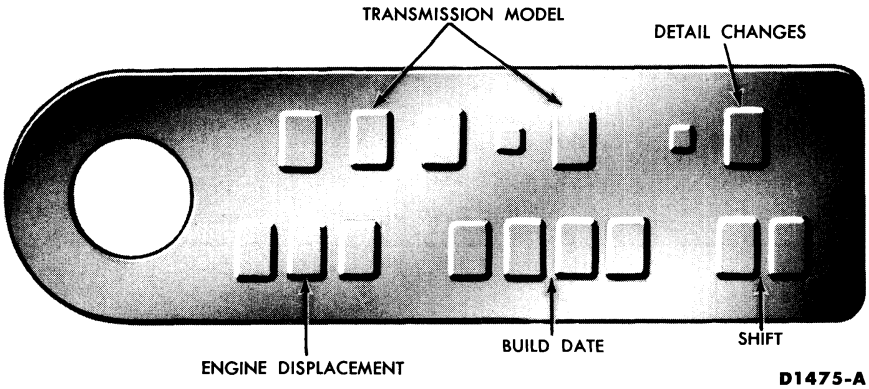



**FIG. 2—Identification Tag**

of the stator blades. As the one-way clutch permits the stator to rotate only in the direction of impeller rotation, the stator begins to turn with the impeller and turbine. The converter operates as an efficient fluid coupling as long as the turbine speed remains greater than 9/10 impeller speed.

A constant flow of fluid into and out of the converter is maintained. The fluid coming out of the converter is forced through a cooler located in the radiator tank.

## PLANETARY GEAR TRAIN, CLUTCHES, BANDS, AND SERVOS

### PLANETARY GEAR TRAIN

The gear train consists of an input shaft that is splined to the turbine of the converter and the forward clutch cylinder (Fig. 4). The forward clutch cylinder rotates the steel internal clutch plates of the forward clutch and the composition clutch plates of the reverse-high clutch. When the reverse-high clutch is applied, the external area of the clutch hub is splined to and drives the input shell to rotate the sun gear. When the forward clutch is applied, the composition clutch plates drive the forward clutch hub and ring gear. The ring gear rotates the forward planet gears.

When applied, the intermediate band holds the reverse-high clutch drum, input shell and sun gear from rotating.

The sun gear, which is driven by the input shell, is meshed with the forward and reverse planet gears. The reverse planet carrier and low-reverse drum are locked together with external splines. The low-reverse drum can be held from rotating by the low-reverse band. The low-reverse drum is also held from rotating by a roller type one way clutch.

The forward planet carrier, reverse ring gear hub, park gear and governor distributor are all splined to the output shaft.

### FORWARD CLUTCH

The input shaft is splined to and drives the forward clutch cylinder (Fig. 4). Rotation of the cylinder drives the steel clutch plates in the forward clutch and the composition clutch plates of the reverse-high clutch.

When the forward clutch piston is applied by hydraulic pressure, the movement of the piston against the disc spring locks the steel and composition clutch plates together to drive the forward clutch hub and ring gear.

When hydraulic pressure is released from the piston, the disc spring moves the piston to the released position. As the disc spring moves, the steel and composition clutch plates are released. This stops the rotation of the forward clutch hub and ring gear (Fig. 4). The forward clutch is applied in all forward drive gear ratios.

**TABLE 1—ENGINE AND TRANSMISSION APPLICATION**

| Engine Model | Transmission Prefix |
|---|---|
| 223–1V | PCV-D–Column Shift |
| 289–2V | PCW-V–Column Shift |

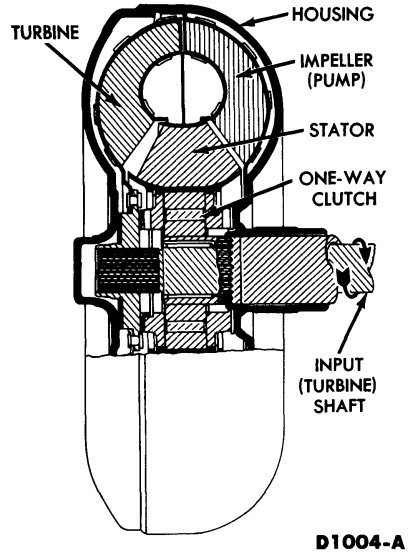



**FIG. 3—Cross Section of Typical Torque Converter**

### REVERSE-HIGH CLUTCH

When hydraulic pressure is directed to the clutch piston, the piston moves against the release springs (Fig. 4). The piston movement locks the steel and rotating composition clutch plates together. The steel clutch plates drive the reverse-high clutch drum which is splined to the input shell. Rotation of the input shell drives the sun gear which is splined to the input shell.

To release the reverse-high clutch, hydraulic pressure is exhausted from the apply side of the piston. The return springs move the piston to the released position. The steel and composition clutch plates are now released to stop rotation of the reverse-high clutch drum, input shell, and sun gear.

### INTERMEDIATE SERVO AND BAND

The intermediate servo is machined into the transmission case and the band has an **external** adjustment screw (Fig. 5). To apply the servo, hydraulic pressure is directed from the control valve body, through a hole in the case to the hole in the servo piston stem. The pressure passes through the center of the piston stem and then to the apply side of the piston. The piston moves against the return spring to tighten the intermediate band around the reverse-high clutch drum.

To release the servo piston, hydraulic pressure is directed to the release side of the piston. The re-

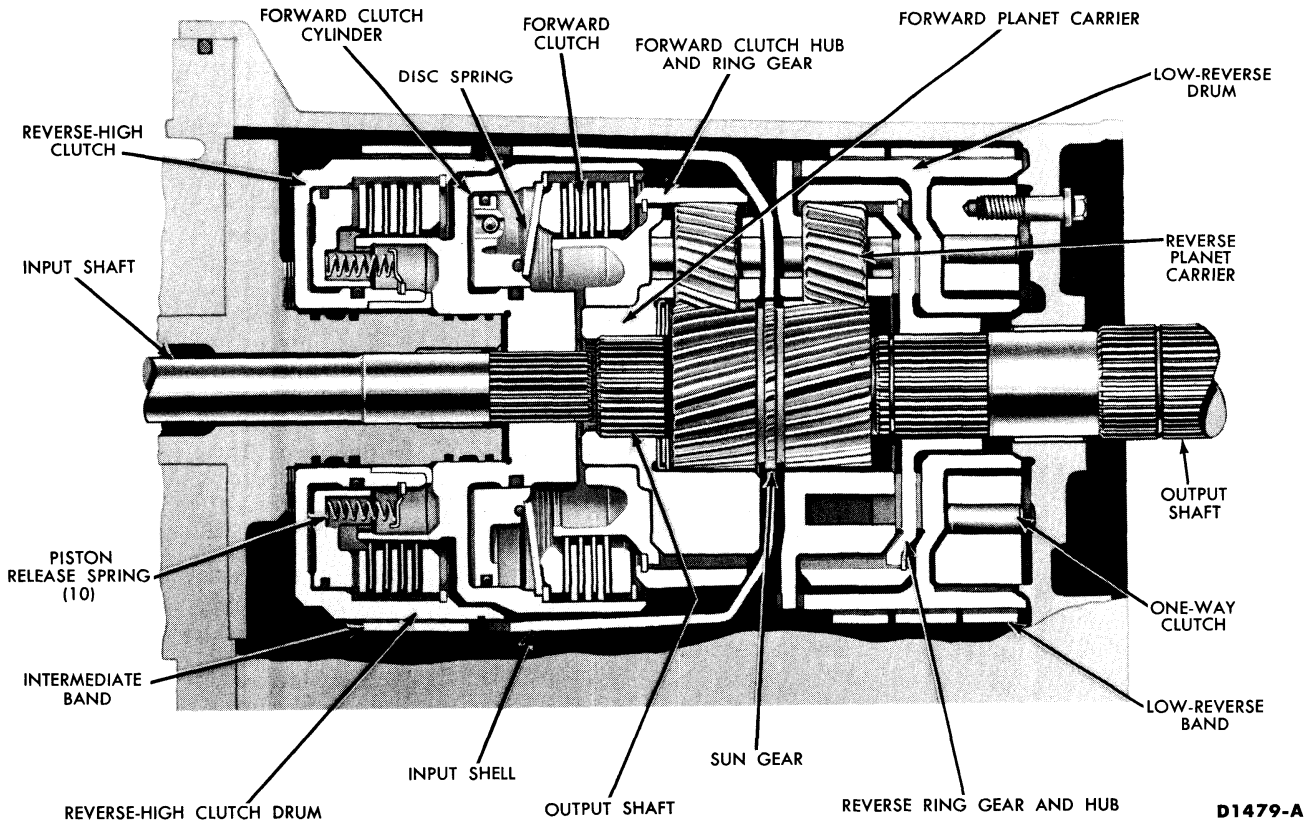



**FIG. 4—Gear Train, Clutches and Bands**

lease pressure is assisted by the compressed return spring to move the servo piston and intermediate band to the off position. The intermediate servo and band are applied only during the intermediate gear operation.

### LOW-REVERSE SERVO AND BAND

The low-reverse servo is machined into the transmission case and the band has an **external** adjustment screw (Fig. 6). To apply the servo, hydraulic pressure is directed from the control valve body through a hole in the case to a hole in the piston stem. The pressure then passes through the center of the piston stem to the apply area of the servo piston. The apply pressure force moves the piston against the piston return spring to tighten the low-reverse band around the low-reverse drum.

To release the low-reverse servo piston and band, the hydraulic pressure is exhausted from the apply side of the piston. The compressed return spring expands to release the piston and the low-reverse band.

### POWER FLOW

**All gear rotations are viewed from the front of transmission.** Table 2 shows the gear ratios obtained in the different selector lever positions.

### POWER FLOW NEUTRAL

In neutral (Fig. 7), the clutches or bands are not applied therefore no power is transmitted to the output shaft.

### POWER FLOW FIRST GEAR

In low gear (Fig. 7), the forward

**TABLE 2—Gear Ratios**

| Transmission Selector Position | Gear | Gear Ratios | Forward Clutch | Reverse High Clutch | Intermediate Band | Low Reverse Band | One-Way Clutch |
|---|---|---|---|---|---|---|---|
| N or P | Neutral | — | Off | Off | Off | Off | Off |
| L | Low | 2.46:1 | On | Off | Off | On | Holding |
| D1 | Low | 2.46:1 | On | Off | Off | Off | Holding |
| D1 or D2 | Intermediate | 1.46:1 | On | Off | On | Off | Over-running |
| D1 or D2 | High | 1.00:1 | On | On | Off | Off | Over-running |
| R | Reverse | 2.20:1 | Off | On | Off | On | Not affected |

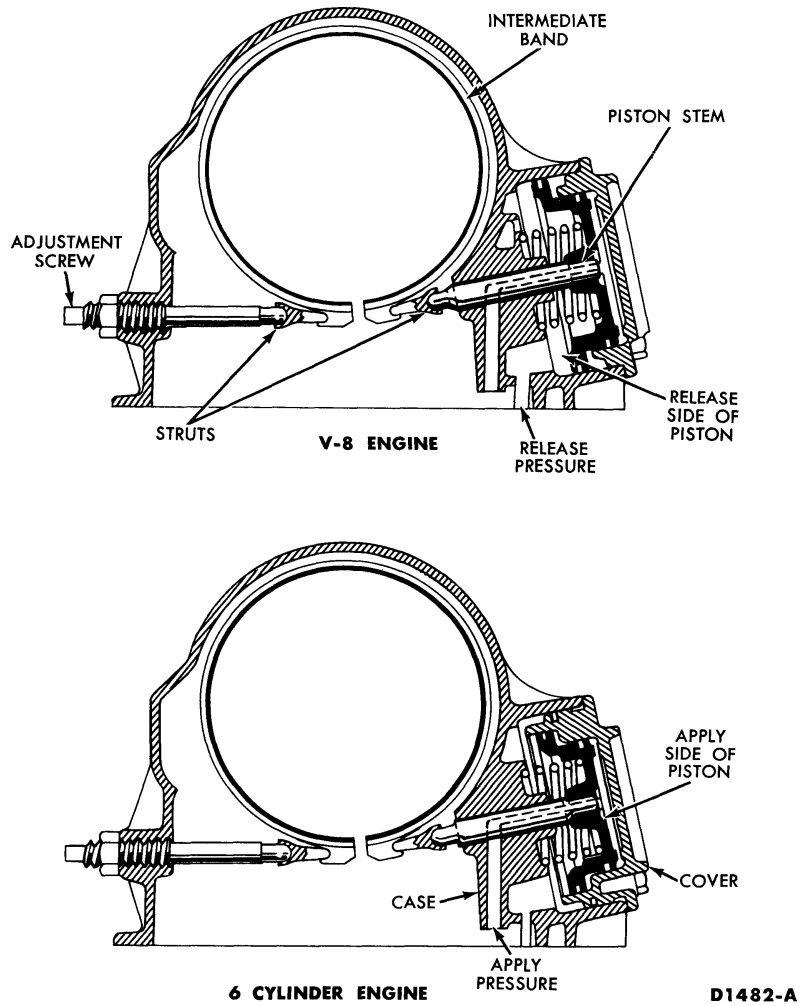



**FIG. 5—Intermediate Servo and Band**

clutch is applied, and the planet one-way clutch or low-reverse band is holding the low-reverse drum and reverse planet carrier from rotating. The power flow is through the input shaft and into the forward clutch. The input shaft is splined to and drives the forward clutch cylinder. Rotation of the forward clutch drives the forward clutch hub and ring gear. The ring gear rotates the forward planet gears clockwise to cause the sun gear to rotate counterclockwise.

Counterclockwise rotation of the sun gear turns the reverse planet gears clockwise. The reverse planet carrier being splined to the low-reverse drum is held from rotating by the one-way clutch or low-reverse band.

With the reverse planet carrier held stationary, the clockwise rotation of the reverse planet gears rotates the reverse ring gear and hub clockwise. The hub of the reverse ring gear is splined to the output shaft and rotates the output shaft clockwise.

The output shaft rotation is at a reduced speed, compared to the input shaft rotation, but at an increased torque.

The output shaft rotation at a reduced speed is caused by the fact that the forward carrier rotates at the same speed of the output shaft and in the same direction since the carrier is splined to the output shaft. The forward ring gear and planet assembly are rotating in the same direction but the planet carrier is rotating at a slower speed than the ring gear. Therefore, the low gear ratio (torque multiplication) is a combination of the ratios provided by the forward and reverse planet assemblies.

## POWER FLOW INTERMEDIATE GEAR

In intermediate gear (Fig. 7), the forward clutch is applied and the intermediate band is holding the reverse-high clutch drum, input shell and sun gear from turning.

The power flow is through the input shaft into the forward clutch and forward planet assembly ring gear. The sun gear is held from rotating by the intermediate band. This causes the forward planet pinions to rotate (walk) around the sun gear, carrying the forward planet carrier with them. The forward planet carrier, being splined to the output shaft, causes clockwise rotation of the output shaft at a reduction in speed compared to the speed of the input shaft, and at an increase in torque.

Clockwise rotation of the output

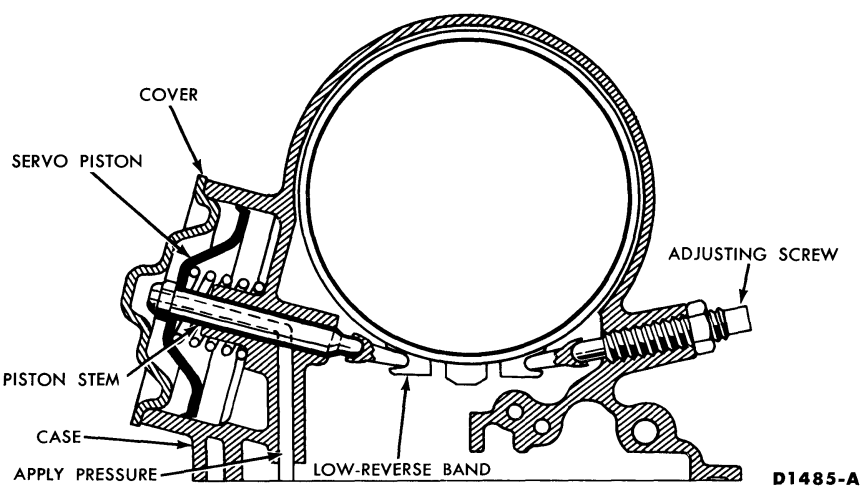
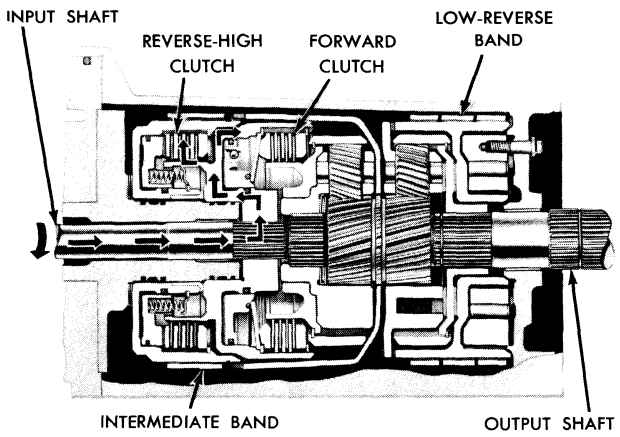
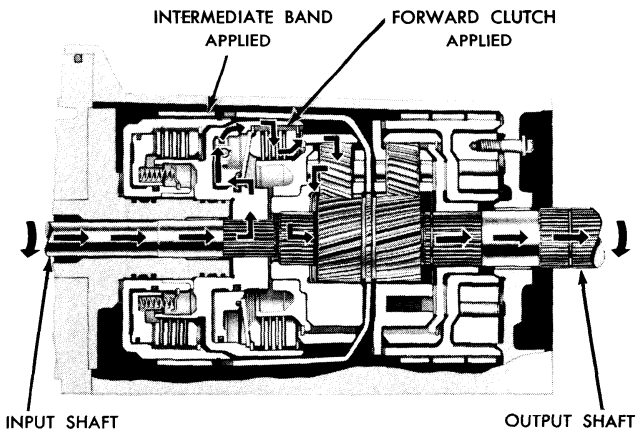


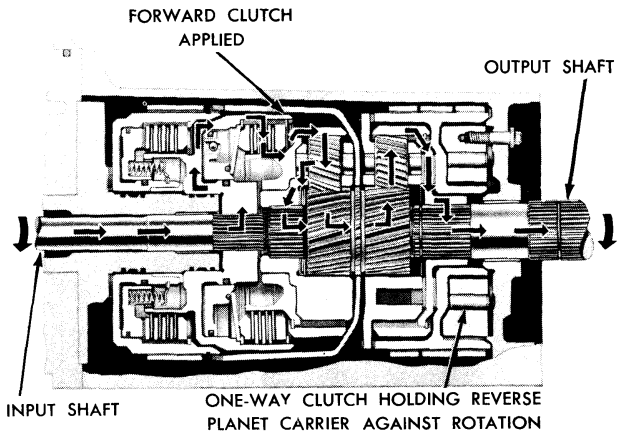

**FIG. 6—Low-Reverse Servo and Band**



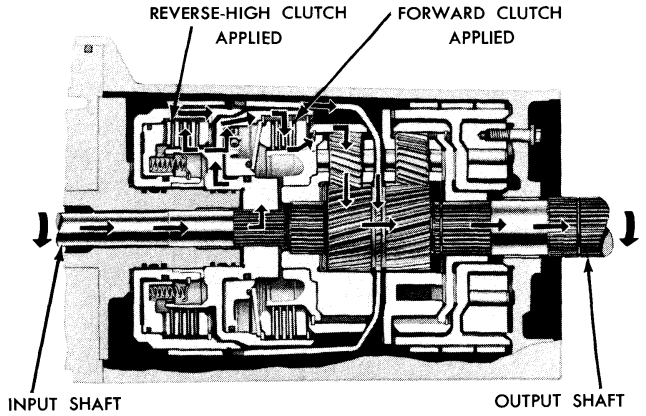

**NEUTRAL**



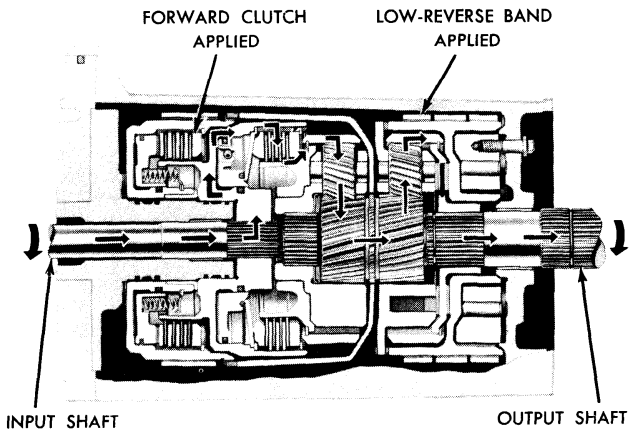

**SECOND GEAR**



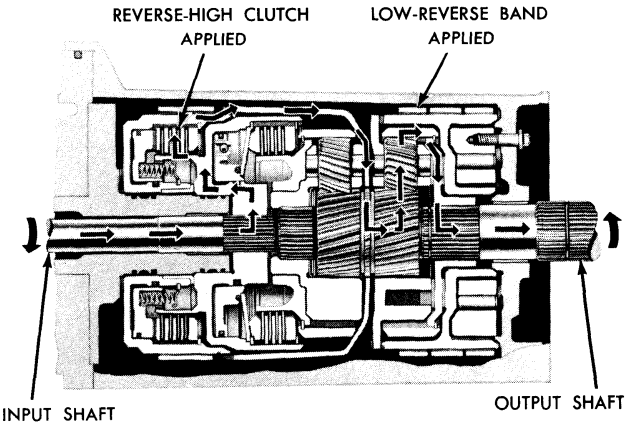

**FIRST GEAR — D1**




**HIGH GEAR**



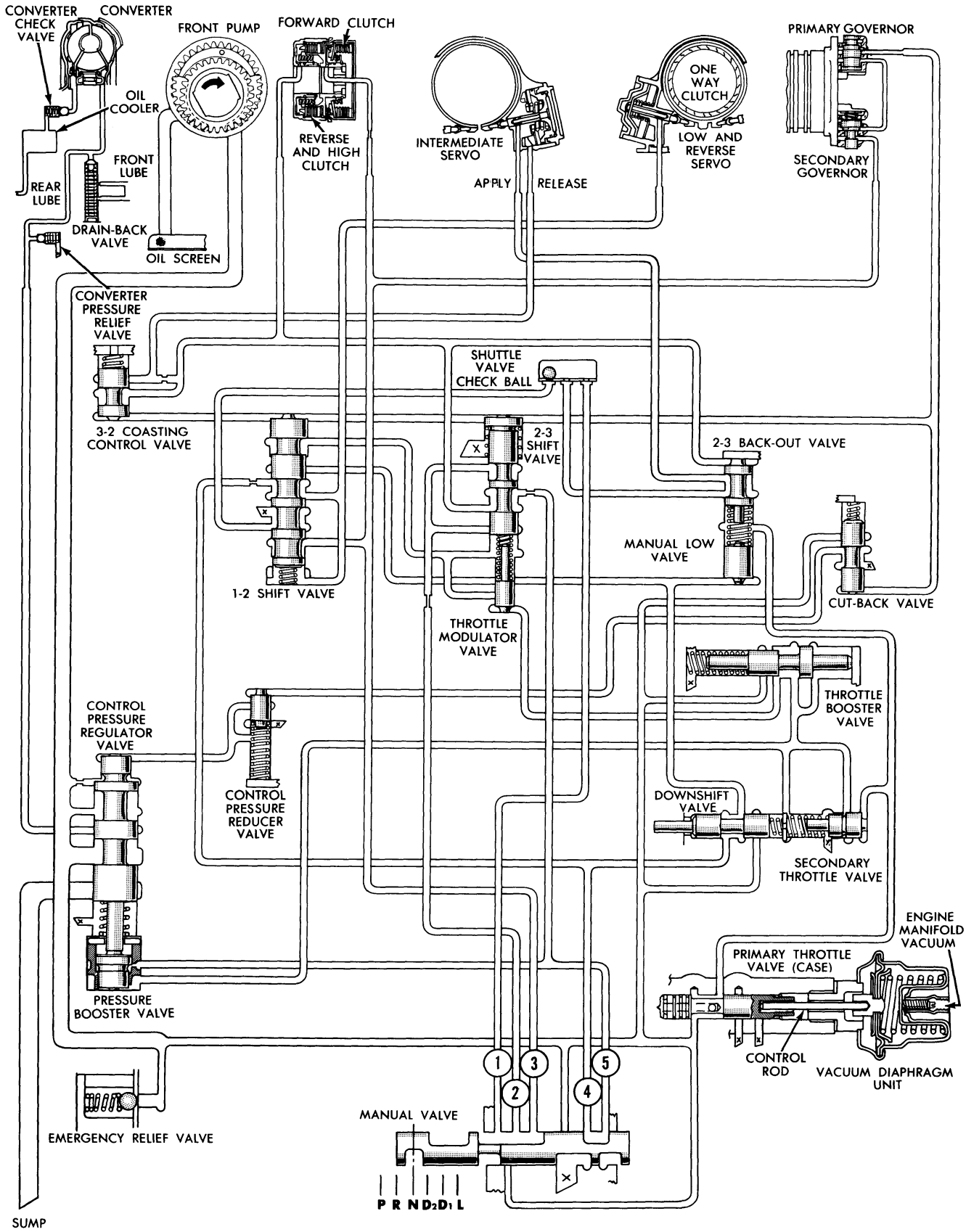

**FIRST GEAR — MANUAL LOW**




**REVERSE**

D1476-A

**FIG. 7—Power Flow**




D1477-A

**FIG. 8—Hydraulic Control System-Neutral Circuit**

shaft causes clockwise rotation of the output shaft ring gear, causing the reverse planet pinions to also rotate (walk) around the sun gear in a clockwise direction. The reverse planet carrier will also rotate clockwise and the one-way clutch inner race, being splined to the reverse planet carrier, will overrun.

### POWER FLOW HIGH GEAR

In high gear (Fig. 7), the forward and reverse-high clutches are applied. The power flow is through the input shaft into the forward clutch cylinder. The forward clutch cylinder rotates the steel clutch plates of the forward clutch and the composition clutch plates of the reverse-high clutch. The forward clutch directs the power flow through the forward clutch hub and ring gear to the forward planet carrier.

The reverse-high clutch directs the power flow through the input shell to the sun gear. With the sun gear and the forward clutch hub ring gear driven at the same speed, the front planet assembly (that is splined to the output shaft) is forced to rotate the output shaft at the same speed and direction to provide high gear.

### POWER FLOW REVERSE

In reverse (Fig. 7), the reverse-high clutch and low-reverse band are applied. The power flow is through the input shaft, reverse-high clutch, input shell, and to the sun gear. Clockwise rotation of the sun gear causes counterclockwise rotation of the reverse planet gears.

The low-reverse band, holding the low-reverse drum and reverse planet carrier from turning, causes the reverse planet gears to rotate counterclockwise.

This rotates the reverse ring gear and hub counterclockwise. The hub splined to the output shaft rotates the output shaft counterclockwise at a reduction in speed and at an increase in torque for reverse gear.

## HYDRAULIC CONTROL SYSTEM OPERATION

### FRONT PUMP

The transmission has only one pump located at the front of the transmission case. The converter hub rotates the pump drive gear to produce hydraulic pressure to the main control valve body and to the primary throttle valve located in the transmission case (Fig. 8).

### CONTROL PRESSURE REGULATOR VALVE

The control pressure regulator valve assembly consists of the control pressure regulator valve, spring, retainer, pressure booster valve, and sleeve, located in one bore in the control valve body (Fig. 8). Front pump oil pressure is directed to the three valleys of the valve. The difference in diameter between the end land and the second land provides an area differential for regulation of control pressure. Fluid pressure in this area can move the valve against the spring force. The spring force is calibrated so that the regulator valve will move at approximately 60 psi front pump pressure, allowing the third land of the valve to open the converter supply port. This permits additional pump volume to be used to pressurize the converter. If pressure supplied by the front pump is greater than that required to maintain 60 psi control pressure, including converter and lube requirements, the regulator valve will move further, allowing the fourth land to open the port which allows excess pump volume to be discharged into the sump (Fig. 8).

Control pressures over 60 psi, which are required under various operating conditions, are obtained by delivering throttle pressure to the pressure booster valve, causing the valve to move against the regulator valve, assisting the spring force. In reverse, control pressure is directed to the pressure booster valve to increase control pressure.

To reduce control pressures above 60 psi when higher pressures are not required, pressure is delivered to the end of the control regulator valve opposite the spring end, opposing the spring force.

The control pressure regulator valve can be balanced in any required position to regulate the necessary changes in control pressure due to the various driving conditions.

### EMERGENCY RELIEF VALVE

The ball-type check valve is located in the front pump pressure circuit (Fig. 8). If, for any reason, regulated front pump pressure exceeds 275 psi, the spring loaded check valve opens to exhaust the excessive control pressure.

### MANUAL VALVE

Two control pressure circuits direct regulated front pump pressure to the manual valve. In the neutral and park position, the manual valve is positioned to restrict control pressure from going to the shift control valves and clutches or servos. When the transmission selector lever is moved to the drive, low, or reverse positions, the manual valve is positioned to direct control pressure to the shift control valves and necessary clutches or servos.

### PRIMARY THROTTLE VALVE

Throttle pressure regulation is controlled by the changes in manifold vacuum acting on the transmission vacuum unit. As the amount of vacuum increases or decreases, the diaphragm spring either compresses or expands. The spring action moves the control rod and positions the throttle valve to regulate throttle pressure.

When the manifold vacuum is below 20 inches, primary throttle pressure is directed to the secondary throttle valve and the 2-3 back-out valve (Fig. 8).

### SECONDARY THROTTLE VALVE

Primary throttle pressure is regulated when engine vacuum is below 20 inches. Throttle pressure is normally used to provide shift delays and to control pressures. Shift delay or further control of pressure is not required within the range of 20-17.5 inches of vacuum. Therefore, the **secondary throttle valve** provides secondary throttle pressure, which will start at 17.5-16.5 inches of vacuum and increase as engine vacuum decreases. The secondary throttle valve is a spring-loaded, balanced-type valve with throttle pressure acting on both ends of the valve (Fig. 8).

Primary throttle pressure is delivered to the end of the secondary throttle valve opposite the spring. When primary throttle pressure is increased to the point where the force on the end of the valve is greater than spring force, the valve will move and allow primary throttle

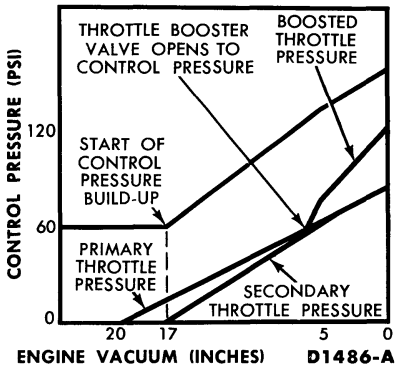



**FIG. 9—Throttle Pressure Regulation**

pressure to enter the secondary throttle pressure circuit. This valve movement closes the exhaust port which is open when the valve is held closed by the spring. Throttle pressure is delivered to the spring end of the valve where it will assist the spring in overcoming the primary throttle pressure force on the other end of the valve.

When the force on the spring end of the valve, caused by secondary throttle pressure, plus the spring force exceeds the primary throttle valve pressure force, the valve will move opening the exhaust port and closing the feed port. In this manner secondary throttle pressure is regulated and depends upon the amount of primary throttle pressure. The secondary throttle pressure regulation will be at a value below primary throttle pressure. In addition, because of the difference in areas of the two ends of the valve (the spring end being smaller), secondary throttle pressure will increase at a slightly higher rate than primary throttle pressure. Figure 9 shows the relationship between primary throttle pressure and secondary throttle pressure.

Secondary throttle pressure is delivered to the end of the pressure booster valve where it will cause the valve to move against the control pressure regulator valve, assisting the valve spring. This will result in higher control pressure being required to balance the control pressure regulator valve and increase the regulated control pressure.

Secondary throttle pressure is also delivered to the throttle booster valve, to the throttle modulator valve at the end of the 2-3 shift valve train, where it is modulated, and then to the 1-2 shift valve.

### THROTTLE BOOSTER VALVE

Carburetor throttle plate openings above 50° provide slight changes in manifold vacuum or increased primary throttle pressure regulation by the transmission vacuum unit. To control the shift points at throttle plate openings above 50°, throttle pressure positions the throttle booster valve to allow control pressure (a higher pressure) to be added to the throttle pressure circuit. This boosts or increases the throttle pressure going only to the shift valves (Fig. 8). Figure 9 shows the rate of increase in boosted throttle pressure compared to the primary and secondary throttle pressure regulation.

### THROTTLE MODULATOR VALVE

The throttle modulator valve, located in the end of the 2-3 shift valve bore, reduces throttle pressure which acts on the ends of the 2-3 shift valve and in the valley of the 1-2 shift valve. Modulated throttle pressure in these areas provides the necessary shift delay action (Fig. 8).

Throttle pressure moves the valve against the spring force to open the throttle pressure circuit to the shift valves. Throttle pressure is now directed to the spring side of the valve. The spring force added to the throttle pressure moves the valve back to the closed position. From the spring side of the valve, this opens the exhaust circuit through the downshift valve to the manual valve (manual valve in D1 or D2 position). This reduces the throttle pressure on the spring side of the valve until throttle pressure (opposite side from spring) again moves the valve to open the circuit to the shift valves.

This type of valve action modulates (reduces) the throttle pressure acting on the 2-3 shift and 1-2 shift valves to control automatic shift points.

### SECONDARY GOVERNOR VALVE

In the forward driving ranges, control pressure from the forward clutch circuit is directed to the secondary governor valve (Fig. 10). Due to the differential in areas of the lands of the valve, the pressure will move the valve and open the exhaust port.

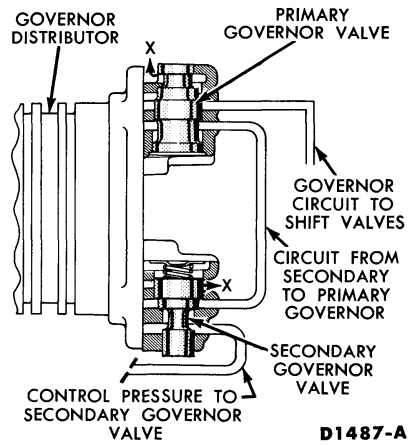



**FIG. 10—Governor Circuit**

However, the valve is spring loaded and as a result the valve is returned by the spring force. This results in a regulated pressure flow from the secondary valve to the primary valve even when the car is standing still. As the car starts to move and the governor assembly rotates, the centrifugal force of the valve will be added to the spring force to close off the exhaust port and the regulated secondary governor pressure will increase in the circuit going to the primary governor valve.

### PRIMARY GOVERNOR VALVE

Governor pressure delivered from the secondary governor valve to the primary governor valve will tend to hold the primary governor valve closed, preventing governor pressure going into the governor circuit to the shift valve (Fig. 10). When the output shaft starts to turn, centrifugal force on the primary governor valve will tend to move the valve in the direction that will allow the governor pressure to pass through the valve and into the circuit to the shift valves. At approximately 10 mph, the centrifugal force of the valve will overcome the governor pressure force allowing the valve to snap open and allow governor pressure through the valve into the governor circuit to the shift valves. The design is such that below 10 mph no governor pressure is present in the circuit to the shift valves. At 10 mph, the governor pressure regulated by the secondary governor valve is approximately 12 psi, and when the primary valve moves, the governor pressure will pass through the valve unaffected. The secondary governor

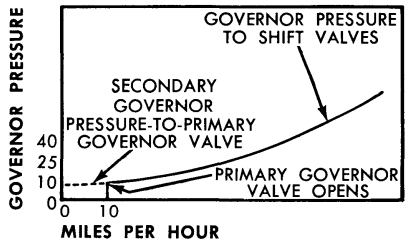



**FIG. 11—Governor Pressure Regulation**

valve now regulates the amount of governor pressure going through the primary valve and in the circuit to the shift valves.

Governor pressure is directed to the cut-back valve, end of the 2-3 shift valve, 1-2 shift valve and the 3-2 coasting control valve. Figure 11 shows the relationship between governor pressure and output shaft rpm. Note that governor pressure regulated by the secondary governor valve is not delivered to the shift valves until the car speed reaches approximately 10 mph, at which time the primary governor valve opens the governor circuit.

### CUT-BACK VALVE

Increased control pressure is required to prevent clutch and band slippage under certain driving conditions. Once the car is moving, conditions requiring high control pressure are considerably reduced. As soon as governor pressure is delivered through the primary governor valve (approximately 10 mph) the cut-back valve is forced to move by governor pressure. This closes the exhaust port and allows control pressure to pass through the cut-back valve, past the control pressure reducer valve (if line pressure is above 41 psi) and to the end of the control pressure regulator valve, opposite the regulator valve spring (Fig. 8).

### CONTROL PRESSURE REDUCER VALVE

The valve is a regulating valve, which reduces control pressure being directed to the end of the control pressure regulator valve by 41 psi. For example, if the control pressure being directed to the control pressure reducer valve is 75 psi, the pressure going to the end of the control pressure regulating valve will be 34 psi.

The reduced control pressure on the end of the control pressure regulator valve opposes regulator valve spring force and will reduce control pressure to provide pressures required for the certain operating conditions. Figure 12 shows the relationship between control pressure and car speed at selected constant vacuum values. Note that cut-back in control pressure occurs at 10 mph. This is caused by the function of the cut-back and control pressure reducer valves, directing control pressure to the end of the control pressure regulator valve (Fig. 8).

### 1-2 SHIFT VALVE

The 1-2 shift valve is held closed by spring force assisted by modulated throttle pressure (Fig. 8). Governor pressure opens the 1-2 shift valve, when the force on the valve created by governor pressure exceeds the spring force and the modulated throttle pressure force. The valve will move downward, closing the exhaust port and allowing control pressure to pass through the valley of the valve to accomplish the 1-2 shift.

If governor pressure is reduced to the point where spring force exceeds governor pressure force, the 1-2 shift valve will move up (close) cutting off the flow though the valve and opening the exhaust port allowing a downshift to low gear.

When the 1-2 shift valve opens the modulated throttle pressure feed port is closed. This prevents torque demand (throttle pressure) 2-1 downshifts. With the 1-2 shift valve open (down), the differential in area between the upper two lands is exposed to the low and reverse gear fluid passages. This passage will direct control pressure to this area of the 1-2 shift valve from the downshift valve when the accelerator pedal is moved through (kickdown) detent to provide a forced 2-1 downshift.

In manual low, control pressure is delivered to the spring end of the 1-2 shift valve, preventing opening of the 1-2 shift valve. If the transmission is in intermediate or high gear, the downshift to low gear is accomplished by the control pressure which passes through the downshift valve from the manual valve in the same manner as the forced downshift in D1 range.

All downshifts to first gear are controlled by car speed, governor pressure regulation acting on the end of the 1-2 shift valve.

In D2 range, movement of the 1-2 shift valve will have no effect on transmission operation since the front band is applied by control pressure that passes through the shuttle check valve ball cavity (Fig. 8), seating the ball on the hole of the separator plate in the circuit from the 1-2 shift valve.

### SHUTTLE VALVE CHECK BALL

The check ball is located in a cavity of the valve body and contacts two holes in the separator plate. The check ball is used to open or close two circuits. In D1 the circuit from the 1-2 shift valve, moves the check ball to block the exhaust circuit to the manual valve and allow pressure to be directed through the 2-3 back-out valve to the apply side of the intermediate servo piston (Fig. 8).

In D2 the control pressure positions the check ball to prevent control pressure going to the exhaust circuit back through the lower valley of the 1-2 shift valve. The valve body cavity is constructed so the check ball can not seat or block off the circuit to the 2-3 back out valve and to apply the intermediate servo piston.

### 2-3 SHIFT VALVE

In D1 and D2, the valve is used to control the apply of the reverse-high clutch, and the release of the intermediate servo during the intermediate to high gear shift operation (Fig. 8). In R the valve directs control pressure to apply the reverse-high clutch for reverse gear.

The 2-3 shift valve is held closed by the 2-3 shift valve spring, throttle modulator valve spring, and the modulated throttle pressure force. In D1 or D2 the control pressure force acting on the differential in area of the lands of the valve also holds the valve closed.

Governor pressure is used to open the 2-3 shift valve. When the governor pressure exceeds the forces holding the valve closed, the valve will move downward (open), closing the exhaust passage through the manual valve and opening the passage to allow control pressure to apply the reverse-high clutch and release the intermediate servo (Fig. 8).

With the 2-3 shift valve opened

(down), the throttle modulator valve is held down blocking off modulated throttle pressure going to the 2-3 shift valve and 1-2 shift valve. The circuit which delivered D1 control pressure to the differential in area of the 2-3 shift valve lands is also closed.

The 2-3 shift valve can be returned to the closed (up) position, causing a downshift under one or more of the following conditions:

**Governor Pressure Reduced.** If governor pressure is reduced to the point where it can no longer hold the shift valve down against spring force and secondary throttle pressure force, the valve will move up causing a downshift. Under closed throttle conditions, the 2-3 shift valve will close at approximately 10 mph (speed at which governor primary valve cuts off governor pressure). Since governor pressure is cut off at this road speed, the 1-2 shift valve also closes at the same time. This will provide a 3-1 downshift when coasting in D1 range.

**Secondary Throttle Pressure Increased.** If secondary throttle pressure is increased sufficiently, it will move the throttle modulator valve and consequently move the 2-3 shift valve up, causing a 3-2 torque demand downshift.

**Control Pressure Introduced Below 2-3 Shift Valve.** If the downshift valve is moved through detent, control pressure is directed to the underside of the 2-3 shift valve, forcing the valve up and causing a forced 3-2 downshift. Maximum 3-2 forced downshift speed is controlled by governor pressure.

**Exhausting D1 Pressure to the 2-3 Shift Valve.** During high gear, if the manual valve is moved to the L range, the circuit that feeds pressure to the 2-3 shift valve will be opened to exhaust, allowing the high-reverse clutch apply and intermediate servo release pressure to be directed to exhaust through the manual valve, causing a 3-2 downshift.

### 2-3 BACK-OUT VALVE

The purpose of the 2-3 back-out valve is to provide smooth upshifts to high gear when the accelerator pedal is suddenly released while accelerating in second gear. Under normal throttle acceleration, when the 2-3 shift valve moves to cause a 2-3 upshift, the control pressure passes

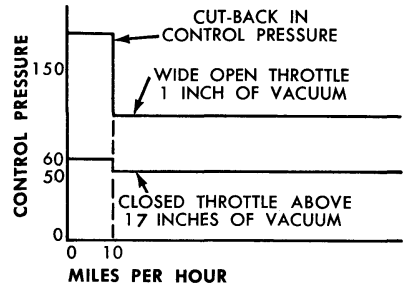



**FIG. 12–Control Pressure Regulation**

through the 2-3 shift valve, to apply the reverse-high clutch and release the intermediate servo. This same pressure is also directed to the end of the 2-3 back-out valve. With the throttle open, primary throttle pressure on the opposite end of the 2-3 back-out valve, assists spring force in holding the valve up, so that there will be no valve movement until after the 2-3 shift has been completed (Fig. 8).

When the car is being accelerated and the throttle is closed (accelerator pedal released) before completion of a 2-3 upshift, there may be enough pressure in the reverse-high clutch cylinder to prevent the clutch from slipping at the reduced engine torque input, but not enough pressure to release the intermediate servo. This condition could cause a harsh 2-3 shift. When the throttle is closed during a 2-3 shift, the primary throttle pressure will be reduced to zero at the 2-3 back-out valve and the reverse-high clutch apply pressure, on the end of the 2-3 back-out valve will move the valve down, against the spring force. This action immediately connects the reverse-high clutch apply circuit to the intermediate servo apply circuit. **This reduces the pressure on the apply side of the servo to the same value as in the reverse-high clutch, and also on the release side of the intermediate servo.** When this happens the intermediate band is released to provide a smooth 2-3 shift.

### MANUAL LOW VALVE

When a shift to manual low range is made or a forced downshift is made from high gear, the function of the manual low valve makes sure that the 2-3 back-out valve will be moved up the instant that pressure drops in the reverse-high clutch apply and intermediate servo release circuit. This is accomplished by directing control pressure to the end of the manual low valve when the L range is selected or when the downshift valve is moved to the downshift position (Fig. 8).

### 3-2 COASTING CONTROL VALVE

During a coasting (closed throttle) downshift, governor pressure is reduced with road speed. When the governor pressure is reduced to zero at about 10 mph, the spring of the 3-2 coasting control valve moves the valve down (Fig. 8). The intermediate servo release pressure now has to pass through the orifice to time the apply of the intermediate servo for a smooth 3-2 downshift.

### DOWNSHIFT VALVE

The downshift valve travel is controlled by the accelerator pedal position and the throttle linkage. The downshift linkage rod does not cause the downshift valve to move until the driver positions the accelerator pedal for the forced downshift operation. With the accelerator pedal fully depressed, the downshift valve is positioned against the spring to open the circuit to the manual low valve, 2-3 shift valve, and 1-2 shift valve.

Depending upon the road speed of the car, the governor pressure force acting on the shift valves can be overcome by the control pressure from the downshift valve to obtain forced downshift operations.

## HYDRAULIC CONTROL SYSTEM OPERATION

### NEUTRAL AND PARK

The position of the manual valve, stops the regulated control pressure from being directed to the shift control valves or the clutches and servos (Fig. 8). The front pump output hydraulic pressure is regulated by the control pressure regulator valve to maintain 55-62 psi in the circuits going to the manual valve, primary throttle valve, downshift valve, throttle boost valve, and cut-back valve (Fig. 8).

With both clutches and bands released, no torque will be transmitted through the clutches to the output shaft.

### INTERMEDIATE GEAR–D2

When the driver moves the transmission selector lever to D2, the manual linkage rod moves the transmission manual lever and manual valve to the D2 position. This opens circuits 1, 2, and 3 to the shift control valves (Fig. 8).

Circuit 1 directs control pressure through the 2-3 back-out valve to apply the intermediate servo. Circuit 2 directs control pressure to the upper valley and lower land of the 2-3 shift valve. Circuit 3 directs control pressure to the 1-2 shift valve lower valley, and then applies the forward clutch piston and directs control pressure to the secondary governor valve (Fig. 8). With the forward clutch and intermediate servo applied, the transmission power flow is for the intermediate gear operation.

### HIGH GEAR–D2

In intermediate gear, as the road speed increases the governor pressure acting on the end of the 2-3 shift valve is increased. When the governor pressure moves the 2-3 shift valve against spring and modulated throttle pressure, the control pressure that was blocked off at the lower land of the 2-3 shift valve can now pass through the lower valley of the valve (Fig. 8). The control pressure is directed from the lower valley of the 2-3 shift valve to apply the reverse-high clutch and release the intermediate servo. With the reverse-high clutch and forward clutch applied, the transmission power flow is for high gear operation.

### LOW GEAR–D1

When the selector lever is moved to the D1 position, control pressure circuits 2 and 3, from the manual valve, are opened to the shift valves (Fig. 8). Circuit 2 directs control pressure to the upper valley and lower land of the 2-3 shift valve. Circuit 3 directs the control pressure to the lower valley of the 1-2 shift valve, then to apply the forward clutch and to the secondary governor valve.

In D1 with only the forward clutch applied, the one-way clutch holds the low-reverse drum and reverse planet carrier from rotation to obtain the low gear power flow operation.

### INTERMEDIATE GEAR–D1

Due to the increased road speed, the governor pressure moves the 1-2 shift valve to open the lower valley of the valve to control pressure. From the lower valley of the 1-2 shift valve, the control pressure is directed to the shuttle valve check ball. The check ball is moved to block off the circuit that will exhaust at the manual valve.

The control pressure from the 1-2 shift valve is directed to the 2-3 back-out valve. The pressure passes through the valley of the 2-3 back-out valve to apply the intermediate servo and band.

With the intermediate band and forward clutch applied, the transmission power flow is for intermediate gear operation.

### HIGH GEAR–D1

To obtain high gear, the increased governor pressure moves the 2-3 shift valve to open the lower valley of the valve to control pressure. From the lower valley of the 2-3 shift valve, the control pressure applies the reverse-high clutch and releases the intermediate servo (Fig. 8). With the reverse-high clutch and forward clutch applied, the power flow is for the high gear operation.

### MANUAL LOW–L

When the manual valve is in the L detent position, circuits 3 and 4 direct control pressure to the shift valves (Fig. 8). Circuit 3 directs control pressure to the 1-2 shift valve, then to apply the forward clutch and also to the secondary governor valve. Circuit 4 directs control pressure through the center valley of the 1-2 shift valve to apply the low reverse servo and band. From the same circuit control pressure is directed to the end of the 1-2 shift valve, to lock the valve in position.

With the forward clutch and low reverse band applied, the power flow is for low gear. To eliminate shift points in manual low, circuit 4 directs control pressure through the downshift valve to the 2-3 and 1-2 shift valves. The control pressure acting at the end of the 2-3 shift valve and in the upper valley of the 1-2 shift valve, locks these valves in position against governor pressure.

### REVERSE GEAR–R

When the manual valve is moved to R, circuits 4 and 5 direct control pressure to the shift valves (Fig. 8). Circuit 4 directs control pressure through the center valley of the 1-2 shift valve to apply the low-reverse servo and band. Circuit 5 directs control pressure through the lower valley of the 2-3 shift valve to apply the reverse-high clutch. The circuit also directs control pressure to the pressure booster valve to assist the control pressure regulator valve spring to obtain higher control pressure regulation in reverse.

With the reverse-high clutch and low-reverse band applied, the power flow is for the reverse gear operation. With the forward clutch circuit 3 not pressurized, no control pressure is directed to the governor valves. Therefore, there is no governor pressure acting on the shift valves in reverse.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### CONTROL LINKAGE ADJUSTMENTS

The transmission control linkage adjustments should be performed in the order in which they appear in this section of the manual.

### THROTTLE AND DOWNSHIFT LINKAGE ADJUSTMENTS

**1.** Apply the parking brake, and place the selector lever at N.

**2.** Run the engine at normal idle speed. If the engine is cold, run the engine at fast idle speed (about 1200 rpm) until it reaches normal operating temperature. When the engine is warm, slow it down to normal idle speed.

**3.** Connect a tachometer to the engine.

**4.** Adjust engine idle speed to the specified rpm with the transmission selector lever at D1 or D2, the drive position.

**5.** The carburetor throttle lever must be against the hot idle speed adjusting screw at specified idle speed in D1 (large dot) or D2 (small dot). To make sure that the carburetor throttle lever is against the adjusting screw, refer to Group 10

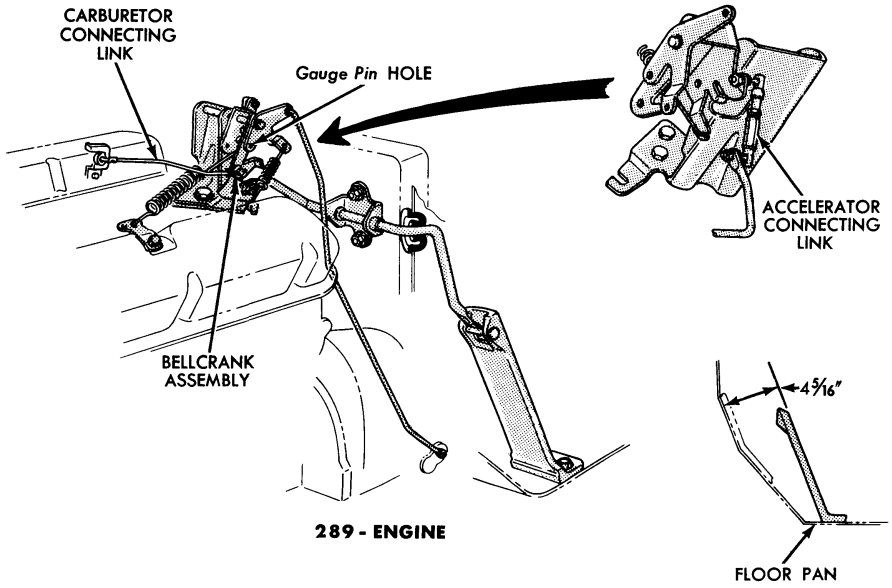



**FIG. 13—Throttle Linkage**

for the carburetor adjusting procedures.

**6.** Adjust the accelerator connecting link to obtain a pedal height of 4 5/16 inches. Measure from a top corner of the pedal to the floor pan (Fig. 13).

### 289 ENGINE ONLY

**1.** Disconnect the carburetor connecting link from the accelerator bellcrank assembly.

**2.** Insert a gauge pin (¼-inch drill rod) through the gauge pin holes as shown in (Fig. 13).

**3.** Lift the carburetor connecting link to its normal operating position. Maintain forward pressure on it so that the carburetor throttle lever is held solidly against the idle adjusting screw. With forward pressure on the link, adjust its length so that the trunnion can be freely fitted into the bellcrank assembly lever. From this free-fit position, rotate the trunnion one full turn counterclockwise to lengthen the link. Remove the gauge pin and connect the link to the bellcrank assembly lever.

**4.** Check the alignment of the gauge pin holes. Open the throttle and permit the throttle linkage retracting spring to return the linkage to its hot idle position. Now, the pin must enter freely. If necessary, readjust the carburetor connecting link to obtain a free entry for the gauge pin.

### 223 ENGINE ONLY

**1.** Check the accelerator pedal height and if necessary adjust the Z-Bar connecting link rod to obtain a pedal height of 4 5/16 inches (Fig. 13).

**2.** Adjust the downshift rod to allow a free fit of the gauge pin (¼-inch drill rod) into the gauge pin holes of the bellcrank.

**3.** Assemble the downshift rod trunnion into the bellcrank. Torque the lock nut to specifications.

## MANUAL LINKAGE ADJUSTMENT

**1.** With the engine stopped, loosen the clamp at the shift lever at point "A" so that the shift rod is free to slide in the clamp (Fig. 14).

**2.** Position the quadrant selector lever in the D1 position.

**3.** Shift the manual lever at the transmission into the D1 detent position, second from the rear.

**4.** Tighten the clamp on the shift rod at point "A".

**5.** Check the pointer alignment and transmission operation for all selector lever detent positions.

## NEUTRAL START SWITCH ADJUSTMENT

**1.** With the manual linkage properly adjusted, loosen the two switch retaining bolts (Fig. 15). Position the transmission manual lever in neutral detent position.

**2.** Rotate the switch and insert the gauge pin (No. 43 drill) into the gauge pin holes of the switch. The gauge pin has to be inserted a full 31/64 inch into the 3 holes of the switch (Fig. 15).

**3.** Torque the two switch retaining bolts to specification. Remove the gauge pin tool from the switch.

**4.** Check the operation of the switch. The engine should start only with the transmission selector lever in N (neutral) and P (park).

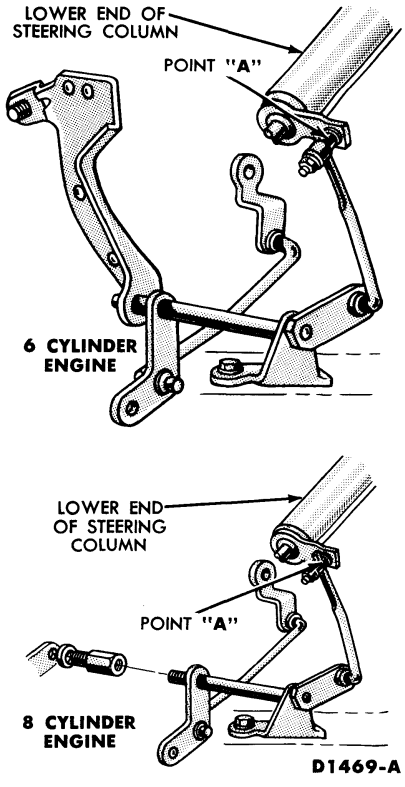



**FIG. 14—Column Shift Manual Linkage**

## NEUTRAL START SWITCH REPLACEMENT

**1.** Remove the downshift linkage rod from the transmission downshift lever.

**2.** Remove the transmission downshift outer lever retaining nut and lever.

**3.** Remove the two neutral start switch retaining bolts.

**4.** Disconnect the two multiple wire connectors. Remove the neutral start switch from the transmission.

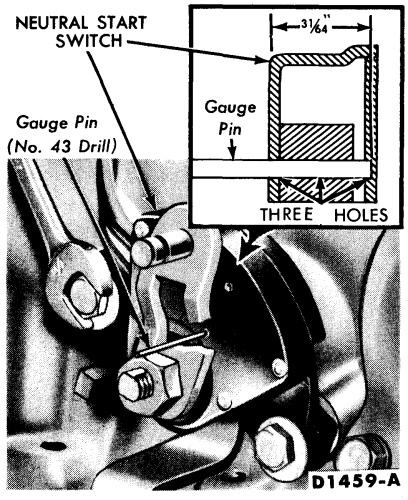



**FIG. 15—Neutral Start Switch**

**5.** Install the neutral start switch on the transmission. Install the two retaining bolts.

**6.** With the transmission manual lever in neutral, check the location of the switch with the gauge pin and adjust the switch if necessary.

**7.** Tighten the switch retaining bolts to specifications and remove the gauge pin.

**8.** Install the outer downshift lever and retaining nut, and torque the nut to specification. Install the downshift linkage rod to the downshift lever.

**9.** Install the switch wires, red to red and blue to blue. Connect the wire multiple connectors. Check the operation of the switch in each detent position. The engine should start only with the transmission selector lever in N (neutral) and P (park).

## BAND ADJUSTMENTS

### INTERMEDIATE BAND

**1.** Clean all the dirt from the band adjusting screw area. Loosen the lock nut several turns.

**2.** With the tool shown in Fig. 16, tighten the adjusting screw until the tool handle clicks. The tool is a pre-set torque wrench which clicks and overruns when the torque on the adjusting screw reaches 10 ft-lbs.

**3. Back off the adjusting screw exactly 1½ turns.**

**4.** Hold the adjusting screw from turning and torque the locknut to specification.

### LOW-REVERSE BAND

**1.** Clean all the dirt from the band adjusting screw area. Loosen the lock nut several turns.

**2.** With the tools shown in Fig. 17, tighten the adjusting screw until the tool handle clicks. The tool is a pre-set torque wrench which clicks and overruns when the torque on the adjusting screw reaches 10 ft-lbs.

**3. Back off the adjusting screw exactly 3 full turns.**

**4.** Hold the adjusting screw from turning and torque the lock nut to specification.

## OIL PAN AND CONTROL VALVE BODY REPLACEMENT

**1.** Raise the car so the transmission oil pan is accessible.

**2.** Loosen the oil pan retaining bolts and lower one edge of oil pan to drain the transmission oil. **If the same fluid is to be used again, filter the fluid through a 100 mesh screen. Re-use the fluid only if it is in good condition.**

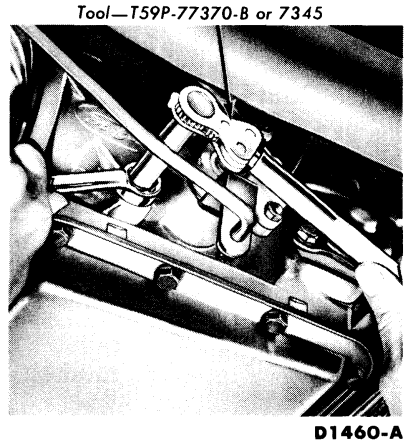



**FIG. 16—Intermediate Band Adjustment**

**3.** Remove the 11 transmission oil pan retaining bolts, oil pan and gasket.

**4.** Remove the eight valve body to case retaining bolts (Fig. 28). Remove the valve body from the case and the inner transmission control levers.

**5.** Refer to the "Major Repair Operation" for control valve body repair operation.

**6.** Thoroughly clean and remove all the gasket material from the oil pan and the oil pan mounting face of the case. Install the valve body to the case, engaging the transmission inner control levers with the valve body manual and downshift valves.

**7.** Install the eight valve body to case retaining bolts. Torque the bolts to specification. **Operate the external manual and downshift levers to check for proper travel of the valve body manual and downshift valves.**

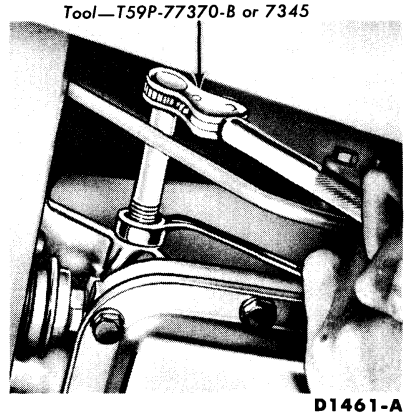



**FIG. 17—Low-Reverse Band Adjustment**

**8.** Place a new gasket on the oil pan. Install the oil pan and 11 retaining bolts. Torque the bolts to specification.

**9.** Lower the car and fill the transmission with fluid. Check the transmission oil pan area for oil leakage.

### INTERMEDIATE SERVO

**1.** Raise the car and remove the four servo cover to case retaining bolts.

**2.** Remove the servo cover, gasket, piston, and piston return spring. Remove the piston from the cover (Fig. 48).

**3.** Remove the piston seals and cover gasket.

**4.** Install new piston seals on the piston. Lubricate the piston seals with clean transmission oil. Install the servo piston in the cover.

**5.** Install the piston return spring in the case. Place a new gasket on the cover. Install the piston and cover into the transmission case. Use two 5/16–18x1¼ bolts, 180° apart to position the cover against the case.

**6.** Install the two servo cover retaining bolts. Remove the two 1¼-inch bolts and install two retaining bolts. Torque the bolts to specification.

**7.** Adjust the intermediate band. Lower the car and check the transmission fluid level.

**8.** If the band can not be adjusted properly, the struts are not in position. Remove the oil pan and valve body. Install the struts, valve body, oil pan, and adjust the band. Refill the transmission with oil.

### LOW-REVERSE SERVO PISTON REPLACEMENT

**1.** Raise the car and remove the four servo cover to case retaining bolts. Remove the identification tag and vent tube retaining clip. Remove the servo cover from the case.

**2.** With the piston stem in the case, move the piston out as far as possible and insert a small screw driver in the hole of the piston stem (Fig. 47). Remove the piston retaining nut.

**3.** Remove the servo piston from the case. **The piston seal cannot be replaced without replacing the piston. The seal is bonded to the piston.**

**4.** Install a new piston on the piston retaining shaft. Install the retaining nut. Torque the nut to specification.

**5.** Install the piston into the case. Install a new seal on the cover. Install the cover by using two 5/16–18 bolts, 1¼ inch long, at 180° apart to position the servo cover on the case. Install the vent tube retaining clip and identification tag. Install two cover retaining bolts. Remove the two installing bolts and install the last two retaining bolts. Torque the cover to case retaining bolts to specification.

**6.** Adjust the low-reverse band. Lower the car and check the transmission fluid level.

**7.** If the band can not be adjusted properly, the struts are not in position. Remove the oil pan and valve body. Install the struts, valve body, oil pan, and adjust the band. Refill the transmission with oil.

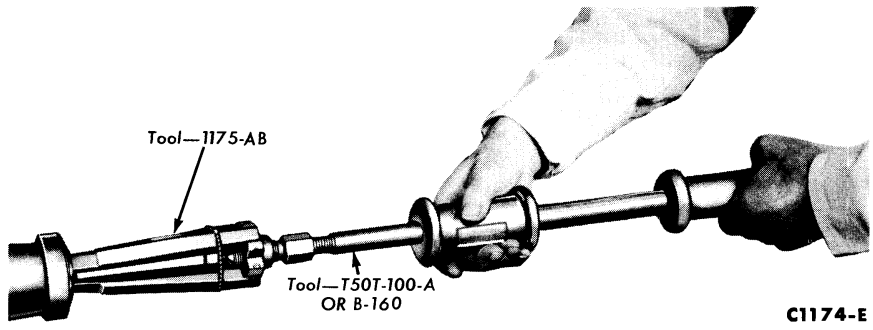



**FIG. 18—Extension Housing Seal Removal**

### EXTENSION HOUSING BUSHING AND REAR SEAL REPLACEMENT

**1.** Disconnect the drive shaft from the transmission.

**2.** When only the rear seal needs replacing, carefully remove it with a tapered chisel or the tools shown in Fig. 18. Remove the bushing as shown in Fig. 19. **Use the bushing remover carefully so that the spline seal is not damaged.**

**3.** When installing a new bushing use the special tool shown in Fig. 20.

**4.** Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.

**5.** Inspect the counterbore of the housing for burrs with crocus cloth.

**6.** Install the seal into the housing with the tool shown in Fig. 21. The seal should be firmly seated in the bore. Coat the inside diameter of the fiber portion of the seal with B8A-19589-A lubricant.

**7.** Coat the front universal joint spline with B8A-19589-A lubricant and install the drive shaft.

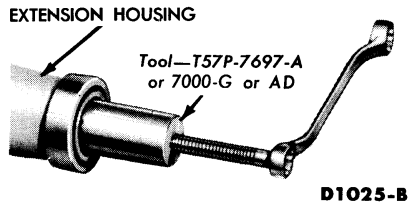



**FIG. 19—Extension Housing Bushing Removal**

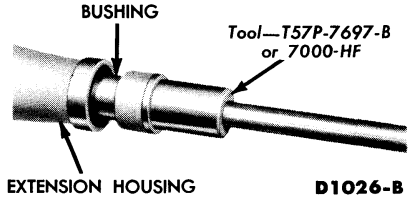



**FIG. 20—Extension Housing Bushing Installation**

### EXTENSION HOUSING AND GOVERNOR REPLACEMENT

**1.** Raise the car on the hoist.

**2.** Remove the drive shaft. Position the transmission jack to support the transmission.

**3.** Remove the speedometer cable from the extension housing.

**4.** Remove the extension housing to crossmember mount retaining bolts. Raise the transmission and remove the mounting pad between the extension housing and the crossmember.

**5.** Loosen the extension housing retaining bolts to drain the transmission fluid. Disconnect the exhaust inlet pipes at the manifold and lower the inlet pipes.

**6.** Remove the six extension housing-to-case retaining bolts and remove the extension housing.

**7.** Remove the governor housing to governor distributor retaining bolts (Fig. 22). Remove the governor housing from the distributor.

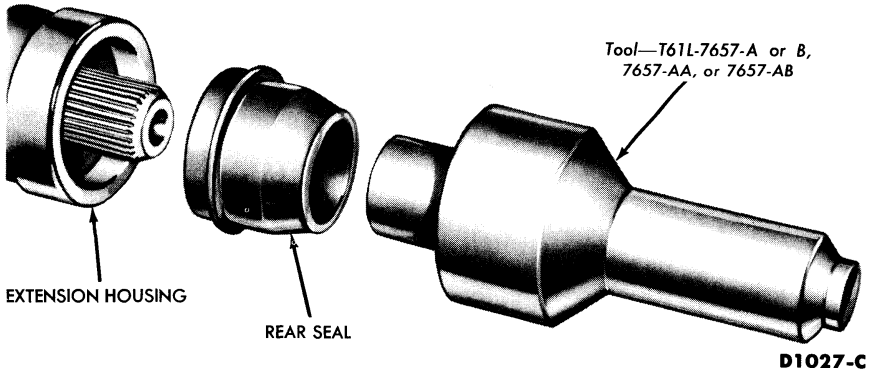



**FIG. 21—Extension Housing Rear Seal Installation**

**8.** Refer to "Major Repair Operations" for governor repair operations.

**9.** Install the governor housing on the governor distributor (Fig. 22). Install the retaining bolts and torque the bolts to specification.

**10.** Install a new extension housing gasket on the case. Install the extension housing and 6 retaining bolts. Torque the bolts to specification.

**11.** Install the transmission mounting pad on the crossmember. Lower the transmission and install the extension housing to crossmember retaining bolts. Torque the retaining bolts to specification. Remove the transmission jack.

**12.** Install the speedometer cable in the extension housing. Install the drive shaft.

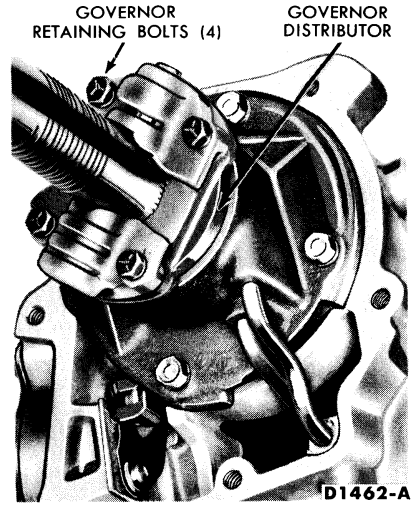



**FIG. 22—Governor Location**

**13.** Install the inlet pipes on the manifold.

**14.** Lower the car and fill the transmission with fluid.

**15.** Check the extension housing area for oil leakage.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

**1.** Raise the car and remove the three converter cover retaining bolts, at the lower front side of the converter housing. Remove the cover.

**2.** Remove the two converter drain plugs (Fig. 23). Drain the oil from the converter. Install the two converter drain plugs.

**3.** Remove the drive shaft and install the extension housing seal replacer tool in the extension housing.

**4.** Remove the vacuum line hose from the transmission vacuum unit. Disconnect the vacuum line from the retaining clip.

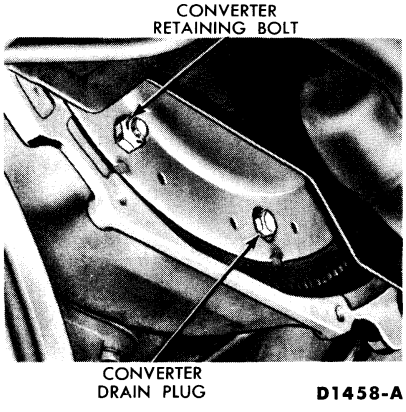



**FIG. 23—Converter Drain Plug Location**

**5.** Remove the two extension housing to crossmember retaining bolts.

**6.** Remove the speedometer cable from the extension housing.

**7.** Disconnect the exhaust pipe flange from the manifolds.

**8.** Remove the parking brake cable from the equalizer lever.

**9.** Loosen the 11 transmission oil pan bolts and drain the oil at one corner of the oil pan. Tighten the retaining bolts.

**10.** Disconnect the oil cooler lines from the transmission case. Remove the oil filler tube from the case. On the 223 six engine, if the filler tube can not be removed from the transmission, remove the tube retaining bracket. The transmission can then be removed or installed with the filler tube assembled to the case.

**11.** Remove the manual and kickdown linkage rods from the transmission control levers.

**12.** Remove the transmission outer downshift lever and the neutral start switch (Fig. 15).

**13.** Remove the starter cable. Remove the starter retaining bolts and remove the starter from the converter housing.

**14.** Remove the four converter to flywheel retaining nuts.

**15.** Position the transmission jack to support the transmission and secure the transmission to the jack with a safety chain.

**16.** Remove the four crossmember retaining bolts and lower the crossmember.

**17.** Remove the five converter housing to engine retaining bolts. Lower the transmission (Fig. 24) and remove it from under the car.

### INSTALLATION

**1.** With the converter properly installed, place the transmission on the jack (Fig. 24). Secure the transmis-

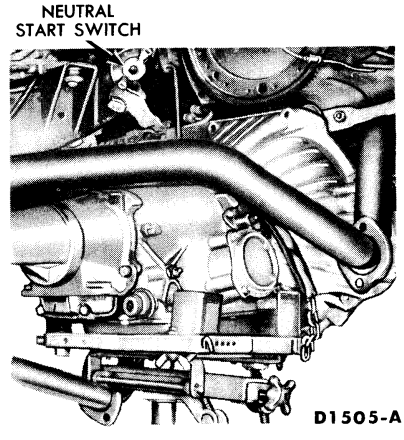



**FIG. 24—Transmission Mounted on Jack**

sion to the jack with the safety chain.

**2.** Raise the transmission into position and install the five converter housing to engine retaining bolts. Torque the bolts to specification. Remove the safety chain from the transmission.

**3.** Position the crossmember and install the four retaining bolts. Torque the bolts to specifications.

**4.** Lower the transmission and install the extension housing and crossmember retaining bolts. Torque the bolts to specification.

**5.** Install the four flywheel to converter retaining nuts. Torque the nuts to specification.

**6.** Remove the transmission jack. Install the vacuum hose on the transmission vacuum unit. Install the vacuum line retaining clip.

**7.** Install the transmission oil filler tube. Connect the oil cooling lines to the transmission case.

**8.** Install the neutral start switch, and adjust the switch (Fig. 15) as outlined under "In-Car Adjustments and Repairs." Torque the retaining bolts to specification. Install the transmission outer downshift lever. Install a new retaining nut, and torque the nut to specification.

**9.** Install the linkage rods on the transmission downshift and manual control levers.

**10.** Install the speedometer cable on the extension housing.

**11.** Connect the exhaust inlet pipes to the manifolds.

**12.** Install and adjust the parking brake cable at the equalizer lever.

**13.** Install the converter housing cover and torque the retaining bolts to specification.

**14.** Install the starter and torque the retaining bolts to specification. Install the starter cable.

**15.** Install the drive shaft. Torque the companion flange U-bolts retaining nuts to specification.

**16.** Lower the car and fill the transmission with oil. Adjust the manual and kickdown linkage.

## 4 MAJOR REPAIR OPERATIONS

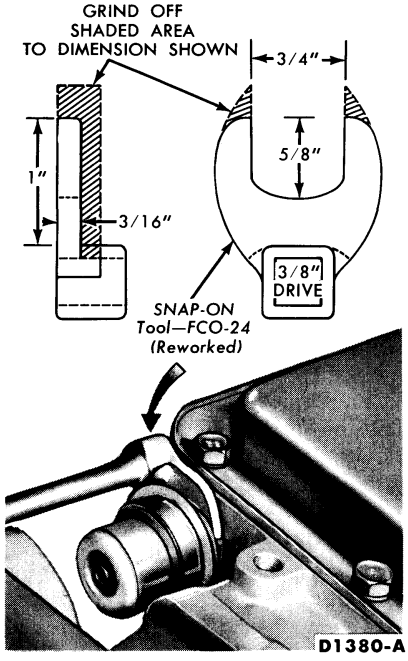



**FIG. 25—Vacuum Unit Removal**

Before removing any of the sub-assemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts. During the repair operations, refer to Part 7-1 for common adjustments and repairs or cleaning and inspection procedures.

During the transmission disassembly or assembly operations, ten thrust washers located between the sub-assemblies must be removed and installed. It is important that each thrust washer be in the correct position during the assembly operation. To properly locate and identify the thrust washers, the various positions of the thrust washers are shown in the illustrations and are numbered 1 through 10. No. 1 is the first thrust washer located at the front pump. The last thrust washer, No. 10, is located at the parking pawl ring gear.

### DISASSEMBLY

**1.** Remove the converter from the transmission front pump and converter housing.

**2.** Remove the transmission vacuum unit with the tool shown in Fig. 25. Remove the vacuum unit gasket and control rod.

**3.** From the vacuum unit hole in the case, remove the primary throttle valve (Fig. 26).

**4.** Remove the two extension housing to case retaining bolts and mount the transmission in the holding fixture as shown in Fig. 27.

**5.** Remove the 11 oil pan retaining bolts, and the oil pan and gasket.

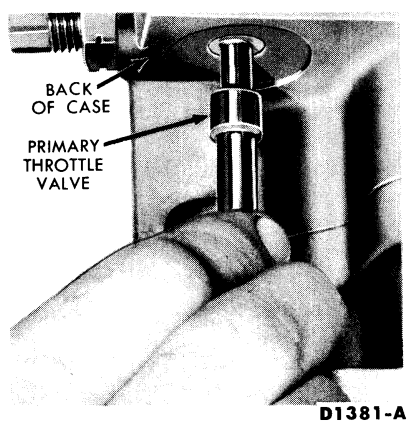



**FIG. 26—Primary Throttle Valve Removal or Installation**

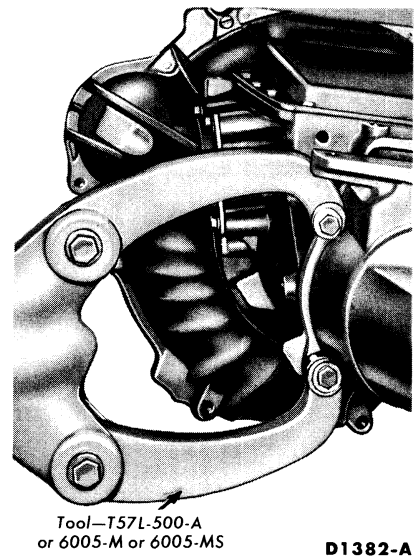



**FIG. 27—Transmission Mounted in Holding Fixture**

**6.** Remove the eight control valve body retaining bolts (Fig. 28). Remove the control valve body from the case.

**7.** Loosen the intermediate band adjusting screw (Fig. 29) and remove the intermediate band struts from the case. Loosen the low-reverse band adjusting screw and remove the low-reverse band struts.

### TRANSMISSION END PLAY CHECK

**1.** To keep the output shaft in alignment during the end play check, install the extension housing oil seal replacer tool or a front universal joint yoke in the extension housing.

**2.** Remove one of the converter housing and front pump to case re-

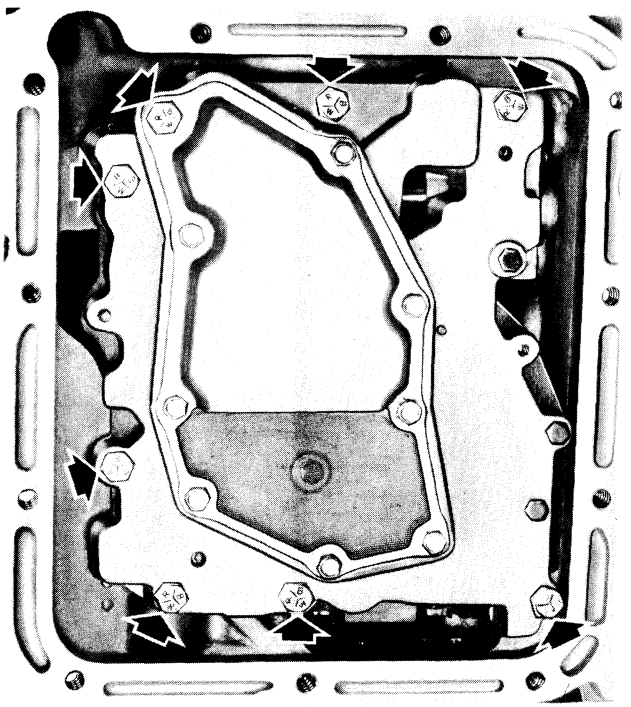



FIG. 28—Control Valve Body Retaining Bolts

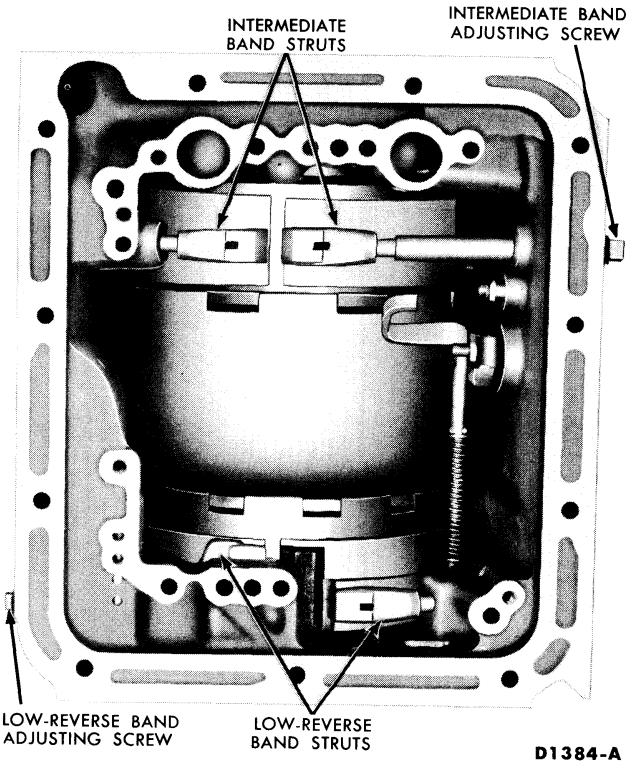



FIG. 29—Band Adjusting Screws and Struts

taining bolts and mount the dial indicator as shown in Fig. 30.

3. The input shaft is a loose part and has to be properly engaged with the spline of the forward clutch hub during the end play checking procedure. Move the input shaft and gear train toward the back of the transmission case.

4. With the dial indicator contacting the end of the input shaft, set the indicator at zero (Fig. 30).

5. Insert a screwdriver behind the input shell (Fig. 30). Move the input shell and the front part of the gear train forward.

6. Record the dial indicator reading. The end play should be 0.008 to 0.042 inch. If the end play is not within specifications, **both selective thrust washers (Fig. 31) must be replaced. The selective thrust washers cannot be replaced individually.**

7. Remove the dial indicator and remove the input shaft from the front pump stator support (Fig. 32).

## REMOVAL OF CASE AND EXTENSION HOUSING PARTS

1. Rotate the holding fixture to put the transmission in a vertical

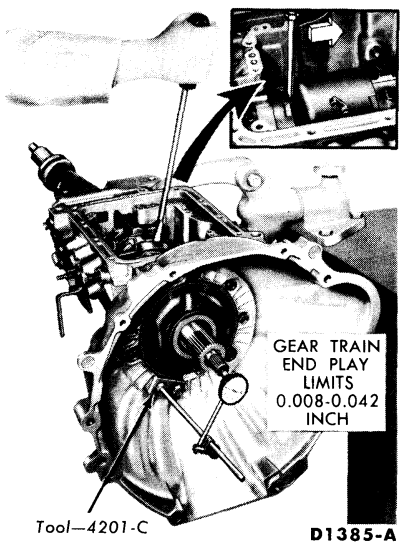



FIG. 30—End Play Check

**SELECTIVE THRUST WASHERS**

| WASHER NO. 1 (FIBER) | | WASHER NO. 2 (STEEL-BACK BRONZE) | |
|---|---|---|---|
| THICKNESS (INCHES) | IDENTIFICATION (DYE-COLOR) | THICKNESS (INCHES) | IDENTIFICATION (STAMPED NO.) |
| .038-.042 | GREEN | .041-.043 | 1 |
| .053-.057 | TAN | .053-.056 | 2 |
| .070-.074 | BLACK | .073-.075 | 3 |
| .087-.091 | YELLOW | .090-.092 | 4 |
| .104-.108 | BLUE | .107-.109 | 5 |

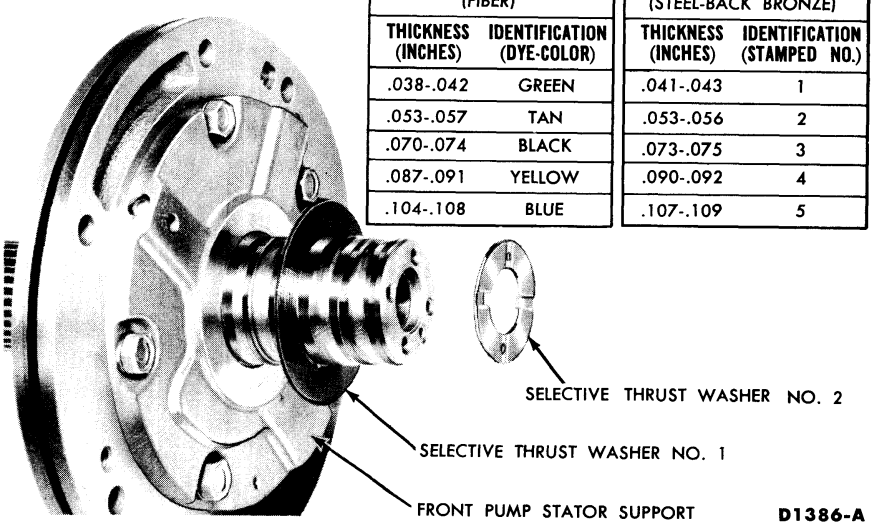



FIG. 31—Selective Thrust Washer Locations

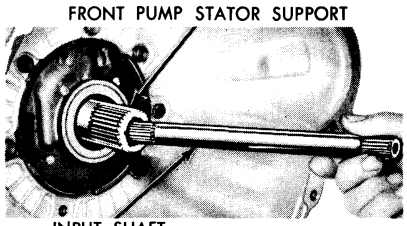



**FIG. 32—Input Shaft Removal or Installation**

position with the converter housing up.

**2.** Remove the six converter housing and front pump to case retaining bolts. Remove the converter housing from the front pump.

**3.** Remove the front pump by inserting a screw driver behind the input shell (Fig. 33). Move the input shell forward until the front pump seal is above the edge of the case. Remove the front pump and gasket from the case. If the selective thrust washer No. 1 did not come out with the front pump, remove it from the top of the reverse-high clutch.

**4.** Remove the intermediate and low-reverse band adjusting screws from the case. Rotate the intermediate band to align the band with the clearance hole in the case (Fig. 34). Remove the intermediate band from the case.

**5.** Using a screwdriver between the input shell and rear planet carrier (Fig. 35), lift the input shell upward and remove the forward part of the gear train as an assembly (Fig. 36).

**6.** Place the forward part of the gear train in the holding fixture shown in Fig. 37.

**7.** From the gear train in the holding fixture, remove the reverse-high clutch and drum from the forward clutch (Fig. 38).

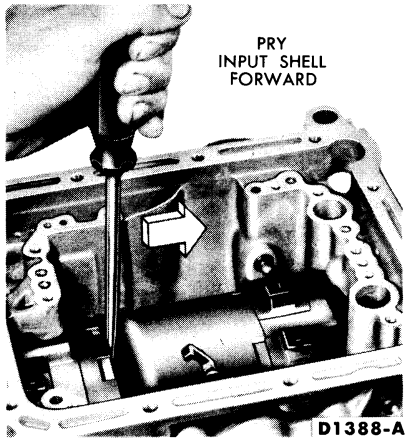



**FIG. 33—Front Pump Removal**

**8.** If thrust washer No. 2 (Fig. 31) did not come out with the front pump, remove the thrust washer from the forward clutch cylinder. Remove the forward clutch from the forward clutch hub and ring gear (Fig. 38).

**9.** If thrust washer No. 3 (Fig. 38) did not come out with the forward clutch, remove the thrust washer from the forward clutch hub.

**10.** Remove the forward clutch hub and ring gear from the front planet carrier (Fig. 38).

**11.** Remove thrust washer No. 4 and the front planet carrier from the input shell.

**12.** Remove the input shell, sun gear and thrust washer No. 5 from the holding fixture.

**13.** From inside the transmission case, remove the inner downshift lever from the manual lever (Fig. 35). Remove thrust washer No. 6 from the top of the reverse planet carrier.

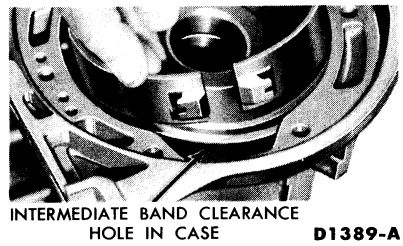



**FIG. 34—Position of Intermediate Band for Removal or Installation**

**14.** Remove the reverse planet carrier and thrust washer No.7 from the reverse ring gear and hub (Fig. 39).

**15.** Move the output shaft forward and with the tool shown in Fig. 40 remove the reverse ring gear hub

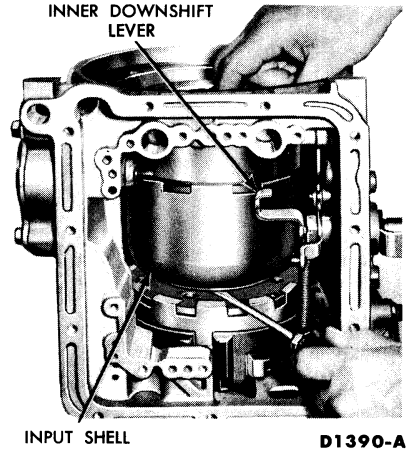



**FIG. 35—Lifting Input Shell and Gear Train**

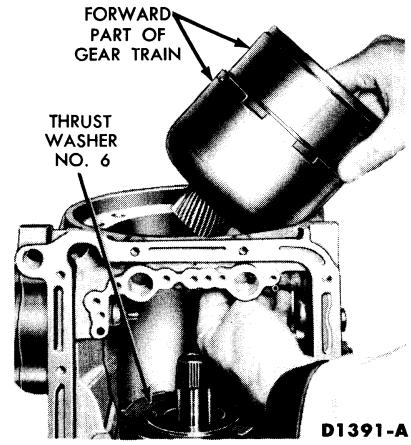



**FIG. 36—Forward Part of Gear Train—Removal or Installation**

to output shaft retaining ring.

**16.** Remove the reverse ring gear and hub from the output shaft. Remove thrust washer No. 8 from the low and reverse drum.

**17.** Remove the low-reverse band from the case (Fig. 41).

**18.** Remove the low-reverse drum from the one-way clutch inner race (Fig. 39).

**19.** Remove the one-way clutch inner race by rotating the race clockwise as it is removed.

**20.** Remove the 12 one-way clutch rollers, springs and the spring retainer from the outer race (Fig. 39). **Do not lose or damage any of the 12 springs or rollers. The outer race of the one-way clutch cannot be removed from the case until the extension housing, output shaft and governor distributor sleeve are removed.**

**21.** Remove the transmission from the holding fixture. Position the




**FIG. 37—Forward Part of Gear Train Positioned in Holding Fixture**

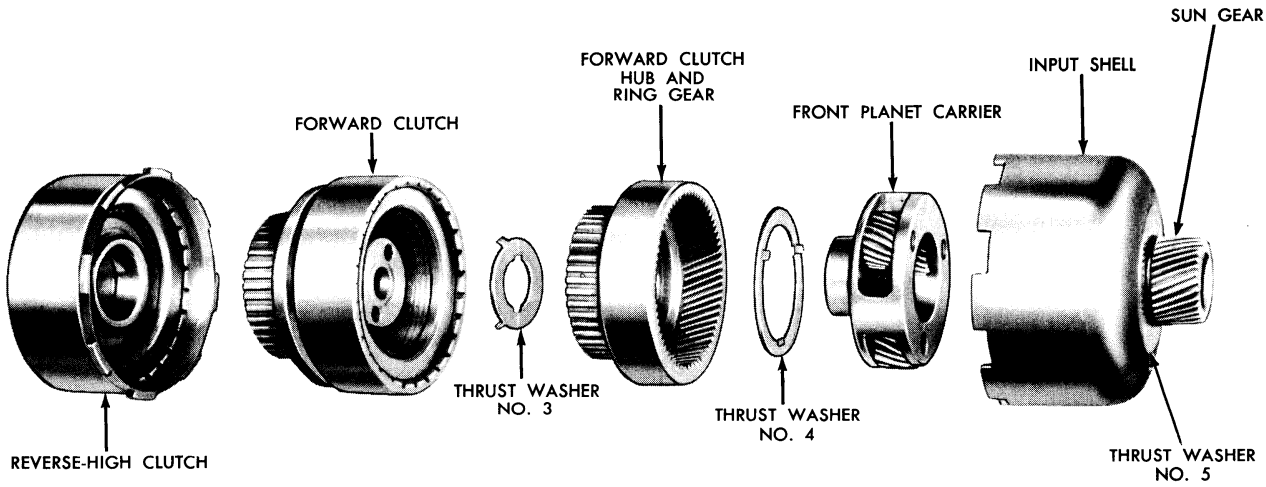



**FIG. 38—Forward Part of Gear Train Disassembled**

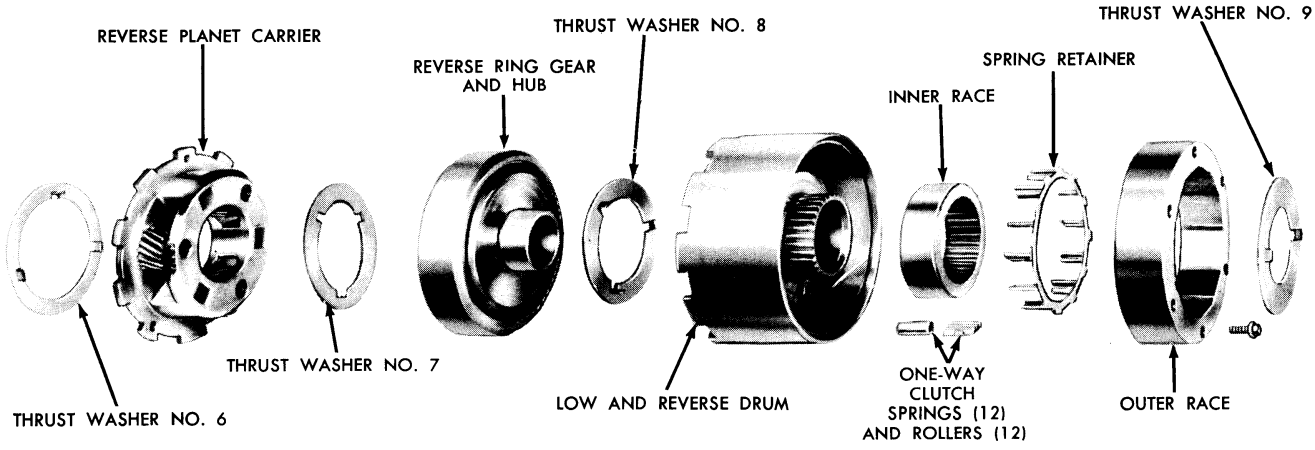



**FIG. 39—Lower Part of Gear Train Disassembled**

transmission on the bench in a vertical position with the extension housing up. Remove the four extension housing to case retaining bolts. Remove the extension housing and gasket from the case.

**22.** Pull outward on the output shaft and remove the output shaft and governor distributor assembly from the governor distributor sleeve (Fig. 42).

**23.** Remove the governor distributor lock ring from the output shaft (Fig. 43). Remove the governor distributor from the output shaft.

**24.** Remove the four distributor sleeve to case retaining bolts. Remove the distributor sleeve from the case. **Do not bend or distort the oil tubes as the tubes are removed from the case with the distributor sleeve.**

**25.** Remove the parking pawl return spring, pawl, and pawl retaining pin from the case (Fig. 44).

**26.** Remove the parking pawl gear and thrust washer No. 10 from the case.

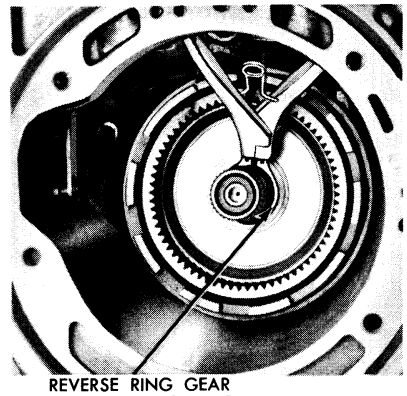



**FIG. 40—Reverse Ring Gear Hub Retaining Ring Removal or Installation**

**27.** Remove the six one-way clutch outer race to case retaining bolts with the tool shown in Fig. 45. As the retaining bolts are removed, hold the outer race located inside the case in position. Remove the outer race and thrust washer No. 9 from the case (Fig. 39).

## PARTS REPAIR OR REPLACEMENT

During the repair of the subassemblies, certain general instructions which apply to all units of the transmissions must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the

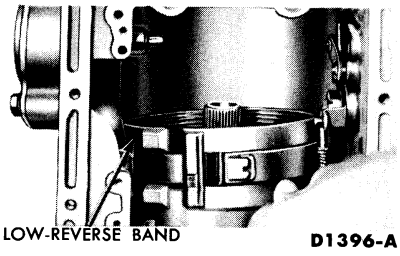



**FIG. 41—Low Reverse Band Removal or Installation**

bearing or mating surfaces.

Lubricate all internal parts of the transmission before assembly with clean automatic transmission fluid. **Do not use any other lubricants except on gaskets and thrust washers which may be coated with vaseline to facilitate assembly.** Always install new gaskets when assembling the transmission.

Tighten all bolts and screws to the recommended torque as outlined in the Specification Section.

## TRANSMISSION CASE AND LINKAGE REPAIR

### Low-Reverse Servo

**1.** Remove the four servo cover to case retaining bolts. Remove the transmission identification tag, vent tube and retaining clip from the case.

**2.** Remove the servo cover, cover seal, servo piston and piston return spring from the case (Fig. 46).

**3.** The servo piston seal is bonded to the piston. If the seal has to be replaced, replace the piston assembly which includes the seal. Disassemble the servo piston from the piston rod by inserting a small screwdriver in the hole of the piston rod and removing the piston retaining nut (Fig. 47). Install the new servo piston and torque the piston retaining nut to specification.

**4.** Place the piston return spring in the servo bore of the case. Lubricate the piston seal with clean transmission oil and install the servo piston into the bore of the case.

**5.** Place a new cover seal on the cover and install the servo cover. Install the identification tag and the vent tube and retaining clip. Install the four cover retaining bolts. Torque the cover to case retaining bolts to specifications.

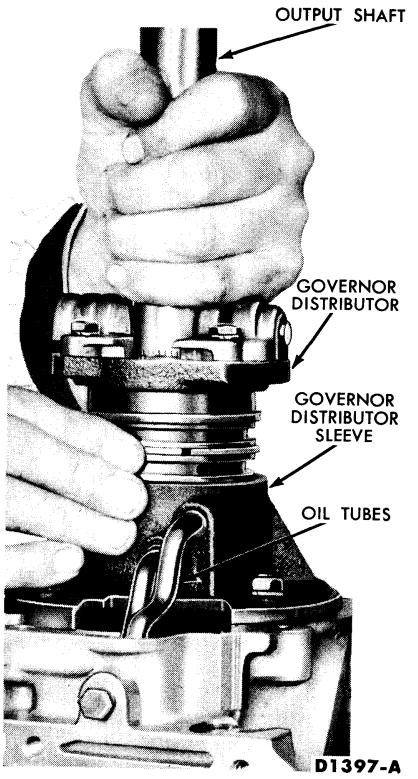



**FIG. 42—Output Shaft and Governor Distribution Removal or Installation**

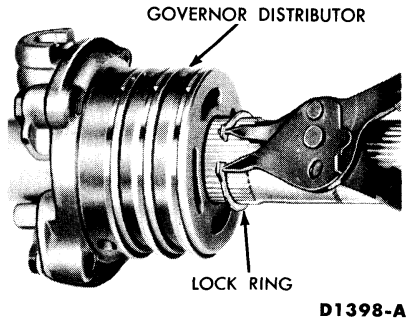



**FIG. 43—Governor Distributor Lock Ring Removal or Installation**

### Intermediate Servo

**1.** Remove the four servo cover to case retaining bolts.

**2.** Remove the servo cover, gasket, servo piston, and piston return spring from the case (Fig. 48).

**3.** On a transmission used with six cylinder engines, remove the intermediate servo piston from the cover by inserting air pressure into the pressure hole in the cover (Fig. 50).

**4.** Remove the seal rings from the servo piston and cover.

**5.** Install a new seal on the cover and servo piston. Figure 49 shows the correct servo piston and cover

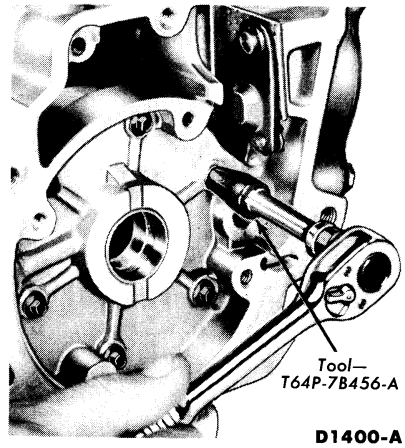



**FIG. 45—One Way Clutch Outer Race Retaining Bolts Removal**

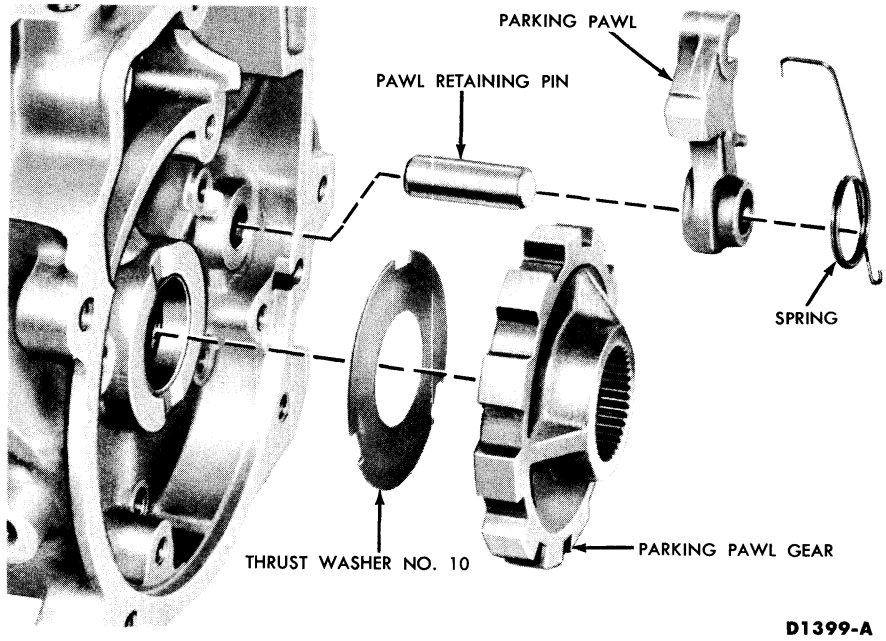



**FIG. 44—Parking Pawl, Return Spring, Retaining Pin and Gear**

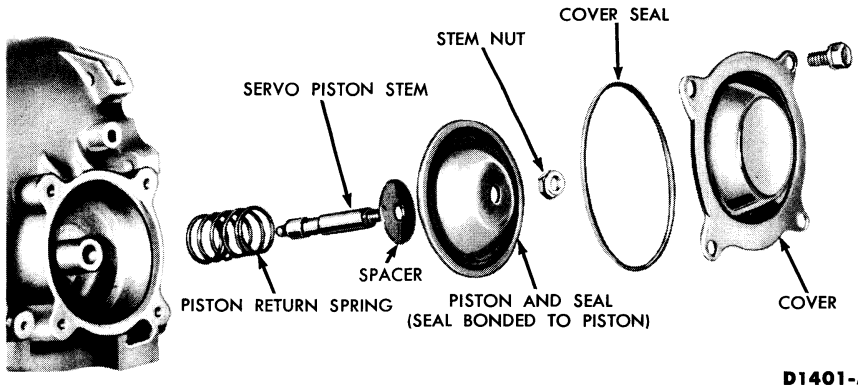



**FIG. 46—Low Reverse Servo**

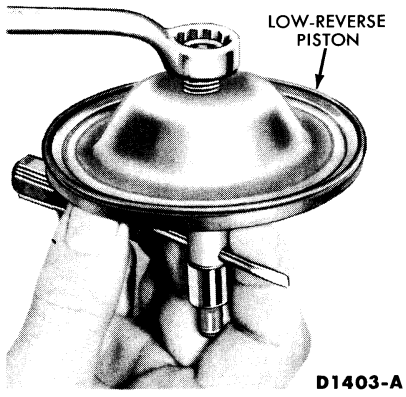



**FIG. 47—Low Reverse Servo Piston Removal or Installation**

for each transmission model. Lubricate the seals with clean transmission oil. Install the piston into the cover. Be careful not to damage the piston seal.

**6.** Install the piston return spring in the servo bore of the case.

**7.** Place a new gasket on the servo cover. Position the servo piston and cover assembly into the case. Use two 5/16—18 bolts, 1¼ inch long, 180° apart, to position the cover against the case. Install two cover retaining bolts. Remove the two 1¼ inch bolts and install the other two cover retaining bolts. Torque the cover retaining bolts to specification.

## DOWNSHIFT AND MANUAL LINKAGE

**1.** The downshift outer and inner levers have been removed from the case during transmission removal and disassembly operations.

From inside the transmission case, remove the upper retaining ring and flat washer from the manual lever

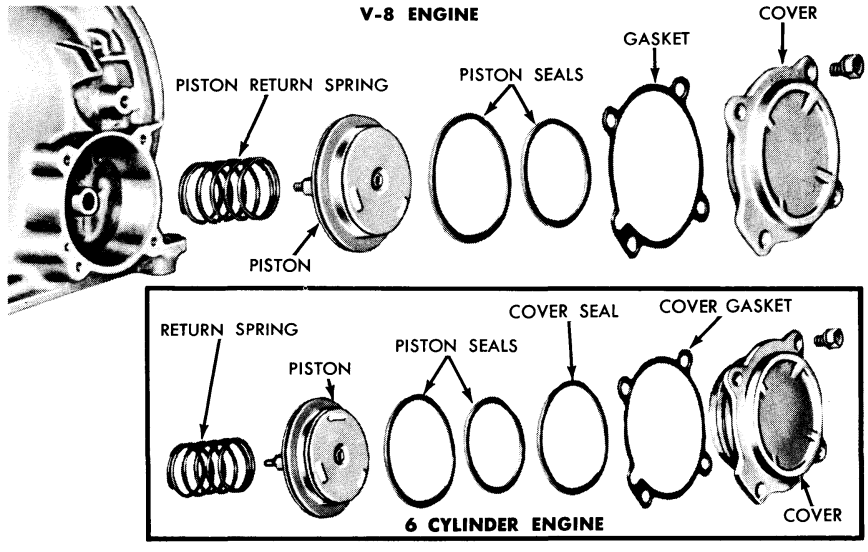



**FIG. 48—Intermediate Servo**

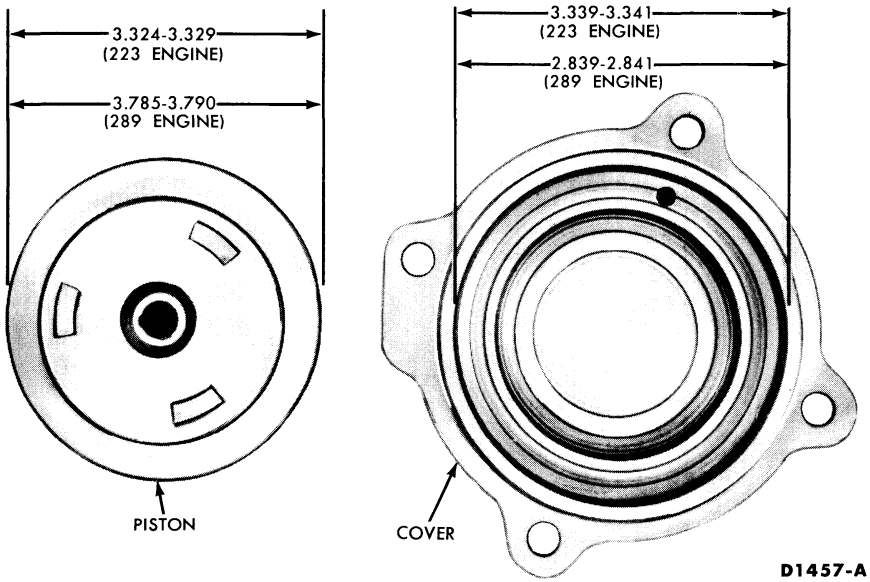



**FIG. 49—Intermediate Servo Piston and Cover Identification**

link (Fig. 51). Remove the upper end of the lever link from the case retaining pin.

**2.** From the back of the transmission case, remove the upper re-




**FIG. 50—Intermediate Servo Piston Removal—6 Engine**

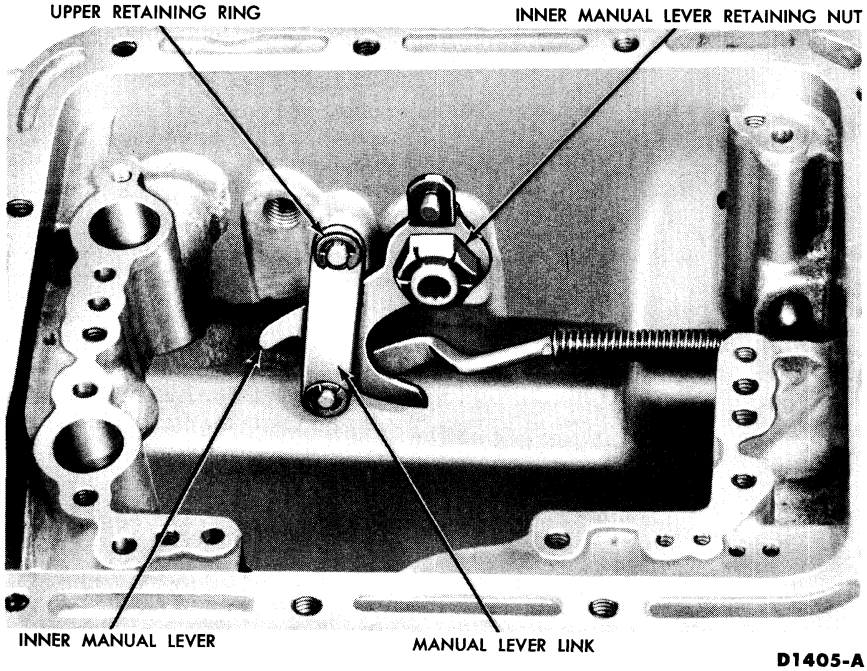



**FIG. 51—Case Internal Linkage**

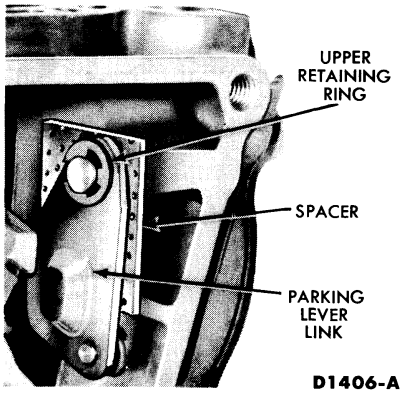



**FIG. 52—Parking Pawl Link and Spacer**

taining ring and flat washer from the parking pawl link (Fig. 52). Remove the pawl link and spacer from the case retaining pin.

3. From the back of the transmission case, remove the parking pawl link, toggle rod, and manual lever link as an assembly (Fig. 53).

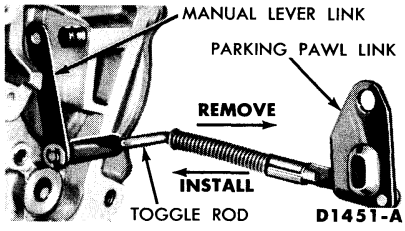



**FIG. 53—Parking Pawl Toggle Rod Assembly Removal or Installation**

4. Remove the rear parking pawl link lower retaining ring, flat washer and link from the toggle rod (Fig. 54).

5. Remove the manual lever link lower retaining ring, flat washer, and link from the toggle rod.

6. Install the manual and parking pawl links, flat washers and retaining rings to the toggle rods.

7. Remove the inner manual lever retaining nut and lever. Remove the outer manual lever from the case.

8. To remove the manual lever seal, use the tools shown in Fig. 55. To install the new seal, use the tool shown in Fig. 56.

9. Install the outer manual lever in the case. Install the inner manual lever and retaining nut (Fig. 51). Torque the retaining nut to specification.

10. From the back of the transmission case, install the parking toggle rod and link assembly into the case (Fig. 53). Install the parking pawl link spacer onto the case retaining pin (Fig. 52). The dimpled side of the spacer should be facing the center of the transmission case.

11. Install the parking pawl link on the case retaining pin. Install the flat washer and link retaining ring (Fig. 52).

12. Position the inner manual lever behind the manual lever link, **with the cam on the lever contacting the lower link pin** (Fig. 57).

13. Install the upper end of the manual lever link on the case retaining pin. Install the flat washer and retaining ring.

14. Operate the manual lever and check for correct linkage operation.

## CONTROL VALVE BODY

### Disassembly

1. Remove the eight oil screen retaining bolts and remove the oil screen from the valve body (Fig. 58).

2. To remove the manual valve, depress the detent spring with the tool shown in Fig. 59. Remove the spring retaining pin from the housing and remove the detent spring and plunger.

3. Remove the three cover plate retaining screws, cover plate, and the manual valve (Fig. 60).

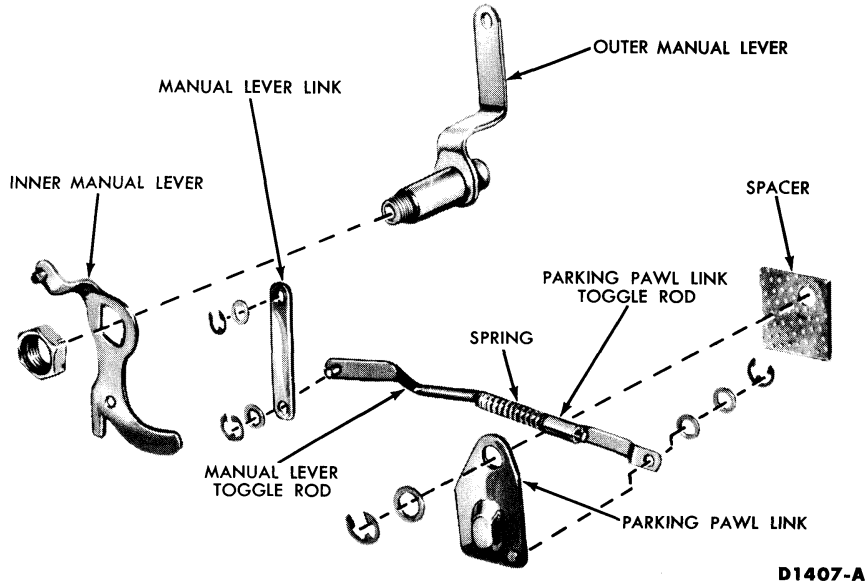



**FIG. 54—Case Linkage**

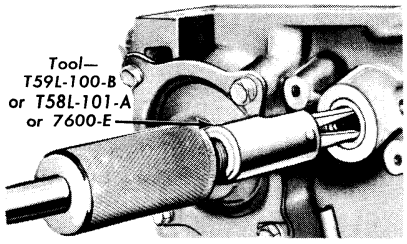



**FIG. 55—Removing Manual Lever Seal**

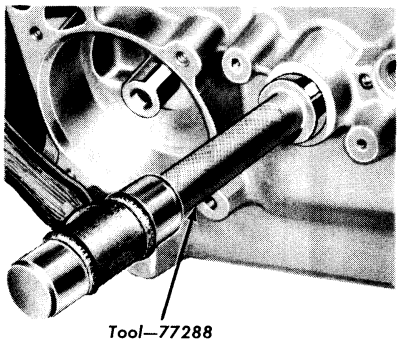



**FIG. 56—Installing Manual Lever Seal**

**4.** Remove the secondary throttle valve and spring. Remove the throttle booster valve and spring.

**5.** Remove the two cover plate retaining screws, cover plate, 2-3 back-out valve, spring, and manual low valve (Fig. 60).

**6.** Remove the cut-back valve and spring.

**7.** Remove the one hold down plate retaining screw and hold down plate (Fig. 63). Remove the three cover plate retaining screws, cover plate, and the 2-3 shift valve and spring (Fig. 60). Remove the throttle modulator valve and spring.

**8.** Remove the 1-2 shift valve and spring.

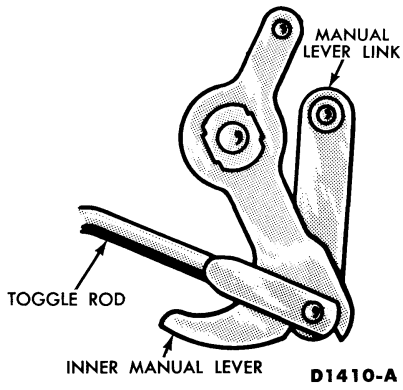



**FIG. 57—Inner Manual Lever Location—As viewed from Control Lever Side of Case**

**9.** Remove the two cover plate retaining screws, cover plate, 3-2 coasting control valve, and spring (Fig. 60).

**10.** Remove the three cover plate retaining screws, cover plate, pressure booster valve, valve sleeve, spring spacer, and spring (Fig. 60).

**11.** Remove the control pressure regulator valve.

**12.** Remove the control pressure reducer valve and spring.

**13.** To separate the upper and lower valve bodies, remove the two retaining screws from the upper valve body. Remove the seven retaining screws from the lower valve body.

With the lower valve body positioned upward, separate the upper and lower valve bodies. **Do not lose the check ball(s) or spring from the upper body (Fig. 61).**

**14.** Remove the hold-down plate retaining screws and plate from the lower valve body. Remove the separator plate and gasket from the lower body (Fig. 62).

**15.** Remove the emergency relief valve check ball and spring from the upper body. Remove the shuttle valve ball from the valve body (Fig. 61).

**16.** Remove the downshift valve spring stop (Fig. 61). Remove the downshift valve and spring.

**Assembly**

**1.** Position the gasket and separator plate on the lower valve body (Fig. 62). Install the hold-down plate and two retaining screws (Fig. 63). Torque the screws to specifications.

**2.** In the upper valve body, install the downshift valve and spring. Compress the spring and install the spring retainer (Fig. 61).

**3.** Install the emergency release valve spring and check valve ball on top of the spring. Install the shuttle valve check ball (Fig. 61).

**4.** Position the lower valve body and separator plate onto the upper body. Install the seven retaining screws. Turn the valve body over and install two retaining screws. **Torque all the retaining screws to specifications.** As each valve is installed, check the free travel of the valve in the bore of the casting.

**5.** Install the control pressure reducer valve and spring in the upper valve body (Fig. 60).

**6.** Install the control pressure regulator valve, spring, spring spacer, pressure booster valve and sleeve.

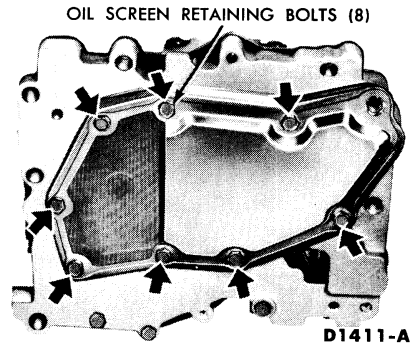



**FIG. 58—Oil Screen Retaining Bolt Location**

**7.** Install the cover plate on the end of the pressure booster valve sleeve and torque the three retaining screws to specification.

**8.** Install the 3-2 coasting control valve and spring. Install the cover plate and torque the two retaining screws to specification (Fig. 60).

**9.** Install the 1-2 shift valve spring and valve. Install the throttle modulator valve and spring and the 2-3 shift valve spring and valve (Fig. 60). Install the cover plate and torque the three retaining screws to specifications. Install the 2-3 back-out valve, spring and manual low valve. Install the hold down plate and retaining bolt (Fig. 63). Torque the retaining bolt to specifications. Install the cut-back valve and install the spring and cover plate, and torque the two cover plate retaining screws to specification (Fig. 60).

**10.** To install the manual valve, place the valve in the upper body with the detents in alignment with the top of the housing. Install the detent plunger and spring. To install the detent spring lock pin, use the tool shown in Fig. 59. Compress the detent spring and install the spring lock pin.

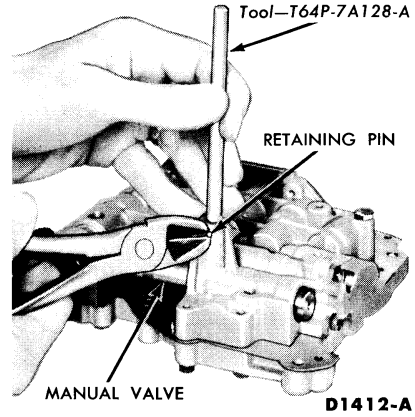



**FIG. 59—Manual Valve Detent Spring Removal or Installation**

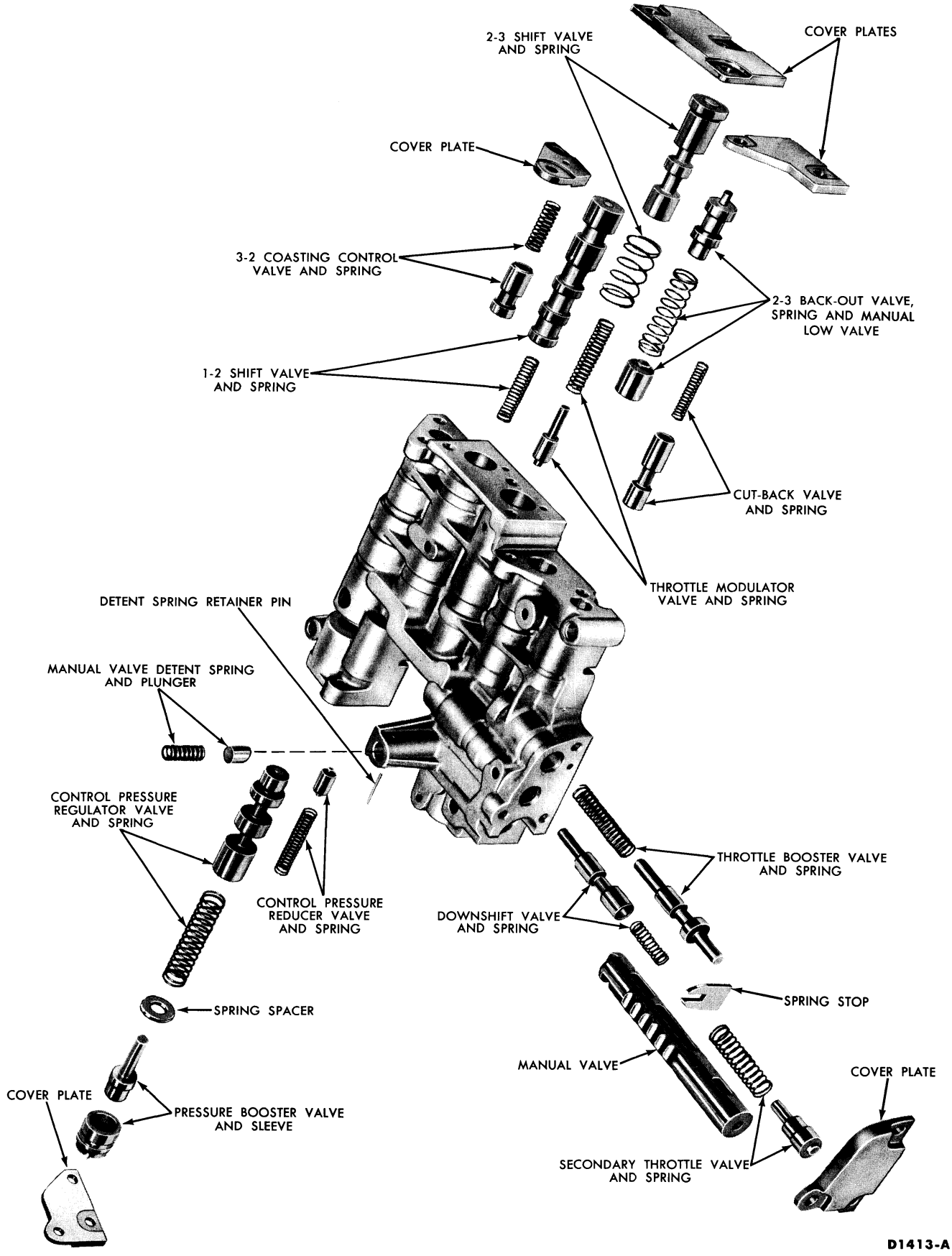



**FIG. 60—Upper Valve Body Disassembled**

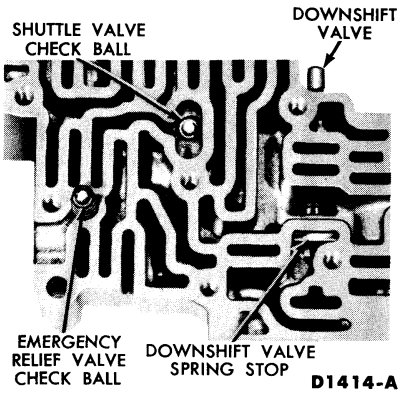



**FIG. 61—Upper Valve Body Check Ball and Spring Location**

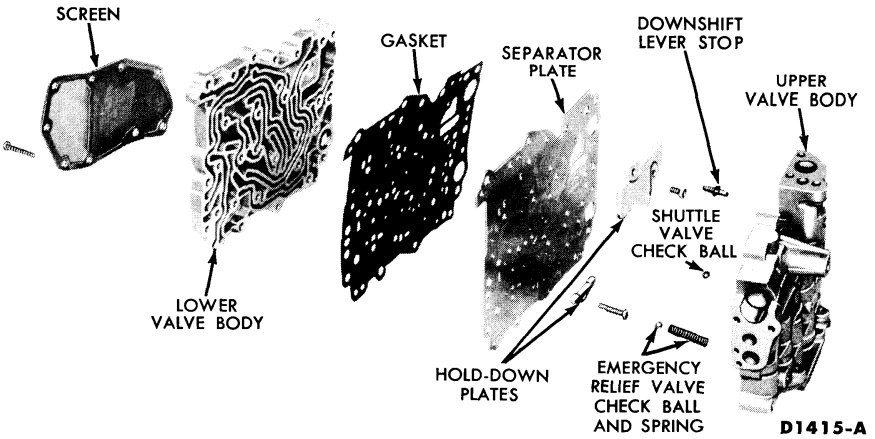



**FIG. 62—Upper and Lower Valve Bodies Separated**

**11.** Install the secondary throttle valve spring and valve. Install the throttle booster valve spring and valve. Install the cover plate and torque the three retaining bolts to specification.

**12.** Place the screen on the lower valve body and install the eight retaining bolts (Fig. 58). Torque the bolts to specification.

**FRONT PUMP**

**1.** Remove the four seal rings from stator support and the O-ring seal from the pump housing.

**2.** Remove the five bolts that retain the stator support to the front pump housing. Remove the stator support from the pump housing (Fig. 64).

**3.** Remove the drive and driven gears from the front pump housing.

**4.** Install the drive and driven gears in the pump housing. Each gear has an identification mark on the side of the gear teeth that are chamfered. **The chamfered side with the identification mark has to be positioned downward against the face of the pump housing.**

**5.** Place the stator support in the pump housing and install the five retaining bolts. Torque the bolts to specifications.

**6.** Install the four seal rings on the stator support. The two large oil rings are assembled first in the oil ring grooves toward the front of the stator support. Install the O-ring seal on the pump housing.

**7.** Check the pump gears for free rotation by placing the pump on the converter drive hub in its normal running position and turning the pump housing.

**8.** If the front pump seal must be replaced, mount the pump in the transmission case and remove the seal with the tool shown in Fig 65. To install the new seal, use the tool shown in Fig. 66.

**REVERSE-HIGH CLUTCH**

**1.** Remove the pressure plate retaining snap ring (Fig. 68).

**2.** Remove the pressure plate, and the drive and driven clutch plates (Fig. 67). If the composition clutch plates are to be reused, do not clean them in a vapor degreaser or with a detergent solution. Wipe the plates with a lint-free cloth.

**3.** To remove the piston spring retainer snap ring, place the clutch hub in the arbor press. With the

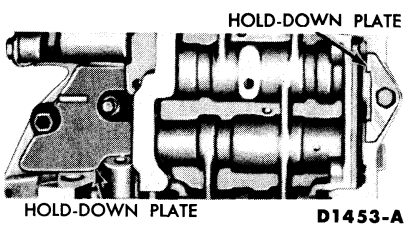



**FIG. 63—Hold Down Plate Location**

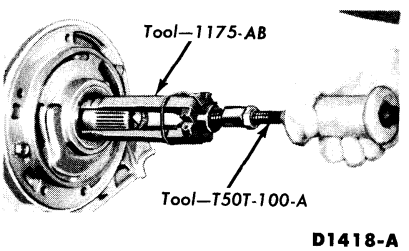



**FIG. 65—Front Pump Seal Removal**

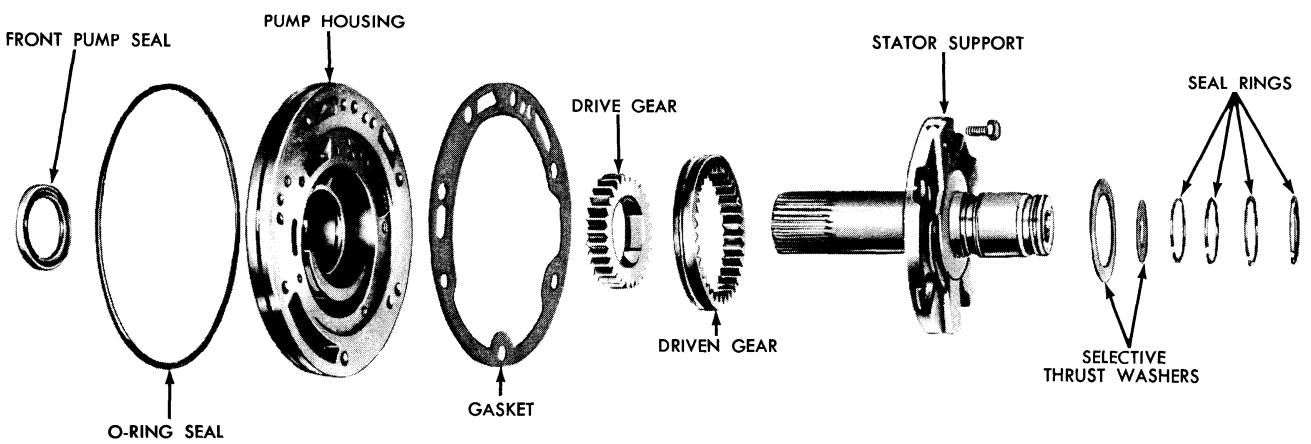



**FIG. 64—Front Pump and Stator Support Disassembled**

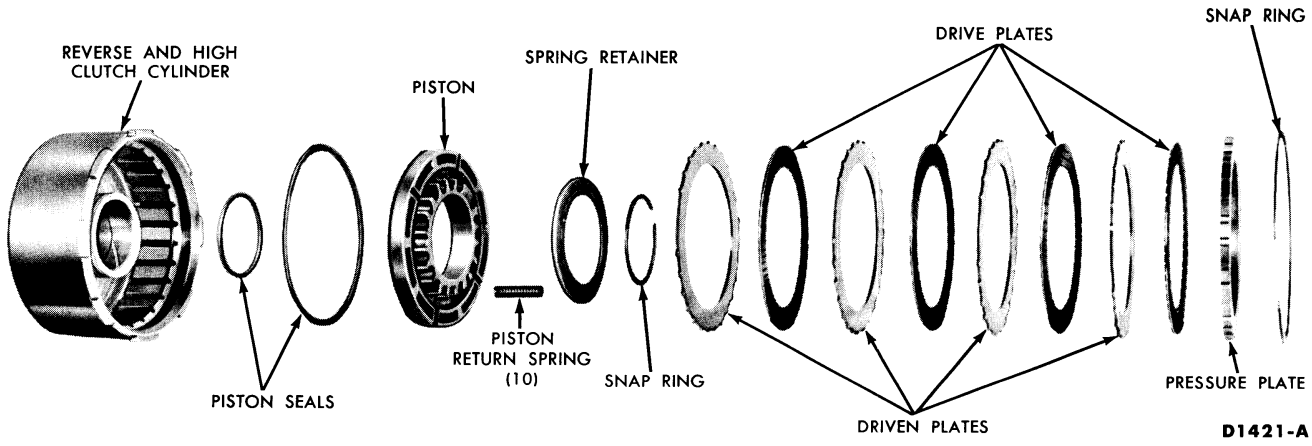



**FIG. 67—Reverse-High Clutch Disassembled**

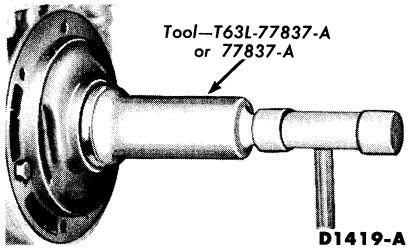



**FIG. 66—Front Pump Seal Installation**

tools shown in Fig. 69, compress the piston return springs and remove the snap ring. When the arbor press ram is released, guide the spring retainer to clear the snap ring groove of the drum.

**4.** Remove the spring retainer and 10 piston return springs.

**5.** Remove the piston by inserting air pressure in the piston apply hole of the clutch hub (Fig. 70).

**6.** Remove the piston outer seal from the piston and the piston inner seal from the clutch drum (Fig. 67).

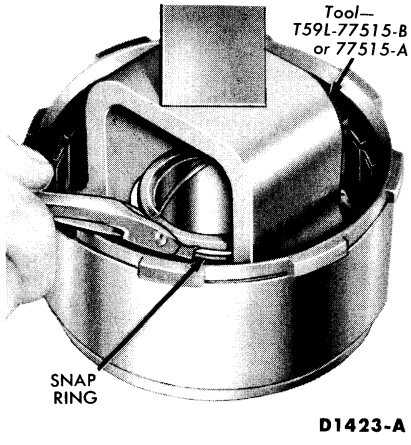



**FIG. 69—Clutch Piston Spring Retainer Snap Ring Removal or Installation**

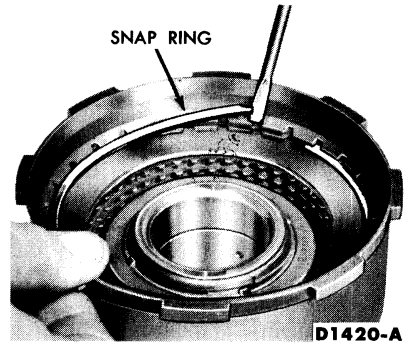



**FIG. 68—Reverse High Clutch Pressure Plate Snap Spring Removal or Installation**

**7.** Install a new inner seal in the clutch drum and a new outer seal on the clutch piston. Lubricate the seals with clean transmission oil and install the piston into the clutch drum.

**8.** Place the 10 clutch piston springs into position on the clutch piston. Place the spring retainer on top of the springs. To install the snap ring use the tools shown in Fig. 69. As the press ram is moved downward, make sure the spring retainer is centered to clear the drum. Install the snap ring. **Before the press ram is released make sure the snap ring is positioned inside of the four snap ring guides on the spring retainer.**

**9.** When new composition clutch plates are used, soak the plates in transmission fluid for fifteen minutes before installing them. Install the clutch plates alternately starting with a steel plate, then a non-metallic plate (Fig. 67). The last plate installed is the pressure plate with the internal chamfered side up. For the correct number of clutch plates required for each transmission model, refer to Part 7-4.

**10.** Install the pressure plate retaining snap ring (Fig. 68). Make sure the snap ring is fully seated in the snap ring groove of the clutch hub.

**FORWARD CLUTCH**

**1.** Remove the clutch pressure plate retaining snap ring (Fig. 71).

**2.** Remove the pressure plate, and the drive and driven clutch plates from the clutch hub (Fig. 72).

**3.** Remove the disc spring re-

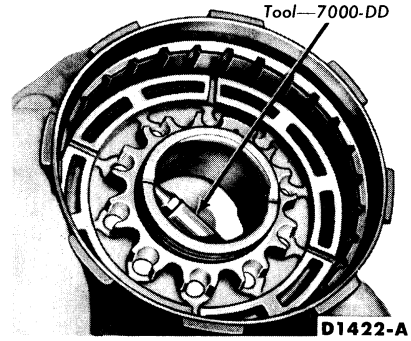



**FIG. 70—Reverse High Clutch Piston Removal**

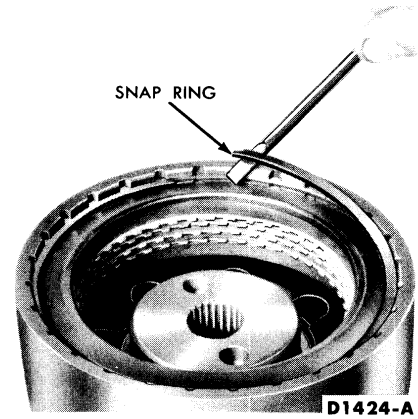



**FIG. 71—Forward Clutch Pressure Plate Snap Ring Removal or Installation**

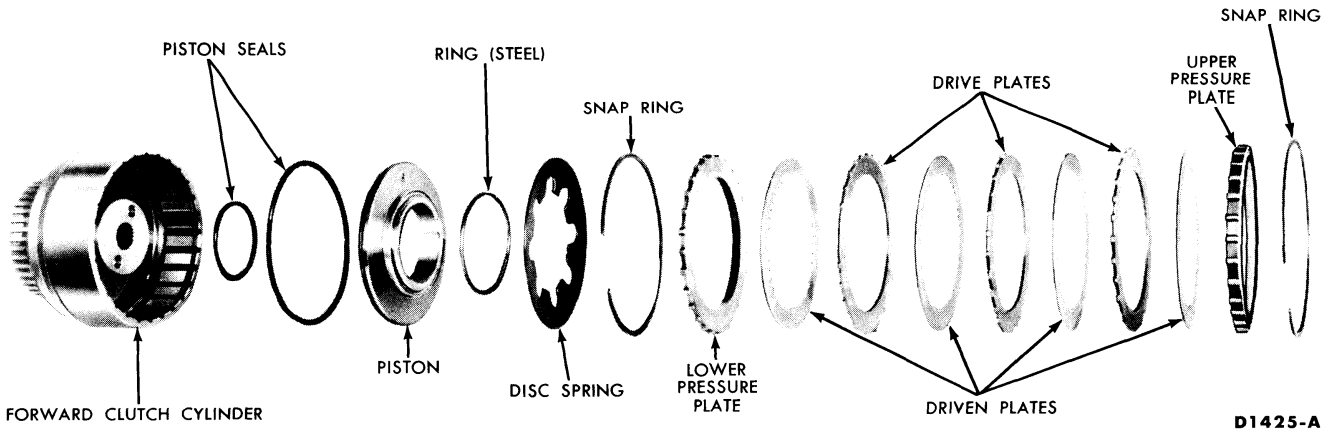



**FIG. 72—Forward Clutch Disassembled**

taining snap ring (Fig. 73).

**4.** Apply air pressure at the clutch piston pressure hole (Fig. 74) to remove the piston from the clutch hub.

**5.** Remove the clutch piston outer seal and the inner seal from the clutch hub (Fig. 72).

**6.** Install new clutch piston seals on the clutch piston and drum. Lubricate the seals with clean transmission fluid.

**7.** Install the clutch piston into the clutch hub. Install the disc spring and retaining snap ring (Fig. 73).

**8. Install the lower pressure plate with the flat side up and radius side downward.** Install one nonmetallic clutch plate and alternately install the drive and driven plates. The last plate installed will be the upper pressure plate with the internal chamfered side up (Fig. 72). Refer to Part 7-4 for the correct number of clutch plates for the applicable model transmission.

**9.** Install the pressure plate retaining snap ring (Fig. 71). Make sure the snap ring is fully seated in the ring groove of the clutch hub.

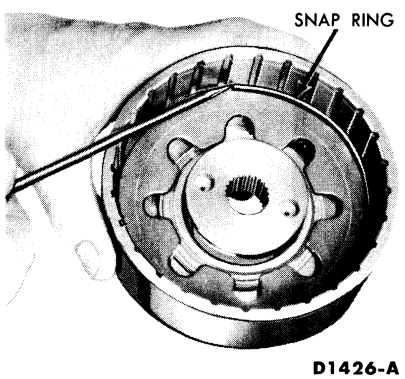



**FIG. 73—Disc Snap Spring Removal or Installation**

**10.** With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 75). Downward pressure on the plate should be used when making this check. The clearance should be 0.022 to 0.042 inches.

**11.** If the clearance is not within specifications, selective snap rings are available in these thicknesses: 0.088-0.092, 0.074-0.078, and 0.060-0.064. Insert the correct size snap ring and recheck the clearance.

**FORWARD CLUTCH HUB AND RING GEAR**

**1.** Remove the forward clutch hub retaining snap ring (Fig. 76).

**2.** Remove the forward clutch hub from the ring gear.

**3.** Install the forward clutch hub in the ring gear. Make sure the hub is bottomed in the groove of the ring gear.

**4.** Install the front clutch hub retaining snap ring. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

**FORWARD PLANET CARRIER**

**1.** Using a small punch inserted into the end of the planet gear retaining pin hole (Fig. 77), force the shaft retaining pins outward. With a pair of side cutters remove the retaining pins.

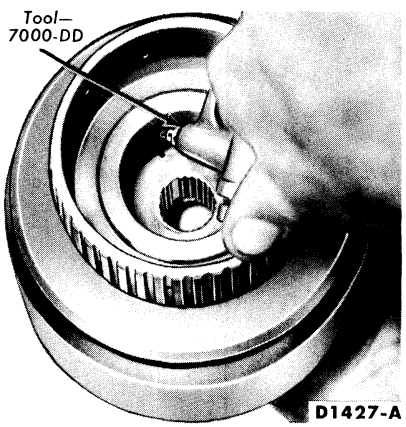



**FIG. 74—Forward Clutch Piston Removal**

**2.** Remove the three planet gear pins (Fig. 78).

**3.** Remove the three planet gears, thrust washers and spacers (Fig. 78).

**4.** Remove the outer race, thrust bearing, and the inner race (Fig. 78).

**5.** Install the inner race, thrust bearing, and outer race.

**6.** Install 21 roller bearings in each planet gear. Retain the roller bearings in each gear with vaseline. Position the planet gears, spacers, and thrust washers in the carrier.

**7.** Install the gear pins and line

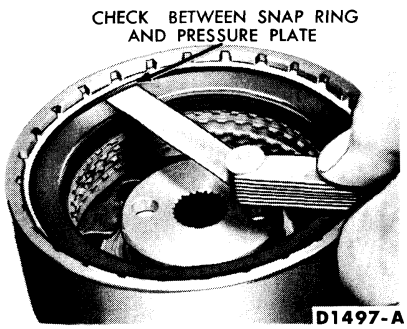



**FIG. 75—Checking Forward Clutch Snap Ring Clearance**

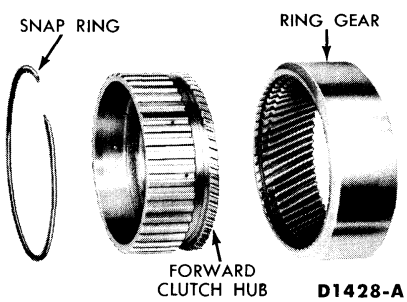



**FIG. 76—Forward Clutch Hub and Ring Gear Disassembled**

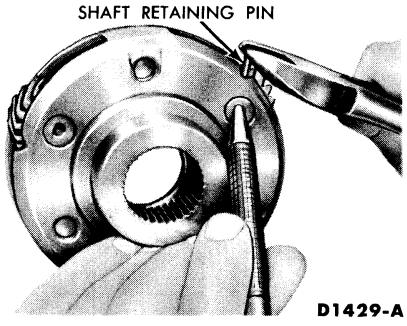



**FIG. 77—Pinion Shaft Lock Pin Removal**

up the retaining pin holes in the pin with the retaining pin holes of the carrier. Install the retaining pins in the carrier and shafts.

**8.** When only the thrust bearing and races have to be removed, remove only two of the planet gear pins. Move the gears outward far enough to allow removal of the thrust bearing and races. This will keep the planet gear roller bearings in position. Reassemble the thrust bearing and races, two gears, and pins.

**INPUT SHELL AND SUN GEAR**

**1.** Remove the external snap ring from the sun gear (Fig. 79).

**2.** Remove thrust washer No. 5 from the input shell and sun gear (Fig. 80).

**3.** From inside the input shell, remove the sun gear. Remove the internal snap ring from the sun gear.

**4.** Install the internal snap ring on the sun gear. Install the sun gear in the input shell.

**5.** Install thrust washer No. 5 on the sun gear and input shell (Fig. 80).

**6.** Install the external snap ring on the sun gear (Fig. 79).

**REVERSE RING GEAR AND HUB**

**1.** Remove the hub retaining snap ring from the reverse ring gear.

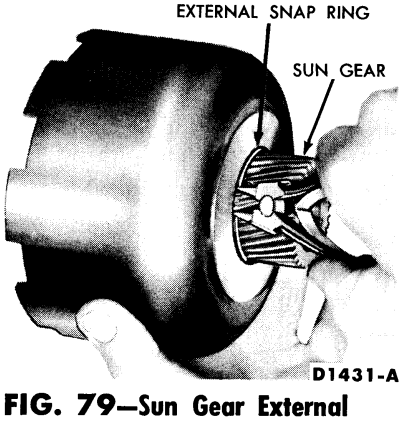



**FIG. 79—Sun Gear External Snap Ring Removal or Installation**

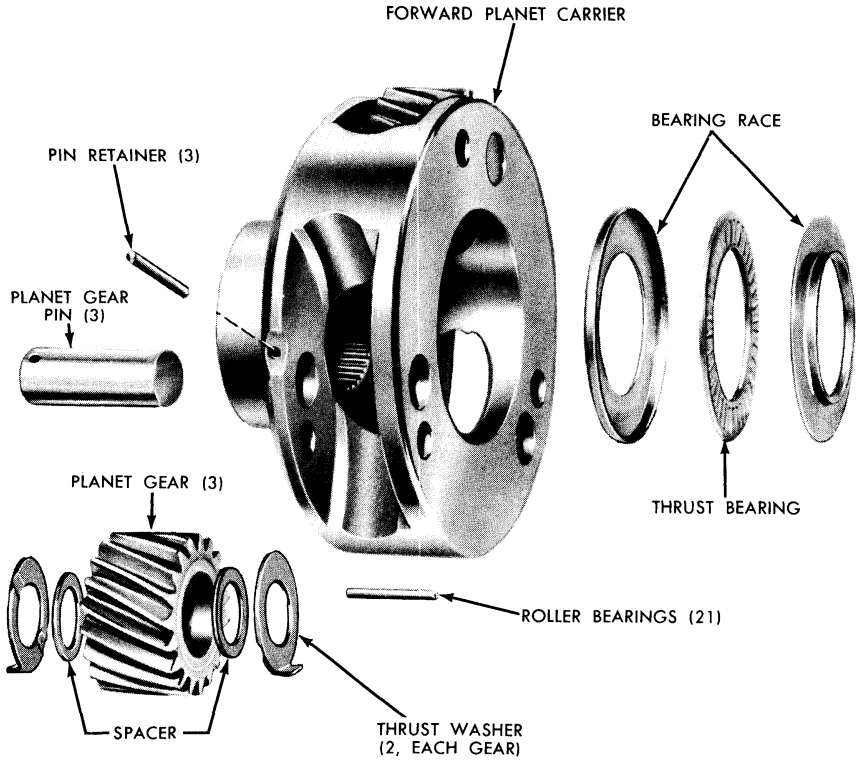



**FIG. 78—Forward Planet Carrier**

**2.** Remove the hub from the reverse ring gear (Fig. 81).

**3.** Install the hub in the reverse ring gear. Make sure the hub is fully seated in the groove of the ring gear.

**4.** Install the snap ring in the reverse ring gear. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

**GOVERNOR**

**1.** Remove the three oil rings from the governor distributor (Fig. 82).

**2.** Remove the two primary governor to distributor retaining bolts. Remove the primary governor housing from the governor distributor (Fig. 82).

**3.** Remove the primary governor valve retaining lock ring (Fig. 83).

**4.** Remove the primary governor valve from the housing. Check the free travel of the valve in the housing.

**5.** Remove the two secondary governor housing to distributor retaining bolts. Remove the secondary

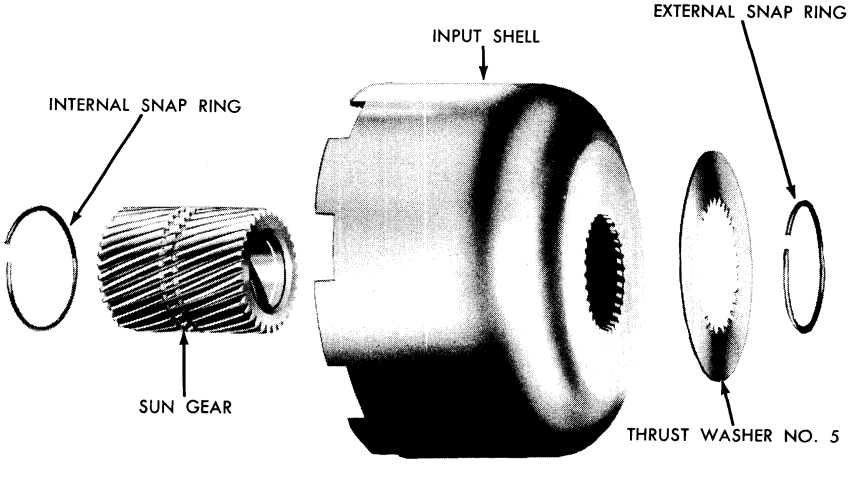



**FIG. 80—Input Shell and Sun Gear Disassembled**

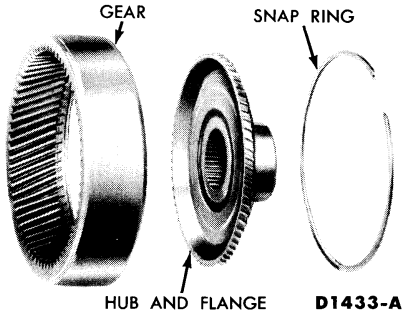



**FIG. 81—Reverse Ring Gear and Hub Disassembled**

governor housing from the governor distributor (Fig. 82).

**6.** Compress the secondary governor valve return spring and remove the spring retainer (Fig. 84).

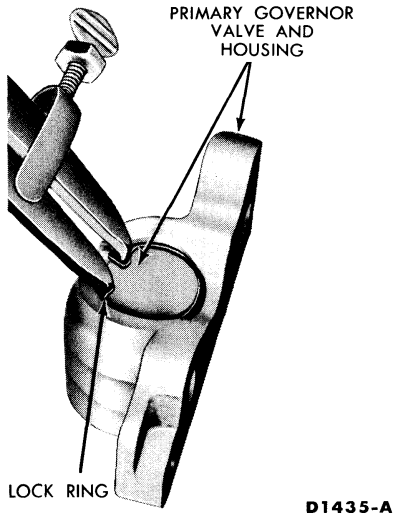



**FIG. 83—Primary Governor Lock Ring Removal or Installation**

**7.** Remove the secondary governor valve and spring (Fig. 82). Check the free travel of the valve in the housing.

**8.** Install the secondary governor valve and spring in the governor housing. Compress the spring and install the spring retainer.

**9.** Place the primary governor valve in the housing and install the lock ring (Fig. 83).

**10.** Position the primary and secondary governor assemblies on the governor distributor (Fig. 82). Install the retaining bolts. Torque the bolts to specification. **Do not overtorque the bolts.**

**11.** Install the three oil rings on the governor distributor (Fig. 82).

**THREAD REPAIR**

Thread service kits may be purchased from local jobbers or the Heli-Coil Corporation. To repair a damaged thread, the following procedures should be carefully followed.

**1.** Drill out the damaged threads, **using the same drill size as the thread O.D.** For example, use a 5/16-inch drill for a 5/16-18 thread.

**2.** Select the proper **special** tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16-18 will not cut the same thread as a standard 5/16-18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed the original thread size (5/16-18) is restored.

**3.** Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used.

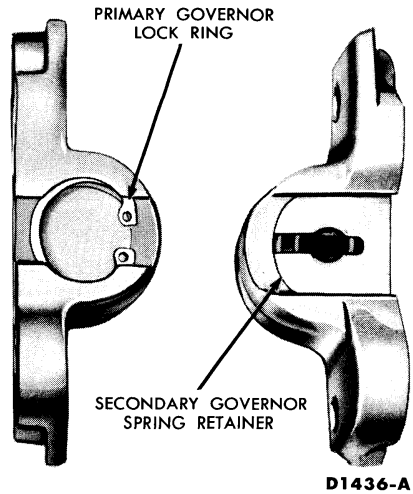



**FIG. 84—Primary and Secondary Governor Valves Assembled**

Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is ½ turn below the face.

**4.** Working through the insert, bend the insert tang straight up and down until it breaks off at the notch.

**5.** If the inserts are not properly installed, they can be removed with the extractor tool. Place the extractor tool in the insert so that the blade rests against the top coil ¼ to ½ turn away from the end of the coil. Tap the tool sharply with a hammer so that the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

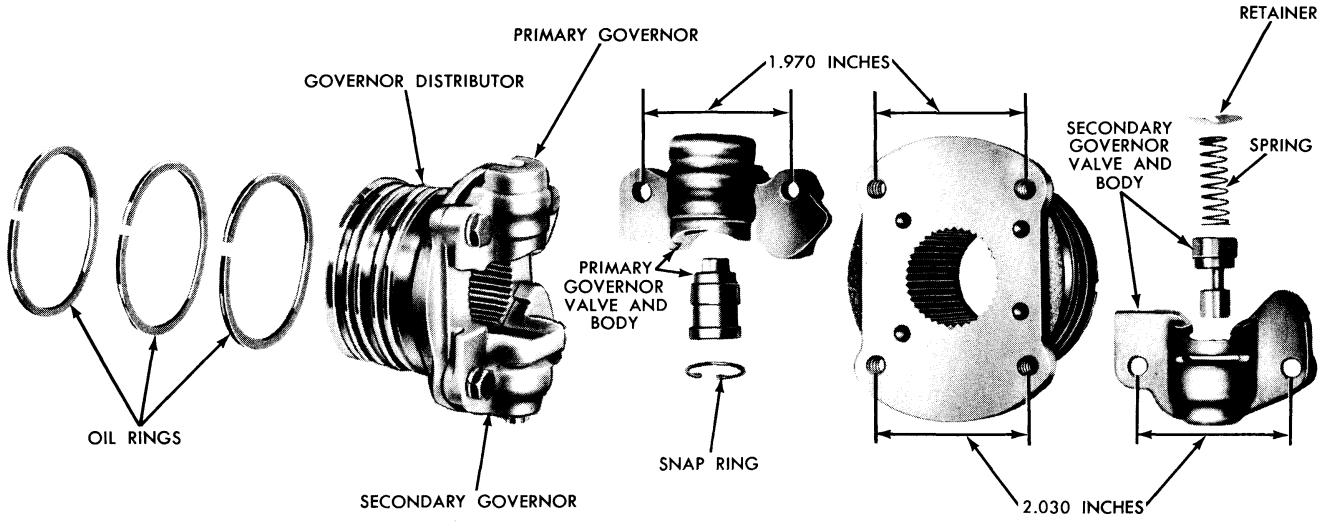
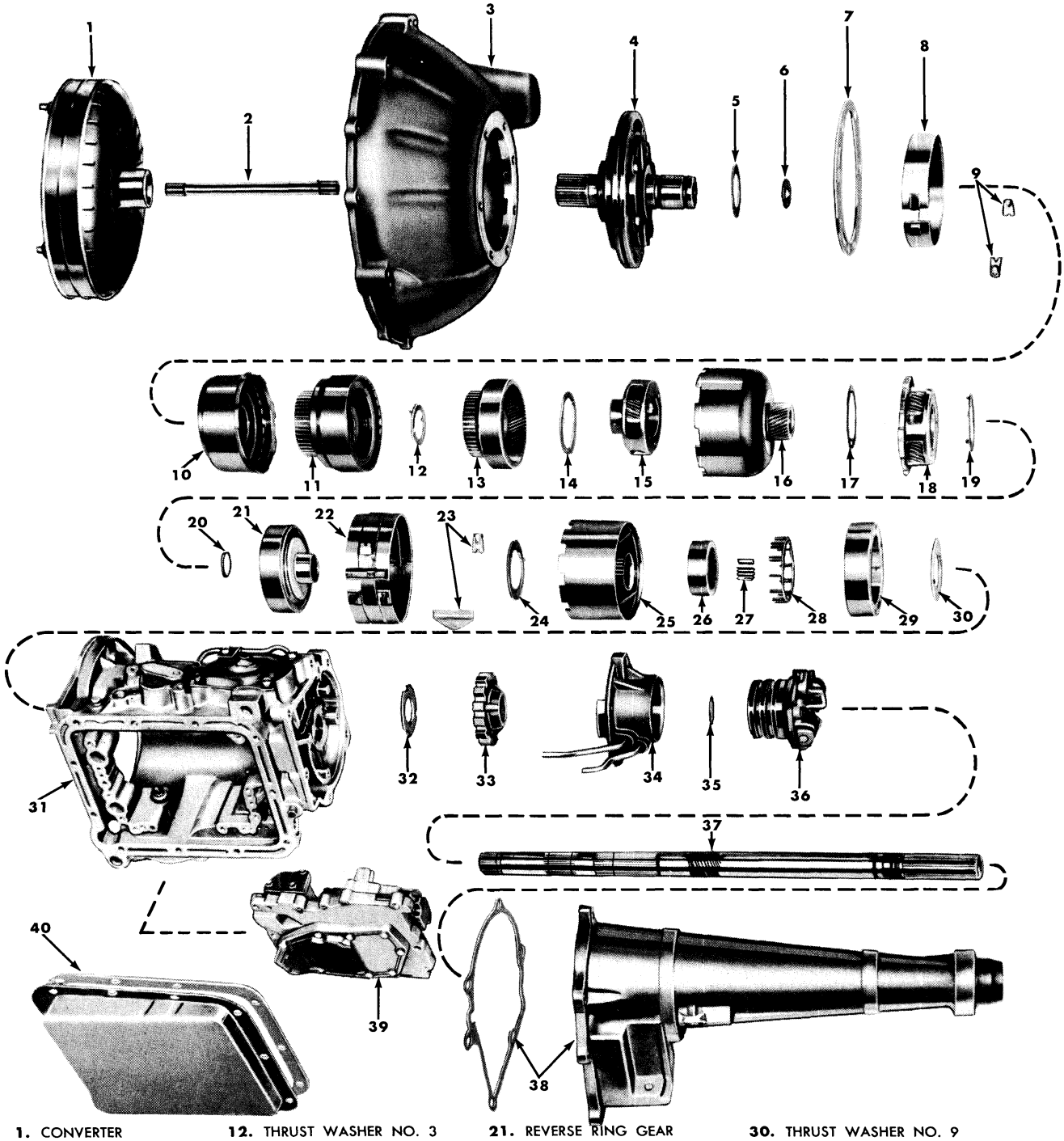



**FIG. 82—Governor and Distributor**




1. CONVERTER
2. INPUT SHAFT
3. CONVERTER HOUSING
4. FRONT PUMP
5. THRUST WASHER NO. 1
6. THRUST WASHER NO. 2
7. FRONT PUMP GASKET
8. INTERMEDIATE BAND
9. BAND STRUTS
10. REVERSE AND HIGH CLUTCH DRUM
11. FORWARD CLUTCH AND CYLINDER
12. THRUST WASHER NO. 3
13. FORWARD CLUTCH HUB AND RING GEAR
14. THRUST WASHER NO. 4
15. FRONT PLANET CARRIER
16. INPUT SHELL, SUN GEAR AND THRUST WASHER NO. 5
17. THRUST WASHER NO. 6
18. REVERSE PLANET CARRIER
19. THRUST WASHER NO. 7
20. SNAP RING
21. REVERSE RING GEAR AND HUB
22. LOW AND REVERSE BAND
23. BAND STRUTS
24. THRUST WASHER NO. 8
25. LOW AND REVERSE DRUM
26. ONE-WAY CLUTCH INNER RACE
27. ROLLER (12) AND SPRING (12)
28. SPRING AND ROLLER CAGE
29. ONE-WAY CLUTCH OUTER RACE
30. THRUST WASHER NO. 9
31. CASE
32. THRUST WASHER NO. 10
33. PARKING GEAR
34. GOVERNOR DISTRIBUTOR SLEEVE
35. SNAP RING
36. GOVERNOR VALVES & DISTRIBUTOR
37. OUTPUT SHAFT
38. EXTENSION HOUSING AND GASKET
39. CONTROL VALVE BODY
40. OIL PAN AND GASKET

D1378-A

**FIG. 85—Transmission Sub-Assemblies**

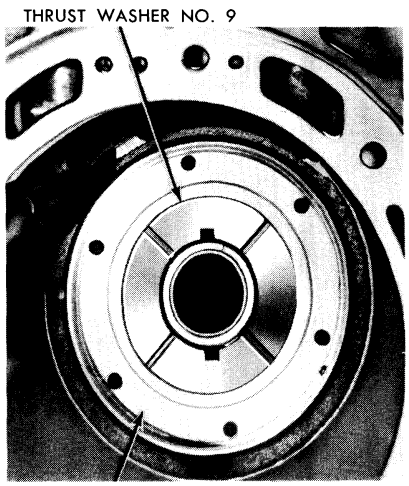



**FIG. 86—Thrust Washer No. 9 Location**

## ASSEMBLY

**When assembling the transmission sub-assemblies (Fig. 85), make sure that the correct thrust washer is used between certain sub-assemblies.** Lubricate all mating surfaces with transmission fluid. Vaseline should be used to hold the thrust washers in their proper location. If the end play is not within specifications after the transmission is assembled, either the wrong selective thrust washers were used, or a thrust washer came out of position during the transmission assembly operation.

1. Install thrust washer No. 9 inside the transmission case (Fig. 86).
2. Place the one-way clutch outer race inside the case. From the back of the case install the six outer race to case retaining bolts. **Torque the bolts to specification with the tools shown in Fig. 87.**

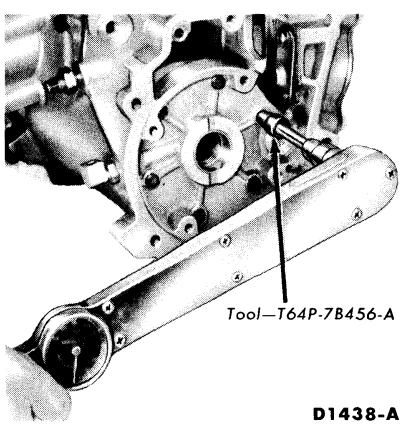



**FIG. 87—One-Way Clutch Outer Race Retaining Bolt Installation**

3. Place the transmission case in a vertical position with the back face of the case upward. Install the parking pawl retaining pin in the case (Fig. 88).
4. Install the parking pawl on the case retaining pin. Install the parking pawl return spring as shown in Fig. 88.
5. Install thrust washer No. 10 on the parking pawl gear (Fig. 89). Place the gear and thrust washer on the back face of the case (Fig. 88).
6. Place the two oil distributor tubes in the governor distributor sleeve. Install the distributor sleeve on the case. As the distributor sleeve is installed, the oil tubes have to be inserted in the two holes in the case and the parking pawl retaining pin has to be inserted in the alignment hole in the distributor sleeve.
7. Install the four governor distributor sleeve to case retaining bolts and torque the bolts to specification.
8. Install the governor distributor assembly on the output shaft. Install the distributor retaining snap ring (Fig. 43).
9. Check the oil rings in the governor distributor, making sure the oil rings are fully inserted in the ring grooves and will rotate freely. Install the output shaft and governor distributor assembly in the distributor sleeve (Fig. 42).
10. Place a new extension housing gasket on the case. Install the extension housing vacuum tube clip, and the extension housing to case retaining bolts. Torque the bolts to specification.
11. Place the transmission in the holding fixture with the front pump mounting face of the case up. **Make sure thrust washer No. 9 is still located at the bottom of the transmission case** (Fig. 86).
12. On the bench, install the 12 one-way clutch springs on the spring retainer (Fig. 90).
13. Place the one-way clutch spring retainer, with the 12 springs installed, into the outer race located inside the transmission case (Fig. 90).
14. Check the position of each spring on the spring retainer. Make sure the springs are properly positioned. Install the inner race inside the spring retainer and 12 springs.
15. Starting at the back of the one-way clutch outer race, install the 12 clutch rollers (Fig. 90). **Each spring will have to be partially compressed as the roller is installed between the outer and inner race (Fig. 90).**

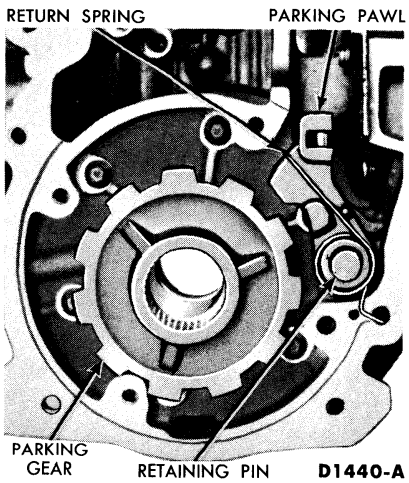



**FIG. 88—Parking Pawl and Gear**

16. After the one-way clutch has been assembled, rotate the inner race clockwise to center the rollers and springs. Install the low and reverse drum (Fig. 85). The splines of the drum have to engage with the splines of the one-way clutch inner race. Check the one-way clutch operation by rotating the low and reverse drum. The drum should rotate clockwise but should not rotate counterclockwise.
17. Install thrust washer No. 8 on top of the low and reverse drum (Fig. 91). Install the low-reverse band in the case, with the end of the band for the small strut toward the low-reverse servo (Fig. 41).

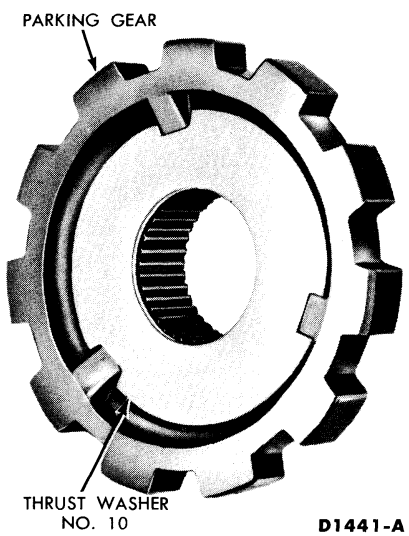
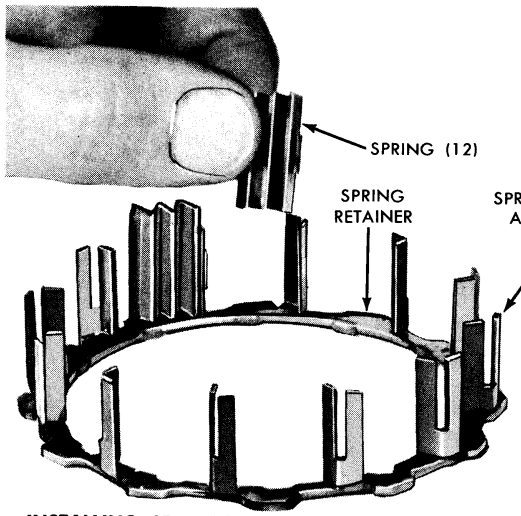
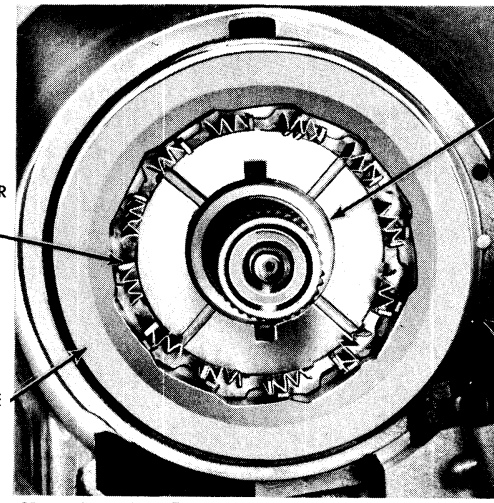


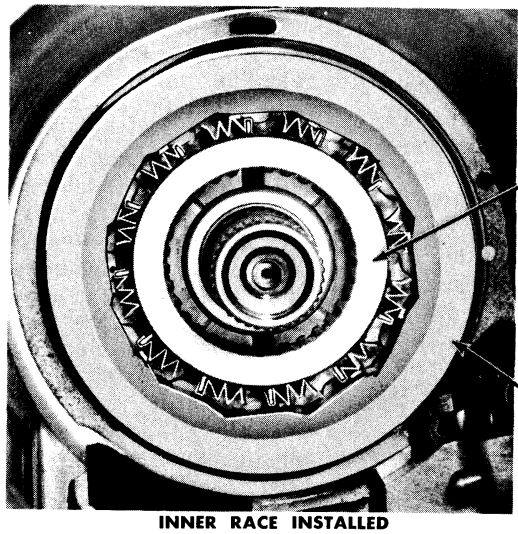

**FIG. 89—Thrust Washer No. 10 Location**



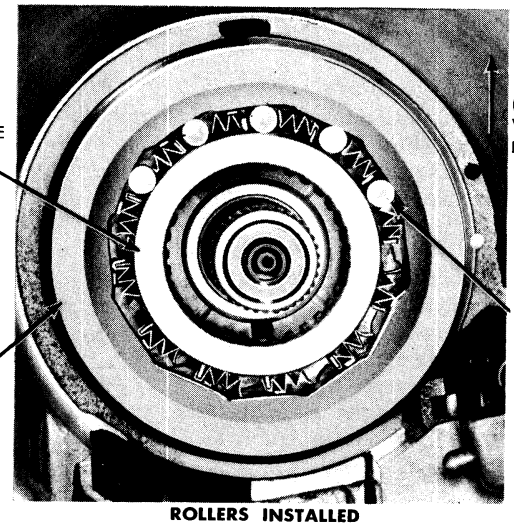

INSTALLING SPRINGS (12) ON SPRING RETAINER
STEP 1



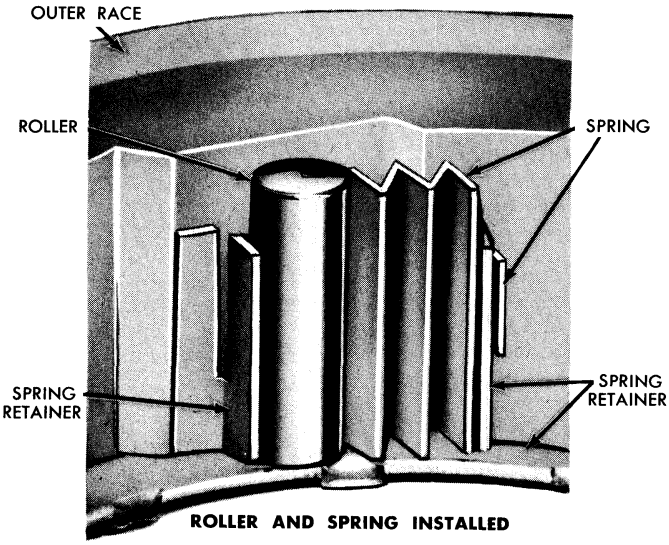

SPRING RETAINER AND 12 SPRINGS INSTALLED
STEP 2



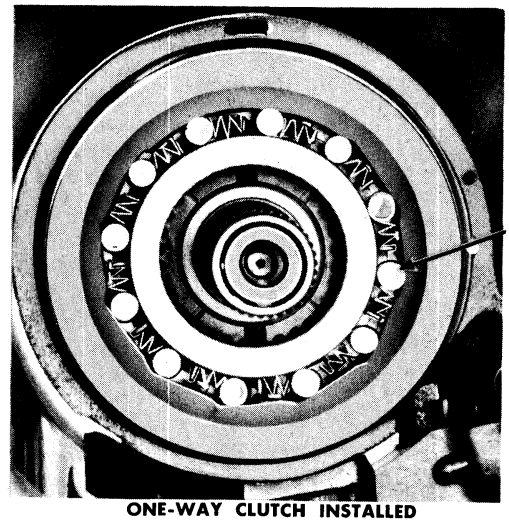

INNER RACE INSTALLED
STEP 3




ROLLERS INSTALLED
STEP 4




ROLLER AND SPRING INSTALLED




ONE-WAY CLUTCH INSTALLED

STEP 5

D1442-A

**FIG. 90—One Way Clutch Installation**

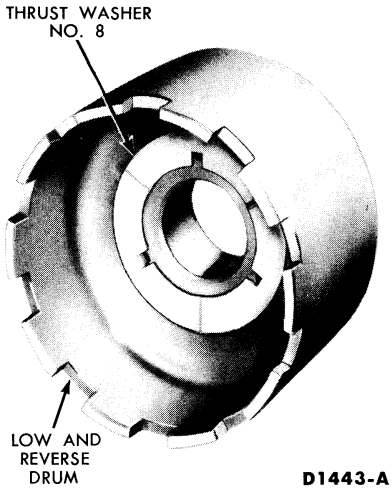



**FIG. 91—Thrust Washer No. 8 Location**

**18.** Install the reverse ring gear and hub on the output shaft.

**19.** Move the output shaft forward and install the reverse ring gear hub to output shaft retaining ring (Fig. 40).

**20.** Place thrust washers Nos. 6 and 7 on the reverse planet carrier (Fig. 92). Install the planet carrier in the reverse ring gear and engage the tabs of the carrier with the slots in the low-reverse drum.

**21. From inside the transmission case, install the inner downshift lever (Fig. 35).**

**22.** On the bench, install the forward clutch in the reverse-high clutch by rotating the units to mesh the reverse-high clutch plates with the splines of the forward clutch (Fig. 93).

**23.** Install thrust washer No. 3 on the forward clutch (Fig. 94).




**FIG. 93—Installing Clutch Units**

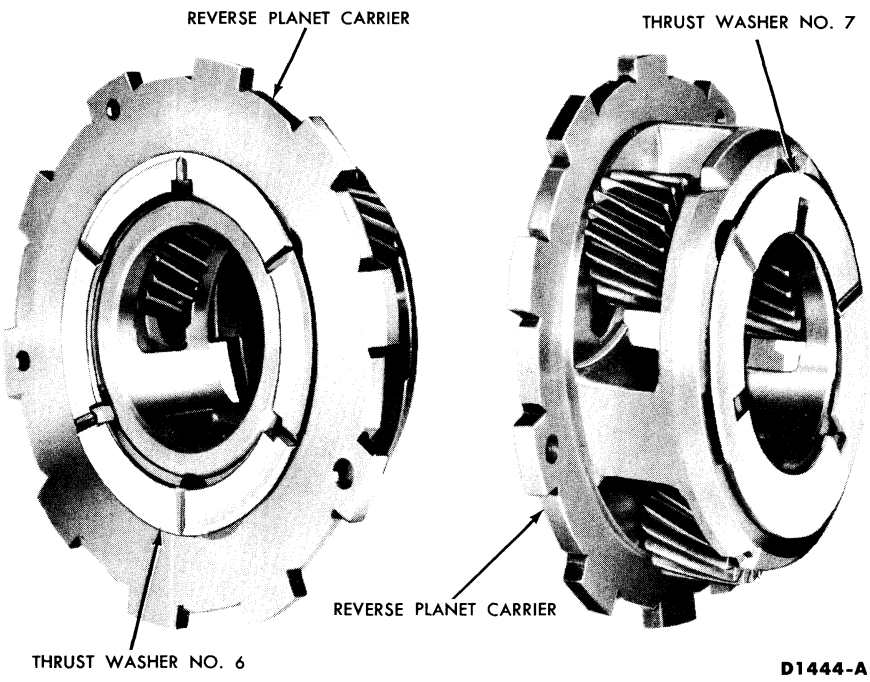



**FIG. 92—Thrust Washer No. 6 and 7 Location**

**24.** Install the forward clutch hub and ring in the forward clutch by rotating the units to mesh the forward clutch plates with the splines on the forward clutch hub (Fig. 95).

**25.** Install thrust washer No. 4 on the front planet carrier (Fig. 96). Install the front planet carrier into the forward clutch hub and ring gear (Fig. 97). **Check the forward thrust bearing race inside the planet carrier for proper location against the thrust bearing. Make sure the race is centered for alignment with the sun gear on the input shell.**

**26.** Install the input shell and sun gear on the gear train (Fig. 98). Rotate the input shell to engage the drive lugs of the reverse-high clutch. If the drive lugs will not engage, the outer race inside the forward planet carrier is not centered to engage the end of the sun gear inside the input shell. Center the thrust bearing race and install the input shell.

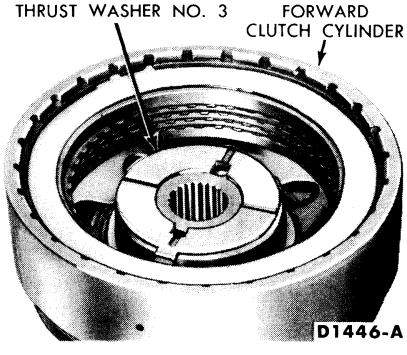



**FIG. 94—Thrust Washer No. 3 Location**

**27.** Hold the gear train together and install the forward part of the gear train assembly in the case (Fig. 36). The input shell sun gear must mesh with the reverse pinion gears. The front planet carrier internal splines must mesh with the splines

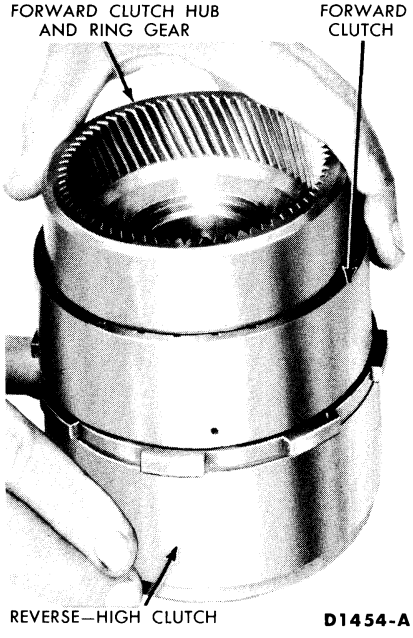



**FIG. 95—Forward Clutch Hub and Ring Gear Installation**

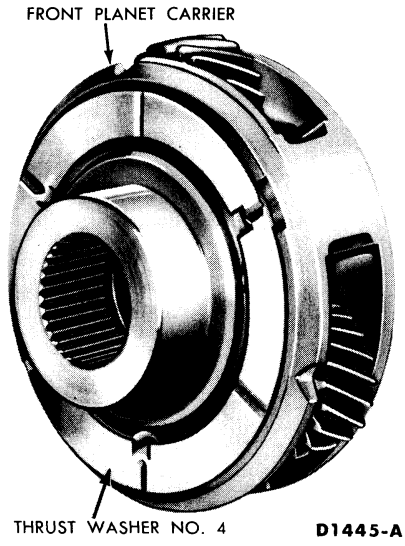



**FIG. 96—Thrust Washer No. 4 Location**

on the output shaft.

**28.** Install the intermediate band through the front of the case (Fig. 34). The side of the band with the anchor tabs goes toward the back of the transmission. A new band should be soaked in transmission fluid for fifteen minutes before it is assembled.

**29. Install a new front pump gasket on the case.** Line up the bolt clearance holes in the gasket with the holes in the case. Using the end play check readings that were obtained during the transmission disassembly procedure, install the correct selective thrust washers No. 1 and 2 (Fig. 31) on the front pump stator support. **Use enough vaseline to hold the thrust washers in position during the front pump installation operation.**

**30.** Lubricate the front pump O-ring seal with clean transmission fluid. Install the front pump stator support into the reverse-high clutch. Align the pump to case retaining bolt holes. Install two front pump to case retaining bolts 180° apart. Tighten the bolts until the front pump is properly seated in the case. Remove the two front pump retaining bolts.

**31.** Install the converter housing on the front pump and case. Install the six converter housing to case retaining bolts. Torque the bolts to specification.

**32.** Install the input shaft (Fig. 32). Rotate the holding fixture to place the transmission in a horizontal position. Check the transmission end play as shown in Fig. 30. If the




**FIG. 97—Front Planet Carrier Installation**

end play is not within specification, either the wrong selective thrust washers (Fig. 31) were used, or one of the 10 thrust washers (Fig. 85) is not properly positioned.

**33.** Remove the dial indicator used for checking the end play and install the one converter housing to case retaining bolt. Torque the bolt to specification.

**34.** Install the intermediate and low-reverse band adjusting screws in the case. Install the struts for each band (Fig. 29).

**35.** Adjust the intermediate and low-reverse band. Refer to In-Car Adjustments and Repair for band adjusting procedures.

**36.** Install a universal joint yoke on the output shaft. Rotate the input and output shafts in both directions to check for free rotation of the gear train.

**37.** Install the control valve body (Fig. 28). As the valve body is installed engage the manual and downshift valves with the inner control levers. Torque the eight control valve body to case retaining bolts to specification.

**38.** Place a new oil pan gasket on the case and install the oil pan and 11 oil pan to case retaining bolts.

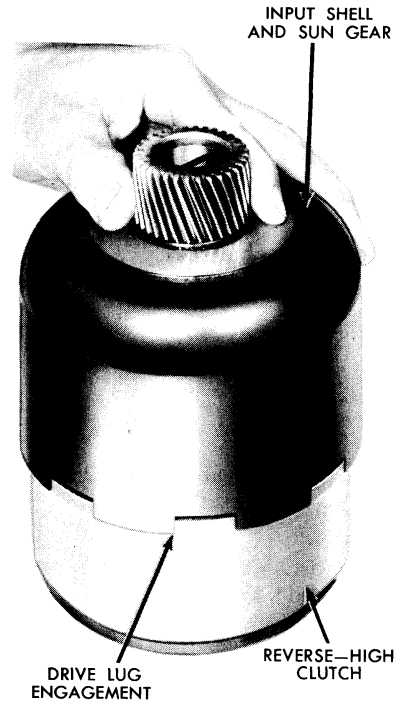



**FIG. 98—Input Shell Installation**

Torque the retaining bolts to specification.

**39.** Remove the transmission from the holding fixture. Install the two extension housing to case retaining bolts. Torque the bolts to specification.

**40.** Install the primary throttle valve in the transmission case (Fig. 26).

**41.** Install the vacuum unit, gasket, and control rod in the case. Using the tools shown in Fig. 99, torque the vacuum unit to 15-23 ft-lbs.

**42. Make sure the input shaft is properly installed in the front pump stator support and gear train.** Install the converter in the front pump and the converter housing.

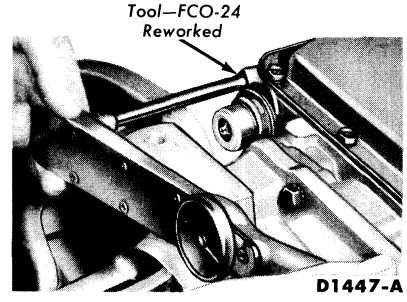



**FIG. 99— Vacuum Unit Installation**

# PART 7-3 CRUISE-O-MATIC OR MERC-O-MATIC DUAL RANGE TRANSMISSION


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 7-55 | 3 Removal and Installation | 7-69 |
| 2 In-Car Adjustments and Repairs | 7-62 | 4 Major Repair Operations | 7-70 |


## 1 DESCRIPTION AND OPERATION

### IDENTIFICATION

Figure 1 identifies the Cruise-O-Matic transmission used by Ford or Merc-O-Matic used by Mercury cars. The identification tag (Fig. 2), includes the model prefix and suffix, a service identification number, and a build date code. The service identification number indicates changes to service details which affect interchangeability **when the transmission model is not changed.** For interpretation of this number, see the Master Parts Catalog.

The tag must be kept with the in-

**TABLE 1—Engine and Transmission Application**

| Car Line | Engine Model | Trans. Prefix | Application |
|---|---|---|---|
| Ford | 289-2V | PCT-G | Column Shift |
| | 289-2V | PCT-H | Console Shift |
| | 352-2V | PCD-P | Column Shift |
| | 352-2V | PCD-R | Console Shift |
| Mercury | 390-4V | PCE-AU | Column Shift |
| | 390-4V | PCE-AW | Police-Column Shift |
| | 390-4V | PCE-AV | Console Shift |
| | 390-4V | PCE-AY | Police-Console Shift |
| Ford-Mercury | 390-2V | PCE-AZ | Column Shift |

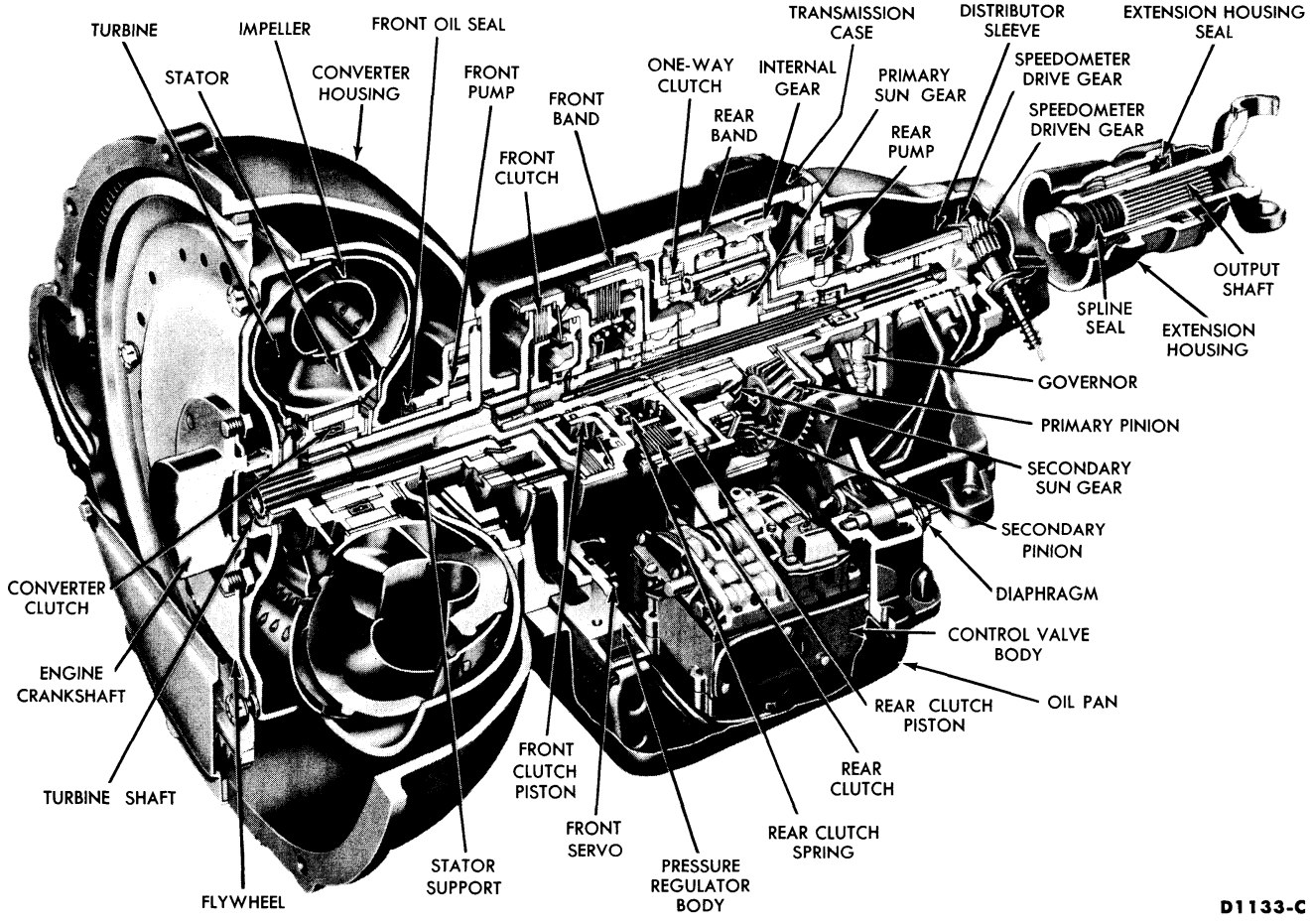



**FIG. 1—Typical Cruise-O-Matic Transmission**

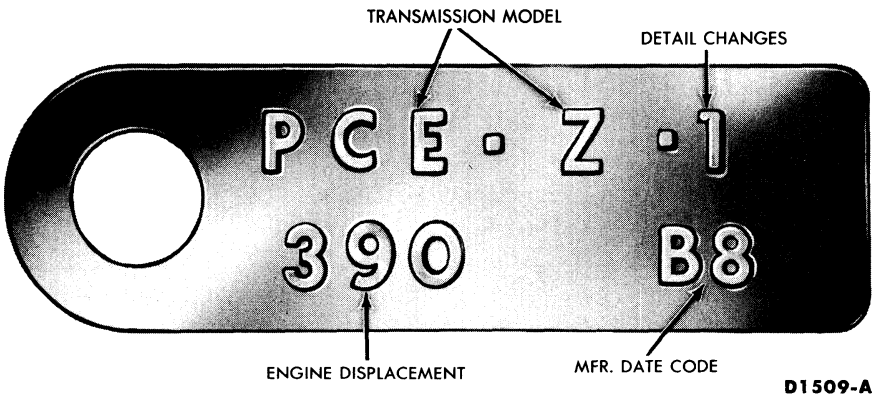



**FIG. 2—Identification Tag**

dividual transmission it was originally installed on. If the tag was removed during disassembly, reinstall it on the same unit.

Table 1 shows the engine and transmission model applications.

## TORQUE CONVERTER

The hydraulic torque converter (Fig. 3) consists of an impeller (pump), a turbine, and a stator. All these parts are enclosed and operate in a fluid-filled housing.

When the engine is running, the fluid in the torque converter flows from the impeller to the turbine and back to the impeller through the stator. This flow produces a maximum torque increase of about 2 to 1 when the turbine is stalled. When enough torque is developed by the impeller, the turbine begins to rotate, turning the turbine shaft.

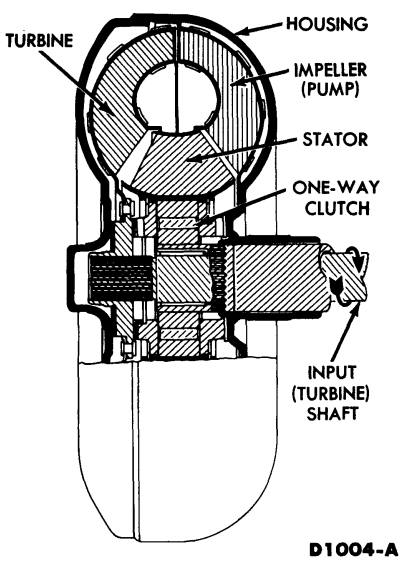



**FIG. 3—Cross-Section of Typical Torque Converter**

The converter torque multiplication gradually tapers off as turbine speed approaches impeller speed, and it becomes 1 to 1 when the turbine is being driven at 9/10 impeller speed. This is known as the "coupling point."

When the turbine is rotating at less than 9/10 impeller speed, the converter is multiplying torque. The fluid leaving the turbine blades strikes the front face of the stator blades. These blades are held stationary by the action of a one-way clutch (Fig. 3) as long as the fluid is directed against the front face of the blades.

When the turbine rotates faster than 9/10 impeller speed the converter no longer multiplies torque. The fluid is directed against the back face of the stator blades. As the one-way clutch permits the stator to rotate only in the direction of impeller rotation, the stator begins to turn with the impeller and turbine. The converter operates as an efficient fluid coupling as long as the turbine speed remains greater than 9/10 impeller speed.

A constant flow of fluid into and out of the converter is maintained. Some of the fluid coming out of the converter is forced through a cooler located in the radiator tank.

## PLANETARY GEAR TRAIN, CLUTCHES, BANDS, AND SERVOS

### PLANETARY GEAR TRAIN

The planetary gear train consists of a primary sun gear, secondary sun gear, primary and secondary pinions which are held in a common carrier, and an internal gear to which the transmission output shaft is attached (Fig. 4).

### FRONT CLUTCH

The front clutch drive plates (Fig. 5) are connected to the turbine shaft through the front clutch drum. The driven plates are connected to the primary sun gear shaft.

The front clutch is operated by fluid pressure against the clutch piston. The piston moves against a disc spring which acts as a lever to lock the drive and driven plates together. When the clutch is applied, the primary sun gear is locked to and driven by the turbine shaft. The piston is returned to the release position by

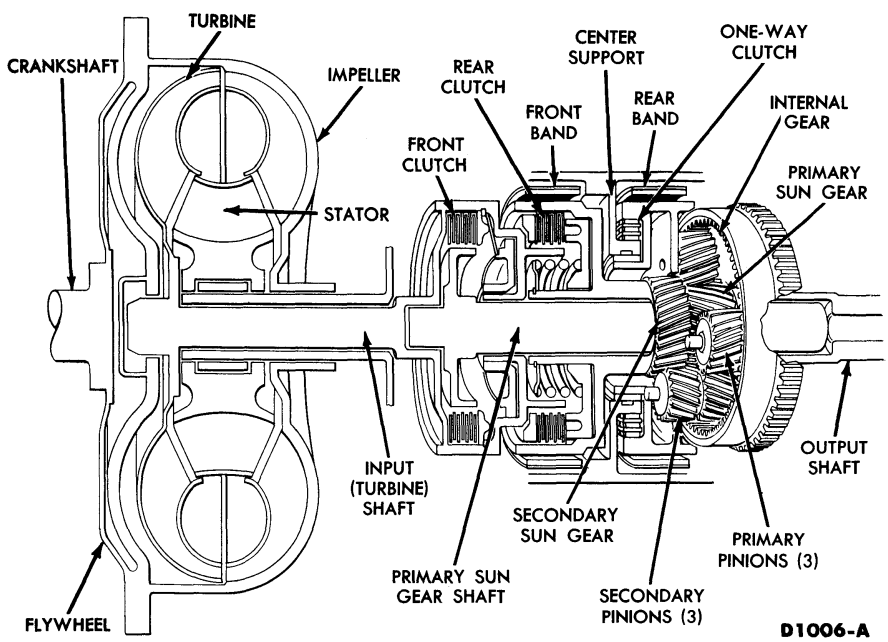



**FIG. 4—Planetary Gear Train**

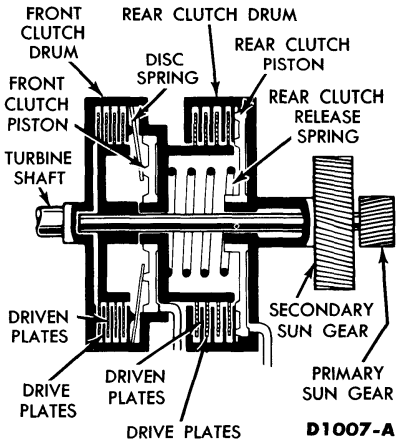



**FIG. 5—Front and Rear Clutches**

the disc spring when the fluid pressure is removed (Fig. 5). A check ball is installed in the front clutch piston to permit fluid exhaust, when the piston is in its released position.

In neutral, the front clutch drum and steel plates are being driven while the bronze plates are stationary. In reverse, the clutch is not applied, since the steel and bronze plates must rotate in opposite directions.

### REAR CLUTCH

The rear clutch (Fig. 5) is operated by fluid pressure against the clutch piston. Movement of the piston compresses the release spring and locks the multiple-disc clutch. The rear clutch drive plates are splined to the front clutch drum and the driven plates are connected to the rear clutch drum and secondary sun gear. When the rear clutch is applied (in the reverse and third gear ratios) the secondary sun gear is driven. The piston is returned to the released position by the release spring (Fig. 5).

In neutral, the rear clutch bronze plates are being driven while the steel plates are free. In second gear, the bronze plates are driven, but the steel plates are held stationary. In first gear, the bronze plates are driven clockwise at engine speed while the steel plates are driven counterclockwise.

### FRONT BAND AND SERVO

One end of the front band, which encircles the rear clutch drum, is anchored to the transmission case, and the other end is connected to the front servo (Fig. 6).

Fluid pressure moves the front servo piston against the inner end

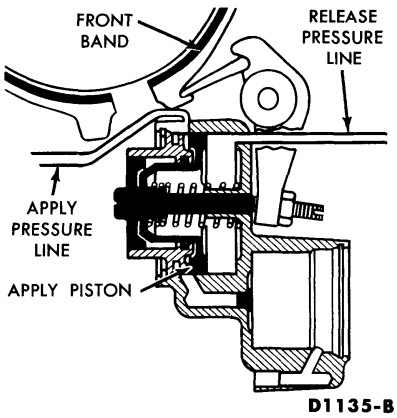



**FIG. 6—Typical Front Servo**

of the front servo actuating lever. Force is transmitted through a strut between the outer end of the lever and the end of the band to tighten the band around the rear clutch drum. Under certain conditions, the servo is released by directing fluid pressure to the opposite side of the piston, assisted by release spring force.

### REAR BAND AND SERVO

The rear band fits around the planetary gear drum. One end of the band contacts the end of the band adjusting screw, and the other end connects to the rear servo.

Two rear servo pistons apply the rear band (Fig. 7). The small (fast acting) piston, which is in direct contact with the servo lever, is located inside the large piston.

Fluid pressure against the large piston flows through a check valve to work against the small piston, which has low pressure resistance from the spring force of the rear band and whatever friction is in the servo lever and band struts. At a low apply pressure and small volume of fluid flow, the small piston moves and tightens the rear band on the pinion carrier.

When the apply pressure builds up to about 10 psi, the large piston moves against its return spring, allowing the check valve to close. When the check valve closes, the fluid in the small piston is trapped, and the apply force of the large piston is added to that of the small piston.

### POWER FLOWS

Table 2 lists the ratios obtained through the various power flows.

### POWER FLOW–NEUTRAL

When the transmission is in neutral (Fig. 8), no gears are held or driven, and no power is transmitted to the output shaft.

### POWER FLOW–FIRST GEAR, L

In first gear when the selector lever is at L, the primary sun gear is driven and the pinion carrier is held by the rear band (Fig. 8). Power is transmitted to the primary pinions, the secondary pinions, and

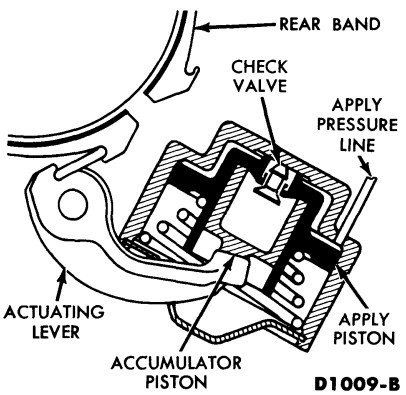



**FIG. 7—Typical Rear Band and Servo**

**TABLE 2—Cruise-O-Matic or Merc-O-Matic Gear Ratios**

| Gear | Selector Lever Position | Clutch Applied | Band Applied | Gear Ratio |
|---|---|---|---|---|
| Neutral | N | None | None | – |
| First | D1 or L | Front | Rear* | 2.40:1 |
| Second | D1 or D2 | Front | Front | 1.47:1 |
| Third | D1 or D2 | Front and Rear | None | 1.00:1 |
| Reverse | R | Rear | Rear | 2.00:1 |

*In first gear D1, the planet carrier is held against rotation by the one-way clutch.

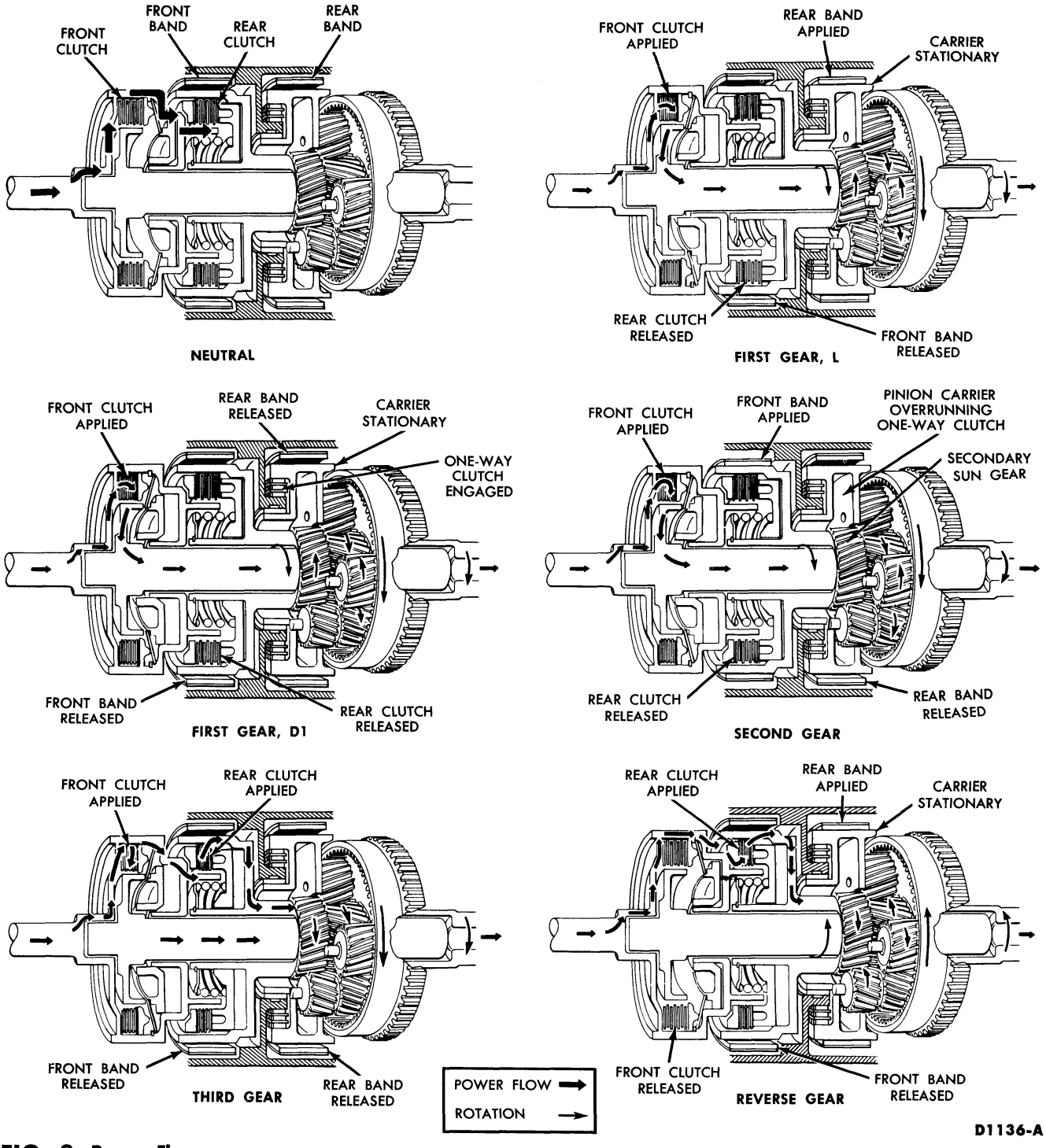



**FIG. 8–Power Flow**

the internal gear, driving the internal gear in the same direction as the primary sun gear. The secondary sun gear turns free in the reverse direction and has no effect on the gear train.

### POWER FLOW–FIRST GEAR, D1

In first gear at the D1 selector lever position (large dot on selector indicator), the pinion carrier is held against rotation by the one-way clutch instead of by the rear band (Fig. 8). First gear in D1 is the only gear that uses the one-way clutch.

### POWER FLOW–SECOND GEAR

Second gear ratio is obtained by driving the primary sun gear and holding the secondary sun gear (Fig. 8). The primary pinions drive the secondary pinions, causing them to "walk" around the secondary sun gear and to carry the internal gear and output shaft around with them.

### POWER FLOW–THIRD GEAR

In third gear, the primary and secondary sun gears are locked to-

gether and driven as a unit (Fig. 8). Therefore, the pinions cannot rotate and the entire planetary train revolves as a unit, which causes the output shaft to rotate at the same speed as the turbine shaft.

### POWER FLOW–REVERSE

Reverse gear is obtained by driving the secondary sun gear and holding the pinion carrier (Fig. 8). The secondary pinions drive the internal gear in the reverse direction. The primary sun gear and the primary pinions rotate freely and have no effect on the gear train.

### POWER FLOW– PARK POSITION

When the selector lever is in the P (park) position, the parking pawl engages the external teeth on the internal gear to lock the internal gear and output shaft to the case. This locks the rear wheels to prevent movement of the car.

### THROTTLE PRESSURE

Throttle pressure adjusts the transmission operation to engine torque. Throttle pressure is produced from control pressure by the throttle valve. The throttle valve is controlled by a spring-loaded vacuum diaphragm unit mounted on the rear of the transmission case.

The vacuum diaphragm is actuated by the engine intake manifold vacuum working against spring pressure. When the vacuum is higher than 16 inches the diaphragm moves against spring pressure and moves the push rod away from the throttle valve to cut off the throttle pressure regulation. As the engine throttle is advanced, manifold vacuum will fall below 16 inches. As the vacuum drops, the spring-loaded diaphragm moves the push rod to open the throttle valve and increase the throttle pressure.

### THROTTLE PRESSURE BOOST VALVE

To compensate for the slight manifold vacuum changes with throttle movements beyond about 50° carburetor valve opening, a throttle pressure boost valve comes into operation. At 51 psi throttle pressure, the spring-loaded boost valve (Fig. 9) comes into balance. Throttle pressure below 51 psi cannot move the boost valve against spring force plus throttle pressure force acting at the boost valve plug. Below 51 psi, therefore, throttle pressure will flow through the boost valve without interference.

Throttle pressure above 51 psi will move the boost valve to the left (Fig. 9). This movement will first cut off throttle pressure flow to the shift valves and the coasting control valve, and it will then open a passage to permit the new boosted throttle pressure to flow to the shift valves and the coasting control valve. Throttle pressure will continue to work against the right-hand end of the boost valve. For each pound of increase in throttle pressure (above 51 psi), the boosted throttle pressure will increase about three pounds.

### GOVERNOR PRESSURE

Governor pressure is produced from front clutch control pressure by the valve in the governor body which rotates at output shaft speed.

The governor valve is a balanced valve. It is balanced between centrifugal force acting on the governor valve plus governor spring force and governor pressure force (Fig. 9). Governor pressure is, therefore, proportional to road speed.

### TRANSITION VALVE

The transition valve controls the front servo apply pressure flow.

In the D1 range, the transition valve blocks front servo apply pressure flow until the 1-2 valve is closed by governor pressure.

In the D2 range (small dot to the right of N), the transition valve permits front servo apply pressure to flow through it at all times.

### 1-2 SHIFT VALVE

The 1-2 shift valve controls the 1-2 upshift in the D1 range. On the 2-1 downshift, either manual (shift to L) or kickdown, the 1-2 shift valve controls the shift only within the road speed range permitted by the inhibitor valve.

The 1-2 valve is held in its rest (open) position by a spring. It is closed by governor pressure. Under various driving conditions, governor pressure is opposed by spring force plus reduced throttle and reduced boosted throttle pressures, and control pressure.

### REAR SERVO LOCKOUT VALVE

The rear servo lockout valve blocks control pressure flow to the rear servo (rear servo apply pressure) in the D1 and D2 ranges.

### THROTTLE REDUCING VALVE

Before throttle pressure or boosted throttle pressure is admitted to the front face of the 2-3 shift valve, plug and 1-2 shift valve, it must open a passage past the spring-loaded throttle reducing valve.

Approximately 20 psi throttle pressure is required to move the valve against its spring far enough to open the passage. Once past the valve, throttle pressure will work on the spring end of the valve and exert a force to cut off throttle pressure flow past the valve. In this case, the valve becomes a balanced valve, wherein, the valve is balanced between throttle pressure force on the one end and spring force plus throttle pressure force on the other end. The pressure past the valve will, therefore, be reduced.

### 2-3 SHIFT VALVE

The 2-3 shift valve controls the 2-3 upshift and the 3-2 downshift. The valve is held in its rest (closed) position by springs. It is opened by governor pressure. Under various driving conditions, governor pressure is opposed by spring force plus throttle or boosted throttle pressures, and control pressure.

### INHIBITOR VALVE

The inhibitor valve prevents a 2-1 downshift, either manual or kickdown, at excessive road speeds.

The inhibitor valve is held in its rest (open) position by a spring. It is closed by governor pressure. Under various driving conditions, governor pressure is opposed by spring force plus control pressure.

### 3-2 COASTING CONTROL VALVE

The 3-2 coasting control valve operates in the front servo release passage.

During a 3-2 closed-throttle downshift in D2 range, the valve is positioned by its spring so that front servo release pressure must exhaust slowly through an orifice. This slow exhaust of release pressure provides a slow front band application.

During a partial-to-full-throttle 3-2 downshift, the 3-2 coasting control valve is positioned by throttle pressure or boosted throttle pressure so

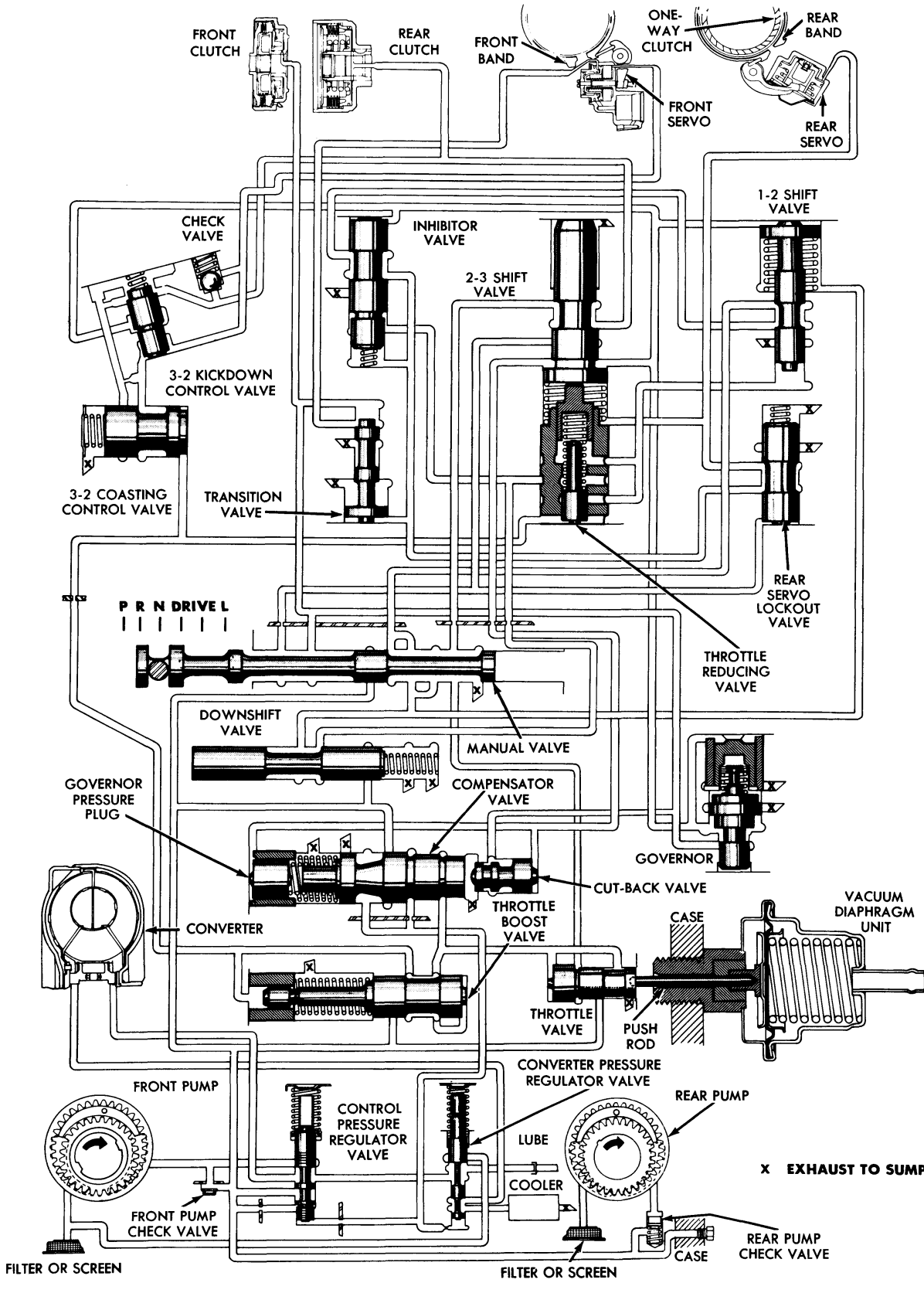



**FIG. 9—Hydraulic Control System Neutral Position**

that front servo release pressure can exhaust rapidly to provide a rapid front band application.

### DOWNSHIFT VALVE

The downshift valve is in the control valve upper body. The inner downshift lever contacts one end of the spring-loaded downshift valve.

Control pressure is directed to a land of the valve. Linkage is connected between the accelerator pedal and downshift lever. The downshift valve is moved to open a passage to direct control pressure to the shift valves and the inhibitor valve, when the accelerator pedal is depressed through the detent (Fig. 9).

### 3-2 DOWNSHIFT CONTROL VALVE

The 3-2 downshift control valve operates in the front servo release pressure passage between the 2-3 valve and the front servo. A check valve is installed parallel with the downshift valve in the same passage so that release pressure flow to the servo by-passes it.

The downshift valve controls the rate of front servo release pressure exhaust (flow from the servo), and thereby the rate of front band application.

The 3-2 downshift control valve eliminates the possibility of a runaway condition in the transmission during a 3-2 kickdown at low car speeds (about 25 mph). It also eliminates the possibility of a tie-up during the same shift at higher speeds (50 mph and more).

### HYDRAULIC CONTROL SYSTEM–NEUTRAL

The manual valve at N selector lever position blocks the fluid flow to both clutches and both bands (Fig. 9). With no fluid pressure in the clutches or servos, the clutches and bands are released by spring pressure, preventing power being transmitted to the transmission output shaft.

Neutral operation of the transmission keeps control pressure up to its proper value, maintains a full torque converter, lubricates the transmission, and maintains a flow of fluid through the cooling system.

### HYDRAULIC CONTROL SYSTEM–D1, FIRST GEAR

When the selector lever is moved from N to D1, the manual valve opens three passages to control pressure. From left to right, the first passage admits control pressure to supply the 2-3 valve and close the rear servo lockout valve. The second passage admits control pressure to apply the front clutch and supply the governor and transition valve. The third passage admits control pressure to flow through the 1-2 and inhibitor valves and close the transition valve.

With the front clutch applied, the primary sun gear tries to drive the pinion carrier in a counterclockwise direction. Counterclockwise rotation at the pinion carrier is prevented by the one-way clutch. With the front clutch applied and the pinion carrier held, the transmission is in first gear.

### HYDRAULIC CONTROL SYSTEM–D1, SECOND GEAR

The 1-2 shift occurs when governor pressure force on the 1-2 shift valve overcomes shift plug pressure and spring forces. The 1-2 valve moves inward, exhausting the fluid which holds the transition valve closed. The transition valve opens and admits control pressure to apply the front band.

The front clutch remains on, and the front band applies to put the transmission in second gear.

### HYDRAULIC CONTROL SYSTEM–D1, THIRD GEAR

The 2-3 shift occurs when governor pressure force overcomes spring and shift plug pressure force at the 2-3 shift valve. When the shift valve opens, control pressure flows through it to apply the rear clutch and release the front band. With both clutches applied, the transmission is in third gear.

### HYDRAULIC CONTROL SYSTEM–D2, SECOND GEAR

When the manual valve is at the D2 selector lever position, control pressure to the 1-2 shift valve is cut off. This condition permits control pressure to flow through the transition valve to apply the front band.

With the front clutch and the front band applied, the transmission operates in second gear.

### HYDRAULIC CONTROL SYSTEM–D2, THIRD GEAR

Operation in D2 range, third gear is the same as in D1 range, third gear except that the closed throttle downshift is from third to second in D2 instead of from third to first as in D1.

### HYDRAULIC CONTROL SYSTEM–D1 AND D2 RANGES, 3-2 KICKDOWN

When the accelerator pedal is depressed through the detent, the downshift valve opens a passage that admits control pressure behind the 2-3 shift plug to oppose governor pressure. If the transmission is in high and road speed is below 47-69 mph, the 2-3 valve will be forced closed against governor pressure. When the 2-3 valve closes, control pressure which has been applying the rear clutch and releasing the front band is exhausted. The apply pressure that was in the front servo in third gear is now free to apply the front band. As soon as the front band applies, the transmission is in second gear.

### HYDRAULIC CONTROL SYSTEM–L, FIRST GEAR

In L range, first gear, control pressure is directed by the manual valve to apply the front clutch and rear band. Control pressure is also directed by the manual valve to lock the 1-2 and 2-3 shift valves in their closed positions. Since neither shift valve can move, the transmission will stay in first gear regardless of throttle position or road speed.

### HYDRAULIC CONTROL SYSTEM–REVERSE

When the manual valve is shifted into reverse, control pressure is directed to apply the rear clutch and rear band. Governor supply pressure is cut off by the manual valve; hence, the transmission cannot shift automatically. Rear clutch pressure is also directed to the throttle valve to regulate throttle pressure to obtain the correct line pressure for the reverse circuit.

## HYDRAULIC CONTROL SYSTEM OPERATION

### PRESSURE PUMPS

The front pump (Fig. 9), driven by the converter impeller, delivers fluid pressure to the hydraulic control system whenever the engine runs. The rear pump, driven by the transmission output shaft, delivers

fluid pressure to the control system when the car moves forward.

Both pumps deliver fluid pressure to the control pressure regulator and control valve body. A regulated control pressure is available at the control valve body whenever the engine is running.

### CONTROL PRESSURE AND COMPENSATOR PRESSURE

Control pressure is regulated by the spring-loaded control pressure regulator valve (Fig. 9). It is adjusted to engine torque, road speed, and selector lever position.

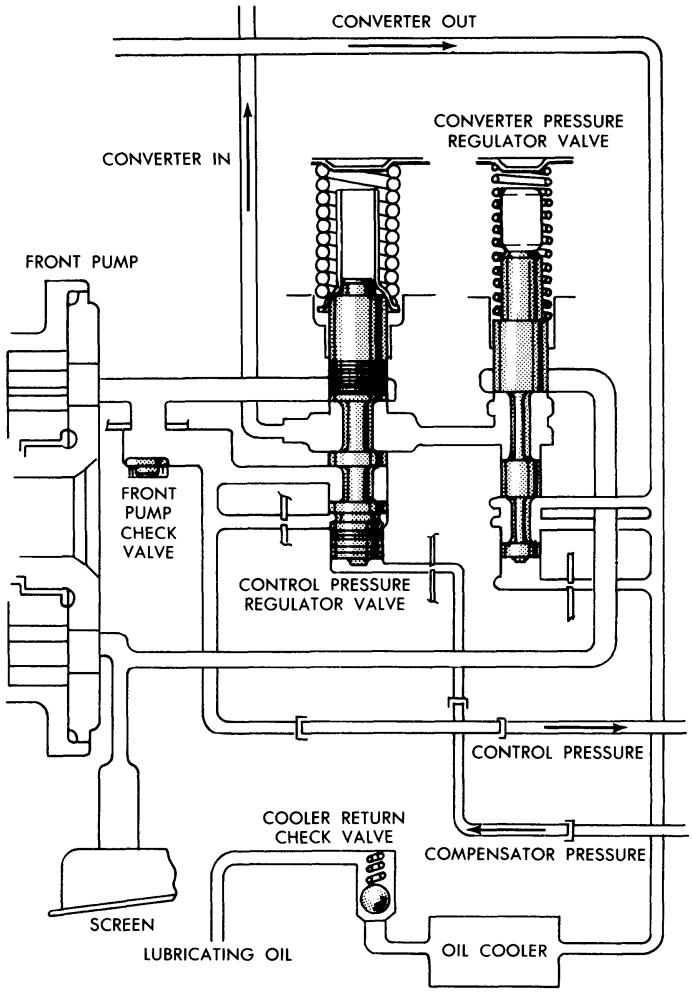
To accomplish this, compensator pressure under various conditions is adjusted by throttle pressure (engine torque), governor pressure (road speed), or selector lever position. Compensator pressure, in turn, adjusts control pressure.

### CONVERTER PRESSURE

Like control pressure, converter pressure is regulated by the converter pressure regulator valve spring and is adjusted to driving conditions by compensator pressure and selector lever positions.

### OIL COOLING AND LUBRICATING SYSTEM

Figure 10 shows the transmission series cooling circuit that is used with 390 C.I.D. engines. The converter out circuit is directed through the oil cooler, then the cooled oil is used in the transmission lubricating circuit. Compensator pressure is replaced by converter out pressure at the end of the converter pressure regulator valve.




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**FIG. 10—Series Cooling Pres. Reg. Circuit 390 Engine**

A spring-loaded check valve is used in the circuit to maintain about 3-5 psi in the converter out circuit. When the converter out circuit exceeds 3-5 psi, the check ball opens against spring pressure and cooled oil is directed to lubricate the various parts of the transmission gear train.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

The transmission control linkage adjustments should be performed in the order in which they appear in this section of the manual.

### THROTTLE AND DOWNSHIFT LINKAGE ADJUSTMENT

**1.** Apply the parking brake, and place the selector lever at N.

**2.** Run the engine at normal idle speed. If the engine is cold, run the engine at fast idle speed (about 1200 rpm) until it reaches normal operating temperature. When the engine is warm, slow it down to normal idle speed.

**3.** Connect a tachometer to the engine.

**4.** Adjust engine idle speed to the specified rpm with the transmission selector lever at D1 or D2.

**The carburetor throttle lever must be against the idle adjusting screw at the specified idle speed in D1 (large dot) or D2 (small dot).** To make sure that the carburetor throttle lever is against the adjusting screw, make the following checks:

Check for clearance between the bottomed dashpot plunger and the carburetor lever at engine idle (Fig. 11).

Check the position of the fast idle cam. It must be in the hot position.

**5.** After the engine idle speed has been properly adjusted, stop the engine and adjust the anti-stall dashpot clearance.

Bottom the dashpot plunger against its spring, and then adjust the clearance between the bottomed plunger and the throttle lever. Refer to Group 8 for dashpot clearance specifications.

**6.** Disconnect the carburetor connecting link from the accelerator bellcrank assembly.

**7.** Insert a gauge pin (¼-inch drill

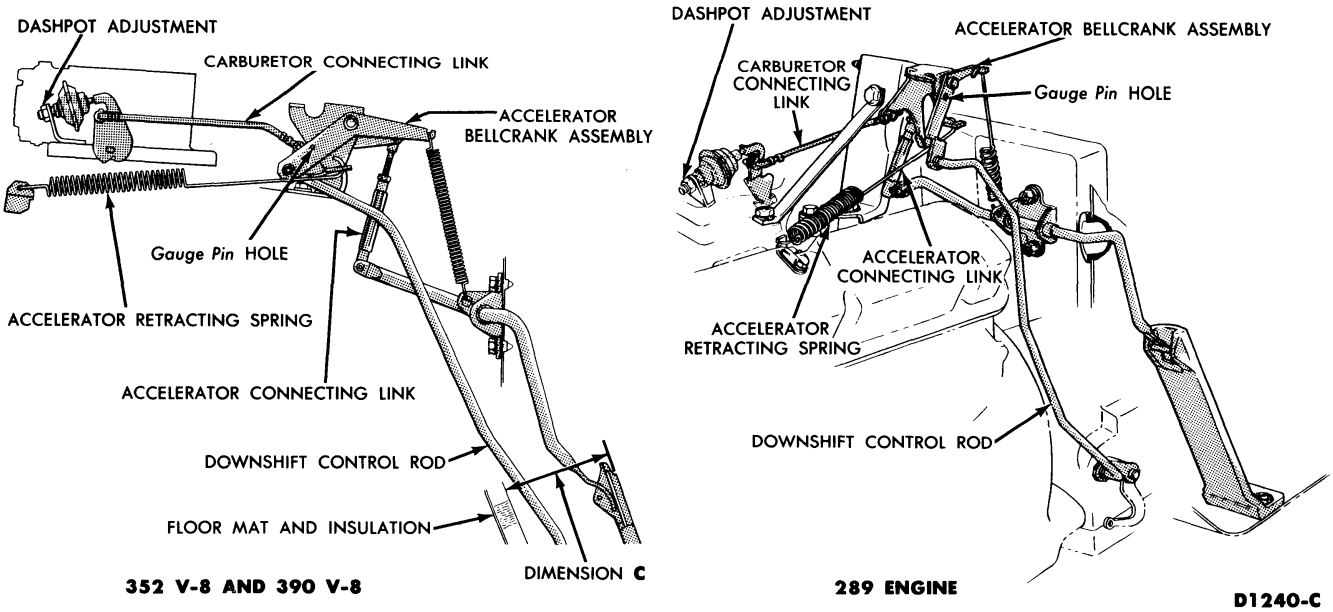



**FIG. 11—Throttle Linkage**

rod) through the gauge pin holes as shown in Fig. 11.

**8.** Lift the carburetor connecting link to its normal operating position. Maintain forward pressure on it so that the carburetor throttle lever is held solidly against the idle adjusting screw. With forward pressure on the link, adjust its length so that the sleeve can be freely fitted into the accelerator assembly lever. From this free-fit position, rotate the sleeve one full turn counterclockwise to lengthen the link. Remove the gauge pin and connect the link to the accelerator assembly lever.

**9.** Check the alignment of the gauge pin holes. Open the throttle and permit the throttle linkage retracting spring to return the linkage to its hot idle position. Now, the pin must enter freely. If necessary, readjust the carburetor connecting link to obtain a free entry for the gauge pin.

**10.** Adjust the accelerator connecting link to obtain a pedal height of about 3⅝ inches. Measure from a top corner of the pedal to the floor mat (Dimension "C," Fig. 11).

The operations given above cover completely the throttle linkage adjustment. There are no adjustments on the vacuum diaphragm unit or the downshift rod.

## MANUAL LINKAGE ADJUSTMENT

### COLUMN SHIFT TRANSMISSIONS

**1.** With the engine stopped, loosen the clamp at the shift lever so that the shift rod is free to slide in the clamp (Fig. 12).

**2.** Position the selector lever in the D1 position (large dot).

**3.** Shift the manual lever at the transmission into the D1 detent position, second from the rear.

**4.** Tighten the clamp on the shift rod.

**5.** Check and reset the pointer alignment for all selector lever detent positions if necessary.

### CONSOLE SHIFT TRANSMISSION

Before adjusting the manual linkage, check the starter neutral switch operation. If the switch needs adjusting the adjustment can be made at the time the manual linkage is adjusted.

**1.** With the engine stopped, check

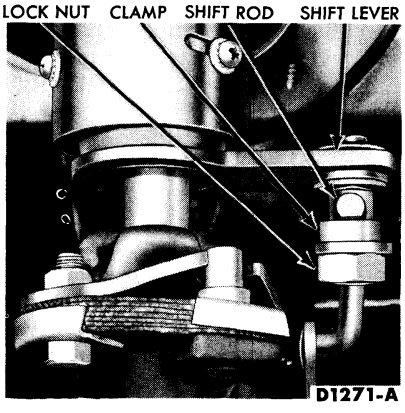



**FIG. 12—Column Shift Manual Linkage Adjustments**

the adjustment of the button assembly on top of the shift knob (Fig. 13). The button should be flush to 0.030 above the knob. To adjust the button, loosen the adjustment screw in the center of the knob. Rotate the button to the proper height and tighten the lock screw. This adjustment positions the detent rod to obtain the proper alignment and detent travel of the rod.

**2.** Move the shift lever to the D1 detent position.

**3.** Raise the car and loosen the manual linkage rod retaining nut (Fig. 13). Move the transmission manual lever to the D1 position, second from the rear. The last detent position is low position.

**4.** With the selector lever and the transmission manual lever in the D1 position, tighten the rod retaining nut to specifications (Fig. 13).

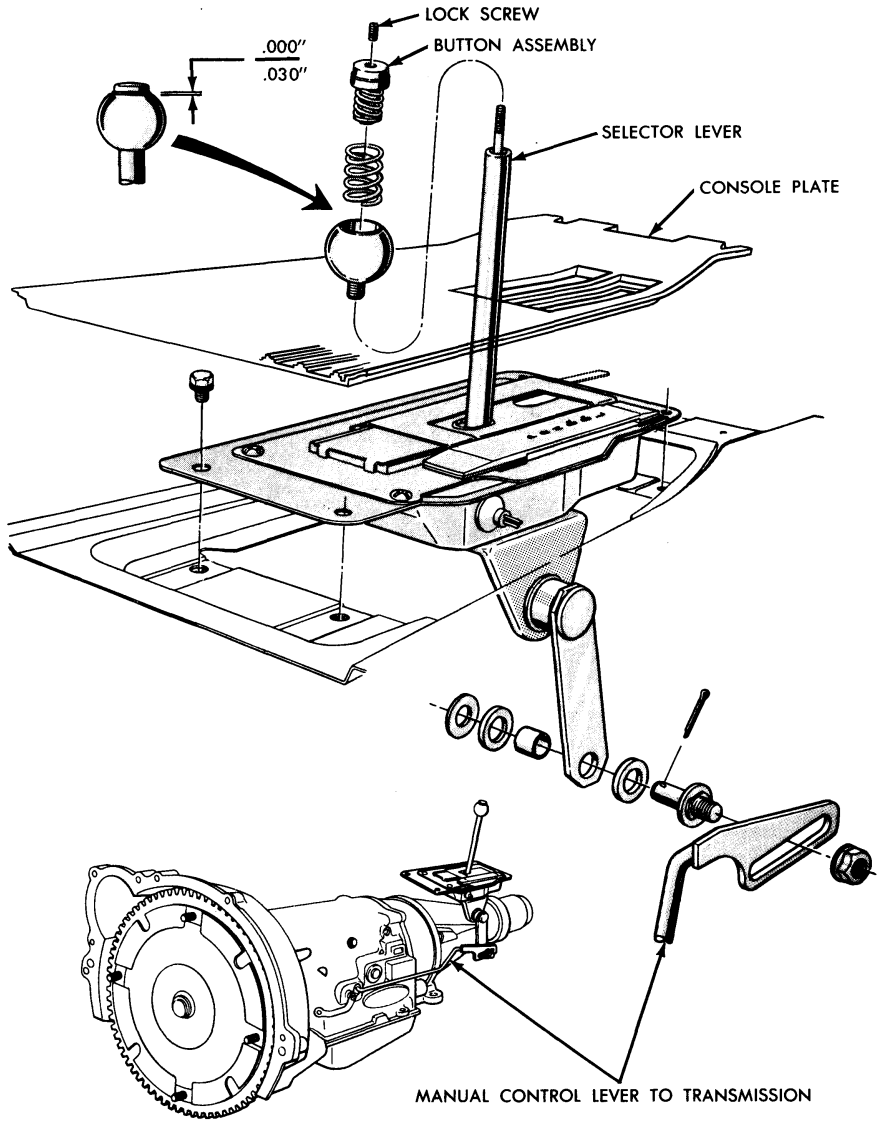
## STARTER NEUTRAL SWITCH ADJUSTMENT

### COLUMN SHIFT

**1.** With the manual linkage properly adjusted, check the starter engagement circuit in all transmission selector lever positions. The circuit must be open in all drive positions and closed only in park and neutral. The starter should engage only in park or neutral.

**2.** To adjust the switch, loosen the retaining screws that locate the switch on the steering column (Fig. 14).

**3.** Place the transmission selector




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**FIG. 13—Console Manual Linkage Adjustment**

lever firmly against the stop of the neutral detent position.

4. Rotate the switch actuating lever until the gauge pin (No. 43 drill) can be inserted into the gauge pin holes (Fig. 14).

5. Tighten the two switch retaining screws and remove the gauge pin.

6. Check the operation of the switch in each selector lever position. **The starter should engage in only the neutral and park detent positions. Whenever the manual linkage is adjusted the starter neutral switch should be checked and if necessary adjusted.**

## CONSOLE SHIFT TRANSMISSION

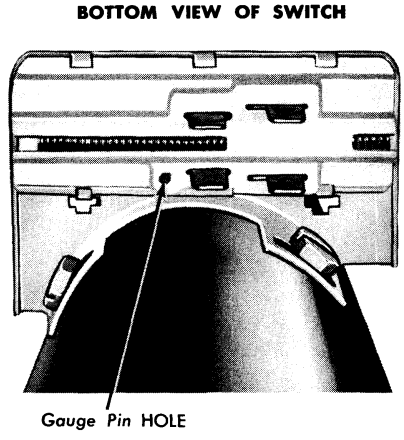
1. Remove the shift lever detent knob screw, detent button and spring and knob assembly from the lever (Fig. 13).

2. Remove the top chrome trim panel from the console.

3. Place the lever in neutral and remove the three screws and quadrant indicator assembly. Slide out the bulb socket (Fig. 15), and be careful not to scratch the plastic quadrant cover.

4. Loosen the combination starter neutral and back-up light switch screw (Fig. 15). Apply the service and parking brakes, turn the ignition key to the start position, and move the combination switch as required until the starter operates. Tighten the switch screws and check for starting in the park position.

5. When operation is satisfactory, turn off the ignition switch and release the service brakes. Place the lever in reverse and check the operation of the back-up lights. After these adjustments, tape the detent rod to the shift lever to prevent the rod from dropping through the shift lever when reassembling the cover and knob assembly.



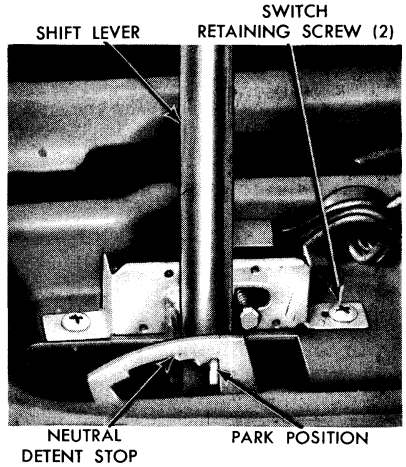

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**FIG. 14—Starter Neutral Switch Column Shift**

6. Place the selector lever in park. Position the quadrant indicator plate. Install the quadrant bulb and socket to the quadrant plate assembly.

7. Install the quadrant plate screws.

8. Install the console cover, knob assembly, and detent button. Check, and if necessary, adjust the manual linkage.




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**FIG. 15—Console Shift Starter Neutral Switch**

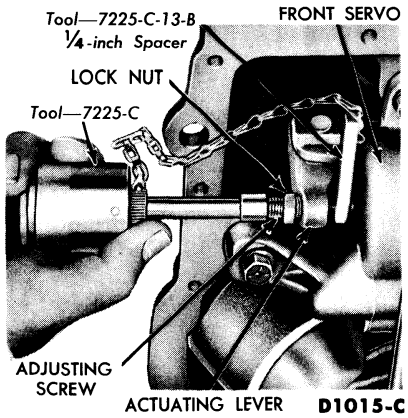



**FIG. 16—Typical Front Band Adjustment**

## BAND ADJUSTMENTS

### FRONT BAND ADJUSTMENT

**1.** Drain the fluid from the transmission by removing the oil filler tube. Use a clean drain can equipped with a 100-mesh screen if the fluid is to be reused.

**2.** Remove the oil pan, then remove the oil screen and clip from the transmission. Clean the inside of the oil pan. Remove all gasket material from the oil pan and pan mounting face of the case.

**3.** Loosen the front servo adjusting screw lock nut two full turns.

**4.** Pull back on the actuating rod, then insert the gauge block, Tool 7225-C13-B, of the front band adjusting Tool 7225-C (Fig. 16), between the servo piston stem and adjusting screw. Tighten the adjusting screw until the wrench overruns. Back off the adjusting screw **exactly one complete turn,** then hold the adjusting screw stationary and tighten the lock nut to specifications. Remove the gauge block. **Severe damage may result if the adjusting screw is not backed off exactly one complete turn.**

**5.** Install the transmission fluid screen. Install the pan using a new gasket.

**6.** Connect the transmission fluid filler tube to the oil pan.

**7.** Refill the transmission to the **FULL** mark on the dipstick.

**8.** Start the engine and engage the transmission in each drive range to fill all fluid passages, then place the selector lever in the "P" position. Check the fluid level and add enough fluid to bring the level up to the **FULL** mark on the dipstick.

### ALTERNATE FRONT BAND ADJUSTMENT PROCEDURE

**1.** Disconnect the fluid filler tube from the oil pan, and drain the fluid from the transmission. **If the same fluid is to be used again in the transmission after the band adjustment, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.**

**2.** Remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.

**3.** Loosen the front servo adjusting screw locknut two full turns with a 9/16-inch wrench. Check the adjusting screw for free rotation in the actuating lever after the lock nut is loosened, and free the screw if necessary.

**4.** Pull the adjusting screw end of the actuating lever away from the servo body, and insert the adjusting tool gauge block (Fig. 17) between the servo piston stem and the adjusting screw.

**5.** Install the socket handle on the 9/16-inch socket.

**6.** Insert the T-handle extension through the socket handle and socket, and install the screwdriver socket on the T-handle extension.

**7.** Place the tool on the adjusting screw so that the screwdriver socket engages the screw and the 9/16-inch socket engages the lock nut.

**8.** With a torque wrench on the T-handle extension, torque the adjusting screw to 10 inch-pounds, and then back off the screw exactly one full turn. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly one full turn.**

**9.** Hold the adjusting screw stationary, and torque the lock nut to

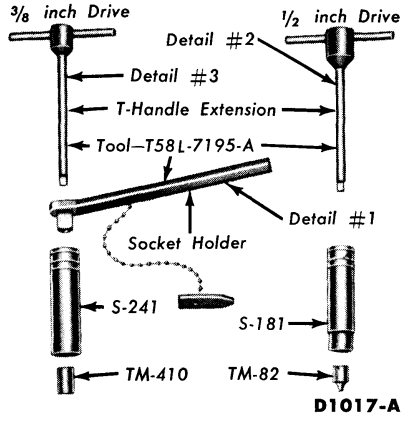



**FIG. 17—Front and Rear Band Adjusting Tools**

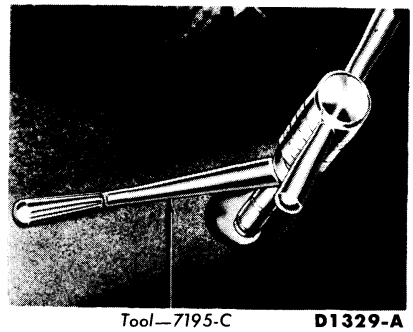



**FIG. 18—Rear Band Adjustment**

specification.

**10.** Remove the gauge block from the transmission.

**11.** Place a new gasket on the oil pan, and install the screen and pan on the transmission.

**12.** Connect the filler tube to the oil pan and tighten the fitting securely.

**13.** Fill the transmission with fluid.

### REAR BAND ADJUSTMENT

**1.** Fold back the floor mat to expose the right side of the floor pan.

**2.** Remove the access hole cover from the floor pan. Remove all dirt from the adjusting screw threads, then oil the threads.

**3.** Loosen the rear band adjusting screw lock nut with Tool 7195-C (Fig. 18). Using the T-handle portion of the tool, tighten the adjusting screw until the wrench overruns.

**If the screw is found to be tighter than wrench capacity (10 ft.-lbs. torque), loosen the screw and tighten until the wrench overruns.**

**4.** Back off the adjusting screw 1½ turns. Hold the adjusting screw stationary, and tighten the adjusting screw lock nut to specifications.

**Severe damage may result if the adjusting screw is not backed off exactly 1½ turns.**

### ALTERNATE REAR BAND ADJUSTMENT PROCEDURE

The tool shown in Fig. 17 may be used to adjust the rear band.

**1.** Place the socket holder on the ¾-inch socket (Fig. 17). Insert the T-handle extension through the handle and socket.

**2.** Place the 5/16-inch 8-point socket on the extension. Place a torque wrench on the T-handle extension.

**3.** Insert the assembled tool in the access hole so that it engages the adjusting screw and the lock nut.

**4.** Loosen the adjusting screw lock nut.

5. Torque the adjusting screw to 10 ft.-lbs.

6. Remove the torque wrench from the T-handle extension and back off the adjusting screw exactly 1½ turns. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly 1½ turns.**

7. Hold the adjusting screw stationary and tighten the lock nut securely.

### REAR BAND ADJUSTMENT WITH CONSOLE

Part of the console assembly will have to be removed to adjust the rear band.

1. Loosen the two forward screws that attach the glove compartment to the console panel.

2. Remove the gear shift lever knob.

3. Remove the four screws that attach the console finish panel casting to the console panel, and remove the casting (Fig. 19).

4. Remove the four bolts that secure the gear shift indicator to the support assembly.

5. Remove the twelve screws that attach the console panel mouldings to the console panel and remove the mouldings (Fig. 19).

6. Remove the eight screws that attach the console panel to the console support assembly.

7. Position the console panel out of the way and adjust the transmission rear band.

8. Install the console panel and secure to the support assembly with eight screws.

9. Install the mouldings and the twelve attaching screws.

10. Secure the gear shift indicator with the four attaching bolts.

11. Install the console finish panel and secure with the four screws. Also tighten the two forward screws of the glove compartment.

12. Install the gear shift lever knob.

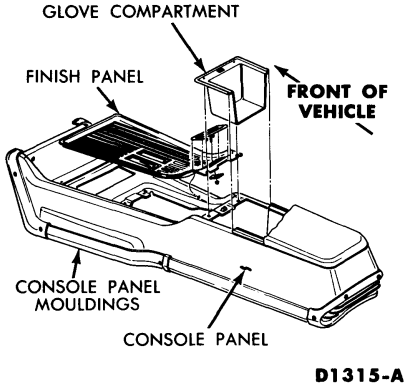



**FIG. 19—Console Component Parts**

### GOVERNOR REPLACEMENT

1. Raise the car so that the transmission extension housing is accessible.

2. Remove the governor inspection cover from the extension housing.

3. Rotate the drive shaft until the governor is in line with the inspection hole (Fig. 20).

4. Remove the governor valve body from the counterweight. **Do not drop attaching bolts or the valve parts into the extension housing.**

5. Lubricate the new governor valve parts with transmission fluid. **The valve must move freely in the valve body bore.**

6. Install the governor valve body on the counterweight so that the valve body cover is facing rearward. Tighten the two attaching bolts securely.

7. Install the governor inspection cover and a new gasket on the extension housing. Torque the attaching screws to specifications.

### OIL PAN AND CONTROL VALVE BODY REPLACEMENT

1. Raise the car so that the transmission oil pan is accessible.

2. Disconnect the fluid filler tube from the oil pan, and drain the fluid from the transmission. **If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.**

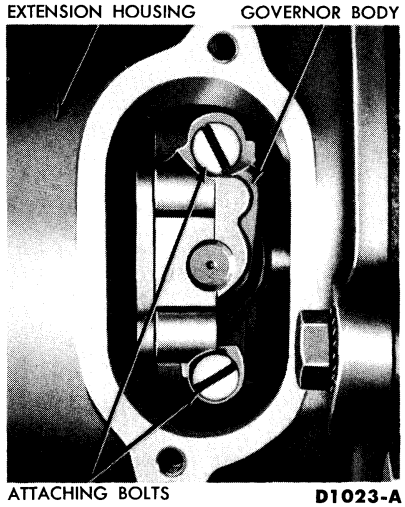



**FIG. 20—Governor in Extension Housing**

3. Disconnect the hose from the vacuum diaphragm unit. Remove the diaphragm unit using tool FCO-24. **Do not use any tools on the diaphragm housing, such as pliers, pipe wrenches, etc. Do not allow solvents to enter the diaphragm unit.** Remove the push rod.

4. Remove the oil pan and gasket, and discard the gasket.

5. Remove the fluid screen retaining clip and the screen.

6. Remove the two tubes which connect to the pressure regulator and the control valve body. **The regulator lubrication tube (Fig. 21) does not have to be removed.**

7. Loosen the front servo attaching bolts three turns.

8. Remove the three control valve body attaching bolts, and lower the valve body while pulling it off the front servo oil tubes (Fig. 21). **Be careful not to damage the valve body or the tubes.**

9. Before installing the control valve body, check for a bent manual valve by rolling it on a flat surface.

10. Install the control valve body by aligning the front servo oil tubes with the holes in the valve body. Shift the manual lever to the L detent, and place the inner downshift lever between the downshift lever stop and the downshift valve. **The manual valve must engage the actuating pin in the manual detent lever.**

11. Install, but do not tighten, the control valve body attaching bolts.

12. Install the tubes to the pressure regulator and the control valve body.

13. Move the control valve body toward the center of the case as far as the attaching bolts will permit. This movement is made to take up clearance between the manual valve and the actuating pin on the manual detent lever.

14. Torque the attaching bolts to specification.

15. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the body away from the center of the case. Move the valve body only enough to relieve the binding. Torque the attaching bolts and recheck the manual valve for binding.

16. Position the push rod in the bore of the vacuum diaphragm unit.

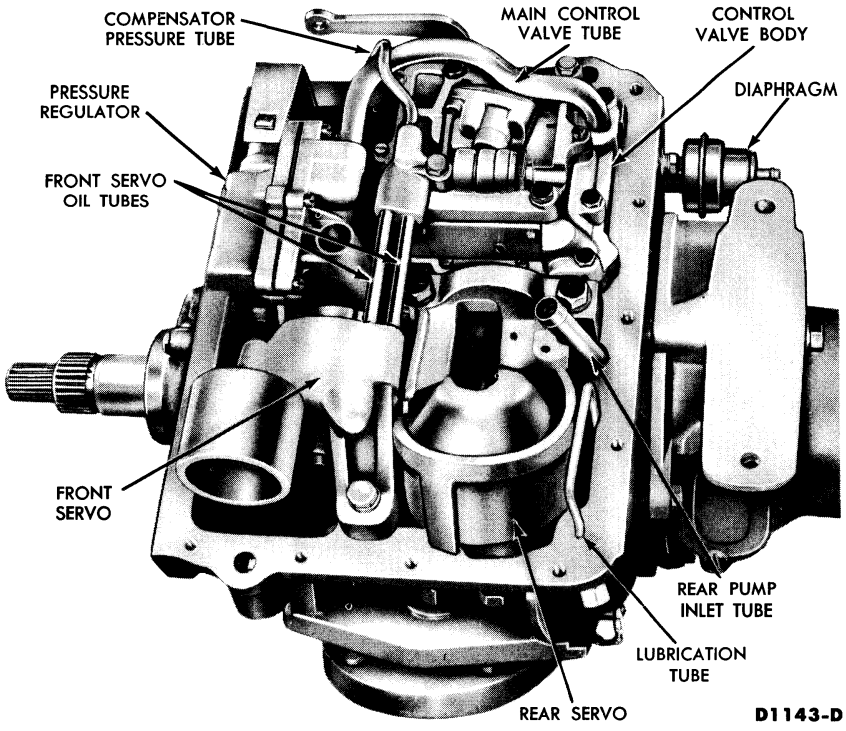



**FIG. 21—Typical Hydraulic Control System Parts—Model PCE**

Using the diaphragm unit as a guide, insert the push rod into the threaded opening of the case. Torque the diaphragm unit to specification. Connect the vacuum hose.

**17.** Torque the front servo attaching bolts to specification.

**18.** Adjust the front band.

**19.** Install the fluid screen and the screen retaining clip.

**20.** Position a new oil pan gasket on the bottom of the transmission case, and install the oil pan. Torque the oil pan screws to specification.

**21.** Connect the fluid filler tube to the oil pan, and tighten the fitting securely.

**22.** Adjust the rear band.

**23.** Fill the transmission with fluid. **If the fluid that was drained from the transmission is to be used again, filter the fluid through a 100-mesh screen as it is poured back into the transmission. Re-use the fluid only if it is in good condition.**

**24.** If the control valve body was replaced, adjust the transmission control linkage.

## PRESSURE REGULATOR REPLACEMENT

**1.** Drain the fluid from the transmission, and remove the oil pan and fluid screen.

**2.** On all models except PCE, remove the pressure regulator lubrication tube.

**3.** Remove the small compensator pressure tube and the large control pressure tube from the control valve body and the pressure regulator.

**4.** Remove the pressure regulator spring retainer, springs, and spacer. **Maintain pressure on the retainer to prevent the springs from flying out.**

**5.** Remove the pressure regulator attaching bolts and washers, and remove the regulator.

**6.** Position the replacement regulator body on the transmission case and install the retaining bolts. Torque the bolts to specification.

**7.** Check the converter pressure and control pressure valves to be sure the valves operate freely in the bores.

**8.** Install the valve springs, spacer, and retainer.

**9.** Install the large control pressure tube, small compensator pressure tube, and the pressure regulator lubrication tube.

**10.** Install the fluid screen and the oil pan, and fill the transmission with fluid.

## FRONT SERVO REPLACEMENT

**1.** Drain the fluid from the transmission, and remove the oil pan and fluid screen.

**2.** Remove the vacuum diaphragm unit.

**3.** On all models except PCE, remove the pressure regulator lubrication tube.

**4.** Loosen the three control valve body attaching bolts.

**5.** Remove the attaching bolts from the front servo (Fig. 21), hold the strut with the fingers, and remove the servo.

**6.** To install the front servo, position the front band forward in the case with the ends of the band facing downward. Align the large end of the servo strut with the servo actuating lever, and align the small end with the band end.

**7.** Rotate the band, strut, and servo to align the anchor end of the band with the anchor in the case.

Push the servo body onto the control valve body tubes.

**8.** Install the attaching bolts and torque to specification.

**9.** Torque the control valve body attaching bolts to specification.

Check the clearance between the manual valve and the manual lever actuating pin as given in Oil Pan and Control Valve Body Replacement.

**10.** On all models except PCE, install the pressure regulator lubrication tube.

**11.** Adjust the front band.

**12.** Install the vacuum diaphragm unit and rod.

**13.** Install the fluid screen and oil pan, and fill the transmission with fluid.

**14.** Adjust the downshift and manual linkage.

## REAR SERVO REPLACEMENT

**1.** Drain the fluid from the transmission, and remove the oil pan and fluid screen.

**2.** Remove the vacuum diaphragm unit.

**3.** On all models except PCE, remove the pressure regulator lubrication tube.

**4.** Remove the control valve body and the two front servo oil tubes.

**5.** Remove the attaching bolts from the rear servo, hold the actuating and anchor struts with the fingers, and remove the servo.

**6.** To install the rear servo, position the servo anchor strut on the servo band, and rotate the band to engage the strut.

**7.** Hold the servo anchor strut in position with the fingers, position the actuating lever strut, and install the servo.

**8.** Install the servo attaching bolts, and torque them to specification. **The longer bolt must be installed in the inner bolt hole.**

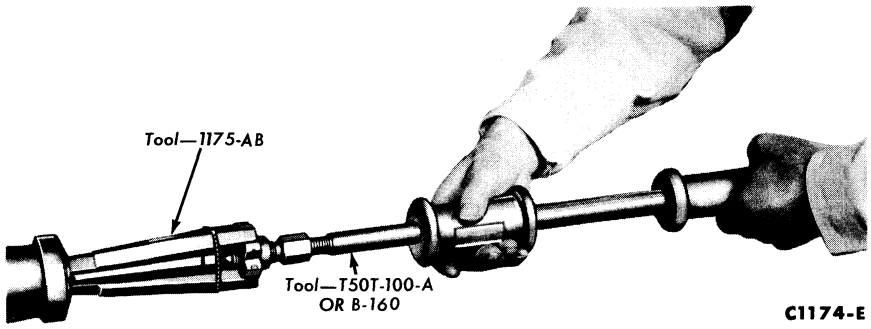



**FIG. 22—Extension Housing Seal Removal**

9. Install the two front servo oil tubes and the control valve body.

Check the clearance between the manual valve and the manual lever actuating pin as given above in Oil Pan and Control Valve Body Replacement.

10. Install the pressure regulator lubrication tube.

11. Adjust the rear band.

12. Install the fluid screen and oil pan, and fill the transmission with fluid.

## EXTENSION HOUSING BUSHING AND REAR SEAL REPLACEMENT

1. Disconnect the drive shaft from the transmission.

2. Carefully remove the seal with the tool shown in Fig. 22.

3. Remove the bushing as shown in Fig. 23. **Use the bushing remover carefully so that the spline seal is not damaged.**

4. When installing a new bushing use the special tool shown in Fig. 24.

5. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.

6. Inspect the counterbore of the housing for burrs. Polish off all burrs with crocus cloth.

7. Install the seal into the housing with the tool shown in Fig. 25. The seal should be firmly seated in the bore.

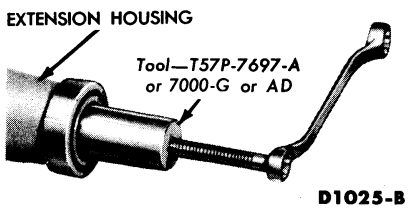



**FIG. 23—Extension Housing Bushing Removal**

## PARKING PAWL

1. On all models except the console shift, loosen the right hand front scuff plate and lift the carpet back until the rear band adjusting stud access hole is accessible. On console shift transmissions, remove the necessary console parts to gain access to the rear band adjusting screw.

2. Remove the access hole plug and, with Tool 7195-C or Tool T58L-7195-A, loosen the adjusting stud lock nut. Turn the adjusting stud in until the tool handle overruns. **This will tighten the rear band around the planet carrier and will hold the planet carrier and clutch assemblies in position during the parking pawl repair operation.**

3. Raise the car and drain the fluid from the transmission.

4. Place the adjustable support stand under the rear of the engine.

5. Disconnect the inlet pipes from the exhaust manifolds.

6. Remove the drive shaft.

7. Disconnect the parking brake cables from the crossmember and equalizer bracket.

8. Remove the cross member to extension housing bolts.

9. Raise the engine with the adjustable support stand until the extension housing clears the rear cross member.

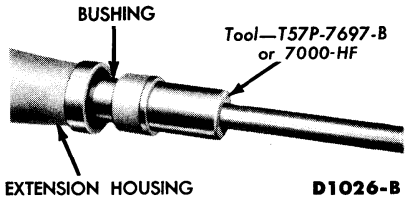



**FIG. 24—Extension Housing Bushing Installation**

10. Remove the retaining bolts and cross member from the frame.

11. Disconnect the speedometer cable from the transmission.

12. Remove the transmission oil pan and oil screen.

13. Remove the vacuum control diaphragm unit and control rod.

14. Remove the main control valve assembly retaining bolts and valve assembly.

15. Remove the tubes that go from the case into the rear pump.

16. Remove the extension housing retaining bolts and housing.

17. Remove the output shaft and rear pump assembly from the case.

18. Remove the parking pawl toggle pin from the case with a magnet.

19. Remove the retainer, washer and the end of the clip-type spring from the end of the parking pawl link pin.

20. Remove the pawl link pin and broken parking pawl.

21. To assemble the new parking pawl, reverse the above procedure. Use new gaskets and refill the transmission with the specified lubricant. Set the transmission linkage. **Adjust the rear band and position the carpet or console parts.**

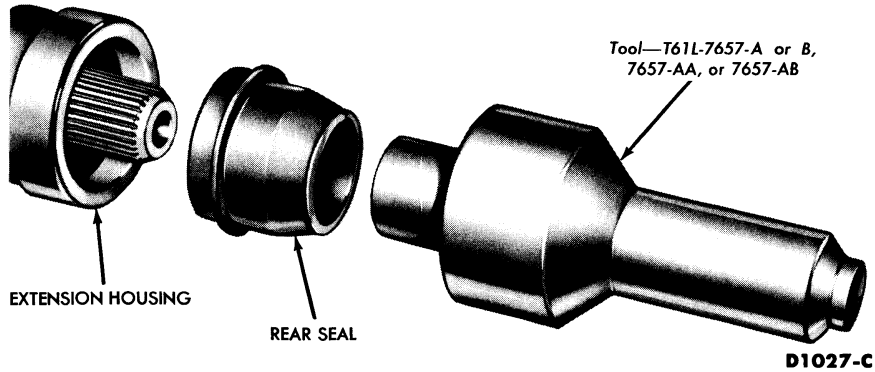



**FIG. 25—Extension Housing Rear Seal Installation**

## 3 REMOVAL AND INSTALLATION

### TRANSMISSION AND CONVERTER REPLACEMENT

#### REMOVAL

1. Drive the car on a hoist, **but do not raise it at this time.**
2. Remove the two upper bolts and lock washers which attach the converter housing to the engine.
3. Raise the car, and remove the cover from the lower front side of the converter housing.
4. Remove one of the converter drain plugs. Then rotate the converter 180° and remove the other plug. **Do not attempt to turn the converter with a wrench on the converter stud nuts.** If desired, the converter may be drained after the unit has been removed from the car.
5. Disconnect the fluid filler tube from the transmission oil pan. Disconnect the vacuum hose from the vacuum diaphragm unit and the tube from the extension housing clip.
6. When the fluid has stopped draining from the transmission and converter, remove the flywheel to converter nuts and flat washers. Install the drain plugs in the converter and torque to specifications. Install the converter housing front plate to hold the converter in place when the transmission is removed.
7. Disconnect the starter cable from the starter and remove the starter.
8. Disconnect the oil cooler lines from the transmission. Remove the transmission vent tube.
9. Disconnect the manual and downshift linkage from the transmission.
10. Disconnect the speedometer cable from the extension housing, and remove the drive shaft.
11. On some cars it may be necessary to loosen and drop the exhaust system to allow the converter to clear the muffler inlet pipe.
12. Support the transmission on a stand. Remove the engine rear support to transmission bolts, and raise the transmission slightly to take the weight off the cross member. Remove the cross member. Support the rear part of the engine.
13. Remove the remaining converter housing to engine attaching bolts. Move the assembly to the rear and down to remove it.

#### INSTALLATION

1. If the converter has been removed from the converter housing, carefully position the converter in the housing, and then install the housing lower front cover plate to prevent the converter from slipping out of the housing.
2. Install the transmission vent tube.

Rotate the converter until the studs are in a vertical position.

3. With the transmission mounted on a support stand, move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot.
4. Install the lower converter housing to engine bolts, then torque the bolts to specification.
5. Install the cross member.
6. Lower the transmission until the extension housing rests on the cross member, and then install the extension housing to cross member bolts.
7. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
8. Install the converter attaching nuts and flat washers. Install the access plates.
9. Connect the oil cooler inlet and outlet lines at the transmission case.
10. Coat the front universal joint yoke seal and spline with B8A-19589-A lubricant, and install the drive shaft.
11. Connect the speedometer cable at the transmission.
12. Connect the manual linkage at the transmission manual lever.
13. Connect the downshift linkage and bushing at the transmission throttle lever.
14. Install the starter motor.
15. Connect the fluid filler tube to the oil pan. Connect the vacuum hose to the vacuum diaphragm unit and the tube to its clip.
16. Lower the transmission support stand. Then install the upper two converter housing to engine bolts and tighten to specification.
17. Fill the transmission with transmission fluid, following the recommended procedure.
18. Check the transmission, converter assembly, and oil cooler lines for fluid leaks, and then adjust the manual and downshift linkages.

### TRANSMISSION REPLACEMENT WITHOUT CONVERTER

The frame construction of the Sunliner will not permit the transmission to be moved rearward enough to clear the turbine shaft from the converter. For this reason, the converter and transmission must be removed as a unit from this model.

#### REMOVAL

1. Raise the car on a hoist.
2. Disconnect the hose from the vacuum diaphragm unit and the tube from its clip. Disconnect the fluid filler tube from the oil pan, and drain the fluid.
3. Disconnect the drive shaft from the rear axle, and remove the drive shaft.
4. Disconnect the oil cooler lines from the transmission. Remove the vent tube.
5. Disconnect the manual and downshift linkage at the transmission.
6. Disconnect the speedometer cable at the extension housing.
7. Remove the two engine rear support to transmission bolts.
8. Position a transmission jack under the transmission and raise it slightly to take the weight off the cross member.
9. Remove the cross member bolts and cross member. With the transmission jack in position, remove the four transmission to converter housing bolts.
10. Support the engine. Tilt the rear of the transmission assembly slightly upward, and with the jack move the assembly toward the rear until it is clear of the turbine shaft. Lower the assembly and remove it from the car.

#### INSTALLATION

1. Install guide pins in the two top transmission to converter housing attaching bolt holes.
2. Mount the transmission on the jack. **Be sure to align the turbine shaft splines with the turbine splines and the converter impeller lugs with the slots in the front pump drive gear.**
3. Raise the transmission, move it toward the front of the car, and position it on the converter housing.
4. Install the transmission to converter housing lower attaching bolts. Remove the two guide pins and install the two upper attaching bolts. Torque the bolts to specification.
5. Install the frame cross member and bolts.

6. Lower the transmission onto the cross member, and install the engine rear support to transmission bolts.

7. Connect the oil cooler to transmission oil inlet and outlet lines to the transmission. Tighten the fittings securely. Install the vent tube.

8. **Lubricate the front universal slip yoke seal and spline with B8A-19589-A lubricant.** Slide the universal joint yoke onto the output shaft, and then connect the drive shaft at the rear axle.

9. Connect the speedometer cable to the extension housing.

10. Connect the manual and downshift linkage at the transmission.

11. Adjust the linkage.

12. Check the operation of the starter neutral switch. Adjust if necessary.

13. Connect the fluid filler tube to the oil pan. Tighten the fittings securely. Connect the hose to the vacuum diaphragm unit and the tube to the clip.

14. Lower the car to the floor and fill the transmission with liquid. Check the fluid level with the transmission at normal operating temperature.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

1. Before removing any of the transmission sub-assemblies, thoroughly clean the outside of the transmission case to prevent dirt from getting inside the mechanism.

2. After the transmission has been removed from the car, place the assembly in the transmission holder shown in Fig. 26.

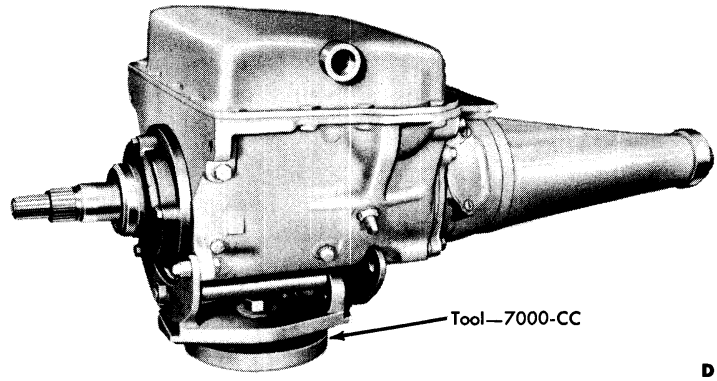
3. Remove the oil pan, gasket, and screen clip.

4. Lift the screen off the forward tube, and then lift it off the rear tube.

5. Remove the spring seat from the pressure regulator. **Maintain constant pressure on the seat to prevent distortion of the spring seat and the sudden release of the springs.** Remove the pressure regulator springs and pilots, but do not remove the valves.

6. Loosen, **but do not remove,** the regulator body attaching bolts. Remove the lubrication tube. If necessary, tap the tube with a soft-faced hammer. **Be careful not to bend or distort the tube.**

7. Lift the rear pump intake tube out of the bore in the transmission case. **Be careful not to bend the tube.**




D1024-A

**FIG. 26—Transmission Mounted on Bench**

8. Remove the small compensator pressure tube. Then remove the large control pressure tube from the pressure regulator and the control valve body. If necessary, tap the tubes with a soft-faced hammer but do not distort them.

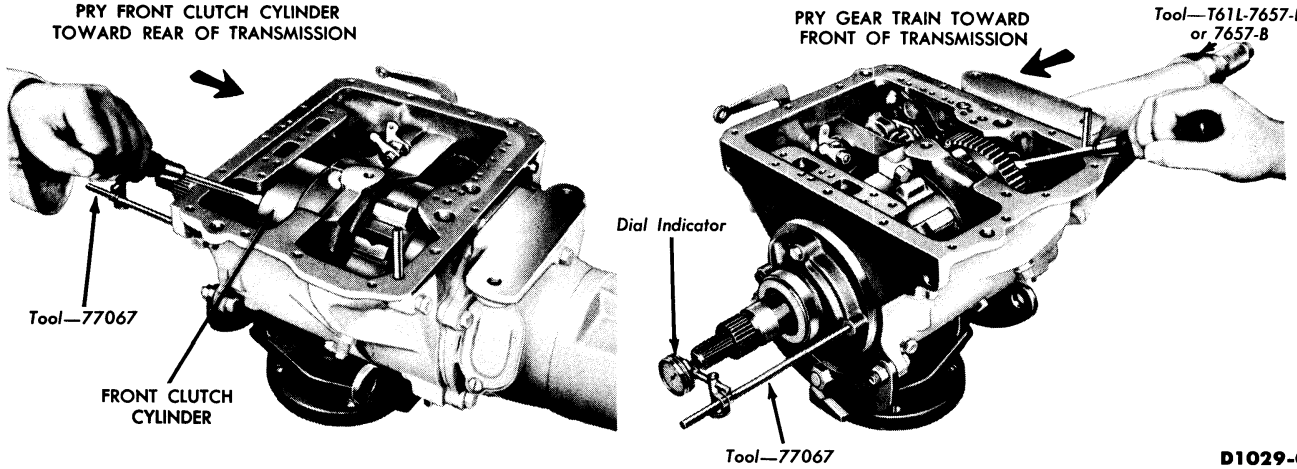
9. Loosen the front and rear servo band adjusting screws five turns. Loosen the front servo attaching bolts three turns.

10. Remove the vacuum diaphragm unit and push rod.

11. Remove the control valve body attaching bolts. Align the levers to permit removal of the valve body. Then lift the valve body clear of the transmission case. Pull the body off the servo tubes and remove it from the case.

12. Remove the regulator body from the case. **Keep the control pressure valve and the converter pressure regulator valve in the pressure regulator to avoid damage to the valves.**

13. Remove the front servo apply




D1029-C

**FIG. 27—Transmission End Play Check**

and release tubes by twisting and pulling at the same time. Remove the front servo attaching bolts. Hold the front servo strut with the fingers, and lift the servo assembly from the case.

**14.** Remove the rear servo attaching bolts. Hold the actuating and anchor struts with the fingers, and lift the servo from the case.

## TRANSMISSION END PLAY CHECK

**1.** Remove one of the front pump attaching bolts. Mount the dial indicator support tool in the front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft as shown in Fig. 27.

**2.** Install the extension housing seal replacer on the output shaft to provide support for the shaft.

**3.** Pry the front clutch cylinder to the rear of the transmission with a large screwdriver (Fig. 27). Set the dial indicator at zero while maintaining a slight pressure on the screwdriver.

**4.** Remove the screwdriver and pry the units toward the front of the transmission by inserting the screwdriver between the large internal gear and the transmission case (Fig. 27).

**5.** Record the indicator reading for use during transmission assembly. End play should be 0.010-0.029 inch (minimum end play is preferred). If end play is not within specifications a new selective thrust washer must be used when the transmission is assembled.

**6.** Remove the indicator support, and then remove the seal replacer from the output shaft.

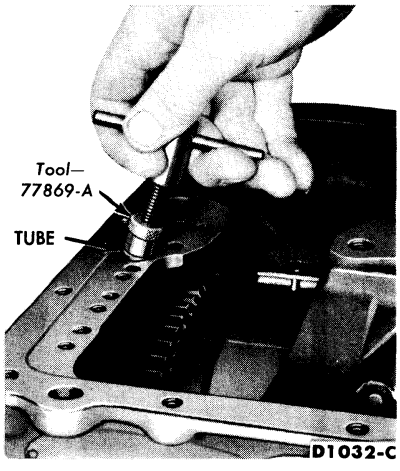



**FIG. 28—Rear Pump Discharge Tube Removal**

## REMOVAL OF CASE AND EXTENSION HOUSING PARTS

**1.** Remove the remaining front pump attaching bolts. Then remove the front pump assembly and gasket. **If necessary, tap the screw bosses with a soft-faced hammer to loosen the pump from the case.**

**2.** Remove the lubrication tube from the case. Remove the five transmission to extension housing bolts. These bolts also attach the rear pump to the case. Remove the extension housing. Install the tube extractor tool in the rear pump discharge tube (Fig. 28) and remove the tube.

**3.** Remove the output shaft assembly (Fig. 29). Be careful not to bend the pressure tubes between the

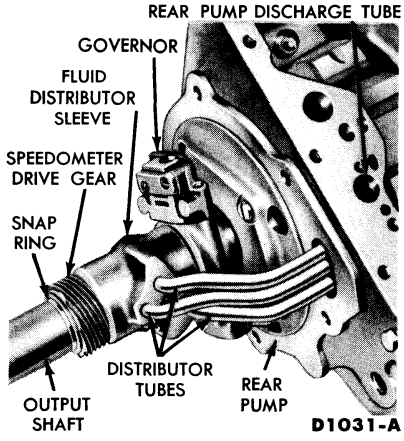



**FIG. 29—Output Shaft Cover and Rear Pump**

distributor sleeve and case as the tubes are removed from the case.

**4.** A nylon speedometer drive gear is used on the output shaft and is a 0.004-0.010-inch shrink fit. If gear replacement is necessary, the old type steel gear may be used.

**5.** To remove the nylon drive gear, place the output shaft assembly

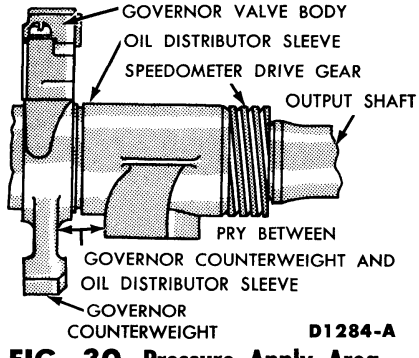



**FIG. 30—Pressure Apply Area for Removing Speedometer Gear**

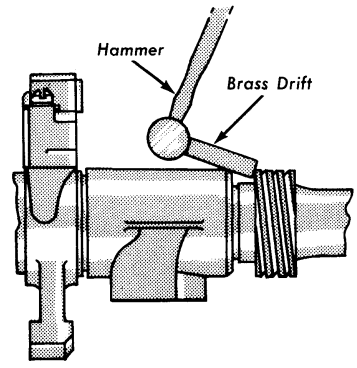



**FIG. 31—Speedometer Drive Gear Removal**

on the bench and remove the oil distributor tubes from the sleeve. Remove the speedometer drive gear snap ring from the shaft. Pry the oil delivery sleeve toward the rear of the shaft with a hammer handle. Make certain to apply pressure on the governor counterweight, and not against the governor valve body (Fig. 30).

**6.** Slide the oil delivery sleeve toward the front of the transmission.

**7.** Using a hammer and a small brass drift, tap the gear evenly and alternately (Fig. 31) to prevent cocking it on the shaft. Tap the gear gently to prevent damaging it.

**8.** If the drive gear ball does not fall out as the speedometer gear is removed, remove the ball from the seat in the output shaft.

**9.** Remove the distributor sleeve. Remove the four seal rings from the output shaft with the fingers to prevent breaking the rings.

**10.** Remove the governor snap ring from the output shaft. Slide the governor assembly off the output shaft. Then remove the governor drive ball. Remove the rear pump, extension housing and pump gaskets. On PCE models, remove the rear pump thrust washer and race (Fig. 32).

**11.** Remove the rear pump drive key from the output shaft. Then remove the bronze thrust washer from the output shaft.

**12.** Remove the selective thrust washer from the rear of the pinion carrier.

**13.** Remove the two seal rings from the primary sun gear shaft. Remove the pinion carrier.

**14.** Remove the primary sun gear rear thrust bearing and race from the pinion carrier.

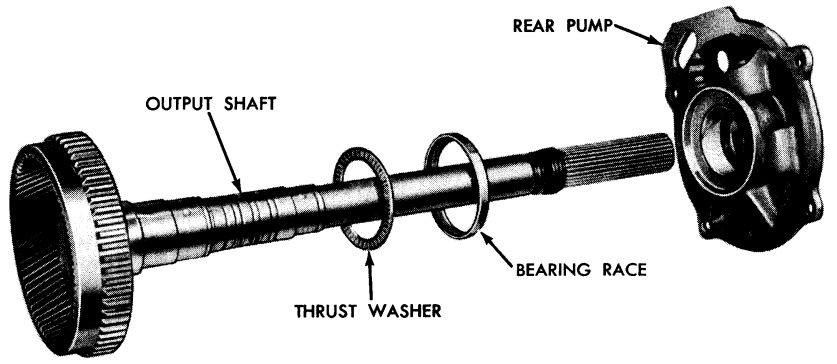



**FIG. 32—Rear Pump Thrust Washer and Race**

**15.** Note the rear band position for reference in assembly. The end of the band next to the adjusting screw has a depression (dimple) in the center of the boss. Squeeze the ends of the rear band together, tilt the band to the rear, and remove the rear band from the case.

**16.** Remove the two center support outer bolts (one each side) from the transmission case.

**17.** Exert enough pressure on the end of the input shaft to hold the clutch units together. Then remove the center support and the front and rear clutch assemblies as a unit (Fig. 33).

**18.** Install the clutch assemblies in the bench fixture (Fig. 34).

**19.** Remove the thrust washer from the front of the input shaft.

**20.** Remove the front band from the case. Lift the front clutch assembly from the primary sun gear shaft.

**21.** Remove the bronze and the steel thrust washers from the rear clutch assembly. Wire the thrust washers together to assure correct installation.

**22.** Remove the front clutch seal rings from the primary sun gear shaft.

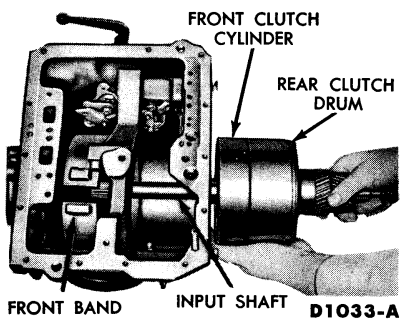



**FIG. 33—Input Shaft and Clutch Removal or Installation**

**23.** Lift the rear clutch assembly from the primary sun gear shaft.

**24.** Remove the rear clutch seal rings from the primary sun gear shaft. **Do not break the seal rings.**

**25.** Remove the primary sun gear front thrust washer.

## PARTS REPAIR AND REPLACEMENT

During the repair of the sub-assemblies, certain general instructions which apply to all units of the transmission must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission with transmission fluid before assembly. **Do not use any other lubricants except on gaskets and thrust washers which may be coated with vaseline to facilitate assembly. Always install new gaskets when assembling parts of the transmission.**

Tighten all bolts and screws to the recommended torque. For detail cleaning and inspection operations refer to Part 7-1.

### PRIMARY SUN GEAR SHAFT

**1.** Position the primary sun gear shaft in the clutch bench fixture.

**2.** Check the fit of the seal rings in their respective bores. A clearance of 0.002-0.009 inch should exist between the ends of the rings.

**3.** Install the seal rings on the shaft, and check for free movement in the grooves.

### REAR CLUTCH

**1.** Remove the clutch pressure plate snap ring, and remove the pressure plate from the drum. Remove the bronze and steel plates.

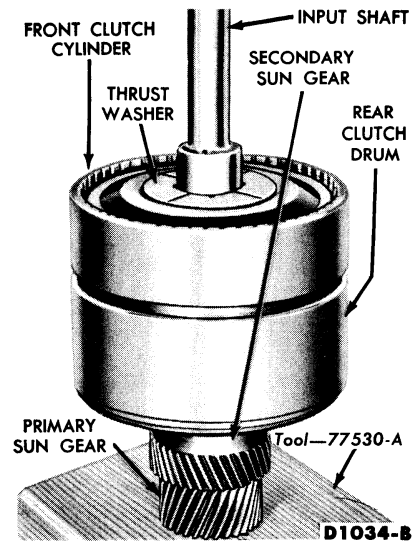



**FIG. 34—Input Shaft and Clutch Mounted in Holding Fixture**

**2.** Compress the spring in an arbor press with the tool shown in Fig. 35 and remove the snap ring.

**3.** Guide the spring retainer while releasing the press to prevent the retainer from locking in the snap ring groove.

**4.** Position the primary sun gear shaft in the rear clutch. Place an air hose nozzle in one of the holes in the shaft, and place one finger over the other hole. Then force the clutch piston out of the clutch drum with air pressure. **Hold one hand over the piston to prevent damage to the piston.**

**5.** Remove the clutch piston inner

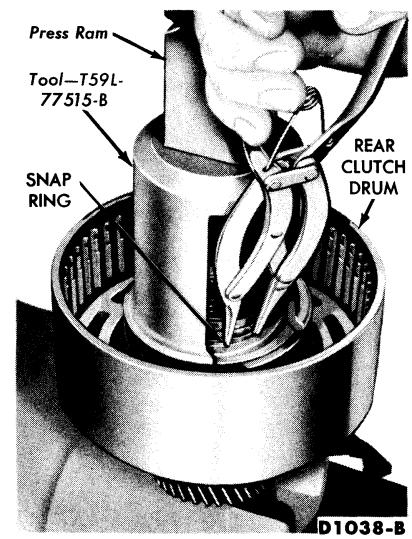



**FIG. 35—Rear Clutch Spring Snap Ring Removal**

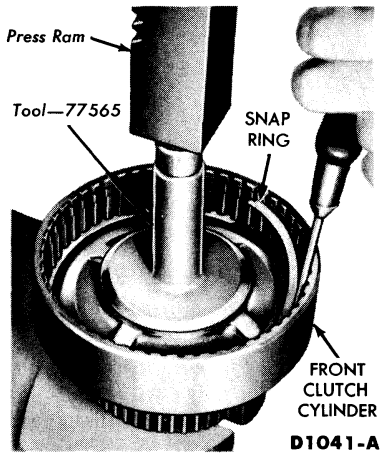



**FIG. 36—Front Clutch Snap Ring Removal**

seal ring from the clutch drum. Remove the clutch piston outer seal ring from the groove in the piston.

**6.** Lubricate all parts to facilitate assembly. Install the clutch piston inner seal ring in the groove in the drum. Install a new outer seal ring on the piston, and install the piston in the clutch drum.

**7.** Install the clutch release spring, and position the retainer on the spring.

**8.** Position the clutch assembly in an arbor press, and then position the proper tool on the spring retainer. Compress the clutch spring, and install the snap ring. **While compressing the spring, guide the retainer to avoid interference of the retainer with the snap ring groove. Make sure the snap ring is fully seated in the groove.** On all models except PCE, when new composition clutch plates are used, soak the plates in automatic transmission fluid for 15 minutes before they are assembled.

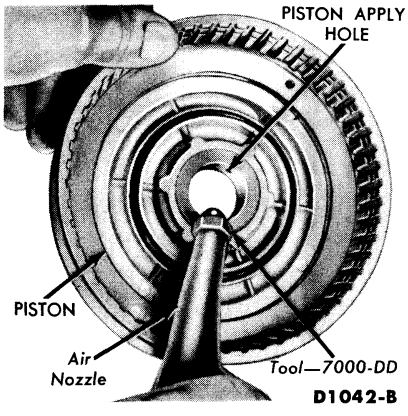



**FIG. 37—Front Clutch Piston Removal**

**9.** Install the composition and the steel clutch plates alternately, starting with a steel plate.

**10.** Install the clutch pressure plate with the bearing surface down. Then install the clutch pressure plate snap ring. Make sure the snap ring is fully seated in the groove.

**11.** Install the thrust washer on the primary sun gear shaft. Lubricate all parts with automatic transmission fluid or petroleum jelly. Install the two center seal rings.

**12.** Install the rear clutch on the primary sun gear shaft. **Be sure all of the needles are in the hub if the unit is equipped with loose needle bearings.** Assemble two seal rings in the front grooves.

**13.** Install the steel and the bronze thrust washers on the front of the secondary sun gear assembly. If the steel washer is chamfered, place the chamfered side down.

## FRONT CLUTCH

**1.** Remove the clutch cover snap ring with a screwdriver, and remove the input shaft from the clutch drum.

**2.** Remove the thrust washer from the thrust surface of the clutch hub. Insert one finger in the clutch hub, and lift the hub straight up to remove the hub from the clutch drum.

**3.** Remove the composition and the steel clutch plates, and then remove the pressure plate from the clutch drum.

**4.** Place the front clutch spring compressor on the release spring, position the clutch drum on the bed of an arbor press, and compress the release spring with the arbor press until the release spring snap ring can be removed (Fig. 36).

**5.** Remove the clutch release spring from the clutch drum.

**6.** Install the special nozzle shown in Fig. 37 on an air hose. Place the nozzle against the clutch apply hole in the front clutch housing, and force the piston out of the housing.

**7.** Remove the piston inner seal from the clutch housing. Remove the piston outer seal from the groove in the piston.

**8.** Lubricate all parts with transmission fluid. Install a new piston inner seal ring in the clutch cylinder. Install a new piston outer seal in the groove in the piston.

**9.** Install the piston in the clutch housing. **Make sure the steel bearing ring is in place on the piston.**

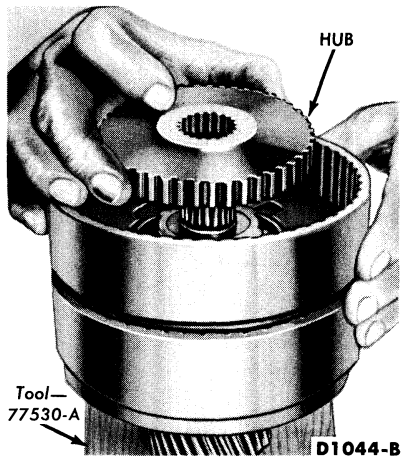



**FIG. 38—Front Clutch Hub Installation**

**10.** Position the release spring in the clutch cylinder with the concave side up. Place the release spring compressor on the spring, and compress the spring with an arbor press. Then install the snap ring as shown in Fig. 35. **Make sure the snap ring is fully seated in the groove.**

**11.** Install the front clutch housing on the primary sun gear shaft by rotating the clutch units to mesh the rear clutch plates with the serrations on the clutch hub. **Do not break the seal rings.**

**12.** Install the clutch hub in the clutch cylinder with the deep counterbore down (Fig. 38). Install the thrust washer on the clutch hub.

**13.** Install the pressure plate in the clutch cylinder with the bearing surface up (Fig. 39). Install the bronze composition and the steel

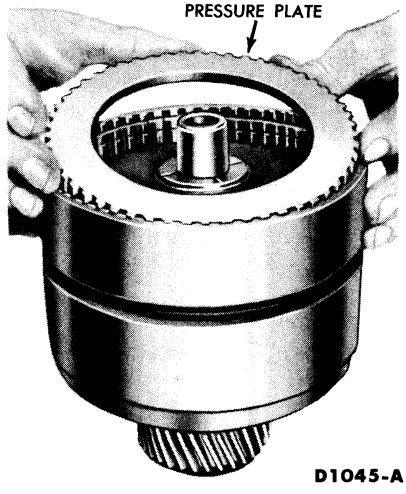



**FIG. 39—Pressure Plate Installation**

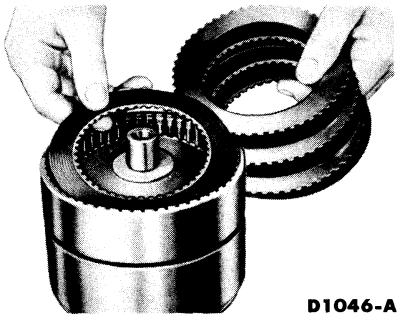

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**FIG. 40—Clutch Plate Installation**

clutch plates alternately, starting with a bronze plate (Fig. 40). Lubricate the plates as they are installed.

**14.** Install the turbine shaft in the clutch cylinder, and then install the snap ring. **Make sure the snap ring is fully seated in the groove.**

**15.** Install the thrust washer on the turbine shaft.

### FRONT PUMP

**1.** Remove the stator support attaching screws and remove the stator support. Mark the top surface of the pump driven gear with Prussian blue to assure correct assembly. **Do not scratch the pump gears.**

**2.** Remove the drive and driven gears from the pump body.

**3.** Refer to Fig. 41 for a disassembled view of the front pump. Inspect the pump body housing, drive gear bushing, gear pockets, and crescent for scores.

**4.** If any parts other than the stator support are found defective, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth. The stator support is serviced separately.

**5.** Bolt the front pump to the transmission case with capscrews.

**6.** Install the oil seal remover shown in Fig. 42. Then pull the front seal from the pump body.

**7.** Clean the pump body counterbore. Then inspect the bore for rough spots. Smooth up the counterbore with crocus cloth.

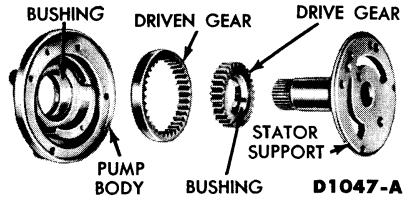



**FIG. 41—Front Pump Disassembled**

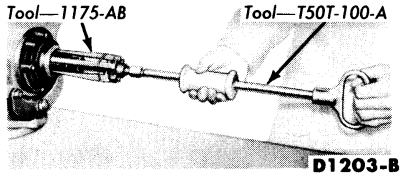



**FIG. 42—Front Pump Seal Removal**

**8.** Remove the pump body from the transmission case.

**9.** Coat the outer diameter of a new seal with FoMoCo Sealing Compound, or its equivalent. Then position the seal in the pump body. Drive the seal into the pump body with the tool shown in Fig. 43 until the seal is firmly seated in the body. Tool 77837 may be reworked (Fig. 44) to install the latest type seal.

**10.** Place the pump driven gear in the pump body with the mark on the gear facing upward. Install the drive gear in the pump body.

**11.** Install the stator support and attaching screws. Check the pump gears for free rotation.

### REAR PUMP

**1.** Remove the screws and lock washers which secure the pump cover to the pump body, and remove the cover. Mark the top face of the pump drive and driven gear with Prussian blue to assure correct installation of gears at assembly (Fig. 45). **Do not scratch or punch marks on the pump gears.**

**2.** Remove the drive and driven gears from the pump body.

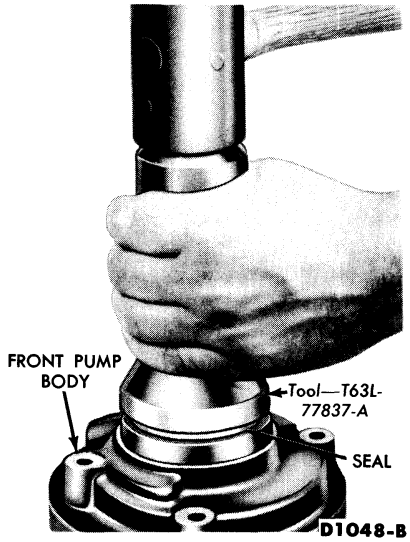



**FIG. 43—Installing Front Pump Seal**

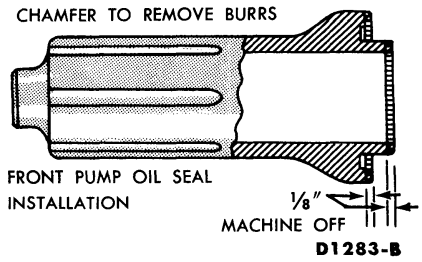



**FIG. 44—Dim. For Reworking Front Pump Seal Installing Tool**

**3.** Place the pump driven gear in the pump body with the mark (placed on the gear at disassembly) facing upward.

**4.** Install the drive gear in the pump body with the mark facing upward. Install the pump cover, attaching screws, and lock washers. Torque the screws to specification.

**5.** Check the pump for free rotation of the gears.

### PRESSURE REGULATOR

**1.** Remove the valves from the regulator body.

**2.** Remove the regulator body cover attaching screws, and remove the cover (Fig. 46).

**3.** Remove the separator plate. Then remove the front pump check valve and spring from the regulator cover.

**4.** Wash all parts thoroughly in clean solvent and blow dry with moisture-free compressed air.

**5.** Inspect the regulator body and cover mating surfaces for burrs.

**6.** Check all fluid passages for obstructions.

**7.** Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth.

**8.** Check the free movement of

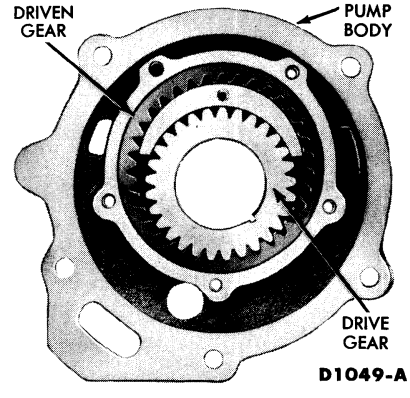



**FIG. 45—Rear Pump Gears**

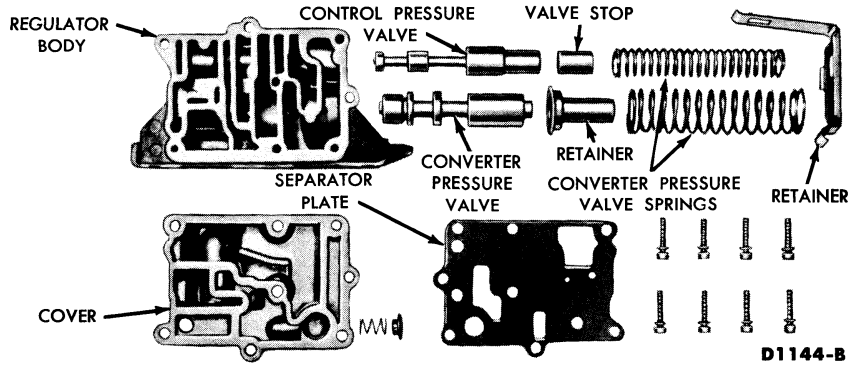



**FIG. 46—Pressure Regulator Assembly**

the valves in their bores. Each valve should fall freely into its bore when both the valve and bore are dry.

**9.** Inspect the valve springs for distortion.

**10.** Position the check valve spring and valve in the regulator cover.

**11.** Position the separator plate on the regulator cover.

**12.** Position the regulator cover and separator plate on the regulator body, and install the attaching screws. Torque the screws to specification.

**13.** Insert the valves in the pressure regulator body (Fig. 46).

## CONTROL VALVE BODY

During the disassembly of the control valve assembly, avoid damage to valve parts and keep the valve parts clean. Place the valve assembly on a clean shop towel while performing the disassembly operation. **Do not separate the upper and lower valve bodies and cover until after the valves have been removed.**

### Disassembly.

**1.** Remove the manual valve (Fig. 47).

**2.** Remove the throttle valve body and the separator plate. Remove the throttle valve and retainer.

**3.** Remove one screw attaching the separator plate to the lower valve body. Remove the upper body front plate. **The plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**

**4.** Remove the compensator sleeve and plug, and remove the compensator valve springs. Remove the compensator valve.

**5.** Remove the throttle boost short valve and sleeve. Remove the throttle boost valve spring and valve.

**6.** Remove the downshift valve and spring.

**7.** Remove the upper valve body rear plate.

**8.** Remove the compensator cut back valve.

**9.** Remove the lower body side plate (Fig. 47). **The plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**

**10.** Remove the 1-2 shift valve and spring. Remove the inhibitor valve and spring.

**11.** Remove the two screws attaching the separator plate to the cover. Remove the lower body end plate. **The end plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**

**12.** Remove the rear servo lockout valve and spring.

**13.** Remove the 2-3 delay and throttle reducing valve sleeve, the throttle reducing valve, spring, and the 2-3 shift delay valve. Remove the 2-3 shift valve spring and valve.

**14.** Remove the transition valve.

**15.** Remove the plate (Fig. 47) from the valve body cover.

**16.** Remove the check ball spring and check ball. Remove the 3-2 kickdown control valve spring and valve.

**17.** Remove the 3-2 coasting control valve spring retainer from the cover. Remove the spring and valve.

**18.** Remove the through bolts and screws. Then separate the bodies.

**19.** Inspect the rear pump check valve for freedom of movement. This valve seat in the lower body is staked for a firm fit and should not be removed unless a new one is to be installed.

### Assembly

**1.** Arrange all parts in their correct positions (Fig. 47). Rotate the valves and plugs when inserting them in their bores to avoid shearing of soft body castings.

**2.** Position the separator plate on the upper body.

**3.** Be sure that the rear pump check valve spring, valve, and seat in the lower body are correctly installed. Position the lower body on the upper body, and start **but do not tighten** the attaching screw.

**4.** Position the cover and separator plate on the lower body and start the four through bolts.

**5.** Align the separator with the upper and lower valve body attaching bolt holes. Install and torque the four valve body bolts to specification. **Excessive tightening of these bolts may distort the valve bodies, causing valves or plugs to stick.**

**6.** Install the 3-2 kickdown control valve and spring and the check ball and spring in the cover. Install the plate.

**7.** Install the 3-2 coasting control valve, spring, and spring retainer in the cover.

**8.** Install the transition valve in the lower body.

**9.** Install the 2-3 shift valve and spring. Install the 2-3 shift delay valve and the spring and throttle reducing valve in the sleeve. Slide the sleeve and valve into position in the lower body.

**10.** Install the rear servo lockout valve spring and valve. Install the lower body end plate.

**11.** Install the inhibitor valve spring and valve in the lower body.

**12.** Install the 1-2 shift valve spring and valve. Install the lower body side plate.

**13.** Install the compensator cutback valve in the upper body. Install the upper body rear plate.

**14.** Install the downshift valve spring and valve.

**15.** Install the throttle boost valve and spring. Install the throttle boost short valve and sleeve.

**16.** Install the compensator valve, inner and outer compensator springs, and the compensator sleeve and plug.

**17.** Position the front plate. Apply pressure to the plate while installing the two attaching screws.

**18.** Install the throttle valve and retainer in the throttle valve body. Position the separator on the upper body and install the throttle valve body. Install the three attaching screws.

**19.** Install four screws attaching the cover to the lower body, two

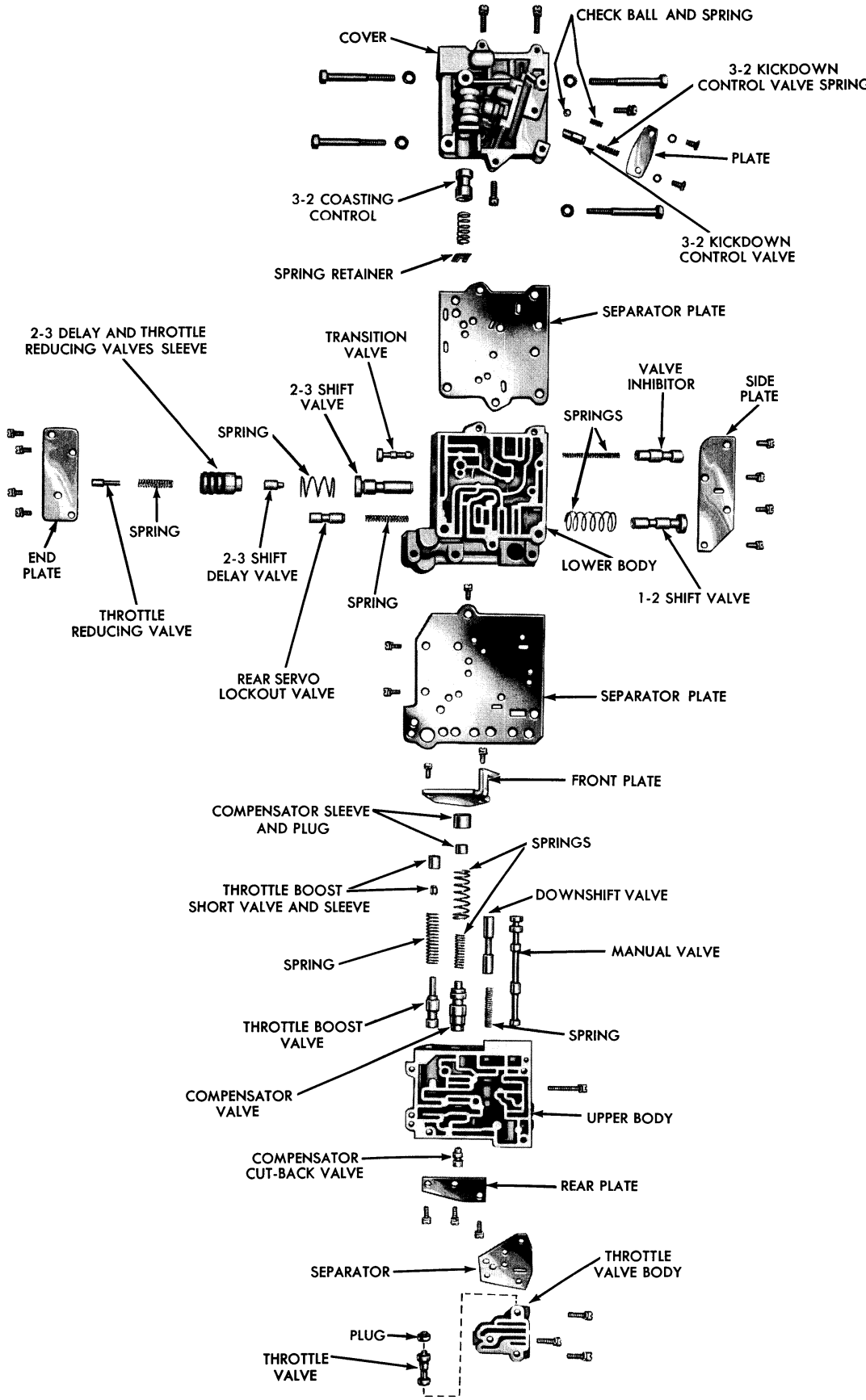



**FIG. 47—Control Valve Body**

screws attaching the separator plate to the upper body, and one screw attaching the separator plate to lower body. Torque the cover and body screws to specification.

**20.** Install the manual valve.

### GOVERNOR

**1.** Remove the governor valve body cover.

**2.** Remove the valve body from the counterweight.

**3.** Remove the plug, sleeve, washer, and valve from the body (Fig. 48).

**4.** Install the governor valve and spring assembly in the bore of the valve body. Install the washer, sleeve, and plug. Make sure the three points on the end of the sleeve seat in the slots in the washer.

**5.** Install the body on the counterweight. **Make sure the fluid passages in the body and the counterweight are aligned.**

**6.** Position the valve body cover on the body, and install the screws.

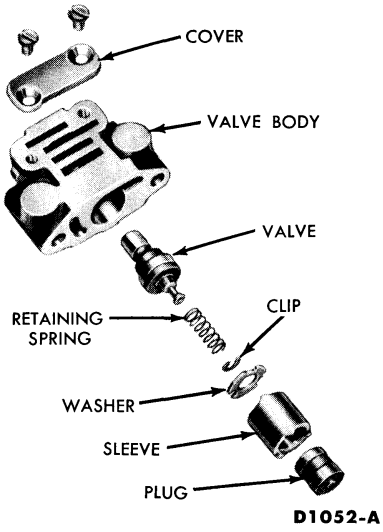



**FIG. 48—Governor Disassembled**

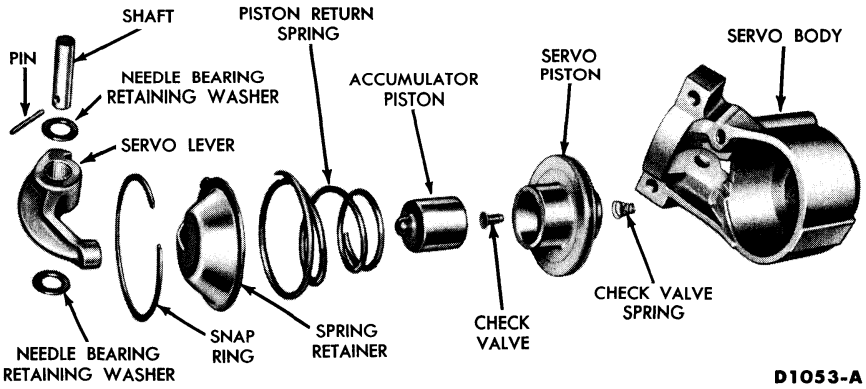



**FIG. 50—Rear Servo**

### FRONT SERVO

**1.** Remove the servo piston retainer snap ring (Fig. 49). The servo piston is spring-loaded. **Apply pressure to the piston when removing the snap ring.**

**2.** Remove the servo piston retainer, servo piston, and the return piston from the servo body. It may be necessary to tap the piston stem lightly with a soft-faced hammer to separate the piston retainer from the servo body.

**3.** Remove the screw and washer from the end of the piston stem, and separate the piston retainer, return piston, and servo piston.

**4.** Remove all the seal rings, and remove the spring from the servo body.

**5.** Inspect the servo body for cracks and the piston bore and the servo piston stem for scores (Fig. 49). Check fluid passages for obstructions.

**6.** Check the actuating lever for free movement, and inspect it for wear. If it is necessary to replace the actuating lever or shaft, remove the retaining pin and push the shaft out of the bracket. If the shaft is not retained by a pin, it is retained in the body by serrations on one end of the shaft. These serrations cause a press fit at that end. To remove the shaft, press on the end opposite the serrations.

Inspect the adjusting screw threads and the threads in the lever.

**7.** Check the servo spring and servo band strut for distortion.

**8.** Inspect the servo band lining for excessive wear and bonding to the metal. **The band should be replaced if worn to a point where the grooves are not clearly evident.**

**9.** Inspect the band ends for cracks and check the band for distortion.

**10.** To assemble, reverse the disassembly procedure.

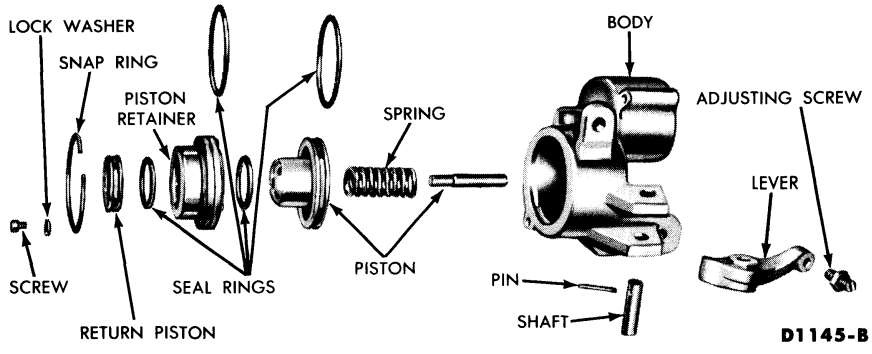



**FIG. 49—Front Servo Disassembled**

### REAR SERVO

**1.** Remove the servo actuating lever shaft retaining pin with a ⅛-inch punch. Remove the shaft and actuating lever needle bearings and thrust washers.

**2.** Press down on the servo spring retainer, and remove the snap ring. **Release the pressure on the retainer slowly to prevent the spring from flying out.**

**3.** Remove the retainer and servo spring (Fig. 50).

**4.** Force the piston out of the servo body with air pressure. Hold one hand over the piston to prevent damage.

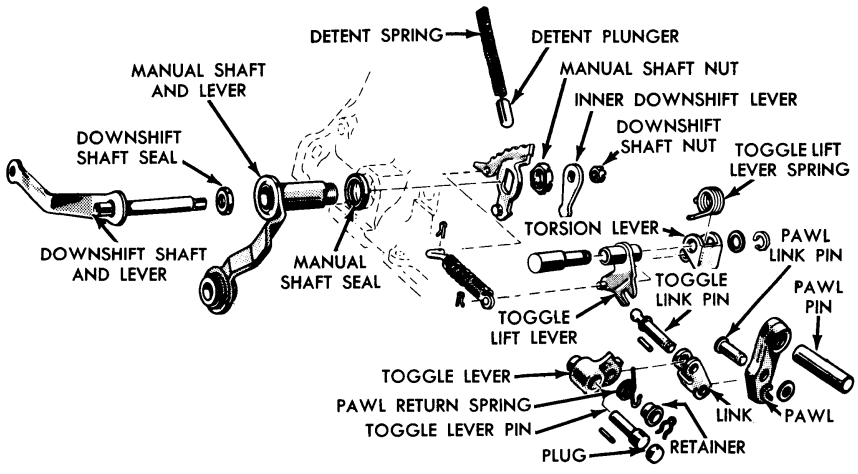
**5.** Remove the piston seal ring. Remove the accumulator piston from the servo piston.

**6.** Install the accumulator piston in the servo piston.

**7.** Install a new seal ring on the servo piston.

**8.** Install the piston in the servo body. **Lubricate the parts to facilitate assembly.** Install the servo spring with the small coiled end against the servo piston.

**9.** Install the spring retainer. Compress the spring with a C-




D1512-A

**FIG. 51—Cruise-O-Matic Transmission Case Control Linkage**

clamp. Then install the snap ring. **The snap ring must be fully seated in the groove.**

**10.** Install the needle bearings in the actuating lever. Install the actuating lever and thrust washers with the socket in the lever bearing on the piston stem. Install the actuating lever shaft, aligning the retaining pin holes, and install the pin.

**11.** Check the actuating lever for free movement.

## TRANSMISSION CASE AND LINKAGE REPAIR

### DISASSEMBLY

**1.** Remove the inner downshift lever shaft nut (Fig. 51). Then remove the inner downshift lever.

**2.** Remove the outer downshift lever and shaft. Remove the downshift shaft seal from the counterbore in the manual lever shaft.

**3.** Remove the cotter pin from the parking pawl toggle operating rod and remove the clip from the parking pawl operating lever. Remove the parking pawl operating rod.

**4.** Rotate the manual shaft until the detent lever clears the detent plunger. Then remove the detent plunger and spring. **Do not allow the detent plunger to fly out of the case.**

**5.** Remove the manual lever shaft nut, and remove the detent lever. Remove the outer manual lever and shaft from the transmission case.

**6.** Remove the clip retaining the toggle operating lever assembly and remove the assembly.

**7.** Tap the toggle lever sharply toward the rear of the case to remove the plug and pin.

**8.** Remove the pawl pin by working the pawl back and forth. Remove the pawl and toggle lever assembly, and then disassemble.

**9.** Remove the manual shaft seal and case vent tube. On PCE models remove the oil cooler return check valve from the back of the case.

**10.** To assemble the case, parts and linkage reverse the disassembly procedure.

### ASSEMBLY

**Do not use force to assemble mating parts.** If the parts do not assemble freely, examine them for the cause of the difficulty. **Always use new gaskets during the assembly operations.**

### CLUTCH ASSEMBLIES

**1.** Install the front band in the transmission case so that the anchor end is aligned with the anchor in the case.

**2.** Make sure the thrust washer is in place on the input shaft. Lift the clutch assemblies out of the holding block. **Do not allow the clutches to separate.**

**3.** Install the clutch sub-assemblies in the transmission case while positioning the servo band on the drum. Hold the units together while installing them (Fig. 33).

### CENTER SUPPORT, ONE-WAY CLUTCH, PINION CARRIER, AND OUTPUT SHAFT

The production center supports are chamfered at the edge of the race (Fig. 52). The service center supports are not chamfered. The following assembly procedures cover both types of center supports.

### INSTALLATION—CENTER SUPPORT WITH CHAMFERED EDGE

**1.** Install the center support and the rear band in the case.

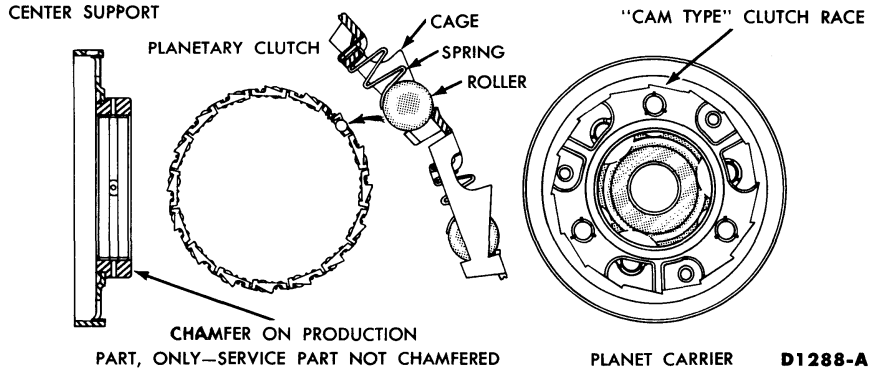
**2.** Install the primary sun gear rear thrust bearing race and the bearing in the planet carrier using petroleum jelly to retain them in place.

**3.** Lubricate the bearing surface on the center support, the rollers of the planetary clutch, and the cam race in the carrier with petroleum jelly.

**4.** Install the planetary clutch in the carrier (Fig. 53).

**5.** Carefully position the planet carrier on the center support. Move the carrier forward until the clutch rollers are felt to contact the bearing surface of the center support.

**6.** While applying forward pressure on the planet carrier, rotate it counterclockwise as viewed from




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**FIG. 52—Planetary Clutch, Planet Carrier and Center Support**

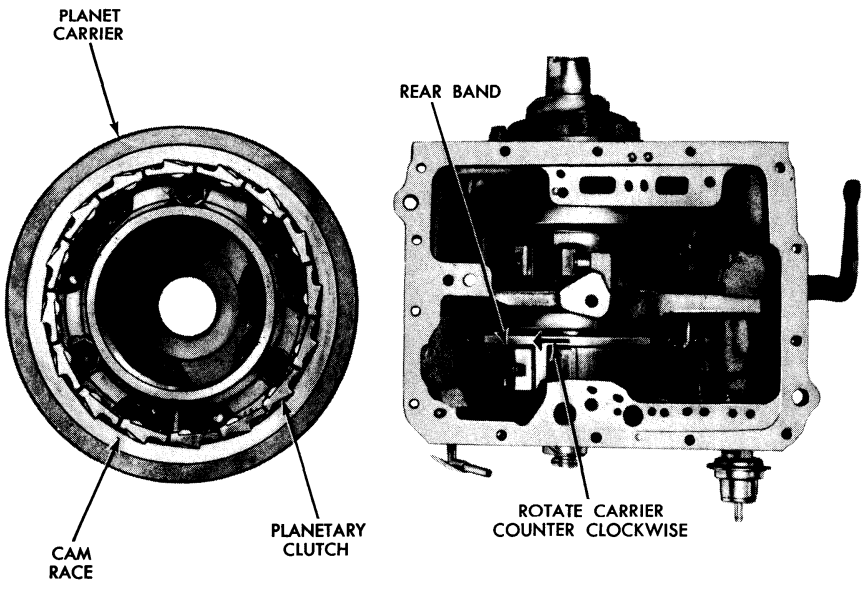



**FIG. 53—Planetary Clutch Installation in Carrier—Using Chamfered C-Support**

the rear (Fig. 53). This will cause the clutch rollers to roll toward the large opening end of the cams in the race, compressing the springs slightly, so that the rollers will ride up the chamfer on the planetary support and onto the inner race.

**7.** Push the planet carrier all the way forward.

**8.** Check the operation of the planetary clutch by rotating the carrier counterclockwise. It should rotate counterclockwise (viewed from the rear) with a slight drag, and it should lock up when attempting to rotate it in a clockwise direction.

### INSTALLATION–CENTER SUPPORT NOT CHAMFERED

**1.** Install the center support and the rear band in the case.

**2.** Install the primary sun gear thrust bearing race and the bearing in the planet carrier using petroleum jelly to retain them in place.

**3.** Lubricate the bearing surface on the center support, the rollers of the planetary clutch, and the cam race in the carrier with vaseline.

**4.** Install the planetary clutch on the center support with the "saw teeth" of the clutch cage pointing in the clockwise direction as viewed from the rear (Fig. 54). Make sure that all rollers are in the cage.

**5.** Position the planet carrier on the support so that the cams in the carrier engage the "saw teeth" on the clutch cage.

**6.** Push the planet carrier forward until the rollers are felt to contact the surface of the cam race.

**7.** While applying forward pressure on the carrier, rotate it counterclockwise as viewed from the rear. This will cause the rollers to roll toward the large opening end of the cams in the race, compressing the springs slightly, so that the rollers will enter the cams.

**8.** Some rollers may become cocked preventing their entry into the outer race. These rollers must be positioned individually with a small screwdriver by pushing the rear of the rollers toward the transmission and into the cam race (Fig. 54). Keep pressure applied to the carrier at all times.

**9.** After all of the rollers have been started into the cam race, rotate the carrier counterclockwise while pushing it forward. Again, straighten any rollers which still may be in a cocked position and prevent the carrier from sliding onto the support.

**10.** Make sure that all springs are entered in the cam race before attempting to push the carrier on the support. Push the carrier all the way forward and check the operation of the clutch by rotating it in a counterclockwise direction. The carrier should rotate counterclockwise with a slight drag and should lock up when attempting to rotate it in a clockwise direction.

**11.** Install the selective thrust washer on the pinion carrier rear pilot. **If the end play was not within**

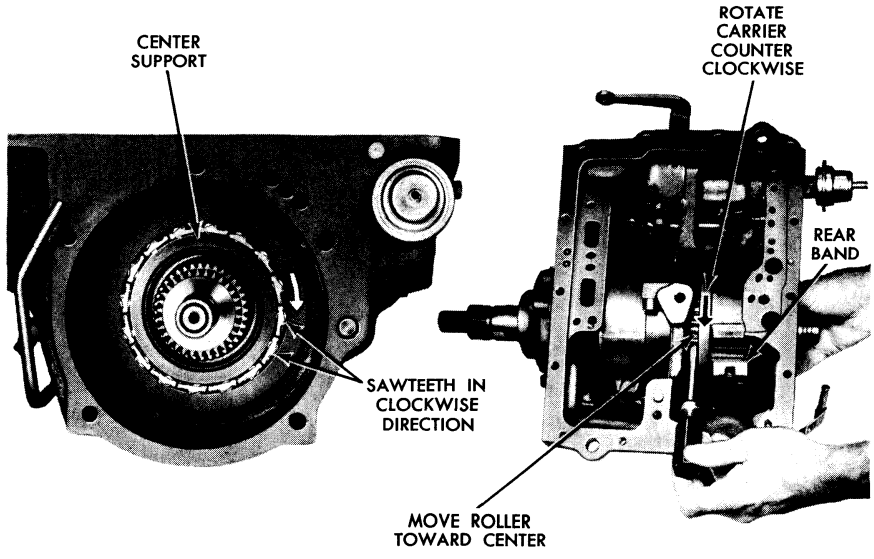



**FIG. 54—Planetary Clutch Installation in Carrier Using Center Support Not Chamfered**

**specifications when checked prior to disassembly, replace the washer with one of proper thickness.** Refer to the Specification Section of Group 7 for selective thrust washer thicknesses.

**12.** Install the output shaft, carefully meshing the internal gear with the pinions.

### REAR PUMP

**1.** Position the rear pump drive key in the keyway on the output shaft.

**2.** Position new front and rear gaskets on the pump body. Retain the gaskets with transmission fluid.

**3.** On PCE models, or when the rear pump housing has been replaced, install the thrust washer and race in the rear pump (Fig. 32). Then install the rear pump. **Be sure the drive key is aligned with the keyway in the pump drive gear.**

### GOVERNOR

**1.** Position the governor drive ball in the pocket in the output shaft. Retain the ball with transmission fluid.

**2.** Install the governor assembly, aligning the groove with the ball in the output shaft.

**3. Install the governor with the governor body plate toward the rear of the transmission.** Install the governor snap ring.

### DISTRIBUTOR

**1.** Place the four seal rings in the distributor sleeve, and check the ring gap.

**2.** Check the fit of the seal rings in the grooves in the output shaft. The rings should rotate freely. Install the rings in the grooves of the output shaft.

**3.** Install the three tubes in the distributor sleeve.

**4.** Install the distributor sleeve on the output shaft, chamfer forward. Lubricate the parts to facilitate assembly. Slide the sleeve forward over the four rings and at the same time start the tubes into the case. The distributor sleeve is located between the governor snap ring and speedometer drive gear.

**5.** Install a new seal on the rear pump outlet tube and install the tube in the transmission case and rear pump body.

### SPEEDOMETER DRIVE GEAR

**1.** Position the speedometer drive gear ball in the pocket of the output shaft. Retain it with fluid.

**2.** If a new speedometer gear is used, the steel gear will slip on to the output shaft. When the nylon gear is re-used dip it in transmission fluid and place it on an illuminated 100-watt light bulb.

**3.** Allow the gear to remain on the bulb for five minutes, then turn it over and heat the other side for five minutes. This will heat the gear to approximately 180°F.

**4.** Make sure the lock ball is in place on the shaft, then quickly slide the gear into place.

**5.** Install the speedometer drive gear snap ring on the output shaft.

### EXTENSION HOUSING

**1.** Insert the extension housing oil seal replacer and pilot in the housing, and install the extension housing on the transmission case. Coat the bolt threads with B5A-19554-A sealer and install the extension housing attaching bolts, breather tube clip, vacuum tube clip, and external tooth lock washers. **The lock washers must be installed with the rolled edge toward the transmission case to insure a tight seal.**

**2.** Torque the extension housing attaching bolts to specification.

**3.** Install a new gasket and the governor inspection cover on the housing.

### FRONT PUMP

**1.** Position a new front pump gasket in the counterbore of the transmission case.

**2.** Install the front pump, aligning the pump bolt holes with the holes in the case. Install three of the front pump attaching bolts and torque them to specification.

### TRANSMISSION END PLAY CHECK

**1.** Mount the dial indicator support in a front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft (Fig. 27).

**2.** Use a large screwdriver to pry the front of the clutch drum toward the rear of the transmission (Fig. 27). Set the dial indicator at zero.

**3.** Remove the screwdriver and pry the units toward the front of the transmission by inserting a screwdriver between the large internal gear and the transmission case (Fig. 27). Note the indicator reading. End play should be 0.010-0.029 inch (minimum end play is preferred).

**4.** Remove the indicator and the tool from the extension housing.

**5.** Install the one remaining front pump attaching bolt and torque it to specification.

### FRONT SERVO

**1.** Position the front band forward in the case with the band ends up.

**2.** Position the servo strut with the slotted end aligned with the servo actuating lever, and with the small end aligned with the band end. Rotate the band, strut, and servo into position engaging the anchor end of the band with the anchor pin in the case.

**3.** Locate the servo on the case, and install the attaching bolts. **Tighten the attaching bolts only two or three threads.**

**4.** Install the servo tubes.

### REAR SERVO

**1.** Position the servo anchor strut, and rotate the rear band to engage the strut.

**2.** Position the servo actuating lever strut with a finger, and then install the servo and attaching bolts. Torque the bolts to specification.

### PRESSURE REGULATOR BODY

**1.** Install the pressure regulator body and attaching bolts, and torque the bolts to specifications.

**2.** Install the control and converter valve guides and springs. Install the spring retainer.

**3.** Install a new seal ring on the rear pump intake tube, and install the tube in the case.

### CONTROL VALVE BODY

**1.** Install the control valve assembly, carefully aligning the servo tubes with the control valve. Align the inner downshift lever between the stop and the downshift valve. Shift the manual lever to the L position. **Align the manual valve with the actuating pin in the manual detent lever. Do not tighten the attaching bolts.**

**2.** Install the large control pressure tube in the valve body and regulator.

3. Install the small control pressure compensator tube in the valve body and regulator.

4. Move the control valve body toward the center of the case as far as the attaching bolts will permit. This movement is made to take up clearance between the manual valve and the actuating pin on the manual detent lever.

5. Torque the attaching bolts to specification.

6. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the body away from the center of the case. Move the body only enough to relieve the binding. Torque the attaching bolts and check the manual valve for binding.

7. Install the lubrication tube, and torque the front servo attaching bolts to specification.

**FRONT SERVO ADJUSTMENT**

1. Loosen the front servo adjusting screw lock nut, and back off the nut three turns.

2. Loosen the adjusting screw five turns.

3. Using the front band adjusting wrench shown in Fig. 16, adjust the front band.

**REAR SERVO ADJUSTMENT**

1. Loosen the adjusting screw lock nut three turns with the ¾-inch socket of the rear band adjusting wrench.

2. Back off the adjusting screw until free travel is obtained.

3. Use the special tools shown in Fig. 18 to adjust the rear band.

**VACUUM DIAPHRAGM UNIT**

1. Position the control rod in the bore of the vacuum diaphragm unit and install the diaphragm unit. Make sure the control rod enters the throttle valve as the vacuum unit is installed.

2. Torque the diaphragm unit to specification.

**FLUID SCREEN AND PAN**

1. Position the fluid screen over the rear pump inlet tube, and then over the front pump inlet tube. Press the screen down firmly. Install the screen retaining clip.

2. Place a new gasket on the transmission case and install the pan. Install the attaching bolts and lock washers and torque the bolts to specification.

If the converter and converter housing were removed from the transmission, install these components. Position the transmission assembly on the transmission jack, and refer to "Transmission Installation Procedures" for installing the transmission.

# PART 7-4 SPECIFICATIONS

## C4 AUTOMATIC DUAL RANGE TRANSMISSIONS ONLY

### CONTROL PRESSURE AT ZERO OUTPUT SHAFT SPEED

| Engine Speed | Throttle | Manifold Vac. Ins. Hg. | Selector Lever Position | Control Pressure (P.S.I.) |
|---|---|---|---|---|
| Idle | Closed | *Above 18 | P, N, D1, D2, L | 55-62 |
| | | | R | 55-96 |
| As Required | As Required | 17.5-16.5 | D1, D2, L | Pressure Starts to Increase |
| As Required | As Required | 10 | D1, D2, L | 95-110 |
| As Required | As Required | 3 | D1, D2, L | 138-148 |
| | | | R | 213-227 |

*Vehicles checked at high altitudes

At Altitudes above sea level it may not be possible to obtain 18" of vacuum at idle. For idle vacuums of less than 18" refer to following table to determine idle speed pressure specification in forward driving ranges (D1, D2, or L).

| Engine Vacuum | Control Pressure (PSI) |
|---|---|
| 17 | 55-65 |
| 16 | 55-71 |
| 15 | 55-77 |
| 14 | 55-83 |
| 13 | 55-89 |
| 12 | 55-95 |
| 11 | 55-101 |

### STALL SPEED LIMITS

| Engine Model | Engine Speed (rpm) |
|---|---|
| 223 Six | 1500-1700 |
| 289-V8 | 1750-1950 |

### LUBRICANT REFILL CAPACITY

| | |
|---|---|
| Approximate Capacity—Quarts | 8.5 |

### CLUTCH PLATES

| Transmission Model | Reverse—High Clutch | | Forward Clutch | |
|---|---|---|---|---|
| | Steel Plates | Composition Plates | Steel Plates | Composition Plates |
| PCW-C (223) | 3 | 3 | 3 | 4 |
| PCW-T (289) | 4 | 4 | 3 | 4 |

### SHIFT SPEEDS (APPROXIMATE)

| Axle Ratio | Automatic Shift Speeds (mph) | | | | | | | | Manual Shift Speeds (mph) |
|---|---|---|---|---|---|---|---|---|---|
| | D1 | | D1 or D2 | | D1 | D1 or D2 | D1 | D2 | L |
| | 1-2 Minimum Throttle | 1-2 Maximum Throttle | 2-3 Minimum Throttle | 2-3 Maximum Throttle | 3-1 Minimum Throttle | 3-2 Maximum Throttle | 2-1 or 3-1 Maximum Throttle | 3-2 Minimum Throttle | 2-1 Minimum Throttle |
| 3.25:1 3.50:1 | 8-10 | 31-41 | 12-24 | 54-71 | 10 (max.) | 64 (max.) | 33 (max.) | 10 (max.) | 22 (max.) |
| 3.00:1 | 9-11 | 36-44 | 14-25 | 64-76 | 11 (max.) | 69 (max.) | 35 (max.) | 11 (max.) | 23 (max.) |

## CHECKS AND ADJUSTMENTS

| Operation | Specification |
|---|---|
| Transmission End Play Check | 0.008-0.042 inch<br>*Selective Thrust Washers Available: |
| Turbine and Stator End Play Check | 0.060 inch (maximum) |
| Intermediate Band Adjustment | Adjust screw to 10-foot-pounds torque, and back off 1½ turns |
| Low-Reverse Band Adjustment | Adjust screw to 10-foot-pounds torque, and back off 3 turns |
| Forward Clutch Pressure Plate to Snap Ring Clearance | 0.022 to 0.042 inch<br>Selective Snap Ring Thicknesses<br>0.092-0.088<br>0.078-0.074<br>0.064-0.060 |

## *SELECTIVE THRUST WASHERS— (No. 1 and 2 Used in Pairs)

| THRUST WASHER NO. 1 | | THRUST WASHER NO. 2 | |
|---|---|---|---|
| Composition Thrust Washer | Color of Washer | No. Stamped on Washer | Metal Thrust Washer |
| 0.108-0.104 | Blue | 5 | 0.109-0.107 |
| 0.091-0.087 | Yellow | 4 | 0.092-0.090 |
| 0.074-0.070 | Black | 3 | 0.075-0.073 |
| 0.057-0.053 | Tan | 2 | 0.058-0.056 |
| 0.042-0.038 | Green | 1 | 0.043-0.041 |

## CONTROL VALVE BODY SPRING IDENTIFICATION

| Spring | Total Coils | Free Length | O.D. | Wire Diameter | Lbs. Load | Length |
|---|---|---|---|---|---|---|
| Main Oil Pressure Reducer Valve | 19 | 1.42 | .281 | .035 | 3.012 | .887 |
| Cut Back Control Valve | 19 | 1.00 | .200 | .020 | 1.05 | .59 |
| Manual Valve Detent | 10 | .74 | .300 | .047 | 8.0 | .601 |
| 3-2 Coasting Control Valve | 10 | .83 | .285 | .023 | 1.0 | .476 |
| Line Pressure Relief | 17 | 1.15 | .198 | .041 | 7.0 | .80 |
| Secondary Throttle Valve | 14 | 1.581 | .350 | .026 | 1.728 | .565 |
| 2-3 Backout Control Valve | 11½ | 1.26 | .45 | .032 | 1.47 | .580 |
| Main Oil Pressure Regulator Valve | 16 | 1.92 | .48 | .049 | 9.09 | .876 |
| Throttle Pressure Modulator Valve | 19 | 1.29 | .29 | .029 | 2.15 | .620 |
| Control 1-2 Shift Valve | 14 | 1.58 | .26 | .026 | 1.7 | .70 |
| Throttle Downshift Valve | 12 | .79 | .24 | .023 | 1.15 | .48 |
| 2-3 Shift Valve | 6½ | 1.18 | .53 | .031 | 1.38 | .39 |
| Throttle Pressure Booster Valve | 16¾ | 1.589 | .311 | .035 | 4.80 | .84 |

## TORQUE LIMITS

| Item | Foot Pounds |
|---|---|
| Pressure Gauge Tap Plug | 9-15 |
| Intermediate Servo Cover to Case Bolts | 12-20 |
| Low-Reverse Servo Cover to Case Bolts | 12-20 |
| Downshift Lever to Case Nut | 12-20 |
| Support Assy. to Frt. Pump Bolts | 12-20 |
| Oil Pan to Case Bolts | 12-16 |
| Distributor Sleeve to Case Bolts | 12-20 |
| Reverse Servo Piston to Shaft Nut | 12-20 |
| Outer Race to Case Bolts | 13-20 |
| Diaphragm Assy. to Case | 15-23 |
| Converter Drain Plug | 20-30 |
| Ext. Hsg. to Case Bolts | 28-40 |

## TORQUE LIMITS (Continued)

| Item | Foot Pounds |
|---|---|
| Convert Housing & Pump to Case Bolts | 28-40 |
| Intermediate Band Adj. Stop to Case Nut | 35-45 |
| Low-Reverse Band Adj. Stop to Case Nut | 35-45 |
| Manual Lever to Shaft Nut | 35-45 |
| **Item** | **Inch Pounds** |
| End Plate to Valve Body Screw | 20-35 |
| Lower to Upper Valve Body Bolts | 20-35 |
| Screen to Valve Body Screws | 20-35 |
| Neutral Switch to Case Screws | 30-45 |
| Screen to Valve Body Bolt | 80-120 |
| Screen and Valve Body to Case Bolts | 80-120 |
| Governor Bodies to Distributor Body Bolts | 80-120 |
| Cooler Line Fittings | 80-120 |

# CRUISE-O-MATIC OR MERC-O-MATIC TRANSMISSIONS ONLY

## CONTROL PRESSURE LIMITS

| Engine Speed or Manifold Vacuum | Throttle Position | Shift Selector Lever Position | Control Line Pressure | |
|---|---|---|---|---|
| | | | All Except Police Interceptor | Police Interceptor |
| Engine Idle—Vacuum above 16 inches | Closed | P, N, D2, D1, L | 57-77 | 70-95 |
| Engine Idle—Vacuum above 16 inches | Closed | R | 71-106 | 81-144 |
| Engine R.P.M. as required for 16-13.7 inches of manifold vacuum | As Required | L, D2, D1, R | Line Pressure Increase | Line Pressure Increase |
| Engine R.P.M.—STALL Vacuum below 1.5 inches | To and thru Detent | L, D2, D1 | 151-176 | 170-200 |
| Engine R.P.M.—STALL Vacuum below 1.5 inches | To and thru Detent | R | 201-213 | 212-228 |

## STALL SPEEDS

| Selector Lever Position | Clutch Applied | Band Applied | Engine Speed (rpm) | | |
|---|---|---|---|---|---|
| | | | 289—2V | 352 V-8 (Dual Carburetor) | 390 V-8 |
| D2 | Front | Front | 1750-1950 | 1550-1750 | 390—2V 1700-1900<br>390—4V 1800-2000<br>Police Interceptor 1750-1950 |
| D1 | Front | One-Way Clutch | | | |
| L | Front | Rear | | | |
| R | Rear | Rear | | | |

## SHIFT SPEEDS (APPROXIMATE)

| Transmission Model | Automatic Shift Speeds (mph) | | | | | | | | Manual Shift Speeds (mph) |
|---|---|---|---|---|---|---|---|---|---|
| | D1 | | D1 or D2 | | D1 | D1 or D2 | D1 | D2 | L |
| | 1-2 Minimum Throttle | 1-2 Maximum Throttle | 2-3 Minimum Throttle | 2-3 Maximum Throttle | 3-1 Minimum Throttle | 3-2 Maximum Throttle | 2-1 or 3-1 Maximum Throttle | 3-2 Minimum Throttle | 2-1 Minimum Throttle |
| PCT | 7-9 | 35-42 | 10-21 | 6 | 6 | 6 | 25-33 | 6-10 | 17-24 |
| PCD | 10-13 | 40-48 | 14-24 | 63-73 | 9-10 | 58-68 | 27-36 | 7-10 | 16-28 |
| PCE | 8-11 | 41-49 | 14-24 | 63-75 | 8-10 | 58-69 | 27-36 | 7-10 | 19-26 |
| PCE Police Interceptor | 6-11 | 47-56 | 14-27 | 79-90 | 6-8 | 73-81 | 37-46 | 4-11 | 25-39 |

## CHECKS AND ADJUSTMENTS

| Operation | Specification |
|---|---|
| Transmission End Play Check | 0.010-0.029 inch<br>Selective Thrust Washers Available:<br>0.063-0.061 inch, 0.069-0.067 inch<br>0.076-0.074 inch, 0.083-0.081 inch |
| Turbine and Stator End Play Check | 0.060 inch (maximum) |
| Front Band Adjustment (Use ¼-inch spacer between adjustment screw and servo piston stem) | Adjust screw to 10 inch-pounds torque, and back off one full turn and lock. |
| Rear Band Adjustment | Adjust screw to 10 ft-lbs torque, and back off 1½ turns and lock. |
| Primary Sun Gear Shaft Ring End Gap Check | 0.002-0.009 inch |

## CHECKS AND ADJUSTMENTS (Continued)

| Operation | Specification |
|---|---|
| Accelerator Pedal Height Adjustment | $3\frac{11}{16}$ inches above floor mat |
| Rear Clutch Steel Plate Coning Clearance Check—PCE model transmission | 0.010 inch (maximum coned) |
| Rear Clutch Steel Plate all except PCE model transmissions | Flat |

## LUBRICANT REFILL CAPACITY

| | |
|---|---|
| Approximate Capacity—Quarts | 10 |

## TORQUE LIMITS

| Item | Foot Pounds |
|---|---|
| Converter to Flywheel Nuts | 15-28 |
| Converter Housing to Transmission Case Bolts | 35-45 |
| Front Pump to Transmission Case Bolts | 17-22 |
| Front Servo to Transmission Case Bolts | 30-35 |
| Rear Servo to Transmission Case Bolts | 40-45 |
| Planetary Support to Transmission Case Screws | 20-25 |
| Upper Valve Body to Lower Valve Body Bolts | 4-6 |
| Control Valve Body to Transmission Case Bolts | 8-10 |
| Pressure Regulator Assembly to Transmission Case Screws | 17-22 |
| Extension Assembly to Transmission Case Bolts | 28-38 |
| Oil Pan to Transmission Case Bolts | 10-13 |
| Case Assembly—Gauge Hole Plugs | 7-15 |
| Rear Band Adjusting Screw Locknut | 35-40 |
| Front Band Adjusting Screw Locknut | 20-25 |
| Manual Control Lever Nut | 35-40 |

## TORQUE LIMITS (Continued)

| Item | Foot Pounds |
|---|---|
| Downshift Lever Nut | 17-20 |
| Front Pump Cover Screws | 25-35* |
| Rear Pump Cover Screws (¼—20) | 80-90* |
| Rear Pump Cover Screws (10—24) | 25-35* |
| Governor Inspection Cover Screws | 50-60* |
| Converter Cover Drain Plug | 15-28 |
| Converter Housing to Engine Bolts | 45-50 |
| Vent Tube Nut | 7-12 |
| Governor Valve Body to Counterweight Screws | 50-60* |
| Governor Valve Body Cover Screws | 20-30* |
| Pressure Regulator Cover Screws | 20-30* |
| Control Valve Body Screws (10—24) | 20-30* |
| Front Servo Release Piston to Servo Piston Screw | 20-30* |
| Vacuum Diaphragm Unit | 20-30 |
| Cooler Return Check Valve (Model PCE) | 15-21 |

*Inch-Pounds

# ENGINE

# GROUP 8


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# PART 8-1 GENERAL ENGINE SERVICE


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This part covers engine diagnosis, tests and adjustment and repair procedures. In addition, the cleaning and inspection procedures are covered.

For engine removal, disassembly, assembly, installation and major repair procedures, refer to the pertinent part of this group.

## 1 DIAGNOSIS AND TESTING

### DIAGNOSIS

Engine performance complaints usually fall under one of the basic headings listed in the "Diagnosis Guide." When a particular trouble can not be traced to a definite cause by a simple check, the possible items that could be at fault are listed in the order of their probable occurrence. Check the items in the order listed. For example, under "Poor Acceleration," the ignition system is listed as a probable cause of trouble. All the conventional ignition system items that affect acceleration are listed. Check all these items before proceeding to the next probable cause.

**For diagnosis of transistor ignition system malfunctions, refer to Group 9.**

### DIAGNOSIS GUIDE

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| **ENGINE WILL NOT CRANK** | The cause of this trouble is usually in the starting system (Group 14).<br>If the starting system is not at fault, check for a hydrostatic lock or a seized engine as follows:<br>Remove the spark plugs, then attempt to crank the engine with the starter. If the engine cranks, it indicates that water is leaking into the cylinders. Remove the cylinder head(s) and inspect the gasket(s) and/or head(s) for cracks. Examine the cylinder block for cracks. |

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**DIAGNOSIS GUIDE (Continued)**

**ENGINE CRANKS NORMALLY, BUT WILL NOT START**

Check the fuel supply. If there is sufficient fuel in the tank and the proper starting procedure is used, the cause of the trouble probably lies in either the ignition or the fuel system.

To determine which system is at fault, perform the following test:

Disconnect a spark plug wire. Check the spark intensity at the end of the wire by installing a terminal adapter in the terminal of the wire to be checked. Then hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine.

**IF THERE IS NO SPARK OR A WEAK SPARK AT THE SPARK PLUGS**

The cause of the trouble is in the ignition system.

To determine if the cause of the trouble is in the primary or the secondary circuit, remove the coil high tension lead from the top of the distributor, **and hold it approximately 3/16 inch from the cylinder head.** With the ignition on, crank the engine and check for a spark.

If the spark at the coil high tension lead is good, the cause of the trouble is probably in the distributor cap, rotor or spark plug wires.

If there is no spark or a weak spark at the coil high tension lead, the cause of the trouble is probably in the primary circuit, coil to distributor high tension lead, or the coil.

**IF THERE IS A GOOD SPARK AT THE SPARK PLUGS**

Check the spark plugs. If the spark plugs are not at fault, check the following items:

**MANUAL CHOKE**

Check the choke linkage for binding or damage. Make certain the choke plate closes when the choke knob on the instrument panel is pulled out and that the plate opens when the knob is pushed in.

**AUTOMATIC CHOKE**

Check the position of the choke plate. If the engine is hot, the plate should be open. If the plate is not open, the engine will load up due to the excessively rich mixture and will not start. If the engine is cold, the plate should be closed. If the plate is not operating properly, check the following items:

The choke plate and linkage for binding.

The fast idle cam for binding.

The thermostatic spring housing adjustment.

**FUEL SUPPLY AT THE CARBURETOR**

Work the throttle by hand several times. Each time the throttle is actuated, fuel should spurt from the accelerating pump discharge port (6-cylinder) or nozzles (V-8).

If fuel is discharged by the accelerating pump, the engine is probably flooded, or there is water in the fuel system, or an engine mechanical item is at fault.

If fuel is not discharged by the accelerating pump, disconnect the carburetor fuel inlet line at the carburetor. Use a suitable container to catch the fuel. Crank the engine to see if fuel is reaching the carburetor.

If fuel is not reaching the carburetor, check:

The fuel filter.

The fuel pump.

The carburetor fuel inlet line for obstructions.

The fuel pump flexible inlet line for a collapsed condition.

The fuel tank line for obstructions.

The fuel tank vent.

If fuel is reaching the carburetor, check:

The fuel inlet system including the fuel inlet needle and seat assembly and the float assembly.

**ENGINE**

Mechanical failure in camshaft drive.

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**DIAGNOSIS GUIDE (Continued)**

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| **ENGINE STARTS, BUT FAILS TO KEEP RUNNING** | **FUEL SYSTEM**<br>Idle fuel mixture needle(s) not properly adjusted.<br>Engine idle speed set too low.<br>The choke not operating properly.<br>Float setting incorrect.<br>Fuel inlet system not operating properly.<br>Dirt or water in the fuel lines or in the fuel filter.<br>Carburetor icing.<br>Fuel pump defective.<br>Check for dirt in the carburetor not allowing fuel to enter or be discharged from the idle system.<br>**IGNITION SYSTEM**<br>Leakage in the high tension wiring.<br>Open circuit in the primary resistance wire. |
| **ENGINE RUNS, BUT MISSES** | Determine if the miss is steady or erratic and at what speed the miss occurs by operating the engine at various speeds under load.<br>**MISSES STEADILY AT ALL SPEEDS**<br>Isolate the miss by operating the engine with one cylinder not firing. This is done by operating the engine with the ignition wire removed from one spark plug at a time, until all cylinders have been checked. Ground the spark plug wire removed.<br>If the engine speed changes when a particular cylinder is shorted out, that cylinder was delivering power before being shorted out. If no change in the engine operation is evident, the miss was caused by that cylinder not delivering power before being shorted out. In this case, check the:<br>**IGNITION SYSTEM**<br>If the miss is isolated in a particular cylinder, perform a spark test on the ignition lead of that cylinder.<br>If a good spark does not occur, the trouble is in the secondary circuit of the system. Check the spark plug wire and the distributor cap.<br>If a good spark occurs, check the spark plug. If the spark plug is not at fault, a mechanical component of the engine is probably at fault.<br>**ENGINE**<br>Intake manifold gasket leak (V-8).<br>Perform a compression test to determine which mechanical component of the engine is at fault.<br>**MISSES ERRATICALLY AT ALL SPEEDS**<br>**EXHAUST SYSTEM**<br>Exhaust system restricted.<br>**IGNITION SYSTEM**<br>Breaker points not properly adjusted.<br>Defective breaker points, condenser, secondary wiring, coil, or spark plugs.<br>High tension leakage across the coil, rotor, or distributor cap.<br>Defective ignition switch.<br>**FUEL SYSTEM**<br>Float setting incorrect.<br>Fuel inlet system not operating properly.<br>Dirt or water in the fuel lines or carburetor.<br>Restricted fuel filter.<br>Loose booster venturi (V-8).<br>**COOLING SYSTEM**<br>Check the cooling system for internal leakage and/or for a condition that prevents the engine from reaching normal operating temperature.<br>**ENGINE**<br>Perform a compression test to determine which mechanical component of the engine is at fault.<br>**MISSES AT IDLE ONLY**<br>**FUEL SYSTEM**<br>Idle fuel mixture needle(s) not properly adjusted.<br>Restriction in idle fuel system.<br>**IGNITION SYSTEM**<br>Excessive play in the distributor shaft.<br>Worn distributor cam.<br>**ENGINE**<br>Valve lash (engines with mechanical valve lifters) or valve clearance (engines with hydraulic valve lifters or silent valve lash) set too tight. Worn camshaft lobe(s).<br>Perform a compression test to determine which mechanical component of the engine is at fault. |

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**DIAGNOSIS GUIDE (Continued)**

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| **ENGINE RUNS, BUT MISSES (Continued)** | **MISSES AT HIGH SPEED ONLY**<br>**FUEL SYSTEM**<br>Power valve or passages clogged or damaged.<br>Low or erratic fuel pump pressure.<br>Fuel inlet system not operating properly.<br>Restricted fuel filter. | Restricted main fuel system.<br>Positive crankcase ventilation system restricted or not operating properly.<br>**COOLING SYSTEM**<br>Engine overheating.<br>**ENGINE**<br>Perform a compression test to determine which mechanical component of the engine is at fault. |
| **ROUGH ENGINE IDLE** | **FUEL SYSTEM**<br>Engine idle speed set too low.<br>Idle fuel mixture needle(s) not properly adjusted.<br>Float setting incorrect.<br>Air leaks between the carburetor, spacer, and the manifold and/or fittings.<br>Intake manifold gasket leak (V-8).<br>Power valve leaking fuel.<br>Idle fuel system air bleeds or fuel passages restricted.<br>Fuel bleeding from the accelerating pump discharge nozzle(s).<br>Secondary throttle plate(s) not closing (4-barrel carburetor).<br>Improper secondary throttle plate stop adjustment (4-barrel carburetor).<br>Incorrect idle speed setting of the secondary carburetors (427 V-8).<br>Leaking fuel pump, lines, or fittings. | **IGNITION SYSTEM**<br>Improperly adjusted or defective breaker points.<br>Fouled or improperly adjusted spark plugs.<br>Incorrect ignition timing.<br>Spark plug misfiring.<br>**EXHAUST SYSTEM**<br>Exhaust control valve inoperative or sticking (Mileage Maker Six and 427 V-8).<br>**ENGINE**<br>Loose engine mounting bolts or worn insulator.<br>Cylinder head bolts not properly torqued.<br>Valve lash or valve clearance set too tight.<br>Crankcase ventilation regulator valve defective or a restricted tube. |
| **POOR ACCELERATION** | **IGNITION SYSTEM**<br>Incorrect ignition timing.<br>Fouled or improperly adjusted spark plugs.<br>Improperly adjusted or defective breaker points.<br>Distributor not advancing properly.<br>Loose or defective spark control valve (6-cylinder).<br>**FUEL SYSTEM**<br>Inoperative accelerating pump inlet ball check.<br>Inoperative accelerating pump discharge ball check.<br>Accelerating pump diaphragm defective.<br>Float setting incorrect.<br>Throttle linkage not properly adjusted. | Accelerating pump stroke not properly adjusted.<br>Leaky power valve, gaskets, or accelerating pump diaphragm.<br>Power valve piston stuck in the up position (6-cylinder).<br>Dirt or corrosion in accelerating system.<br>Distributor vacuum passages in the carburetor blocked.<br>Restricted fuel filter.<br>Defective fuel pump.<br>**BRAKES**<br>Improper adjustment.<br>**TRANSMISSION**<br>Clutch slippage (manual - shift transmissions).<br>Improper band adjustment (automatic transmissions).<br>Converter One-Way Clutch (automatic transmissions). |
| **ENGINE DOES NOT DEVELOP FULL POWER, OR HAS POOR HIGH SPEED PERFORMANCE** | **FUEL SYSTEM**<br>Restricted air cleaner.<br>Restricted fuel filter.<br>Clogged or undersize main jets and/or low float setting.<br>Power valve or passages clogged or damaged.<br>Fuel pump pressure incorrect. | Distributor vacuum passage in the carburetor blocked.<br>**IGNITION SYSTEM**<br>Ignition timing not properly adjusted.<br>Defective coil, condenser, or rotor. |

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**DIAGNOSIS GUIDE (Continued)**

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|---|---|---|
| **ENGINE DOES NOT DEVELOP FULL POWER, OR HAS POOR HIGH SPEED PERFORMANCE (Continued)** | Distributor not advancing properly.<br>Excessive play in the distributor shaft.<br>Distributor cam worn.<br>Fouled or improperly adjusted spark plugs.<br>Improperly adjusted or defective breaker points.<br>**EXHAUST SYSTEM**<br>Exhaust control valve inoperative or sticking (Mileage Maker Six).<br>Restriction in system.<br>**COOLING SYSTEM**<br>Thermostat inoperative or incorrect heat range. | Thermostat installed incorrectly.<br>Check the cooling system for internal leakage and/or for a condition that prevents the engine from reaching normal operating temperature.<br>**ENGINE**<br>Perform an engine compression test to determine which mechanical component of the engine is at fault.<br>One or more camshaft lobes worn beyond wear limit.<br>Worn valve guides.<br>**TRANSMISSION**<br>Improper band adjustment (automatic transmissions). |
| **EXCESSIVE FUEL CONSUMPTION** | Determine the actual fuel consumption with test equipment installed in the car.<br>If the test indicates that the fuel consumption is not excessive, demonstrate to the owner how improper driving habits will affect fuel consumption.<br>If the test indicates that the fuel consumption is excessive, make a preliminary check of the following items before proceeding to the fuel and ignition systems.<br>**PRELIMINARY CHECKS**<br>**CHASSIS ITEMS**<br>Check:<br>Tires for proper pressure.<br>Front wheel alignment.<br>Brake adjustment too tight.<br>**EXHAUST SYSTEM**<br>Check the exhaust control valve operation (Mileage Maker Six and 427 V-8).<br>System restricted.<br>**ODOMETER**<br>Check calibration.<br>**IGNITION SYSTEM**<br>Check:<br>Distributor breaker points.<br>Ignition timing.<br>**ENGINE**<br>Crankcase ventilation regulator valve defective or restricted tubes (Positive Crankcase Ventilation System).<br>**FINAL CHECKS**<br>**FUEL SYSTEM**<br>Check:<br>Fuel pump pressure.<br>Engine idle speed.<br>Idle fuel mixture needle(s) for proper adjustment. | Automatic choke for proper operation.<br>Fast idle speed screw for proper adjustment.<br>Accelerating pump stroke adjustment.<br>Anti-stall dashpot for proper adjustment.<br>Air cleaner for restrictions.<br>Float setting for fuel level.<br>Jets for wear and/or damage.<br>Power valve operation.<br>Air bleeds for obstructions.<br>Accelerating pump discharge port (6-cylinder) or nozzles (V-8) for siphoning.<br>Accelerator linkage for binds.<br>Choke adjustment.<br>**IGNITION SYSTEM**<br>Check:<br>Ignition timing.<br>Spark plug condition and adjustment.<br>Distributor spark advance operation.<br>Spark control valve for proper seating (6-cylinder).<br>**ENGINE**<br>Perform an engine compression test to determine which mechanical component of the engine is at fault.<br>Check valve lash (engines with mechanical valve lifters) or valve clearance (engines with hydraulic valve lifters or Silent Valve Lash) adjustment.<br>**COOLING SYSTEM**<br>Check thermostat operation and heat range.<br>**TRANSMISSION**<br>Check band adjustment (automatic transmissions). |

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**DIAGNOSIS GUIDE (Continued)**

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| **ENGINE OVERHEATS** | **TEMPERATURE SENDING UNIT AND GAUGE**<br>Unit or gauge defective (not indicating correct temperature), or constant voltage regulator defective.<br>**ENGINE**<br>Cylinder head bolts not properly torqued.<br>Incorrect valve lash (engine with mechanical valve lifters) or valve clearance (engines with hydraulic valve lifters or Silent Valve Lash).<br>Low oil level or incorrect viscosity oil used. | **COOLING SYSTEM**<br>Insufficient coolant.<br>Cooling system leaks.<br>Drive belt tension incorrect.<br>Radiator fins obstructed.<br>Thermostat defective.<br>Thermostat improperly installed.<br>Cooling system passages blocked.<br>Water pump inoperative.<br>Faulty fan drive.<br>**IGNITION SYSTEM**<br>Incorrect ignition timing.<br>Incorrect distributor advance. |
| **LOSS OF COOLANT** | **COOLING SYSTEM**<br>Leaking radiator.<br>Loose or damaged hose connections.<br>Water pump leaking.<br>Radiator cap defective.<br>Overheating.<br>**ENGINE**<br>Cylinder head gasket defective. | Intake manifold to cylinder head gasket defective (V-8).<br>Cylinder head or intake manifold bolts (V-8) not properly torqued.<br>Cylinder block core plugs leaking.<br>Temperature sending unit leaking.<br>Cracked cylinder head or block, or warped cylinder head or block gasket surface. |
| **ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE** | **TEMPERATURE SENDING UNIT AND GAUGE**<br>Unit or gauge defective (not indicating correct temperature) or constant voltage regulator defective. | **COOLING SYSTEM**<br>Thermostat inoperative or of incorrect heat range. |
| **NOISY HYDRAULIC VALVE LIFTER** | A noisy hydraulic valve lifter can be located by operating the engine at idle speed and placing a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a shock will be felt when the valve seats.<br>Another method of identifying a noisy lifter is by the use of a piece of hose. With the engine operating at idle speed, place one end of the hose near the end of the valve stem and the other end to the ear and listen for a metallic noise. Repeat this procedure on each intake and exhaust valve until the noisy lifter(s) has been located.<br>The most common causes of hydraulic valve lifter troubles are dirt, gum, varnish, carbon deposits and air bubbles.<br>Dirt in the lifter assembly can prevent the disc valve from seating, or it may become lodged between the plunger and body surfaces. In either case, the lifter becomes inoperative due to failure to "pump-up," or because the internal parts are no longer free to function properly. When dirt is found to be responsible for lifter malfunction, remove | the lifter assembly and thoroughly clean it. Recommended engine oil and filter change intervals should be followed to minimize lifter problems caused by dirt (Group 19).<br>Deposits of gum and varnish cause similar conditions to exist which may result in lifter malfunction. If these conditions are found to be present, the lifter should be disassembled and cleaned in solvent to remove all traces of deposits.<br>Air bubbles in the lubricating oil, caused by an excessively high or low oil level, may likewise cause lifter malfunction. A damaged oil pick-up tube may allow air to be drawn into the lubricating system.<br>Check for engine oil aeration as follows:<br>Check the engine oil level to be sure it is within specification and correct as required. **Be sure the correct engine oil dipstick is being used.**<br>Operate the engine at approximately 1200 rpm until normal operating temperature is reached. Stop the engine and remove the oil pressure sending unit. Install a fitting in this opening with a petcock-type valve that will permit attachment of |

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**DIAGNOSIS GUIDE (Continued)**

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| **NOISY HYDRAULIC VALVE LIFTER (continued)** | a ¼ to ⅜ inch diameter hose of sufficient length to direct the oil discharge into the oil filler pipe. Close the valve.<br>Start the engine and operate it at approximately 500 rpm for a minimum of five minutes; then, open the valve slightly to permit a steady discharge of oil. Check the oil flow.<br>Increase the engine speed to approximately 1000 rpm and check for air bubbles in the oil. **To facilitate checking for air bubbles, direct the oil flow over white paper or through a piece of transparent tube. The engine should not be operated at excessive speeds or for extended periods with the oil bleed attached.**<br>If oil aeration is evident, remove the oil pan for further test and/or inspection of the oil pump intake system. Perform corrective action as required to remove air from the lubricating oil. |
| **SILENT VALVE MECHANISM (Silent Lash)** | **MALFUNCTIONING OR SLUGGISHLY OPERATING ECCENTRIC**<br>A properly operating eccentric should compensate for variation in the adjustment screw within 30 seconds at approximately 1000 engine rpm.<br>To determine if the eccentric is operating correctly, operate the engine at 1000 rpm. Slowly vary the position of the adjustment screw to change the operating range of the eccentric. The eccentric should move in and out within 30 seconds to compensate for the turning of the adjustment screw. If it does not, check to see if the eccentric is properly installed and/or if it has reached the limit of its travel, with the eccentric against the stop on the rocker arm. When the screw is turned, the valve may be held open for a short period of time. This is normal and will close after the eccentric has operated long enough to compensate. If it does not compensate in the specified time, replace the eccentric.<br>**EXCESSIVE VALVE NOISE**<br>Check the adjustment of the rocker arm eccentric.<br>If the eccentric is out of adjustment, check the related parts for abnormal wear, then adjust the eccentric. Check the eccentric operation as explained under "Malfunctioning or Sluggishly Operating Eccentric." If the operation is unsatisfactory, replace the parts as neccessary. |

## TESTING

### CAMSHAFT LOBE LIFT

**1.** Remove the air cleaner and the valve rocker arm cover(s).

**2.** On an engine with mechanical valve lifters or silent valve lash, slide the rocker arm assembly serving the camshaft lobe to be checked to one side. Secure it in this position. To move the rocker arm on either end of the shaft, remove the retaining pin and washers and slide the rocker arm off the shaft.

On an engine with hydraulic valve lifters, remove the valve rocker arm shaft assembly and install a solid tappet-type push rod in the push rod bore of the camshaft lobe to be checked.

**3.** On a 289 V-8 engine with ball stud rocker arms, remove the rocker arm stud nut, fulcrum seat and rocker arm.

Make sure the push rod is in the lifter cup. Install a dial indicator in such a manner as to have the ball socket adapter of the indicator on the end of the push rod and in the same plane as the push rod movement (Fig. 1).

Make sure the push rod is in the tappet socket or the lifter push rod cup. Install a dial indicator so that the actuating point of the indicator is in the push rod socket and in the same plane as the push rod movement (Fig. 2 or 3).

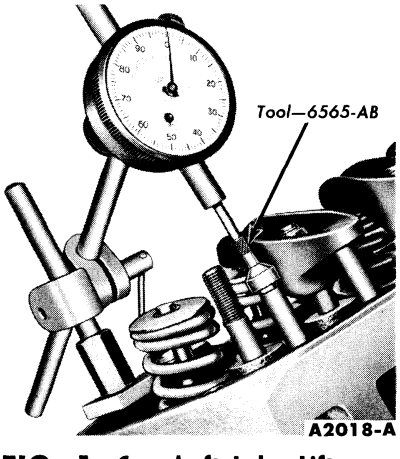



**FIG. 1—Camshaft Lobe Lift—289 V-8**

**4.** Install an auxiliary starter switch. "Bump" the crankshaft over until the tappet or lifter is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.

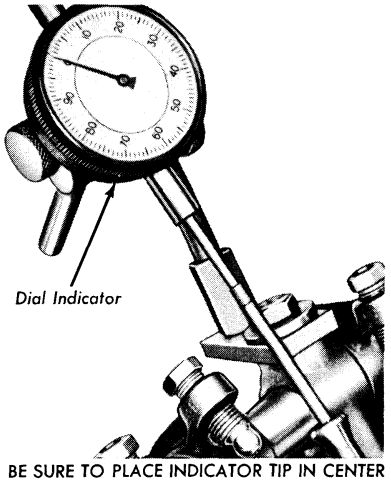



**FIG. 2—Camshaft Lobe Lift—Mechanical Valve Lifters**

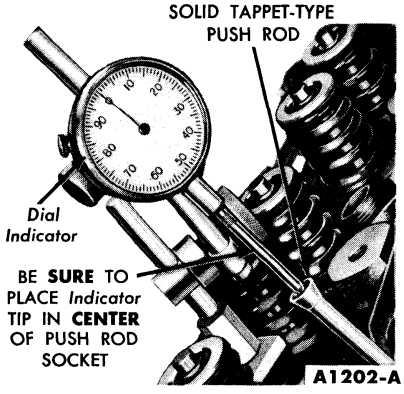



**FIG. 3—Camshaft Lobe Lift—Hydraulic Valve Lifters**

**5.** Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position.

**6.** Compare the total lift recorded on the indicator with specifications.

**7.** To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero.

**8.** Remove the dial indicator.

On an engine with mechanical valve lifters or silent valve lash, position the valve rocker arm. If an end valve rocker arm was removed, slide it into position on the shaft and install the washers and retaining pin. Perform a preliminary valve lash adjustment as necessary (Section 2). Install the valve rocker arm cover(s) and **partially tighten the retaining bolts.** Operate the engine until normal operating temperature has been reached. Remove the valve rocker arm cover(s). Check and adjust the valve lash or silent lash clearance (Section 2).

On an engine with hydraulic valve lifters, install the valve rocker arm shaft.

On an engine with ball stud rocker arms, install the rocker arm, fulcrum seat and stud nut. Adjust the valve clearance (Section 2).

**9.** Install the valve rocker arm cover(s) and the air cleaner.

## COMPRESSION TEST

**1.** Be sure the crankcase oil is at the proper level, and the battery is properly charged. Operate the engine for a minimum of 30 minutes at 1200 rpm or until the engine is at normal operating temperature. Turn the ignition switch off, then remove all the spark plugs. Remove the coil high tension lead from the distributor cap and coil.

**2.** Set the primary throttle plates and choke plate in the wide open position.

**3.** Install a compression gauge in No. 1 cylinder.

**4.** Using an auxiliary starter switch, crank the engine a minimum of five pumping strokes and record the highest reading. **On engines equipped with transistor ignition, refer to Group 9 for the procedure on installing an auxiliary starter switch.** Note the number of compression strokes required to obtain the highest reading.

**5.** Repeat the test on each cylinder, cranking the engine the same number of times for each cylinder as was required to obtain the highest reading on the No. 1 cylinder.

**Test Conclusions.** A variation of ± 20 psi from specified pressure is satisfactory. However, the compression of all cylinders should be uniform within 10 psi.

A reading of more than the allowable tolerance above normal indicates excessive deposits in the cylinder or wrong cylinder head(s) on the engine.

A reading of more than the allowable tolerance below normal indicates leakage at the cylinder head gasket, piston rings or valves or wrong cylinder head(s) on the engine.

A low, even compression in two adjacent cylinders indicates a cylinder head gasket leak. This should be checked before condemning the rings or valves.

To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of heavy oil into the combustion chamber. Crank the engine to distribute the oil and repeat the compression test. The oil will temporarily seal leakage past the rings. If approximately the same reading is obtained, the rings are satisfactory, but the valves are leaking. If the compression has increased 10 pounds or more over the original reading, there is leakage past the rings.

During a compression test (if the pressure fails to climb steadily and remains the same during the first two successive strokes), but climbs higher on the succeeding strokes, or fails to climb during the entire test, it indicates a sticking valve.

## MANIFOLD VACUUM TEST

A manifold vacuum test aids in determining the condition of an engine and also in helping to locate the cause of poor engine performance. To check manifold vacuum:

**1.** Operate the engine for a minimum of 30 minutes at 1200 rpm.

**2.** Install an accurate, sensitive vacuum gauge in the intake manifold fitting.

On V-8 engines, remove the plug or power brake line at the rear of the intake manifold (front of crankcase ventilation outlet).

**3.** Operate the engine at the recommended idle rpm, with the transmission selector lever in neutral.

**4.** Check the vacuum reading on the gauge.

**Test Conclusions.** Manifold vacuum is affected by carburetor adjustment, valve timing, ignition timing, the condition of the valves, cylinder compression, the condition of the ventilation system, and leakage of the manifold, carburetor, carburetor spacer or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors are at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough so as to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted, where necessary, in order to arrive at the correct diagnosis of the trouble.

Table 1 lists various types of readings and their possible causes.

Allowance should be made for the effect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

## POSITIVE CRANKCASE VENTILATION SYSTEM TEST

A malfunctioning positive crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crankcase ventilation system and making carburetor adjustments. The removal of the crankcase ventilation system from the engine will adversely affect the fuel economy and engine ventilation with resultant shortening of engine life.

**TABLE 1—Manifold Vacuum Gauge Readings**

| Gauge Reading | Engine Condition |
|---|---|
| 18 inches or over—All engines. | Normal. |
| Low and steady. | Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings. |
| Very low. | Manifold, carburetor, spacer or cylinder head gasket leak. |
| Needle fluctuates steadily as speed increases. | A partial or complete loss of power in one or more cylinders caused by a leaking valve, cylinder head or intake manifold gasket leak, a defect in the ignition system or a weak valve spring. |
| Gradual drop in reading at engine idle. | Excessive back pressure in the exhaust system. |
| Intermittent fluctuation. | An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve. |
| Slow fluctuation or drifting of the needle. | Improper idle mixture adjustment or carburetor, spacer or intake manifold gasket leak, or malfunctioning crankcase ventilation system. |

**To determine whether the loping or rough engine idle condition is caused by a malfunctioning crankcase ventilation system, assemble a service tool from a known good regulator valve and install it in the ventilation system as follows:**

**1.** Disassemble a known good regulator valve. Note that the spring normally holds the conical valve spool away from the valve seat in the regulator valve body (Fig. 4). The valve spool is correctly installed in the valve body when the conical end of the spool is pointing in the same direction as the flow arrow on the valve body.

Assemble the regulator valve with the spring between the valve spool and connector to keep the spool seated in the body. This ensures a restricted flow through the regulator valve which is the normal valve function during engine operation at idle speeds.

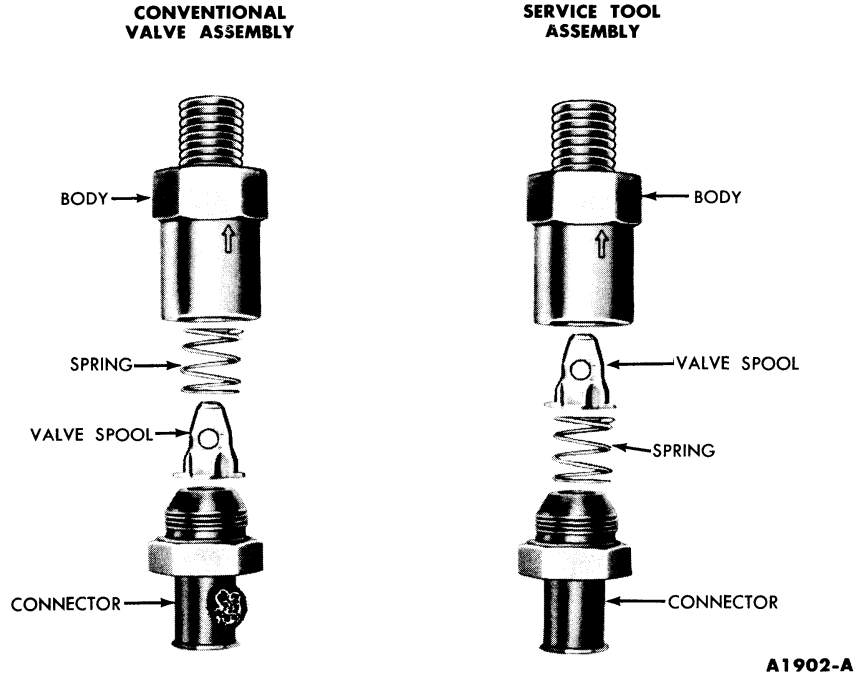



**FIG. 4—Typical Regulator Valve Service Tool Assembly**

**Identify the service tool as such by painting the engine cubic inch displacement figure on the valve body.**

**When the regulator valve has been assembled as a service tool, the calibration of the spring may change; therefore, the service tool or its parts should not be used as replacement parts.**

**2.** Disconnect the regulator valve at the intake manifold end (regulator valve connection) and leave the opposite end attached to the crankcase ventilation outlet tube.

**3.** Attach the service valve tool to the connection which leads to the intake manifold. **Leave the opposite end of the valve vented to the atmosphere.**

**4.** Start the engine and compare the engine idle condition to the prior idle condtion.

If the loping or rough idle condition remains when the regulator valve tool is installed, the crankcase ventilation system is not at fault. Further engine component diagnosis will have to be conducted to find the malfunction.

If the idle condition is found to be satisfactory, refer to Section 3 for the cleaning and inspection procedures.

## HYDRAULIC VALVE LIFTER TESTS

Dirt, deposits of gum and varnish and air bubbles in the lubricating oil can cause hydraulic valve lifter failure or malfunction.

**Dirt, gum and varnish can keep a check valve from seating and cause a loss of hydraulic pressure.** An open valve disc will cause the plunger to force oil back into the valve lifter reservoir during the time the push rod is being lifted to force the valve from its seat.

Air bubbles in the lubricating system can be caused by too much oil in the system or too low an oil level. Air may also be drawn into the lubricating system through an opening in a damaged oil pick-up tube. **Air in the hydraulic system can cause a loss of hydraulic pressure.**

Assembled valve lifters can be

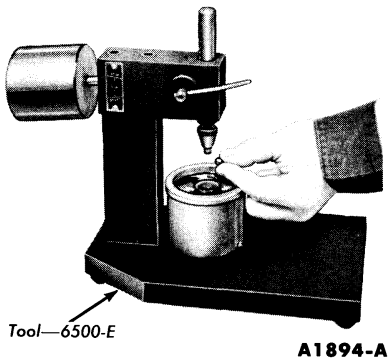



**FIG. 5—Placing Steel Ball in Valve Lifter Plunger**

tested with tool 6500-E to check the leak down rate. The leak down rate specification (for gauging purposes) is 10-100 seconds at 50 lbs. load. Plunger travel is 0.125 inch. Test the valve lifters as follows:

**1.** Place the valve lifter in the tester, with the plunger facing upward. Pour hydraulic tester fluid into the cup to a level that will cover the valve lifter assembly. **The fluid can be purchased from the manufacturer of the tester. Do not use kerosene, for it will not provide an accurate test.**

**2.** Place a 5/16-inch steel ball in the plunger cup (Fig. 5).

**3.** Adjust the length of the ram so that the pointer is in line with the starting mark when the ram contacts the valve lifter plunger (Fig. 6).

**4.** Work the valve lifter plunger up and down until the lifter fills with fluid and all traces of air bubbles have disappeared (Fig. 7).

**5.** Allow the ram and weight to force the valve lifter plunger down-

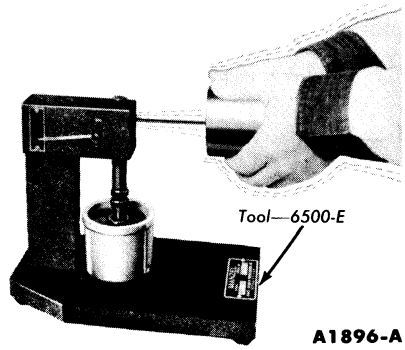



**FIG. 7—Operating Plunger Until Air Bubbles Disappear**

ward. Measure the exact time it takes for the pointer to travel from the "Start Timing" to the "Stop Timing" marks of the tester (Fig. 8).

**6.** A valve lifter that is satisfactory must take at least 10 seconds, but not more than 100 seconds, to leak down.

**7.** If the valve lifter is not within specifications, disassemble the lifter and clean and inspect it as outlined in Section 3. Assemble the lifter and test the lifter again. If it does not meet specifications, replace it with a new lifter. **Always test a new lifter before installing it in the engine.**

**8.** Remove the fluid from the cup and bleed the fluid from the lifter by depressing the plunger up and down (Fig. 7). **This step will aid in depressing the lifter plungers when checking the valve clearance.**

### CRANKSHAFT END PLAY

**1.** Force the crankshaft toward the rear of the engine.

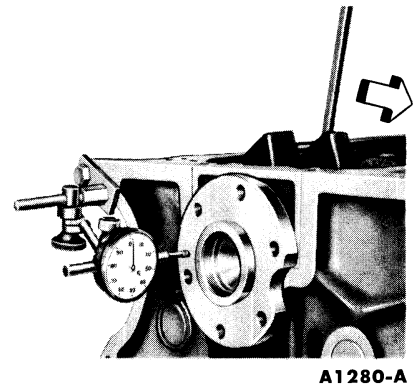



**FIG. 9—Typical Crankshaft End Play**

**2.** Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 9).

**3.** Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

**4.** If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the procedure recommended under "Main Bearing Replacement" in the pertinent engine section. Check the end play.

### FLYWHEEL FACE RUNOUT—MANUAL-SHIFT TRANSMISSIONS

Install a dial indicator so that the indicator point bears against the

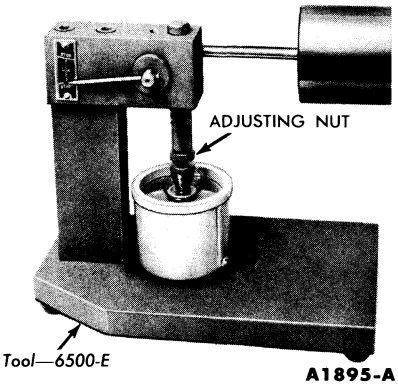



**FIG. 6—Adjusting the Ram Length**

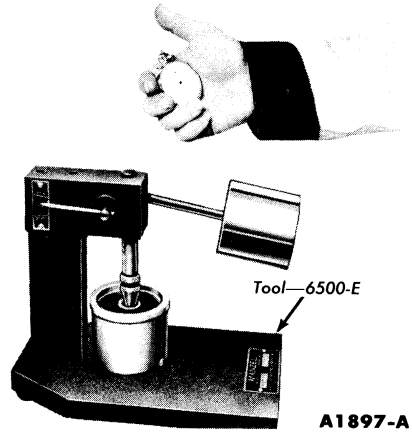



**FIG. 8—Checking Leak Down Rate**

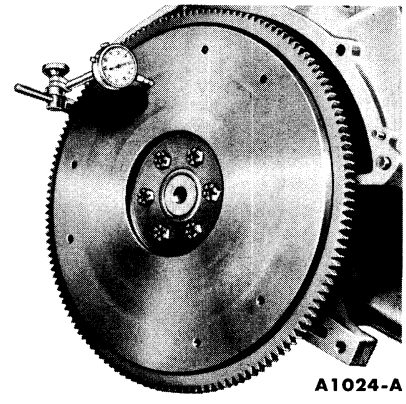



**FIG. 10—Flywheel Face Runout**

flywheel face (Fig. 10). Turn the flywheel making sure that it is full forward or rearward so that crankshaft end play will not be indicated as flywheel runout.

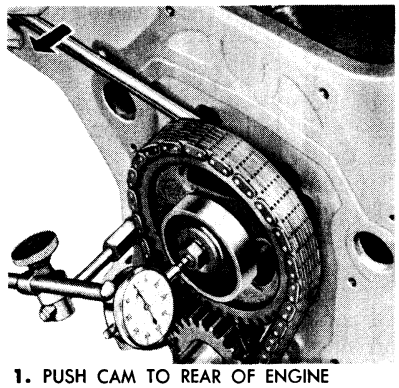
If the clutch face runout exceeds specifications, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft-flywheel mounting face if the mounting flange runout is excessive. If the ring gear runout exceeds specifications, replace it or reinstall it on the flywheel. Refer to "Ring Gear Replacement" for the proper procedure.

### CAMSHAFT END PLAY

Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket retaining screw (Fig. 11). Zero the dial indicator. Position a large screwdriver between the camshaft sprocket and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate.

On a Police Special Six or Taxi Special Six engine, the spacer is cast integrally with the camshaft gear. Therefore, if the end play is excessive, replace the thrust plate when the camshaft is installed.

Remove the dial indicator.



1. PUSH CAM TO REAR OF ENGINE
2. SET DIAL ON ZERO
3. PULL CAM FORWARD AND RELEASE

A1101-A

**FIG. 11—Typical Camshaft End Play**

### TIMING CHAIN DEFLECTION

**1.** Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.

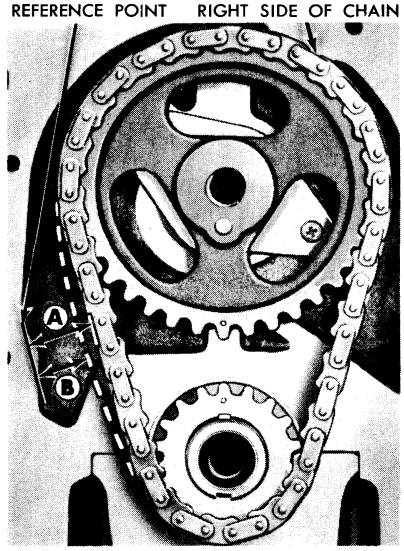
**2.** Establish a reference point on the block and measure from this point to the chain (Fig. 12).

**3.** Rotate the crankshaft in the opposite direction to take up the slack on the right of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

If the deflection exceeds specifications, replace the timing chain and sprockets.

### TIMING GEAR BACKLASH

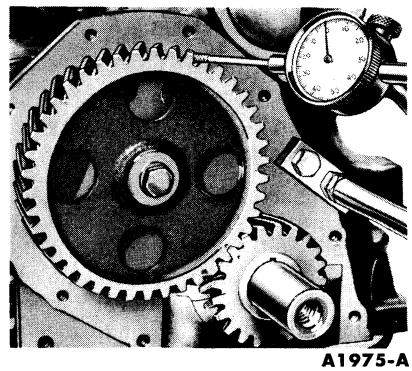
Install a dial indicator on the cylinder block (Fig. 13). Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator (Fig. 13). Hold the gear firmly against the block while making the check. Refer to the specifications for the backlash limits.




TAKE UP SLACK ON LEFT SIDE, ESTABLISH REFERENCE POINT. MEASURE DISTANCE **A**. TAKE UP SLACK ON RIGHT SIDE. FORCE LEFT SIDE OUT. MEASURE DISTANCE **B**. DEFLECTION IS **A** MINUS **B**.

A1284-B

**FIG. 12—Typical Timing Chain Deflection**



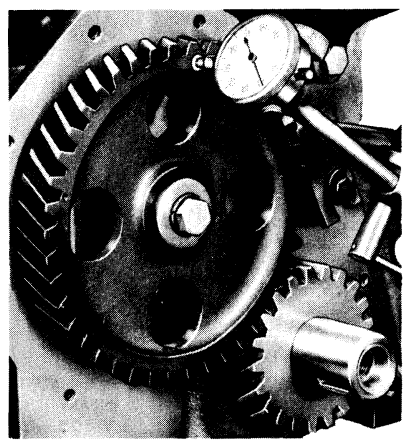
A1975-A

**FIG. 13—Typical Timing Gear Backlash**

### TIMING GEAR RUNOUT

Install a dial indicator on the cylinder block as shown in Fig. 14. Hold the camshaft gear against the camshaft thrust plate and zero the indicator. Rotate the crankshaft to turn the camshaft, while holding the camshaft gear against the thrust plate. Check the gear runout through one complete revolution of the camshaft. If the gear runout exceeds specifications, remove it and check for burrs or foreign particles on or between the camshaft and gear joining flanges. Recheck the runout; if it still exceeds specifications, replace both gears.

Follow the above procedure to check crankshaft gear runout.



A1969-A

**FIG. 14—Typical Gear Runout**

## 2 COMMON ADJUSTMENTS AND REPAIRS

### ADJUSTMENTS

### VALVE LASH–MECHANICAL VALVE LIFTERS

**Preliminary (Cold).** If the valve rocker arm shaft assembly has been removed and installed, it will be necessary to make a preliminary (cold) valve lash adjustment before starting the engine. If the adjustment is made for an engine tune-up, follow the final (hot) adjustment procedure.

On V-8 engines the cylinders are numbered from front to rear–right bank, 1-2-3-4; left bank, 5-6-7-8. On 6-cylinder engines the cylinders are numbered consecutively from the front to the rear.

On the 390 special police and 427 V-8 engines, the valves are arranged from front to rear on both banks, E-I-E-I-I-E-I-E. On the 223 six Taxi engine the valves are arranged from front to rear E-I-I-E-I-E-E-I-E-I-I-E.

**1.** Turn all the valve adjusting screws until interference is noted. Check the torque required to turn the screw further. If the torque required to turn a screw is less than 7 ft-lbs (84 in-lbs), try an oversize self-locking adjusting screw. If this is still unsatisfactory, replace the rocker arm and adjusting screw.

**2.** Disconnect the coil high tension lead and starter relay leads, and install an auxiliary starter switch.

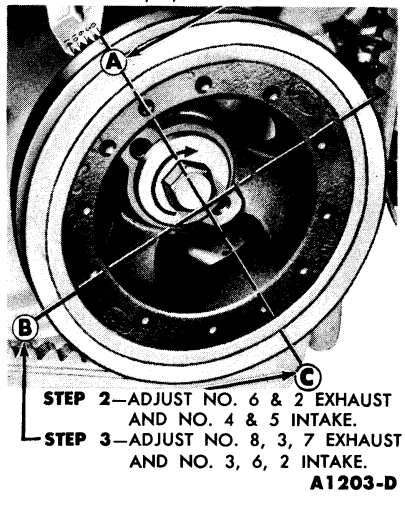
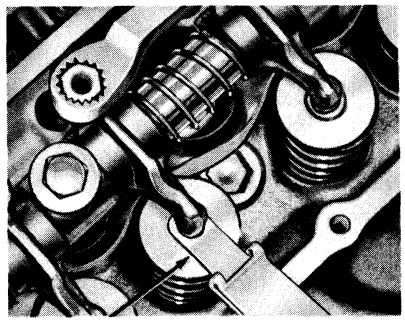



**FIG. 15—Preliminary Valve Lash Adjustment**



*Step-Type Feeler Gauge* A1466-A

**FIG. 16—Valve Lash Adjustment —Mechanical Valve Lifters**

**On engines equipped with transistor ignition, refer to Group 9 for the procedure on installing an auxiliary starter switch.**

**3.** On the 390 Special Police and 427 V-8 engines, make three chalk marks on the crankshaft damper (Fig. 15). Space the marks approximately 90° apart so that with the timing mark, the damper is divided into four equal parts (90° represents ¼ of the distance around the damper circumference). Set the intake and exhaust valve lash to specifications (Fig. 16) with a step-type feeler gauge ("go" and "no go").

Rotate the crankshaft until No. 1 piston is near TDC at the end of the compression stroke. Adjust the following valves:

| | |
|---|---|
| No. 1 Exhaust | No. 1 Intake |
| No. 4 Exhaust | No. 7 Intake |
| No. 5 Exhaust | No. 8 Intake |

Rotate the crankshaft 180° or ½ turn in the direction shown in Fig. 15 (this puts No. 4 piston on TDC). Adjust the following valves:

| | |
|---|---|
| No. 2 Exhaust | No. 4 Intake |
| No. 6 Exhaust | No. 5 Intake |

Rotate the crankshaft another ¾ turn in the same direction (this puts No. 3 piston on TDC). Adjust the following valves:

| | |
|---|---|
| No. 3 Exhaust | No. 2 Intake |
| No. 7 Exhaust | No. 3 Intake |
| No. 8 Exhaust | No. 6 Intake |

**4.** On the 223 Six Taxi engine, make two chalk marks on the crankshaft damper (Fig. 17). Space the marks approximately 120° apart so that with the timing mark, the damper is divided into three equal parts (120° represents ⅓ of the distance around the damper circumference).

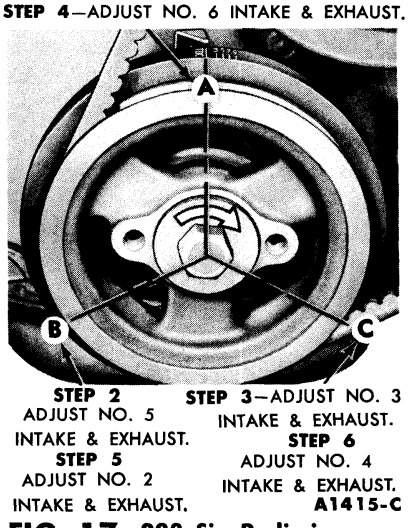



**FIG. 17—223 Six Preliminary Valve Lash**

Using an auxiliary starter switch, rotate the crankshaft until the No. 1 piston is near TDC at the end of the compression stroke.

Adjust the intake and exhaust valve lash for No. 1 cylinder (Fig. 16). **Use a step-type feeler gauge ("go" and "no go") to adjust the valves to specifications.**

Repeat this procedure for the remaining set of valves, turning the crankshaft with an auxiliary starter switch, ⅓ turn at a time, in the direction of rotation, while adjusting the valves in the firing order sequence (1-5-3-6-2-4). This procedure requires two complete turns of the crankshaft.

**Final (Hot).** It is very important that the valve lash be held to the correct specifications because:

If the lash is set too close, the valve will open too early and close too late, resulting in rough engine idle. Burning and warping of the valves will occur also because the valves cannot make firm contact with the seats long enough to cool properly. If the lash is excessive, it will cause the valve to open too late and close too early causing valve bounce. In adition, damage to the camshaft lobe is likely because the tappet foot will not follow the pattern of the camshaft lobe causing a shock contact between these two parts.

**1.** Be sure the engine is at normal operating temperature before attempting to set the valve lash.

**2.** With the engine idling, set the valve lash (Fig. 16) using a step-type feeler gauge only ("go" and "no go"). The final (hot) intake and exhaust valve lash settings are listed in the Specifications Section.

For example, to obtain the correct setting if the valve lash is 0.019 inch, use a step-type feeler gauge of 0.018 inch ("go") and 0.020 inch ("no go"). The "go" step should enter, and the "no go" step should not enter. The resultant setting will be to the required setting (0.019 inch).

### VALVE CLEARANCE—HYDRAULIC VALVE LIFTERS (352 V-8 AND 390 V-8)

The valve arrangement is E-I-E-I-I-E-I-E from front to rear on both cylinder banks.

A 0.060-inch shorter push rod (color coded white) or a 0.060-inch longer push rod (color coded yellow) are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Valve stem to valve rocker arm clearance should be to the specified clearance with the hydraulic lifter completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if not compensated for, the hydraulic valve lifter will cease to function. To determine whether a shorter or a longer push rod is necessary, make the following check:

**1. Position the crankshaft as outlined in steps 2 and 3.** Position the hydraulic lifter compressor tool on the rocker arm and slowly apply pressure to bleed down the hydraulic lifter until the plunger is completely bottomed (Fig. 18). Hold the lifter in the fully collapsed position and insert the clearance gauge between the valve stem and the rocker arm of the valve being checked. If the first step of the gauge enters, the old push rod may be used. If the first step will not enter, replace the standard push rod with a shorter service push rod. If the second step of the gauge enters, the operating range of the lifter is excessive which indicates that the incorrect push rod has been installed or severe wear has occurred at the push rod ends, rocker arm, or valve stem. In this case, it will be necessary to determine the area of discrepancy and the incorrect or defective part(s) should be replaced. If all the valve train components except the push rod are within limits, install a 0.060-inch longer push rod.

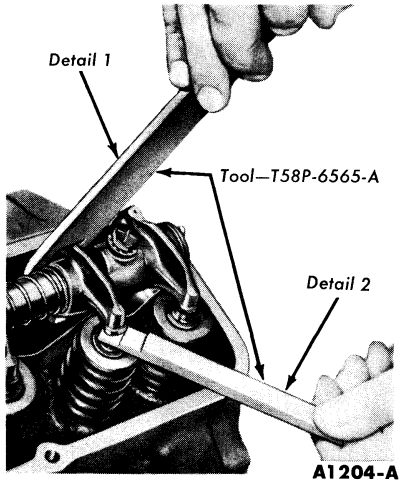



**FIG. 18—Valve Clearance—Hydraulic Valve Lifters**

**2.** Rotate the crankshaft until No. 1 piston is on TDC at the end of the compression stroke. With No. 1 piston on TDC, check the following valves:

| | |
|---|---|
| No. 1 Intake | No. 1 Exhaust |
| No. 3 Intake | No. 4 Exhaust |
| No. 7 Intake | No. 5 Exhaust |
| No. 8 Intake | No. 8 Exhaust |

**3.** After these valves have been checked, rotate the crankshaft 360° (one revolution) to position No. 6 piston on TDC and check the following valves:

| | |
|---|---|
| No. 2 Intake | No. 2 Exhaust |
| No. 4 Intake | No. 3 Exhaust |
| No. 5 Intake | No. 6 Exhaust |
| No. 6 Intake | No. 7 Exhaust |

**When compressing the valve spring to remove the push rods, be sure the piston in the individual cylinder is below TDC to avoid contact between the valve and the piston.**

To replace a push rod, it will be necessary to remove the valve rocker arm shaft assembly.

Upon replacement of a valve push rod and/or valve rocker arm shaft assembly, the engine should not be cranked or rotated until the hydraulic lifters have had an opportunity to leak down to their normal operating position. The leakdown rate can be accelerated by using the tool shown in Fig. 18 on the valve rocker arm and applying pressure in a direction to collapse the lifter.

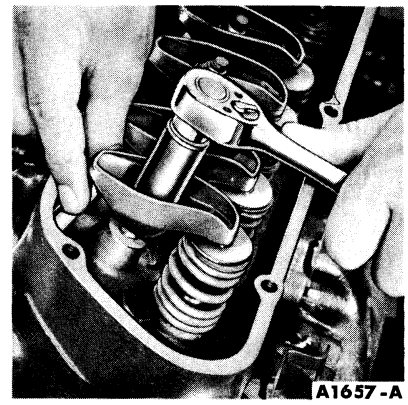



**FIG. 19—Valve Clearance Adjustment**

### VALVE CLEARANCE—HYDRAULIC VALVE LIFTERS (289 V-8)

**1. Position the crankshaft as outlined in steps 2 and 3.** Loosen the rocker arm stud nut until there is end clearance in the push rod, then tighten the nut to just remove all the push rod to rocker arm end clearance. This may be determined by rotating and/or moving the push rod with the fingers as the stud nut is tightened (Fig. 19). When the push rod end clearance has been eliminated, tighten the stud nut an additional two turns to place the hydraulic lifer plunger in the center of its travel.

**2.** Rotate the crankshaft until No. 1 piston is on TDC at the end of the compression stroke. With No. 1 piston on TDC, adjust the following valves:

| | |
|---|---|
| No. 2 Exhaust | No. 1 Intake |
| No. 5 Exhaust | No. 1 Exhaust |
| No. 7 Intake | No. 3 Intake |
| No. 8 Intake | No. 4 Exhaust |

**3.** After these valves have been adjusted, rotate the crankshaft 360° (one revolution) to position No. 6 piston on TDC, and adjust the following valves:

| | |
|---|---|
| No. 2 Intake | No. 6 Intake |
| No. 3 Exhaust | No. 6 Exhaust |
| No. 4 Intake | No. 7 Exhaust |
| No. 5 Intake | No. 8 Exhaust |

**The engine should not be cranked or rotated until the hydraulic lifters have had an opportunity to leak down to their normal operating position.** The leak-down rate can be accelerated by presing down on the push rod end of the rocker arm.

The valves can also be adjusted by positioning each piston on TDC at

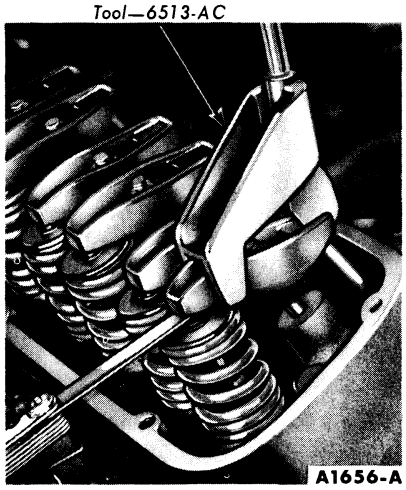



**FIG. 20—Valve Clearance Check**

the end of the compression stroke in the firing order sequence.

**4.** Operate the engine and check for rough engine idle or a noisy lifter(s). Valve clearance set too tight will cause rough engine idle, and valve clearance set too loose will cause a noisy lifter(s). If it has been determined that these conditions are caused by improper valve clearance, adjust the affected valve(s) using the following procedure:

Follow steps 2 and 3 in the above procedure. Apply pressure to slowly bleed down the valve lifter until the plunger is completely bottomed (Fig. 20). While holding the valve lifter in the fully collapsed position, check the available clearance between the rocker arm and valve stem tip (Fig. 20). If the clearance is not within specifications, rotate the rocker arm stud nut "clockwise" to decrease the clearance and "counterclockwise" to increase the clearance. **Normally one turn of the rocker arm stud nut will vary the clearance by 0.066 inch.**

### VALVE CLEARANCE–SILENT LASH VALVE (MILEAGE MAKER SIX)

The silent lash rocker arm is adjusted with the engine not operating.

**1.** Remove the valve rocker arm cover.

**2.** Make two chalk marks on the crankshaft damper (Fig. 17). Space the marks approximately 120° apart so that with the timing mark, the damper is divided into three equal parts (120° represents ⅓ of the distance around the damper circumference).

**3.** Rotate the crankshaft until the

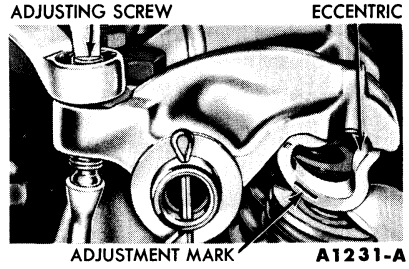



**FIG. 21—Depressing Valve Rocker Arm Eccentric**

No. 1 piston is near TDC at the end of the compression stroke.

**4.** Adjust the intake and exhaust rocker arm for the No. 1 cylinder. Push the eccentric toward the rocker arm until the plunger is completely pushed into its bore in the rocker arm (Fig. 21). Turn the adjusting screw in until the eccentric and plunger are held in the depressed position (Fig. 21).

**5.** Slowly turn the adjusting screw out until the adjustment mark on the eccentric is centered over the valve stem (Fig. 22). Torque the lock nut to specifications to lock the adjustment. The correct position of the adjustment mark is shown in Fig. 23.

**6.** Repeat steps 4 and 5 on the remaining sets of "rocker" arms. Position the piston in each cylinder following the firing order (1-5-3-6-2-4) on TDC after the compression stroke and adjust the rocker arms (intake and exhaust). To position the individual pistons on TDC in the firing order, turn the damper approximately ⅓ turn at a time (Fig. 17), in the direction of rotation. This procedure requires two complete turns of the crankshaft.

**7.** After all the rocker arms have been adjusted, start the engine and operate it at normal idle speed. Observe the position of the adjustment mark on each eccentric. Make minor adjustments, as necessary, with the

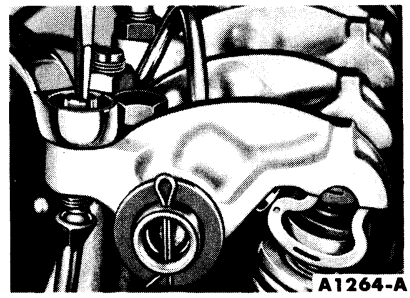



**FIG. 22—Aligning Eccentric Mark**

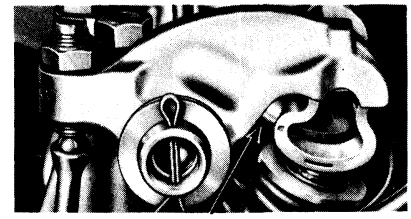



**FIG. 23—Correct Position of Eccentric**

engine idling by turning the adjusting screws in or out.

**8.** After making the minor adjustments, stop the engine and install the valve rocker arm cover.

## REPAIRS

### VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Dress up minor surface defects on the rocker arm shaft and in the rocker arm bore with a hone.

If the pad at the valve end of the rocker arm has a grooved radius, replace the rocker arm. **Do not attempt to true this surface by grinding.**

For a 289 V-8 engine, refer to "Cylinder Head Repair" for the rocker arm stud replacement procedure.

### PUSH RODS

Following the procedures in Section 3 under "Push Rod Inspection," check the push rods for straightness.

If the runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**

### CYLINDER HEADS

Replace the head if it is cracked. **Do not plane or grind more than 0.010 inch from the cylinder head gasket surface.** Remove all burrs or scratches with an oil stone.

**Rocker Arm Stud Replacement—289 V-8.** If it is necessary to remove a rocker arm stud, a rocker arm stud kit (tool T62F-6A527-A) is available which contains the following: a stud remover, a 0.006-inch reamer, a 0.015-inch reamer and a stud installer.

Rocker arm studs that are broken or have damaged threads may be replaced with standard studs. Loose studs in the head may be replaced with 0.006 or 0.015-inch oversize studs which are available for service. The standard studs have no identification markings, whereas the 0.006-

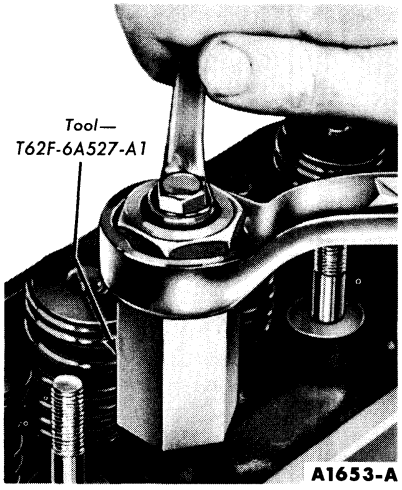



**FIG. 24—Rocker Arm Stud Removal**

inch oversize stud has two grooves around the pilot end of the stud and the 0.015 inch oversize stud has a step produced by the increased diameter of the stud approximately $1\frac{5}{32}$ inches from the pilot end.

When going from a standard size rocker arm stud to a 0.015-inch oversize stud, always use the 0.006-inch reamer before finish reaming with the 0.015-inch reamer.

**1.** Position the sleeve of the rocker arm stud remover (tool T62F-6A527-A1) over the stud with the bearing end down. Thread the puller into the sleeve and over the stud until it is fully bottomed. Hold the sleeve with a wrench, then rotate the puller clockwise to remove the stud (Fig. 24).

If the rocker arm stud was broken off flush with the stud boss, use an easy-out to remove the broken stud following the instructions of the tool manufacturer.

**2.** If a loose rocker arm stud is being replaced, remove the stud bore using the proper reamer (or reamers in sequence) for the selected oversize stud (Fig. 25). **Make sure the metal particles do not enter the valve area.**

**3.** Screw the new stud into the sliding driver of the rocker arm stud installed (tool T62F-6A527-A4) and coat the end of the stud with Lubriplate. Align the stud and installer with the stud bore, then tap the sliding driver until it bottoms (Fig. 26). When the installer contacts the stud boss, the stud is installed to its correct height.

**Reaming Valve Guides.** If it becomes necessary to ream a valve guide (Fig. 27) to install a valve with an oversize stem, a reaming kit is available which contains the following reamer and pilot combinations: a 0.003-inch O.S. reamer with a standard diameter pilot, a 0.015-inch O.S. reamer with a 0.003-inch O.S. pilot, and a 0.030-inch reamer with a 0.015-inch O.S. pilot.

When going from a standard size valve to an oversize valve, always use the reamer in sequence. **Always reface the valve seat after the valve guide has been reamed.**

**Refacing Valve Seats.** Refacing of the valve seat should be closely coordinated with the refacing of the valve face so that the finished seat will match the valve face and be centered. This is important so that the valve and seat will have a good compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

Grind the valve seats of all engines to a true 45° angle (Fig. 28). Remove only enough stock to clean up pits and grooves, or to correct the valve seat runout. After the seat has been refaced, use a seat width scale or a machinist scale to measure the seat width (Fig. 29). Narrow the seat, if necessary, to bring it within specifications.

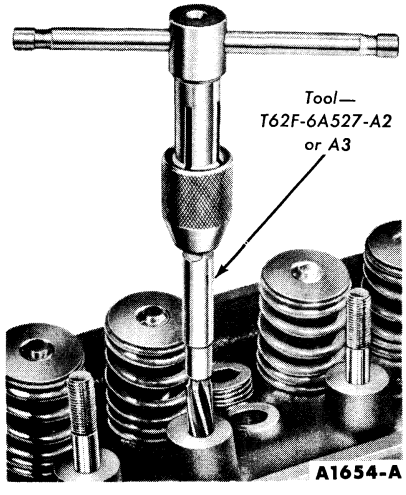



**FIG. 25—Reaming Rocker Arm Stud Bore**

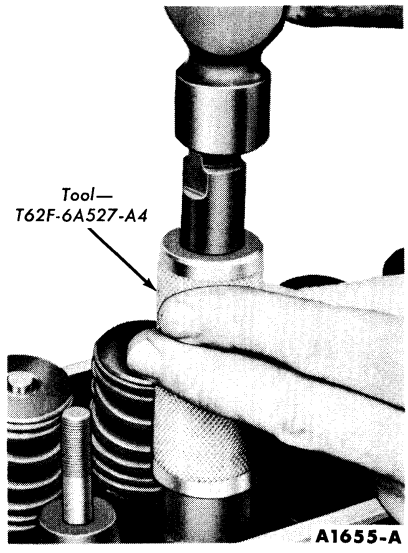



**FIG. 26—Rocker Arm Stud Installation**

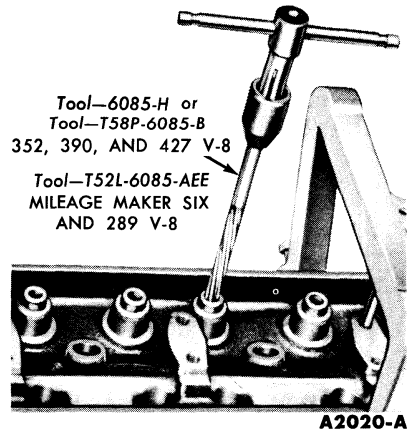



**FIG. 27—Reaming Valve Guides**

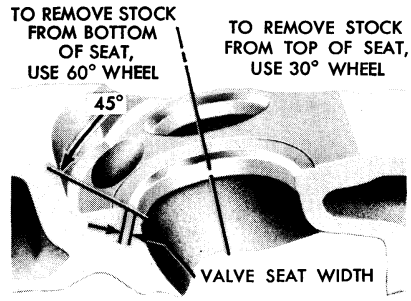



**FIG. 28—Valve Seat Refacing**

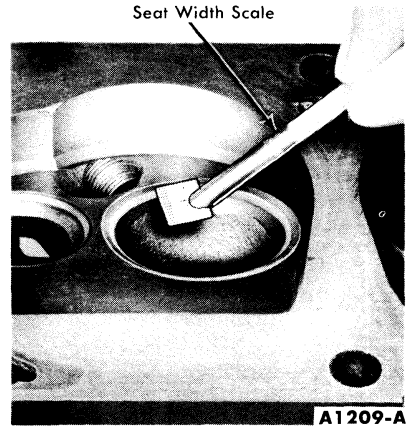



**FIG. 29—Valve Seat Width**

If the valve seat width exceeds the maximum limit, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications.

On the valve seats of all engines, use a 60° angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 30° angle wheel to remove stock from the top of the seats (lower the seats).

The finished valve seat should contact the approximate center of the valve face. It is good practice to determine where the valve seat contacts the face. To do this, coat the seat with Prussion blue and set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

### VALVES

Valves defects, such as minor pits, grooves, etc. may be removed. Discard valves that are severely damaged, or if the face runout or stem clearance exceed specifications.

Discard any defective parts of the valve assembly.

**Refacing Valves.** The valve refacing operation should be closely coordinated with the valve seat refacing operation so that the finished angles of the valve face and of the valve seat will provide a compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

If the valve face runout is excessive and/or to remove pits and grooves, reface the valves to a true 44° angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than 1/32 inch after grinding, replace the valve as the valve will run too hot in the engine. **The interference fit of the valve and seat should not be lapped out.**

Remove all grooves or score marks from the end of the valve stem, and chamfer it as necessary. Do not remove more than 0.010 inch from the stem.

If the valve and/or valve seat has been refaced, it will be necessary to check the clearance between the rocker arm pad and the valve stem with the valve train assembly installed in the engine.

**Select Fitting Valves.** If the valve stem to valve guide clearance exceeds the wear limit, ream the valve guide for the next oversize valve stem. Valves with oversize stem diameters of 0.003, 0.015, and 0.030 inch are available for service. **Always reface the valve seat after the valve guide has been reamed.** Refer to "Reaming Valve Guides."

### CAMSHAFT

Remove light scuffs, scores, or nicks from the camshaft machined surfaces with a smooth oil stone.

### CRANKSHAFT

Dress minor imperfections with an oil stone. If the journals are severely marred or exceed the wear limit, they should be refinished to size for the next undersize bearing.

**Refinishing Journals.** Refinish the journal to give the proper clearance with the next undersize bearing. If the journal will not "clean up" to maximum undersize bearing available, replace the crankshaft.

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

After refinishing the journals, chamfer the oil holes, then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may be used also as a polishing agent.

### PISTONS, PINS AND RINGS

**Fitting Pistons.** Pistons are available for service in standard sizes and the oversizes shown in Table 2.

**TABLE 2—Oversize Service Pistons**

| Engine | | Piston Oversize (Inches) |
|---|---|---|
| 223 | | 0.020, 0.030, 0.040, 0.060 |
| 289 | (2V) | 0.020, 0.030, 0.040 |
| | (4V) | Standard Only |
| 352 | | 0.020, 0.030, 0.040, 0.060 |
| 390 | (2V)* | 0.020, 0.030 |
| | (4V) | 0.020, 0.030, 0.040 |
| 427 | | Standard Only |

*Mercury Only

If the clearance is greater than the maximum limit, recheck calculations to be sure that the proper size piston has been selected, check for a damaged piston, then try a new piston.

If the clearance is less than the minimum limit, recheck calculations before trying another piston. If none can be fitted, refinish the cylinder for the next size piston.

**When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.**

If the taper and out-of-round conditions of the cylinder bore are within limits, new piston rings will give satisfactory service provided the piston clearance in the cylinder bore is within limits. If the new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall "glaze."

**To fit a piston:**

1. Calculate the size piston to be used by taking a cylinder bore check. Follow the procedures outlined in Section 3.

2. Select the proper size piston to provide the desired clearance.

3. Make sure the piston and cylinder block are at room temperature (70°F.) **After any refinishing operation, allow the cylinder bore to cool and make sure the piston and bore are clean and dry before the piston fit is checked.**

4. Attach a tension scale to the end of a feeler gauge ribbon that is free of dents or burrs. The feeler ribbon should be ½-inch wide and of one of the thicknesses listed in Fig. 30.

5. Position the ribbon in the cylinder bore so that it extends the entire length of the piston at 90° from the piston pin location.

6. Invert the piston and install it in the bore so that the end of the piston is about 1½ inches below the top of the cylinder block and the piston pin is parallel to the crankshaft axis.

**When checking the piston to bore clearance, the ribbon and piston fit in the bore must be snug in order to obtain an accurate reading. It is necessary to support the weight of the connecting rod with one hand to prevent twisting the piston in the bore and obtaining an erroneous reading. A used piston must always be checked in the bore from which it was removed.**

7. Hold the piston and slowly pull the scale in a straight line with the

| PISTON CLEARANCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| RIBBON 0.0015 THICK & 0.500 WIDE | | RIBBON 0.002 THICK & 0.500 WIDE | | RIBBON 0.0035 THICK & 0.500 WIDE | | RIBBON 0.006 THICK & 0.500 WIDE | |
| Ribbon Pull Lbs. | Clearance Inches | Ribbon Pull Lbs. | Clearance Inches | Ribbon Pull Lbs. | Clearance Inches | Ribbon Pull Lbs. | Clearance Inches |
| 13 | — | 13 | — | 13 | 0.0012 | 13 | 0.0038 |
| 12 | — | 12 | — | 12 | 0.0014 | 12 | 0.0040 |
| 11 | — | 11 | — | 11 | 0.0016 | 11 | 0.0041 |
| 10 | — | 10 | — | 10 | 0.0018 | 10 | 0.0043 |
| 9 | — | 9 | 0.0002 | 9 | 0.0021 | 9 | 0.0045 |
| 8 | — | 8 | 0.0005 | 8 | 0.0023 | 8 | 0.0047 |
| 7 | 0.0002 | 7 | 0.0007 | 7 | 0.0025 | 7 | 0.0049 |
| 6 | 0.0004 | 6 | 0.0010 | 6 | 0.0027 | 6 | 0.0050 |
| 5 | 0.0007 | 5 | 0.0012 | 5 | 0.0030 | 5 | 0.0057 |
| 4 | 0.0009 | 4 | 0.0015 | 4 | 0.0032 | 4 | 0.0059 |
| 3 | 0.0012 | 3 | 0.0017 | 3 | 0.0033 | 3 | 0.0060 |
| 2 | 0.0015 | 2 | 0.0020 | 2 | 0.0036 | 2 | 0.0062 |
| 1 | 0.0017 | 1 | 0.0022 | 1 | 0.0038 | 1 | 0.0063 |
| 0 | 0.0020 | 0 | 0.0025 | 0 | 0.0040 | 0 | 0.0065 |

A1930-A

**FIG. 30—Piston Clearance Chart**

ribbon, noting the pull required to remove the feeler ribbon (Fig. 31).

**8.** Knowing the ribbon thickness and the actual pull required, the piston clearance can be determined by referring to Fig. 30.

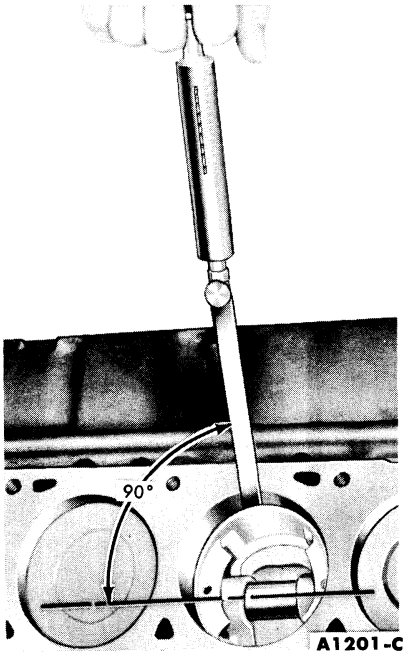



**FIG. 31—Checking Piston Fit**

**Example.** If a 5-pound pull on the scale is required with a 0.002 inch ribbon, then the clearance between the piston and cylinder bore is 0.0012 inch.

**9.** If the reading on the scale is greater than the pull shown in Fig. 30, check the piston for any damage that may effect the pull reading. If no damage is evident, try another piston. Check the fit of the new piston. Each piston thus fitted should immediately be marked with the respective cylinder number.

It is recommended that the clearance between the fitted piston and cylinder wall be held to the mean limit. The minimum and maximum clearances shown in the specifications pertain only to the fitting of a new piston in a new bore. The wear limit specification is only to be used as an allowable limit when fitting a used piston in a used bore.

### Fitting Piston Rings

**1.** Select the proper ring set for the size piston to be used.




**FIG. 32—Piston Ring Gap**

**2.** Position the ring in the cylinder bore in which it is going to be used.

**3.** Push the ring down into the bore area where normal ring wear is not encountered.

**4.** Use the head of a piston to position the ring in the bore so that the ring is square with the cylinder wall. **Use caution to avoid damage to the ring or cylinder bore.**

**5.** Measure the gap between the ends of the ring with a feeler gauge (Fig. 32). If the ring is less than the recommended lower limit, try another ring set.

**6.** Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 33). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**

**Fitting Piston Pins.** The piston pin should be a light thumb press fit at normal temperature (70°F.). Standard piston pins are color coded green. Pins of 0.001-inch oversize (color coded blue) and 0.002-inch oversize (color coded yellow) are available.

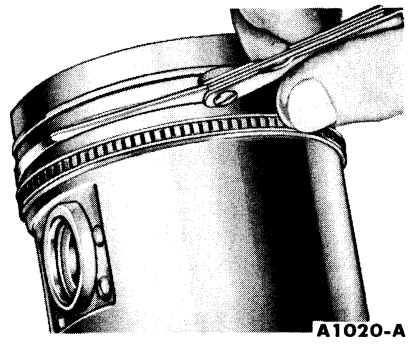



**FIG. 33—Ring Side Clearance**

Install the piston pin in the piston and rod. Install a new retainer at each end of the pin to hold it in place. Make sure the retainers are properly seated in their grooves. On the 289 V-8 install the piston pin, following the procedure under "Piston Assembly".

If the pin hole in the piston must be reamed or honed, use precision honing equipment or an expansion-type piloted reamer.

If a reamer is used, place the reamer in a vise and revolve the piston around the reamer. Set the reamer to the size of the pin bore, then expand the reamer slightly and trial ream the pin bore. Take a light cut. Use a pilot sleeve of the nearest size to maintain alignment of the bores.

Check the hole size, using the new piston pin. If the bore is small, expand the reamer slightly and make another cut. Repeat the procedure until the proper fit is obtained. Check the piston pin for fit in the respective rod or rod bushing. If necessary, ream or hone the rod or bushing to fit the pin to specifications.

### CYLINDER BLOCK

**Refinishing Cylinder Walls.** Honing is recommended for refinishing cylinder walls only when the walls have minor imperfections, such as light scuffs and scratches or for fitting pistons to the specified clearance. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. Before any cylinder is refinished, all main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the refinishing operation.

Refinish only the cylinder or cylinders that require it. **All pistons are the same weight, both standard and oversize; therefore, various sizes of pistons can be used without upsetting engine balance.**

Refinish the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when refinished for the maximum oversize piston recommended, replace the block.

Refinish the cylinder to within approximately 0.0015 inch of the required oversize diameter. This will allow enough stock for the final step of honing so that the correct surface finish and pattern are obtained. Use clean sharp hones of No. 220-280 grit for this operation.

For the proper use of the refinishing equipment, follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work.

After the final operation in either of the two refinishing methods described and prior to checking the piston fit, thoroughly wash the cylinder walls with solvent to remove all abrasive particles; then thoroughly dry the walls. Check the piston fit. Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons are fitted, thoroughly clean the entire block to remove all particles from the bearing bores, oil passages, cylinder head bolt holes, etc. Coat the cylinder walls with oil.

### FLYWHEEL RING GEAR– MANUAL-SHIFT TRANSMISSIONS

To replace a defective ring gear, heat the defective ring gear with a blow torch on the engine side of the gear, and knock it off the flywheel. **Do not hit the flywheel when removing the ring gear.**

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. **Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the ring gear teeth.**

## 3 CLEANING AND INSPECTION

### INTAKE MANIFOLD

#### CLEANING

Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent, and dry it with compressed air. On the 352 and 390 V-8 engines, clean any accumulated varnish from the maze screen on the baffle plate.

#### INSPECTION

Inspect the manifold for cracks, damaged gasket surfaces, or other defects that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. **Remove all filings and foreign matter that may have entered the manifold as a result of repairs.**

On the 352, 390 and 427 V-8 engines, check the baffle plate on the underside of the manifold for looseness, and be sure the maze screen is in place.

### EXHAUST MANIFOLDS

#### CLEANING

Remove all gasket material from the manifolds.

On the right exhaust manifold of the V-8 engines, make sure the automatic choke air inlet and outlet holes are completely open and the cover does not leak.

Blow out the automatic choke air heat tube and clean air tube, if so equipped, with compressed air.

#### INSPECTION

Inspect the manifolds for cracks, damaged gasket surfaces, or other defects that would make them unfit for further service.

On the Mileage Maker Six and 427 V-8 check the exhaust control valve for freedom from binding throughout the valve travel.

### VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

#### CLEANING

Clean all the parts thoroughly. Make sure all oil passages are open.

On ball stud rocker arms, make sure the oil passage in the push rod end of the rocker arm is open.

On silent valve lash rocker arms, make sure the oil passage to the eccentric is open.

#### INSPECTION

On rocker arm shaft assemblies, check the clearance between each rocker arm and the shaft by checking the ID of the rocker arm bore and the OD of the shaft. If the




**FIG. 34—Silent Lash Rocker Measurement**

clearance between any rocker arm and the shaft exceeds the wear limit, replace the shaft and/or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs.

Inspect the pad at the valve end of the rocker arms for a grooved radius.

On engines with mechanical or silent lash valve lifters, check the rocker arm adjusting screws and the push rod end of the rocker arms for stripped or broken threads, and the ball end of the adjusting screw for nicks, scratches, or excessive wear. Inspect the oil tubes for cracks or sharp bends.

On the silent valve lash rocker arms, inspect the eccentric for abnormal wear in the area of contact with the valve stem tip and the rocker arm bearing recess. Inspect the eccentric bearing recess machined in the rocker arm. Evidence of wear in this area can best be determined by measuring the length of the inner slot or relief area machined in the cavity (Fig. 34). Using a divider, measure the length of the slot. Take the measurement perpendicular to the arm axis. If the slot length has decreased to or below the recommended minimum, replace the arm. Check for broken locating springs.

On ball stud rocker arms, check the rocker arm and fulcrum seat for excessive wear, cracks, nicks or burrs. Check the rocker arm stud and nut for stripped or broken threads.

## PUSH RODS

### CLEANING

On a 289 V-8 engine, clean the push rods in a suitable solvent.

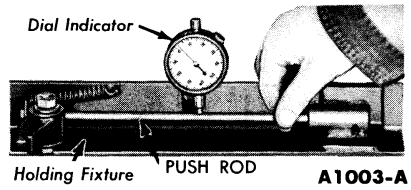



**FIG. 35—Push Rod Runout**

Blow out the oil passage in the push rod with compressed air.

### INSPECTION

Check the ends of the push rods for nicks, grooves, roughness or excessive wear.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator (Fig. 35).

## CYLINDER HEADS

### CLEANING

With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. **Be careful not to damage the cylinder head gasket surface.** After the valves are removed, clean the valve guide bores with a valve guide cleaning tool. Use cleaning solvent to remove dirt, grease, and other deposits.

Remove all deposits from the valves with a fine wire brush or buffing wheel.

### INSPECTION

Check the cylinder head for cracks, and the gasket surface for burrs and nicks. Replace the head if it is cracked.

**Cylinder Head Flatness.** Check the flatness of the cylinder head gasket surface (Fig. 36).

**Valve Seat Runout.** Check the valve seat runout with an accurate

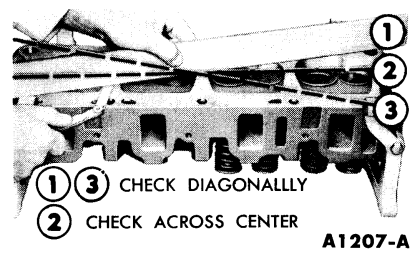



**FIG. 36—Typical Cylinder Head Flatness**

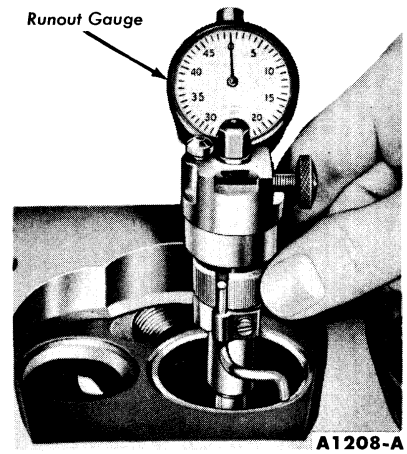



**FIG. 37—Typical Valve Seat Runout**

gauge (Fig. 37). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat.

**Valve Seat Width.** Measure the valve seat width (Fig. 29).

**Valves.** The critical inspection points and tolerances of the valves are illustrated in Fig. 38.

Inspect the valve face and the edge of the valve head for pits, grooves, scores, or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for signs of burning or erosion, warpage, and cracking.

Inspect the valve springs, valve spring retainers, locks, and sleeves for defects.

**Valve Face Runout.** Check the valve face runout (Fig. 39). It should not exceed the specified wear

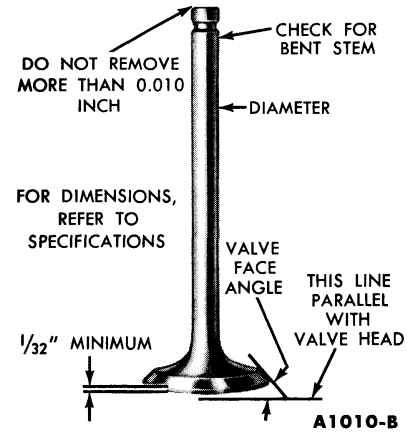



**FIG. 38—Critical Valve Tolerances**

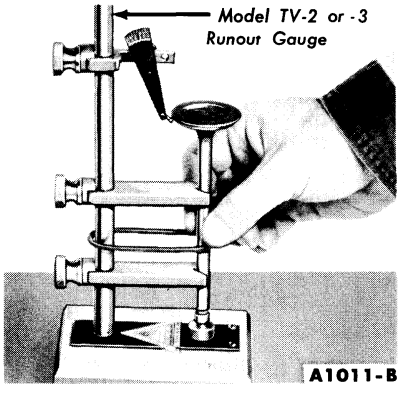



**FIG. 39—Valve Face Runout**

limit. If the runout exceeds the wear limit, the valve should be refaced or replaced as outlined under "Refacing Valves" in this section.

**Valve Stem Clearance.** Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 40 or its equivalent. Use a flat-end indicator point.

**Valve Spring Pressure.** Check the springs for proper pressure (Figs. 41 or 42) at the specified spring lengths. Do not remove the damper spring if one is installed when checking the pressure. Weak valve springs cause poor engine performance. Replace any spring not within specifications.

**Valve Spring Squareness.** Check each spring for squareness, using a steel square and a surface plate (Fig. 43). Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the

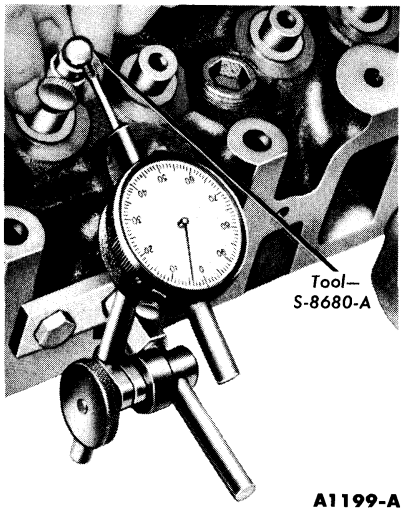



**FIG. 40—Valve Stem Clearance**

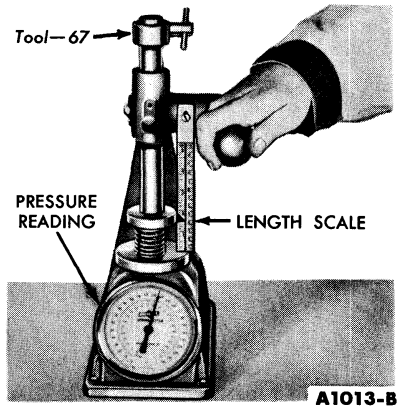



**FIG. 41—Valve Spring Pressure—Ford**

spring slowly and observe the space between the top coil of the spring and the square. The out-of-square limit is 1/16 inch.

## HYDRAULIC VALVE LIFTERS

### CLEANING

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint-free cloth.

### INSPECTION

Inspect the parts and discard the entire lifter assembly if any part shows signs of pitting, scoring, galling, or evidence of non-rotation. Replace the entire assembly if the plunger is not free in the body. The plunger should drop to the bottom of the body by its own weight.

Assemble the lifter assembly and check for freeness of operation by pressing down on the push rod cup. The lifters can also be checked with a hydraulic tester to test the leakdown rate. Follow the instructions of the test unit manufacturer.




**FIG. 42—Valve Spring Pressure—Mercury**

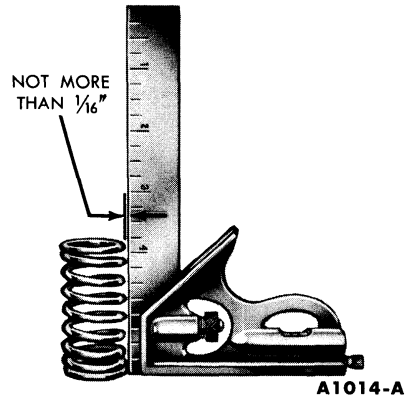



**FIG. 43—Valve Spring Squareness**

## TAPPETS

### CLEANING

Thoroughly clean the tappets in clean solvent and wipe them with a clean, lint-free cloth.

### INSPECTION

Inspect the tappets, and discard any that show signs of pitting, scoring or galling. Replace any tappets that show evidence of non-rotation.

## TIMING CHAIN AND SPROCKETS

### CLEANING

Clean all parts in solvent and dry them with compressed air.

### INSPECTION

Inspect the chain for broken links and the sprockets for cracks and worn or damaged teeth. Replace all the components of the timing chain and sprocket assembly, if any one item needs replacement.

Inspect the fuel pump drive eccentric for scores, nicks and excessive wear. If the eccentric is scored, replace it.

On the Mileage Maker Six, inspect the timing chain vibration damper (snubber pad) for wear and distortion.

## TIMING GEARS

### CLEANING

Clean the gears in solvent, and dry them with compressed air.

### INSPECTION

Inspect the gear teeth for scores, nicks, etc. Note the condition of the teeth contact pattern. If the teeth are scored, replace the gears. Replace both gears if either gear needs replacing.

## CAMSHAFT

### CLEANING AND INSPECTION

Clean the camshaft in solvent and wipe dry. Inspect the camshaft lobes for scoring and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general area of the lobe toe. This pitting is not detrimental to the operation of the camshaft, therefore, the camshaft should not be replaced until the lobe lift loss has exceeded 0.005 inch.

The lift of the camshaft lobes can be checked with the camshaft installed in the engine or on centers. Refer to "Camshaft Lobe Lift."

Check the distributor drive gear for broken or chipped teeth.

## CRANKSHAFT

### CLEANING

**Handle the crankshaft with care to avoid possible fractures or damage to the finished surfaces.** Clean the crankshaft with solvent, then blow out all oil passages with compressed air.

### INSPECTION

Inspect main and connecting rod journals for cracks, scratches, grooves or scores.

Measure the diameter of each journal in at least four places to determine an out-of-round, taper or undersize condition (Fig. 44).

On engines used with a manual-shift transmission, check the fit of the clutch pilot bushing in the bore of the crankshaft. The bushing is pressed into the crankshaft and should not be loose. Inspect the inner surface of the bushing for wear or a bell-mouth condition. Check the ID of the bushing (Fig. 45). Replace the bushing if it is worn or damaged or the ID is not within specifications.

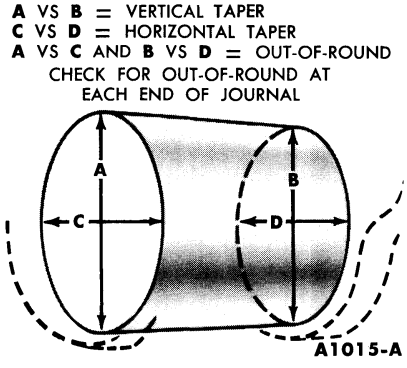



**FIG. 44—Crankshaft Journal Measurements**

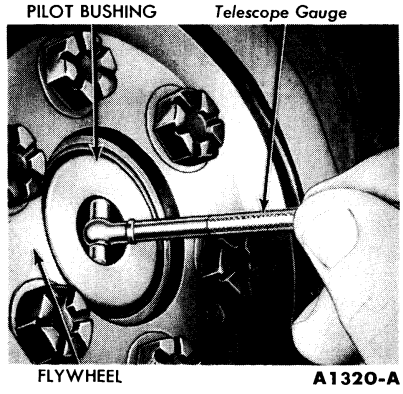



**FIG. 45—Typical Clutch Pilot Bushing Wear Check**

Inspect the pilot bearing, when used, for roughness, evidence of overheating or loss of lubricant. Replace it if any of these conditions are found.

## FLYWHEEL—MANUAL SHIFT TRANSMISSIONS

### INSPECTION

Inspect the flywheel for cracks, heat check, or other defects that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout, following the procedure in Section 1.

## CONNECTING RODS

### CLEANING

Remove the bearings from the rod and cap. Identify the bearings if they are to be used again. Clean the connecting rod in solvent, including the rod bore and the back of the inserts. **Do not use a caustic cleaning solution.** Blow out all passages with compressed air.

### INSPECTION

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves.

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined crankpin, or a tapered connecting rod bore.

Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits and/or if the connecting rod is fractured, it should be replaced.

Check the piston pin to connecting rod bushing clearance. Replace the connecting rod if the bushing is so worn that it cannot be reamed or honed for an oversize pin.

On the 289 V-8, check the I.D. of the connecting rod piston pin bore. Replace the connecting rod if the pin bore is not within specifications.

Replace defective connecting rod nuts and bolts.

After the connecting rods are assembled to the piston, check the connecting rods for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist is excessive, the connecting rod should be straightened or replaced.

## PISTONS, PINS AND RINGS

### CLEANING

Remove deposits from the piston surfaces. Clean gum or varnish from

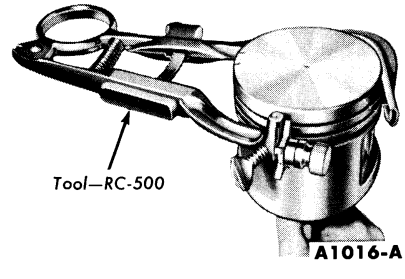



**FIG. 46—Cleaning Ring Grooves —Ford**

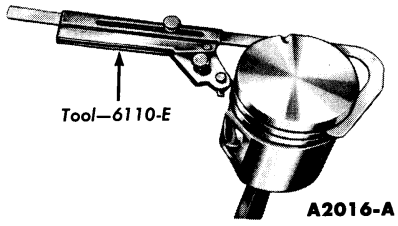



**FIG. 47—Cleaning Ring Grooves —Mercury**

the piston skirt, piston pins, and rings with solvent. **Do not use a caustic cleaning solution or a wire brush to clean pistons.** Clean the ring grooves with a ring groove cleaner (Figs. 46 or 47). Make sure the oil ring slots (or holes) are clean.

### INSPECTION

Carefully inspect the pistons for fractures at the ring lands, skirts, and pin bosses, and for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves has a high step, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation, or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands, fractures, and/or damage from detonation or pre-ignition.

Check the piston to cylinder bore clearance with a tension scale and ribbon, following the procedure under "Fitting Pistons" in this section. Check the ring side clearance following the procedure under "Fitting Piston Rings" in this section.

Replace piston pins showing signs of fracture or etching and/or wear. Check the piston pin fit in the piston and rod. Refer to "Pistons and Connecting Rods Assembly," in the pertinent engine section.

Check the O.D. of the piston pin and the I.D. of the pin bore in the piston. Replace any piston pin or piston that is not within specifications.

Replace all rings that are scored, chipped, or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling the engine. **Rings should not be transferred from one piston to another regardless of mileage.**

## MAIN AND CONNECTING ROD BEARINGS

### CLEANING

Clean the bearing inserts and caps thoroughly in solvent, and dry with compressed air. **Do not scrape gum or varnish deposits from the bearing shells.**

### INSPECTION

Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of bearing failures and their causes are shown in Fig. 48. The copper lead bearing base may be visible through the bearing overlay. This does not mean that the bearing is worn. Do not replace the bearing if the bearing clearance is within recommended limits. Check the clearance of bearings that appear to be satisfactory with Plastigage. Fit new bearings following the recommended procedure in the pertinent part of Group 8.

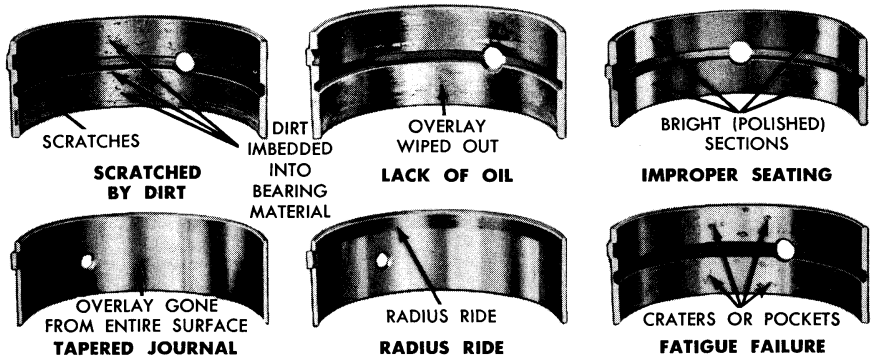



**FIG. 48—Typical Bearing Failures**

## CYLINDER BLOCK

### CLEANING

Thoroughly clean the block in solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs which seal oil passages, then clean out all the passages. Blow out all passages, bolt holes, etc. with compressed air. Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

### INSPECTION

After the block has been thoroughly cleaned, check it for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the defective area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches, and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head.

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs

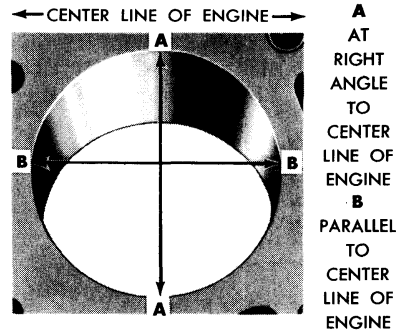



**FIG. 49—Cylinder Bore Out-of-Round and Taper**

of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle, and bottom with the gauge placed at right angles and parallel to the centerline of the engine (Fig. 49).

Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the wear limits.

If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder walls and installing new service piston rings providing the piston clearance is within limits. Use the finest grade of honing stone for this operation.

## OIL PAN

### CLEANING

Scrape any dirt or metal particles from the inside of the pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign particles are removed from below the baffle plate.

### INSPECTION

Check the pan for cracks, holes, damaged drain plug threads, and a loose baffle or a damaged gasket surface.

Repair any damage, or replace the pan if repairs cannot be made.

## OIL PUMP

### CLEANING

Wash all parts in a solvent and dry them thoroughly with compressed air. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and metal particles are removed.

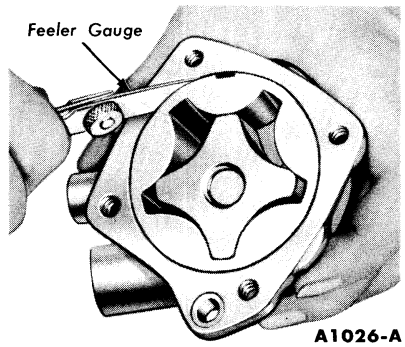



**FIG. 50—Outer Race to Housing Clearance**

### INSPECTION

Check the inside of the pump housing and the outer race and rotor for damage or excessive wear.

Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored or grooved, replace the cover.

Measure the outer race to housing clearance (Fig. 50).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance between the straight edge and the rotor and outer race (Fig. 51).

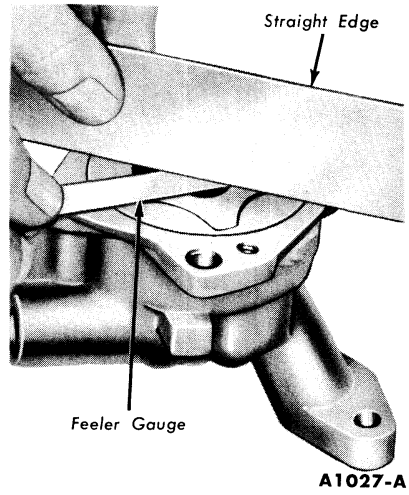



**FIG. 51—Rotor End Play**

**The outer race, shaft and rotor are replaceable only as an assembly.**

Check the drive shaft to housing bearing clearance by measuring the OD of the shaft and the ID of the housing bearing.

Inspect the relief valve spring for a collapsed or worn condition.

Check the relief valve spring tension. If the spring tension is not within specifications and/or the spring is defective, replace the spring.

Check the relief valve piston for scores and free operation in the bore.

## CRANKCASE VENTILATION SYSTEM MAINTENANCE

Refer to Group 19 for the correct mileage interval for maintenance.

### CLEANING

The breather cap located on the oil filler tube should be cleaned with a solvent at the proper mileage interval. **Do not oil the mesh screen after cleaning.**

On positive crankcase ventilation systems, remove the regulator valve, intake manifold fitting, exhaust tube, connections, and outlet adapter at the recommended interval. Clean the valve, exhaust tube, intake manifold fitting, and outlet adapter in clean carburetor solvent and dry them with compressed air. Clean the rubber hose connections with a low volatility petroleum base solvent and dry them with compressed air.

On the vent tube-type crankcase ventilation system (427 V-8), the road draft tube seldom requires cleaning except during a high mileage engine overhaul. However, if there is evidence of crankcase pressure, the tube should be checked for excessive sludge and cleaned out if necessary. In addition the maze screen in the intake manifold baffle plate should be cleaned in solvent to remove any accumulation of sludge deposits.

# PART 8-2 MILEAGE MAKER SIX


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| 3 | Engine Removal and Installation | 8-44 |
| 4 | Major Repair Operations | 8-45 |

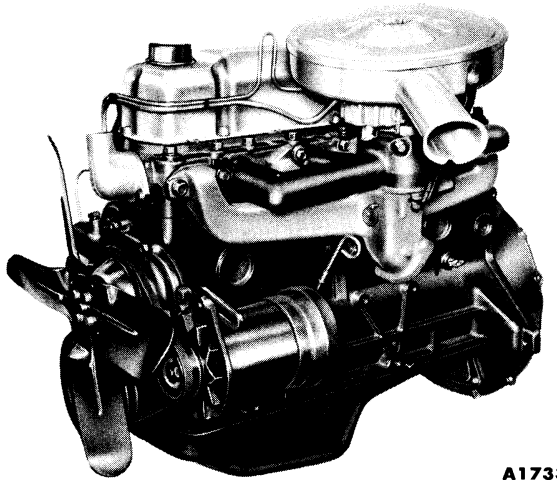

## 1 DESCRIPTION AND OPERATION

The Mileage Maker Six engines (Figs. 1, 2, 3 and 4) have a displacement of 223 cubic inches and a compression ratio of 8.5:1. The warranty plate identification symbols for the engines are as follows:

Mileage Maker Six—Symbol "V"; Police Special Six and Taxi Special Six—Symbol "E".

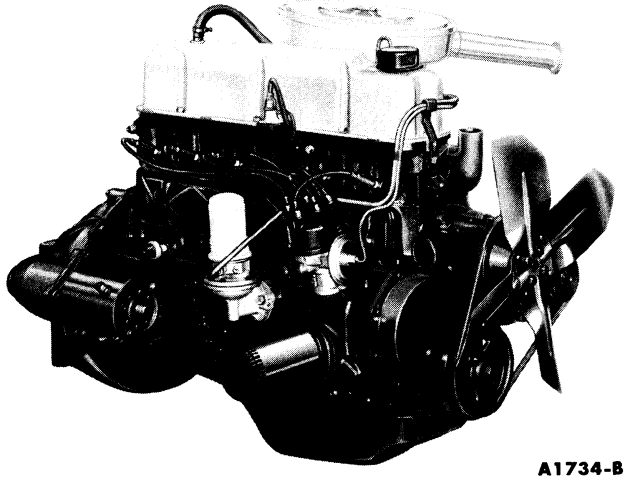
### MANIFOLDS

A chamber (heat riser) is cast into the intake manifold center section between the carburetor and exhaust manifold. A thermostatically controlled valve, located in the exhaust manifold (Fig. 5), directs exhaust gases into this area to provide the



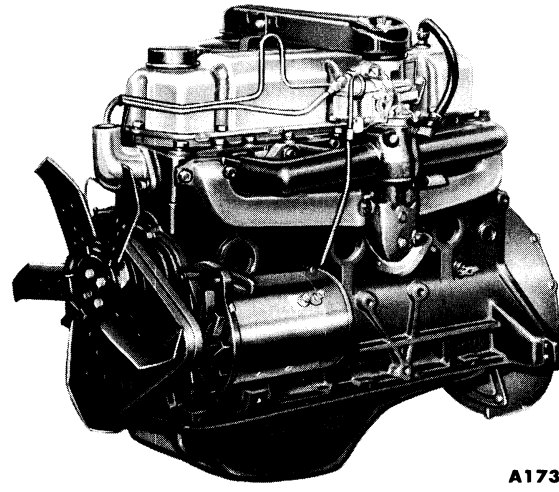
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**FIG. 1—Mileage Maker Six—Left Front View**



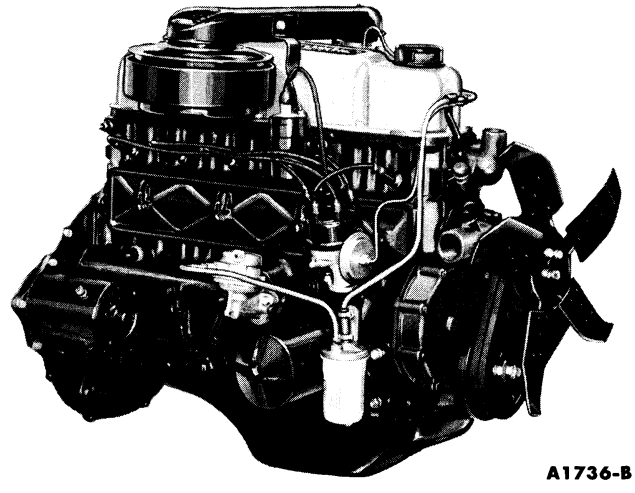
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**FIG. 2—Mileage Maker Six—Right Front View**



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**FIG. 3—Police Special Six and Taxi Special Six—Left Front View**



A1736-B

**FIG. 4—Police Special Six and Taxi Special Six—Right Front View**

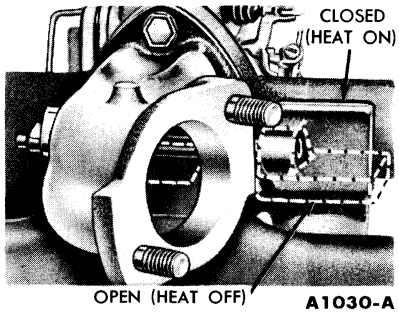



**FIG. 5—Exhaust Control Valve**

heat necessary to assist in vaporizing the incoming fuel mixture until the engine reaches normal operating temperature.

### CYLINDER HEAD

The cylinder head carries the valves, valve rocker arm shaft assembly, manifold assembly, ignition coil, the coolant outlet housing and thermostat. Valve guides are cast integrally in the head. The valves are arranged from front to rear, E-I-I-E-I-E-E-I-E-I-I-E.

### CYLINDER BLOCK

The cylinders are numbered from 1-6 starting at the front of the engine. The firing order is 1-5-3-6-2-4.

The distributor, located at the right front of the engine, drives the oil pump through an intermediate drive shaft.

The crankshaft is supported by four main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The pistons have two compression rings and one oil control ring. The top compression ring is chrome-plated and the lower compression ring is phosphate-coated. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.

### VALVE TRAIN

#### MILEAGE MAKER SIX

The intake and exhaust valve assemblies are the rotating type. The tappets are the solid steel mushroom-type.

The camshaft is supported by four bearings pressed into the block. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft thrust is controlled by a thrust plate located between the timing chain snubber pad and the front journal of the camshaft. An eccentric, made integral with the camshaft, operates the fuel pump.

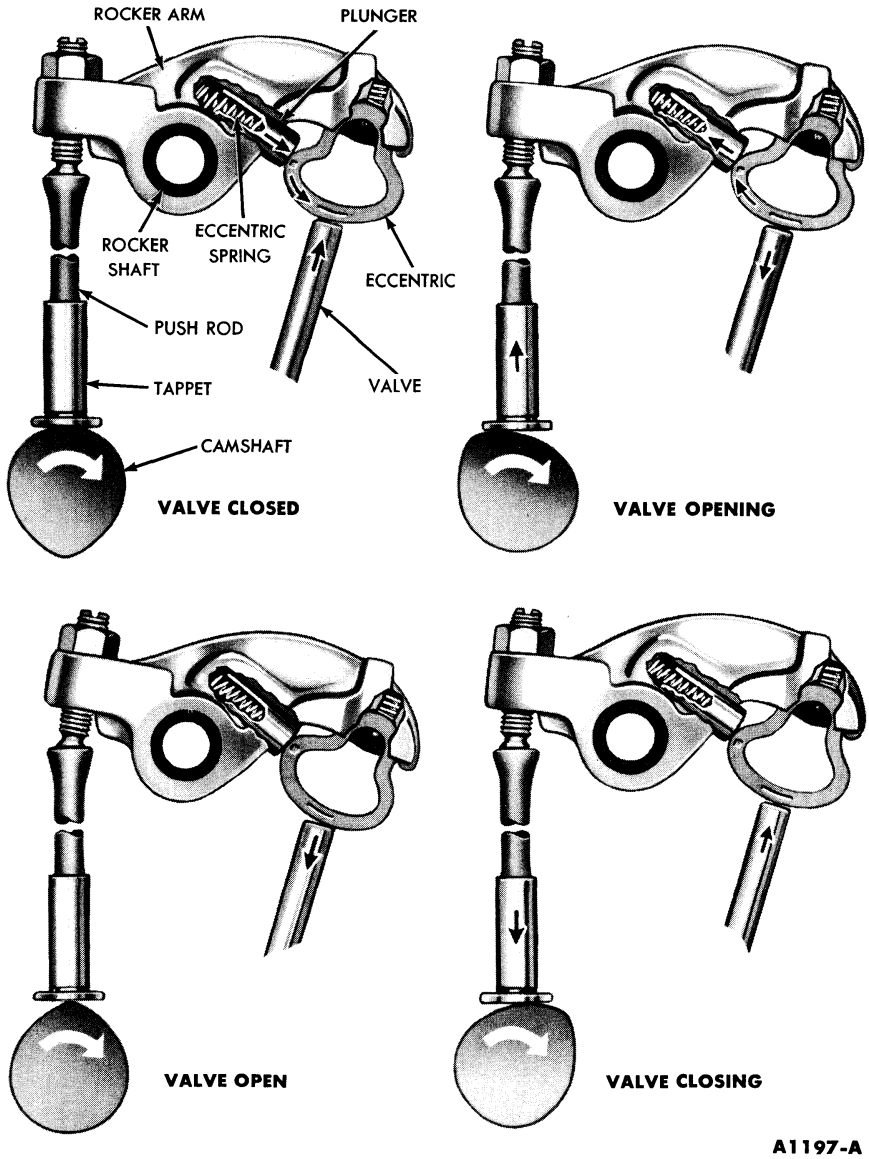


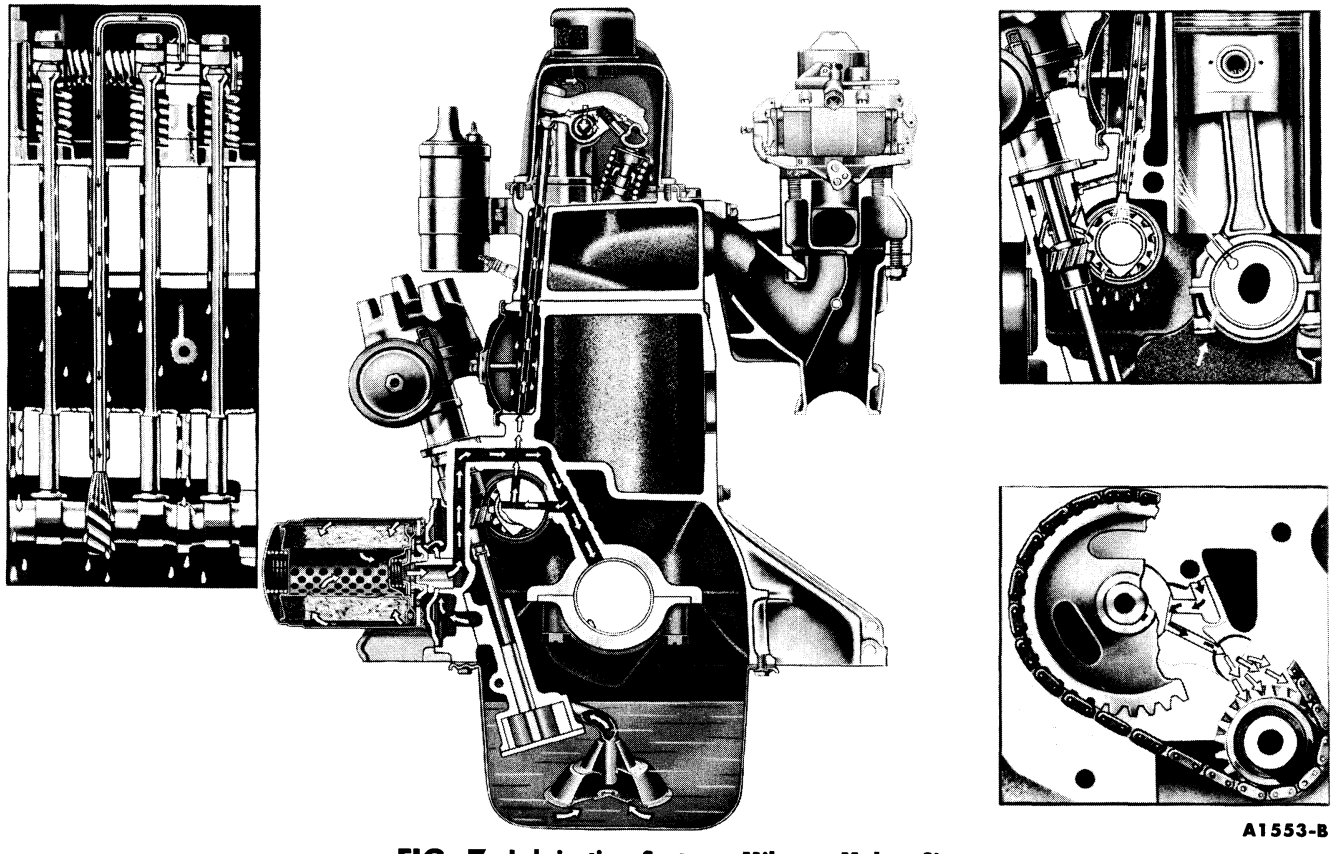

**FIG. 6—Silent Lash Rocker Arm Operation—Mileage Maker Six**

Silent lash rocker arms are used which mechanically provide zero valve lash and minimize valve train noise and wear. The operation and parts identification of the silent lash rocker arms are shown in Fig. 6.

When the valve is closed, the tappet is on the base circle of the camshaft lobe and the valve push rod is in its lowest position. With the rocker arm in this position. With eccentric actuating spring expands forcing the plunger outward against the valve, and takes up any clearance that may be present (Fig. 6).

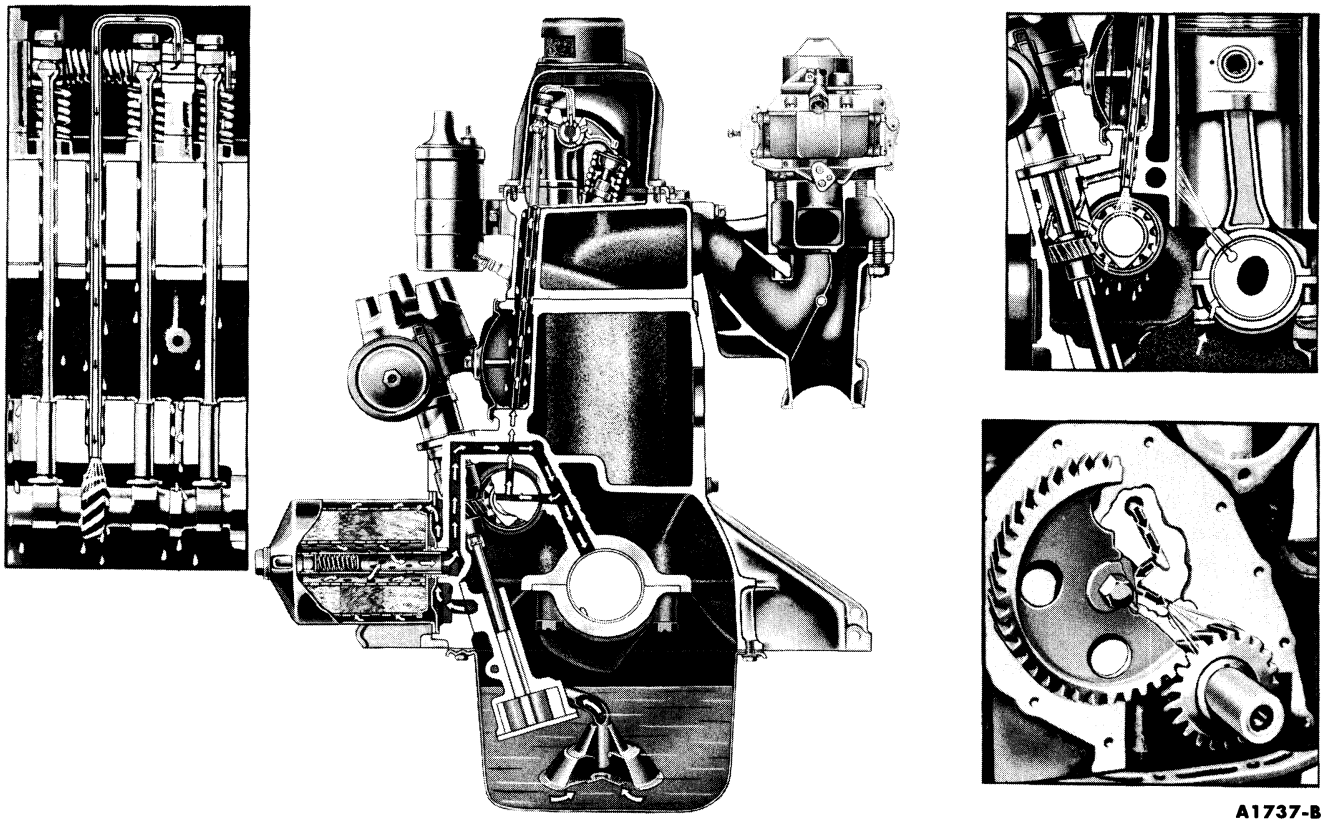
As the camshaft rotates and the valve begins to open, the valve push rod is forced up against the rocker arm, which in turn pushes the eccentric down on the valve. This action moves the eccentric inward, slightly, and compresses the spring and plunger (Fig. 6). As the high point on the camshaft lobe rotates past the tappet, the push rod is lowered and the valve spring closes the valve. The eccentric actuating spring expands and pushes the plunger against the eccentric. The eccentric then moves outward against the valve to take up any clearance that tends to be present.

The rocker arm eccentric functions throughout the rocker arm motion during the valve opening and closing cycle, compensating for expansion or wear of the valve train. Therefore, solid contact (zero lash) between all parts of the valve train mechanism is maintained.



A1553-B

FIG. 7—Lubrication System—Mileage Maker Six



A1737-B

FIG. 8—Lubrication System—Police Special Six and Taxi Special Six

### POLICE SPECIAL SIX AND TAXI SPECIAL SIX

The intake and exhaust valves are the rotating type. The tappets are the solid steel mushroom-type. Conventional rocker arms with self-locking adjustment screws are used in the engine. A specified valve lash (clearance) between the pads of the rocker arms and the valve stems is maintained by means of the adjusting screws.

The camshaft is supported by four bearings pressed into the block. It is driven by an attached gear that is in mesh with a gear on the crankshaft. The distributor drive gear is driven by an integral gear located on the front of the camshaft. **The camshaft is driven in reverse rotation (counterclockwise); however, the teeth on the distributor are machined in a manner that allows the distributor to be driven in a counterclockwise (normal) direction.**

## LUBRICATION SYSTEM

### MILEAGE MAKER SIX

Oil from the oil pan sump is forced through the pressure-type lubrication system (Fig. 7) by a rotor-type oil pump. A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

The engine has a full-flow Rotunda filter which filters the entire output of the pump before the oil enters the engine. The filter has an integral relief valve and mounting gasket. The relief valve permits oil to bypass the filter if it becomes clogged, thereby maintaining an emergency supply of oil to the engine at all times. An anti-drain back diaphragm prevents a reverse flow of oil when the engine is stopped.

From the filter, the oil flows into the main oil gallery. The oil gallery supplies oil to all the camshaft and main bearings through a drilled passage in each main bearing web.

The timing chain and sprockets are lubricated through a flat on the No. 1 camshaft bearing.

Oil slingers prevent leakage by directing oil away from the crankshaft front and rear oil seals.

Cylinder walls, pistons and piston pins are lubricated through a drilled hole in each connecting rod which indexes with a drilled hole in the connecting rod journal of the crankshaft.

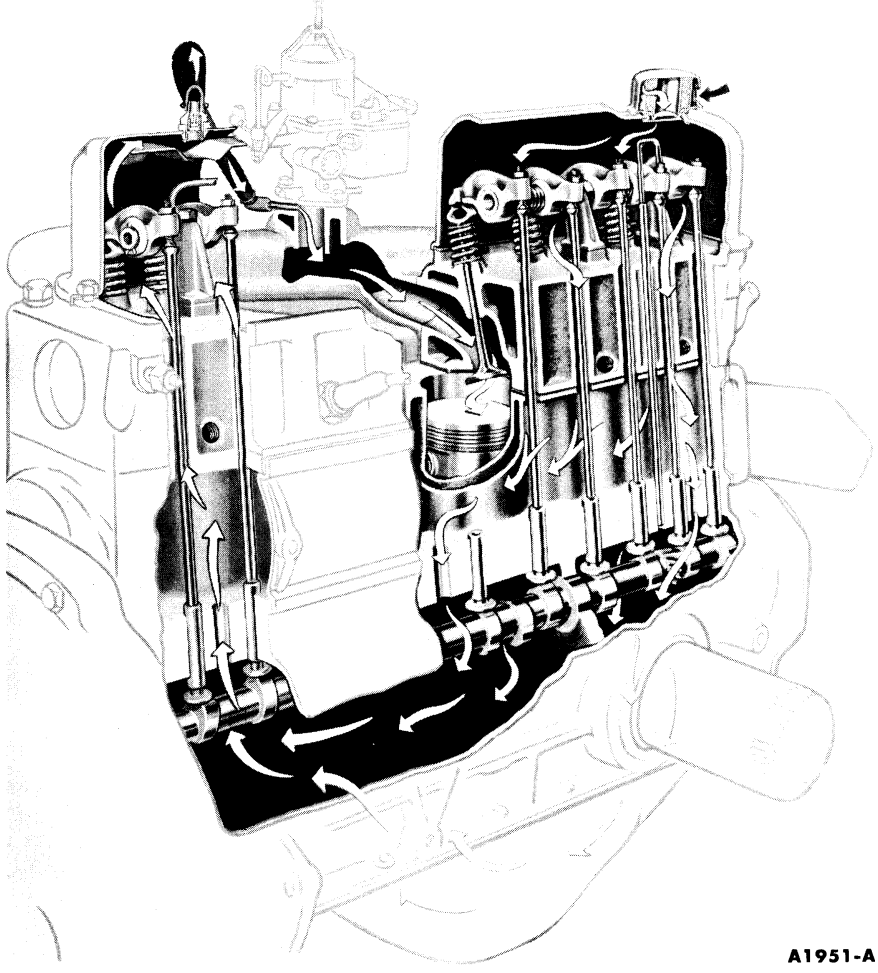
Oil, under full-jet metered pressure, is fed through a drilled passage in the cylinder block at the No. 3 camshaft bearing. The passage in the block indexes with a hole in the cylinder head. An oil inlet tube directs the oil into the hollow rocker shaft through the No. 4 valve rocker arm support. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the eccentric, rocker arm shaft bore, valve, and ball end of the rocker arm. Excess oil spirals down the rotating push rod and assists in lubricating the tappet and push rod seat. An oil outlet tube exhausts excess oil from the rocker shaft to lubricate the distributor drive gear. The oil outlet tube is located at the No. 1 rocker arm support. The oil from each rocker arm drains into the push rod chamber through holes provided in the cylinder head.

The oil in the push rod chamber drains back into the oil pan through an opening at the back of the block.

### POLICE SPECIAL SIX AND TAXI SPECIAL SIX

The engine has a full-flow, replaceable oil filter element (canister-cover type) which filters the entire output of the oil pump before the oil enters the engine (Fig. 8).

A by-pass system provides oil to the engine in case the filter element becomes clogged. The by-pass is located in the hollow center bolt of the filter assembly and consists of a spring-loaded valve. When the filter is clean and oil will flow through it, the pressure difference between the inner and outer faces of the valve is not great enough to overcome the spring pressure behind the valve; therefore, no oil flows through the by-pass. When the element is dirty and will not permit sufficient flow of oil, the pressure acting on the inner face of the valve drops. If the pressure difference between the valves is great enough to overcome the spring pressure, the valve will open. Oil then by-passes the element, maintaining an emergency supply of oil



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**FIG. 9—Typical Positive Crankcase Ventilation System**

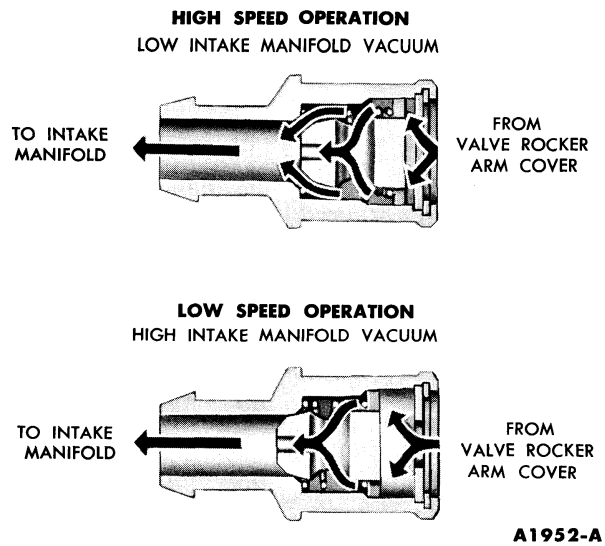



**FIG. 10—Positive Crankcase Ventilation Regulator Valve Operation**

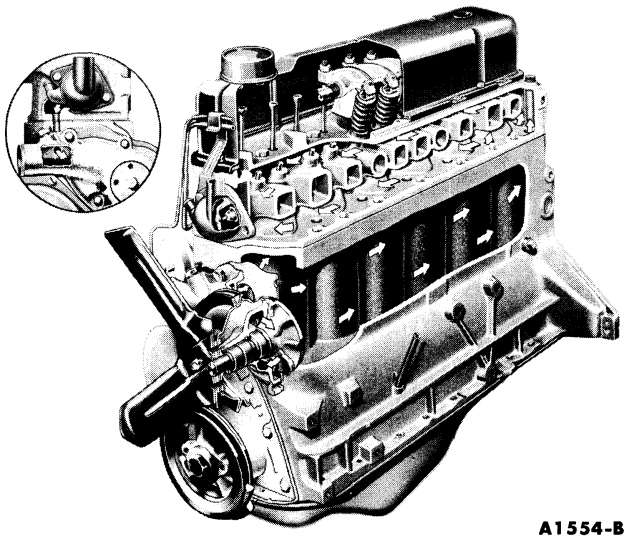



**FIG. 11—Typical Cooling System**

to the engine.

The timing gear sprockets are lubricated through a flat on the No. 1 camshaft bearing.

Oil, under full jet metered pressure, is fed through a drilled passage in the cylinder block at the No. 3 camshaft bearing. The passage in the block indexes with a hole in the cylinder head. An oil inlet tube directs the oil into the hollow rocker shaft through the No. 4 valve rocker arm support. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the rocker arm pads and valve stems, rocker arm shaft bores, and the ball ends of the rocker arm adjusting screws and valve push rods.

### POSITIVE CRANKCASE VENTILATION SYSTEM

The air flow in the positive crankcase ventilation system is shown in Fig. 9.

Ventilating air enters the engine through the oil filler cap located on the front of the valve rocker arm cover. The filler cap contains a filtering element which filters the incoming air.

From the oil filler cap, the air flows into the front section of the valve rocker arm shaft chamber. The ventilating air moves down past the push rods and into the crankcase. Air is diverted from the front section of the crankcase through holes in the front of the cylinder block wall to ventilate the timing chain or gear chamber.

The rotating action of the crankshaft causes the air to flow towards the rear of the crankcase and up into the rear section of the valve rocker arm cover. The air then enters a spring-loaded regulator valve that regulates the amount of air to meet changing operating conditions. The air is then directed to the intake manifold through the crankcase vent hose.

During idle, intake manifold vacuum is high. The high vacuum overcomes the tension of the spring pressure and seats the valve (Fig. 10). With the valve in this position, all the ventilating air passes through a calibrated orifice in the valve. With the valve seated, there is minimum ventilation. As engine speed increases and manifold vacuum decreases, the spring forces the valve off its seat and to the full open position (Fig. 10). This increases the flow of ventilating air.

### COOLING SYSTEM

The coolant is drawn from the bottom of the radiator by the water pump, which delivers the coolant to the cylinder block (Fig. 11).

As the coolant enters the block, it travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder head where it cools the combustion chambers, valves, and valve seats on its return to the front of the engine.

The coolant from the cylinder head flows into the coolant outlet housing, past the thermostat if it is open, and into the top of the radiator. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. The entire system is pressurized to 13-15 psi.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### ENGINE SUPPORTS

The front supports are located on each side of the cylinder block (Fig. 12). The rear support is located at the transmission extension housing (Fig. 12).

### ENGINE FRONT SUPPORT

The procedures given apply to either a right or left installation.

**Removal**

**1.** Remove the support insulator to frame nut and lock washer.

**2.** Position a support jack and a wood block under the oil pan. Raise the jack to relieve the weight of the engine.

**3.** Remove the bolts and lock washers securing the support bracket to the engine.

**4.** Raise the engine and remove the support bracket and insulator as a unit.

**5.** Remove the nuts and lock washers securing the insulator assembly to the support bracket and separate the two units.

**Installation**

**1.** Install the insulator on the rear support bracket and secure it with

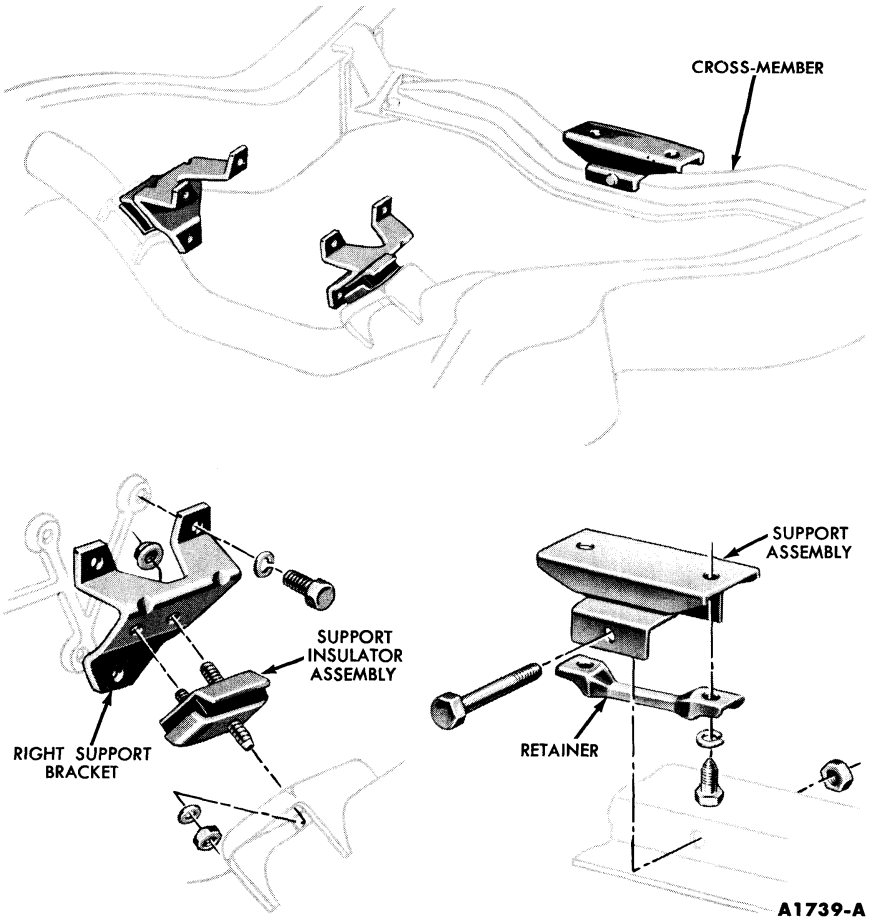



**FIG. 12—Engine Supports**

the lock washers and retaining nuts. Torque the nuts to specifications.

**2.** Install the insulator and support in the frame side member.

**3.** Secure the support bracket to the engine with the retaining bolts and lock washers. Torque the bolts to specifications.

**4.** Lower the engine and remove the jack. Install the insulator to frame member retaining nut and washer. Torque the nut to specifications.

**5.** If only one support was removed, tighten the other support.

### ENGINE REAR SUPPORT

#### Removal

**1.** Remove the support flange to cross member retaining bolt and nut.

**2.** Raise the transmission with a jack to obtain clearance at the transmission extension housing; then remove the retainer and support assembly mounting bolts and washers. Remove the support assembly and the retainer.

#### Installation

**1.** Position the support assembly and retainer; then install the mounting bolts and lock washers. Torque the bolts to specifications.

**2.** Lower the transmission. Install the support assembly to cross member retaining bolt and nut. Torque the nut to specifications.

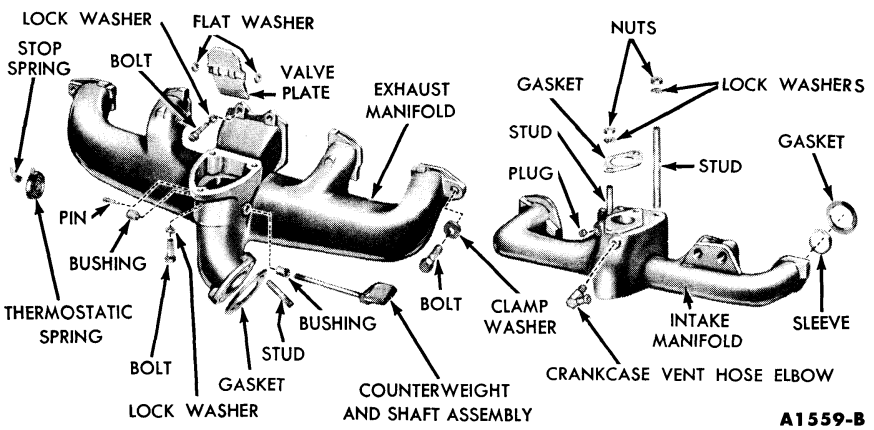



**FIG. 13—Manifold Assemblies**

## MANIFOLDS

### REMOVAL

**1.** Remove the air cleaner.

On a car with an automatic transmission, disconnect the throttle control rod and the accelerating assembly connecting link from the accelerator bracket. Disconnect the accelerator retracting spring from the block mounted bracket. Remove the bracket.

On a car with a manual-shift transmission, disconnect the accelerator retracting spring and the accelerator rod assembly from the bellcrank.

**2.** Loosen the hose clamp and remove the crankcase vent hose from the hose fitting in the intake manifold.

**3.** Disconnect the choke control cable from the carburetor.

**4.** Disconnect the fuel inlet line and the distributor vacuum line from the carburetor.

**5.** Disconnect the muffler inlet pipe from the exhaust manifold.

**6.** Remove the bolts fastening the manifolds to the head (one bolt retains the oil level dipstick tube bracket). Lift the manifold assemblies from the head. Remove the gaskets and sleeves.

**7.** To separate the manifolds, remove the air cleaner bracket and remove the nuts and the bolt joining the intake and exhaust manifolds.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

The manifold assemblies are shown in Fig. 13.

**1.** Clean the gasket surfaces at the cylinder head and manifolds.

**2.** If the intake and exhaust mani-

folds have been separated, place the intake manifold over the studs on the exhaust manifold. Position the air cleaner bracket to the exhaust manifold. Install the lock washers, nuts and bolt, then tighten them fingertight.

**3.** Install new intake manifold gaskets using new sleeves, if necessary, in the ports of the cylinder head.

**4.** Place a new exhaust manifold to muffler inlet pipe gasket on the muffler inlet pipe.

**5.** Coat the mating surfaces lightly with graphite grease. Place the manifold assemblies in position against the head. **Make sure that none of the gaskets have become dislodged.** Position the oil level dipstick tube bracket. Install the attaching washers and bolts. Torque the bolts to specifications, tightening from the center to the ends.

If the intake and exhaust manifolds were separated, tighten the bolt and nut joining them.

**6.** Install the exhaust manifold to muffler inlet pipe lock washers and nuts. Torque the nuts to specifications.

**7.** Connect the crankcase vent hose to the intake manifold and position the hose clamp.

**8.** Connect and adjust the choke control cable. Connect the fuel inlet line and the distributor vacuum line to the carburetor.

On a car with an automatic transmission, install the accelerator retracting spring bracket. Connect the spring. Connect the accelerator assembly connecting link and adjust the transmission control linkage.

On a car with manual-shift transmission, connect the accelerator retracting spring and the accelerator rod assembly.

**9.** Install the air cleaner. Adjust the engine idle speed and idle fuel mixture.

## EXHAUST CONTROL VALVE REPLACEMENT

The exhaust control valve (Fig. 5) is located in the outlet of the exhaust manifold. Normally, it does not require replacement unless it becomes inoperative due to excessive corrosion or damage.

**1.** Remove the manifold assemblies and separate the intake and exhaust manifolds following the procedures under "Manifold Removal."

**2.** Before removing the control valve assembly, note the position of the counterweight in relation to the valve plate. Remove the stop spring and thermostatic spring from the front end of the shaft.

**3.** Using an acetylene torch inside the manifold, cut the shaft on both sides of the valve plate. **Use caution to avoid damage to the shaft bearing bores.**

**4.** Remove the valve, shaft and flat washers.

**5.** Clean the bushings of corrosion and repair any damage that may have occurred. Replace the bushings if necessary.

When new bushings are installed, press the bushings into the manifold until they are flush with or 0.010 inch below the inside wall of the manifold.

**6.** After installation, ream the bushings with a 5/16-inch reamer.

**7.** Lubricate the new shaft and bushings with FoMoCo Exhaust Control Valve Solvent (COAA-19A 501-A) or a penetrating oil and graphite mixture.

**8.** Insert the shaft through the washers, bushings and valve plate (flat washer on each side of the valve plate).

**9.** Rotate the shaft in the valve plate until the counterweight is in the normal "up" (heat on) position (Fig. 5).

**10.** Position the shaft in the valve plate so that the end of the thermostatic spring projects 15/16 inch from the outside wall of the manifold.

**11.** Tack weld the valve to the shaft. Move the assembly back and forth to check for a binding condition.

**12.** If there is no binding, weld the valve to the shaft in the original manner. The shaft and valve are stainless steel to minimize corrosion and/or damage by excessive heat.

**13.** Install the thermostatic spring in the shaft slot. Secure the spring by crimping the shaft at the slot. Wind the spring ¾ turn and hook the open end of the spring over the stop pin. The thermostatic spring should hold the valve in the closed (heat on) position (i.e. in the proper position to direct the flow of gases into the heat riser).

**14.** Install the stop spring.

**15.** Lubricate the shaft bushings while operating the valve manually to replace the original lubricant lost by the welding operation. Install the manifold assemblies following the procedure under "Manifold Installation."

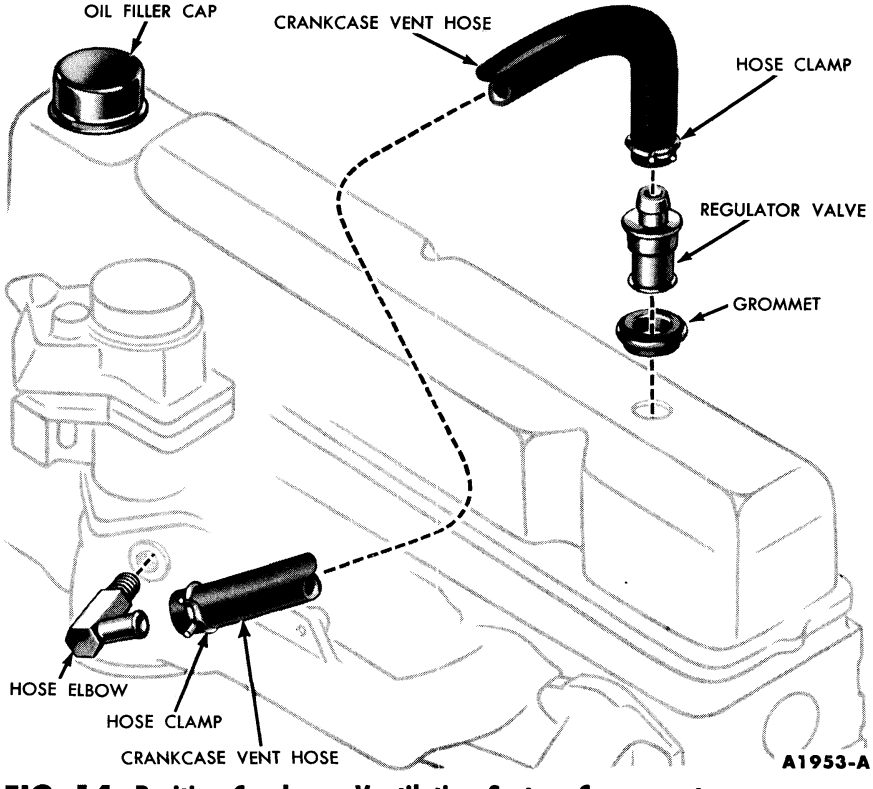



**FIG. 14—Positive Crankcase Ventilation System Components**

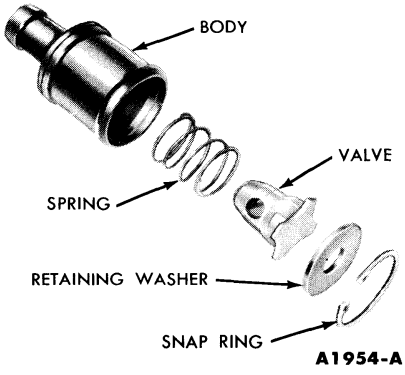



**FIG. 15—Regulator Valve Assembly**

## POSITIVE CRANKCASE VENTILATION SYSTEM

The positive crankcase ventilation system components are shown in Fig. 14.

### REMOVAL

1. Remove the air cleaner.
2. Grasp the crankcase vent hose near the rocker arm cover grommet and pull to remove the regulator valve from the rocker arm cover.
3. Using hose clamp pliers, slide both hose clamps toward the center of the vent hose. Remove the regulator valve from the vent hose and remove the vent hose from the hose fitting (elbow) in the intake manifold.
4. Remove the vent hose fitting (elbow) from the intake manifold.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

1. Install the vent hose fitting (elbow) in the intake manifold.
2. Position the hose clamps on the vent hose. Install the hose on the fitting in the intake manifold and the regulator valve in the hose. Using hose clamp pliers, slide the clamps into position.
3. Insert the regulator valve into the rocker arm cover mounting grommet.
4. Install the air cleaner. Operate the engine and check for leaks.

### REGULATOR VALVE DISASSEMBLY

**When disassembling or assembling the regulator valve, exercise care to avoid damaging the calibrated spring. Under no circumstances should the calibrated spring be altered in any manner.**

Using a snap ring retainer tool, remove the snap ring retainer from the end of the regulator valve assembly. Remove the valve retaining washer. Soak the valve body, spring and valve in solvent, as necessary, until the valve spring can be easily removed without distorting the valve spring.




**FIG. 16—Oil Inlet Line Removal**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### TESTING

Refer to Part 8-1, Section 1 for the test procedures.

### REGULATOR VALVE ASSEMBLY

Install the spring and valve into the valve body. **Be sure the pointed end of the valve is toward the hose connection (Fig. 15).** Install the valve retaining washer and snap ring retainer.

## VALVE ROCKER ARM SHAFT ASSEMBLY

### REMOVAL

1. Remove the air cleaner. Grasp the crankcase vent hose near the valve rocker arm cover grommet and pull the regulator valve from the rocker arm cover. Position the vent hose and regulator valve out of the way.
2. Remove the valve rocker arm cover and discard the gasket.
3. Loosen, but do not remove, the rocker arm shaft support cap screws two turns at a time in sequence to remove the valve spring load from the rocker arms.
4. Remove the cap screw and bracket from the No. 4 valve rocker arm shaft support. Pull the oil inlet line out of the support, then pull the line out of the block with pliers (Fig. 16). Discard the O-ring seal.
5. Remove the cap screw from the No. 1 valve rocker arm shaft support. Remove the oil outlet line and bracket.
6. Remove the remaining support cap screws. Remove the valve rocker arm shaft assembly.

### INSTALLATION

1. Apply Lubriplate to both ends of the push rods and install the push rods. **Be sure the ball end of the push rods is seated in the tappet.**
2. Position the valve rocker arm shaft assembly on the head.
3. Install the oil outlet line, bracket, and retaining screw on the No. 1 support. Make sure the oil line enters the shaft locating hole.
4. Install a new O-ring seal on the lower end of the oil inlet line. Position the line in the No. 4 support. Make sure the O-ring seal is in the oil supply counterbore. Install the bracket and support bolt.
5. Tighten all the valve rocker arm shaft retaining bolts two turns at a time in sequence. Torque the bolts to specifications.
6. On a Mileage Maker Six engine with silent lash rocker arms, adjust the valve clearance (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six engine, perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

7. Clean the valve rocker arm cover. Coat one side of a new valve rocker arm cover gasket with oil-resistant sealer. Lay the cemented side of the gasket in place in the cover. Install the cover, making sure that the gasket seats evenly around the head. Partially tighten the cover bolts.
8. Operate the engine for a minimum of 30 minutes to stabilize engine temperatures. Remove the regulator valve from the rocker arm cover and remove the cover.

On a Mileage Maker Six engine, adjust the valve clearance if necessary (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six, perform a hot valve lash adjustment (Part 8-1, Section 2).

9. Install the valve rocker arm cover. The cover is tightened in two steps. First, torque the retaining bolts to specifications. Two minutes after

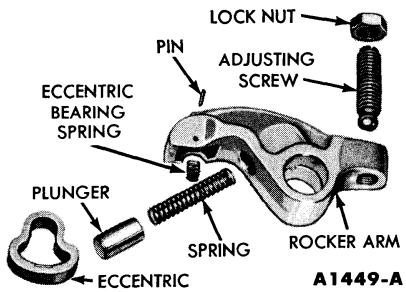



**FIG. 17—Silent Lash Rocker Arm Assembly**

the initial tightening, torque the bolts to the same specifications.

**10.** Insert the regulator valve (with vent hose attached) into the valve rocker arm cover mounting grommet. Install the air cleaner.

### DISASSEMBLY

**1.** Remove the cotter pins from each end of the valve rocker arm shaft. Remove the spring washers.

**2.** Slide the rocker arms, springs and supports off the shaft. Be sure to identify the parts.

**3.** On a Mileage Maker Six engine with silent lash rocker arms, if it is necessary to disassemble a valve rocker arm, push the eccentric retaining pin outward using needle nose pliers. Remove the eccentric, plunger, plunger spring and eccentric bearing spring. Identify all parts so that they may be installed in the rocker arm from which they were removed.

**4.** If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end. Use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

### ASSEMBLY

**1.** Lubricate all moving parts with engine oil. Apply Lubriplate to the pad and to the eccentric foot of the valve rocker arms.

**2.** If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the shaft.

**3.** If a valve silent lash rocker arm was disassembled, install the plunger spring, plunger, eccentric bearing spring and eccentric in the rocker arm from which they were removed (Fig. 17). **Be sure the eccentric is installed with the recessed dot (side with the smallest radius) toward the spring and plunger.** Push the eccentric retaining pin inward to its original position.

**4.** Install a spring washer and a cotter pin on one end of the shaft.

**5.** Install the rocker arms, supports, and springs in the order shown in Figs. 18 or 19. **Be sure the oil holes in the shaft are facing downward.** Complete the assembly by installing the remaining spring washer and the cotter pin.

### CYLINDER HEAD

### REMOVAL

**1.** Drain the cooling system. Remove the air cleaner.

**2.** Disconnect the radiator upper hose and the heater hose from the coolant outlet housing.

**3.** Disconnect the water temperature sending unit wire from the sending unit, and the battery ground cable from the cylinder head.

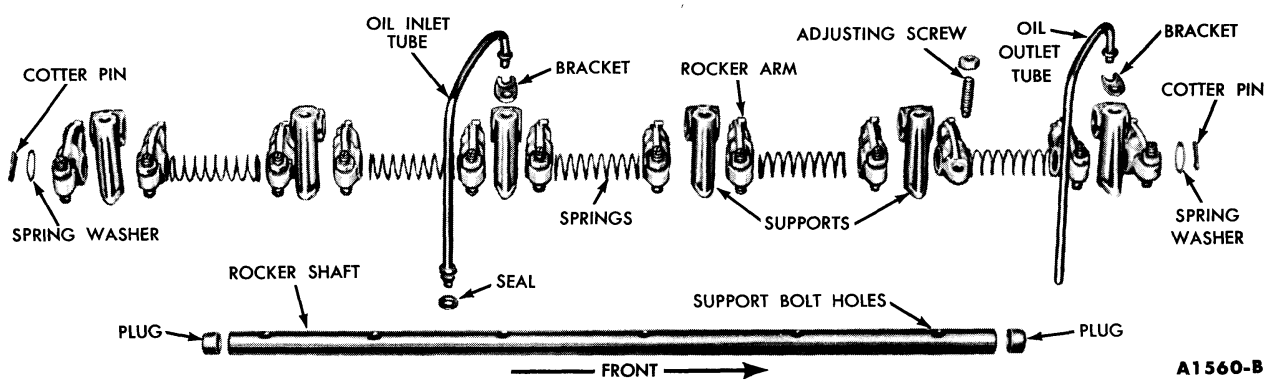



**FIG. 18—Valve Rocker Arm Shaft Assembly—Mileage Maker Six**

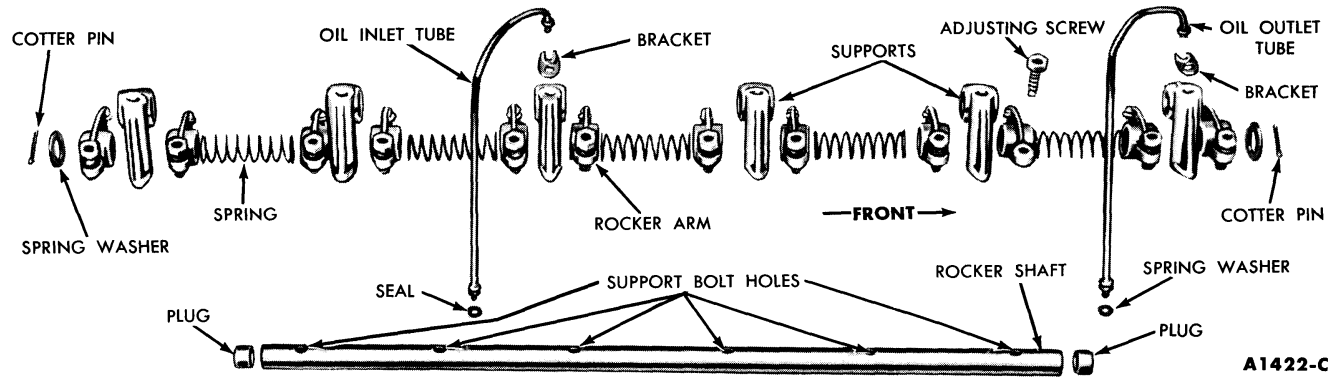



**FIG. 19—Valve Rocker Arm Shaft Assembly—Police Special Six and Taxi Special Six**

4. Disconnect the carburetor fuel inlet line and the distributor vacuum line from the distributor.

5. Disconnect the high tension lead at the coil. Remove the coil from the head and move it to one side. Remove the distributor cap and the spark plug wires as an assembly. Remove the spark plugs.

6. Disconnect the fuel inlet line and the distributor vacuum line from the carburetor. Remove the lines as an assembly.

7. Disconnect the choke control cable from the carburetor.

8. Disconnect the accelerator retracting spring. Disconnect the accelerator rod assembly from the accelerator assembly.

9. Grasp the crankcase vent hose near the valve rocker arm cover grommet and pull to remove the regulator valve from the rocker arm cover. Disconnect the crankcase vent hose from the hose fitting in the intake manifold and remove the vent hose and regulator valve.

10. Remove the valve rocker arm shaft assembly following Steps 2 thru 6 under "Valve Rocker Arm Shaft Assembly Removal."

11. Remove the valve push rods in sequence and identify them so that they can be installed in their original position (Fig. 20).

12. Remove the manifold to cylinder head bolts (one bolt retains the oil level dipstick tube bracket). Pull the manifold assembly away from the cylinder head. Support the assembly so that the muffler inlet pipe will not be damaged.

13. Install the cylinder head holding fixtures for convenience in lifting the head and to protect the gasket surfaces (Fig. 21).

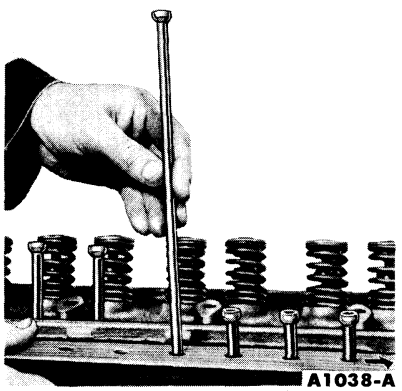



**FIG. 20—Valve Push Rod Removal**

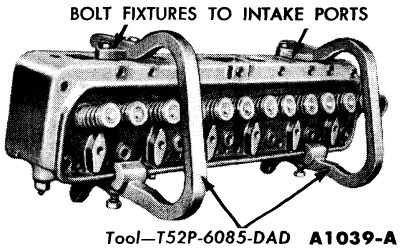



**FIG. 21—Cylinder Head Holding Fixtures**

14. Remove all cylinder head bolts. Install the cylinder head guide studs (Fig. 22). Lift the cylinder head assembly off the engine. **Do not pry between the head and block as the gasket surfaces may become damaged.**

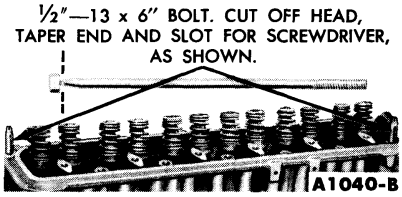



**FIG. 22—Cylinder Head Guide Studs**

## INSTALLATION

1. Clean the head and block gasket surfaces.

2. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the head and block gasket surfaces (Part 8-1, Section 3).

3. Position the gasket over the guide studs on the cylinder block.

4. Lift the cylinder head over the guides and slide it down carefully.

5. Coat the threads of the bolts for the left side of the cylinder head with water-resistant sealer.

6. Install, but do not tighten, two bolts at opposite ends of the head to hold the head and gasket in position.

7. Remove the guides. Remove the cylinder head holding fixtures. Install the remaining bolts.

8. The cylinder head bolts are tightened in three progressive steps. Follow the sequence shown in Fig. 23. Torque the bolts to 95 ft-lbs, then to 105 ft-lbs. Finally, torque the bolts to 115 ft-lbs.

9. Apply Lubriplate to both ends of the push rods. Install the push rods in their original bores, positioning the lower end of the rods in the tappet sockets.

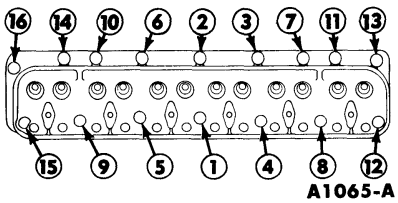



**FIG. 23—Cylinder Head Bolt Torque Sequence**

10. Install the valve rocker arm shaft assembly by following steps 1 thru 5 under "Valve Rocker Arm Shaft Assembly Installation."

11. On a Mileage Maker Six engine with silent lash rocker arms, adjust the valve clearance (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six engine, perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

12. Clean the intake manifold gasket surfaces. Install the new manifold gaskets using new sleeves, if necessary, in the ports of the cylinder head. Place the manifold assembly in position against the head. **Make sure none of the gaskets have become dislodged.**

13. Install the manifold assembly retaining lock washers and bolts (one bolt retains the oil level dipstick tube bracket). Torque the bolts to specifications.

14. Connect the crankcase vent hose to the intake manifold. Connect and adjust the choke control tube.

15. Position the fuel inlet line and the vacuum line on the engine. Connect the distributor vacuum line and the carburetor fuel inlet line from the carburetor.

16. Connect the accelerator rod assembly and the accelerator retracting spring.

17. Install the ignition coil, spark plugs, and the distributor cap and spark plug wire assembly.

18. Connect the spark plug wires and the coil high tension lead.

19. Connect the carburetor fuel inlet line to the fuel pump, and the distributor vacuum line at the distributor.

20. Connect the battery ground cable. Connect the water temperature sending unit wire.

21. Connect the radiator upper hose to the coolant outlet housing. Connect the heater hose to the coolant outlet housing, but do not tighten the clamp.

**22.** Fill and bleed the cooling system, then tighten the heater hose clamp.

**23.** Clean the valve rocker arm cover. Coat one side of a new valve rocker arm cover gasket with oil-resistant sealer. Lay the cemented side of the gasket in place in the cover. Install the cover, making sure that the gasket seats evenly around the head. **Partially tighten the cover bolts.**

**24.** Operate the engine until engine temperatures have stabilized. Adjust the engine idle speed and idle fuel mixture.

On a car with an automatic transmission, adjust the transmission control linkage.

**25.** Remove the regulator valve from the valve rocker arm cover. Remove the rocker arm cover.

On a Mileage Maker Six engine, operate the engine at normal idle speed and observe the position of the adjustment mark on each eccentric. Make minor adjustments if required, with the engine idling by turning the adjusting screws in or out as necessary (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six engine, perform a hot valve lash adjustment (Part 8-1, Section 2).

**26.** Install the valve rocker arm cover, and tighten the cover in two steps. First, torque the retaining bolts to specifications. Two minutes after the initial tightening, torque the bolts to the same specifications.

**27.** Insert the regulator valve in the valve rocker arm cover grommet. Install the air cleaner.

### DISASSEMBLY

**1.** Remove the coolant outlet housing and thermostat. Discard the gasket.

**2.** Remove the temperature sending unit from the head.

**3.** Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surface.**

**4.** Compress the valve springs (Fig. 24), then remove the valve retainer locks and release the spring.

**5.** Remove the sleeve, spring retainer, spring, stem seal and valve. Discard the valve stem seals. Identify all valve parts.

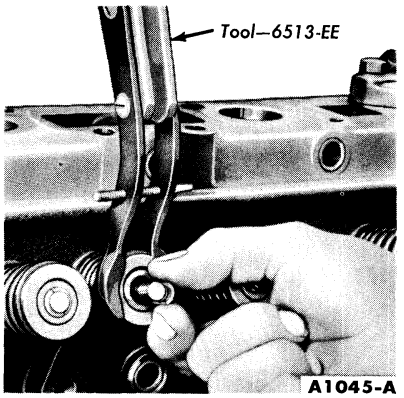



**FIG. 24–Compressing Valve Spring–On Bench**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Cylinder head repair operations and checks, such as valve and valve seat refacing, cylinder head flatness checks, etc., are covered in Part 8-1, Section 2.

### ASSEMBLY

**1.** Lubricate the valve guides and valve stems with engine oil. Apply Lubriplate to the tip of the valve stems.

**2.** Install each valve (Fig. 25) in the valve guide from which it was removed or to which it was fitted. Install a new stem seal on the valve.

**3.** Install the valve spring assembly over the valve. Install the spring retainer and sleeve.

**4.** Compress the spring and install the retainer locks (Fig. 24).

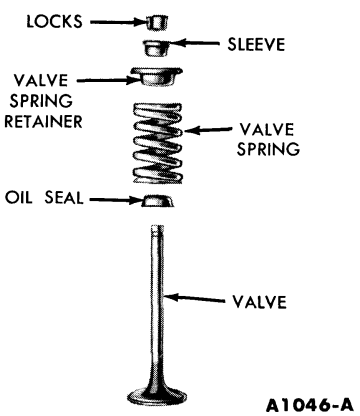



**FIG. 25–Valve Assembly**

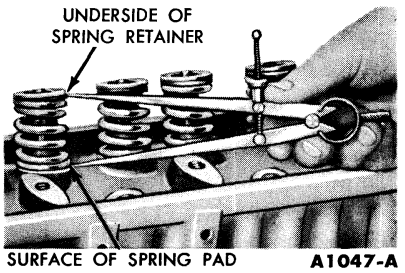



**FIG. 26–Valve Spring Assembled Height**

**5.** Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 26).

Check the dividers against a scale. If the assembled height is greater than the specified limit, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.**

**6.** Install the temperature sending unit.

**7.** Using a new gasket coated with water-resistant sealer, install the thermostat and coolant outlet elbow. Torque the retaining bolts to specifications.

### VALVE SPRING, RETAINER AND STEM SEAL REPLACEMENT

Broken valve springs, or defective valve stem seals and retainers may be replaced without the need of removing the cylinder head, providing damage to the valve or valve seat has not occurred.

**1.** Remove the air cleaner. Remove the crankcase ventilation regulator valve from the valve rocker arm cover and remove the valve rocker arm cover. Remove the applicable spark plug.

**2.** Crank the engine until the applicable piston is on TDC after the compression stroke. Be sure that both valves are closed.

**3.** Install an air line with an adapter in the spark plug hole.

**4.** Back off the adjusting screw in the applicable rocker arm. Push the rocker arm to one side and secure it in this position with wire. To move

the rocker arm on either end of the shaft, it will be necessary to remove the retaining pin and washers and slide the rocker arm off the shaft.

**5.** Remove the push rod.

**6.** Turn on the air supply. Using valve spring compression tool K-D915, compress the valve spring and remove the valve spring retainer locks and sleeve.

**7.** Remove the valve spring retainer, spring and stem seal.

**8.** Install a new valve stem seal. Place the spring in position over the valve. Install the spring retainer and sleeve. Compress the valve spring and install the valve spring retainer lock.

**9.** Apply Lubriplate to both ends of the push rod. Install the push rod making sure the lower end of the rod is positioned in the tappet push rod cup.

**10.** Remove the wire securing the valve rocker arm and slide the rocker arm into position. If an end valve rocker arm was removed, slide it into position on the shaft and install the washers and retaining pin. Turn off the air and remove the air line and adapter. Install the spark plug and spark plug wire.

**11.** Adjust the valve lash or clearance if necessary (Part 8-1, Section 2).

**12.** Install the valve rocker arm cover and install the crankcase ventilation regulator valve (with hose attached) in the valve rocker arm cover mounting grommet. Connect the spark plug wires. Install the air cleaner.

## CYLINDER FRONT COVER

### REMOVAL

**1.** Drain the cooling system and crankcase.

On a car with an automatic transmission, disconnect the transmission oil cooler lines from the radiator.

**2.** Disconnect the radiator upper hose from the coolant outlet housing and the radiator lower hose at the water pump. Remove the radiator.

**3.** Remove the fan, drive belt and pulley.

On a car with power steering, remove the power steering pump drive belt. Remove the power steering pump pulley from the crankshaft damper.

**4.** Remove the cap screw and washer from the end of the crankshaft, then remove the damper (Fig. 27).

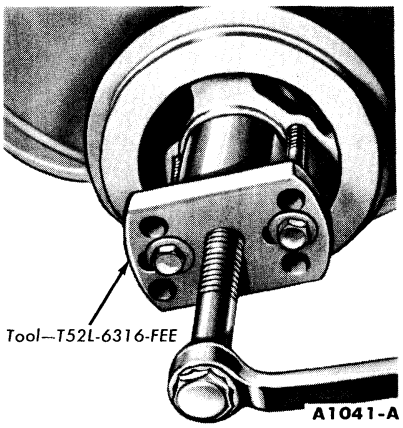



**FIG. 27—Damper Removal**

**5.** Remove the oil level dipstick. Remove the oil pan and related parts by following the procedure under "Oil Pan Removal." Remove the oil pump screen and inlet tube assembly.

**6.** Disconnect the heater hose from the water pump. Disconnect the generator adjusting arm at the water pump. Remove the water pump.

**7.** Remove the cylinder front cover and discard the gasket.

### FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

**1.** Drive out the old seal with a pin punch, then clean out the recess in the cover.

**2.** Coat a new seal with grease, then install the seal (Fig. 28). Drive the seal in until it is fully seated in the recess. After installation, check to be sure the spring is properly positioned in the seal.

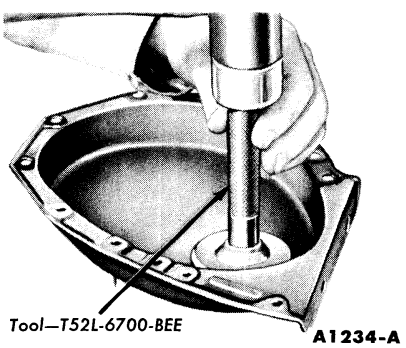



**FIG. 28—Front Oil Seal Installation**

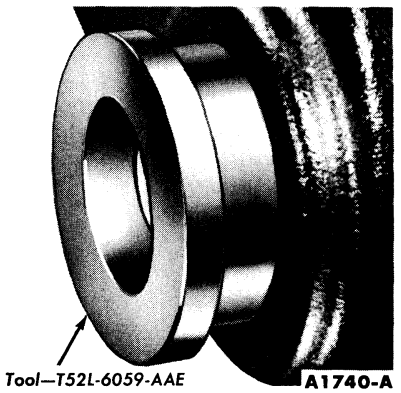



**FIG. 29—Cylinder Front Cover Alignment**

### INSTALLATION

**1.** Clean the cylinder front cover and the gasket surface of the cylinder block. Coat the gasket surface of the block and cover with sealer. Position a new gasket on the block.

**2.** Insert the small diameter end of tool T52L-6059-AAE in the bore of the cover. Position the cover and pilot assembly over the end of the crankshaft and against the block (Fig. 29). Install the cylinder front cover bolts. Torque the bolts to specifications.

**3.** Lubricate the crankshaft with a white lead and oil mixture. Lubricate the front oil seal rubbing surface with grease.

**4.** Align the damper keyway with the key on the crankshaft. Install the damper on the crankshaft (Fig. 30).

**5.** Install the lock washer and cap screw. Torque the cap screw to specifications.

**6.** Coat the water pump gasket and retaining bolts with water-resistant sealer. Install the water pump. Connect the heater hose. Connect

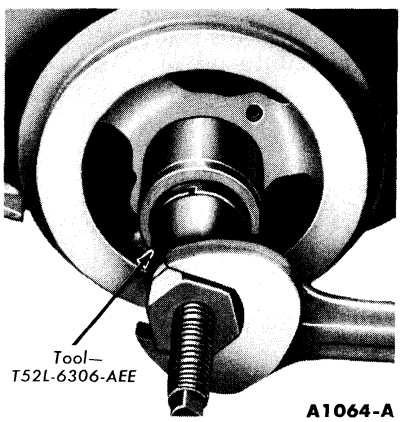



**FIG. 30—Damper Installation**

the generator adjusting arm at the water pump.

**7.** Install the pulley, drive belt and fan. Adjust the drive belt.

On a car with power steering, install the power steering pump pulley on the crankshaft damper. Install and adjust the power steering pump drive belt.

**8.** Clean and install the oil pump screen and inlet tube assembly. Install the oil pan and related parts following the procedure under "Oil Pan Installation." Install the oil level dipstick.

**9.** Install the radiator. Connect the radiator lower hose at the water pump and the radiator upper hose at the coolant outlet housing.

On a car with an automatic transmission, connect the transmission oil cooler lines.

**10.** Fill and bleed the cooling system. Fill the crankcase.

**11.** Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gasket for leaks.

## TIMING CHAIN

On the Mileage Maker Six engine, the camshaft is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft.

### REMOVAL

**1.** Remove the cylinder front cover and related parts by following the procedure outlined under "Cylinder Front Cover Removal."

**2.** Remove the crankshaft front oil slinger. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.

**3.** Establish a reference point on the block and measure from this point to the chain (Fig. 31).

**4.** Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain. Force the left side of the chain out with the fingers. Measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

**5.** If the deflection exceeds ½ inch, replace the timing chain and/or sprockets.

**6.** Crank the engine until the timing marks on the sprockets and chain are positioned as shown in Fig. 32.

**7.** Remove the camshaft sprocket retaining bolt and washer. Slide both sprockets and timing chain forward. Remove them as an assembly.

**8.** Remove the timing chain vibration damper (snubber pad).

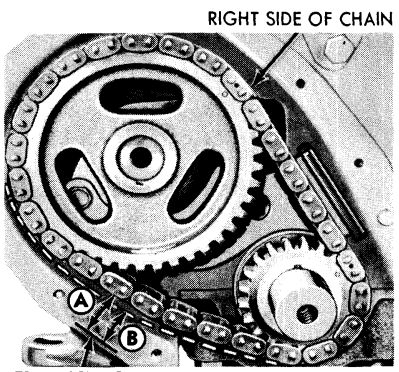



**FIG. 31—Timing Chain Deflection**

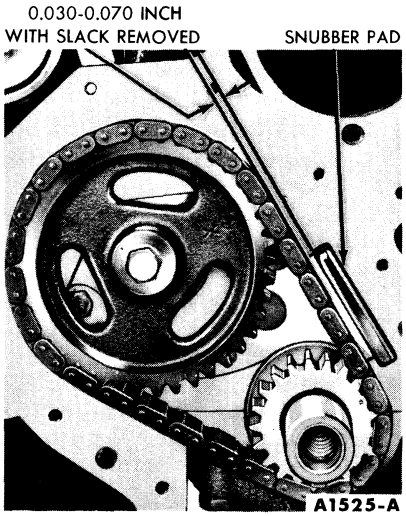



**FIG. 33—Pad to Chain Clearance**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

**1.** Install the timing chain vibration damper (snubber pad).

**2.** Place the keys in position in the slots on the camshaft and crankshaft.

**3.** Position the sprockets and timing chain on the camshaft and crankshaft. Leave sufficient clearance between the sprockets and the front face of the cylinder block to insert an open-end wrench. Remove the slack from the drive side of the chain and measure the clearance between the pad and chain (Fig. 33). If the clearance is not to specifications, loosen the damper retaining screws. Reposition the damper assembly until the proper clearance is obtained. Torque the damper screws to specifications.

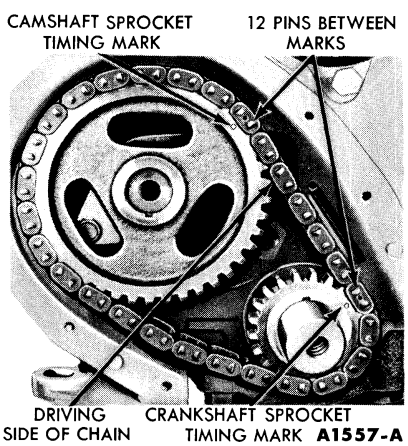



**FIG. 32—Aligning Timing Marks**

**4.** Be sure the timing marks on the sprockets and chain are positioned as shown in Fig. 32. Install the camshaft sprocket cap screw and washer. Install the crankshaft front oil slinger.

**5.** Install the cylinder front cover and related parts by following the procedure outlined under "Cylinder Front Cover Installation."

## TIMING GEARS

On the Police Special Six and Taxi Special Six engines, a gear to gear driven camshaft is used.

### REMOVAL

**1.** Remove the cylinder front cover and related parts by following the

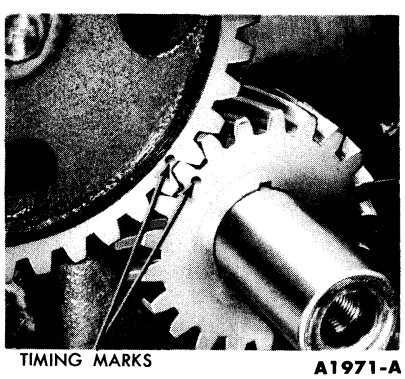



**FIG. 34—Aligning Timing Gears**

procedure outlined under "Cylinder Front Cover Removal."

**2.** Remove the crankshaft front oil slinger. Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator (Part 8-1, Section 1). Hold the gear firmly against the block while making the check. Refer to the specifications for the backlash limits.

**3.** Check the camshaft and crankshaft gear runout with a dial indicator (Part 8-1, Section 1). If the gear runout is excessive, replace the gear and/or gears.

**4.** Crank the engine until the timing marks on the gears are positioned as shown in Fig. 34.

**5.** Remove the camshaft gear retaining bolt, washers and the timing gears.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## INSTALLATION

**1.** Place the keys into position in the slots on the camshaft and crankshaft.

**2.** Position the gears on the camshaft and crankshaft. Be sure the timing marks on the timing gears are positioned as shown in Fig. 34. Install the camshaft sprocket cap screw and washers. Install the oil slinger on the crankshaft.

**3.** Install the cylinder front cover and related parts by following the procedures outlined under "Cylinder Front Cover Installation."

## CAMSHAFT

The camshaft and related parts are shown in Fig. 35.

## REMOVAL

**1.** Remove the crankshaft damper, cylinder front cover, and oil pan following the procedures in this section.

**2.** Remove the grille and the grille center support. Remove the air cleaner.

**3.** Remove the valve rocker arm cover and the valve rocker arm shaft assembly as outlined in this section. Remove the valve push rods in sequence (Fig. 20).

**4.** Disconnect the primary wire and the high tension wire from the coil. Disconnect the vacuum line from the distributor. Remove the distributor cap and spark plug wires as an assembly. Remove the distributor.

**5.** Disconnect the ignition wires from the clip on the valve push rod cover. Remove the cover.

**6.** Disconnect the fuel line from the fuel pump. Remove the fuel pump. Remove the oil filter.

**7.** Remove the crankshaft front oil slinger. Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket (or gear) retaining screw. Set the dial on zero. Position a large screwdriver between the camshaft sprocket (or gear) and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications.

On a Mileage Maker Six engine, if the end play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate when the camshaft is installed.

On a Police Special Six or Taxi Special Six engine, the spacer is cast integrally with the camshaft gear. Therefore, if the end play is excessive, replace the thrust plate when the camshaft is installed.

**8.** Remove the dial indicator.

On a Mileage Maker Six engine, remove the timing chain and sprockets by following the procedure outlined under "Timing Chain Removal."

On a Police Special Six or Taxi Special Six engine, remove the timing gears as outlined under "Timing Gear Removal."

**9.** Turn the camshaft until the tappets can be lifted with either a magnet (Fig. 36), or the fingers.

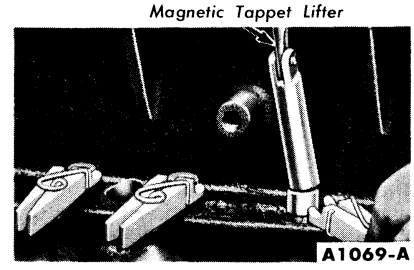



**FIG. 36—Lifting and Securing Valve Tappets**

Raise the tappets clear of the camshaft lobes and secure them with spring-type clothes pins or window regulator spring clips (Fig. 36 and 37).

**10.** Remove the Woodruff key, snubber pad (Mileage Maker Six engine only), camshaft thrust plate, and spacer (Mileage Maker Six engine only). Carefully remove the camshaft by pulling it toward the front of the engine. **Use caution to**

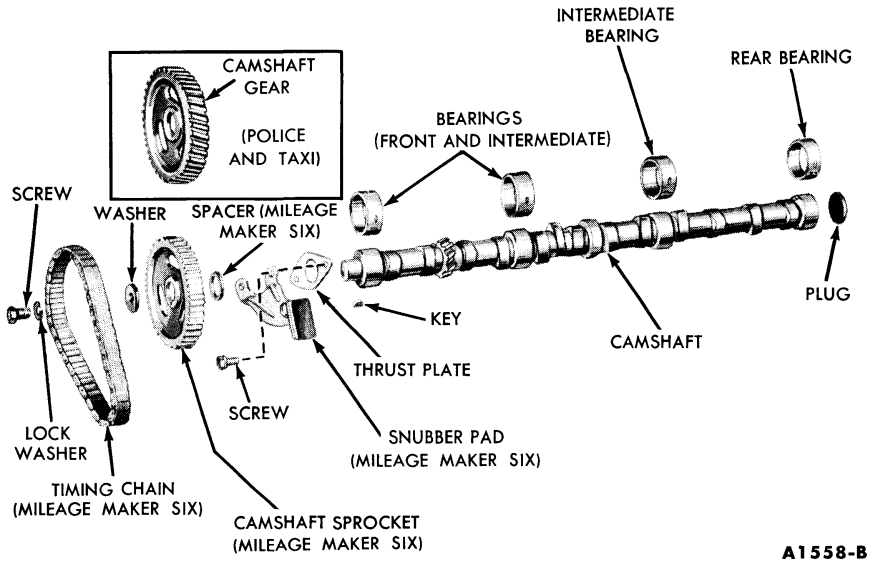



**FIG. 35—Camshaft and Related Parts**

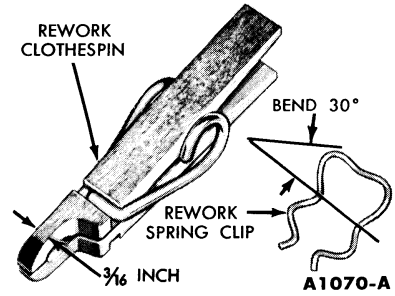



**FIG. 37—Tappet Retainers**

**avoid damaging the camshaft bearings.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIR

Refer to Part 8-1, Section 2 for the repair procedures.

### INSTALLATION

**1.** Oil the camshaft and apply Lubriplate to all the lobes. Carefully slide the camshaft through the bearings.

**2.** Install the camshaft spacer (Mileage Maker Six only) and Woodruff key. **Be sure the chamfer on the spacer is to the rear or faces the camshaft journal (Mileage Maker Six only.)**

**3.** Install the camshaft thrust plate and snubber pad (Mileage Maker Six engine only). Torque the retaining screws to specifications.

On a Mileage Maker Six engine, install the timing chain and sprockets by following the procedure outlined under "Timing Chain Installation."

On a Police Special Six or Taxi Special Six engine, install the timing gears as outlined under "Timing Gear Installation."

**5.** Replace the crankshaft front oil seal. Install the cylinder front cover, the crankshaft damper, and related parts following the procedures outlined under "Cylinder Front Cover Installation."

**6.** Install the grille and center support grille. Align the headlights.

**7.** Clean the oil pan and oil pump inlet tube screen. Install the oil pump inlet tube and the oil pan and related parts. Install a new oil filter.

**8.** Release the tappets. Apply Lubriplate to both ends of the push rods. Install the push rods in sequence. Position the lower ends of the rods in the tappet socket.

**9.** Install the valve rocker arm shaft assembly by following steps 2 thru 5 under "Valve Rocker Arm Shaft Assembly Installation."

On a Mileage Maker Six engine with silent lash rocker arms, adjust the valve clearance (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six engine, perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

**10.** Install the valve rocker arm cover with a new gasket, and **partially tighten the retaining bolts.** Insert the regulator valve in the valve rocker arm cover grommet.

**11.** Clean the valve push rod cover. Cement a new gasket to the valve push rod cover, using neoprene adhesive. Install the cover and ignition wiring clip.

The cover is tightened in two steps. Torque the retaining bolts to specifications. Two minutes after the initial tightening, torque the bolts to the same specifications.

**12.** Install the ignition wires in the clip. Install the fuel pump and connect the fuel line.

**13.** Position the No. 1 piston on TDC after the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open. Install the distributor hold down bolts.

**14.** Connect the distributor primary wire and the vacuum line.

**15.** Install the distributor cap, and connect the spark plug wires and the coil high tension lead.

**16.** Fill and bleed the cooling system. Fill the crankcase.

**17.** Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

**18.** Operate the engine until engine temperatures have stabilized. Adjust the engine idle speed and fuel mixture. Remove the regulator valve from the valve rocker arm cover. Remove the valve rocker arm cover.

On a Mileage Maker Six engine with silent lash rocker arms, operate the engine at normal idle speed and observe the position of the adjustment mark on each eccentric. Make minor adjustments, if required, with the engine idling by tuning the adjusting screws in or out as necessary (Part 8-1, Section 2)

On a Police Special Six or Taxi Special Six engine, perform a hot valve lash adjustment (Part 8-1, Section 2).

**19.** Install the valve rocker arm cover and tighten in two steps. First, torque the retaining bolts to specifications. Two minutes after the initial tightening, torque the bolts to the same specifications.

**20.** Insert the regulator valve in the valve rocker arm cover grommet. Install the air cleaner.

### CAMSHAFT BEARING BORE PLUG REPLACEMENT

**1.** On a car with manual-shift transmission, slide the transmission to the rear and remove the clutch pressure plate and disc following the procedure in Group 5.

On a car with an automatic transmission, remove the transmission and converter housing following the procedure in Group 7.

**2.** Remove the flywheel retaining bolts. Remove the flywheel and the engine rear cover.

**3.** Drill a ½-inch hole in the camshaft rear bearing bore plug. Remove the plug as shown in Fig. 38.

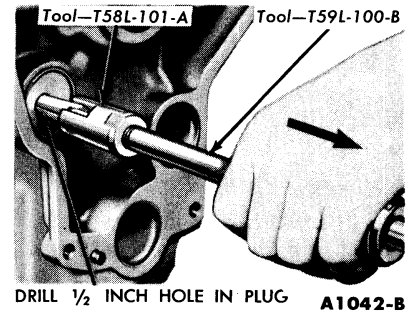



**FIG. 38—Camshaft Rear Bearing Bore Plug Removal**

**4.** Clean out the plug bore recess thoroughly.

**5.** Coat the flange of a new plug with oil-resistant sealer and install it with the flange facing out (Fig. 39).

**6.** Install the engine rear cover plate and flywheel. Torque the flywheel retaining bolts to specifications.

On a car with a manual-shift

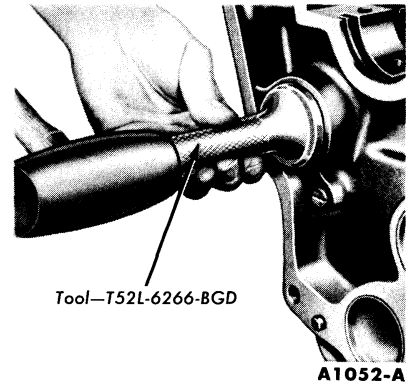



**FIG. 39—Camshaft Rear Bearing Bore Plug Installation**

transmission, install the clutch pressure plate and disc, and install the transmission following the procedure in Group 5.

On a car with an automatic transmission, install the transmission and converter housing following the procedure in Group 7.

## TAPPET REPLACEMENT

Inspection procedures are outlined under "Tappet Inspection" in Part 8-1, Section 3.

**1.** Remove the camshaft and related parts following the procedure in this section.

**2.** Remove and install one tappet at a time through the bottom of the block. Apply Lubriplate to each tappet foot. Coat the remainder of each tappet with engine oil before installation. A flexible-type holding tool can be used if desired. As each tappet is installed, secure it in the up position.

**3.** After the tappets are installed, install the camshaft and related parts as outlined in this section.

## MAIN AND CONNECTING ROD BEARING REPLACEMENT

The main and connecting rod bearing inserts are selective fit. **Do not file or lap bearing caps or use shims to obtain the proper bearing clearance.**

Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to the Parts Catalog for the available sizes. **Red marked bearings increase the clearance; blue marked bearings decrease the clearance.** Undersize bearings, which are not selective fit, are available for use on journals that have been refinished.

### MAIN BEARING

**1.** Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.

**2.** Remove the oil pump inlet tube assembly and the oil pump.

**3. Replace one bearing at a time, leaving the other bearings securely fastened.** Remove the main bearing cap to which new bearings are to be installed.

**4.** Insert the upper bearing removal tool (tool 6331) in the oil hole in the crankshaft.

**5.** Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

**6.** Clean the crankshaft journal. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

**7.** To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that tool 6331 can be inserted in the oil hole in the crankshaft. With tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

**8.** Replace the cap bearing.

**9.** Support the crankshaft so that its weight will not compress the Plastigage and provide an erroneous reading. Position the support so that it will bear against the counterweight adjonining the bearing which is being checked.

**10.** Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about ¼ inch off center (Fig. 40).

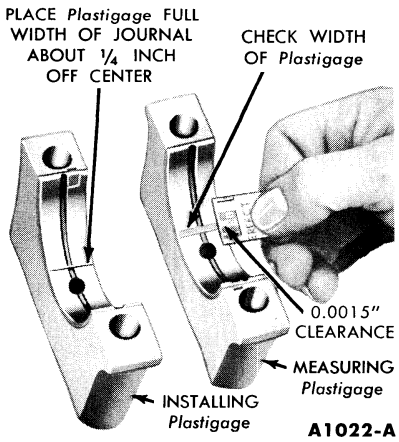



**FIG. 40—Installing and Measuring Plastigage—Engine Installed**

**11.** Install the cap and torque the bolts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

**12.** Remove the cap, then using the Plastigage scale, check the width of the Plastigage. **When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.**

**13.** If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.

**14.** After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Torque the cap bolts to specifications.

**15.** Repeat the procedure for the remaining bearings that require replacement.

**16.** If the rear main bearing is to be replaced, remove the rear main bearing cap. Remove and discard the rear seal and side seals.

**17.** Clean the rear journal oil seal groove. Preform the new seal by hand to the approximate radius of the cap.

Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, then press both ends of the seal into the groove, working from the ends to the center.

Position the seal forming tool as shown in Fig. 41 and complete the seal installation. After installation, cut the ends of the seal flush.

**18.** Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface (Fig. 41). **Do not apply sealer to the area forward of the side seal groove.** Install the rear main bearing

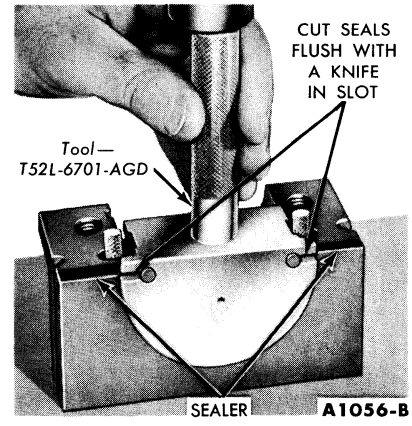



**FIG. 41—Rear Oil Seal to Retainer Installation**

cap. Torque the main bearing cap bolts to specifications.

**19.** Dip the side seals in light engine oil, then immediately install them in the grooves. **Do not use sealer on the side seals. The seals are designed to expand when dipped in oil. Using sealer may retard this expansion.** It may be necessary to tap the seals into place for the last ½ inch of travel. Do not cut the seal projecting ends.

**20.** Check the retainer side seals for leaks by squirting a few drops of oil into the parting lines between the retainer and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the grooves.**

**21.** If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 58). Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 58). This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications (Fig. 58).

**22.** Clean the oil pump inlet tube screen. Install the oil pump and the inlet tube assembly.

**23.** Install the oil pan and related parts. Install the oil level dipstick.

**24.** Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

**25.** Check and adjust the ignition timing.

## CONNECTING ROD BEARING

**1.** Follow steps 1 and 2 under "Main Bearing Replacement."

**2.** Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

**3.** Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure.

**4.** Clean the crankshaft journal. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

**5.** Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slot provided.

**6.** Pull the connecting rod assembly down firmly on the crankshaft journal.

**7.** Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about ¼ inch off center.

**8.** Install the cap and torque the connecting rod nuts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

**9.** Refer to steps 12 and 13 under "Main Bearing Replacement."

**10.** After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap.

**11.** Repeat the procedure for the remaining connecting rods that require new bearings.

**12.** Follow steps 22 thru 25 under "Main Bearing Replacement."

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## PISTONS AND CONNECTING RODS

### REMOVAL

**1.** Drain the cooling system and the crankcase.

**2.** Refer to "Cylinder Head Removal" and remove the cylinder head and related parts.

**3.** Remove the oil pan and related parts. Remove the oil pump inlet tube and the oil pump.

**4.** Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

**5.** Make sure all the connecting rod caps are marked so that they can be installed in their original locations. Remove the connecting rod cap.

**6.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.

### INSTALLATION

**1.** Clean the oil pump inlet tube screen, and the oil pan and block gasket surfaces.

**2.** Oil the piston rings, pistons and cylinder walls with light engine oil.

**3. Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rods and bearing caps are numbered from 1 to 6 beginning at the front of the engine. The numbers on the connecting rods and bearing caps must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**

**4.** Make sure the ring gaps are properly spaced around the circumference of the piston. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 42). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation in the piston head toward the front of the engine.**

**5.** Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement."

**6.** After the bearings have been

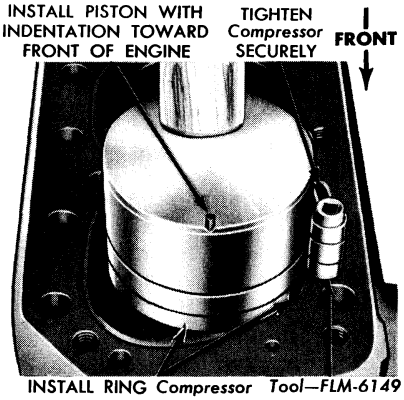



**FIG. 42—Piston Installation**

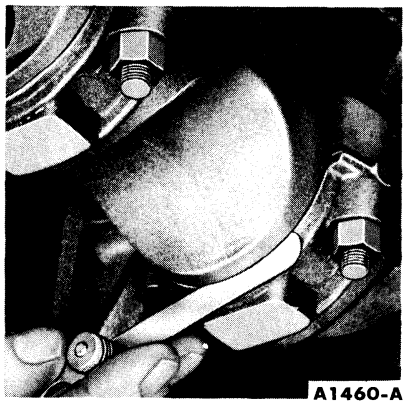



**FIG. 43—Connecting Rod Side Clearance**

fitted, apply a light coat of engine oil to the journals and bearings.

**7.** Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap. Torque the nuts to specifications.

**8.** After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crakshaft journal (Fig. 43).

**9.** Install the oil pump and the oil pump inlet tube. Install the oil pan and related parts.

**10.** Refer to "Cylinder Head Installation" and install the cylinder head and related parts, following steps 1 thru 23.

**11.** Fill and bleed the cooling system. Fill the crankcase.

**12.** Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil and coolant leaks.

**13.** Operate the engine until engine temperatures have stabilized. Check and adjust the ignition timing. Adjust the engine idle speed and fuel mixture.

On a Mileage Maker Six engine with silent lash rocker arms, operate the engine at normal idle speed and observe the position of the adjustment mark on each eccentric. Make minor adjustments, if required, with the engine idling by turning the adjusting screws in or out as necessary (Part 8-1, Section 2).

On a Police Special Six or Taxi Special Six engine, perform a hot valve lash adjustment (Part 8-1, Section 2).

**14.** Clean the valve rocker arm cover. Install the valve rocker arm cover, making sure that the gasket seats evenly around the head. The cover is tightened in two steps. Torque the retaining bolts to specifications. Two minutes after the initial tightening, torque the bolts to the same specifications.

**15.** Connect the crankcase vent hose to the fitting in the intake manifold. Insert the regulator valve (with vent hose attached) into the valve rocker arm cover mounting grommet.

**16.** Install the air cleaner.

On a car with an automatic transmission, adjust the transmission control linkage.

### DISASSEMBLY

**1.** Remove the bearing inserts from the connecting rod and cap.

**2.** Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed.

**3.** Remove the piston rings. Remove the piston pin retainers, then drive the pin out of the piston and rod (Fig. 44). Discard the retainers.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

To fit new pistons, pins or rings, refer to Part 8-1, Section 2.

### ASSEMBLY

The piston, connecting rod and related parts are shown in Fig. 45.

**1.** Lubricate all parts with light engine oil.

**2.** Position the connecting rod in the piston and push the pin into place. **Assemble the piston and connecting rod with the oil squirt hole in the rod and the indentation in the piston positioned as shown in Fig. 46.**

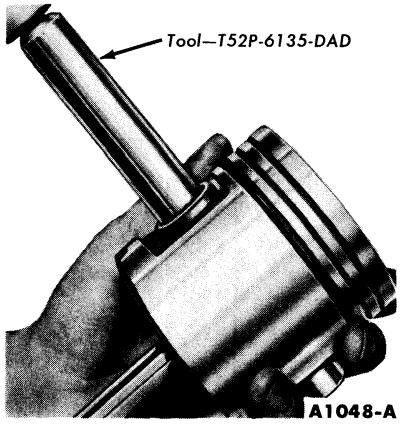



**FIG. 44—Piston Pin Removal**

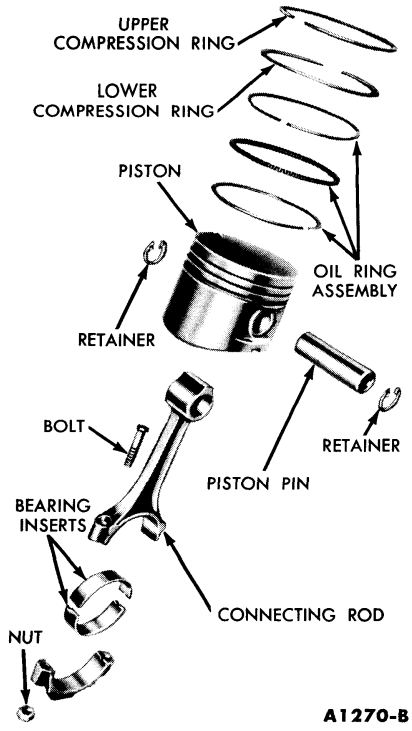



**FIG. 45—Piston, Connecting Rod and Related Parts**

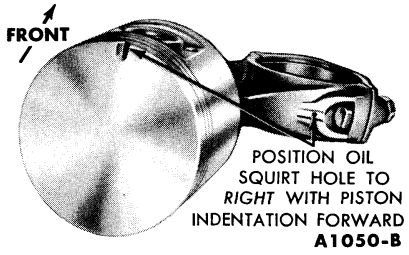



**FIG. 46—Oil Hole Position**

**3.** Insert new piston pin retainers into the piston.

**4.** Clean the piston ring grooves (Part 8-1, Section 3). Follow the instructions contained on the piston ring package and install the piston rings.

**5.** Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (step 6 under "Fitting Piston Rings" in Part 8-1, Section 2).

**6.** Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

### FLYWHEEL

### REMOVAL

**1.** Disconnect the transmission from the engine and slide it to the

rear following the procedure in Group 5 (manual-shift transmission)

**2.** On a manual-shift transmission, remove the pressure plate and cover assembly following the procedure in Group 5.

**3.** Remove the flywheel retaining bolts and remove the flywheel.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures for manual-shift transmissions.

### REPAIRS

To check flywheel face runout or replace flywheel ring gear for manual-shift transmissions, refer to Part 8-1, Section 2.

### INSTALLATION

**1.** Position the flywheel on the crankshaft flange and install the retaining bolts. Torque the bolts in sequence across from each other to specifications.

**2.** On a manual-shift transmission, install the clutch disc and the pressure plate and cover assembly following the procedure in Group 5.

**3.** Connect the transmission to the engine following the procedure in Group 5 (manual-shift transmission) or Group 7 (automatic transmission).

### CLUTCH PIVOT BUSHING REPLACEMENT

Inspection procedures are outlined under "Crankshaft Cleaning and Inspection" in Part 8-1, Section 3.

**1.** Disconnect the transmission from the engine and slide it to the rear following the procedure in Group 5.

**2.** Remove the pressure plate and cover assembly following the procedure in Group 5.

**3.** Remove the clutch pilot bushing (Fig. 47).

**4.** Coat the clutch pilot bushing bore in the crankshaft with a small quantity of wheel bearing lubricant. **Avoid using too much lubricant because it may be thrown onto the disc when the clutch revolves.**

**5.** Install the clutch pilot service bearing (Fig. 48).

**6.** Install the clutch disc and the pressure plate and cover assembly following the procedure in Group 5.

**7.** Connect the transmission to the engine following the procedure in Group 5.

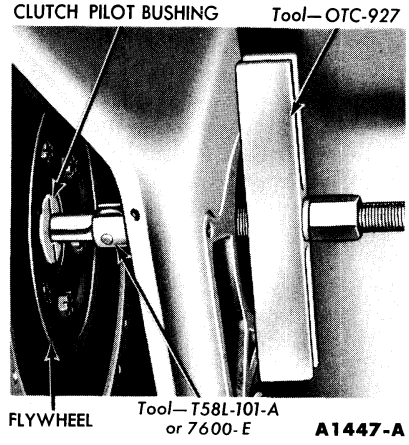



**FIG. 47—Clutch Pilot Bushing Removal**

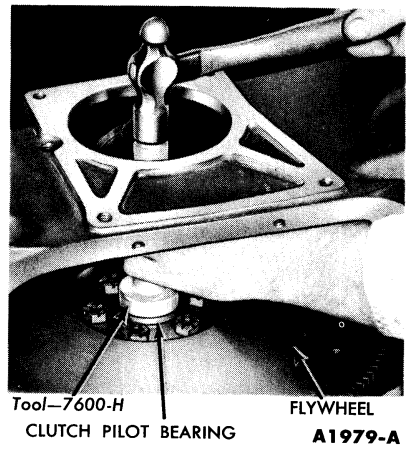



**FIG. 48—Clutch Pilot Service Bearing Installation**

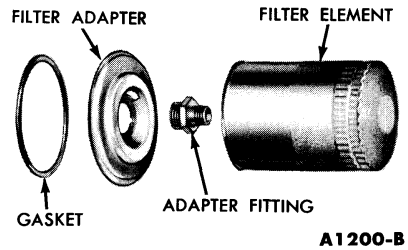



**FIG. 49—Disposable—Type Oil Filter Assembly**

### OIL FILTER REPLACEMENT

### DISPOSABLE-TYPE OIL FILTER

The Rotunda oil filter assembly is shown in Fig. 49.

**1.** Place a drip pan under the filter. Unscrew the filter from the adapter fitting.

**2.** Check to see if the filter adapter plate is properly positioned (Fig. 50).

**3.** Coat the gasket on the filter with oil. Place the filter in position

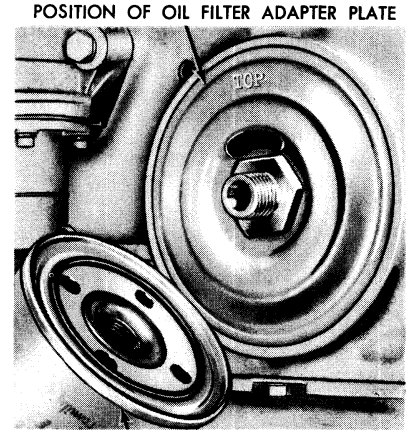



**FIG. 50—Disposable—Type Oil Filter Replacement**

on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

**4.** Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

### REPLACEABLE ELEMENT-TYPE OIL FILTER

The oil filter assembly is shown in Fig. 51.

**1.** Place a drip pan under the filter. Remove the filter center bolt, then remove the filter assembly and gasket. Discard the gasket.

**2.** Remove the filter element, neoprene gasket, spring and seat; then, remove the center bolt from the container and the fiber gasket from the bolt. Discard the element and gaskets.

**3.** Wash all parts in solvent. Make sure the openings in the bolt are clean.

**4.** Install the new filter element in the housing, following the instructions furnished with the new element.

**5.** Clean the cylinder block filter recess. Install a new gasket.

**6.** Place the filter assembly in position and thread the center bolt into the adapter finger-tight.

**7.** Rotate the filter assembly slightly, in each direction, to make sure the gasket is seated evenly.

**8.** Torque the bolt to specifications. **Do not over-torque the bolt.**

**9.** Add oil to the crankcase, if necessary. Operate the engine at fast idle and check for oil leaks.

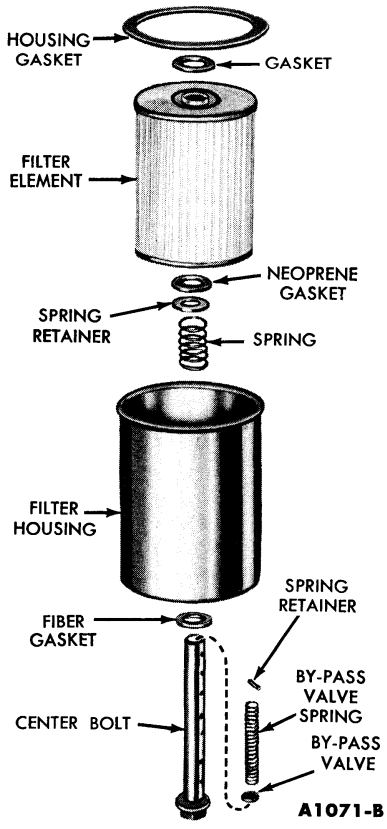



**FIG. 51—Replaceable Element—Type Oil Filter Assembly**

## OIL PAN

### REMOVAL

**1.** Drain the crankcase. Remove the flywheel housing inspection cover and the oil level dipstick.

On Station Wagons, remove the stabilizer bar lower control arm retaining nuts, washers, and rubber bushings. Remove the stabilizer bar to frame rail retaining bolts and brackets. Position the stabilizer bar as far forward as possible.

**2.** Remove the oil pan retaining screws. Rotate the crankshaft as required to gain clearance to remove the oil pan, then remove the oil pan and gasket.

**3.** Remove the oil pump inlet tube and screen assembly.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

**1.** Clean and install the oil pump inlet tube and screen assembly.

**2.** Make sure the gasket surfaces of the block and oil pan are clean. Coat the block surface and oil pan gasket surface with sealer and position the gasket on the oil pan.

**3.** Hold the oil pan in place against the block and install a screw, finger-tight, at each end of the oil pan. Install the remaining screws, and torque the screws from the center outward in each direction to specifications.

**4.** Install the flywheel housing inspection cover and the oil level dipstick.

On Station Wagons, position the stabilizer bar to chassis retaining brackets. Position the stabilizer bar to frame rails and install the retaining bolts. Position the stabilizer bar to lower control arm washers, rubber bushings, and retaining nuts.

**5.** Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for oil leaks.

## OIL PUMP

### REMOVAL

**1.** Remove the oil pan and related parts as outlined under "Oil Pan Removal" in this section.

**2.** Disconnect the distributor vacuum line and primary wire from the distributor. Remove the distributor cap.

**3.** Identify the position of the distributor and rotor. Loosen the distributor and rotate it slightly to disengage it from the oil pump. Remove the distributor.

**4.** Remove the oil pump and inlet tube assembly. Discard the oil pump gasket.

### INSTALLATION

**1.** Clean the gasket material from the block and pump.

**2.** Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the pump shaft to distribute the oil within the pump body.

**3.** Place a new gasket on the retaining bolts. Slide the pump mounting flange over the retaining bolts, and install the lock washers and nuts. Torque the nuts to specifications.

**4.** Using the identification marks as guides, install the distributor.

**5.** Connect the distributor vacuum line and primary wire to the distributor. Install the distributor cap.

**6.** Install the oil pan and related parts as outlined under "Oil Pan Installation" in this section.

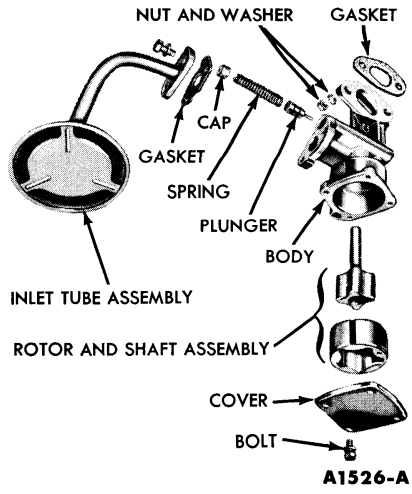



**FIG. 52—Oil Pump Assembly**

**7.** Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for oil leaks.

**8.** Check the ignition timing and adjust if necessary.

### DISASSEMBLY

**1.** Remove the oil inlet tube from the oil pump. Remove and discard the gasket.

**2.** Remove the cover retaining screws, then remove the cover. Remove the inner rotor and shaft assembly, then remove the outer race.

**3.** Scrape away the staking marks and insert a self-threading sheet metal screw of proper diameter into the oil pressure relief valve chamber cap. Pull the cap out of the chamber. Remove the spring and plunger.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### ASSEMBLY

The oil pump assembly is shown in Fig. 52.

**1.** Clean all parts thoroughly. Install the oil pressure relief valve plunger, spring and a new cap. Stake the cap into position.

2. Install the outer race (recessed dot facing out) and the inner rotor and shaft assembly. **The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.** Install the cover and torque the retaining screws to specifications.

**3.** Position a new oil inlet tube gasket on the oil pump and install the inlet tube.

## 3 ENGINE REMOVAL AND INSTALLATION

The engine removal and installation procedures are for the engine only without the transmission attached.

### REMOVAL

**1.** Drain the cooling system and the crankcase. Remove the hood.

**2.** Disconnect the battery ground cable from the battery, the heater hose from the water pump and coolant outlet housing, and flexible fuel line from the fuel tank line.

**3.** Disconnect the radiator upper hose at the coolant outlet housing and connect the radiator lower hose from the water pump.

On a car with an automatic transmission, disconnect the transmission oil cooler lines from the radiator.

**4.** Remove the radiator. Remove the air cleaner.

**5.** Disconnect the accelerator retracting spring and the accelerator rod assembly at the bellcrank. Disconnect the accelerator shaft retaining spring from the accelerator shaft equalizer bracket plate. Disconnect the choke control cable from the carburetor.

On a car with an automatic transmission, remove the accelerator bellcrank from the intake manifold, then tie the bellcrank to the dash panel.

**6.** Disconnect the exhaust manifold from the muffler inlet pipe. Disconnect the generator wires from the generator, and the engine ground strap from the converter housing or flywheel housing.

**7.** Disconnect the primary wire from the coil, the oil pressure and temperature sending unit wires from the sending units, and the starter cable from the starter.

**8.** Remove the starter (and the automatic transmission fluid filler tube bracket). Remove the engine rear plate upper right bolt.

On a car with a manual-shift transmission, remove the flywheel inspection cover. Disconnect the clutch release spring and rod. Remove the clutch bracket from the rear of the engine block.

On a car with an automatic transmission, remove the converter housing access cover and cover assembly. Remove the flywheel to converter nuts, then secure the converter assembly in the housing. Remove the

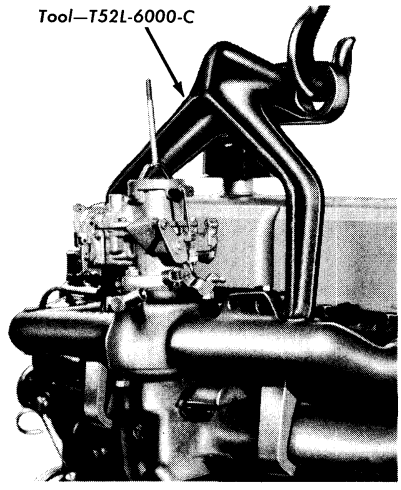



**FIG. 53—Engine Lifting Hook—Typical**

transmission oil cooler lines from the retaining clip at the engine and remove the clip from the engine right mount.

**9.** Remove the flywheel or converter housing to engine bolts. Support the transmission with a jack. Remove the remaining engine rear plate retaining bolts.

**10.** Remove the engine right and left support insulator to frame retaining nut.

**11.** Attach the engine lifting hook (Fig. 53). Raise the engine slightly, then carefully pull it from the transmission. Lift the engine out of the chassis, then install it on a work stand (Fig. 54).

### INSTALLATION

**1.** Place a new gasket on the muffler inlet pipe.

**2.** Lower the engine carefully into the chassis. Make sure the studs on the exhaust manifold are aligned

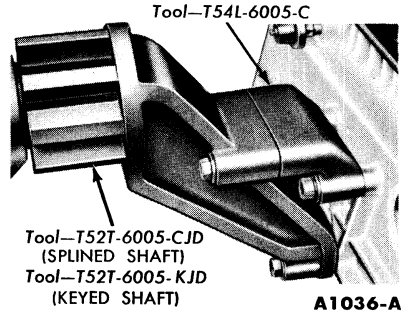



**FIG. 54—Engine Mount**

with the holes in the muffler inlet pipe and the dowels in the block engage the holes in the flywheel or converter housing.

On a car with an automatic transmission, start the coverter pilot into the crankshaft. Remove the retainer securing the converter in the housing.

On a car with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission with relation to the engine if the transmission input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (with the transmission in gear) until the shaft splines mesh with the clutch disc splines.** Install the flywheel housing bolts and torque them to specifications. Remove the jack supporting the transmission.

**3.** Install the converter or flywheel housing upper retaining bolts. Remove the engine lifting hook.

**4.** Install the engine left and right support insulator to engine retaining nuts (install the automatic transmission oil cooler lines bracket).

**5.** Install the remaining converter or flywheel housing retaining bolts. Install the engine rear plate lower retaining bolts.

**6.** Install the starter (and automatic transmission fluid filler tube bracket).

On a car with an automatic transmission, install the transmission oil cooler lines in the bracket at the engine block.

**7.** Install the exhaust manifold to muffler inlet pipe lock washers and nuts. Torque the nuts to specifications. Connect the engine ground strap, the generator wires and the choke control cable.

On a car with an automatic transmission, install the accelerator bellcrank on the intake manifold.

On a car with a manual-shift transmission, connect the clutch release spring and rod. Adjust the clutch pedal free travel. Install the flywheel housing inspection cover.

**8.** Connect the accelerator retracting spring and the accelerator rod assembly.

**9.** Connect the starter cable, the coil primary wire, the oil pressure and temperature sending unit wires,

flexible fuel line, the heater hoses, and the battery ground cable.

**10.** Install the radiator. Connect the radiator lower hose to the water pump and the radiator upper hose to the coolant outlet housing.

On a car with an automatic transmission, connect the oil cooler lines.

**11.** Fill and bleed the cooling system. Fill the crankcase. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

On a car with an automatic transmission, adjust the transmission control linkage.

**12.** Install the air cleaner. Install and adjust the hood.

## 4 MAJOR REPAIR OPERATIONS

To perform the operations in this section, it will be necessary to remove the engine from the car and install it on a work stand.

### CRANKSHAFT

The crankshaft and related parts are shown in Fig. 55.

### REMOVAL

**1.** Disconnect the distributor vacuum line and primary wire from the distributor. Remove the distributor cap.

**2.** Remove the distributor.

**3.** Remove the oil level dipstick.

**4.** Disconnect the generator adjusting arm from the water pump and remove the water pump.

**5.** Turn the engine on the work stand so that the front of the engine is up. Remove the crankshaft damper retaining capscrew and lock washer, then remove the crankshaft damper (Fig. 27).

**6.** Remove the cylinder front cover and gasket.

**7.** On the Mileage Maker Six engine, check the timing chain deflection and remove the timing chain and sprockets by following steps 2 thru 7 under "Timing Chain Removal" in Part 8-2, Section 2.

On the Police Special Six and Taxi Special Six engines, check the timing gear backlash and runout and remove the timing gears by following steps 2 thru 5 under "Timing Gear Removal" in Part 8-2, Section 2.

**8.** Remove the flywheel and engine rear cover plate.

**9.** Turn the engine on the work stand so that the bottom of the engine is up. Remove the oil pan and gasket. Remove the oil pump and inlet tube assembly. Discard the oil pump gasket.

**10. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod from which the cap is being removed is down. Remove the connecting rod cap. Push the connecting rod and piston assembly up in the cylinder.

**11.** Remove the main bearing caps.

**12.** Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

To refinish journals, dress minor imperfections, etc., refer to Part 8-1, Section 2.

### INSTALLATION

**1.** Remove the rear journal oil seal from the block and rear main bearing cap. Remove the cap to block side seals.

**2.** Remove the main bearing inserts from the block and bearing caps.

**3.** Remove the bearing inserts from the connecting rod caps.

**4.** Clean the rear journal oil seal

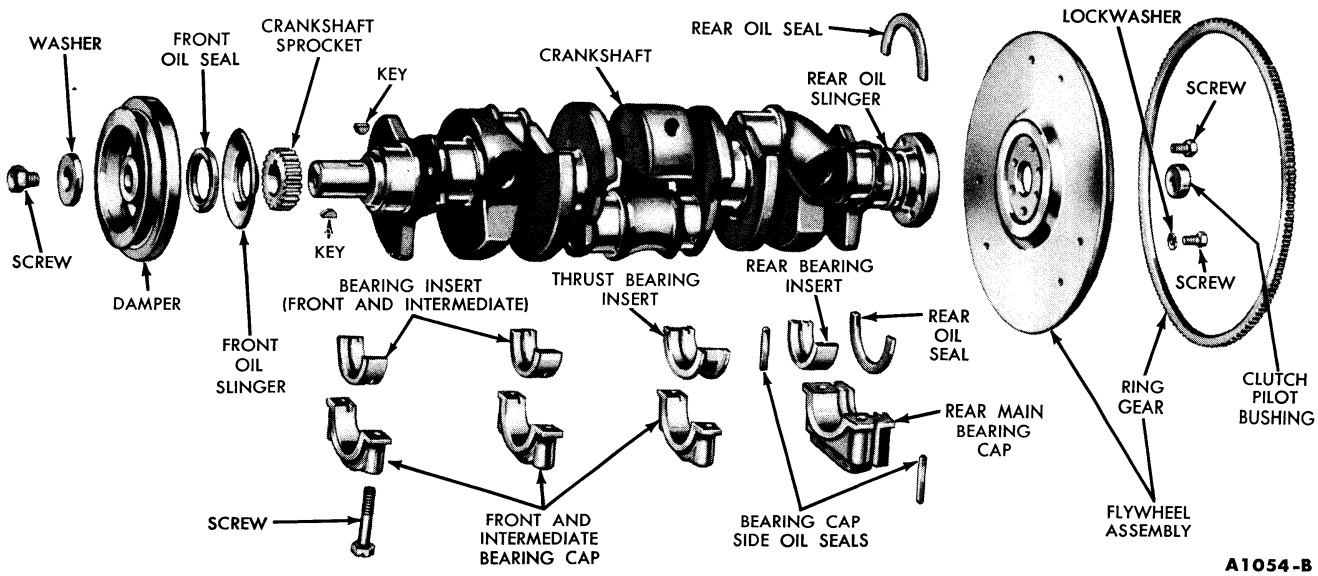



**FIG. 55—Crankshaft and Related Parts**

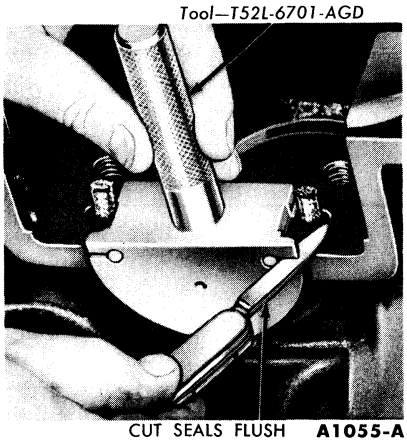



**FIG. 56—Rear Oil Seal to Block Installation**

grooves. Preform the new seals by hand to the approximate radius of the oil seal grooves in the cap and block.

**5.** Insert the new seal in the oil seal groove in the cap and block, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, then press both ends of the seal into the groove, working from the ends to the center.

**6.** Position the seal forming tool as shown in Figs. 41 and 56 and complete the seal installation. After installation, cut the end of the seals flush.

**7.** If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.

**8.** Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

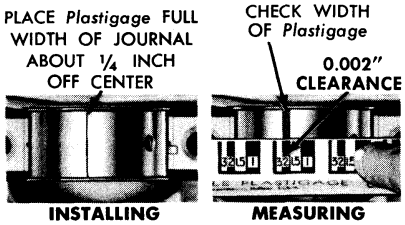



**FIG. 57—Installing and Measuring Plastigage—Engine Removed**

**9.** Install the lower main bearing inserts in the bearing caps.

**10.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**11.** Check the clearance of each main bearing. Place a piece of Plastigage on the crankshaft journal the full width of the journal and about ¼ inch off center (Fig. 57). Follow steps 11 thru 14 under "Main bearing Replacement."

**12.** After the bearings have been installed, apply a light coat of engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Torque the bearing cap bolts to specifications.

**13.** Install the thrust bearing cap with the bolts finger-tight.

**14.** Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 58).

**15.** Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 58). This will align the thrust surfaces of both halves of the bearing.

**16.** Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications (Fig. 58).

**17.** Force the crankshaft toward the rear of the engine.

**18.** Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 59).

**19.** Set the dial on zero. Push the crankshaft forward and note the reading on the dial.

**20.** If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or foreign matter. If the thrust faces are not defective, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure (steps 11, 12, 13 and 14), then check the end play.

**21.** Install and check the rear main bearing cap side seals for leaks by following steps 19 and 20 under "Main Bearing Replacement" in Section 3.

**22.** Install the bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement."

**23.** If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings. Turn the engine on the workstand so that the front end is up.

**24.** Turn the crankshaft throw to the bottom of its stroke, and then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.

**25.** Install the connecting rod cap, then torque the nuts to specifications.

**26.** After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal (Fig. 43).

**27.** Clean the oil pan, oil pump and oil pump screen.

**28.** Install the oil pump assembly following steps 1 thru 3 under "Oil Pump Installation."

**29.** Install the oil pan following steps 1 thru 3 under "Oil Pan Installation."

**30.** Turn the engine on the work stand so that the rear of the engine is up. Position the engine rear cover plate on the cylinder block. Position the flywheel on the crankshaft and install the retaining bolts. Torque the bolts to specifications.

On a flywheel for a manual-shift transmission, use tool 7563 to locate the clutch disc. Install the pressure plate. Torque the retaining bolts to specifications.

**31.** Turn the engine on the work stand so that the front end is up.

**32.** Replace the crankshaft front oil seal.

**33.** On the Mileage Maker Six engine, install the timing chain and sprockets by following steps 1 thru 3 under "Timing Chain Installation" in Part 8-2, Section 2.

On the Police Special Six and Taxi Special Six engines, install the timing gears by following steps 1 and 2 under "Timing Gear Installation" in Part 8-2, Section 2.

**34.** Install the cylinder front cover and crankshaft damper by following the procedure outlined under "Cylinder Front Cover Installation" in Page 8-2, Section 2.

**35.** Coat a new water pump gasket and the retaining bolts with water-resistant sealer. Install the water pump. Connect the generator adjusting arm to the water pump.

**36.** Install the oil level dipstick.

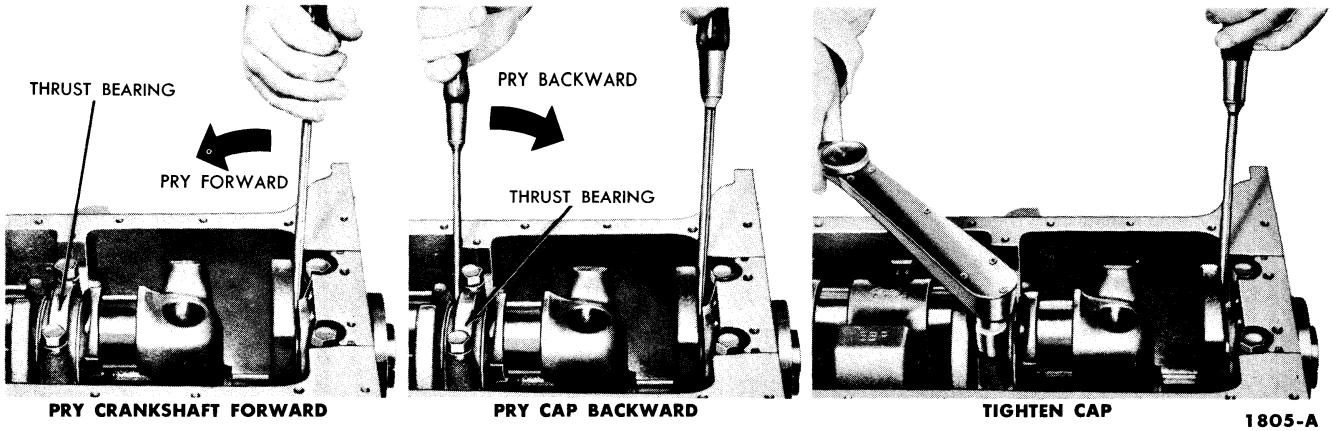



**FIG. 58—Thrust Bearing Alginment**

**37.** Position No. 1 piston on TDC at the end of the compression stroke. Position the distributor and intermediate drive shaft into the block with the rotor at the No. 1 firing position and the breaker points open. Install the retaining bolts. **Make sure the oil pump intermediate drive shaft is properly seated in the oil pump. It may be necessary to reposition the intermediate shaft in order to engage it in the oil pump.**

**38.** Connect the distributor vacuum line and primary wire to the distributor. Install the distributor cap.

**39.** Remove the engine from the work stand and install it in the car.

**40.** Check the ignition timing and adjust if necessary.

## CAMSHAFT BEARING REPLACEMENT

Camshaft bearings are available pre-finished to size for standard and 0.015-inch undersize journal diameters. The No. 1 camshaft bearing is not interchangeable with the other bearings.

**1.** Remove the flywheel, engine rear cover plate and the camshaft.

**2.** Remove the camshaft rear bearing bore plug.

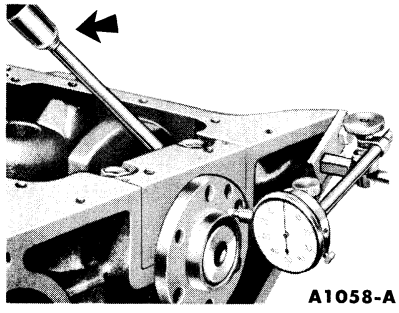



**FIG. 59—Crankshaft End Play**

**3.** Remove the camshaft bearings (Fig. 60).

**4.** Position the bearings at the bearing bores, and press them in place (Fig. 60). **Be sure the front bearing is installed 0.005-0.020 inch below the front face of the cylinder block.** Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. Particular care should be taken with the No. 3 bearing because it supplies oil to the valve rocker arms.

**5.** Clean the camshaft rear bearing bore plug recess thoroughly. Coat the flange of a new plug with oil-resistant sealer and install it with the flange facing as in (Fig. 39). Drive the plug in until the flange is flush or slightly below the casting surface.

**6.** Install the camshaft, engine rear cover plate, flywheel and related parts. Install the engine in the car.

## ENGINE DISASSEMBLY

**1.** Disconnect the distributor vacuum line and the fuel inlet line from the carburetor.

**2.** Remove the carburetor and gasket.

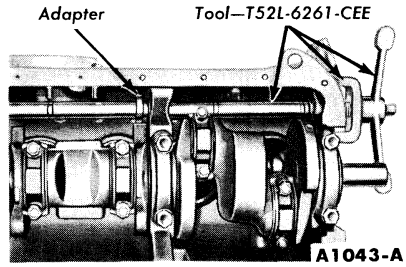



**FIG. 60—Camshaft Bearing Removal or Installation**

**3.** Remove the oil level dipstick.

**4.** Grasp the crankcase vent hose near the rocker arm cover grommet and pull the regulator valve from the rocker arm cover. Disconnect the crankcase vent hose from the fitting in the intake manifold. Remove the vent hose fitting from the intake manifold.

**5.** Remove the manifolds as an assembly. Remove the gaskets and sleeves. Separate the manifolds and remove the air cleaner bracket.

**6.** On the Mileage Maker Six engine, remove the fuel inlet line and distributor vacuum line as an assembly.

On the Police Special Six or Taxi Special Six engine, remove the fuel inlet line, fuel filter and distributor vacuum line as an assembly.

**7.** Disconnect the high tension lead from the coil. Remove the coil from the cylinder head.

**8.** Remove the distributor cap and spark plug wires as an assembly. Remove the distributor.

**9.** Remove the spark plugs, oil pressure and temperature sending units.

**10.** Remove the oil filter assembly. Remove the fuel pump and gasket.

**11.** Remove the valve push rod cover. Remove the valve rocker arm cover.

**12.** Remove the cap screw and bracket from the No. 4 rocker arm support. Pull the oil inlet line out of the support, then pull it out of the block with pliers (Fig. 16). Be careful not to damage the line.

**13.** Remove the cap screw from the No. 1 rocker arm support. Remove the oil outlet line and bracket.

**14.** Loosen the cap screws two turns at a time in sequence. Remove the valve rocker arm shaft assembly.

**15.** Remove the valve push rods in sequence and identify them so that they can be installed in their original positions (Fig. 20).

**16.** Install the cylinder head holding fixtures for convenience in lifting the head and to protect the gasket surfaces (Fig. 21).

**17.** Remove all cylinder head bolts.

**18.** Install the cylinder head guide studs (Fig. 22).

**19.** Lift the cylinder head assembly off the engine. **Do not pry between the head and block as the gasket surfaces may become damaged.**

On a flywheel for a manual-shift transmission, mark the pressure plate cover so that it can be replaced in the same position. Remove the clutch pressure plate and cover assembly.

**20.** Remove the flywheel and engine rear cover plate.

**21.** Loosen the generator mounting bolts and disconnect the generator adjusting arm from the water pump.

**22.** Remove the drive belt(s), fan and pulley. Remove the generator and water pump.

**23.** Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft damper, and remove the damper (Fig. 27).

**24.** Remove the cylinder front cover and discard the gasket.

**25.** Remove the crankshaft front oil slinger. Check the camshaft end play following step 7 under "Camshaft Removal." Remove the dial indicator.

**26.** On the Mileage Maker Six engine, check the timing chain deflection and remove the timing chain and sprockets by following steps 2 thru 7 under "Timing Chain Removal" in Part 8-2, Section 2.

On the Police Special Six and Taxi Special Six engines, check the timing gear backlash and runout, and remove the timing gears by following steps 2 thru 5 under "Timing Gear Removal" in Part 8-2, Section 2.

**27.** Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

**28.** Invert the engine on the work stand. Push all the tappets down to allow clearance for removal of the camshaft.

**29.** Remove the Woodruff key, snubber pad (Mileage Maker Six), camshaft thrust plate, and spacer (Mileage Maker Six). Carefully remove the camshaft by pulling it toward the front of the engine. **Use caution to avoid damaging the journals and lobes.**

**30.** Remove the oil pan. Discard the gasket. Remove the oil pump and inlet tube assembly. Discard the oil pump gasket.

**31. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod being removed is down. Remove the connecting rod cap.

**32.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**

**33.** Remove the bearing inserts from the connecting rods and caps. Install the rod caps on the connecting rods from which they were removed.

**34.** Remove the main bearing caps.

**35.** Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

**36.** Remove the rear journal oil seal from the block and rear main bearing cap, and remove the cap to block side seals.

**37.** Remove the main bearing inserts from the block and bearing caps. Install the main bearing caps in their original positions.

**38.** Remove all the tappets, keeping them in order so that they can be installed in their original location.

**39.** Remove the camshaft rear bearing bore plug (Fig. 38).

**40.** Remove the camshaft bearings (Fig. 60).

## ENGINE ASSEMBLY

**1.** Remove the glaze from the cylinder bores by following the instructions of the tool manufacturer.

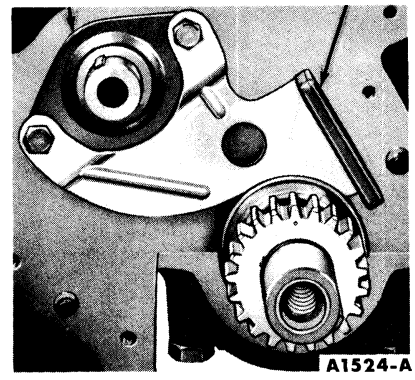



**FIG. 61—Timing Chain Vibration Damper Installation**

**2.** Invert the engine on the work stand.

**3.** Position new camshaft bearings in the bearing bores and press them in place (Fig. 60). Align the oil holes in the bearing with the oil holes in the cylinder block when the bearings are installed. **Be sure the camshaft front bearing is installed 0.005-0.020 inch below the front face of the cylinder block.** Particular care should be taken with No. 3 bearing because it supplies oil to the valve rocker arms.

**4.** Check the No. 3 camshaft bearing for proper alignment of the oil holes by squirting oil into the opening in the cylinder block and observing the flow through the oil holes at No. 3 camshaft bearing.

**5.** Clean out the camshaft rear bearing bore plug recess thoroughly.

**6.** Coat the flange of a new plug with oil-resistant sealer and install it with the flange facing out (Fig. 39).

**7.** Drive the plug in until it is flush or slightly below the casting surface.

**8.** Dip the tappet foot in Lubriplate, then coat the remainder of each valve tappet with engine oil. Install the tappets in their original bores.

**9.** Oil the camshaft and apply Lubriplate to all lobes. Be sure all the valve tappets are seated, then carefully slide the camshaft through the bearings.

**10.** On the Mileage Maker Six engine, install the camshaft spacer. **Be sure the chamfer on the inside of the spacer is to the rear or faces the camshaft journal.**

**11.** Install the thrust plate and snubber pad (Mileage Maker Six only) as shown in Fig. 61. Torque the retaining screws to specifications.

**12.** Be sure that the rear journal oil seal grooves are clean, then install a new rear journal oil seal in the block (Fig. 56) and rear main bearing cap (Fig. 41). After installation, cut the ends of the seals flush.

**13.** If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean.

**14.** Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

**15.** Install the lower main bearing inserts in the bearing caps.

**16.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**17.** Check the clearance of each main bearing following the procedure under "Main Bearing Replacement."

**18.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Torque the bearing cap bolts to specifications.

**19.** Install the thrust bearing cap and check the crankshaft end play by following steps 14 thru 20 under "Crankshaft Installation."

**20.** Install the rear bearing cap side seals and check for leaks by following steps 19 and 20 under "Main Bearing Replacement" in Section 3.

**21.** Turn the engine on the work stand so that the front end is up.

**22.** Install the pistons and connecting rods by following steps 2 thru 8 under "Piston and Connecting Rod Installation."

**23.** On the Mileage Maker Six engine, install the timing chain and sprockets by following steps 1 thru 3 under "Timing Chain Installation" in Part 8-2, Section 2.

On the Police Special Six and Taxi Special Six engines, install the timing gears by following steps 1 and 2 under "Timing Gear Installation" in Part 8-2, Section 2.

**24.** Clean the cylinder front cover and the gasket surface of the cylinder block. Install a new crankshaft front oil seal.

**25.** Coat the gasket surface of the block and the cover with sealer. Position a new gasket on the block. Insert the small diameter of tool T52L-6059-AAE in the bore of the cover. Position the cover and pilot assembly over the end of the crankshaft and against the block. Install the cylinder front cover bolts. Torque the bolts to specifications.

**26.** Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease. Line up the damper key-way with the key on the crankshaft. Install the damper on the crankshaft (Fig 30).

**27.** Coat the water pump retaining bolts and gasket with water-resistant sealer. install the water pump. Torque the bolts to specifications.

**28.** Install the generator. Position the generator adjusting arm to the water pump backing plate. Install the retaining bolt.

**29.** Install the pulley and fan. Install and adjust the drive belt(s).

**30.** Invert the engine on the work stand.

**31.** Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the shaft to distribute the oil within the pump body.

**32.** Place a new gasket on the oil pump retaining bolts. Slide the pump mounting flange over the retaining bolts and install the lock washers and nuts.

**33.** Make sure the gasket surfaces of the block and oil pan are clean. Coat the block surface and oil pan gasket surface with sealer and position the gasket on the block.

**34.** Position the oil pan on the block. Install the retaining screws. Torque the screws from the center outward in each direction to specifications.

**35.** Position the engine rear cover plate on the cylinder block. Position the flywheel on the crankshaft and install the retaining bolts. Torque the bolts to specifications.

On a flywheel for a manual-shift transmission, use tool 7563 to locate the clutch disc, then install the pressure plate. Torque the retaining bolts to specifications.

**36.** Clean the head and block gasket surfaces. Inspect the head for any damage and repair as necessary.

**37.** Position the gasket over the guide studs on the cylinder block.

**38.** Lift the cylinder head over the guides and slide it down carefully.

**39.** Coat the threads of the bolts for the left side of the cylinder head with a water-resistant sealer. Install, but do not tighten, the two bolts at opposite ends of the head to hold the head and gasket in position. Remove the guides, then install the remaining bolts. Remove the cylinder head holding fixtures.

**40.** The cylinder head bolt tightening procedure is performed in three progressive steps. Follow the sequence shown in Fig. 23. Torque the bolts to 95 ft-lbs, then torque them to 105 ft-lbs. Finally, torque the bolts to 115 ft-lbs. **After the cylinder head bolts have been torqued to specifications, the bolts should not be disturbed.**

**41.** Apply Lubriplate to both ends of the push rods. Install the push rods in their proper sequence, positioning the lower end of the rods in the tappet sockets.

**42.** Position the valve rocker arm shaft assembly on the head. **Be sure the oil holes in the shaft are facing downward.** Install the oil outlet line, bracket, and retaining screw on the No. 1 support. Make sure the oil line enters the shaft locating hole.

**43.** Install a new O-ring seal on the lower end of the oil inlet line. Position the line in the No. 4 support. Make sure the O-ring seal is in the oil supply counterbore, then install the bracket and support bolt.

**44.** Tighten all the valve rocker arm shaft retaining bolts two turns at a time in sequence. Torque the bolts to specifications.

**45.** On the Mileage Maker Six engine with silent lash rocker arms, adjust the valve clearance (Part 8-1, Section 2).

On the Police Special Six or Taxi Special Six engine, perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

**46.** Clean the valve push rod cover. Cement a new gasket to the valve push rod cover, using neoprene adhesive. Install the cover and torque the retaining screws to specifications. Two minutes after the initial tightening, torque the screws to the same specifications.

**47.** Using a new gasket, install the fuel pump.

**48.** Install the oil filter assembly following the procedure under "Oil Filter Replacement."

**49.** Position No. 1 piston on TDC at the end of the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points

open. Install the hold down clamp. **Make sure the distributor intermediate drive shaft is properly seated in the oil pump. It may be necessary to reposition the intermediate shaft in order to engage it in the oil pump.**

**50.** Install the spark plugs, oil pressure and temperature sending units. Install the distributor cap and spark plug wire assembly. Connect the spark plug wires.

**51.** Install the coil on the cylinder head and connect the coil high tension lead.

**52.** On the Mileage Maker Six engine, position the fuel inlet line and the vacuum line on the engine. Connect the fuel inlet line to the fuel pump. Connect the distributor vacuum line and primary wire to the distributor.

On the Police Special Six or Taxi Special Six engine, install the fuel filter. Position the fuel inlet line and the vacuum line on the engine. Connect the fuel lines to the filter and fuel pump. Connect the distributor vacuum line and primary wire at the distributor.

**53.** Place the intake manifold over the studs on the exhaust manifold. Position the air cleaner bracket to the exhaust manifold. Install the lock washers, nuts and bolt, tightening them finger-tight.

**54.** Install new intake manifold gaskets using new sleeves, if necessary, in the ports of the cylinder head.

**55.** Coat the mating surfaces lightly with graphite grease. Place the manifold assembly in position against the head. **Make sure that none of the gaskets have become dislodged.**

**56.** Position the oil level dipstick tube bracket to the manifold. Install the manifold attaching washers and bolts. Torque the bolts to specifications, tightening them from the center to the ends. Torque the bolt and nuts joining the intake and exhaust manifolds to specifications.

**57.** Position the carburetor gasket on the intake manifold. Install the carburetor.

**58.** Clean the valve rocker arm cover. Coat one side of a new cover gasket with oil-resistant sealer. Lay the cemented side of the gasket in place in the cover. Install the cover, making sure that the gasket seats evenly around the head. **Partially tighten the retaining bolts.**

**59.** Connect the fuel inlet line and the distributor vacuum line to the carburetor.

**60.** Clean the crankcase vent system components as outlined in Part 8-1, Section 3. Install the crankcase vent hose fitting in the intake manifold. Position the hose clamps on the vent hose. Install the hose on the fitting in the intake manifold and the regulator valve in the hose. Using the clamp pliers, slide the clamps into position. Insert the regulator valve into the rocker arm cover mounting grommet.

**61.** Install the oil level dipstick.

**62.** Install the engine in the car.

**63.** Operate the engine until normal operating temperature is reached. Check the ignition timing and adjust it if necessary. Adjust the engine idle fuel mixture and idle speed.

**64.** Remove the regulator valve from the valve rocker arm cover. Remove the valve rocker arm cover.

On the Mileage Maker Six engine with silent lash rocker arms, start the engine and operate it at normal idle speed. Observe the position of the adjustment mark on each eccentric. Make minor adjustments, as necessary, with the engine idling by turning the adjusting screws in or out as necessary.

On the Police Special Six or Taxi Special Six engine, perform a hot valve lash adjustment (Part 8-1, Section 2).

**65.** Install the valve rocker arm cover. The cover is tightened in two steps. Torque the retaining bolts to specifications. Two minutes after the initial tightening, torque the bolts to the same specifications.

**66.** Insert the regulator valve (vent hose attached) into the valve rocker arm cover. Install the air cleaner.

# PART 8-3 CHALLENGER 289 V-8


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| 2 In-Car Adjustments and Repairs | 8-56 |
| 3 Engine Removal and Installation | 8-72 |
| 4 Major Repair Operations | 8-73 |

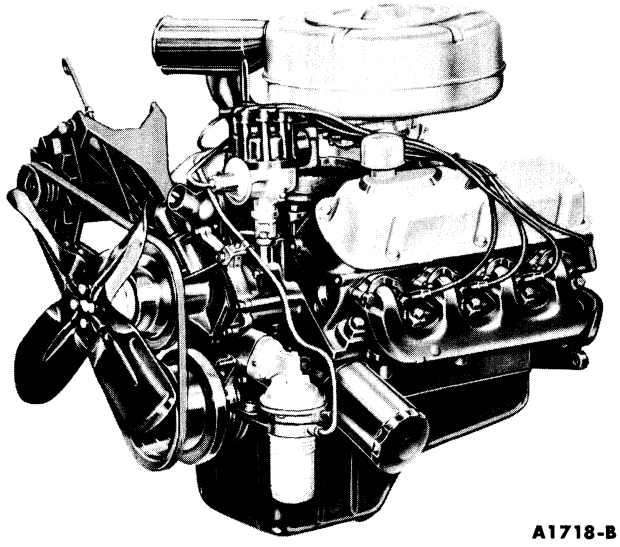

## 1 DESCRIPTION AND OPERATION

The Challenger 289 V-8 engine (Figs. 1, 2, 3 and 4) has a piston displacement of 289 cubic inches and a compression ratio of 9.0:1. The patent plate symbol for the engine is "C".

### MANIFOLDS

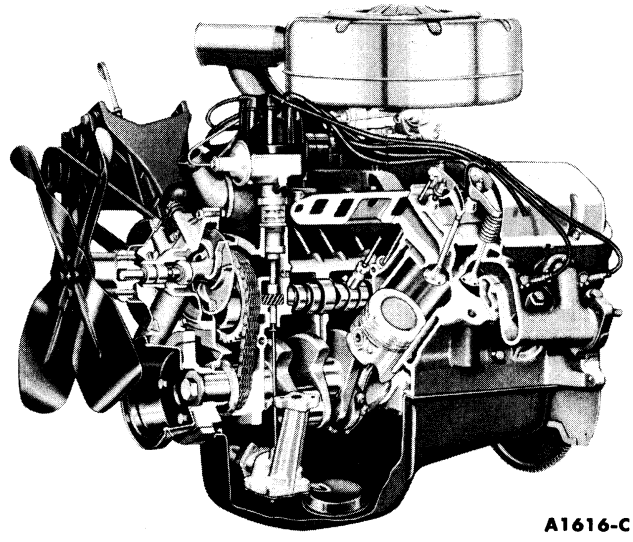
Coolant flows from the front of the engine through the intake manifold into the heater inlet hose and circulates through the heater. On cars that do not have a heater, the coolant is returned to the water pump through a bypass hose.

Exhaust gases flowing through the crossover passage (Fig. 5) provide the initial heat necessary to assist in



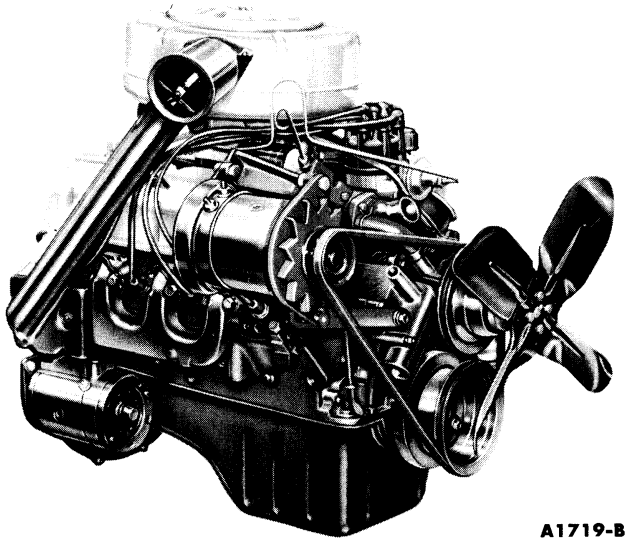
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FIG. 1—¾ Left Front View



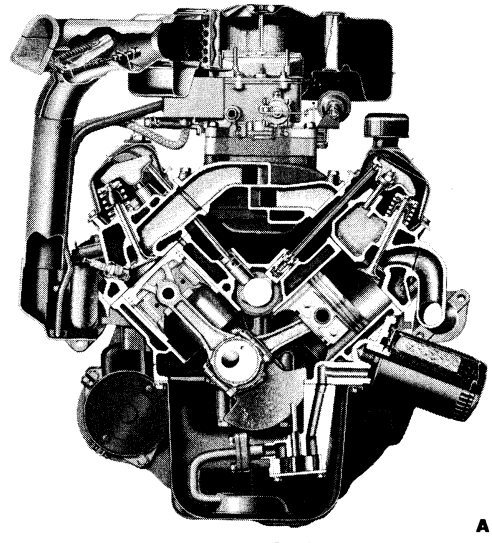
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FIG. 3—Front ¾ Sectional View



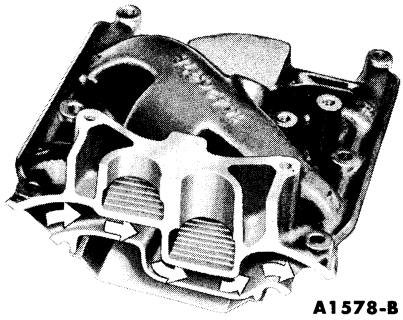
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FIG. 2—¾ Right Front View



A1717-B

FIG. 4—Front Cross Sectional View



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**FIG. 5—Intake Manifold Exhaust Gas Crossover Passage**

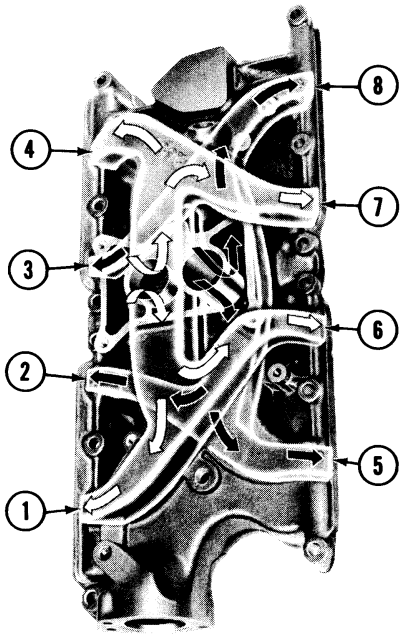
vaporizing the incoming fuel mixture.

The intake manifold has two sets of fuel passages, each with its own separate inlet connection to the carburetor (Fig. 6). The right barrel of the carburetor feeds Nos. 1, 4, 6 and 7 cylinders and the left barrel feeds Nos. 2, 3, 5 and 8 cylinders.

Filtered air is drawn from the air cleaner, through an air inlet tube, into the heat chamber in the right exhaust manifold. Here the air is heated and then directed to the automatic choke through the air outlet choke tube (Fig. 7).

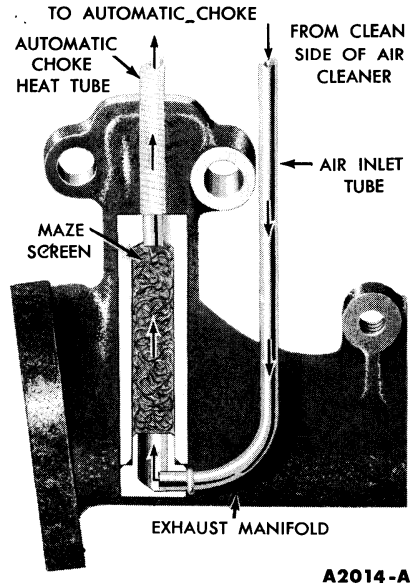
## CYLINDER HEADS

The cylinder head assemblies contain the valves and the valve rocker arm assemblies. The valve guides and push rod guides are machined in the head with a cast combustion chamber. The valve arrangement from front to rear on the left bank is E-I-E-I-E-I-E-I and on the right bank I-E-I-E-I-E-I-E (Fig. 8).




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**FIG. 6—Intake Manifold Fuel Passages**




A2014-A

**FIG. 7—Automatic Choke Heat Chamber**

## CYLINDER BLOCK

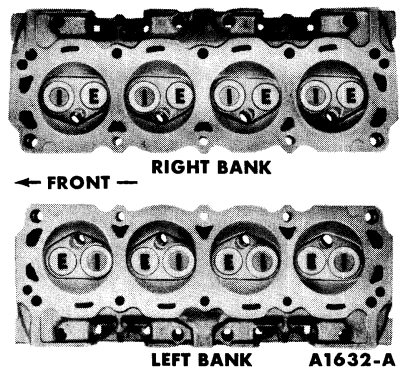
The cylinders are numbered from front to rear, on the right bank, 1, 2, 3 and 4 and on the left bank 5, 6, 7 and 8. The firing order is 1-5-4-2-6-3-7-8.

The oil pump, mounted inside the oil pan at the left front, is driven by the distributor through an intermediate drive shaft.

The oil filter is mounted on the left lower front of the block.

The crankshaft is supported by five main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The pistons have two compression rings and one control ring. The top compression ring is chrome-plated and the lower compression ring is phosphate-coated. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.




A1632-A

**FIG. 8—Valve Port Arrangement**

## VALVE TRAIN

The push rods are tubular steel with ball ends. The push rods supply oil from a metering valve (disc) in the hydraulic valve lifters through drilled holes in the ball ends for independent lubrication of each rocker arm.

The rocker arms have a drilled hole in the push rod end for lubrication. They are individually mounted on a stud that is pressed into the cylinder head. A fulcrum seat controls the rocker motion and a nut secures the rocker arm on the stud.

The camshaft is supported by five stepped bearings pressed into the block with a dowel for positioning the camshaft sprocket. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft end play is controlled by a thrust plate attached to the cylinder block. An eccentric, bolted to the front end of the camshaft, operates the fuel pump.

Hydraulic valve lifters are used which provide zero valve lash. The operation and parts identification of the hydraulic valve lifters are shown in Fig. 9.

When the valve is closed, the lifter assembly is on the base circle of the camshaft lobe and the valve push rod is in its lowest position. With the lifter assembly in this position, the plunger spring expands, forcing the plunger upward. This action is transmitted to the valve rocker arm via the valve push rod until there is solid contact between the valve and the valve end of the valve rocker arm (zero valve lash). In this position, the oil hole in the lifter and plunger is indexed with the lifter oil gallery in the cylinder block.

As the lifter plunger moves upward, the volume of the compression chamber is increased, resulting in reduced oil pressure in the compression chamber. Therefore, to equalize the resulting pressure differential between the supply chamber and the compression chamber,

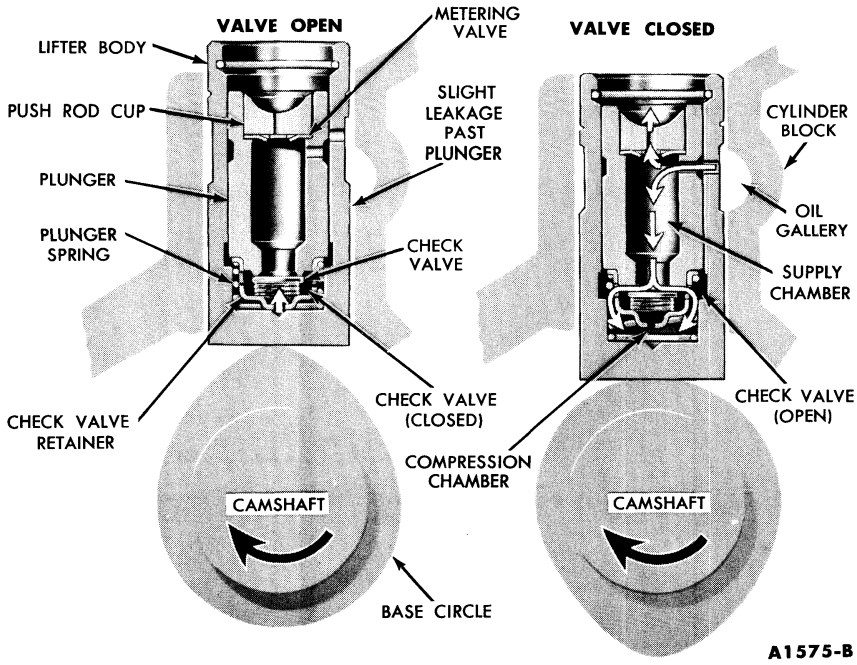



**FIG. 9—Typical Hydraulic Valve Lifter Operation**

the check valve moves off its seat and permits oil to flow from the supply chamber to the compression chamber. When the compression chamber becomes filled with oil, the pressure in the two chambers are equalized. The oil flow ceases and the check valve spring seats the check valve and closes the check valve port.

As the camshaft rotates, the lifter assembly is raised by the camshaft lobe. This increases the push rod force against the lifter plunger and hydraulic pressure immediately builds up in the compression chamber until it acts as a solid member of the valve operating mechanism. The lifter then becomes a hydraulic ram which forces the valve in the cylinder head to open. During this period, a slight leakage of oil past the plunger occurs (calibrated leak down rate).

As the high point of the camshaft lobe rotates and passes by the foot of the valve lifter, the valve in the cylinder head seats and the valve lifter assembly is forced downward. Reduced force on the lifter plunger at this time relieves the pressure on the lifter plunger and it is free to be moved upward by the plunger spring. This action allows oil to flow once again through the indexed oil holes in the lifter body and plunger.

The operating cycle is completed for each revolution of the camshaft. Zero clearance (lash) in the valve train mechanism is maintained at all times by the hydraulic force and expansion of the plunger spring between the lifter body and plunger.

## LUBRICATION SYSTEM

Oil from the oil pan sump, located in the front of the oil pan, is forced through the pressure-type lubrication system (Fig. 10) by a rotor oil pump. A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

All the oil discharged by the pump passes through an exclusive design full flow-type Rotunda filter before it enters the engine. The filter is mounted at the lower left front of the engine.

On a disposable-type oil filter, a relief valve in the filter permits oil to bypass the filter if the element becomes clogged.

On a replaceable element-type oil filter, a bypass provides oil to the engine in case the filter element becomes clogged. The bypass is located in the hollow center bolt of the filter and consists of a spring-loaded valve. When the element is clean and oil will flow through it, the pressure difference between the inner and outer faces of the valve is not great enough to overcome the spring pressure behind the valve. Therefore, no oil flows through the bypass. When the element is dirty and will not permit a sufficient flow of oil, the pressure acting on the inner face of the valve drops. If the pressure difference between the valve faces is great enough to overcome spring pressure, the valve will open. Oil then bypasses the element, maintaining an emergency supply of oil to the engine.

From the filter, the oil flows into the main oil gallery which is located to the right side of the camshaft. The oil gallery supplies oil to each individual main bearing, through drilled passages in the block. Passages are drilled from each main bearing to each camshaft bearing. Number 1 main bearing feeds No. 1 camshaft bearing, and No. 2 main bearing feeds No. 2 camshaft bearing, etc. The oil then flows through notches or grooves in the main bearings to lubricate the crankshaft journals. The timing chain and sprockets are lubricated by oil deflected from the front camshaft bearing by an oil drip trough on the cylinder front cover.

The crankshaft is drilled from the main bearings to the connecting rod bearings.

A small groove is located in the connecting rod at the mating face where the cap contacts the connecting rod. This groove is used as an oil squirt hole for cylinder wall lubrication. Oil from the connecting rod squirt hole lubricates the opposite cylinder wall. For example, the No. 1 connecting rod oils No. 5 cylinder, etc. As the crankshaft turns, the hole in the connecting rod bearing aligns with the hole in the journal causing a direct squirt of oil onto the cylinder wall (Fig. 10).

Oil passages are drilled from the main oil gallery to each valve lifter oil gallery. Oil from here feeds the valve lifter assemblies. A reservoir at each valve lifter bore boss traps oil so that oil is available for valve lifter lubrication as soon as the engine starts.

When the hydraulic lifter is on the base circle of the camshaft lobe (valve closed), the oil hole in the hydraulic lifter and plunger is indexed with the lifter oil gallery and oil flows into the plunger. The pressure differential above and below the

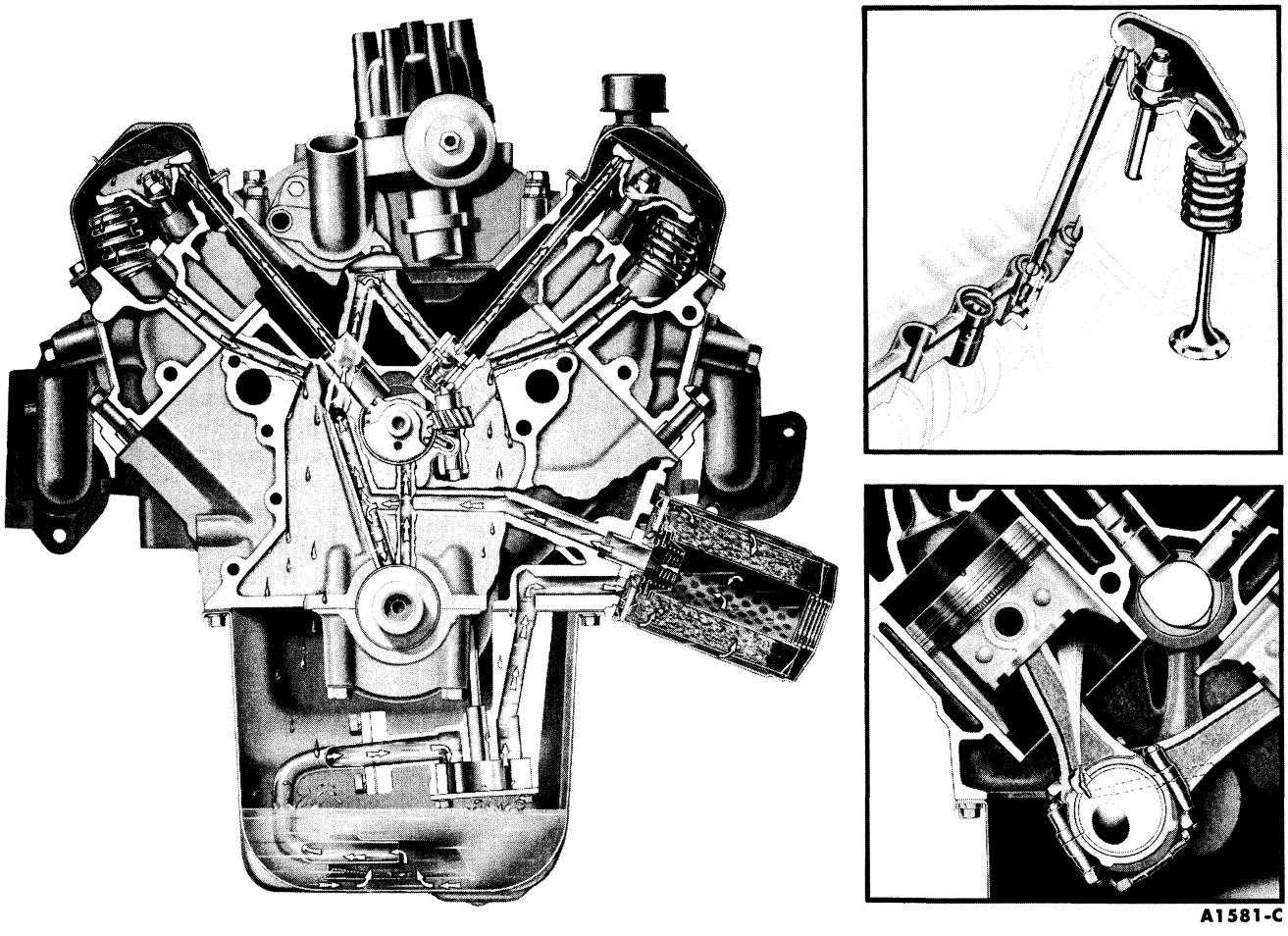



**FIG. 10—Lubrication System**

check valve (disc or ball check) forces the check valve open and oil fills the compression chamber below the plunger. Oil is also metered through the metering valve (disc) through the oil passages in the push rod cup and then flows up the hollow push rod. In this position, the drilled hole in the ball end of the push rod is indexed with a drilled hole in the rocker arm and the oil lubricates the upper valve train bearing areas (Fig. 10). Excess oil is returned to the oil pan through drain back holes located at each end of the cylinder head and block (Fig. 10).

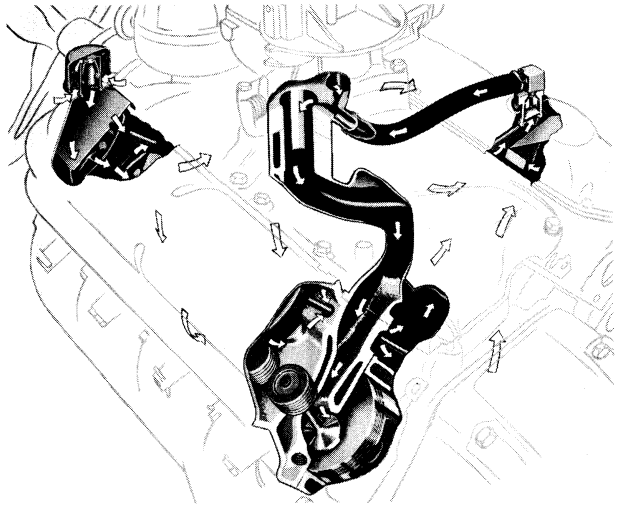
### AIR INTAKE SYSTEM

The temperature of the air entering the air cleaner is thermostatically controlled by an air intake duct and thermostat assembly (Fig. 4). This system suplies warm air to the engine during the warm-up period, resulting in better fuel vaporization and reducing the posibility of carburetor icing. The air duct shroud and tube assembly together with the air duct and thermostat assembly direct warm air into the air cleaner and carburetor.

If the temperature of the air passing over the thermostat is less than 75°F., the valve plate in the air duct is held in an up or "heat on" position by a valve plate tension spring. When the valve plate is in the "heat on" position, the air entering the air cleaner is drawn through the shroud and tube assembly. The air passing through the shroud and tube is first directed over the exhaust manifold and heated.

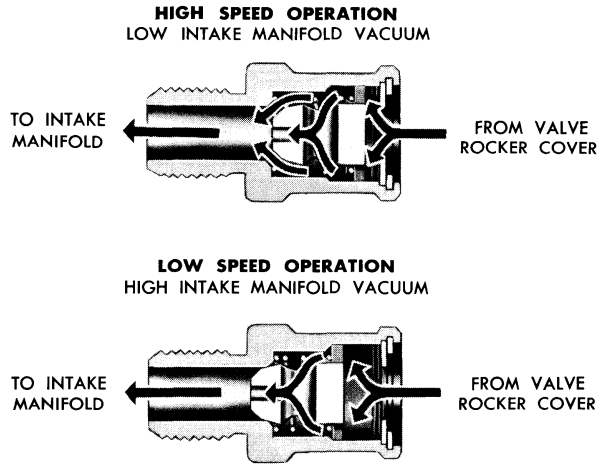
A wax filled thermostat is connected to the valve plate by a thermostat rod. The incoming air passes over the thermostat before entering the air cleaner. As the temperature of the air passing over the thermostat approaches 85°F., the wax begins to expand and pushes the thermostat rod against the valve plate. The tension of the valve plate spring is overcome and the valve plate is moved downward to partially close off the warm air duct to allow the cooler air from the engine compartment to mix with the warm air directed from the exhaust manifold.

If the temperature of the incoming air is approximately 105°F., the valve plate moves downward to a "heat off" position to close off the warm air duct. Cooler air from the engine compartment is then directed to the air cleaner without passing over the exhaust manifold.



A2011-A

**FIG. 11—Positive Crankcase Ventilation System**




A1988-A

**FIG. 12—Positive Crankcase Ventilation Regulator Valve**

## POSITIVE CRANKCASE VENTILATION SYSTEM

The air flow in the positive crankcase ventilation system is shown in Fig. 11.

Ventilating air enters the engine through the oil filler cap located on the front of the left valve rocker arm cover. The filler cap contains a filtering element which filters the incoming air.

From the oil filler cap, the air flows into the front section of the valve rocker arm shaft chamber. The ventilating air moves down past the push rods into the front of the lower crankcase and into the timing chain chamber.

The rotating action of the crankshaft causes the air to flow towards the rear of the crankcase and up into the rear section of the valve rocker arm cover. The air then enters a spring-loaded regulator valve that regulates the amount of air to meet changing operating conditions. The air is then directed to the intake manifold through the crankcase vent hose.

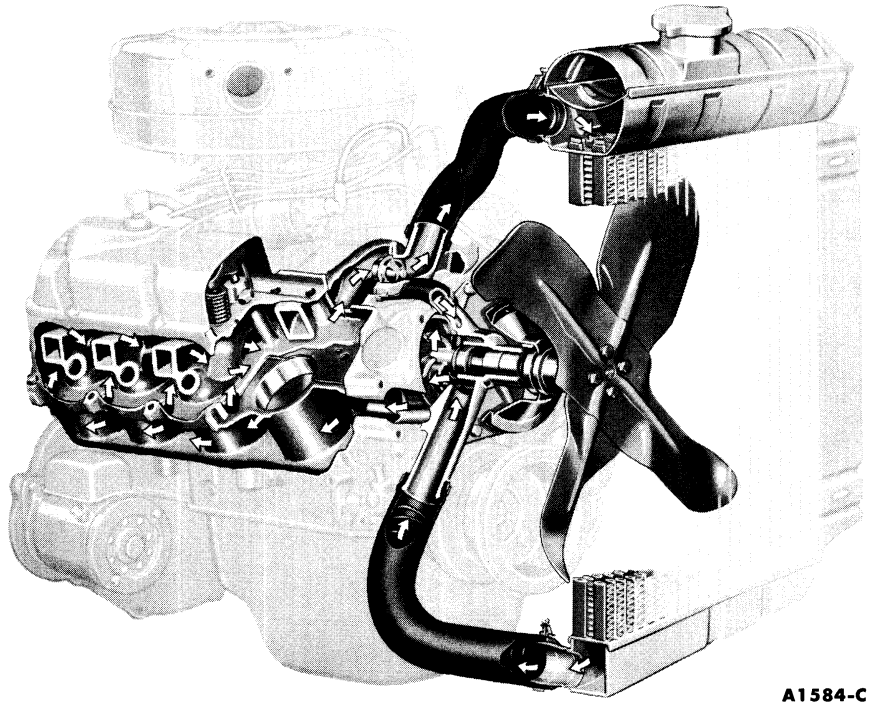
At idle speed, intake manifold is high. The high vacuum overcomes the tension of the spring pressure and seats the valve (Fig. 12). With the valve in this position, all the ventilating air passes through a calibrated orifice in the valve. With the valve seated, there is minimum ventilation. As engine speed increases and manifold vacuum decreases, the spring forces the valve off its seat and to the full open position (Fig. 12). This increases the flow of ventilating air.

## COOLING SYSTEM

The coolant is drawn from the bottom of the radiator by the water pump which delivers the coolant to the cylinder block (Fig. 13).

The coolant travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder heads, where it cools the combustion chambers, valves and valve seats on its return to the front of the engine.

The coolant from each cylinder head flows through the water passages in the intake manifold past the water thermostat, if it is open, into the top of the radiator. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. The entire system is pressurized to 13-15 psi.



A1584-C

**FIG. 13—Cooling System**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### ENGINE FRONT SUPPORTS

The front supports are located on each side of the cylinder block (Fig. 14). The procedures given apply to either a right or left installation.

#### REMOVAL

1. Remove the engine support insulator to frame nuts and lock washers on both engine supports.
2. Raise the engine slightly with a jack and a wood block placed under the oil pan.
3. Remove the engine support insulator to cylinder block retaining bolts and lock washers. Remove the engine support insulator assembly and dust shield.

#### INSTALLATION

1. Position the engine support insulator assembly and dust shield to the cylinder block and install the retaining bolts and lock washers. Torque the bolts to specifications.
2. Lower the engine into position and remove the jack and wood block.
3. Install the engine support insulator to frame nuts and lock washers. Torque the nuts to specifications.

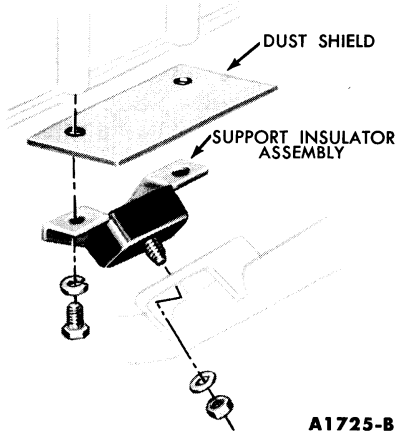



**FIG. 14—Engine Front Support**

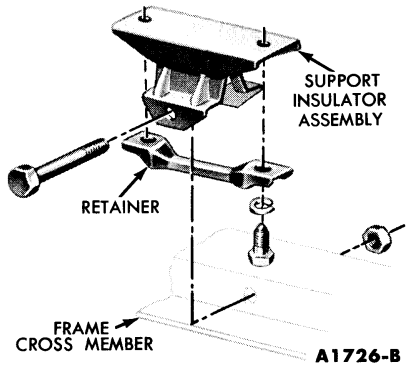



**FIG. 15—Engine Rear Support**

### ENGINE REAR SUPPORT

The rear support is located at the transmission extension housing (Fig. 15).

#### REMOVAL

1. Remove the support insulator to cross member retaining bolt and lock washer.
2. Remove the support insulator to transmission extension housing bolts and lock washers.
3. Raise the transmission with a floor jack. Remove the support insulator and retainer.

#### INSTALLATION

1. Position the support insulator and retainer on the transmission extension housing.
2. Install the support insulator to transmission extension housing bolts and lock washers. Torque the bolts to specifications. Lower the transmission.
3. Install the support insulator to cross member retaining bolt and lock washer. Torque the bolt to specifications.

### INTAKE MANIFOLD

The intake manifold assembly is shown in Fig. 16.

#### REMOVAL

1. Drain the cooling system. Disconnect the automatic choke heat chamber air inlet hose at the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.** Remove the air cleaner and intake duct assembly.
2. Disconnect the accelerator rod

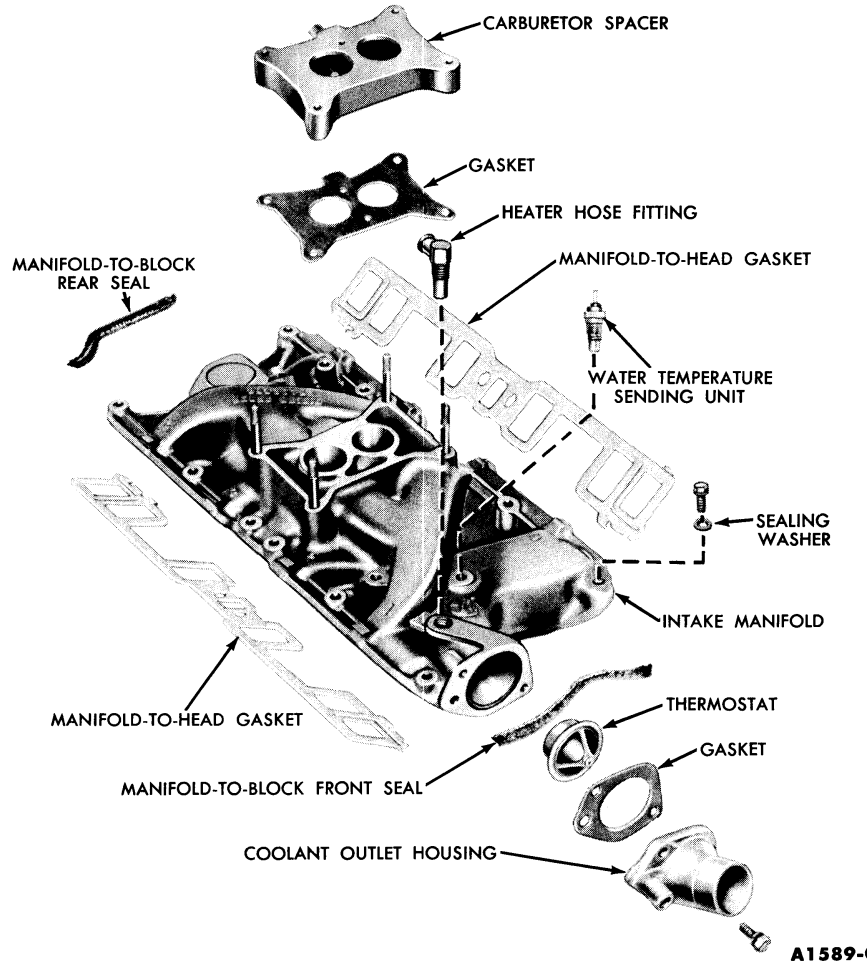



**FIG. 16—Intake Manifold Assembly**

from the carburetor. Remove the accelerator retracting spring. Remove the bellcrank assembly from the intake manifold and position it out of the way. (On a car with power steering and air conditioning, remove the speed-up control assembly from the bellcrank before removing the bellcrank from the intake manifold.)

On a car with an automatic transmission, disconnect the throttle valve vacuum line at the intake manifold.

**3.** Disconnect the high tension lead and wires from the coil. Remove the coil from the intake manifold. Disconnect the battery ground cable.

**4.** Disconnect the spark plug wires from the spark plugs by grasping the moulded cap only. Remove the wires from the harness brackets on the valve rocker arm covers. Remove the distributor cap and spark plug wire assembly.

**5.** Remove the carburetor fuel inlet line and the automatic choke heat tube.

**6.** Disconnect the distributor vacuum line from the carburetor. Remove the distributor hold down bolt and remove the distributor and vacuum line.

**7.** Disconnect the radiator upper hose from the coolant outlet housing, and the water temperature sending unit wire at the sending unit. Remove the heater hose from the automatic choke housing and disconnect the hose from the intake manifold.

**8.** Loosen the clamp on the water pump bypass hose at the coolant outlet housing and slide the hose off the outlet housing.

**9.** Disconnect the engine ground strap from the block and crankcase vent hose at the carburetor spacer.

**10.** Remove the intake manifold and carburetor as an assembly. Remove the intake manifold gaskets and seals. Discard the intake manifold retaining bolt sealing washers.

**11.** If the manifold is to be disassembled, remove the coolant outlet housing, gasket and thermostat. Remove the temperature sending unit, carburetor, spacer and gaskets.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

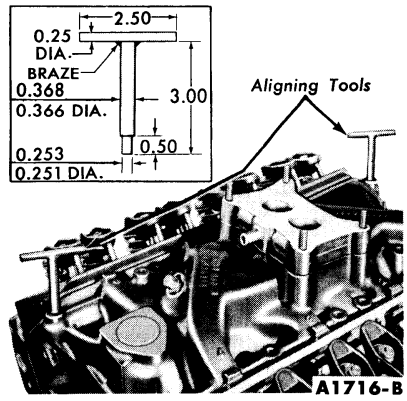



**FIG. 17—Intake Manifold Alignment**

## INSTALLATION

Intake manifold alignment tools are required when installing the intake manifold on the cylinder block and cylinder heads. Fabricate two alignment tools according to the specifications shown in Fig. 17.

**1.** If the intake manifold was disassembled, install the temperature sending unit (threads coated with electrical conductive sealer), carburetor, spacer and gaskets. Position the thermostat in the intake manifold. Coat the thermostat gasket with water-resistant sealer and position it on the intake manifold. Install the coolant outlet housing.

**2.** Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block. Coat the cylinder block seal surfaces with oil-resistant sealer.

**3.** Position new seals on the cylinder block and new gsakets on the cylinder heads with the gaskets interlocked with the seal tabs. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads. The correct installation of the gaskets and seals is shown in Fig. 18.

**4.** Carefully lower the intake manifold into position on the cylinder block and cylinder heads. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**

**5.** Be sure the holes in the manifold gaskets and manifold are in alignment. Position the intake manifold alignment tools (Fig. 17) in the front and rear bolt holes (Nos. 10 and 12) on the left bank of the manifold.

**6.** Using new sealing washers, install the intake manifold retaining bolts. Working from the center to the ends, torque the bolts in sequence (Fig. 19) to 3-5 ft-lbs.

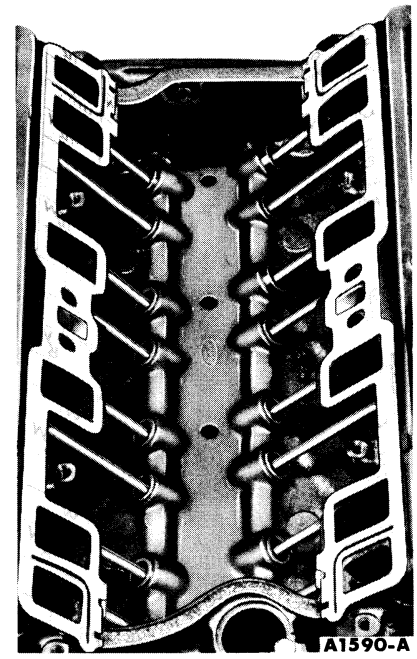



**FIG. 18—Intake Manifold Gaskets and Seals Installed**

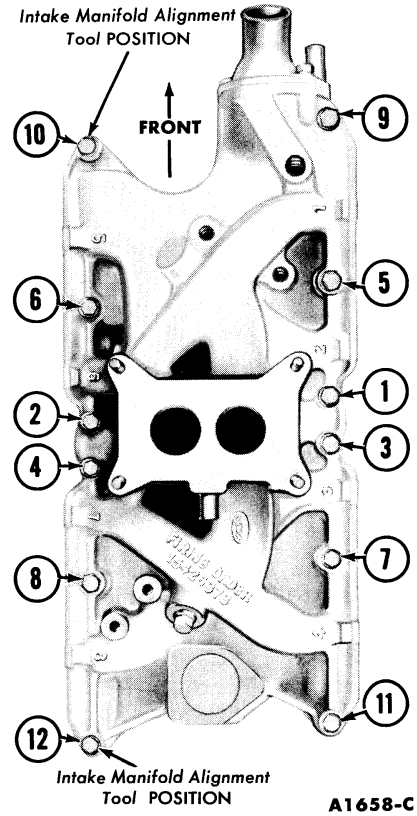



**FIG. 19—Intake Manifold Torque Sequence**

**7.** Remove the manifold alignment tools from the front and rear bolt holes (Nos. 10 and 12). Using new sealing washers, install the two remaining bolts and torque to 3-5 ft-lbs.

**8.** Torque all the manifold retaining bolts in sequence to 11-14 ft-lbs. Finally, torque all the retaining bolts in sequence to 14-16 ft-lbs (Fig. 19).

**9.** Install the water pump bypass hose on the coolant outlet housing. Slide the clamp into position and tighten the clamp.

**10.** Connect the water temperature sending unit and the radiator upper hose. Install the heater hose against the automatic choke housing and connect the hose at the intake manifold.

**11.** Install the carburetor fuel inlet line and the automatic choke heat tube.

**12.** Rotate the crankshaft damper until the No. 1 piston is on TDC at the end of the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**13.** Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the plugs.

**14.** Connect the battery ground cable and crankcase vent hose. Install the ignition coil. Connect the high tension lead and coil wires.

**15.** Install the bellcrank assembly and accelerator retracting spring. Connect the accelerator rod.

On a car with power steering and air conditioning, install the speed-up control assembly on the bellcrank assembly.

On a car with an automatic transmission, connect the throttle valve vacuum line.

**16.** Fill and bleed the cooling system.

**17.** Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line at the carburetor.

**18.** Operate the engine at fast idle and check all hose connections and gaskets for leaks. Operate the engine until engine temperatures have stabilized and adjust the engine idle speed and idle fuel mixture.

On a car with power steering and air conditioning, adjust the speed-up control assembly as outlined in Group 3.

**19.** Adjust the transmission throttle linkage. Install the air cleaner and intake duct assembly.

**20.** Connect the automatic choke heat chamber air inlet hose.

## EXHAUST MANIFOLDS

### REMOVAL

**1.** Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose from the air cleaner.**

**2.** Remove the air cleaner and intake duct assembly.

**3.** Disconnect the exhaust manifold from the muffler inlet pipe.

**4.** Remove the automatic choke heat tube from the right exhaust manifold.

**5.** Remove the retaining bolts and tab washers and remove the exhaust manifold.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

**1.** Clean the mating surfaces of the exhaust manifold and cylinder head. Scrape the gasket material from the mounting flange of the exhaust manifold and muffler inlet pipe.

**2.** Apply graphite grease to the mating surface of the exhaust manifold.

**3.** Position the exhaust manifold on the cylinder head and install the retaining bolts and tab washers. Working from the center to the ends, torque the bolts to specifications. Lock the bolts by bending one tab of the washer over a flat on the bolt.

**4.** Place new gaskets on the muffler inlet pipe. Position the muffler inlet pipe to the manifold. Install and torque the retaining nuts to specifications.

**5.** Install the automatic choke heat tube on the right exhaust manifold. Install the air cleaner and intake duct assembly.

**6.** Connect the automatic choke heat chamber air inlet hose.

**7.** Start the engine and check for exhaust leaks.

## POSITIVE CRANKCASE VENTILATION SYSTEM

The positive crankcase ventilation system components are shown in Fig. 20.

### REMOVAL

**1.** Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.** Remove the air cleaner and intake duct assembly.

**2.** Using hose clamp pliers, slide both crankcase vent hose clamps towards the center of the vent hose. Disconnect the crankcase vent hose from the carburetor spacer and regulator valve.

**3.** Pull the regulator valve and fitting (elbow) out of the valve rocker arm cover mounting grommet.

### INSTALLATION

**1.** Insert the regulator valve and fitting (elbow) into the valve rocker arm cover mounting grommet.

**2.** Position the hose clamps on the vent hose. Connect the vent hose to the carburetor spacer and regulator valve. Using hose clamp pliers, slide the clamps into position.

**3.** Install the air cleaner and intake duct assembly. Connect the automatic choke heat chamber air inlet hose. Start the engine and check for leaks.

### REGULATOR VALVE DISASSEMBLY

**1.** Remove the hose fitting (elbow) from the regulator valve.

**2.** Using a snap ring retainer tool, remove the snap ring retainer from the end of the regulator valve assembly.

**3.** Remove the valve retainer washer, valve and valve spring (Fig. 21). **Carefully remove the valve spring from the regulator valve to avoid damaging the calibrated spring. Under no circumstances should the calibrated spring be altered in any manner.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

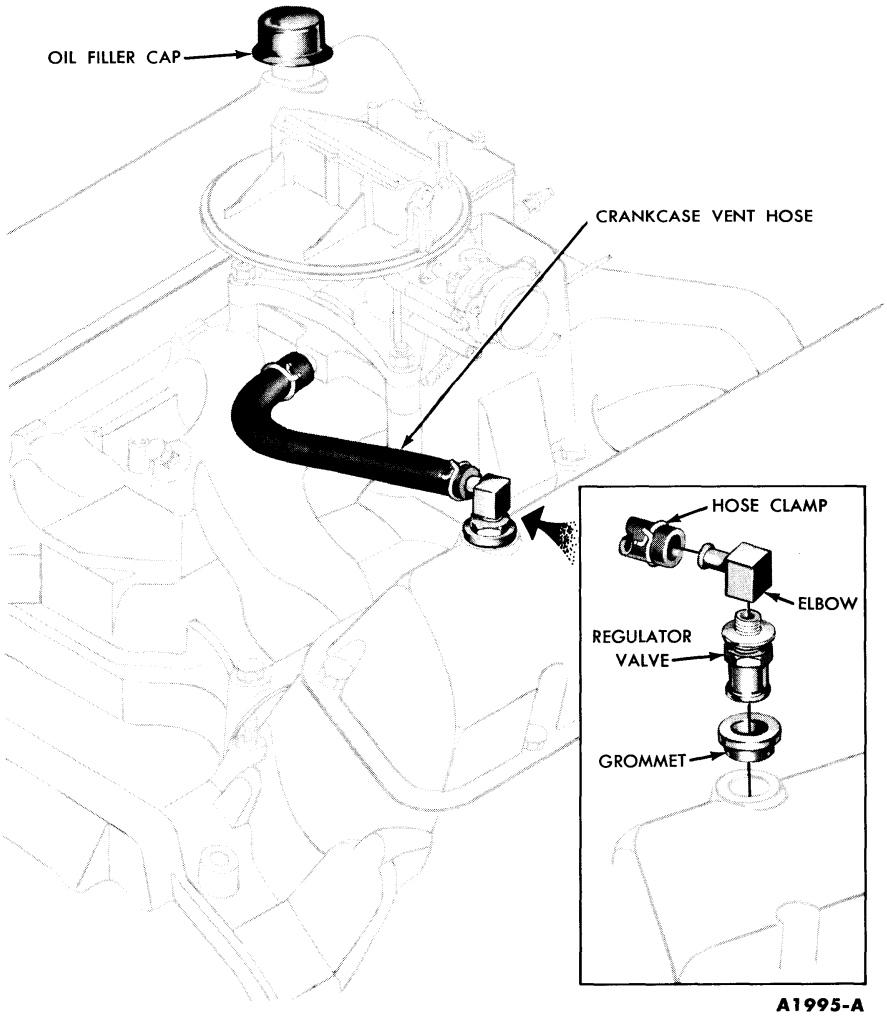



**FIG. 20—Positive Crankcase Ventilation System Components**

### TESTING

Refer to Part 8-1, Section 1 for the test procedures.

### REGULATOR VALVE ASSEMBLY

1. Install the spring and valve into the valve body. **Be sure the pointed end of the valve is toward the threaded end or hose connection of the valve.**

2. Install the valve retaining washer and snap ring retainer.

3. Install the hose fitting (elbow) on the regulator valve.

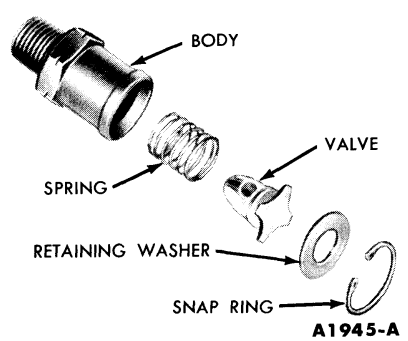



**FIG. 21—Regulator Valve Assembly**

### VALVE ROCKER ARM ASSEMBLY

The valve rocker arm assembly is shown in Fig. 22.

### REMOVAL

1. Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.**

2. Remove the air cleaner and intake duct assembly.

3. Disconnect the spark plug wires from the spark plugs by grasping the moulded cap only. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.

To remove the right valve rocker arm cover, remove the automatic choke heat tube. Remove the crankcase ventilation regulator valve from the valve rocker arm cover.

4. Remove the valve rocker arm cover(s).

5. Remove the valve rocker arm stud nut, fulcrum seat and rocker arm.

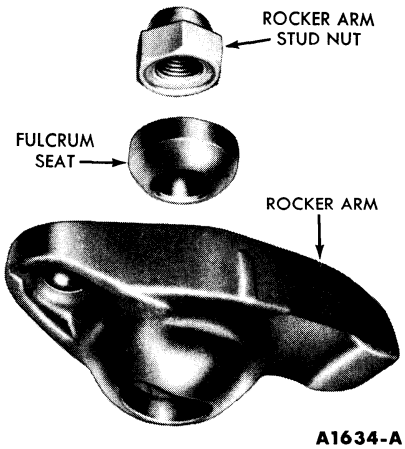



**FIG. 22—Valve Rocker Arm Assembly**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

If removal of the rocker arm stud is necessary, refer to the procedure under "Cylinder Head Repairs" in Part 8-1, Section 2.

### INSTALLATION

1. Apply Lubriplate to the top of the valve stem and at the push rod guide in the cylinder head.

2. Install the valve rocker arm, fulcrum seat and stud nut. Adjust the valve clearance following the procedure in Part 8-1, Section 2.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface. Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s). in place in the cover(s) as shown in Fig. 23.

4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. In-

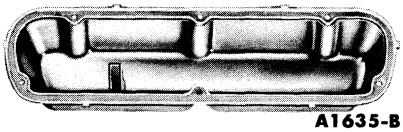

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**FIG. 23—Valve Rocker Arm Cover Gasket Installation**

stall the bolts. The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

If the right cover was removed, install the automatic choke heat tube and the crankcase ventilation regulator valve.

**5.** Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires.

**6.** Install the air cleaner and intake duct assembly.

**7.** Connect the automatic choke heat chamber air inlet hose.

## CYLINDER HEADS

### REMOVAL

**1.** Remove the intake manifold and carburetor as an assembly following the procedure under "Intake Manifold Removal."

**2.** Disconnect the battery ground cable from the cylinder head. Remove the rocker arm cover(s).

On a car with an air conditioner, isolate and remove the compressor as outlined in Group 15.

On a car with power steering, disconnect the power steering pump bracket from the left cylinder head and remove the drive belt from the pump pulley. Wire the power steering pump out of the way and in a position that will prevent the oil from draining out.

**3.** Disconnect the wires from the generator or alternator. Remove the generator or alternator mounting bracket bolts and remove the generator or alternator, shield and bracket as an assembly.

**4.** Disconnect the exhaust manifold(s) from the muffler inlet pipe(s).

**5.** Loosen the rocker arm stud nuts so that the rocker arms can be rotated to the side. Remove the push rods in sequence (Fig. 24).

**6.** Install the cylinder head holding fixtures (Fig. 25). Remove the cylinder head retaining bolts and lift the cylinder head off the block. **Do not pry between the head and the block.** Remove and discard the cylinder head gasket.

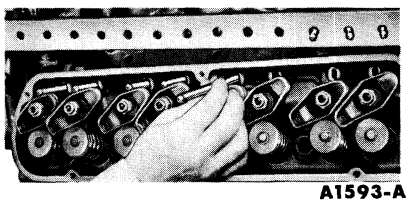
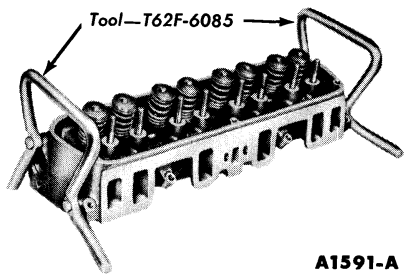

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**FIG. 24—Valve Push Rod Removal**



A1591-A

**FIG. 25—Cylinder Head Holding Fixtures**

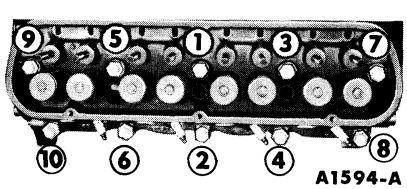
### INSTALLATION

**1.** Clean the cylinder head and cylinder block gasket surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket.

**2.** Position the new cylinder head gasket over the cylinder dowels on the block. Coat the head bolts with water-resistant sealer. Position the cylinder head to the block and install the retaining bolts. Remove the holding fixtures.

**3.** The cylinder head bolts are tightened in three progressive steps. Torque all the bolts in sequence (Fig. 26) to 50 ft-lbs., then to 60 ft-lbs. and finally to 70 ft-lbs. **After the cylinder head bolts have been torqued to specifications, the bolts should not be disturbed.**

**4.** Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Visually check the push rods for straightness or check push rod runout with a dial indicator. If runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**



A1594-A

**FIG. 26—Cylinder Head Bolt Torque Sequence**

**5.** Install the push rods in their original positions. Apply Lubriplate to the valve stem tips and the push rod guides in the cylinder head.

**6.** Install the rocker arms. Perform a valve clearance adjustment as outlined in Part 8-1, Section 2.

**7.** Position a new gasket(s) on the the muffler inlet pipe(s). Connect the exhaust manifold(s) at the muffler inlet pipe(s). Torque the nuts to specifications.

**8.** Position the generator or alternator, shield and bracket and position the drive belt over the pulley. Install the retaining bolts and adjust the drive belt tension to specifications. Connect the generator or alternator wires.

**9.** Connect the battery ground cable. Apply oil-resistant sealer to one side of new cover gaskets. Lay the cemented side of the gaskets in place in the cover(s). Install the valve rocker arm cover(s).

On a car with an air conditioner, install the compressor as outlined in Group 15.

On a car with power steering, install the drive belt and power steering pump bracket. Install the bracket retaining bolts. Adjust the drive belt to specifications.

**10.** Install the intake manifold and related parts following the procedure under "Intake Manifold Installation."

### DISASSEMBLY

**1.** Clean the carbon out of the cylinder head combustion chambers before removing the valves.

**2.** Compress the valve springs (Fig. 27). Remove the spring retainer locks and release the spring.

**3.** Remove the spring retainer, spring, stem seal and valve. Discard the valve stem seals. Identify all valve parts.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

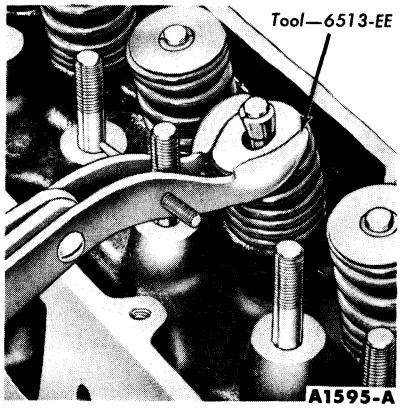



**FIG. 27—Compressing Valve Spring—On Bench**

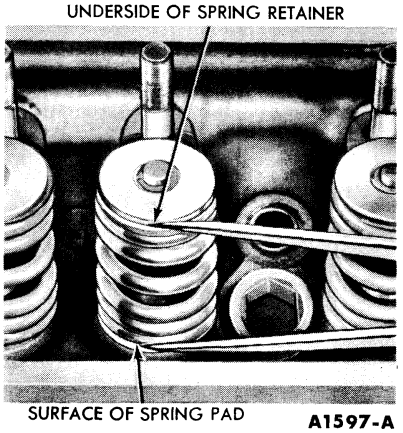



**FIG. 29—Valve Spring Assembled Height**

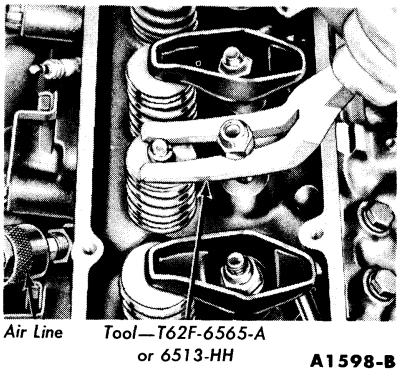



**FIG. 30—Compressing Valve Spring—In Chassis**

## REPAIRS

Cylinder head repair and rocker arm stud replacement procedures, and checks such as valve and valve seat refacing, cylinder head flatness checks, etc., are covered in Part 8-1, Section 2.

## ASSEMBLY

**1.** Install each valve (Fig. 28) in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve.

**2.** Install the valve spring over the valve, and then install the spring retainer. Compress the spring and install the retainer locks (Fig. 27).

**3.** Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 29). Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height.

**Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.**

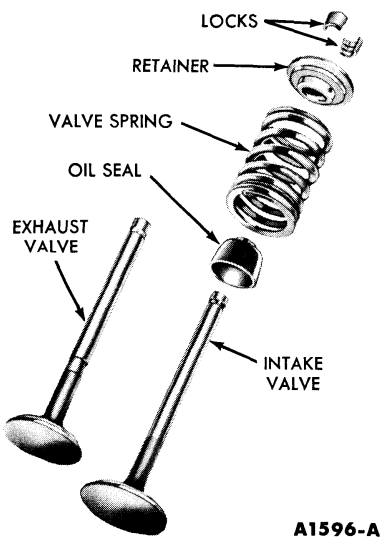



**FIG. 28—Valve Assembly**

## VALVE SPRING, RETAINER AND STEM SEAL REPLACEMENT

Broken valve springs or defective valve stem seals and retainers may be replaced without the need of removing the cylinder head, provided damage to the valve or valve seat has not occurred.

**1.** Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.**

**2.** Remove the air cleaner and intake duct assembly.

To remove the right valve rocker arm cover, remove the automatic choke heat tube. Remove the crankcase ventilation regulator valve from the valve rocker arm cover.

**3.** Remove the valve rocker arm cover and the applicable spark plug.

**4.** Crank the engine until the applicable piston is on TDC after the compression stroke. Be sure that both valves are closed. **Be sure that the piston is on TDC to prevent the crankshaft from turning when the air is applied.**

**5.** Install an air line with an adapter in the spark plug hole and turn on the air supply.

**6.** Remove the applicable valve rocker arm stud nut, fulcrum seat, valve rocker arm and push rod. Install the stud nut and position the compressor tool as shown in Fig. 30. Compress the valve spring and remove the retainer locks, spring retainer and valve spring.

**7.** Remove and discard the valve stem seal (Fig. 31).

**8.** Install a new valve stem seal (Fig. 31). Place the spring in position over the valve and install the valve spring retainer. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and stud nut.

**9.** Install the push rod. Apply Lubriplate to the tip of the valve stem and at the push rod guide in the cylinder head.

**10.** Install the valve rocker arm, fulcrum seat and stud nut. Adjust the valve clearance following the procedure in Part 8-1, Section 2.

**11.** Turn off the air and remove

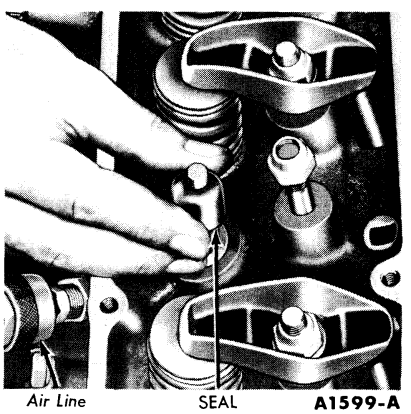



**FIG. 31—Valve Stem Seal Removal or Installation**

the air line and adapter. Install the spark plug and connect the spark plug wire.

**12.** Clean and install the rocker arm cover.

If the right cover was removed, install the automatic choke heat tube and the crankcase ventilation regulator valve.

**13.** Install the air cleaner and intake duct assembly.

**14.** Connect the automatic choke heat chamber air inlet hose.

## CYLINDER FRONT COVER AND TIMING CHAIN

### REMOVAL

**1.** Drain the cooling system and the crankcase. Disconnect the battery ground cable.

**2.** Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.** Remove the air cleaner and intake duct assembly.

**3.** Disconnect the radiator upper hose from the coolant outlet housing, and the radiator lower hose from the water pump.

**4.** Disconnect the heater hose from the water pump. Slide the water pump bypass hose clamp toward the water pump.

**5.** Loosen the generator or alternator mounting bolts at the generator or alternator. Remove the generator or alternator support bolt at the water pump.

**6.** Remove the fan, spacer, pulley and drive belt.

On a car with power steering, loosen the drive belt tension and remove the belt.

On a car with an air conditioner, remove the compressor drive belt.

**7.** Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the pulley on the crankshaft vibration damper (Fig. 32) and remove the vibration damper.

**8.** Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump retaining bolts and lay the pump to one side with the flexible fuel line still attached.

**9.** Remove the oil level dipstick. Disconnect the dipstick tube bracket from the generator or alternator mounting bracket.

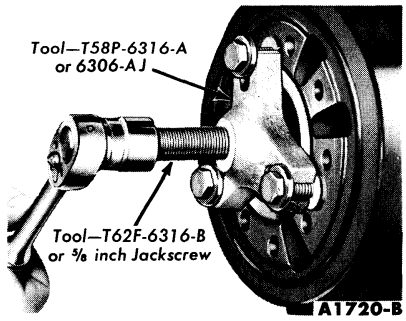



**FIG. 32—Crankshaft Vibration Damper Removal**

**10.** Remove the oil pan to cylinder front cover retaining bolts. Remove the cylinder front cover and water pump as an assembly (one screw retains the fuel line bracket).

If a new cylinder front cover is to be installed, remove the water pump and dipstick tube from the old cylinder front cover and install them on the new cover.

**11.** Discard the cylinder front cover gasket. Remove the crankshaft front oil slinger.

**12.** Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.

**13.** Establish a reference point on the block and measure from this point to the chain (Fig. 33).

**14.** Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

If the deflection exceeds ½ inch, replace the timing chain and/or sprockets.

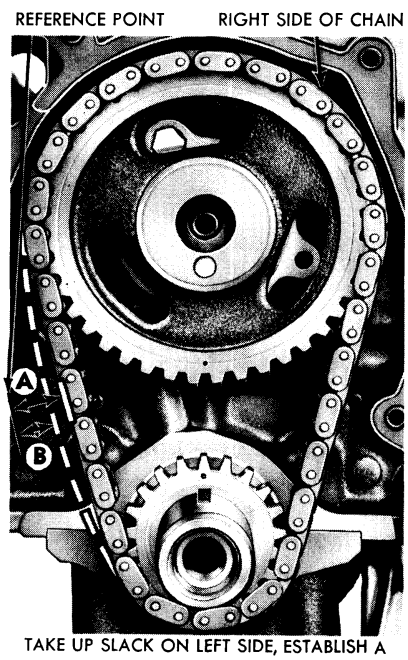
**15.** Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 34.

**16.** Remove the camshaft sprocket cap screw, washers and fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 35).

**17.** Remove the oil pan and oil pump following the procedure under "Oil Pan Removal" and "Oil Pump Removal.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.




TAKE UP SLACK ON LEFT SIDE, ESTABLISH A REFERENCE POINT. MEASURE DISTANCE **A**. TAKE UP SLACK ON RIGHT SIDE. FORCE LEFT SIDE OUT. MEASURE DISTANCE **B**. DEFLECTION IS **A** MINUS **B**. A1602-B

**FIG. 33—Timing Chain Deflection**

### FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

**1.** Drive out the old seal with a pin-punch. Clean out the recess in the cover.

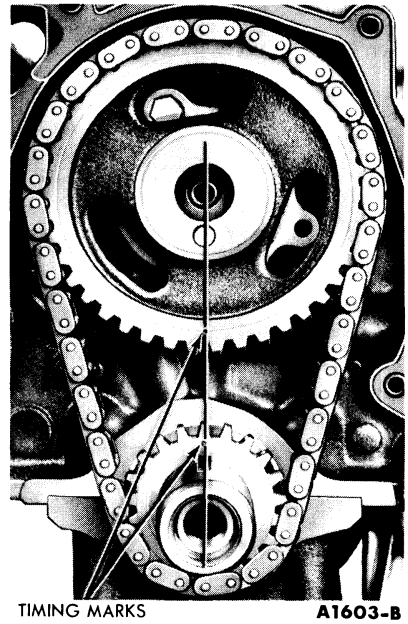



**FIG. 34—Aligning Timing Marks**

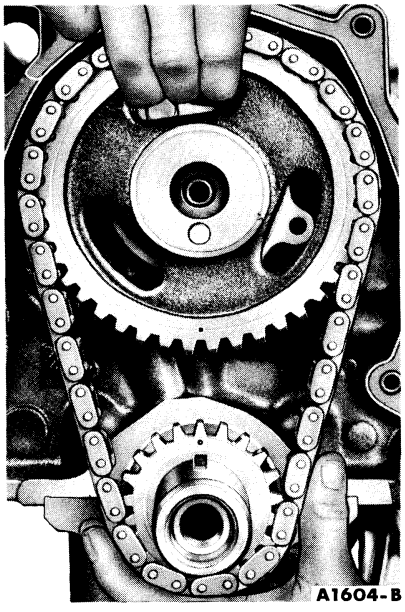



**FIG. 35—Timing Chain Removal or Installation**

2. Coat a new seal with grease, then install the seal (Fig. 36). Drive the seal in until it is fully seated in the recess. Check the seal after installation to be sure the spring is properly positioned in the seal.

INSTALLATION

1. Position the sprockets and timing chain on the camshaft (Fig. 35). Be sure the timing marks on the sprockets are positioned as shown in Fig. 34.

2. Install the fuel pump eccentric, washers and camshaft sprocket cap screw. Torque the sprocket cap screw to specifications. Install the crankshaft front oil slinger (Fig. 37).

3. Clean the cylinder front cover, oil pan and the block gasket surfaces.

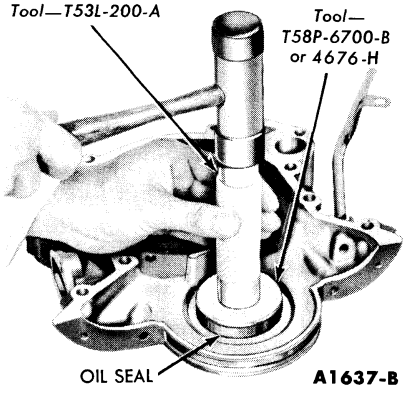



**FIG. 36—Crankshaft Front Oil Seal Replacement**

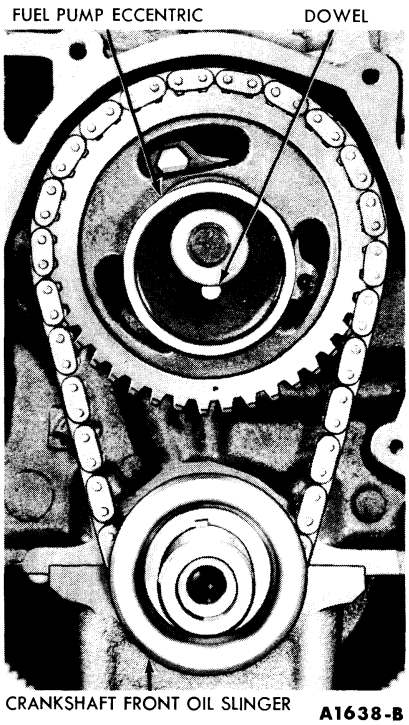



**FIG. 37—Fuel Pump Eccentric and Front Oil Slinger Installed**

4. Coat the gasket surfaces of the block and cover with sealer. Position a new gasket on the block.

5. Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 38). Coat the threads of the retaining screws with water-resistant sealer and install the screws (one screw retains the fuel line bracket). While pushing in on the pilot, torque the screws to specifications. Remove the pilot.

6. Line up the crankshaft vibration damper keyway with the key on

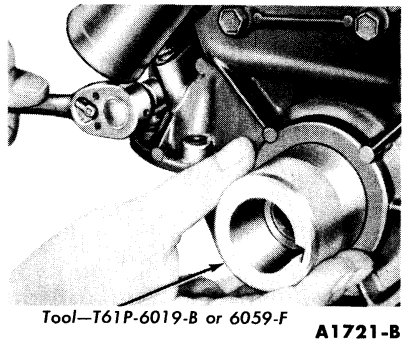



**FIG. 38—Cylinder Front Cover Alignment**

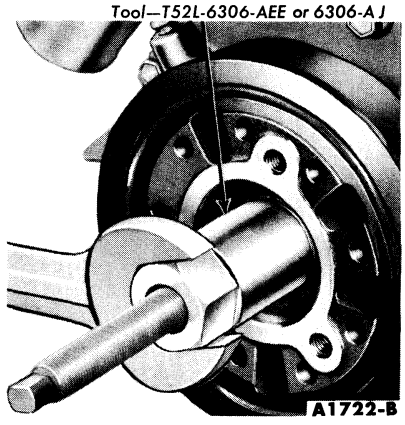



**FIG. 39—Crankshaft Vibration Damper Installation**

the crankshaft. Install the vibration damper on the crankshaft (Fig. 39). Install the cap screw and washer. Torque the screw to specifications. Install the crankshaft pulley.

7. Install the oil pump and oil pan following the procedure under "Oil Pump Installation" and "Oil Pan Installation."

8. Install the fuel pump using a new gasket. Connect the fuel pump outlet pipe.

9. Connect the dipstick tube bracket at the generator mounting bracket. Install the oil level dipstick.

On a car with power steering, install the drive belt and tighten the power steering pump bracket. Adjust the drive belt tension to specifications.

On a car with an air conditioner, install and adjust the drive belt to specifications.

10. Install the water pump pulley, drive belt, spacer and fan.

11. Install the generator or alternator support bolt at the water pump. Tighten the generator or alternator mounting bolts. Adjust the drive belt tension to specifications.

12. Connect the heater hose and the water pump bypass hose. Slide the bypass hose clamp into position.

13. Connect the radiator upper and lower hoses. Connect the battery ground cable.

14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quality of engine oil.

15. Operate the engine at fast idle and check for coolant and oil leaks. Check and adjust the ignition timing.

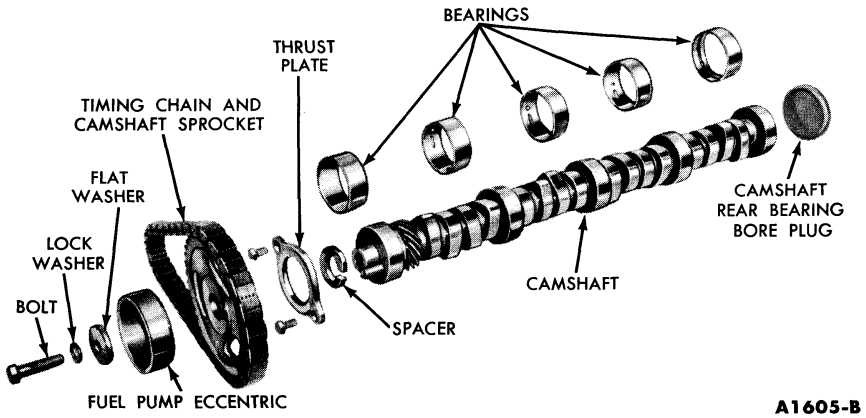



**FIG. 40—Camshaft and Related Parts**

16. Install the air cleaner and intake duct assembly.

17. Connect the automatic choke heat chamber air inlet hose.

## CAMSHAFT

The camshaft and related parts are shown in Fig. 40.

### REMOVAL

1. Remove the cylinder front cover and the timing chain following the procedure under "Cylinder Front Cover and Timing Chain Removal."

2. Disconnect the spark plug wires from the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Disconnect the coil high tension lead from the coil. Remove the distributor cap and spark plug wire assembly.

3. Disconnect the ignition coil wires from the coil and remove the coil from the intake manifold.

4. Disconnect the distributor vacuum line from the carburetor. Remove the distributor hold down bolt and clamp and remove the distributor.

5. Disconnect the carburetor fuel inlet line from the carburetor and fuel pump. Remove the fuel line. Disconnect the automatic choke heat tube from the carburetor. Remove the heater hose from the automatic choke and disconnect the heater hose from the intake manifold.

On a car with an automatic transmission, disconnect the throttle valve vacuum line from the intake manifold. Disconnect the transmission oil cooler lines from the radiator.

6. Remove the radiator.

7. Disconnect the accelerator rod from the carburetor. Remove the accelerator retracting spring. Remove the bellcrank assembly from the intake manifold and position it out of the way. (On a car with power steering and air conditioning, remove the speed-up control assembly from the bellcrank before removing the bellcrank from the intake manifold.)

8. Disconnect the water temperature sending unit wire from the sending unit and the engine ground strap at the engine.

9. Disconnect the crankcase vent hose from the carburetor spacer. Remove the intake manifold and carburetor as an assembly. Remove the intake manifold gaskets and seals.

10. Remove the crankcase ventilation regulator valve from the valve rocker arm cover. Remove the valve rocker arm covers. Loosen the valve rocker arm stud nuts and rotate the rocker arms to the side.

11. Remove the valve push rods in sequence so that they can be installed in their original positions.

12. Using a magnet, remove the valve lifters and place them in a rack so that they can be installed in their original bores (Fig. 41).

If the valve lifters are stuck in their bores by excessive varnish, etc. it may be necessary to use a plier-type tool (T52T-6500-DJD or 6500-D) to remove the lifters. Rotate the lifter back and forth to loosen it from the gum or varnish that may have formed at the lifter.

13. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

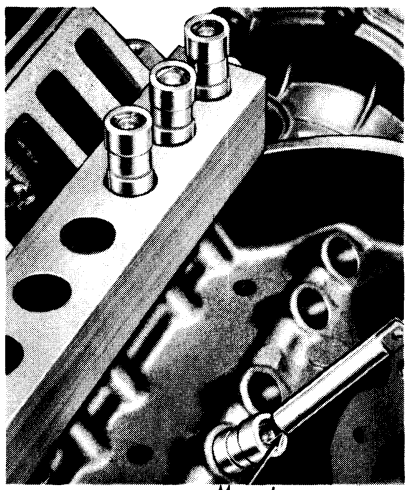



**FIG. 41—Valve Lifter Removal**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

### INSTALLATION

1. Oil the camshaft and apply Lubriplate to the lobes. Carefully slide the camshaft through the bearings. Install the camshaft thrust plate.

2. Install the valve lifters in the bores from which they were removed.

3. Install the push rods in their original position. Apply Lubriplate to the valve stem tips and the push rod guides in the cylinder head. Position the rocker arms over the push rods.

4. Install the intake manifold and related parts by following steps 1 thru 6 under "Intake Manifold Installation."

5. Connect the water temperature sending unit and the engine ground strap.

6. Install the bellcrank assembly and accelerator retracting spring. Connect the accelerator rod.

On a car with power steering and air conditioning, install the speed-up control assembly on the bellcrank assembly.

7. Install the radiator.

On a car with an automatic transmission, connect the transmission oil cooler lines and throttle valve vacuum line.

**8.** Install the heater hose against the automatic choke housing and connect the heater hose at the intake manifold. Position and connect the fuel line.

**9.** Replace the crankshaft front oil seal. Install the timing chain, cylinder front cover and related parts following steps 1 thru 13 under "Cylinder Front Cover and Timing Chain Installation."

**10.** With No. 1 piston on TDC at the end of the compression stroke, position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**11.** Perform a valve clearance adjustment as outlined in Part 8-1, Section 2.

**12.** Clean the valve rocker arm covers and the cylinder head gasket surface. Apply oil-resistance sealer to one side of new cover gaskets. Lay the cemented side of the gaskets in place in the covers.

**13.** Position the covers on the cylinder heads. Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

**14.** Clean the crankcase ventilation regulator valve, fitting and vent hose (Part 8-1, Section 2). Insert the regulator and fitting into the valve rocker arm cover mounting grommet. Position and install the crankcase vent hose.

**15.** Install the automatic choke heat tube. Install the ignition coil and connect the wires.

**16.** Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the plugs. Connect the high tension lead at the coil.

**17.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

**18.** Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line at the carburetor.

**19.** Operate the engine at fast idle and check all hose connections and gaskets for leaks. Operate the engine until engine temperatures have stabilized and adjust the engine idle speed and idle fuel mixture.

On a car with power steering and air conditioning, adjust the speed-up control assembly as outlined in Group 3.

**20.** Adjust the transmission throttle linkage. Install the air cleaner and intake duct assembly.

**21.** Connect the automatic choke heat chamber air inlet hose.

## CAMSHAFT REAR BEARING BORE PLUG REPLACEMENT

**1.** On a car with a manual-shift transmission, remove the transmission, clutch pressure plate and disc following the procedures in Group 5.

On a car with an automatic transmission, remove the transmission and converter housing following the procedure in Group 7.

**2.** Remove the flywheel retaining bolts and remove the flywheel.

**3.** Drill a ½-inch hole in the camshaft rear bearing bore plug and remove the plug, using the tools shown in Fig. 62.

**4.** Clean out the plug bore recess thoroughly and coat the flange of a new plug with water-resistant sealer. Install the new plug with the flange facing out. Drive the plug in until it is slightly below the chamfer in the bore (Fig. 65).

**5.** Coat the flywheel retaining bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the retaining bolts in sequence across from each other to specifications.

On a car with a manual-shift transmission, install the clutch pressure plate, disc and the transmission following the procedures in Group 5.

On a car with an automatic transmission, install the transmission and converter housing following the procedure in Group 7.

## HYDRAULIC VALVE LIFTER REPLACEMENT

**1.** Remove the intake manifold and related parts by following steps 1 thru 10 under "Intake Manifold Removal."

**2.** Remove the crankcase ventilation regulator valve from the valve rocker arm cover. Remove the valve rocker arm covers. Loosen the valve rocker arm stud nuts and rotate the rocker arms to the side.

**3.** Remove the valve push rods in sequence so that they can be installed in their original positions.

**4.** Using a magnet, remove the valve lifters and place them in a rack so that they can be installed in their original bores (Fig. 41).

If the valve lifters are stuck in their bores by excessive varnish, etc., it may be necessary to use a plier-type tool (T52T-6500-DJD or 6500-D) to remove the lifters. Rotate the lifter back and forth to loosen it from the gum or varnish that may have formed at the lifter.

**The internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.**

**5.** Clean and install the valve lifters in the bores from which they were removed. If a new lifter(s) is being installed, test the new lifter(s) for a free fit in the bore in which it is to be installed.

**6.** Install the push rods in their original position. Apply Lubriplate to the valve stem tips and the push rod guides in the cylinder head.

**7.** Position the rocker arms over the push rods. Perform a valve clearance adjustment as outlined in Part 8-1, Section 2.

**8.** Install the valve rocker arm covers. Install the crankcase ventilation regulator valve in the valve rocker arm cover.

**9.** Install the intake manifold and related parts by following steps 2 thru 20 under "Intake Manifold Installation."

## HYDRAULIC VALVE LIFTER DISASSEMBLY

Each valve lifter is a matched assembly. If the parts of one lifter are intermixed with those of another, improper valve operation may result. Disassemble and assemble each lifter separately. Keep the lifter assemblies in proper sequence so that they can be installed in their original bores.

**1.** Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.

**2.** Remove the push rod cup, metering valve (disc), plunger and spring.

**3.** Invert the plunger assembly and remove the check valve retainer by carefully prying up on it with a screw driver. Remove the check valve (disc or ball check) and spring.

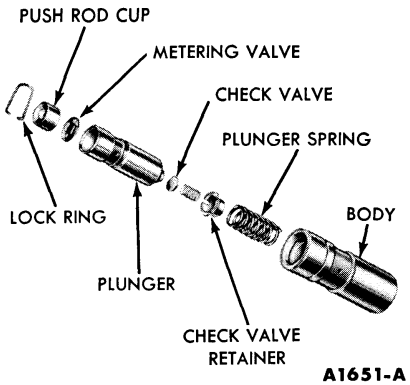



**FIG. 42—Typical Hydraulic Valve Lifter Assembly**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### HYDRAULIC VALVE LIFTER ASSEMBLY

A typical hydraulic valve lifter assembly is shown in Fig. 42.

1. Place the plunger upside down on a clean work bench.

2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).

3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.

4. Place the plunger spring, and then the plunger (open end up) into the lifter body.

5. Position the metering valve (disc) in the plunger, and then place the push rod seat in the plunger.

6. Depress the plunger, and position the closed end of the lock ring in the groove of the lifter body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.

### TESTING

Refer to Part 8-1, Section 1 for the testing procedures.

### MAIN AND CONNECTING ROD BEARING REPLACEMENT

The main and connecting rod bearing inserts are selective fit. **Do not file or lap bearing caps or use bearing shims to obtain the proper bearing clearance.**

Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to the Parts Catalog for the available sizes. **Red marked bearings increase the clearance; blue marked bearings decrease the clearance.** Undersize bearings, which are not selective fit, are available for use on journals that have been refinished.

### MAIN BEARING

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.

2. Remove the oil pump inlet tube assembly and the oil pump.

3. **Replace one bearing at a time, leaving the other bearings securely fastened.** Remove the main bearing cap to which new bearings are to be installed.

4. Insert the upper bearing removal tool (tool 6331) in the oil hole in the crankshaft.

5. Rotate the crankshaft in the direction of the engine rotation to force the bearing out of the block.

6. Clean the crankshaft journal. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

7. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that tool 6331 can be inserted in the oil hole in the crankshaft. With tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

8. Replace the cap bearing.

9. Support the crankshaft so that its weight will not compress the Plastigage and provide an erroneous reading. Position a jack so that it will bear against the counterweight adjoining the bearing which is being checked.

10. Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about ¼ inch off center (Fig. 43).

11. Install the cap and torque the bolts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

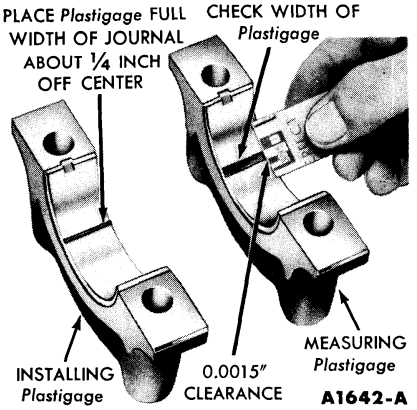



**FIG. 43—Installing and Measuring Plastigage—Engine Installed**

12. Remove the cap. Using the Plastigage scale, check the width of the Plastigage. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.

13. If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal and install undersize bearings.

14. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings and install the bearing cap. Torque the cap bolts to specifications.

15. Repeat the procedure for the remaining bearings that require replacement.

16. If the rear main bearing is to be replaced, remove the rear main bearing cap. Remove and discard the rear oil seal.

17. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap. Preform the new seal by hand to the approximate radius of the cap.

18. Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, and then press both ends of the seal into the groove, working from the ends to the center.

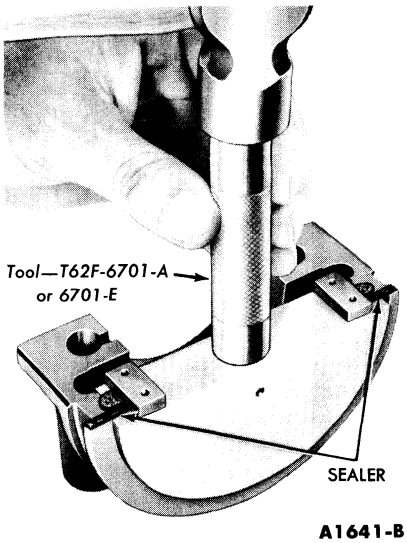



**FIG. 44—Seal to Rear Bearing Cap Installation**

**19.** Position the seal forming tool as shown in Fig. 44 and complete the seal installation. After installation, cut the ends of the seal flush.

**20.** Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface (Fig. 44). **Do not apply sealer to the area forward of the oil slinger groove.** Install the rear main bearing cap and torque the cap bolts to specifications.

**21.** If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 60). Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 60). This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications (Fig. 60).

**22.** Clean the oil pump inlet tube screen. Install the oil pump and the inlet tube assembly.

**23.** Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.

**24.** Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

### CONNECTING ROD BEARING

**1.** Follow steps 1 and 2 under "Main Bearing Replacement."

**2.** Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

**3.** Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure.

**4.** Clean the crankshaft journal. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

**5.** Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

**6.** Pull the connecting rod assembly down firmly on the crankshaft journal.

**7.** Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about ¼ inch off-center.

**8.** Install the cap and torque the connecting rod nuts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

**9.** Refer to Steps 12 and 13 under "Main Bearing Replacement."

**10.** After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Torque the nuts to specifications.

**11.** Repeat the procedure for the remaining connecting rods that require new bearings.

**12.** Follow steps 22 thru 24 under "Main Bearing Replacement."

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## PISTONS AND CONNECTING RODS

### REMOVAL

**1.** Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this section.

**2.** Remove any ridge and/or deposits from the upper end of the cylinder bores as follows:

Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

**3.** Make sure all connecting rod caps are marked so that they can be installed in their original positions.

**4.** Turn the crankshaft until the connecting rod being removed is down.

**5.** Remove the connecting rod cap.

**6.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**

**7.** Remove the bearing inserts from the connecting rod and cap.

**8.** Install the cap on the connecting rod from which it was removed.

### INSTALLATION

**1.** If new piston rings are to be installed, remove the cylinder wall glaze. Follow the instructions of the tool manufacturer.

**2.** Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**

**3.** Make sure the ring gaps are properly spaced around the circumference of the piston.

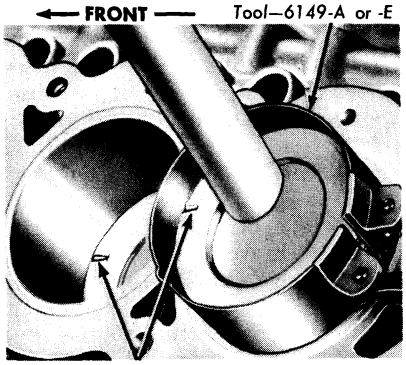



**FIG. 45–Piston Installation**

**4.** Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 45). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation notch in the piston head toward the front of the engine.**

**5.** Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement."

**6.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

**7.** Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.

**8.** Install the connecting rod cap. Torque the nuts to specifications.

**9.** After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 46).

**10.** Disassemble, clean, and assemble the oil pump. Clean the oil pump inlet tube screen, and the oil pan and block gasket surfaces.

**11.** Install the oil pump and the oil pan.

**12.** Install the cylinder heads following steps 1 thru 9 under "Cylinder Head Installation."

**13.** Install the intake manifold following steps 2 thru 15 under "Intake Manifold Installation."

**14.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

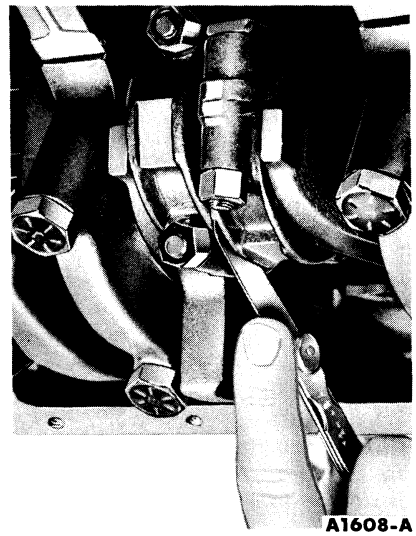



**FIG. 46–Connecting Rod Side Clearance**

**15.** Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line at the carburetor.

**16.** Operate the engine at fast idle and check for oil and coolant leaks. Operate the engine until engine temperatures have stabilized and adjust the engine idle speed and idle fuel mixture.

On a car with power steering and air conditioning, adjust the speed-up control assembly as outlined in Group 3.

**17.** Adjust the transmission throttle linkage. Install the air cleaner and intake duct assembly.

**18.** Connect the automatic choke heat chamber air inlet hose.

### DISASSEMBLY

**1.** Remove the bearing inserts from the connecting rod and cap.

**2.** Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed.

**3.** Remove the piston pin from the piston and connecting rod (Fig. 47). Remove the piston rings.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

### ASSEMBLY

The piston, connecting rod and related parts are shown in Fig. 48. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications. Refer to Part 8-5.

**1.** Apply a light coat of engine oil to all parts. **Assemble the piston to the connecting rod with the oil squirt hole in the connecting rod and the indentation notch in the piston positioned as shown in Fig. 49.**

**2.** Start the piston pin in the piston and connecting rod. Draw the piston pin through the piston and connecting rod until the end of the pin seats in Detail 2 (Fig. 50).

**3.** Follow the instructions contained on the piston ring package and install the piston rings.

**4.** Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 8-1, Section 2). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**

**5.** Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

## FLYWHEEL

### REMOVAL

**1.** On a car with a manual-shift transmission, remove the transmission, clutch pressure plate and disc following the procedures in Group 5.

On a car with automatic transmission, remove the transmission and converter housing following the procedure in Group 7.

**2.** Remove the flywheel retaining bolts and remove the flywheel.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures for manual-shift transmissions.

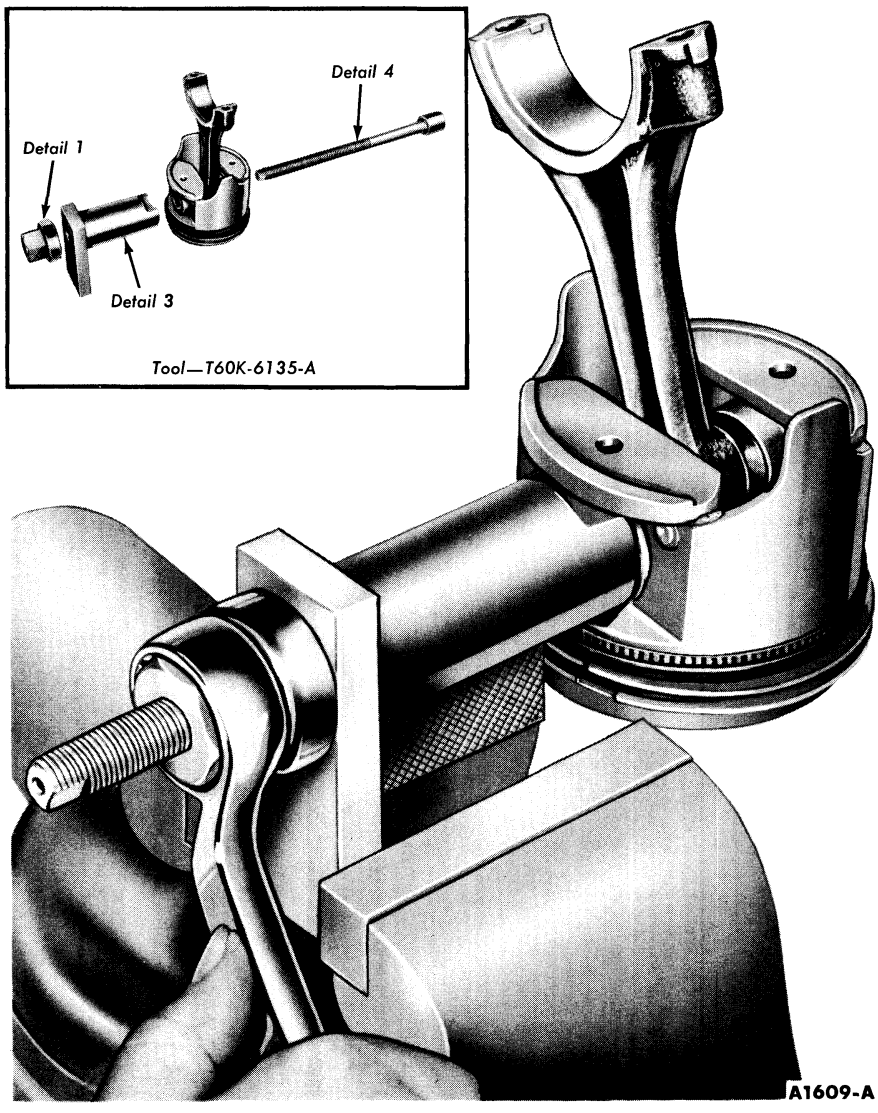



**FIG. 47—Piston Pin Removal**

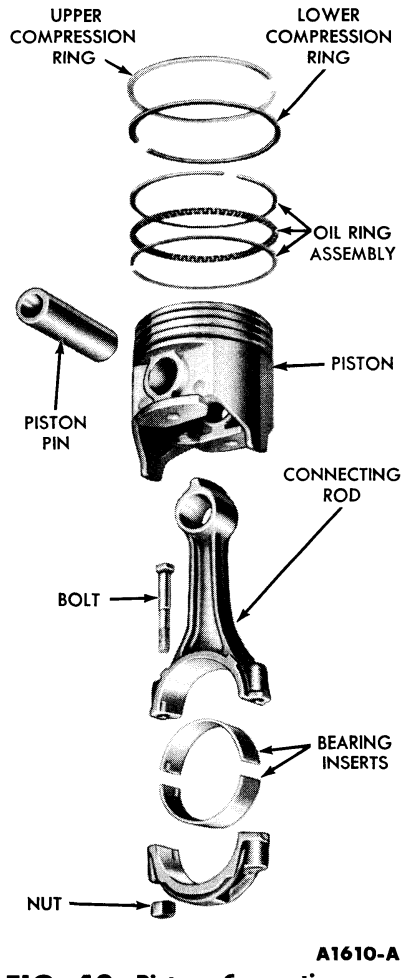



**FIG. 48—Piston, Connecting Rod and Related Parts**

### REPAIRS

To check flywheel face runout or replace flywheel ring gear for manual-shift transmissions, refer to Part 8-1, Section 2.

### INSTALLATION

**1.** Coat the threads of the flywheel retaining bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts in sequence across from each other to specifications.

**2.** On a car with a manual-shift transmission, install the clutch pressure plate, disc and the transmission following the procedures in Group 5.

On a car with an automatic transmission, install the transmission and converter housing following the procedure in Group 7.

### CLUTCH PILOT BUSHING

### REPLACEMENT

**1.** Remove the transmission, clutch pressure plate and disc, following the procedures in Group 5.

**2.** Remove the pilot bushing as shown in Fig. 66.

**3.** Coat the pilot bushing bore in the crankshaft with a small quantity of wheel bearing lubricant. **Avoid using too much lubricant as it may be thrown onto the clutch disc when the clutch revolves.**

**4.** Install the pilot service bearing as shown in Fig. 67.

**5.** Install the clutch pressure plate, disc and the transmission, following the procedures in Group 5.

### OIL FILTER REPLACEMENT

### DISPOSABLE-TYPE OIL FILTER

The Rotunda oil filter assembly is shown in Fig. 51.

**1.** Place a drip pan under the filter. Unscrew the filter from the adapter fitting and clean the adapter recess.

**2.** Coat the gasket on a new Rotunda filter with oil. Place the new

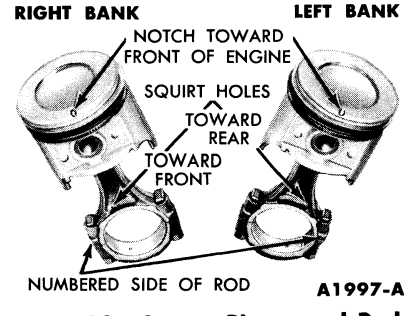



**FIG. 49—Correct Piston and Rod Positions**

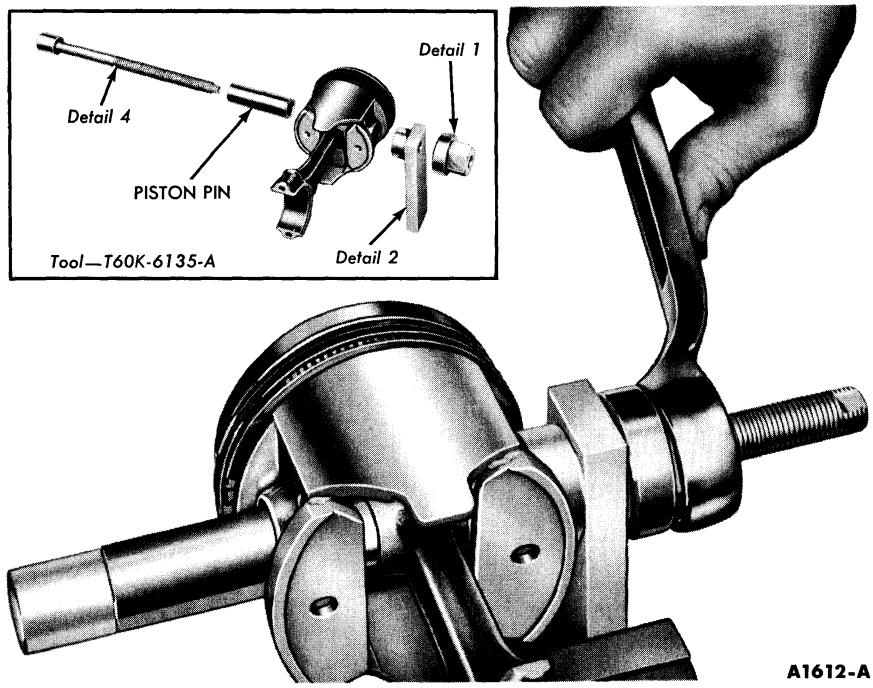



**FIG. 50—Piston Pin Installation**

Rotunda filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, and then advance it ½ turn.

**3.** Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

### REPLACEABLE ELEMENT-TYPE OIL FILTER

The oil filter assembly is shown in Fig. 52.

**1.** Place a drip pan under the filter. Loosen the filter center bolt, and then remove the filter assembly and gasket.

**2.** Remove the filter element, neoprene gasket, spring and seat. Remove the center bolt from the filter cover and the fiber gasket from the bolt. Discard the filter element and all gaskets.

**3.** Wash all parts in solvent.

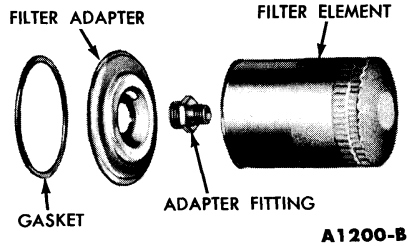



**FIG. 51—Disposable-Type Oil Filter Assembly**

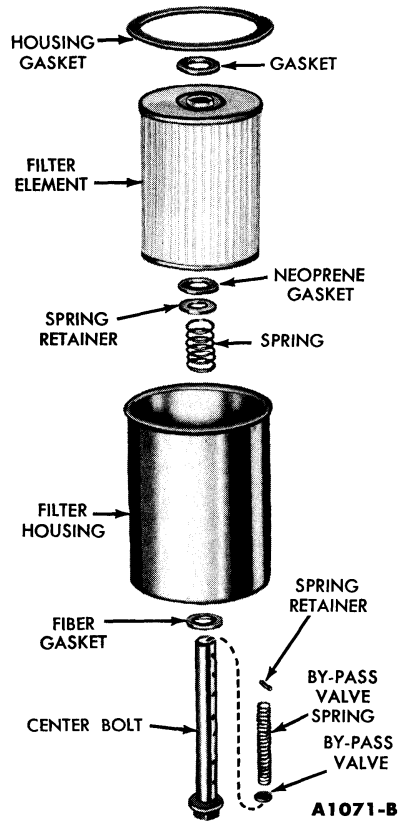



**FIG. 52—Replaceable Element-Type Oil Filter Assembly**

Make sure all the openings in the center bolt are clean.

**4.** Install a new Rotunda filter element in the filter cover following the instructions furnished with the new element.

**5.** Clean the oil filter cover mounting surface on the adapter. Position a new gasket in the adapter recess.

**6.** Place the filter assembly in position, and thread the center bolt into the adapter finger-tight. Rotate the filter slightly, in each direction, to make sure the gasket is seated evenly.

**7.** Torque the center bolts to 20-25 ft-lbs. **Do not over-tighten the center bolt.**

**8.** Add oil to the crankcase if necessary. Operate the engine at fast idle, and check for leaks.

**9.** If oil leaks are evident, perform the necessary repair to correct the leakage.

## OIL PAN

### REMOVAL

**1.** Drain the crankcase. Remove the oil level dipstick.

**2.** Disconnect the starter cable from the starter. Remove the starter and dust seal.

**3.** Remove the oil pan retaining bolts and crank the engine as required to obtain clearance and remove the oil pan.

**4.** Remove the oil pump inlet tube and screen assembly.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

**1.** Clean and install the oil pump inlet tube and screen assembly.

**2.** Clean the gasket surfaces of the block and oil pan. The oil pan has a two-piece gasket. Coat the block surface and the oil pan gasket surface with sealer. Position the oil pan gaskets on the cylinder block (Fig. 53).

**3.** Position the oil pan front seal on the cylinder front cover (Fig. 53). **Be sure the tabs on the seal are over the oil pan gasket.**

**4.** Position the oil pan rear seal on the rear main bearing cap (Fig. 53). **Be sure the tabs on the seal are over the oil pan gasket.**

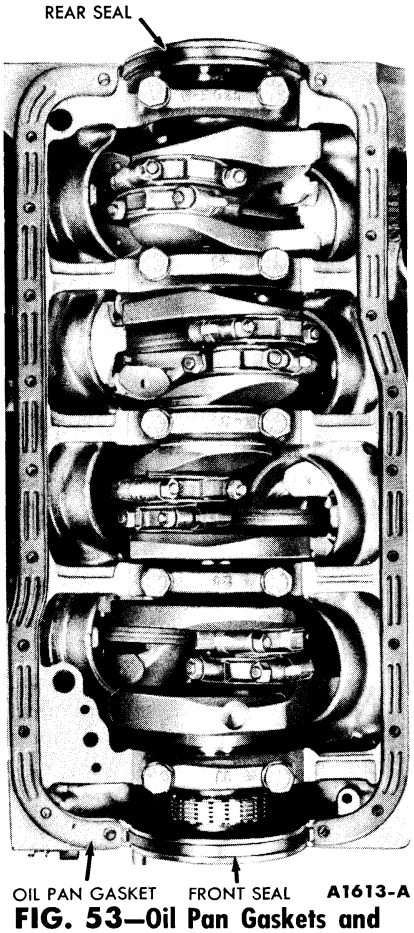



**FIG. 53—Oil Pan Gaskets and Seals Installed**

5. Hold the oil pan in place against the block and install a bolt, finger-tight, on each side of the oil pan. Install the remaining bolts. Torque the bolts from the center outward in each direction to specifications.

6. Install the starter and dust seal. Connect the starter cable.

7. Install the oil level dipstick. Fill the crankcase with the proper grade and quantity of engine oil. Start the engine and check for oil leaks.

## OIL PUMP

### REMOVAL

1. Remove the oil pan and related parts as outlined under "Oil Pan Removal."

2. Remove the oil pump inlet tube and screen assembly.

3. Remove the oil pump retaining bolts and remove the oil pump, gasket and intermediate drive shaft.

### INSTALLATION

1. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

2. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.

3. Position a new gasket on the pump housing. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.** Torque the oil pump retaining screws to specifications.

4. Clean and install the oil pump inlet tube and screen assembly (Fig. 54).

5. Install the oil pan and related parts as outlined under "Oil Pan Installation."

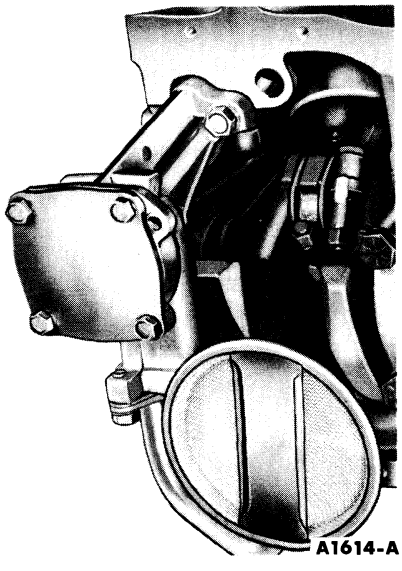



**FIG. 54—Oil Pump and Inlet Tube Installed**

### DISASSEMBLY

1. Remove the oil inlet tube from the oil pump and remove the gasket.

2. Remove the cover retaining screws, then remove the cover. Remove the inner rotor and shaft assembly, then remove the outer race.

3. Insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out, of the chamber. Remove the spring and plunger.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### ASSEMBLY

The oil pump assembly is shown in Fig. 55.

1. Oil all parts thoroughly.

2. Install the oil pressure relief valve plunger, spring and a new cap.

3. Install the outer race, and the inner rotor and shaft assembly. **The race rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.** Install the cover and torque the cover retaining screws to specifications.

4. Position a new gasket and the oil inlet tube on the oil pump and install the retaining bolts.

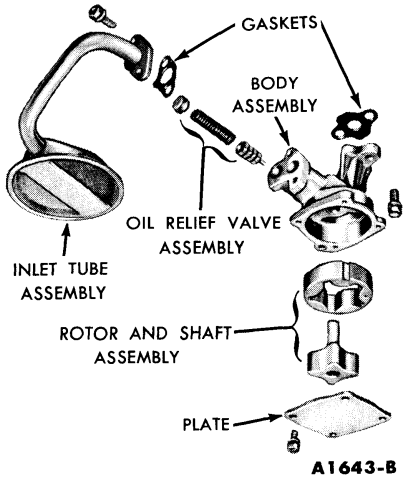



**FIG. 55—Oil Pump Assembly**

## 3 ENGINE REMOVAL AND INSTALLATION

The engine removal and installation procedures are for the engine only without the transmission attached.

### REMOVAL

1. Drain the cooling system and the crankcase. Remove the oil filter.

2. Remove the hood. Disconnect the battery ground cable from the cylinder head.

3. Disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover. **Do not remove the air inlet hose at the air cleaner.** Remove the air cleaner and intake duct assembly.

4. Disconnect the radiator upper hose from the coolant outlet housing and the radiator lower hose at the water pump.

On a car with an automatic transmission, disconnect the transmission oil cooler lines from the radiator.

5. Remove the radiator. Remove the fan, spacer, belt and pulley.

6. Disconnect the wires from the generator or alternator. Loosen the generator or alternator adjusting bolts to allow the generator or alternator to swing down and out of the way.

7. Disconnect the oil pressure sending unit wire from the sending unit, and the flexible fuel line at the fuel tank line. Plug the fuel tank line.

8. Disconnect the accelerator rod from the bellcrank.

On a car with an automatic transmission disconnect the throttle valve vacuum line from the intake manifold. Disconnect the manual shift rod from the bellcrank and remove the retracting spring. Disconnect the transmission filler tube bracket from the cylinder block.

On a car with an air conditioner, isolate and remove the compressor as outlined in Group 15.

On a car with power steering and air conditioning, remove the speed-up control assembly from the bellcrank assembly.

On a car with power steering, disconnect the power steering pump bracket from the cylinder head. Remove the drive belt. Wire the power steering pump out of the way and in a position that will prevent the oil from draining out. Disconnect the brake vacuum line from the intake manifold.

9. Remove the heater hose from the automatic choke housing. Disconnect the heater hoses from the water pump and intake manifold. Disconnect the water temperature sending unit wire from the sending unit.

10. Remove the flywheel or converter housing to engine upper bolts.

11. Disconnect the primary wire from the ignition coil and position the wire out of the way. Disconnect the ground strap from the block.

12. Raise the front of the car. Disconnect the starter cable from the starter. Remove the starter and dust seal.

13. Disconnect the muffler inlet pipes from the exhaust manifolds. Disconnect the engine support insulators from the brackets on the frame underbody.

On a car with a manual-shift transmission, remove the remaining flywheel housing to engine bolts. Disconnect the clutch pedal retracting spring. Remove the clutch equalizer bar bracket retaining bolts and remove the clutch release rod at the release lever.

On a car with an automatic transmission, remove the converter housing inspection cover. Disconnect the flywheel from the converter. Secure the converter assembly in the housing. Remove the remaining converter housing to engine bolts.

14. Lower the car, and then support the transmission. Install the engine left lifting bracket on the front of the left cylinder head, and install the engine right lifting bracket at the rear of the right cylinder head. Then attach the engine lifting sling (Fig. 56).

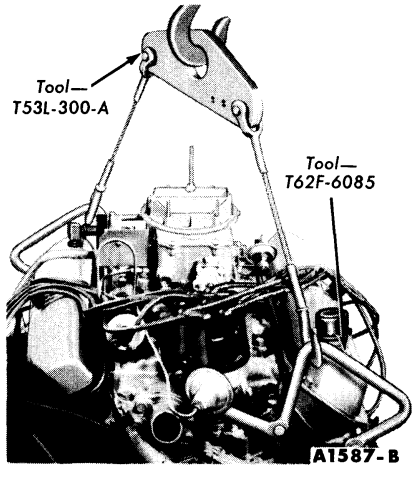



**FIG. 56—Engine Lifting Brackets and Sling**

15. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment so that the rear cover plate is not bent or other components damaged. Install the engine on a work stand.

### INSTALLATION

1. Position new gaskets on the muffler inlet pipes.

2. Attach the engine lifting brackets and sling (Fig. 40). Remove the engine from the work stand.

3. Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and the dowels in the block are through the rear cover plate and engage the holes in the flywheel housing.

On a car with an automatic transmission, start the converter pilot into the crankshaft.

On a car with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

4. Install the flywheel or converter housing upper bolts.

5. Install the engine support insulator to bracket retaining nuts. Disconnect the engine lifting sling and remove the lifting brackets.

6. Raise the front of the car. Connect both exhaust manifolds to the muffler inlet pipes. Torque the nuts to specifications.

7. Position the dust seal and install the starter.

On a car with a manual-shift transmission, install the remaining flywheel housing to engine bolts. Connect the clutch release rod. Position the clutch equalizer bar and bracket and install the retaining bolts. Install the clutch pedal retracting spring.

On a car with an automatic transmission, remove the retainer securing the converter in the housing. Attach the converter to the flywheel. Install the converter housing inspection cover. Install the remaining converter housing retaining bolts.

**8.** Remove the support from the transmission and lower the car.

**9.** Connect the engine ground strap and coil primary wire.

**10.** Connect the water temperature sending unit wire. Install the heater hose on the automatic choke housing and connect the hose to the intake manifold.

**11.** Connect the accelerator rod to the bellcrank.

On a car with an automatic transmission, connect the transmission filler tube bracket. Connect the manual shift rod and install the retracting spring. Connect the throttle valve vacuum line.

On a car with an air conditioner, install the compressor as outlined in Group 15.

On a car with power steering and air conditioning, install the speed-up control assembly on the bellcrank assembly.

On a car with power steering, install the drive belt and power steering pump bracket. Install the bracket retaining bolts. Adjust the drive belt tension to specifications. Connect the brake vacuum line.

**12.** Remove the plug from the fuel tank line and the oil pressure sending unit wire.

**13.** Install the pulley, belt, spacer and fan. Adjust the belt tension to specifications.

**14.** Tighten the generator or alternator adjusting bolts. Connect the generator or alternator wires and the battery ground cable.

**15.** Install the radiator. Connect the radiator upper and lower hoses.

On a car with an automatic transmission, connect the transmission oil cooler lines.

**16.** Install the oil filter. Fill and bleed the cooling system. Connect the heater hose at the water pump. Fill the crankcase with the proper grade and quantity of oil.

**17.** Adjust the transmission throttle linkage.

On a car with power steering and air conditioning, adjust the speed-up control assembly as outlined in Group 3.

**18.** Operate the engine at fast idle and check all gaskets and hose connections for leaks.

**19.** Install the air cleaner and intake duct assembly. Connect the automatic choke heat chamber air inlet hose.

**20.** Install and adjust the hood.

## 4 MAJOR REPAIR OPERATIONS

To perform the operations in this section, it will be necessary to remove the engine from the car and install it on a work stand.

### CRANKSHAFT

The crankshaft and related parts are shown in Fig. 57.

### REMOVAL

**1.** Disconnect the spark plug wires from the plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Remove the distributor cap and spark plug wire assembly. Remove the spark plugs to allow easy rotation of the crankshaft.

**2.** Remove the fuel pump and oil filter. Slide the water pump bypass hose clamp toward the water pump. Remove the generator or alternator, shield and mounting bracket.

**3.** Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 39) and remove the damper.

**4.** Remove the cylinder front cover and water pump as an assembly.

**5.** Remove the crankshaft front oil slinger. Check the timing chain deflection, then remove the timing chain and sprockets by following steps 12 thru 16 under "Cylinder Front Cover and Timing Chain Removal."

**6.** Invert the engine on the work stand. Remove the clutch pressure plate and disc (manual-shift transmission). Remove the flywheel. Remove the oil pan and gasket. Remove the oil pump.

**7. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.

**8.** Remove the main bearing caps.

**9.** Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

To refinish journals, dress minor imperfections, etc., refer to Part 8-1, Section 2.

### INSTALLATION

**1.** Remove the rear journal oil seal from the block and rear main bearing cap.

**2.** Remove the main bearing inserts from the block and bearing caps.

**3.** Remove the connecting rod bearing inserts from the connecting rods and caps.

**4.** If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.

**5.** Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.

**6.** Install the lower main bearing inserts in the bearing caps.

**7.** Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap. Preform the new seal by hand to the approximate radius of the cap.

**8.** Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb

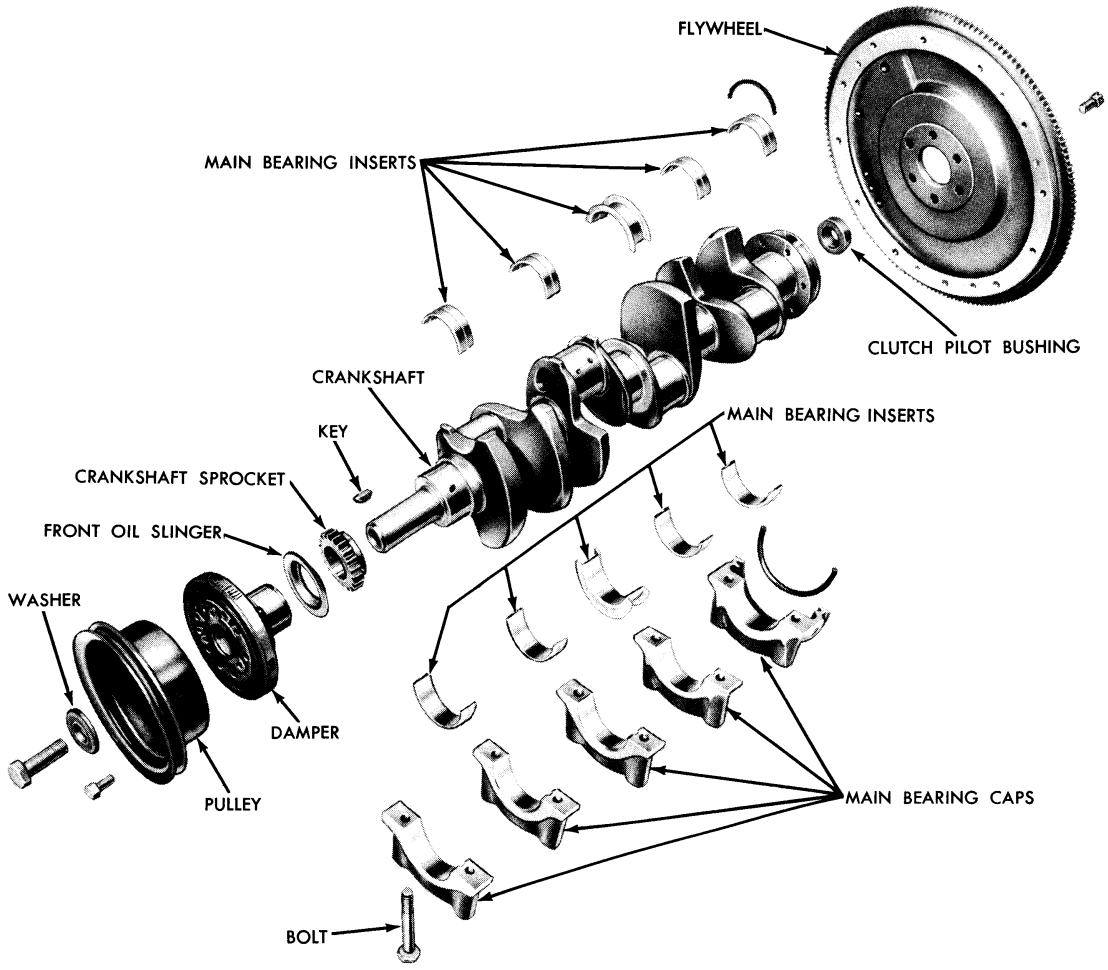



**FIG. 57—Crankshaft and Related Parts**

at the center of the seal, and then press both ends of the seal into the groove, working from the ends to the center.

**9.** Position the seal forming tool as shown in Fig. 58 and complete the seal installation. After installation, cut the ends of the seal flush.

**10.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**11.** Check the clearance of each main bearing as follows:

Place a piece of Plastigage on the crankshaft journal the full width of the journal and about ¼ inch off-center (Fig. 59). Follow steps 11 thru 15 under "Main Bearing Replacement."

**12.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install a new seal in the rear main bearing cap and install the rear main bearing cap by following steps 17 thru 20 under "Main Bearing Replacement." Install all the bearing caps, except

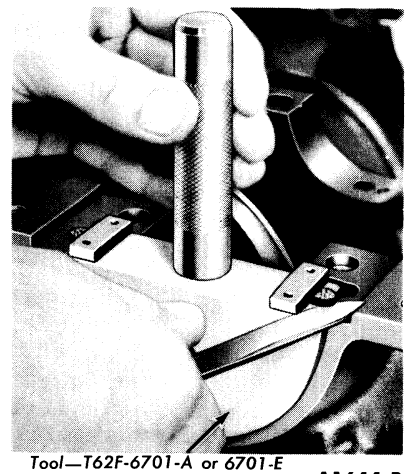



**FIG. 58—Rear Oil Seal to Block Installation**

the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Torque the bearing cap bolts to specifications.

**13.** Install the thrust bearing cap with the bolts finger-tight.

**14.** Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 60).

**15.** Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 60). This will align the thrust surfaces of both halves of the bearing.

**16.** Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications (Fig. 60).

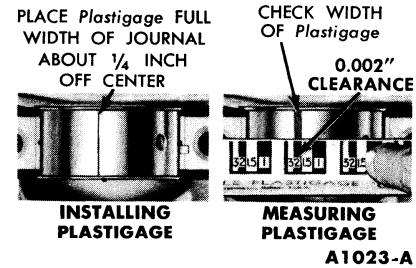



**FIG. 59—Installing and Measuring Plastigage—Engine on Work Stand**

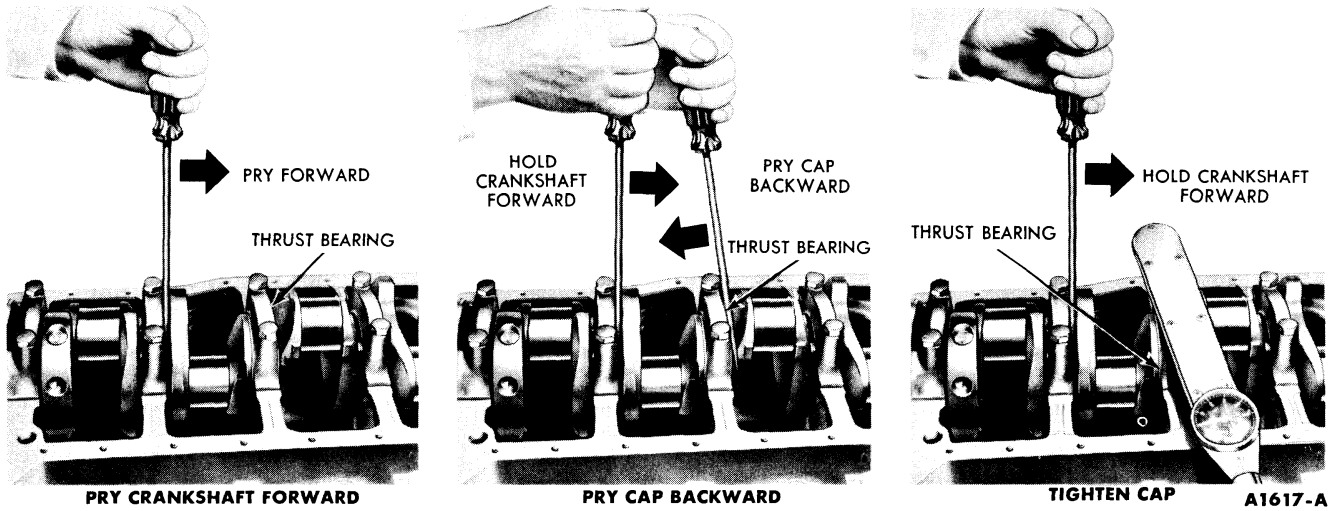



**FIG. 60—Thrust Bearing Alignment**

**17.** Force the crankshaft toward the rear of the engine.

**18.** Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 61).

**19.** Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

**20.** If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks or dirt. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure (steps 13, 14, 15 and 16), and check the end play.

**21.** Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the recommended procedure.

**22.** After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

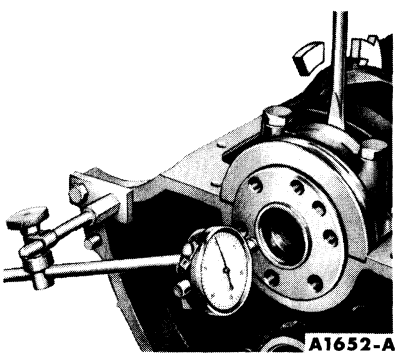



**FIG. 61—Crankshaft End Play**

**23.** Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.

**24.** Install the connecting rod cap. Torque the nuts to specifications.

**25.** After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 46).

**26.** Clean the oil pan, oil pump and oil pump screen. Install the oil pump and oil pan.

**27.** Coat the threads of the flywheel retaining bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts to specifications.

On a flywheel for a manual-shift transmission, use tool 6392-N to locate the clutch disc. Install the pressure plate. Tighten the retaining bolts.

**28.** Install the timing chain and sprockets, cylinder front cover and crankshaft pulley and adapter, following steps 1 thru 6 under "Cylinder Front Cover and Timing Chain Installation."

**29.** Install the Rotunda oil filter, fuel pump and connect the fuel lines. Install the generator or alternator shield and mounting bracket.

**30.** Install the spark plugs, distributor cap and spark plug wires. Connect the spark plug wires and high tension lead.

**31.** Install the engine in the car.

## CAMSHAFT BEARING REPLACEMENT

Camshaft bearings are available pre-finished to size for standard and 0.015-inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

**1.** Remove the camshaft, the flywheel and the crankshaft. Push the pistons to the top of the cylinders.

**2.** Remove the camshaft rear bearing bore plug (Fig. 62). Remove the camshaft bearings (Fig. 63).

**3.** Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 63. Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. **Be sure the front bearing is**

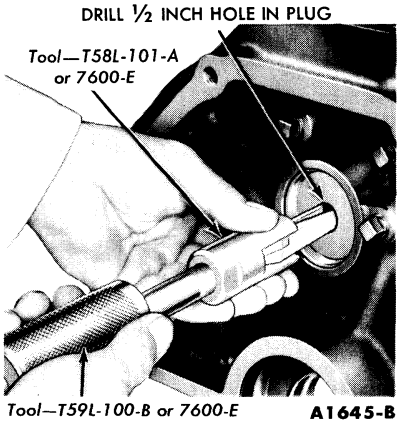



**FIG. 62—Camshaft Rear Bearing Bore Plug Removal**

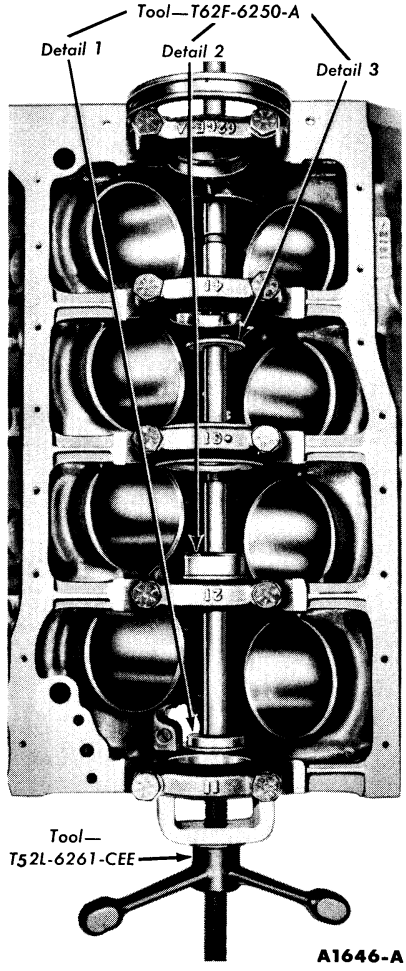



**FIG. 63—Camshaft Bearing Replacement**

**installed 0.005-0.020 inch below the front face of the cylinder block (Fig. 64).**

**4.** Clean out the camshaft rear bearing bore plug recess thoroughly. Coat the flange of a new plug with water-resistant sealer and install the

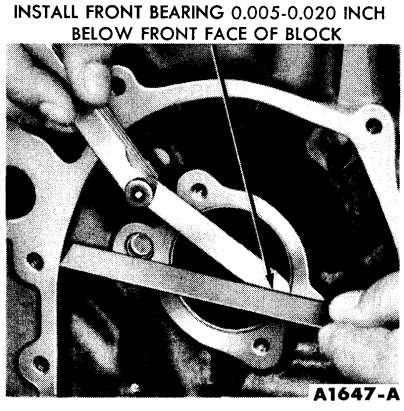



**FIG. 64—Camshaft Front Bearing Measurement**

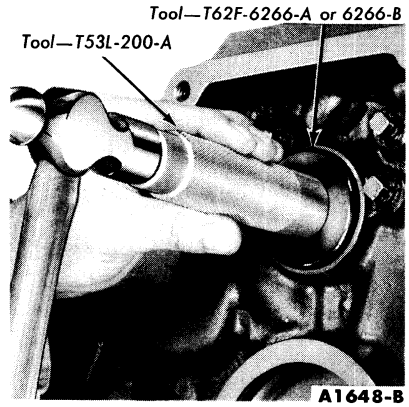



**FIG. 65—Camshaft Rear Bearing Bore Plug Installation**

plug with the flange facing out. Drive the plug in until it is slightly below the chamfer in the bore (Fig. 65).

**5.** Install the camshaft, crankshaft, flywheel and related parts. Install the engine in the car.

## ENGINE DISASSEMBLY

**1.** Install the engine on the work stand.

**2.** Remove the distributor cap and spark plug wire assembly.

**3.** Disconnect the distributor vacuum line from the distributor. Remove the carburetor fuel inlet line and fuel pump outlet line. Remove the fuel pump and discard the gasket. Remove the oil filter.

**4.** Slide the clamp on the water pump bypass hose toward the water pump. Remove the automatic choke heat tube.

**5.** Disconnect the crankcase vent hose at the carburetor and regulator valve. Remove the regulator valve from the valve rocker arm cover. Remove the valve rocker arm covers.

**6.** Remove the generator or alternator, shield and mounting bracket. Remove the ignition coil. Remove the distributor hold down bolt and remove the distributor.

**7.** Remove the intake manifold retaining bolts. Raise the manifold and carefully remove it from the engine. Discard the intake manifold gaskets, seals and sealing washers.

**8.** Loosen the valve rocker arm stud nuts so that the valve rocker arms can be rotated to the side. Remove the valve push rods in sequence and put them in a rack or holder so that they can be installed in their original position.

**9.** Using a magnet, remove the valve lifters and place them in a rack so that they can be installed in their original bores (Fig. 41).

If the valve lifters are stuck in their bores by excessive varnish, etc., it may be necessary to use a plier-type tool (T52T-6500-DJD or 6500-D) to remove the lifters. Rotate the lifter back and forth to loosen it from the gum or varnish that may have formed at the lifter.

**The internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.**

**10.** Remove the exhaust manifolds and the spark plugs.

**11.** Install the cylinder head holding fixtures (Fig. 25). Remove the cylinder head bolts and lift the cylinder heads off the block. **Do not pry between the head and the block.** Discard the cylinder head gaskets.

**12.** Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 32) and remove the vibration damper.

**13.** Remove the oil pan to cylinder front cover retaining bolts. Remove the cylinder front cover retaining screws (one screw retains the fuel line bracket). Remove the cylinder front cover and water pump as an assembly. Discard the gasket and remove the crankshaft front oil slinger.

**14.** Check the timing chain deflection and remove the timing chain and sprockets by following steps 12 thru 16 under "Cylinder Front Cover and Timing Chain Removal." Remove the crankshaft sprocket key.

**15.** Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.** After the ridge has been removed, remove the cutter from the cylinder bore.

On a flywheel for a manual-shift transmission, remove the clutch pressure plate and disc.

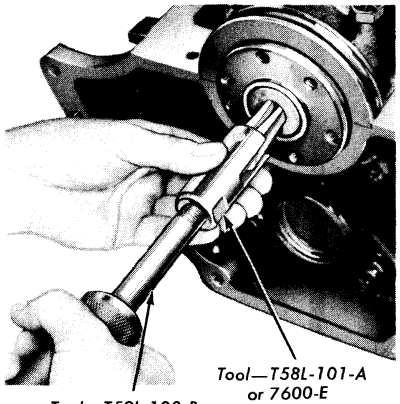



**FIG. 66—Clutch Pilot Bushing Removal**

**16.** Remove the flywheel and rear cover plate. Remove the clutch pilot bushing (Fig. 66).

**17.** Invert the engine. Remove the oil pan and discard the gaskets and seals.

**18.** Remove the oil pump and inlet tube as an assembly. Remove the intermediate drive shaft. Discard the oil pump gasket.

**19. Make sure all connecting rods and caps are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod being removed is down. Remove the rod cap.

**20.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the connecting rod journal or the cylinder wall when removing the piston and rod.**

**21.** Remove the bearing inserts from the connecting rods and caps. Install the rod caps on the connecting rods from which they were removed.

**22.** Remove the main bearing caps.

**23.** Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

**24.** Remove the rear journal oil seal from the block and rear bearing cap.

**25.** Remove the main bearing inserts from the block and bearing caps. Install the main bearing caps in their original positions.

**26.** Remove the camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

**27.** Remove the camshaft rear bearing bore plug (Fig. 62). Remove the camshaft bearings (Fig. 63).

## ENGINE ASSEMBLY

**1.** Remove the glaze from the cylinder bores by following the instructions of the tool manufacturer.

**2.** Invert the engine on the work stand.

**3.** Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 63. Align the oil holes in the cylinder block when the bearings are installed. **Be sure the camshaft front bearing is installed 0.005-0.020 inch below the front face of the cylinder block (Fig. 64).**

**4.** Clean out the camshaft rear bearing bore plug recess thoroughly. Coat the flange of a new plug with water-resistant sealer and install it with the flange facing out (Fig. 65). Drive the plug in until it is slightly below the chamfer in the bore.

**5.** Oil the camshaft and apply Lubriplate to all lobes, and then carefully slide it through the bearings.

**6.** Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap. Preform the new seal by hand to the approximate radius of the cap.

**7.** Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, and then press both ends of the seal into the groove, working from the ends to the center.

**8.** Position the seal forming tool as shown in Fig. 58 and complete the seal installation. After installation, cut the ends of the seal flush.

**9.** If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.

Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

**10.** Install the lower main bearing inserts in the bearing caps.

**11.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**12.** Check the clearance of each main bearing following the procedure under "Main Bearing Replacement."

**13.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

**14.** Install a new journal seal in the cap (Fig. 44) by following steps 6, 7 and 8. Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface (Fig. 44). **Do not apply sealer to the area forward of the oil slinger groove.** Install the rear main bearing cap and the remainder of the caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original positions.** Torque the bearing cap bolts to specifications.

**15.** Install the thrust bearing cap and check crankshaft end play by following steps 13 thru 20 under "Crankshaft Installation."

**16.** Turn the engine on the work stand so that the front end is up.

**17.** Install the pistons and connecting rods by following steps 1 thru 9 under "Piston and Connecting Rod Installation."

**18.** Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 35). Be sure the timing marks on the sprockets are positioned as shown in Fig. 34.

**19.** Lubricate the timing chain and sprockets with engine oil.

**20.** Install the fuel pump eccentric, washer and camshaft sprocket cap screw. Torque the sprocket cap screw to specifications. Install the crankshaft front oil slinger (Fig. 37).

**21.** Clean the cylinder front cover and the cylinder block gasket surfaces. Install a new crankshaft front oil seal (Fig. 36).

**22.** Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

**23.** Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover (and water pump) and pilot over the end of the crankshaft and against the block (Fig. 69).

**24.** Install the cylinder front cover screws finger-tight (one screw retains

the fuel line bracket). While pushing in on the pilot, torque the cover bolts to specifications. Remove the pilot.

**25.** Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease.

**26.** Line up the crankshaft vibration damper keyway with the key on the crankshaft, and then install the vibration damper on the crankshaft (Fig. 39). Install the damper cap screw and washer, and torque the screw to specifications. Install the crankshaft pulley.

**27.** Using a new gasket, install the fuel pump.

**28.** Turn the engine on the work stand so that the top of the engine is up.

**29.** Clean the cylinder head and block gasket surfaces. Install the head gasket over the cylinder head dowels.

**30.** Place the cylinder head on the engine, then remove the holding fixtures. Coat the head bolt threads with water-resistant sealer, and then install the bolts.

**31.** The cylinder head bolt tightening procedure is performed in three progressive steps. Torque the bolts in sequence (Fig. 26) to 50 ft-lbs, then to 60 ft-lbs and finally to 70 ft-lbs. **After the cylinder head bolts have been torqued to specifications, the bolts should not be disturbed.**

**32.** Coat the mating surfaces of the exhaust manifold with a light film of graphite grease. Position new gaskets on the muffler inlet pipe.

**33.** Position the exhaust manifolds on the cylinder heads and install the retaining bolts and tab washers. Torque the retaining bolts to specifications, working from the center to the ends. Lock the bolts by bending one tab of the washer over a flat on the bolt.

**34.** Install the spark plugs.

**35.** Coat the outside of each valve lifter with engine oil to provide initial lubrication. **Do not fill the lifters with oil. The lifters will fill much faster after the engine is started if they are free of any oil film which may cause an oil seal between the plunger and the lifter body.** Place each lifter in the bore from which it was removed.

**36.** Install the push rods in their original positions. Apply Lubriplate over the valve stem tips and the push rod guides in the cylinder head. Install the rocker arms over the push rods. Perform a valve clearance adjustment as outlined in Part 8-1, Section 2.

**37.** Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block.

**38.** Coat the intake manifold and cylinder block seal surfaces with oil-resistant sealer.

**39.** Position new seals on the cylinder block and new gaskets on the cylinder heads with the gaskets interlocked with the seal tabs. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads. The correct installation of the gaskets and seals is shown in Fig. 18.

**40.** Carefully lower the intake manifold on the cylinder block and cylinder heads. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**

**41.** Be sure the holes in the manifold gaskets and manifold are in alignment. Position the intake manifold alignment tools (Fig. 17) in the front and rear (Nos. 10 and 12) bolt holes on the left bank of the manifold.

**42.** Using new sealing washers, install the intake manifold retaining bolts. Working from the center to the ends, torque the bolts in sequence (Fig. 19) to 3-5 ft-lbs.

**43.** Remove the manifold alignment tools from the front and rear bolt holes (Nos. 10 and 12). Using new sealing washers, install the two remaining bolts and torque to 3-5 ft-lbs.

**44.** Torque all the manifold retaining bolts in sequence to 11-14 ft-lbs. Finally, torque all the retaining bolts in sequence to 14-16 ft-lbs.

**45.** Install the water pump bypass hose on the coolant outlet housing. Slide the clamp into position and tighten the clamp.

**46.** Rotate the crankshaft until the No. 1 piston is on TDC, then position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**47.** Install the ignition coil. Position and install the generator or alternator, shield and mounting bracket.

**48.** Clean the valve rocker arm covers and the cylinder head gasket surface. Apply oil-resistant sealer to one side of new cover gaskets. Lay the cemented side of the gaskets in place in the covers.

**49.** Position the covers on the cylinder heads. Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

**50.** Insert the crankcase ventilation regulator valve in the valve rocker arm cover mounting grommet. Connect the crankcase vent hose to the carburetor spacer and regulator valve.

**51.** Install the automatic choke heat tube. Install the distributor cap. Position the spark plug wires in the brackets on the valve rocker arm covers. Connect the spark plug wires.

**52.** Connect the carburetor fuel inlet line and pump outlet line.

**53.** Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

**54.** Invert the engine on the work stand. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.

**55.** With the stop properly positioned, insert the intermediate drive shaft into the oil pump.

**56.** Position a new gasket on the pump housing and install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.** Torque the oil pump retaining screw to specifications.

**57.** Clean the gasket surfaces of the block and oil pan. Coat the block surface and the oil pan gasket surface with sealer. Position new gaskets on the block and position a new seal on the cylinder front cover and rear main bearing cap. Make sure the tabs on the seal are over the oil

pan gasket. Install the retaining screws and torque them from the center outward to specifications (one screw retains the fuel line bracket).

**58.** Clean the oil filter adapter gasket surface. Coat the gasket on the filter with oil. Place the Rotunda filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

**59.** Install the clutch pilot service bearing (Fig. 67). Coat the threads of the flywheel retaining bolts with oil-resistant sealer. Position the rear cover plate on the block and the flywheel on the crankshaft flange. Install and torque the bolts to specifications.

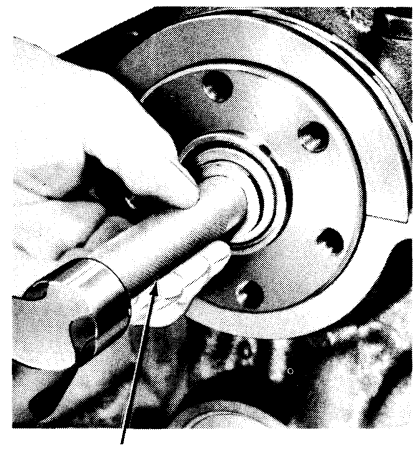
On a flywheel for a manual-shift transmission, use tool T58P-7563-A to locate the clutch disc. Install the pressure plate.

**60.** Install the engine in the car. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

**61.** Operate the engine and check for oil and coolant leaks. Check and adjust the ignition timing. Connect the distributor vacuum line to the distributor.

**59.** Adjust the engine idle speed, fuel mixture and anti-stall dashpot (if applicable). Adjust the transmission throttle linkage.

On a car with power steering and air conditioning, adjust the speed-up control assembly as outlined in Group 3.



*Tool—T52T-12175-AJD or 7600-H*

A1650-B

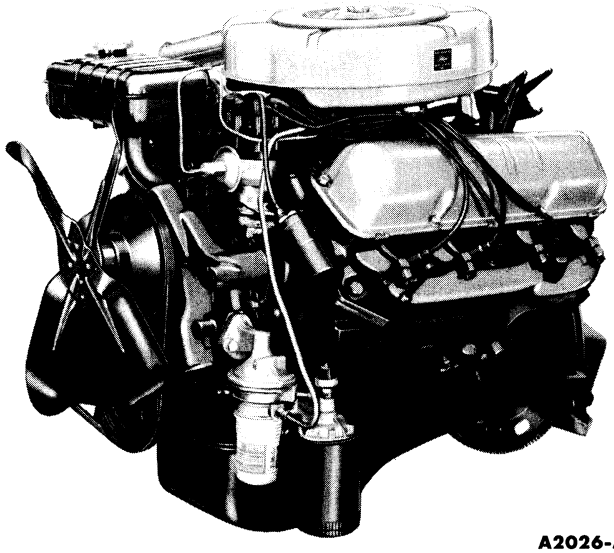
**FIG. 67—Clutch Pilot Bearing Installation**

# PART 8-4 352, 390 AND 427 V-8


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| 1 Description and Operation | 8-80 |
| 2 In-Car Adjustments and Repairs | 8-85 |
| 3 Engine Removal and Installation | 8-104 |
| 4 Major Repair Operations | 8-106 |

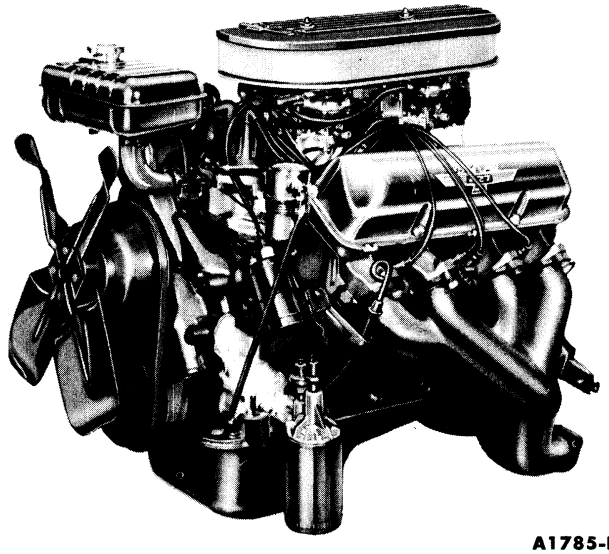

## 1 DESCRIPTION AND OPERATION

The 352 V-8, 390 V-8 and the 427 V-8 engines (Figs. 1 and 2) have the same basic design. Typical engine sections are shown in Figs. 3 and 4. Differences in the engines are called out when they exist. Refer to Table 1 for the engine identification and application.



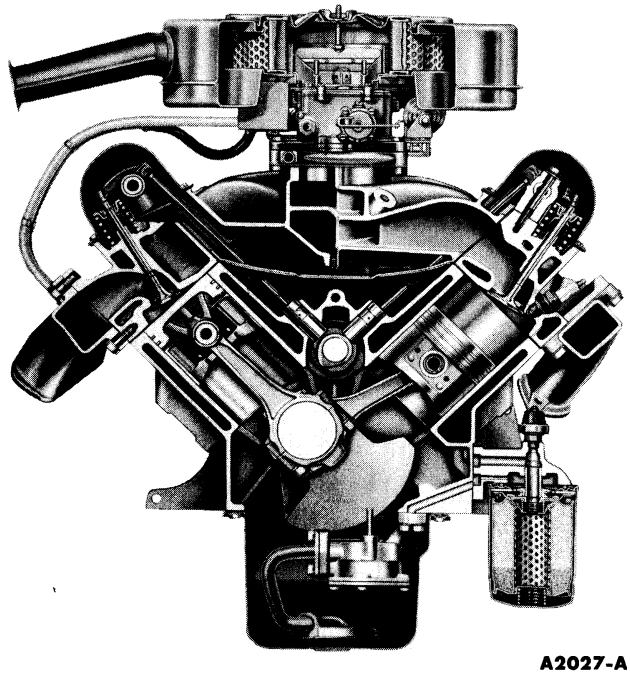
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**FIG. 1—Typical 352 or 390 V-8**



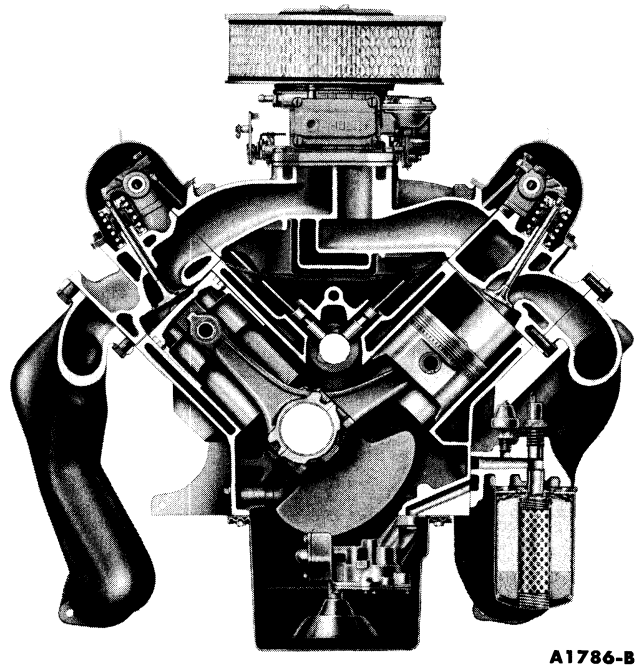
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**FIG. 2—Typical 427 V-8 (8V) High Performance Engine**



A2027-A

**FIG. 3—Typical 352 or 390 V-8 Engine Sectional**



A1786-B

**FIG. 4—Typical 427 V-8 Engine Sectional**

**TABLE 1—Engine Identification and Application**

| Engine | Patent Plate Engine Code | Engine Prefix | Piston Displacement | Bore and Stroke | Compression Ratio | Valve Lifters | Carburetor | Distributor | Exhaust Required | Fuel Required | Transmission |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 352 V-8 | X | EDT | 352 | 4.00 x 3.50 | 9.3:1 | Hydraulic | 4-Barrel Ford | Dual Advance | Dual | Regular | 3-Spd Manual Dual Range—Automatic |
| 390 Special V-8 | H | EES | 390 | 4.05 x 3.78 | 9.4:1 | Hydraulic | Dual Ford | Dual Advance | Single* | Regular | Dual Range—Automatic |
| 390 V-8 | Y | EES | 390 | 4.05 x 3.78 | 9.4:1 | Hydraulic | Dual Ford | Dual Advance | Single* | Regular | 3-Spd Manual 4-Spd Manual Dual Range—Automatic |
| 390 V-8 | Z | EES | 390 | 4.05 x 3.78 | 10.1:1 | Hydraulic | 4-Barrel Ford | Dual Advance | Dual | Premium | 3-Spd Manual Overdrive Dual Range—Automatic |
| Police Interceptor 390 V-8 | P | EES | 390 | 4.05 x 3.78 | 10.1:1 | Mechanical | 4-Barrel Ford | Dual Advance | Dual | Premium | 3-Spd Manual 4-Spd Manual Dual Range—Automatic |
| 427 High Performance V-8 | Q | EGB | 427 | 4.23 x 3.78 | 11.5:1 | Mechanical | 4-Barrel Holley | Centrifugal Advance | Dual | Super-Premium | 4-Spd Manual |
| 427 High Performance V-8 | R | EGB | 427 | 4.23 x 3.78 | 11.2:1 | Mechanical | 2 4-Barrel Holley | Centrifugal Advance | Dual | Super-Premium | 4-Spd Manual |

*Dual exhaust on Convertibles

## MANIFOLDS

On the 352 and 390 V-8 engines, an engine coolant heated spacer is located between the carburetor and the intake manifold (Fig. 5). The coolant flows from the front of the engine through the spacer inlet hose and into the carburetor coolant spacer. The coolant circulates through the spacer and flows into the heater inlet hose and into the heater. Exhaust gases provide the initial heat necessary to assist in vaporizing the incoming fuel mixture.

On the 427 V-8 engine, an exhaust control valve, located between the right exhaust manifold and muffler inlet pipe, directs exhaust gases into this area to provide the heat necessary to assist in vaporizing the incoming fuel mixture.

The intake manifold has two sets of fuel passages, each with its own separate inlet connection to the carburetor (Fig. 6). The right barrel(s) of the carburetor feed Nos. 1, 4, 6, and 7 cylinders and the left barrel(s) feed Nos. 2, 3, 5, and 8 cylinders.

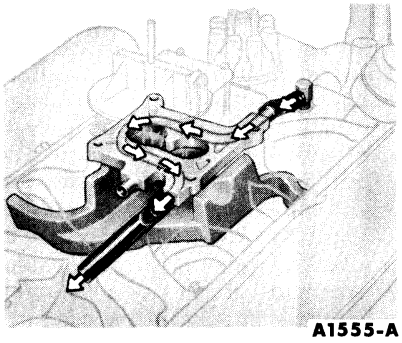
Exhaust manifolds are mounted to the cylinder heads. Compression pressure in the cylinder heads forces engine exhaust through the exhaust manifolds into the exhaust system (Fig. 7).

The distributor is mounted at the left front of the intake manifold.

Warm air for the automatic choke is drawn from the heat chamber of the right exhaust manifold (Fig. 8) for the 352 and 390 V-8 and from the left exhaust manifold for the 427 V-8.

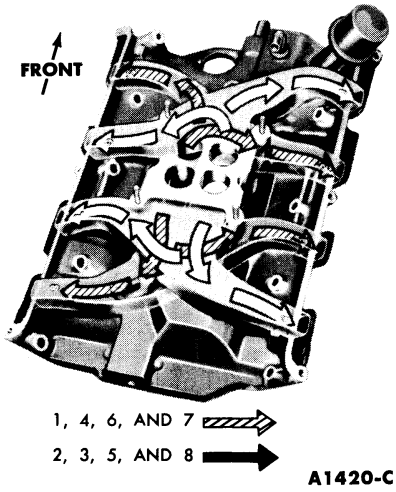
## CYLINDER HEADS

The cylinder head assemblies contain the valves and the valve rocker arm shaft assembly. The combustion chambers are machined in the head. Valve guides are an integral part of the head. The valves are ar-



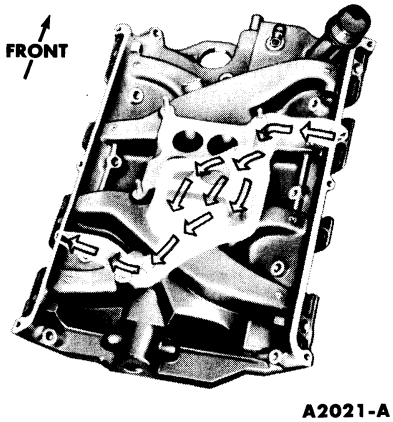
A1555-A

**FIG. 5—Typical Intake Manifold Coolant Passages-352 and 390 V-8**



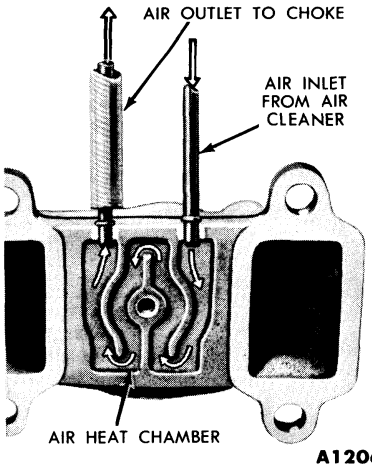

A1420-C

**FIG. 6—Typical Intake Manifold Fuel Passages**



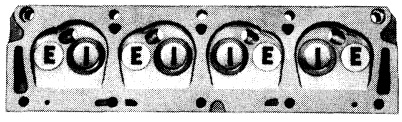

A2021-A

**FIG. 7—Typical Intake Manifold Exhaust Gas Passages**




A1206-B

**FIG. 8—Automatic Choke Heat Chamber-352 and 390 V-8**




A1244-A

**FIG. 9—Valve Port Arrangement**

ranged from front to rear on both banks E-I-E-I-I-E-I-E (Fig. 9).

## CYLINDER BLOCK

The cylinders are numbered from front to rear, on the right bank 1, 2, 3, and 4 and on the left bank 5, 6, 7, and 8. The firing order is 1-5-4-2-6-3-7-8.

The oil pump, mounted inside the oil pan at the front, is driven by the distributor through an intermediate drive shaft.

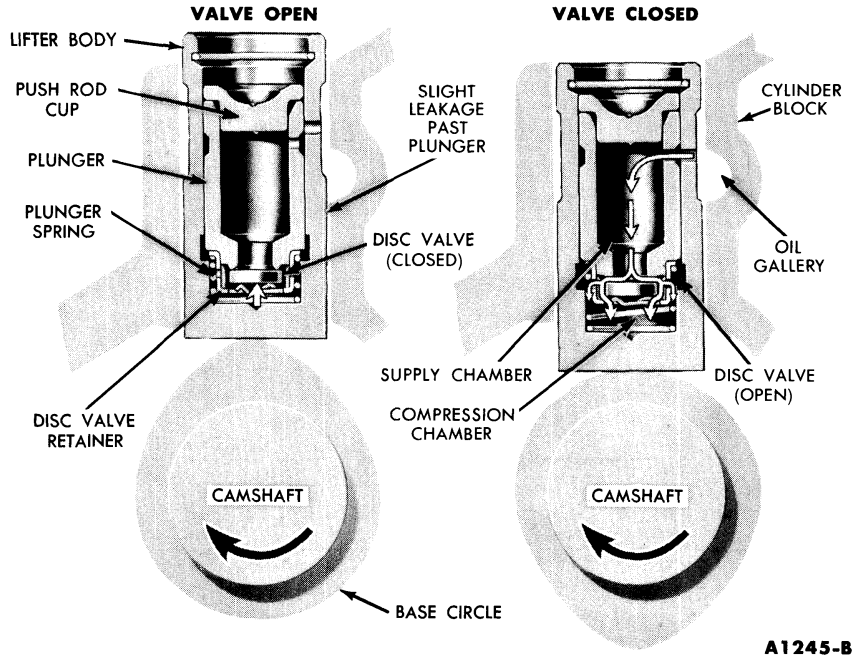
The crankshaft is supported by five main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

On the 427 V-8 engine, cross-bolted main bearing caps are used to reinforce the cylinder block for high-speed, high-stress operation.

The pistons have two compression rings and one oil control ring. The top compression ring is chrome-plated and the lower compression ring is phosphate-coated. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.

## VALVE TRAIN

The intake and exhaust valve assemblies are the rotating-type which slightly rotate each time the valve opens and closes.




A1245-B

**FIG. 10—Typical Hydraulic Valve Lifter Operation**

The push rods are solid steel with oil cushioned sockets.

The camshaft is supported by five bearings pressed into the block. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft thrust is controlled by a thrust plate bolted to the front of the cylinder block. An eccentric, bolted to the front end of the camshaft, operates the fuel pump.

On the 390 Police Interceptor V-8 and 427 V-8 engines, mechanical valve lifters are used. Valve lash is maintained by self-locking adjusting screws.

On all other engines, hydraulic valve lifters are used which provide zero valve lash. The valve lifters are housed in bores located in the cylinder block valve lifter chamber. The valve lifters operate directly on the camshaft lobes, thereby transmitting the thrust of the camshaft lobes, by the means of hydraulic pressure, to the push rods which actuate the valve train. Figure 10 shows the various components and operation of a typical hydraulic valve lifter.

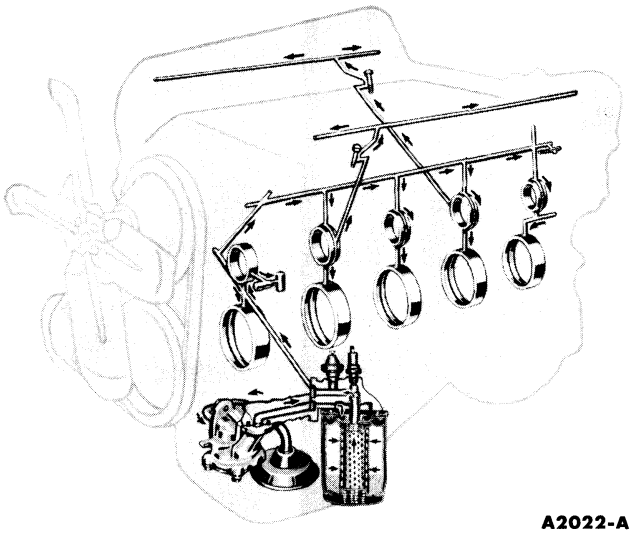
When either an exhaust valve or an intake valve is closed, the actuating valve lifter is on the base circle (lowest position) of the camshaft lobe.

When the valve lifter is in this position, the lifter plunger spring expands. This action forces the lifter plunger and valve push rod upward, forcing the valve end of the rocker arm to maintain solid contact with the valve (zero valve lash). In this position, the oil hole in the lifter body and plunger is indexed with the oil gallery in the cylinder block.

As the lifter plunger moves upward, the volume of the compression chamber is increased, resulting in reduced oil pressure in the compression chamber. Therefore, to equalize the resulting pressure differential between the supply chamber and the compression chamber, the disc valve moves off its seat and permits oil to flow from the supply chamber to the compression chamber. When the compression chamber becomes filled with oil, the pressures in the two chambers are equalized. The oil flow ceases and the disc valve spring seats the disc valve and closes the disc valve port.

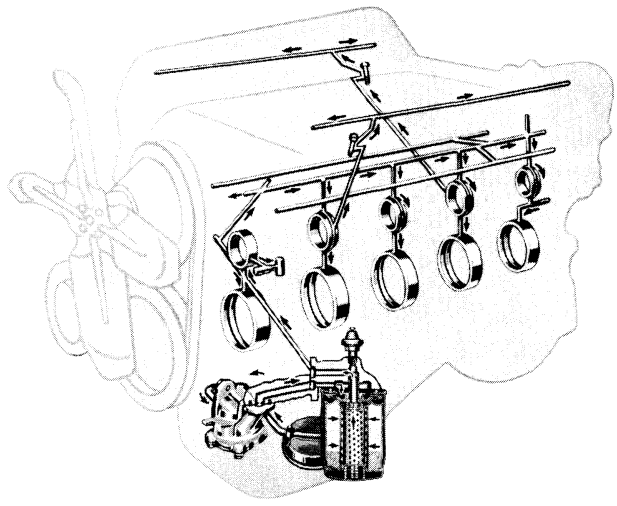
As the camshaft rotates, the lifter assembly is raised by the camshaft lobe. This increases the push rod force against the lifter plunger and hydraulic pressure immediately builds up in the compression chamber until it acts as a solid member of the valve operating mechanism. The lifter then becomes a hydraulic ram which forces the valve in the cylinder head to open. During this period, a slight leakage of oil past the plunger occurs (calibrated leak down rate).

As the high point of the camshaft lobe rotates and passes by the foot of the valve lifter, the valve in the cylinder head seats and the valve



A2022-A

**FIG. 11—Lubrication System—352 and 390 V-8**



A2023-A

**FIG. 12—Lubrication System—427 V-8**

lifter assembly is forced downward. Reduced force on the lifter plunger at this time relieves the pressure on the lifter plunger and it is free to be moved upward by the plunger spring. This action allows oil to flow once again through the indexed oil holes in the lifter body and plunger.

The operating cycle is completed for each revolution of the camshaft. Zero clearance (lash) in the valve train mechanism is maintained at all times by the hydraulic force and expansion of the plunger spring between the lifter body and plunger.

## LUBRICATION SYSTEM

Oil from the oil pan sump, located in the front of the oil pan, is forced through the pressure-type lubrication system (Figs. 11 and 12) by a rotor-type oil pump. A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

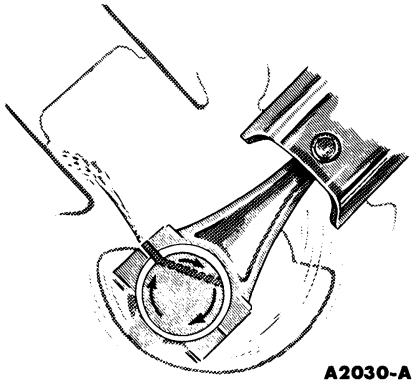
All the oil discharged by the pump passes through a full flow-type filter before it enters the engine. The filter is mounted in a vertical position at the lower left front of the engine. A relief valve in the filter permits oil to bypass the filter element if it becomes clogged.

On the 427 V-8 engine, an auxiliary oil pressure safety relief valve is located at the rear of the main oil gallery to prevent excessively high oil pressures in the system during cold starts.

From the filter, the oil flows into the main oil gallery which is located in the center of the valve push rod chamber floor. The oil gallery supplies oil to each individual camshaft bearing, through drilled passages in the block. Passages are drilled from each camshaft bearing to each main bearing. Number 1 camshaft bearing feeds No. 1 main bearing, and No. 2 camshaft bearing feeds No. 2 main bearing, etc. The oil then flows through notches or grooves in the main bearings to lubricate the crankshaft journals.

On the 352 and 390 V-8 engines, a jiggle pin in the main oil gallery front plug allows any air that may be trapped in the oil to escape.

Oil drains from the front cam bearing and a bore in the front of the cylinder block to the thrust face of the camshaft sprocket that rides against the cylinder block front surface. The rotation of the camshaft sprocket sprays the oil onto the timing chain and crankshaft sprockets.



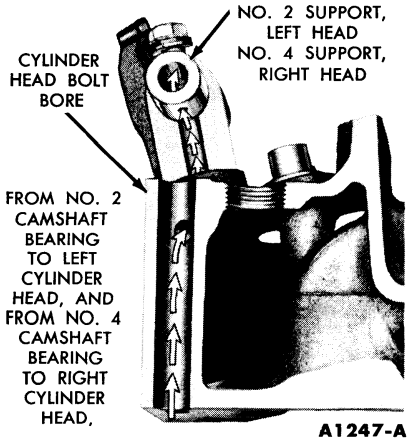
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**FIG. 13—Connecting Rod Bearing and Cylinder Bore Lubrication**

The crankshaft is drilled from the main bearings to the connecting rod bearings.

A small groove is located in the connecting rod at the mating face where the cap contacts the connecting rod. This groove is used as an oil squirt hole for cylinder wall lubrication. Oil from the connecting rod squirt hole lubricates the opposite cylinder wall. For example, the No. 1 connecting rod oils No. 5 cylinder, etc. As the crankshaft turns, the hole in the connecting rod bearing aligns with the hole in the journal causing a direct squirt of oil onto the cylinder wall (Fig. 13).

On engines with hydraulic valve lifters, oil passages are drilled from the main oil gallery to each valve lifter oil gallery. Oil from here feeds the valve lifter assemblies. A reservoir at each valve lifter bore boss traps oil so that oil is available for




A1247-A

**FIG. 14—Valve Rocker Arm Shaft Lubrication**

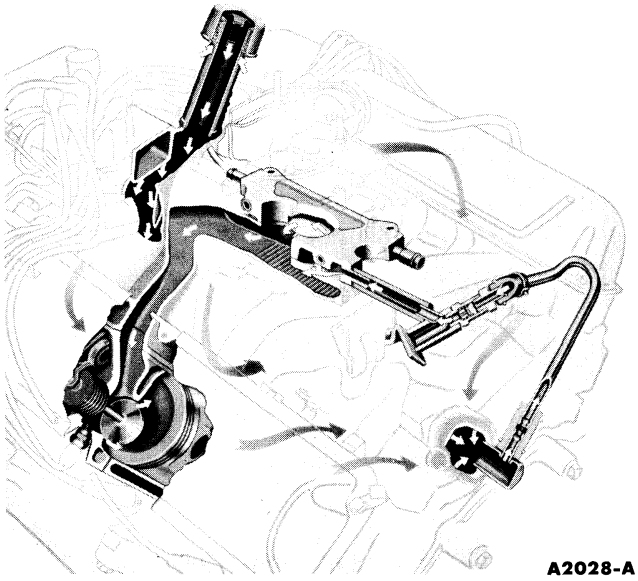



**FIG. 15—Typical Positive Crankcase Ventilation System**

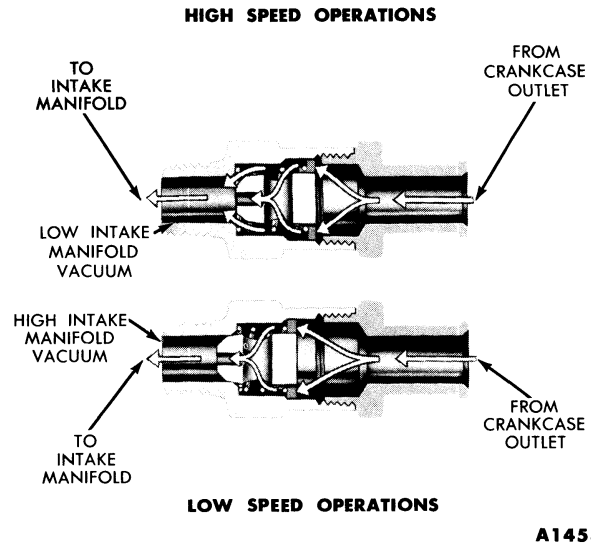



**FIG. 16—Positive Crankcase Ventilation Regulator Valve**

valve lifter lubrication as soon as the engine starts.

An oil passage is drilled from No. 2 camshaft bearing web to the left cylinder head between Nos. 5 and 6 cylinders to lubricate the valve rocker arm shaft assembly (Fig. 14). The oil passage in the cylinder head is drilled from the cylinder head bolt bore to the No. 2 valve rocker arm shaft support.

The oil flows through the valve rocker arm shaft through drilled holes in each valve rocker arm to lubricate the bushing and both ends of the valve rocker arm. The excess oil spirals down the rotating push rods and lubricates the push rod seats. The right valve rocker arm shaft assembly is similarly lubricated from No. 4 camshaft bearing via the No. 4 valve rocker arm shaft support.

A baffle located under the valve rocker arm shaft assembly shields the valve stems from oil splash. Excess oil is returned to the oil pan through drain back holes located at each end of the cylinder head and in the push rod chamber floor.

## CRANKCASE VENTILATION

The engines are equipped with a positive crankcase ventilation system. However, the vent tube-type crankcase ventilation system is also available for the 427 V-8 engine.

### VENT TUBE-TYPE CRANKCASE VENTILATION SYSTEM

A crankcase ventilation tube is located at the rear of the engine. The forward motion of the car causes a partial vacuum to be formed at the tube outlet. This vacuum action causes air to be drawn through the engine from the oil filler cap located at the front of the intake manifold. The filler cap contains a filtering element which filters the incoming air.

From the filler cap, the air flows into the front section of the valve push rod chamber where there are few contaminating vapors. Here, the incoming air has a chance to warm up before contacting contaminating vapors originating in the crankcase. Warm ventilating air minimizes the formation of crankcase sludge.

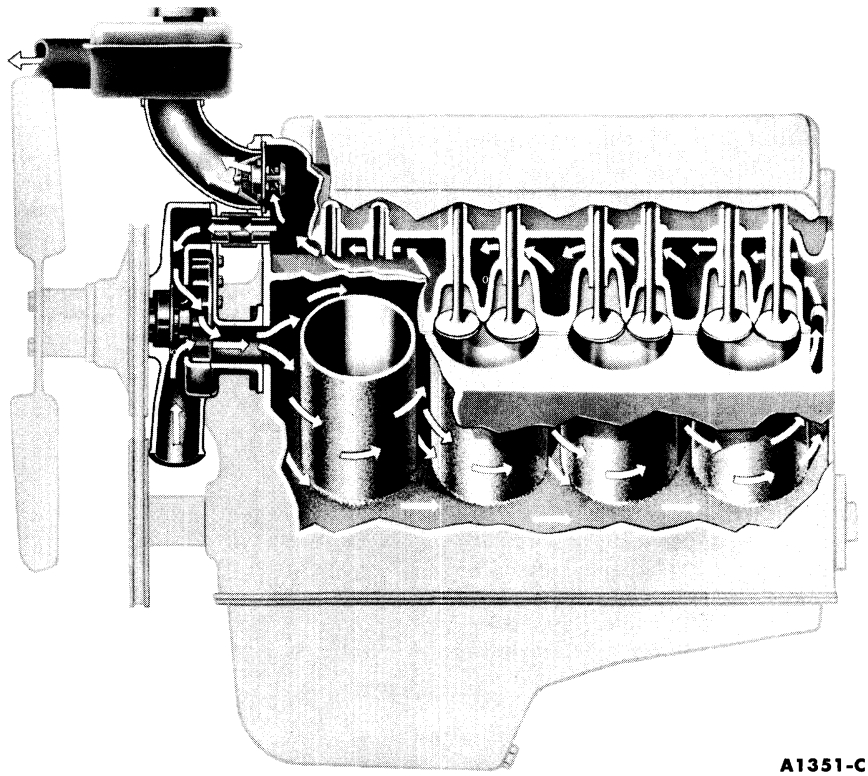



**FIG. 17—Typical Cooling System**

The ventilating air is directed by a baffle, located on the underside of the intake manifold, upward into the front of both valve rocker arm chambers. The baffle also directs air to the front of the lower crankcase and into the timing chain chamber.

Air from the valve rocker arm chamber and from the crankcase flows into the rear of the valve push rod chamber. All air is then directed out the crankcase ventilation tube.

### POSITIVE CRANKCASE VENTILATION SYSTEM

Ventilating air enters the engine in the normal manner through the breather cap and is distributed through the engine in the same manner as in the vent tube-type system. However, instead of the ventilating air being discharged to the atmosphere, it is directed to the intake manifold through the carburetor spacer. The air is directed to the intake manifold through an exhaust tube which extends from the crankcase ventilation outlet to a spring-loaded regulator valve and then into the carburetor spacer (Fig. 15). The valve regulates the amount of air to meet changing operating conditions.

During idle, intake manifold vacuum is high. The high vacuum overcomes the tension of the spring pressure and seats the valve (Fig. 16). With the valve in this position, all the ventilating air passes through a calibrated orifice in the valve. With the valve seated, there is a minimum ventilation. As engine speed increases and manifold vacuum decreases, the spring forces the valve off its seat and to the full open position. This increases the flow of ventilating air.

### COOLING SYSTEM

The coolant is drawn from the bottom of the radiator by the water pump which delivers the coolant to the cylinder block (Fig. 15).

The coolant travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder heads where it cools the combustion chambers, valves, and valve seats on its return to the front of the engine.

The coolant from each cylinder head flows through the water passages in the intake manifold past the water thermostat, if it is open, into the radiator supply tank. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. The entire system is pressurized to 12-15 psi.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### ENGINE SUPPORTS

The front supports are located on each side of the crankcase and the rear support is located at the transmission extension housing (Fig. 18).

### ENGINE FRONT SUPPORT

The procedures given apply to either a right or left installation.

**Removal**

**1.** On a car with an automatic transmission, remove the transmission oil cooling inlet and outlet tubes from the retaining bracket on the cylinder block.

**2.** Remove the insulator to frame nut and lock washer. **If only one support is being removed, loosen the other support.**

**3.** Using a jack and a wood block placed under the oil pan, raise the engine to allow just enough clearance for removal of the insulator(s).

**4.** Remove the insulator to engine bolts and lock washers. Remove the insulator (and restriction flange on 427 V-8).

**Installation**

**1.** Position the insulator assembly on the engine (and restriction flange on 427 V-8). Install the insulator to engine bolts and lock washers finger-tight.

**2.** Lower the engine carefully to make sure the insulator stud engages the frame mounting hole.

**3.** Install the insulator to frame nut and lock washer. Torque the insulator nut and bolts to specifications.

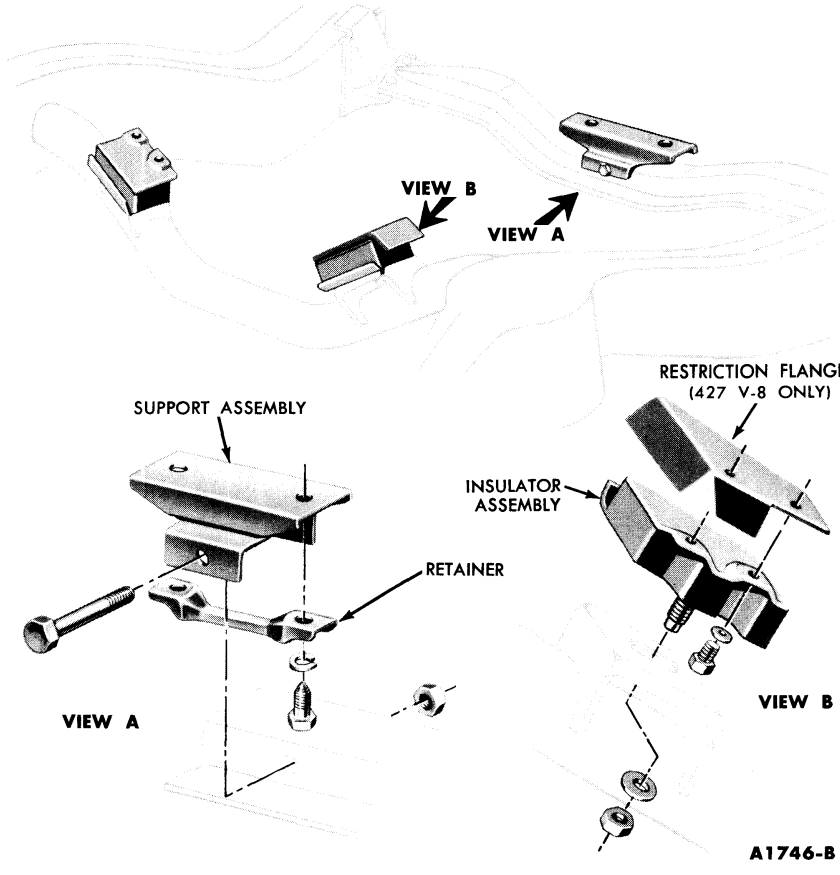



**FIG. 18—Engine Front and Rear Supports**

4. If only one support was removed, tighten the other support.

5. On a car with an automatic transmission, install the transmission oil cooling inlet and outlet tubes in the retaining bracket on the cylinder block.

### ENGINE REAR SUPPORT

**Removal**

1. Remove the support retaining bolts and washers.

2. Raise the engine slightly to gain clearance and remove the support assembly.

**Installation**

1. Position the support assembly. Lower the engine.

2. Install the support to extension housing flat washers, lock washers, and bolts. Torque the bolts to specifications.

## VALVE ROCKER ARM SHAFT ASSEMBLY

### REMOVAL–HYDRAULIC VALVE LIFTERS

1. Disconnect the automatic choke heat chamber air inlet tube (352 and 390 V-8) and remove the air cleaner.

2. Disconnect the spark plug wires at the spark plugs. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.

To remove the right valve rocker arm cover, remove the carburetor choke air heat tube.

To remove the left valve rocker arm cover on cars with power brakes, disconnect the brake booster vacuum line at the manifold and position the line out of the way.

3. Remove the valve rocker arm cover(s).

If the left cover is removed, position the wire loom out of the way.

4. Crank the engine until the No. 1 piston is at TDC at the end of the compression stroke. Rotate the crankshaft damper an additional 45° (identified by "XX" on the damper).

5. Starting at the No. 4 cylinder, loosen the right valve rocker arm shaft support bolts in sequence, two turns at a time. After the bolts are all loosened, remove the valve rocker arm shaft assembly and the oil baffle plate. Starting at the No. 5 cylinder, follow the same procedure on the left valve rocker arm shaft support bolts. **This procedure must be followed to avoid damage to the valve mechanism.**

### REMOVAL–MECHANICAL VALVE TAPPETS

1. Follow steps 1 thru 3 under "Removal–Hydraulic Valve Lifters."

2. Release the spring tension on the valve rocker arm by loosening the adjusting screws.

3. Remove the shaft support bolts. Remove the shaft assembly and the baffle plate.

### INSTALLATION–HYDRAULIC VALVE LIFTERS

1. Apply Lubriplate to the pad end of the rocker arms, to the tip of the valve stems, and to both ends of the push rods.

2. Crank the engine until the No. 1 piston is on TDC at the end of the compression stroke.

3. Rotate the crankshaft damper an additional 45° (identified by "XX" on the damper).

4. Position the baffle plate and the valve rocker arm shaft assembly on the cylinder heads with the valve push rods in place and the rocker shaft support bolts finger-tight. **Be sure the shaft is positioned so that the oil holes are to the bottom.**

5. Starting at the No. 4 cylinder, tighten the bolts in sequence, two turns at a time, until the supports fully contact the cylinder head. Torque the bolts in sequence to specifications.

6. Starting at the No. 5 cylinder, follow the same procedure for the left valve rocker arm shaft support bolts. The additional time consumed in this procedure will permit the hydraulic lifters to leak down. This will minimize the possibility of bending the push rods, valves, or the rocker arms. **Be sure that the hydraulic lifters have leaked down to their normal operating position before cranking the engine. This is necessary in order to avoid possible damage to the valves, push rods, or valve rocker arms.**

7. Check the valve clearance and correct if necessary (Part 8-1, Section 2).

8. Clean the valve rocker arm cover(s). Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s) in place in the cover(s).

9. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts (and the wire loom clamps on the left cover). The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

On a car with power brakes, if the left cover was removed, connect the brake booster vacuum line to the intake manifold.

If the right cover was removed, install the carburetor choke air heat tube.

10. Connect the spark plug wires. Install the air cleaner and connect the automatic choke heat chamber air inlet tube (352 and 390 V-8).

### INSTALLATION–MECHANICAL VALVE TAPPETS

1. Apply Lubriplate to the pad and ball end of the rocker arms, to the tip of the valve stems, and to both ends of the push rods.

2. Position the baffle plate and the valve rocker arm shaft assembly on the cylinder head with the valve push rods in place and the rocker shaft support bolts finger tight. **Be sure the oil holes in the shaft are facing downward.**

3. Tighten the support bolts and torque to specifications.

4. Perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

5. Temporarily lay the valve rocker arm covers in place and temporarily connect the spark plug wires. Operate the engine for 30 minutes at 1200 rpm to stabilize engine temperatures. Remove the valve rocker arm covers and perform a hot valve lash adjustment with the engine idling (Part 8-1, Section 2).

6. Follow steps 8 thru 10 under "Installation–Hydraulic Valve Lifters".

### DISASSEMBLY

1. Remove the cotter pins from each end of the valve rocker arm shaft. Remove the flat washer and spring washer from each end of the shaft.

2. Slide the rocker arms, springs and the supports off the shaft. Be sure to identify all the parts.

3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce one plug. Then insert a steel rod through the plug and knock out the plug on the opposite

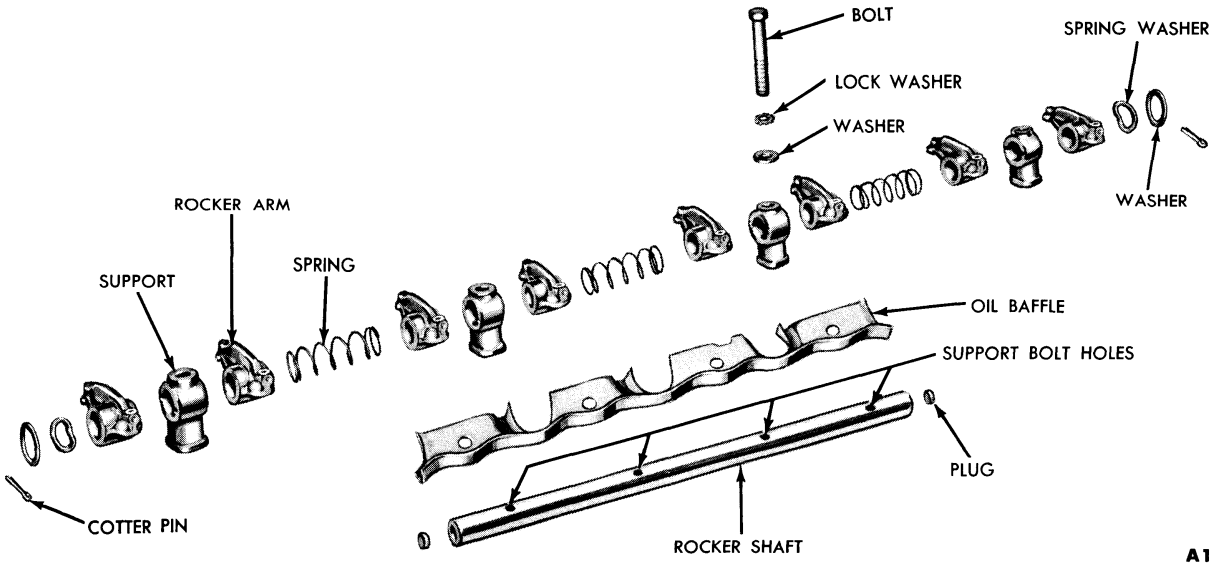



**FIG. 19—Valve Rocker Arm Shaft Assembly-Hydraulic Valve Lifters**

end. Working from the open end, knock out the remaining plug.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

### ASSEMBLY

**1.** Oil all the moving parts with engine oil. Apply Lubriplate to the pad of the valve rocker arms.

**2.** If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the rocker arm shaft.

**3.** Install the rocker arms, supports and springs in the order shown in Figs. 19 or 20. **Be sure the oil holes in the shaft are facing downward.** Complete the assembly by installing the remaining flat washer, the spring washer and the cotter pin.

## INTAKE MANIFOLD

### REMOVAL

**1.** Drain the cooling system. Disconnect the automatic choke heat chamber air inlet tube (352 and 390 V-8) and remove the air cleaner.

On a car with a manual-shift transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator retracting spring.

On a car with an automatic transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator cross shaft bracket from the intake manifold and position it out of the way.

**2.** Disconnect the coil high tension lead. Disconnect the primary wire at the distributor. Disconnect the oil pressure sending unit wire at the sending unit (and oil temperature

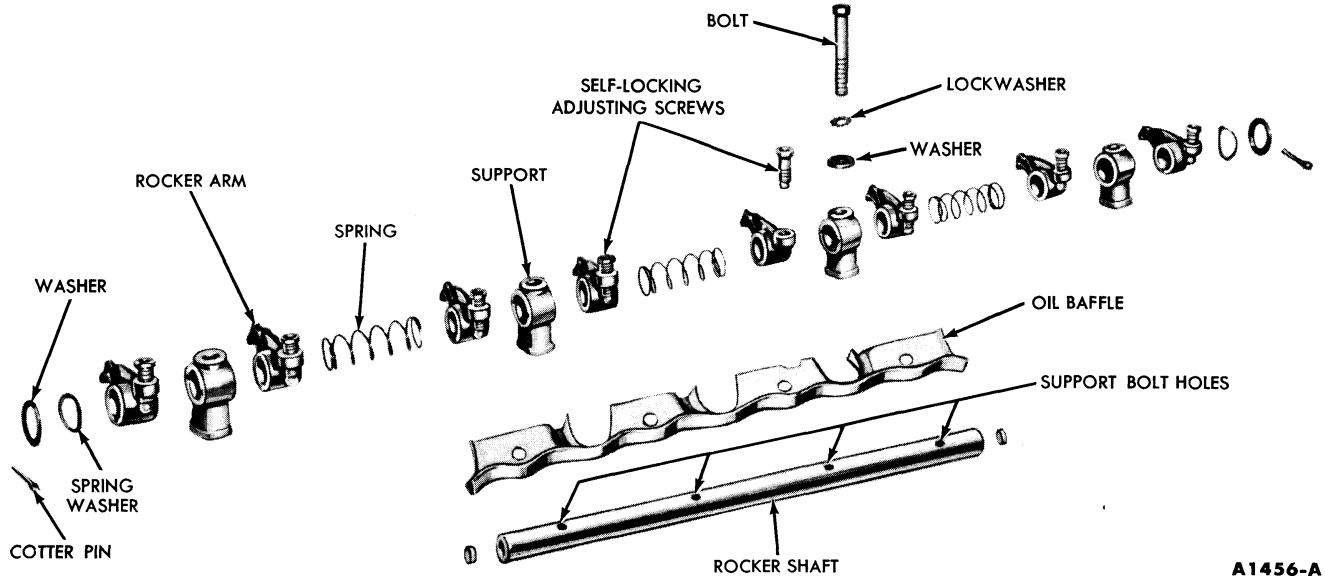



**FIG. 20—Valve Rocker Arm Shaft Assembly—Mechanical Valve Tappets**

sending unit wire on the 427 V-8 engine if se equipped).

**3.** Disconnect the spark plug wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Remove the distributor cap and spark plug wire assembly. Disconnect the distributor vacuum line at the distributor.

**4.** Remove the carburetor fuel inlet line and the automatic choke air heat tube. Disconnect the brake booster vacuum line at the intake manifold and at the flexible hose. Remove the vacuum line.

**5.** Remove the distributor hold down bolt and clamp and remove the distributor.

**6.** Disconnect the radiator upper hose at the radiator supply tank, the heater hose at the intake manifold, and the water temperature sending unit wire at the sending unit.

**7.** Slide the clamp on the water pump bypass hose toward the water pump. Remove the automatic choke air heat tube.

**8.** Remove the valve rocker arm covers. Position the wire loom attached to the left valve rocker arm cover out of the way.

**9.** Refer to "Valve Rocker Arm Shaft Assembly" and remove the valve rocker arm shaft assembly by following steps 4 and 5 under "Removal–Hydraulic Valve Lifters" or steps 2 and 3 under "Removal–Mechanical Valve Tappets."

**10.** Remove the valve push rods in sequence.

On a 427 V-8 engine equipped with the vent tube-type crankcase ventilation system, remove the vent tube.

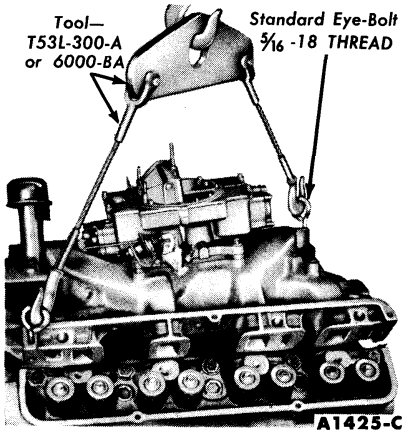



**FIG. 21–Intake Manifold Removal or Installation**

**11.** Remove the intake manifold retaining bolts.

**12.** Install standard eye bolts with 5/16-18 threads in the left front and right rear rocker arm cover screw holes and attach the engine lifting sling (Fig. 21).

**13.** Raise the manifold and carefully remove the intake manifold and radiator supply tank as an assembly. Remove the intake manifold gaskets and seals.

**14.** If the manifold is to be disassembled, remove the radiator supply tank, thermostat and gasket. Remove the carburetor, spacer and gasket.

On an engine with positive crankcase ventilation, remove the crankcase ventilation system components.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## INSTALLATION

The intake manifold assembly is shown in Fig. 22.

### Engines With Hydraulic Valve Lifters

**1.** If the intake manifold was disassembled, install the carburetor, spacer, and gasket. Coat the thermostat gasket with water-resistant sealer and place it in position on the intake manifold. Install the thermostat and radiator supply tank.

**2.** Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block.

**3.** Coat the intake manifold and cylinder block seal surfaces with oil-resistant sealer.

**4.** Position new seals on the cylinder block and new gaskets on the cylinder heads. Position the gasket slots in the end tabs over the ribs on the seal. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads. The correct installation of the gaskets and seals are shown in Fig. 23.

**5.** Install the eye bolts in the intake manifold and attach the engine lifting sling and carefully lower the intake manifold on the engine (Fig. 23).

**6.** Position the intake manifold by inserting the distributor in place. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**

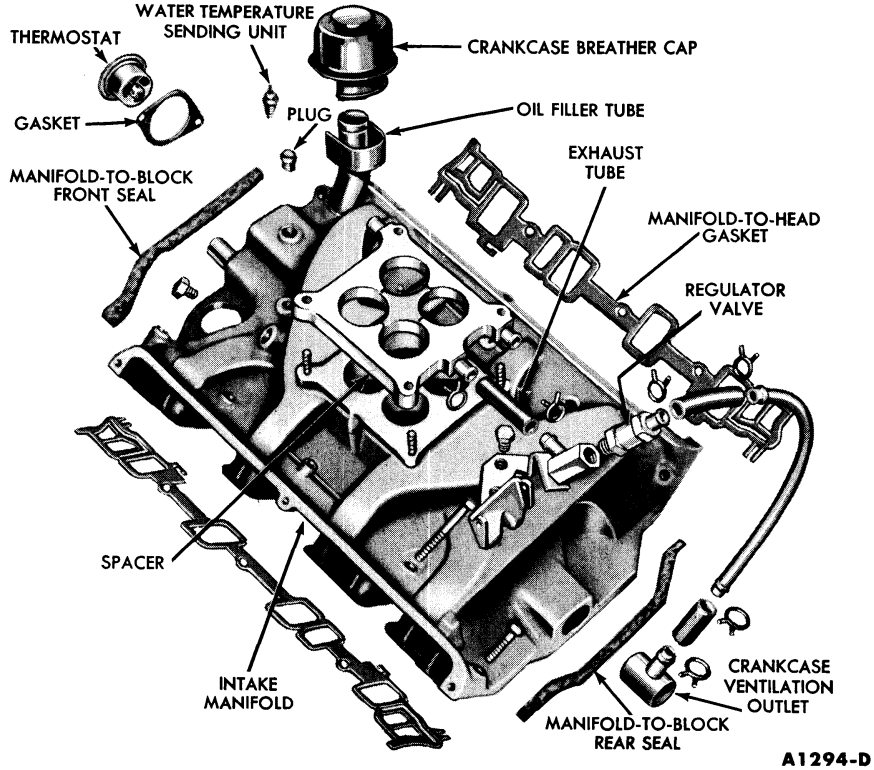



**FIG. 22–Typical Intake Manifold Assembly**

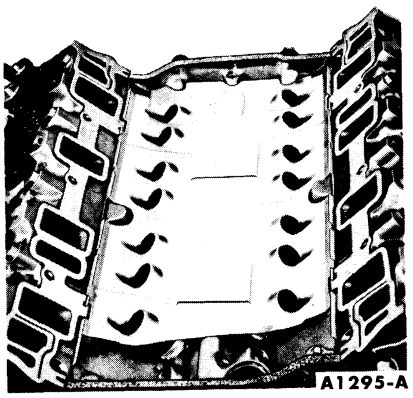



**FIG. 23—Intake Manifold Gaskets and Seals Installed**

**7.** Start the water pump bypass hose on the intake manifold.

**8.** Be sure the holes in the manifold gaskets and manifold are in alignment. Install the manifold retaining bolts and torque the bolts to specifications in sequence as shown in Fig. 24.

**9.** Remove the distributor and the engine lifting sling and eye bolts.

**10.** Slide the water pump bypass hose clamp into position. Connect the water temperature sending unit, the heater hose and the radiator upper hose.

**11.** Install the crankcase ventilation system components.

**12.** Apply Lubriplate to both ends of the push rods. Install the push rods in their original bores, positioning the lower ends of the rods in the lifter cups. Refer to "Valve Rocker Arm Shaft Assembly" and install the valve rocker arm shaft assembly by following steps 1 thru 7 under "Installation—Hydraulic Valve Lifters."

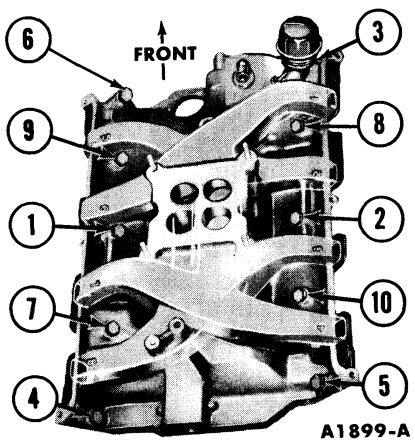



**FIG. 24—Intake Manifold Torque Sequence**

**13.** Rotate the crankshaft damper until the No. 1 piston is on TDC at the end of the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**14.** Clean the valve rocker arm covers. Apply oil-resistant sealer to one side of new cover gaskets. Lay the cemented side of the gaskets in place in the covers. Install the valve rocker arm covers.

**15.** Connect the brake booster vacuum line and connect the flexible hose.

**16.** Install the carburetor fuel inlet line and connect the distributor vacuum line. Install the automatic choke air heat tube.

**17.** Install the distributor cap. Connect the spark plug wires.

**18.** Connect the oil pressure sending unit wire, the coil high tension lead, and the coil primary wire.

On a car with an automatic transmission, install the accelerator cross shaft bracket. Connect the accelerator rod.

On a car with a manual-shift transmission, install the accelerator retracting spring and connect the accelerator rod.

**19.** Fill and bleed the cooling system.

**20.** Start the engine and check and adjust the ignition timing. Operate the engine until engine temperatures have stabilized and adjust the engine idle speed and idle fuel mixture.

On a car with an automatic transmission, adjust the transmission control linkage.

**21.** Install the air cleaner and connect the automatic choke heat chamber air inlet tube (352 and 390 V-8).

**Engines with Mechanical Valve Tappets**

**1.** Follow steps 1 thru 10 under "Engines With Hydraulic Valve Lifters." Torque the intake manifold bolts to specifications in sequence as shown in Fig. 24.

On a 427 V-8 engine with the vent tube-type crankcase ventilation system, install the vent tube and gasket.

**2.** Refer to "Valve Rocker Arm Shaft Assembly" and install the valve rocker arm shaft assembly by following steps 1 thru 4 under "Installation – Mechanical Valve Tappets."

**3.** Rotate the crankshaft damper until the No. 1 piston is on TDC at the end of the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**4.** Install the carburetor fuel inlet line and connect the distributor vacuum line.

**5.** Temporarily lay the valve rocker arm covers in place.

**6.** Install the vacuum booster line.

**7.** Install the distributor cap. Temporarily connect the spark plug wires.

**8.** Connect the oil pressure sending unit, the coil high tension lead, and the coil primary wire.

On a car with an automatic transmission, install the accelerator cross shaft bracket. Connect the accelerator rod.

On a car with a manual-shift transmission, install the accelerator retracting spring and connect the accelerator rod.

**9.** Fill and bleed the cooling system.

**10.** Start the engine and check the ignition timing. Operate the engine until engine temperatures have stabilized. Adjust the engine idle speed and idle fuel mixture. Remove the valve rocker arm covers and perform a hot valve lash adjustment with the engine idling (Part 8-1, Section 2).

On a car with an automatic transmission, adjust the transmission control linkage.

**11.** Turn the engine off. Clean the valve rocker arm covers. Apply oil-resistant sealer to one side of new cover gaskets. Lay the cemented side of the gaskets in place in the covers. Install the valve rocker arm covers. Install the automatic choke air heat tube.

**12.** Install the air cleaner and connect the automatic choke heat chamber air inlet tube (390 V-8).

## EXHAUST MANIFOLDS

### REMOVAL—352 AND 390 V-8

**1.** Disconnect the exhaust manifold from the muffler inlet pipe.

**2.** Remove the automatic choke air heat tube and air inlet tube from the right exhaust manifold.

**3.** Remove the retaining bolts and tab washers and remove the exhaust manifolds.

**REMOVAL–427 V-8**

**1.** Remove the exhaust manifold retaining bolts that are accessible from the top of the engine.

To remove the left exhaust manifold, remove the clutch pedal to equalizer rod lower adjusting nut. Remove the automatic choke air heat tube.

**2.** Raise the car. Remove the remaining manifold retaining bolts.

To remove the left exhaust manifold, remove the equalizer inner bracket from the engine and the equalizer bar. Disconnect the retracting spring and release rod. Position the equalizer bar out of the way.

To remove the right exhaust manifold, remove the idler arm to chassis bolts and lower the idler arm assembly. Disconnect the engine front support insulators at the frame. Raise the engine approximately 1 or 2 inches to provide necessary clearance to remove the right manifold.

**3.** Disconnect the muffler inlet pipe at the exhaust manifold and remove the exhaust manifolds.

On the right exhaust manifold, remove the exhaust control valve assembly.

**CLEANING AND INSPECTION**

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

**INSTALLATION–352 AND 390 V-8**

**1.** Clean the mating surfaces of the exhaust manifold and cylinder head. Scrape the gasket material from the mounting flange of the exhaust manifold and muffler inlet pipe.

**2.** Apply graphite grease to the mating surface of the exhaust manifold.

**3.** Position the exhaust manifold on the cylinder head and install the retaining bolts and tab washers. Working from the center to the ends, torque the retaining bolts to specifications. Lock the bolts by bending one tab of the washer over a flat on the bolt.

**4.** Install the automatic choke air heat tube and air inlet tube on the right exhaust manifold.

**5.** Position a new gasket on the muffler inlet pipe and connect the exhaust manifold to the inlet pipe. Install and torque the retaining nuts to specifications.

**6.** Start the engine and check for exhaust leaks.

**INSTALLATION–427 V-8**

**1.** Clean the muffler inlet pipe gasket surfaces.

On a right manifold, clean both sides of the exhaust control valve assembly.

**2.** Position the manifold to the cylinder and install the bolts accessible from beneath the engine. Working from the center to the ends, torque the retaining bolts to specifications. Lock the bolts by bending one tab of the washer over a flat on the bolt.

If the right manifold was removed, lower the engine and install the front insulator lock washers and nuts. Torque the nuts to specifications. Position and install the idler arm assembly. Torque the retaining bolts to specifications.

If the left manifold was removed, position the equalizer bar to the outer bracket. Position the release rod and connect the retracting spring. Install the equalizer inner bracket.

**3.** On the left manifold, position a new gasket to the manifold and connect the muffler inlet pipe to the manifold. Torque the nuts to specifications.

On the right manifold, place new gaskets on both sides of the exhaust control valve and position it over the inlet pipe studs on the manifold. Connect the muffler inlet pipe to the manifold and torque the nuts to specifications.

**4.** Lower the car and install the remaining manifold retaining bolts. Working from the center to the ends, torque the retaining bolts to specifications. Lock the bolts by bending one tab of the washer over a flat on the bolt.

If the left manifold was removed, install the clutch pedal to equalizer rod lower adjusting nut. Install the automatic choke air heat tube.

**5.** Start the engine and check for exhaust leaks.

## POSITIVE CRANKCASE VENTILATION SYSTEM

The positive crankcase ventilation system installations are shown in Figs. 25, 26 and 27.

**REMOVAL–352, 390 AND 427 V-8 (4V)**

**1.** Disconnect and remove the vent tube from the vent hoses on the crankcase outlet adapter and the regulator valve.

**2.** On the 352 and 390 V-8, remove the vent hose from the crankcase outlet adapter. Remove the outlet adapter from the intake manifold.

On the 427 V-8 (4V), remove the vent hose from the crankcase outlet adapter. Remove the outlet adapter, gasket and oil separator element.

**3.** Remove the vent hose from the regulator valve. Remove the regulator valve from the bracket and connector assembly.

**4.** Remove the vent hose from the carburetor spacer and the bracket and connector assembly. Remove the bracket and connector assembly from the intake manifold.

**REMOVAL–427 V-8 (8V)**

**1.** Loosen the clamps on the vent hose and remove the vent hose.

**2.** Remove the crankcase outlet adapter, gasket and oil separator element.

**3.** Remove the regulator valve from the manifold fitting. Remove the manifold fitting.

**INSTALLATION–352, 390 V-8 AND 427 V-8 (4V)**

**1.** Install the bracket and connector assembly on the intake manifold. Install the vent hose on the carburetor spacer and the bracket and connector assembly.

**2.** Install the regulator valve in the bracket and connector assembly. Install the vent hose on the regulator valve and tighten the clamp.

**3.** On the 352 and 390 V-8, install the crankcase outlet adapter. If the adapter enters the intake manifold more than ½ inch, replace the adapter. Install the vent hose on the outlet adapter and tighten the clamp.

On the 427 V-8 (4V), clean the gasket surfaces of the intake manifold and outlet adapter. Install the oil separator element in the intake manifold. Position a new gasket to the intake manifold and install the outlet adapter.

**4.** Install the vent tube in the vent hoses on the crankcase outlet adapter and the regulator valve. Tighten the clamps.

**INSTALLATION–427 V-8 (8V)**

**1.** Clean the gasket surfaces of the intake manifold and outlet adapter.

**2.** Install the oil separator element in the intake manifold. Position a

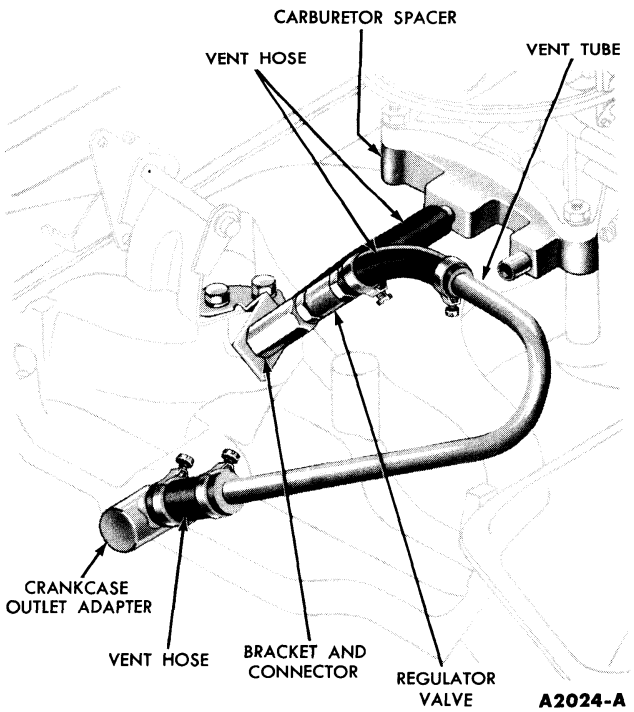



**FIG. 25—Positive Crankcase Vent System Installation-352 and 390 V-8**

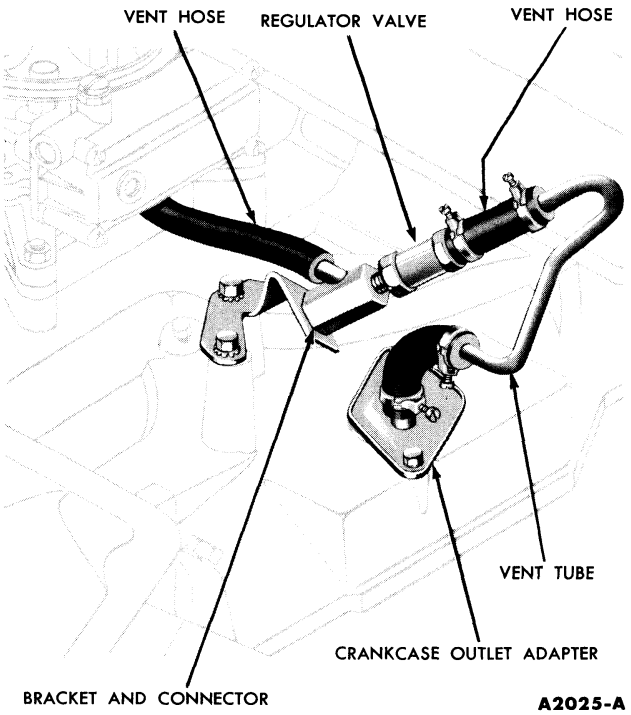



**FIG. 26—Positive Crankcase Vent System Installation-427 V-8 (4V)**

new gasket to the intake manifold and install the outlet adapter.

**3.** Install the fitting in the intake manifold. Install the regulator valve in the fitting.

**4.** Slide the vent hose clamps towards the center of the hose and position the vent hose on the outlet adapter and the regulator valve. Slide the clamps into position and tighten the clamps.

### REGULATOR VALVE DISASSEMBLY

Place the hex on the regulator valve body in a vise. Remove the connector. Soak the valve, spring and valve body in solvent, as necessary, until the valve and spring can be easily removed without distorting the spring. **Under no circumstances should the calibrated spring be altered in any manner.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### TESTING

Refer to Part 8-1, Section 2 for the test procedures.

### REGULATOR VALVE ASSEMBLY

Position the spring and valve inside the regulator valve body (Fig. 28 or 29). Install the regulator valve connector.

## CYLINDER HEADS

### REMOVAL

**1.** Remove the intake manifold, positive crankcase vent system components, carburetor, and radiator

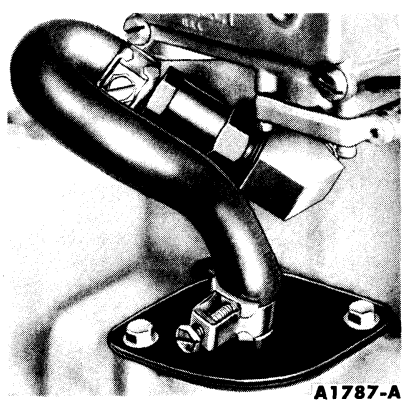



**FIG. 27—Positive Crankcase Vent System Installation-427 V-8 (8V)**

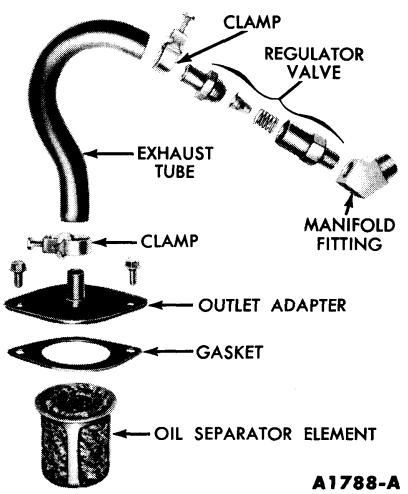



**FIG. 28—Positive Crankcase Vent System Components—427 V-8 (8V)**

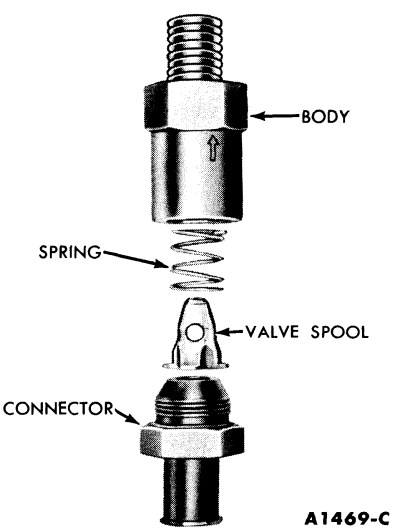



**FIG. 29—Typical Regulator Valve Assembly**

supply tank as an assembly following the procedure under "Intake Manifold Removal."

**2.** On the 352 V-8 and 390 V-8, disconnect the exhaust manifolds at the muffler inlet pipes. Leave the manifolds attached to the cylinder heads.

On the 427 V-8, remove the exhaust manifold to cylinder head retaining bolts. Refer to "Exhaust Manifold Removal." Leave the manifolds attached to the muffler inlet pipes, and secure them to the car frame with wire.

If the left cylinder head is to be removed, remove the ignition coil and the fuel filter (390 Police Interceptor V-8 and 427 V-8).

**3.** Remove the cylinder head bolts. Install the cylinder head holding fixtures (Fig. 30).

**4.** Lift the cylinder heads off the block. **Do not pry between the head and the block.** Remove and discard the cylinder head gasket.

## INSTALLATION

**1.** Clean the cylinder head and cylinder block gasket surfaces.

On the 427 V-8, clean the exhaust manifold gasket surfaces.

**2.** If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket surfaces (Part 8-1, Section 3).

**3.** Apply cylinder head gasket sealer to both sides of a new gasket. Guided by the word "FRONT" on the gasket, install the gasket over the cylinder head dowels.

**4.** Place the cylinder head on the engine, then remove the holding fixtures.

**5.** Install the cylinder head bolts. The cylinder head bolts are tightened in three progressive steps.

On the 352 and 390 V-8 engines, torque all the bolts in sequence (Fig. 31) to 70 ft-lbs. Then torque them to 80 ft-lbs, and finally to 90 ft-lbs.

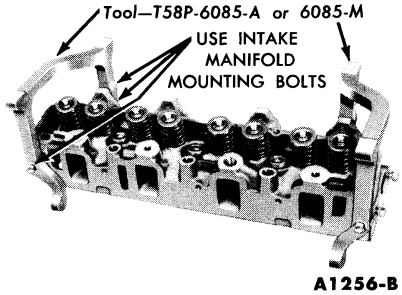



**FIG. 30—Cylinder Head Holding Fixtures**

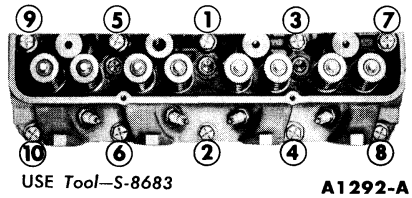



**FIG. 31—Cylinder Head Bolt Torque Sequence**

On the 427 V8 engine, torque all the bolts in sequence (Fig. 31) to 90 ft-lbs. Then torque them to 100 ft-lbs, and finally to 110 ft-lbs.

**After the cylinder head bolts have been torqued to specifications, the bolts should not be disturbed.**

**6.** On the 352 V-8 and 390 V-8, position new gaskets on the muffler inlet pipes. Connect the exhaust manifolds to the muffler inlet pipes. Torque the nuts to specifications.

On the 427 V-8, use new gaskets and position the exhaust manifolds to the cylinder heads. Install and torque the retaining bolts to specifications.

If the left cylinder head was removed, install the ignition coil and the fuel filter (390 Police Interceptor V-8 and 427 V-8).

**7.** Install the intake manifold and related parts following the procedure under "Intake Manifold Installation."

## DISASSEMBLY

**1.** Clean the carbon out of the cylinder head combustion chambers before removing the valves.

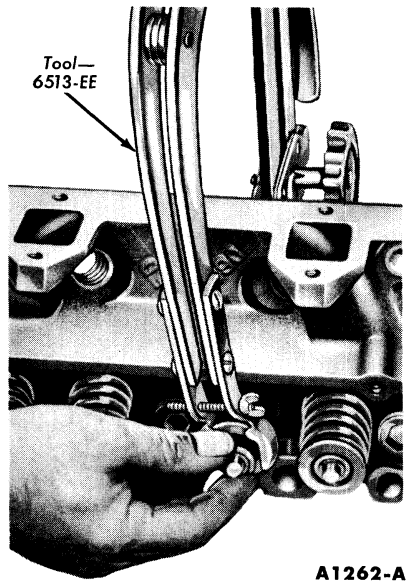



**FIG. 32—Compressing Valve Spring—On Bench**

**2.** Compress the valve springs (Fig. 32). Remove the spring retainer locks and release spring.

**3.** Remove the sleeve, spring retainer, spring (and damper spring if applicable), step seal and valve. Discard the valve stem seals. Identify all valve parts.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## REPAIRS

Cylinder head repair procedures and checks such as valve and valve seat refacing, cylinder head flatness checks, etc., are covered in Part 8-1, Section 2.

## ASSEMBLY

**1.** Install each valve (Fig. 33) in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve.

**2.** Install the valve spring over the valve, and then install the spring retainer and sleeve.

**On the 390 and 427 V-8 engines, make sure the damper spring is installed in the valve spring so that the coil end of the damper spring is 135° counterclockwise from the coil end of the valve spring.**

**3.** Compress the spring and install the retainer locks (Fig. 32).

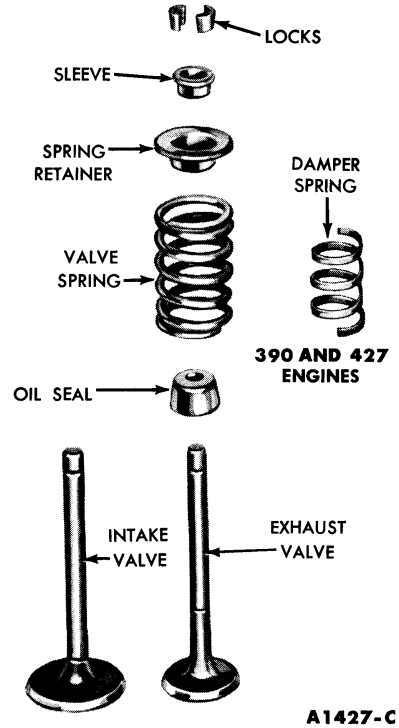



**FIG. 33—Typical Valve Assembly**

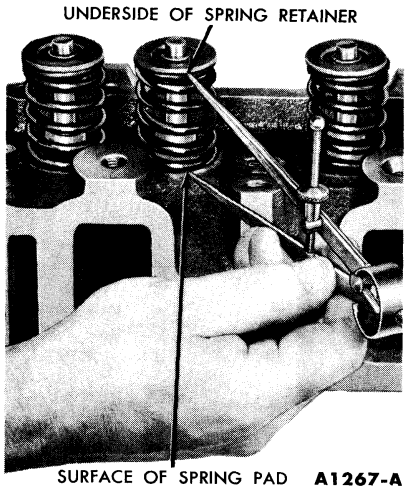



**FIG. 34—Valve Spring Assembled Height**

4. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 34). Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height (Fig. 35).

**Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.**

## VALVE SPRING, RETAINER AND STEM SEAL REPLACEMENT

Broken valve springs, or defective valve stem seals and retainers may be replaced without the need of removing the cylinder head, provided damage to the valve or valve seat has not occurred.

1. Disconnect the automatic choke heat chamber air inlet tube (352 and 390 V-8) and remove the air cleaner. Remove the valve rocker arm cover(s), following steps 2 and 3 under "Valve Rocker Arm Shaft Assembly Removal."

2. Remove the applicable spark plug. Remove the high tension lead wire from the coil terminal. Connect an auxiliary starter switch to the starter relay. Crank the engine until the piston of the affected cylinder is on TDC of the power stroke.

3. Loosen the valve rocker arm support bolts evenly and alternately, two turns at a time, until the valve spring tension has been released. Remove the push rod(s) of the valve to be serviced.

4. Tighten the valve rocker arm support bolts evenly and alternately, two turns at a time, until they are snug. Push the rocker arm to one side and secure it in this position (Fig. 37). If an end valve is to be worked on, it will be necessary to remove the rocker arm from the shaft.

5. Install an air adapter in the spark plug hole and connect the air supply hose to the adapter (Fig. 36). Turn on the air supply. **Air pressure may turn the crankshaft until the piston reaches the bottom of its stroke.**

6. Compress the valve spring and remove the valve retainer locks from the valve (Fig. 37). **If air pressure fails to hold the valve in the closed position during this operation, it can be presumed that the valve is not seating or is damaged. If this condition occurs, remove the cylinder head for further inspection.**




**FIG. 35—Valve Spring Spacer Installation**

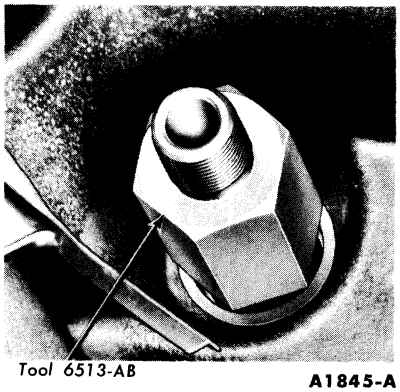



**FIG. 36—Installation of Air Adapter Tool in Spark Plug Hole**

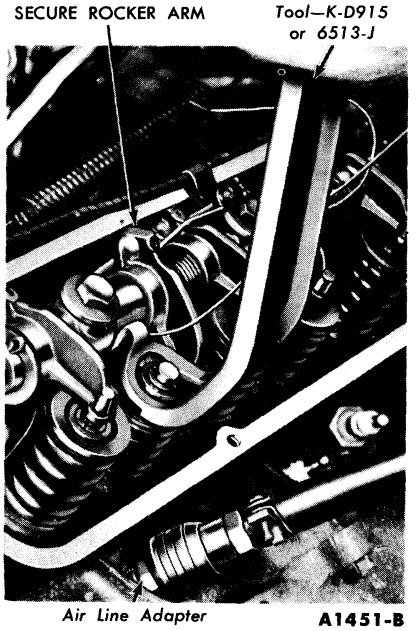



**FIG. 37—Compressing Valve Spring—In Chassis**

7. Remove the valve spring and related parts. Remove the valve stem seal (Fig. 38). **If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.**

8. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric

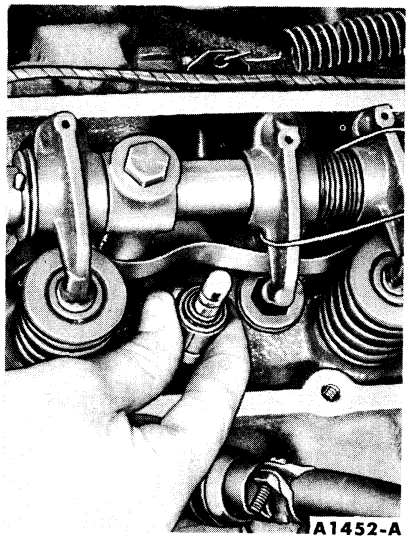



**FIG. 38—Valve Stem Seal Removal**

movement during rotation. Move the valve up and down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 8-1, Section 2.**

**9.** If the condition of the valve proved satisfactory, hold the valve in the closed position and apply the air pressure within the cylinder.

**10.** Inspect the valve stem seal for a cracked, torn or brittle condition, and replace it if necessary. Install the seal on the valve stem.

**11.** Install the valve springs, retainer and sleeve over the valve stem. **On the 390 and 427 V-8 engines, make sure the valve damper spring is installed in the valve spring so that the coil end of the damper spring is 135° counterclockwise from the coil end of the valve spring.**

**12.** Compress the valve spring (Fig. 37) and install the valve retainer locks. Tap the valve stem tip with a soft mallet to make certain that the retainer locks are properly seated.

**13.** Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 34). Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camhaft lobes which could lead to spring breakage and worn camshaft lobes.**

**14.** Remove the air line and adapter. Install the spark plug. Remove the wire securing the valve rocker arm and slide the rocker arm in position. Install the end rocker arm(s), if they were removed.

**15.** Loosen the valve rocker arm support bolts evenly and alternately, two turns at a time, until spring tension is removed. Apply Lubriplate to both ends of the push rod. Position the push rod within the rocker arm socket and the valve lifter seat.

**16.** Tighten the rocker arm shaft support bolts evenly and alternately, two turns at a time, until they are snug. Torque the bolts to specifications.

**17.** Remove the auxiliary starter switch. Install the high tension lead wire to the ignition coil terminal.

**18.** On engines with hydraulic valve lifters, check the valve clearances and correct if necessary (Part 8-1, Section 2).

**19.** On engines with mechanical valve tappets, perform a preliminary (cold) valve lash adjustment (Part 8-1, Section 2).

Temporarily lay the valve rocker arm covers in place and temporarily connect the spark plug wires. Operate the engine until engine temperatures have stabilized. Remove the valve rocker arm covers and perform a hot valve lash adjustment with the engine idling (Part 8-1, Section 2).

**20.** Refer to "Valve Rocker Arm Shaft Assembly" and install the valve rocker arm cover(s), following steps 8 and 9 under "Installation—Hydraulic Valve Lifters." Install the spark plug wires.

**21.** Install the air cleaner and connect the automatic choke heat chamber air inlet tube (352 and 390 V-8).

## CYLINDER FRONT COVER AND TIMING CHAIN

### REMOVAL

**1.** Drain the cooling system and the crankcase. Disconnect the automatic choke heat chamber air inlet tube (352 and 390 V-8) and remove the air cleaner. Disconnect the battery ground cable.

**2.** Disconnect the radiator upper hose at the radiator supply tank. Disconnect the radiator lower hose at the water pump.

On a car with an automatic transmission, disconnect the transmission oil cooler lines at the radiator.

**3.** Remove the radiator.

**4.** Disconnect the heater hose at the water pump. Slide the water pump bypass hose clamp toward the engine.

On a car with power steering, disconnect the power steering pump bracket from the water pump and remove the drive belt. Wire the pump assembly to the left side of the car in a position that will prevent the oil from draining out.

On a car with an air conditioner, remove the compressor drive belt.

**5.** Loosen the generator or alternator mounting bolts at the generator or alternator. Remove the drive belt. Remove the generator or alternator support bolt at the water pump. Remove the water pump, drive belt adjusting arm, pulley and fan as an assembly.

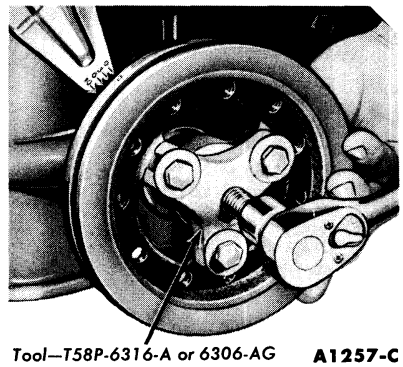



**FIG. 39—Crankshaft Damper Removal**

On a car with power steering, remove the power steering pulley from the crankshaft damper.

**6.** Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft damper (Fig. 39) and remove the damper.

**7.** Disconnect the carburetor fuel inlet line at the fuel pump.

**8.** Remove the fuel pump retaining bolts and lay the pump to one side with the flexible fuel line still attached.

**9.** If the crankshaft sleeve is not stepped down (the same OD on both ends), remove it as shown in Fig. 40. If the sleeve is stepped down, remove it with a three-jawed puller.

**10.** Remove the screws fastening the cylinder front cover to the block. Remove the cylinder front cover.

On a car with an air conditioner,

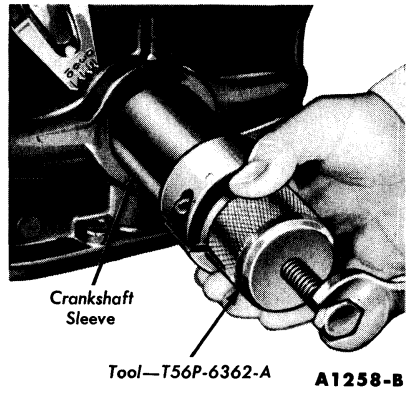
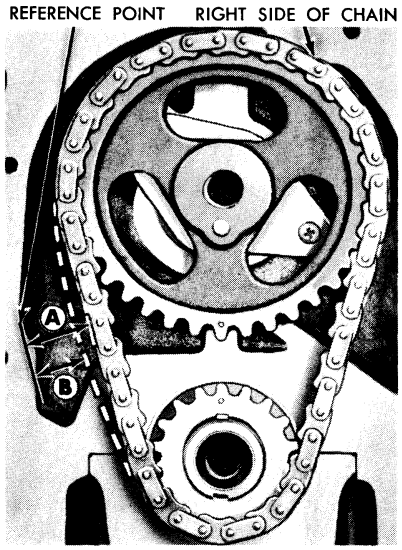



**FIG. 40—Crankshaft Sleeve Removal**




TAKE UP SLACK ON LEFT SIDE, ESTABLISH REFERENCE POINT. MEASURE DISTANCE **A**. TAKE UP SLACK ON RIGHT SIDE. FORCE LEFT SIDE OUT. MEASURE DISTANCE **B**. DEFLECTION IS **A** MINUS **B**. A1284-B

**FIG. 41—Timing Chain Deflection**

the compressor brackets are retained by cylinder front cover screws.

**11.** Discard the cylinder front cover gasket. Remove the crankshaft front oil slinger.

**12.** Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.

**13.** Establish a reference point on the block and measure from this point to the chain (Fig. 41).

**14.** Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

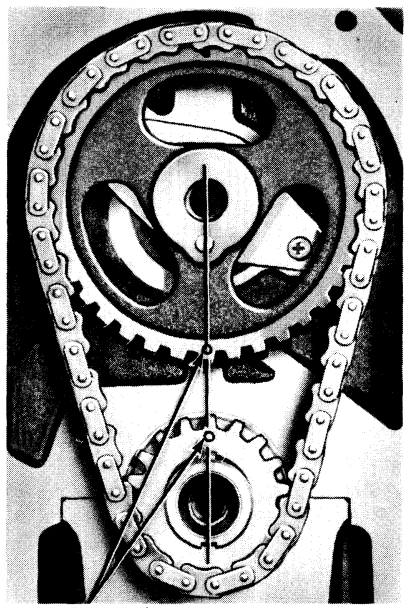
If the deflection exceeds ½ inch, replace the timing chain and both sprockets.

**15.** Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 42.

**16.** Remove the camshaft sprocket cap screw and the fuel pump eccentric.

**17.** Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 43).

**18.** Remove the oil pan and oil pump screen, following the procedure under "Oil Pan Removal."



TIMING MARKS A1283-B

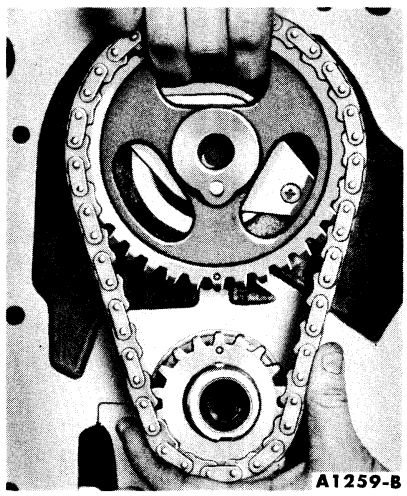
**FIG. 42—Aligning Timing Marks**

## FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

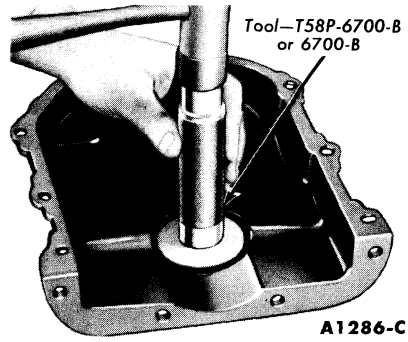
**1.** Drive out the old seal with a pin punch. Clean out the recess in the cover.

**2.** Coat a new seal with grease, then install the seal (Fig. 44). Drive the seal in until it is fully seated in the recess. Check the seal after installation to be sure the spring is properly positioned in the seal.



A1259-B

**FIG. 43—Timing Chain Removal or Installation**




A1286-C

**FIG. 44—Oil Seal Installation**

## INSTALLATION

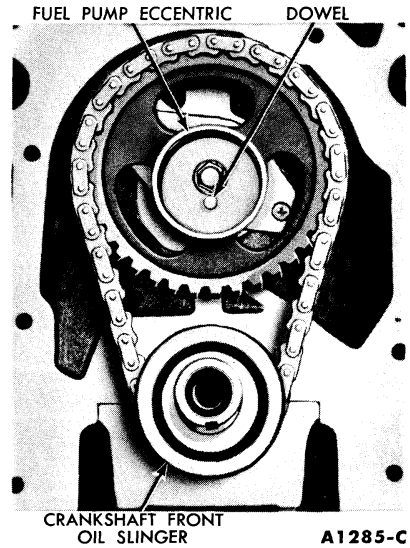
**1.** Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 43). Be sure the timing marks on the sprockets are positioned as shown in Fig. 42.

**2.** Install the fuel pump eccentric and the camshaft sprocket cap screw (Fig. 45). Torque the sprocket cap screw to specifications. Install the crankshaft front oil slinger.

**3.** Clean the cylinder front cover, oil pan, and the block gasket surfaces.

**4.** Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

**5.** Lubricate and install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft.




A1285-C

**FIG. 45—Fuel Pump Eccentric and Front Oil Slinger Installed**

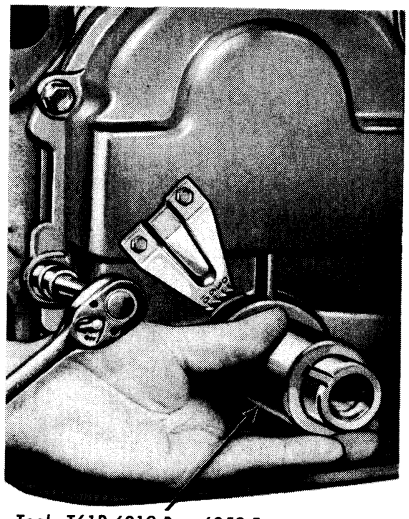



**FIG. 46—Cylinder Front Cover Alignment**

Position the cover and pilot over the end of the crankshaft and against the block (Fig. 46). Install the retaining screws.

On a car with an air conditioner, position the compressor bracket on the cylinder front cover and install the retaining screws finger-tight.

While pushing in on the pilot, torque the screws to specifications. Remove the pilot.

**6.** Install the crankshaft sleeve.

**7.** Lubricate the hub and line up the damper keyway with the key on the crankshaft. Install the damper on the crankshaft (Fig. 47).

**8.** Install the damper cap screw and washer. Torque the screw to specifications.

On a car with power steering, install the power steering pump pulley on the damper. Torque the screws to specifications.

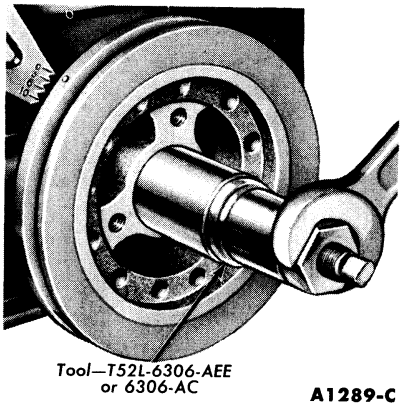



**FIG. 47—Crankshaft Damper Installation**

**9.** Clean the oil pan and the oil pump screen. Install the oil pump screen and oil pan, following the procedure under "Oil Pan Installation."

**10.** Clean the water pump gasket surfaces. Coat new gaskets with sealer and position the gaskets on the block. Install the water pump, pulley, fan and generator or alternator adjusting arm as an assembly.

**11.** Install and adjust the generator or alternator drive belt(s) to the specified tension.

On a car with an air conditioner, install and adjust the drive belt.

On a car with power steering, install the power steering pump drive belt and attach the pump bracket to the water pump. Adjust the drive belt tension to the specified tension.

**12.** Install the fuel pump, using a new gasket.

**13.** Connect the carburetor fuel inlet line. Connect the heater hoses. Slide the water pump bypass tube clamp forward on the tube.

**14.** Install the radiator. Connect the radiator lower hose at the water pump and the radiator upper hose at the radiator supply tank. Connect the battery ground cable.

On a car with an automatic transmission, connect the transmission oil cooler lines.

**15.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Connect the heater hose to the intake manifold.

**16.** Operate the engine at fast idle and check for coolant and oil leaks. Adjust the ignition timing. Install the air cleaner and connect the automatic choke heat chamber air inlet tube (352 and 390 V-8).

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedure.

## CAMSHAFT

The camshaft and related parts are shown in Fig. 48.

### REMOVAL

**1.** Remove the cylinder front cover and the timing chain and sprockets following steps 1 thru 11 under "Cylinder Front Cover and Timing Chain Removal."

**2.** Remove the grille.

**3.** Refer to "Valve Rocker Arm Shaft Assembly Removal" and remove the valve rocker arm covers and the valve rocker arm shaft assemblies.

**4.** Disconnect the coil high tension lead at the coil. Remove the distributor cap and spark plug wire assembly. Disconnect the distributor vacuum line at the distributor. Remove the distributor hold-down bolt and clamp and remove the distributor.

**5.** Remove the valve push rods in sequence and place them in a rack so that they can be installed in their original positions.

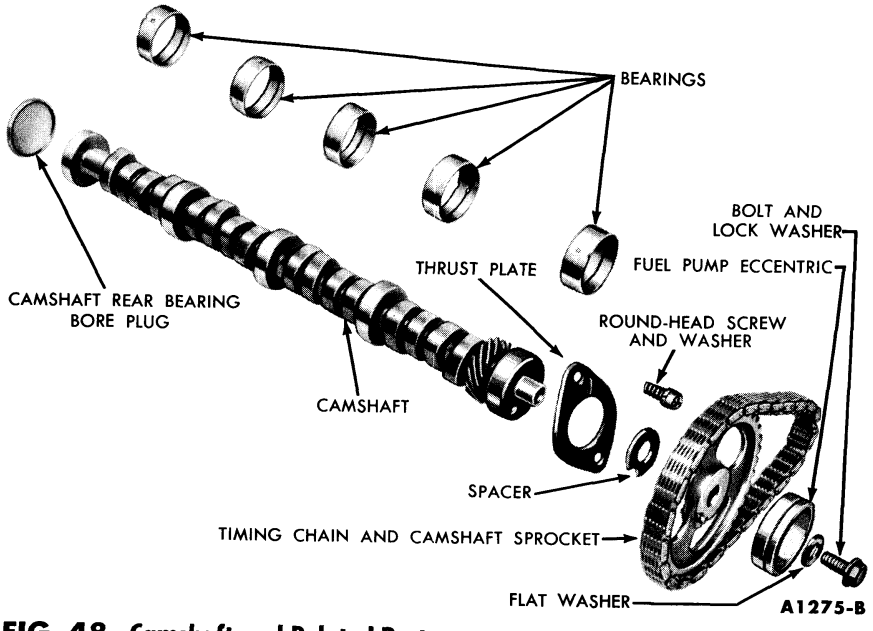



**FIG. 48—Camshaft and Related Parts**

**6.** Position an inspection light through a push rod opening and into the valve push rod valley (Fig. 49). Remove the valve lifters or tappets with a magnet through the push rod openings. In some cases it will be necessary to transfer the lifter or tappet over to an adjoining push rod opening in order to remove it. Place the lifters or tappets in a rack so that they can be installed in their original positions.

**7.** Remove the oil pan and oil pump screen by following the procedure under "Oil Pan Removal."

**8.** Install a dial indicator so the indicator point is on the camshaft sprocket retaining screw. Push the camshaft toward the rear of the engine and set the dial indicator on zero. Pull the camshaft forward and release it. Compare the indicator reading with the specifications. If the end play is excessive, check the spacer for correct installation before it is removed. **The side of the spacer having a chamfer on the ID must be against the camshaft front journal.** If the spacer is installed correctly, replace the thrust plate.

**9.** Remove the dial indicator. Remove the timing chain and sprockets following steps 12 thru 17 under "Cylinder Front Cover and Timing Chain Removal."

**10.** Remove the camshaft thrust plate and spacer. Carefully remove the camshaft by pulling it toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

### INSTALLATION–ENGINES WITH HYDRAULIC VALVE LIFTERS

**1.** Oil the camshaft and apply Lubriplate to the lobes. Carefully slide the camshaft through the bearings. Install the thrust plate and spacer. **The chamfered ID of the spacer must be towards the camshaft front journal. Be sure the thrust plate oil groove is up and towards the front (next to camshaft sprocket).**

**2.** Follow the procedure in step 8 of "Camshaft Removal" and check the camshaft end play.

**3.** Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 43) with the timing marks on the sprockets aligned as shown in Fig. 42.

**4.** Install the fuel pump eccentric and the camshaft sprocket cap screw (Fig. 45). Torque the sprocket cap screw to specifications. Install the front oil slinger.

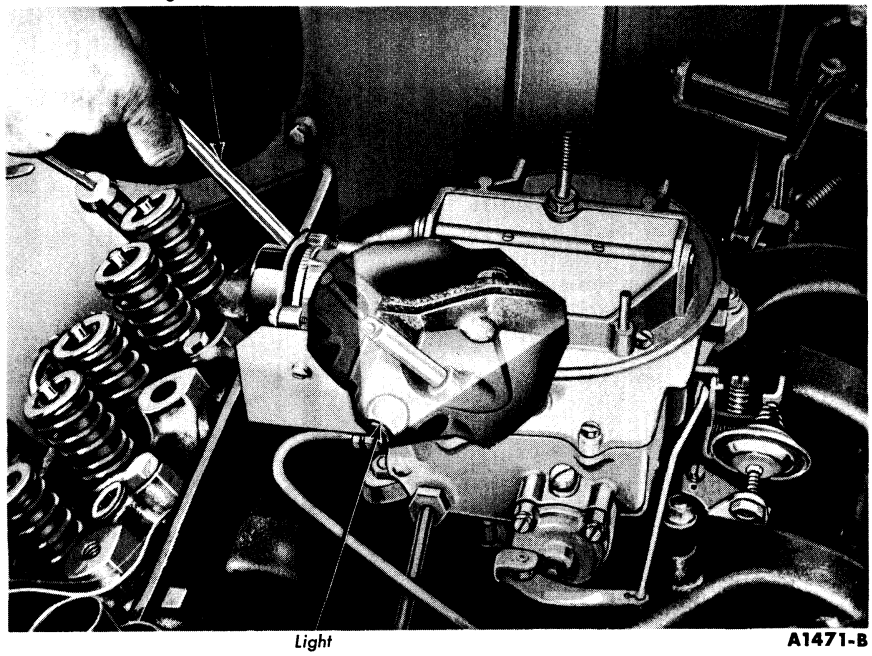



**FIG. 49–Typical Valve Lifter Removal Intake Manifold Installed**

**5.** Replace the crankshaft front oil seal. Install the cylinder front cover, the crankshaft damper, and related parts following steps 3 thru 14 under "Cylinder Front Cover and Timing Chain Installation."

**6.** Install the grille.

**7.** With No. 1 piston on TDC at the end of the compression stroke, position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**8.** Install the distributor cap. Connect the coil high tension lead.

**9.** Install the valve lifters in the bores from which they were removed. Install the push rods in their original positions.

**10.** Refer to "Valve Rocker Arm Shaft Assembly Installation" and install the valve rocker arm shaft assembly following steps 1 thru 9 under "Engines With Hydraulic Valve Lifters".

**11.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

**12.** Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

### INSTALLATION–ENGINES WITH MECHANICAL VALVE TAPPETS

**1.** Follow steps 1 thru 4 under "Installation–Engines With Hydraulic Valve Lifters."

**2.** Replace the crankshaft front oil seal. Install the cylinder front cover, the crankshaft damper, and related parts following steps 3 thru 14 under "Cylinder Front Cover and Timing Chain Installation."

**3.** Install the grille.

**4.** With No. 1 piston on TDC at the end of the compression stroke, position the distributor in the block with the rotor on the No. 1 firing position and the points just open. Install the hold down clamp.

**5.** Install the distributor cap. Connect the coil high tension lead.

**6.** Install the tappets in the bores from which they were removed. Install the push rods in their original positions.

**7.** Refer to "Valve Rocker Arm Shaft Assembly Installation" and install the valve rocker arm shaft as-

sembly following steps 1 thru 4 under "Mechanical Valve Tappets."

**8.** Temporarily lay the valve rocker arm covers in place and temporarily connect the spark plug wires.

**9.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

**10.** Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Operate the engine for 30 minutes at 1200 rpm to stabilize engine temperatures. Remove the valve rocker arm covers and perform a hot valve lash adjustment with the engine idling (Part 8-1, Section 2).

**11.** Clean the valve rocker arm cover(s). Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s) in place in the cover(s).

**12.** Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts (and the wire loom clamps on the left cover). The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

**13.** Connect the brake booster vacuum line. Install the carburetor choke heat tube.

**14.** Connect the spark plug wires.

## CAMSHAFT REAR BEARING BORE PLUG REPLACEMENT

**1.** On a car with a manual-shift transmission, slide the transmission to the rear and remove the clutch pressure plate, disc and flywheel housing following the procedure in Group 5.

On a car with an automatic transmission, remove the transmission and converter housing following the procedure in Group 7.

**2.** Remove the flywheel retaining bolts and remove the flywheel.

**3.** Drill a ½-inch hole in the camshaft rear bearing bore plug and use tool T-7600-E to remove the plug.

**4.** Clean out the plug bore recess thoroughly.

**5.** Coat the flange of a new plug with oil-resistant sealer and install it with the flange facing out (Fig. 75).

**6.** Install the flywheel.

On a car with a manual-shift transmission, install the clutch pressure plate, disc, and flywheel housing and install the transmission following the procedure in Group 5.

On a car with an automatic transmission, install the transmission and converter housing following the procedure in Group 7.

## VALVE LIFTER OR TAPPET REPLACEMENT

The following procedure is applicable for removing one or all of the valve lifters and it applies to either hydraulic valve lifters or solid valve tappets. This procedure cannot be used if the valve lifters or tappets are stuck in their bore by excessive varnish, etc. In this case, it will be necessary to remove the intake manifold. After the intake manifold has been removed, remove the valve lifters or tappets.

**1.** Refer to "Valve Rocker Arm Shaft Assembly Removal" and remove the valve rocker arm covers and the valve rocker arm shaft assemblies by following steps 1 thru 5 under "Hydraulic Valve Lifters" or steps 1 thru 3 under "Mechanical Valve Tappets."

**2.** Position an inspection light through a push rod opening and into the valve push rod valley (Fig. 49). Remove the valve lifters or tappets with a magnet through the push rod openings. In some cases it will be necessary to transfer the lifter or tappet over to an adjoining push rod opening in order to remove it. Place the lifters in a rack so that they can be installed in their original positons.

**On an engine with hydraulic valve lifters, the internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.**

**3.** Install the new (or cleaned) hydraulic valve lifters or tappets through the push rod openings with a magnet (Fig. 49). Install the push rods in their original positions.

**4.** Refer to "Valve Rocker Arm Shaft Assembly Installation" and install the valve rocker arm shaft assemblies and the rocker arm covers by following the procedure for "Hydraulic Valve Lifters" or "Mechanical Valve Tappets."

## HYDRAULIC VALVE LIFTER DISASSEMBLY

Each valve lifter is a matched assembly. If the parts of one lifter are intermixed with those of another, improper valve operation may result. Disassemble and assemble each lifter separately. Keep the lifter assemblies in proper sequence so that they can be installed in their original bores.

**1.** Grasp the lock ring with the needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.

**2.** Remove the push rod cup. Remove the plunger (Fig. 50) and plunger spring.

**3.** Invert the plunger assembly and remove the disc valve retainer by carefully prying up on it with a screw driver. Remove the disc valve and spring.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## HYDRAULIC VALVE LIFTER ASSEMBLY

A typical hydraulic valve lifter assembly is shown in Fig. 51.

**1.** Place the plunger upside down on a clean work bench.

**2.** Place the disc valve in position over the oil hole on the bottom of the plunger. Set the disc valve spring on top of the disc.

**3.** Position the disc valve retainer over the disc and spring and push the retainer down into place on the plunger.

**4.** Place the plunger spring, and then the plunger (open end up) into the lifter body.

**5.** Place the push rod cup in the plunger.

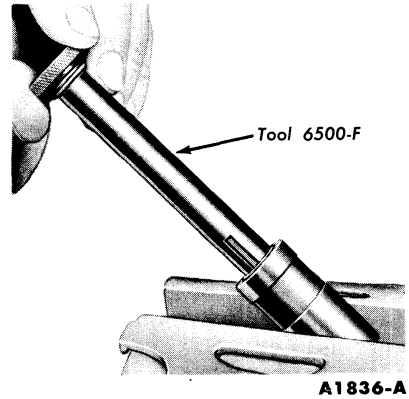
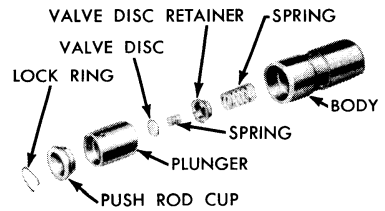



**FIG. 50—Lifter Plunger Removal**




**NOTE:** PLUNGER AND BODY ARE MATCHED SELECTIVE FIT SETS. DO NOT MISMATE PAIRS.

A1835-A

**FIG. 51—Typical Hydraulic Valve Lifter Assembly**

6. Push the plunger and push rod cup into the body and install the lock ring (Fig. 52). Release the plunger, then depress it again to fully seat the lock ring.

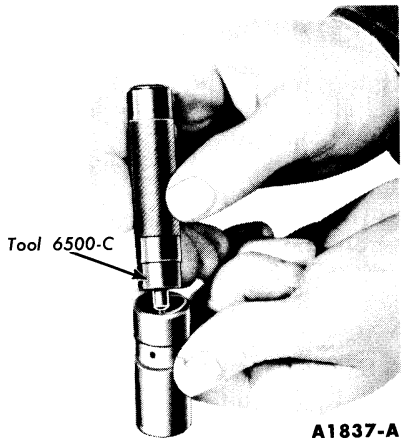
### TESTING

Refer to Part 8-1, Section 1 for the testing procedures.

## MAIN AND CONNECTING ROD BEARING REPLACEMENT

The main and connecting rod bearing inserts are selective fit. **Do not file or lap bearing caps or use shims to obtain the proper bearing clearance.**

Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to the Parts Catalog for the available sizes. **Red marked bearings increase the clearance; blue marked bearings decrease the clearance.** Undersize bearings, which are not selective fit, are available for use on journals that have been refinished.




A1837-A

**FIG. 52—Lock Ring Installation**

### MAIN BEARING REPLACEMENT

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and oil pump. Remove the spark plugs to allow easy rotation of the crankshaft.

2. **Replace one bearing at a time leaving the other bearing securely fastened.** Remove the main bearing cap to which new bearings are to be installed.

**On a 427 V-8, remove the main bearing cap cross-bolts, washers and spacers (Fig. 78) before removing the cap retaining bolts.**

3. Insert the upper bearing removal tool (tool 6331-E) in the oil hole in the crankshaft (Fig. 53).

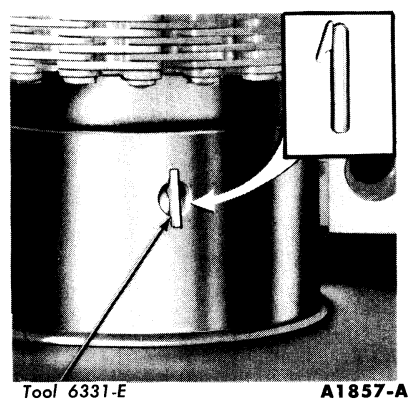
4. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

5. Clean the crankshaft journal and bearing inserts. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

6. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that tool 6331 can be inserted in the oil hole in the crankshaft (Fig. 53). With tool 6331-E positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

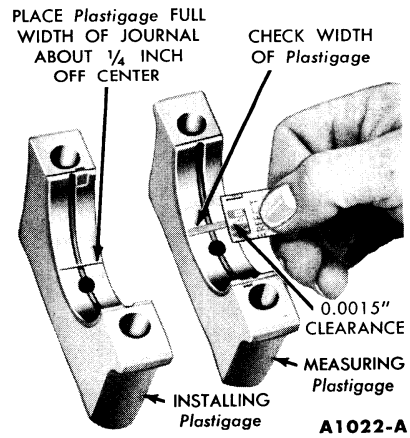
7. Replace the cap bearing.

8. Support the crankshaft so that its weight will not compress the Plastigage and provide an erroneous reading. Position a small jack so that it will bear against the counterweight adjoining the bearing which is being checked.




A1857-A

**FIG. 53—Upper Main Bearing Insert Removal or Installation**




A1022-A

**FIG. 54—Installing and Measuring Plastigage—Engine In Chassis**

9. Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about ¼ inch off-center (Fig. 54).

10. Install the cap and torque the bolts to specifications. **Do not turn the crankshaft while the Plastigage is in place. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.**

11. If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.

12. After the bearing has been checked and found to be satisfactory, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Torque the cap bolts to specifications.

On a 427 V-8 install the main bearing cap cross-bolts, washers and spacers, following the procedure in step 15 of "Engine Assembly."

13. Repeat the procedure for the remaining bearings that require replacement.

14. If the rear main bearing is to be replaced, remove the rear main bearing cap. Remove and discard the rear seal and side seals.

15. Clean the rear journal oil seal groove.

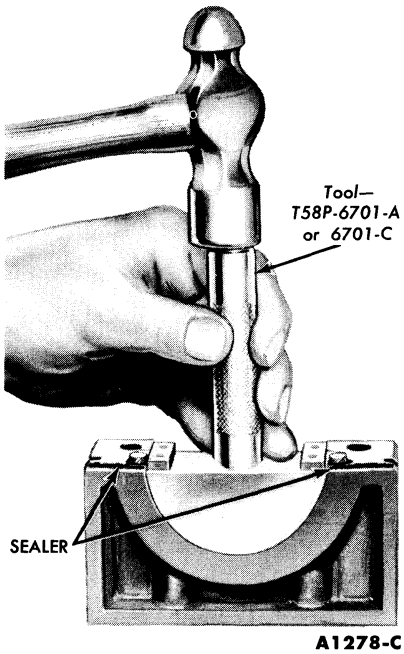



**FIG. 55—Seal to Rear Bearing Cap Installation**

**16.** Install a new rear journal oil seal in the rear main bearing cap (Fig. 55). After installation, cut the ends of the seals flush.

**17.** Apply a thin coating of oil resistant sealer to the rear main bearing cap at the rear of the top mating surface (Fig. 55). **Do not apply sealer to the area forward of the side seal groove.** Install the rear main bearing cap. Torque the cap bolts to specifications.

**18.** Dip the side seals in light engine oil, then immediately install them in the grooves. **Do not use sealer on the side seals. The seals are designed to expand when dipped in oil. Using sealer may retard this expansion.** It may be necessary to tap the seals into place for the last ½ inch of travel. Do not cut the seal projecting ends.

**19.** Check the retainer side seals for leaks by squirting a few drops of oil into the parting lines between the rear main bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the seal grooves.**

**20.** Disassemble, clean, and assemble the oil pump.

**21.** Install the oil pump and oil pan. Install the oil level dipstick. Fill the crankcase with the proper amount and viscosity oil. Install the spark plugs.

**22.** Operate the engine and check for oil leaks.

## CONNECTING ROD BEARING REPLACEMENT

**1.** Follow step 1 under "Main Bearing Replacement."

**2.** Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down.

**3.** Remove the connecting rod cap. Push the connecting rod up into the cylinder and remove the bearing insert from the rod and cap.

**4.** Follow step 5 under "Main Bearing Replacement."

**5.** Install the new bearings in the connecting rod and cap. Pull the connecting rod assembly down firmly on the crankshaft journal.

**6.** Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about ¼ inch off-center.

**7.** Install the cap and torque the connecting rod nuts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

**8.** Remove the cap, then using the Plastigage scale check the width of the Plastigage following steps 9 thru 11 under "Main Bearing Replacement".

**9.** After the bearing clearance has been checked and found to be satisfactory, apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap.

**10.** Repeat the procedure for the remaining connecting rods that require new bearings.

**11.** Follow steps 20, 21 and 22 under "Main Bearing Replacement."

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

## PISTON AND CONNECTING ROD ASSEMBLY

### REMOVAL

**1.** Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump following the procedures in this section.

**2.** Remove any ridge and/or deposits from the upper end of the cylinder bores as follows:

Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter (tool 6011-E). Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

**3.** Make sure all connecting rod caps are marked so that they can be installed in their original locations.

**4.** Turn the crankshaft until the connecting rod being removed is down.

**5.** Remove the connecting rod cap.

**6.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**

**7.** Remove the bearing inserts from the connecting rod and cap.

**8.** Install the cap on the connecting rod from which it was removed.

### INSTALLATION

**1.** If new piston rings are to be installed, remove the cylinder wall glaze. Follow the instructions of the tool manufacturer.

**2.** Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing cap are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**

**3.** Make sure the ring gaps are properly spaced around the circumference of the piston.

**4.** Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder

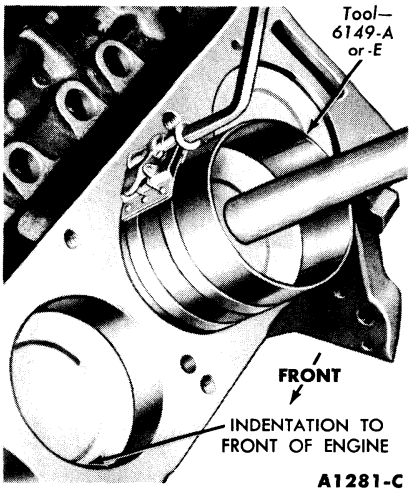



**FIG. 56–Typical Piston Installation**

(Fig. 56). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation in the piston head toward the front of the engine.**

**5.** Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement."

**6.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

**7.** Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.

**8.** Install the connecting rod cap. Torque the nuts to specifications.

**9.** After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 57).

**10.** Disassemble, clean, and assemble the oil pump. Clean the oil pump inlet tube screen, and the oil pan and block gasket surfaces.

**11.** Prime and install the oil pump. Install the oil pan.

**12.** Install the cylinder heads by following steps 1 thru 6 under "Cylinder Head Installation."

**13.** Refer to "Intake Manifold Installation" and install the intake manifold by following steps 2 thru 17 under "Engines with Hydraulic Valve Lifters" or steps 1 thru 8 under "Engines with Mechanical Tappets."

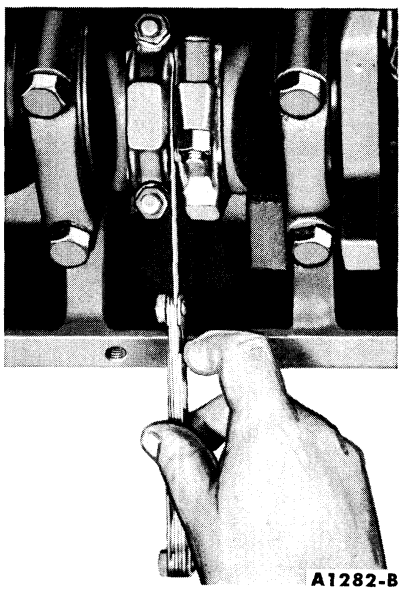



**FIG. 57–Connecting Rod Side Clearance**

**14.** Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

**15.** Operate the engine and check for oil and coolant leaks. Check and adjust the ignition timing.

On an engine with mechanical lifters perform a final (hot) valve lash adjustment (Part 8-1, Section 2).

**16.** Adjust the engine idle speed and fuel mixture.

On an engine with mechanical lifters, install the valve rocker arm covers.

**17.** Install the air cleaner and connect the automatic choke heat chamber air inlet tube (352 and 390 V-8).

## DISASSEMBLY

**1.** Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed.

**2.** Remove the piston rings. Remove the piston pin retainers. Drive the pin out of the piston and connecting rod (Fig. 58). Discard the retainers.

## CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

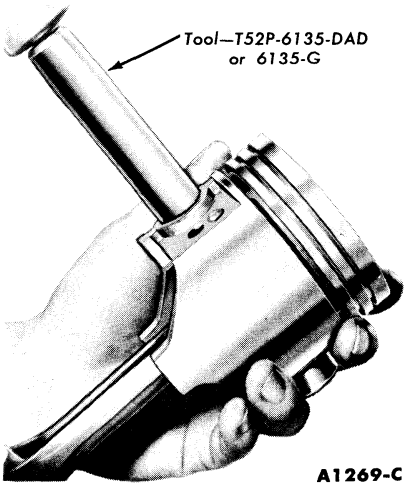



**FIG. 58–Piston Pin Removal**

## REPAIRS

Refer to Part 8-1, Section 2 for the repair procedures.

## ASSEMBLY

The piston, connecting rod and related parts are shown in Fig. 59.

**1.** Lubricate all parts with light engine oil. Position the connecting rod in the piston and push the pin into place. Assemble the piston and connecting rod as shown in Fig 60.

**2.** Insert new piston pin retainers into the piston. Follow the instruc-

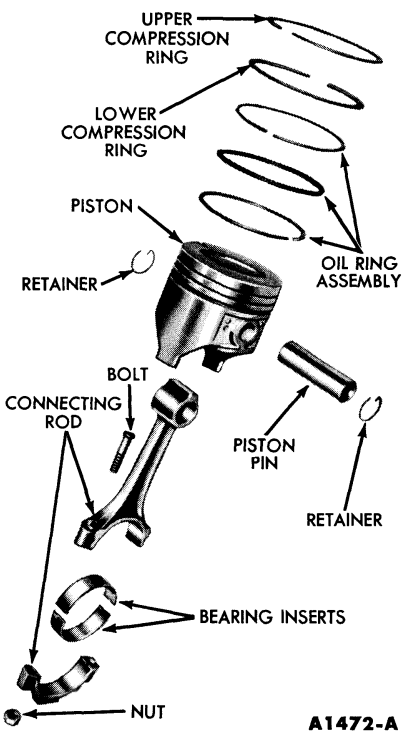



**FIG. 59–Typical Piston, Connecting Rod and Related Parts**

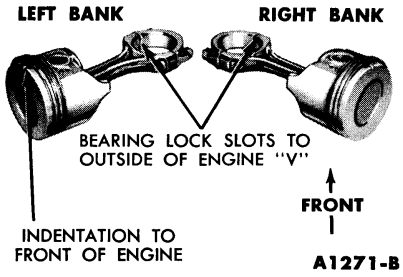



**FIG. 60—Typical Connecting Rod and Piston Assembly**

tions contained on the piston ring package and install the piston rings.

**3.** Check the ring side clearance of the compression rings with a feeler gauge (step 6 under "Fitting Piston Rings" in Part 8-1, Section 2).

**4.** Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

## FLYWHEEL

### REMOVAL

**1.** Disconnect the transmission from the engine and slide it to the rear as outlined in Group 5 (manual-shift transmissions) or on an automatic transmission remove the transmission (Group 7).

On a manual-shift transmission, remove the pressure plate and cover assembly as outlined in Group 5.

**2.** Remove the flywheel retaining bolts and remove the flywheel.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

To check flywheel face runout or replace flywheel ring gear, refer to Part 8-1, Section 2.

### INSTALLATION

**1.** Install the flywheel on the crankshaft flange and install the retaining bolts. Torque the bolts in sequence across from each other to specifications.

On a manual-shift transmission, install the pressure plate and cover assembly (Group 5).

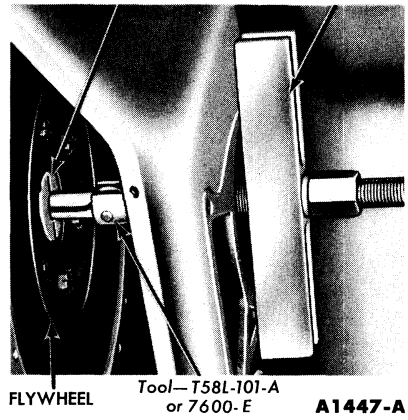



**FIG. 61—Typical Clutch Pilot Bushing Removal**

**2.** Connect the transmission to the engine as outlined in Group 5 (manual-shift transmissions) or on an automatic transmission, install the transmission (Group 7).

## CLUTCH PILOT BUSHING REPLACEMENT

Inspection procedures are outlined under "Crankshaft Cleaning and Inspection" in Part 8-1, Section 3.

**1.** Disconnect the transmission from the engine and slide it to the rear as outlined in Group 5.

**2.** Remove the pressure plate and cover assembly and the clutch disc as outlined in Group 5.

**3.** Remove the pilot bushing (Fig. 61).

**4.** Coat the pilot bushing bore in the crankshaft with a small quantity of wheel bearing lubricant. **Avoid using too much lubricant as it may be thrown onto the clutch disc when the clutch revolves.**

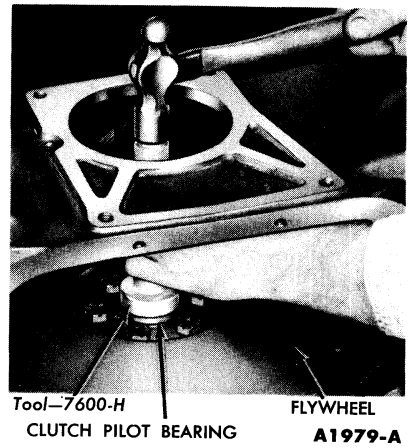



**FIG. 62—Typical Clutch Pilot Servicing Bearing Installation**

**5.** Install the pilot service bearing (Fig. 62).

**6.** Install the clutch disc and the pressure plate and cover assembly as outlined in Group 5.

**7.** Connect the transmission to the engine as outlined in Group 5.

## OIL FILTER REPLACEMENT

The Rotunda oil filter assembly is shown in Fig. 63.

**1.** Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

**2.** Coat the gasket on the new filter with oil. Place the filter in position on the adapter (Fig. 64). Hand tighten the filter until the gasket contacts the adapter face. Then advance it ½-turn.

**3.** Operate the engine at fast idle and check for leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

## OIL PAN AND OIL PUMP

### REMOVAL

**1.** Raise the car and place safety stands into position. Drain the oil from the crankcase.

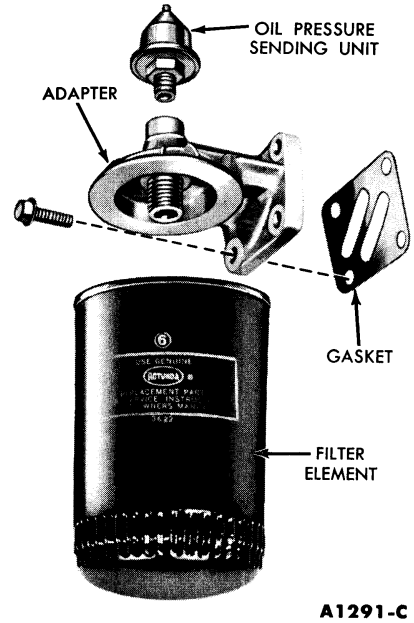



**FIG. 63—Typical Rotunda Oil Filter Assembly**




**FIG. 64—Rotunda Oil Filter Replacement**

2. Disconnect the stabilizer bar at the connecting links and pull the ends down.

3. To allow clearance for removal of the oil pan, remove the engine front support insulator to frame nuts and lock washers. Install a block of wood on a floor jack and position the jack under the front leading edge of the oil pan. Raise the engine approximately 1¼ inches and insert a 1 inch block of wood between the insulators and the frame cross member. Remove the floor jack.

4. Remove the oil pan retaining screws and lower the oil pan to the frame cross member.

5. Crank the engine to obtain the necessary clearance between the crankshaft counterweight and the rear of the oil pan. Remove the oil pan.

6. Remove the oil pump retaining screws, then remove the oil pump and intermediate drive shaft.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### INSTALLATION

1. Clean the oil pan and block gasket surfaces. Clean the oil pump inlet tube screen. Position a new oil pump inlet tube gasket on the oil pump and install the tube.

2. Apply oil-resistant sealer to the oil pan gasket surfaces and position the gasket on the oil pan.

Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

3. Position a new gasket on the pump housing. Insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. (Fig. 65). **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.** Torque the oil pump retaining screws to specifications.

4. Hold the oil pan in place against the cylinder block and install a retaining screw on each side of the pan. Using the special spring washers, install the oil pan to rear main bearing cap bolts. Install the remaining screws and tighten them from the center outward. Torque the screws to specifications.

5. Position the floor jack and block of wood under the leading edge of the oil pan. Raise the engine slightly and remove the wood blocks from beneath the insulators. Lower the engine and remove the jack. Install the insulator to frame lock washers and nuts. Torque the nuts to specifications.

6. Connect the stabilizer bar. Replace the oil filter. Remove the safety stands and lower the car.

7. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for oil leaks.

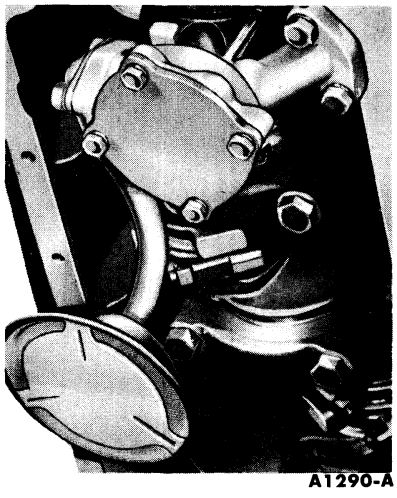



**FIG. 65—Typical Oil Pump and Inlet Tube Installation**

### OIL PUMP DISASSEMBLY

1. Remove the oil inlet tube from the oil pump and remove the gasket.

2. Remove the cover retaining screws, then remove the cover. Remove the inner rotor and shaft assembly and the outer race.

3. Remove the staking marks at the relief valve chamber cap. Insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### OIL PUMP ASSEMBLY

The oil pump assembly is shown in Fig. 66.

1. Oil all parts thoroughly.

2. Install the oil pressure relief valve plunger, spring and a new cap. Stake the cap.

3. Install the outer race, and the inner rotor and shaft assembly. **The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.** Install the cover. Torque the cover retaining screws to specifications.

4. Position a new gasket and the oil inlet tube on the oil pump and install the retaining bolts.

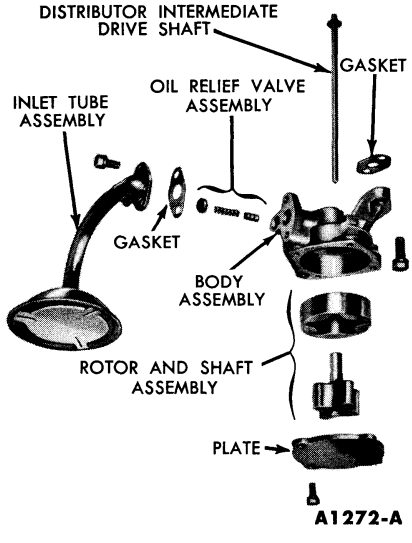



**FIG. 66—Typical Oil Pump Assembly**

# 3 ENGINE REMOVAL AND INSTALLATION

The engine removal and installation procedures are for the engine only without the transmission attached.

## 352 AND 390 V-8

### REMOVAL

**1.** Drain the cooling system and the crankcase. Remove the hood. Disconnect the automatic choke heat chamber air inlet tube and remove the air cleaner. Disconnect the battery ground cable.

**2.** Disconnect the radiator upper hose at the engine and the radiator lower hose at the water pump.

On a car with an automatic transmission, disconnect the transmission oil cooler lines at the radiator.

**3.** Remove the radiator. Remove the oil level dipstick and the ignition coil.

**4.** Disconnect the oil pressure sending unit wire at the sending unit, and the flexible fuel line at the fuel tank line.

On a car with a manual-shift transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator retracting spring.

On a car with an automatic transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator retracting spring. Remove the accelerator cross shaft bracket from the intake manifold and position it out of the way.

On a car with power steering, disconnect the power steering pump bracket from the water pump. Wire the power steering pump in a position that will prevent the oil from draining out. Disconnect the brake vacuum hose at the pipe and position the hose out of the way.

**5.** Disconnect the heater hoses at the water pump and intake manifold, the generator or alternator wires at the generator or alternator, and the water temperature sending unit at the sending unit.

**6.** Remove the wire loom from the clips on the left valve rocker arm cover and position it out of the way.

**7.** Remove the flywheel or converter housing to engine upper bolts.

**8.** Raise the front of the car. Remove the starter and dust seal.

**9.** Disconnect the muffler inlet pipes from the exhaust manifolds. Disconnect the engine support insulators at the frame.

On a car with an automatic transmission, remove the flywheel housing cover. Remove the oil cooler lines retaining clip from the engine block. Disconnect the converter from the flywheel. Secure the converter assembly in the housing. Remove the remaining flywheel housing to engine bolts, and remove the transmission fluid filler tube bracket.

On a car with a manual-shift transmission, remove the flywheel housing inspection cover and the clutch pedal retracting spring. Disconnect the clutch release bracket at the equalizer rod and remove the bracket from the engine. Remove the remaining flywheel housing to engine bolts.

**10.** Lower the car, then support the transmission. Install the engine left lifting bracket on the front of the left cylinder head, and install the engine right lifting bracket at the rear of the right cylinder head, then attach the engine lifting sling (Fig. 67).

**11.** Raise the engine slightly and carefully pull it from the transmission. Lift the engine out of the engine compartment and install it on a work stand.

### INSTALLATION

**1.** Place a new gasket over the studs of the exhaust manifolds.

**2.** Attach the engine lifting brackets and sling (Fig. 67). Remove the engine from the work stand.

**3.** Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and the dowels in the block engage the holes in the flywheel housing.

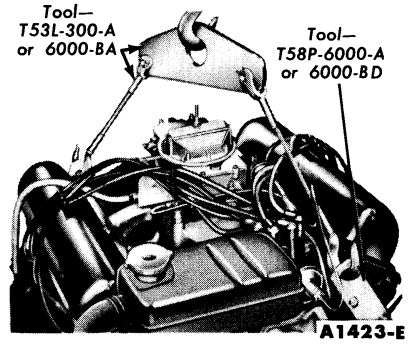



**FIG. 67—Typical Engine Lifting Bracket and Sling**

On a car with an automatic transmission, start the converter pilot into the crankshaft.

On a car with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

**4.** Install the flywheel housing upper bolts.

**5.** Install the remaining flywheel housing to engine block retaining bolts.

**6.** Install the engine support insulators, lock washers and nuts.

**7.** Disconnect the engine lifting sling and remove the lifting brackets.

**8.** Raise the front of the car. Connect both exhaust manifolds to the muffler inlet pipes. Torque the nuts to specifications.

**9.** Position the dust seal and install the starter.

On a car with an automatic transmission, remove the retainer securing the converter in the housing. Attach the converter to the flywheel. Install the transmission fluid filler tube bracket. Install the flywheel housing cover assembly. Install the oil cooler lines bracket.

On a car with a manual-shift transmission, install the clutch bracket. Connect the clutch release rod and install the clutch retracting spring. Install the flywheel housing lower cover.

**10.** Remove the support from the transmission and lower the car.

**11.** Connect the generator or alternator wires, the water temperature sending unit wire, and connect the heater hose at the intake manifold. Connect the battery ground cable.

**12.** Connect the flexible fuel line and the oil pressure sending unit wire.

**13.** Install the ignition coil and connect the coil primary and high tension wires. Position the wire loom in the retaining clips on the left

valve rocker arm cover. Install the oil level dipstick.

On a car with an automatic transmission, install the accelerator cross shaft bracket and connect the accelerator rod.

On a car with a manual-shift transmission, install the accelerator retracting spring. Connect the accelerator rod.

On a car with power steering, connect the power steering pump bracket.

**14.** Install the radiator. Connect the radiator upper and lower hoses. Install the hood.

On a car with an automatic transmission, connect the transmission oil cooler lines.

**15.** Fill and bleed the cooling system. Connect the heater hose at the water pump. Fill the crankcase with the proper grade and quantity of oil.

**16.** Operate the engine at fast idle and check all gaskets and hose connections for leaks. Install the air cleaner and connect the automatic choke heat chamber air inlet tube.

On a car with an automatic transmission, adjust the transmission control linkage and accelerator linkage.

## 427 V-8

### REMOVAL

**1.** Drain the cooling system and the crankcase. Remove the hood and the air cleaner. Disconnect the battery ground cable.

**2.** Disconnect the radiator upper hose at the engine and the radiator lower hose at the water pump.

**3.** Remove the radiator. Remove the oil level dipstick.

**4.** Disconnect the oil pressure sending unit wire at the sending unit, and the flexible fuel line at the fuel tank line. Plug the fuel tank line.

**5.** Disconnect the accelerator rod at the carburetor. Remove the accelerator retracting spring.

**6.** Disconnect the heater hoses at the water pump and intake manifold, the generator or alternator wires at the generator or alternator, and the water temperature sending unit at the sending unit.

**7.** Disconnect the wire loom at the distributor and ignition coil. Remove the wire loom from the clips on the left valve rocker arm cover and position it out of the way.

**8.** Remove the flywheel housing to engine upper bolts.

**9.** Raise the front of the car. Disconnect the muffler inlet pipe at the right exhaust manifold.

**10.** Disconnect the engine front support insulators at the frame. Raise the engine approximately 1 or 2 inches to provide necessary clearance to remove the right exhaust manifold.

**11.** Remove the right exhaust manifold. Disconnect the muffler inlet pipe at the left exhaust manifold.

**12.** Disconnect the starter cable. Remove the starter and dust seal.

**13.** Remove the flywheel housing inspection cover and the clutch pedal retracting spring. Disconnect the clutch release bracket at the equalizer rod and remove the bracket from the engine. Remove the remaining flywheel housing to engine bolts.

**14.** Lower the car, then support the transmission. Install the engine left lifting bracket on the front of the left cylinder head, and install the engine right lifting bracket at the rear of the right cylinder head, then attach the engine lifting sling (Fig. 67).

**15.** Raise the engine slightly and carefully pull it from the transmission. Lift the engine out of the engine compartment and install it on a work stand.

### INSTALLATION

**1.** Clean the muffler inlet pipe gasket surfaces and both sides of the exhaust control valve assembly.

**2.** Attach the engine lifting brackets and sling (Fig. 67). Remove the engine from the work stand.

**3.** Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and the dowels in the block engage the holes in the flywheel housing.

**4.** Start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

**5.** Install the flywheel housing upper bolts. Install the remaining flywheel housing to engine block retaining bolts.

**6.** Raise the front of the car. Position the dust seal and install the starter. Connect the starter cable.

**7.** Raise the engine approximately 1 or 2 inches and position the right exhaust manifold. Install and torque the retaining bolts to specifications.

**8.** Make sure the engine support insulator bolts are properly aligned with the support brackets on the frame. Completely lower the engine and install the engine support insulator lock washers and nuts. Torque the nuts to specifications.

**9.** Disconnect the engine lifting sling and remove the lifting brackets.

**10.** Place new gaskets on both sides of the exhaust control valve and position it over the inlet pipe studs on the right exhaust manifold. Connect the muffler inlet pipe to the exhaust manifold and torque the nuts to specifications.

**11.** Position a new gasket to the left exhaust manifold and connect the muffler inlet pipe to the manifold. Install and torque the nuts to specifications.

**12.** Install the clutch bracket. Connect the clutch release rod and install the clutch retracting spring. Install the flywheel housing lower cover.

**13.** Remove the support from the transmission and lower the car.

**14.** Connect the generator or alternator wires, the water temperature sending unit wire, and connect the heater hose at the intake manifold. Connect the battery ground cable.

**15.** Connect the flexible fuel line and the oil pressure sending unit wire.

**16.** Connect the coil primary and high tension wires. Connect the wire loom at the distributor. Position the wire loom in the retaining clips on the left valve rocker arm cover.

**17.** Install the oil level dipstick. Install the accelerator retracting spring. Connect the accelerator rod and adjust the accelerator linkage.

**18.** Install the radiator. Connect the radiator upper and lower hoses. Install the hood.

**19.** Fill and bleed the cooling system. Connect the heater hose at the water pump. Fill the crankcase with the proper grade and quantity of oil.

**20.** Operate the engine at fast idle and check all gaskets and hose connections for leaks. Install the air cleaner.

## 4 MAJOR REPAIR OPERATIONS

To perform the operations in this section, it will be necessary to remove the engine from the car and install it on a work stand.

### CRANKSHAFT

The crankshaft and related parts are shown in Fig. 68.

### REMOVAL

1. Remove the generator or alternator adjusting arm bracket bolt from the generator or alternator and the upper support bracket bolt at the water pump. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Remove the fuel pump. Slide the water pump bypass hose clamp toward the rear of the engine. Remove the water pump and fan as an assembly.
3. Remove the crankshaft damper cap screw and washer. Install the puller on the damper (Fig. 39) and remove the damper.
4. If the crankshaft sleeve is not stepped down (the same OD on both ends), remove it as shown in Fig. 40. If the sleeve is stepped down, remove it with a three-jawed puller (tool 7675-N).
5. Remove the cylinder front cover.
6. Remove the crankshaft front oil slinger. Check the timing chain deflection, then remove the timing chain and sprockets by following the applicable steps under "Cylinder Front Cover Removal."
7. Invert the engine on the work stand. Remove the flywheel. Remove the oil pan and gasket. Remove the oil pump.
8. **Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Remove the connecting rod bearing caps. Turn the crankshaft until the connecting rod from which the cap is being removed is down and remove the cap. Push the connecting rod and piston assembly up into the cylinder.
9. Remove the main bearing caps.

**On a 427 V-8, remove the main bearing cap cross bolts, washers and spacers (Fig. 78) before removing the cap retaining bolts.**

10. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

### CLEANING AND INSPECTION

Refer to Part 8-1, Section 3 for the cleaning and inspection procedures.

### REPAIRS

To refinish journals, dress minor imperfections, etc., refer to Part 8-1, Section 2.

### INSTALLATION

1. Remove the rear journal oil seal from the block and rear main bearing cap. Remove the rear main bearing cap to block side seals.
2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.
5. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.

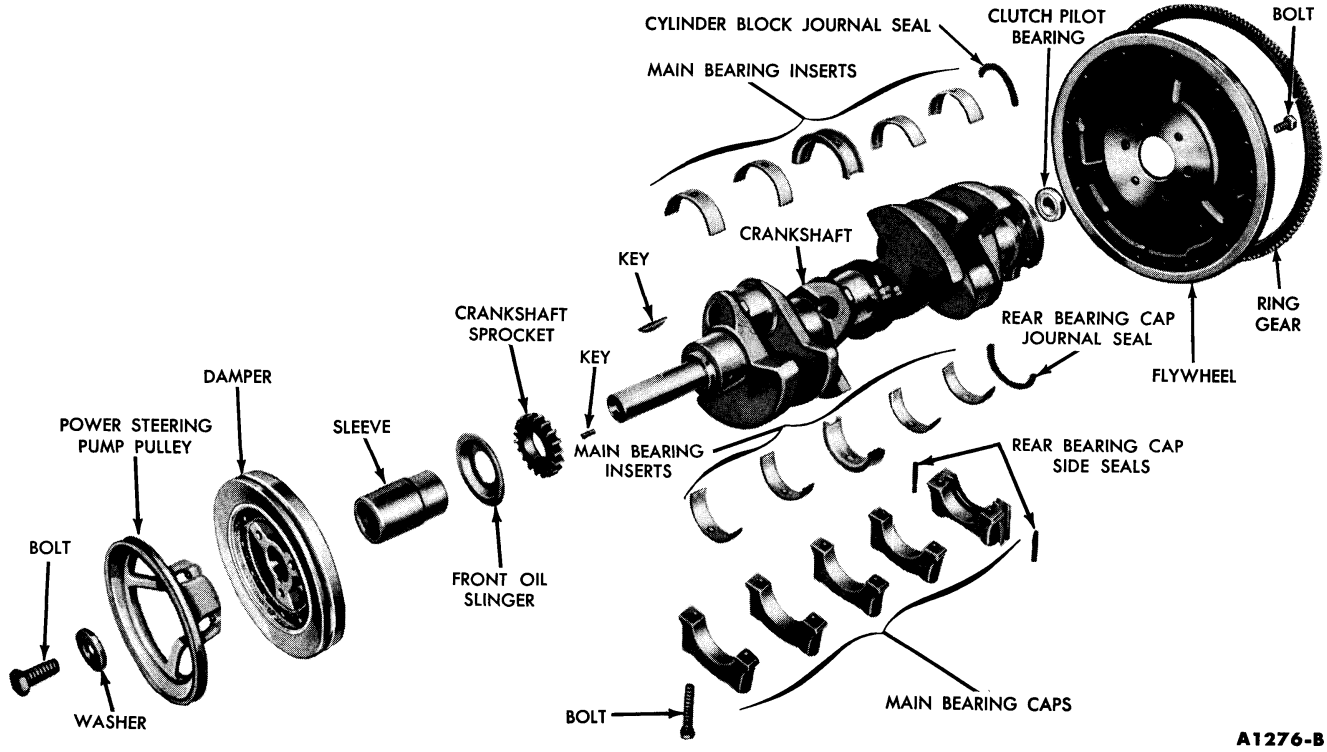



**FIG. 68—Typical Crankshaft and Related Parts**

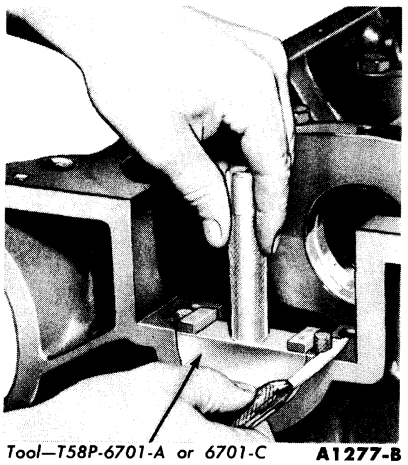



**FIG. 69—Seal to Block Installation**

**6.** Install the lower main bearing inserts in the bearing caps.

**7.** Install a new rear journal oil seal in the block (Fig. 69). After installation, cut the ends of the seals flush. **It is very important that the seal be cut flush with the surface of the cylinder block. This prevents rough edges which may project from the groove and lodge between the bearing cap and cylinder block.**

**8.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**9.** Check the clearance of each main bearing as follows:

Place a piece of Plastigage on the crankshaft journal the full width of the journal and about ¼ inch off-center (Fig. 70). Follow steps 10 and 11 under "Main Bearing Replacement" in Part 8-2, Section 2.

**10.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install a new seal in the rear main bearing cap and install the rear main bearing cap by following steps 15 thru 19 under "Main Bearing Replacement" in Part 8-2, Section 2. Install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Torque the bearing cap bolts to specifications.

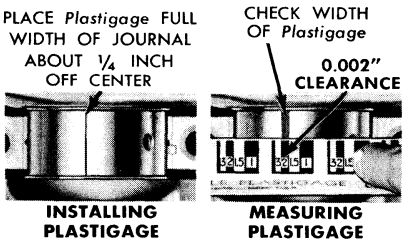



**FIG. 70—Installing and Measuring Plastigage—Engine on Work Stand**

On a 427 V-8 install the main bearing caps, following the procedure in step 15 of "Engine Assembly."

**11.** Install the thrust bearing cap with the bolts finger-tight.

**12.** Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 71).

**13.** Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 71). This will align the thrust surfaces of both halves of the bearing.

**14.** Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications (Fig. 71).

**15.** Force the crankshaft toward the rear of the engine.

**16.** Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 72).

**17.** Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

**18.** If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure (steps 11, 12, 13 and 14), then check the end play.

**19.** Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under "Main Bearing Replacement."

**20.** After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

**21.** Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.

**22.** Install the connecting rod cap. Torque the nuts to specifications.

**23.** After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 57).

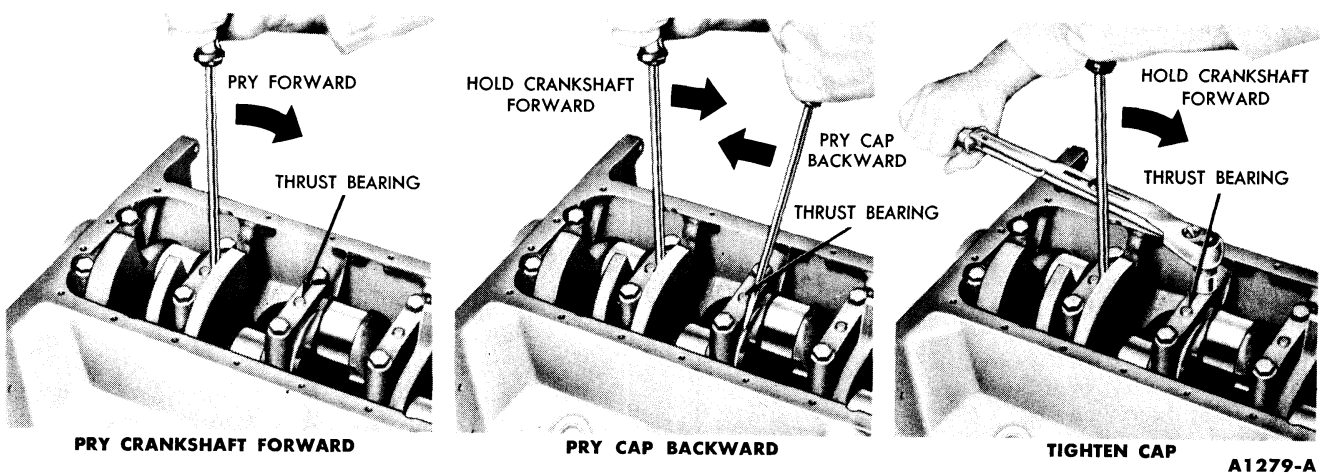



**FIG. 71—Thrust Bearing Alignment**

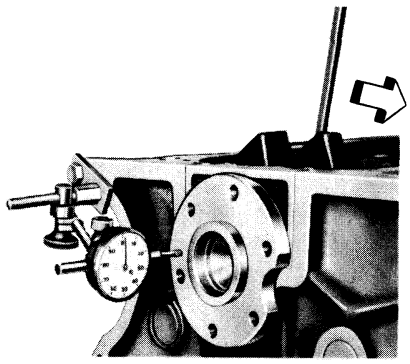

A1280-A

**FIG. 72—Crankshaft End Play**

**24.** Clean the oil pan, oil pump and oil pump screen. Install the oil pump and oil pan.

**25.** Position the flywheel on the crankshaft. Install the retaining bolts. Torque the bolts to specifications.

On a flywheel for a manual-shift transmission, use tool 7563 to locate the clutch disc. Install the pressure plate. Tighten the retaining bolts.

**26.** Install the timing chain and sprockets, cylinder front cover and crankshaft damper, following steps 1 thru 9 under "Cylinder Front Cover Installation."

**27.** Install the oil filter, fuel pump and carburetor fuel inlet line. Install the generator or alternator. Install the spark plugs.

**28.** Install the engine in the car.

## CAMSHAFT BEARING REPLACEMENT

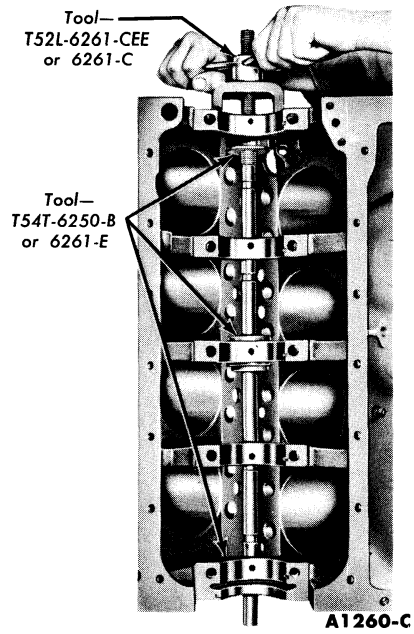
Camshaft bearings are available pre-finished to size for standard and 0.015-inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

**1.** Remove the camshaft, the flywheel, and the crankshaft. Push the pistons to the top of the cylinders.

**2.** Remove the camshaft rear bearing bore plug. Remove the camshaft bearings (Fig. 73).

**3.** Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 73. Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. **Be sure the front bearing is installed 0.005-0.020 inch below the front face of the cylinder block (Fig. 74).**

**4.** Clean out the camshaft rear bearing bore plug recess thoroughly.



A1260-C

**FIG. 73—Camshaft Bearing Replacement**

Coat the flange of a new plug with oil-resistant sealer and install the plug, with the flange facing out (Fig. 75).

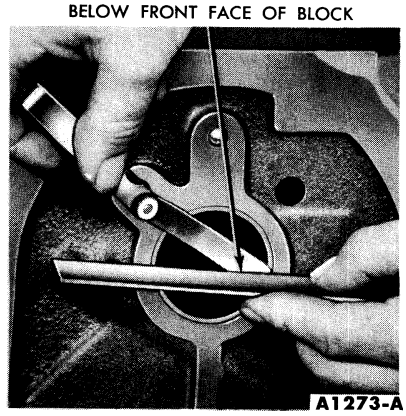
**5.** Install the camshaft, crankshaft, flywheel and related parts. Install the engine in the car.

## ENGINE DISASSEMBLY

**1.** Install the engine on the work stand.

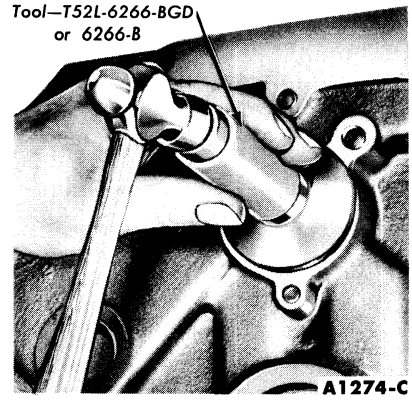
**2.** Remove the distributor cap and spark plug wire assembly.

**3.** Disconnect the distributor vacuum line at the distributor. Remove the carburetor fuel inlet line. Remove the fuel pump and discard the gasket.



A1273-A

**FIG. 74—Camshaft Front Bearing Measurement**



A1274-C

**FIG. 75—Camshaft Rear Bearing Bore Plug Installation**

**4.** Slide the clamp on the water pump by-pass hose toward the water pump. Remove the automatic choke air heat tube and air inlet tube. Remove the valve rocker arm covers.

On an engine with mechanical lifters, loosen the valve rocker arm shaft support bolts in sequence, two turns at a time. After all the bolts are loosened, remove the valve rocker arm shaft assembly.

On an engine with hydraulic valve lifters, crank the engine until the No. 1 piston is at TDC at the end of the compression stroke. Rotate the crankshaft damper an additional 45° (identified on the damper by "XX"). Starting at the No. 4 cylinder, loosen the right rocker arm shaft support bolts in sequence, two turns at a time. After the bolts are all loosened, remove the valve rocker arm shaft assembly and the oil baffle plate. Starting at the No. 5 cylinder, follow the same procedure on the left valve rocker arm shaft support bolts. **This procedure must be followed to avoid damage to the valve mechanism.**

**5.** Remove the valve push rods in sequence and put them in a rack so that they can be installed in their original bore.

On a 427 V-8 engine equipped with the vent tube-type crankcase ventilation system, remove the vent tube.

**6.** Remove the distributor hold down bolt and clamp and remove the distributor.

**7.** Remove the intake manifold retaining bolts.

**8.** Install standard eye bolts with 5/16- 18 threads in the left front and right rear rocker arm cover screw holes and attach the engine lifting sling (Fig. 21).

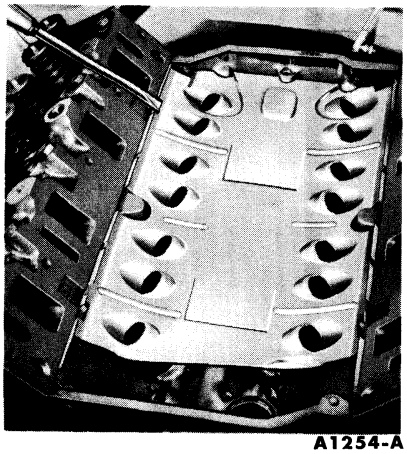

A1254-A

**FIG. 76—Baffle Plate Removal**

**9.** Raise the intake manifold and carefully remove it from the engine. Discard the intake manifold gaskets and seals.

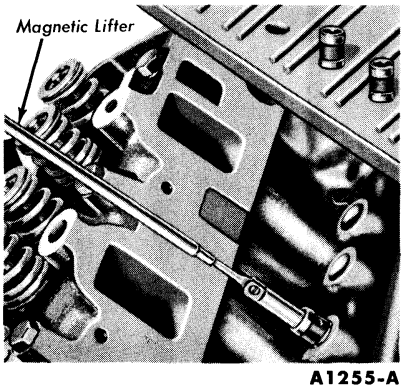
**10.** Remove the baffle plate from the valve push rod chamber floor by prying up on the baffle with a screw driver (Fig. 76).

**11.** Lift the valve lifters or tappets from the cylinder block and place them in a rack so that they can be installed in their original bore (Fig. 77).

**The internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.**

**12.** Remove the exhaust manifolds and the spark plugs. Remove the automatic choke air chamber cover from the right exhaust manifold.

**13.** Remove the cylinder head bolts, and then install the cylinder head holding fixtures (Fig. 30).



A1255-A

**FIG. 77—Valve Lifter or Tappet Removal—Intake Manifold Removed**

**14.** Lift the cylinder heads off the block. **Do not pry between the head and the block.** Discard the cylinder head gaskets.

**15.** Remove the oil filter. Remove the oil filter adapter assembly and oil pressure sending unit as an assembly. Discard the gasket.

**16.** Remove the generator or alternator, bracket and drive belts.

**17.** Remove the water pump, pulley and fan as an assembly.

On a car with power steering, remove the power steering pulley.

**18.** Remove the damper (Fig. 39).

**19.** If the crankshaft sleeve is not stepped down (the same OD on both ends), remove it as shown in Fig. 40. If the crankshaft sleeve is stepped down (different OD on each end), remove it with a three-jawed puller (tool 7675-N).

**20.** Remove the cylinder front cover. Discard the gasket, Remove the crankshaft front oil slinger.

**21.** Check the timing chain deflection by following steps 12, 13 and 14 under "Cylinder Front Cover and Timing Chain Removal."

**22.** Remove the camshaft sprocket cap screw and the fuel pump eccentric. Remove the sprockets and timing chain as an assembly (Fig. 43). Remove the crankshaft sprocket key.

**23.** Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.** After the ridge has been removed, remove the cutter from the cylinder bore.

On a flywheel for a manual-shift transmission, mark the pressure plate cover so that it can be replaced in the same position, and remove the clutch pressure plate and cover assembly.

**24.** Remove the flywheel.

**25.** Invert the engine. Remove the oil pan. Discard the gasket.

**26.** Remove the oil pump and inlet tube as an assembly. Remove the oil pump drive shaft. Discard the oil pump gasket.

**27. Make sure all connecting rods and caps are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod being removed is down. Remove the rod cap.

**28.** Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the connecting rod journal or the cylinder wall when removing the piston and rod.**

**29.** Remove the bearing inserts from the connecting rods and caps. Install the rod caps on the connecting rods from which they were removed.

**30.** Remove the main bearing caps.

**On a 427 V-8, remove the main bearing cap cross-bolts, washers and spacers (Fig. 78) before removing the cap retaining bolts.**

**31.** Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

**32.** Remove the rear journal oil seal from the block and rear bearing cap, and remove the cap to block side seals.

**33.** Remove the main bearing inserts from the block and bearing caps. Install the main bearing caps in their original positions.

**34.** Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

**35.** Remove the camshaft rear bearing bore plug. Remove the camshaft bearings (Fig. 73).

## ENGINE ASSEMBLY

**1.** Remove the glaze from the cylinder bores by following the instructions of the tool manufacturer.

**2.** Invert the engine on the work stand.

**3.** Position the new camshaft bearings at the bearing bores, and press them in place with the tool shown in Fig. 73. Align the oil holes in the cylinder block when the bearings are installed. **Be sure the camshaft front bearing is installed 0.005-0.020 inch below the front face of the cylinder block (Fig. 74).**

**4.** Check the oil passage that feeds the rocker arm shafts for obstructions by squirting oil into the opening on each cylinder bank and observing the flow through the oil holes at Nos. 2 and 4 bearings.

**5.** Clean out the camshaft rear bearing bore plug recess thoroughly.

**6.** Coat the flange of a new plug with oil-resistant sealer and install it with the flange facing out (Fig. 75). Drive the plug in until it is flush or slightly below the casting surface.

**7.** Oil the camshaft and apply Lubriplate to all lobes, then carefully slide it through the bearings.

**8.** Be sure that the rear oil seal grooves are clean. Install a new rear journal oil seal in the block (Fig. 69). After installation, cut the ends of the seals flush.

**9.** If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.

Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

**10.** Install the lower main bearing inserts in the bearing caps.

**11.** Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

**12.** Check the clearance of each main bearing following the procedure under "Main Bearing Replacement."

**13.** After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

**14.** Be sure that the oil seal grooves in the rear main bearing cap are clean. Install a new journal seal in the cap (Fig. 55). After installation, cut the ends of the seal flush. Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface (Fig. 55). **Do not apply sealer to the area forward of the side seal groove.** Install the rear main bearing cap and the remainder of the caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Torque the bearing cap bolts to specifications.

**15.** On a 427 V-8, torque the main bearing cap bolts to specifications.

Make sure the cross-bolt spacers are installed in their proper locations (Fig. 78). Production spacers are marked L-2, R-2, L-3, R-3, L-4 and R-4.

Install and torque the cross-bolts in two steps, following the sequence shown in Fig. 78. First, torque all the cross-bolts to 20 ft-lbs. Finally, torque all the cross-bolts to 40 ft-lbs.

**16.** Install the thrust bearing cap and check crankshaft end play by following steps 11 thru 18 under "Crankshaft Installation."

**17.** Turn the engine on the work stand so that the front end is up.

**18.** Install the pistons and connecting rods by following steps 1 thru 17 under "Piston and Connecting Rod Installation."

**19.** Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 43). Be sure the timing marks on the sprockets are positioned as shown in Fig. 42.

**20.** Lubricate the timing chain and sprockets with engine oil.

**21.** Install the fuel pump eccentric (Fig. 45) and the camshaft sprocket cap screw. Torque the sprocket cap screw to specifications. Install the crankshaft front oil slinger.

**22.** Clean the cylinder front cover and the cylinder block gasket surfaces. Install a new crankshaft front oil seal (Fig. 44).

**23.** Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

**24.** Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 46).

**25.** Install the cylinder front cover bolts finger-tight. Position the generator or alternator support bracket and the generator adjusting arm bracket, then install the bolts (on a car equipped with an air conditioner, connect the compressor and brackets to the cylinder front cover). While pushing in on the pilot, torque the cover bolts to specifications. Remove the pilot.

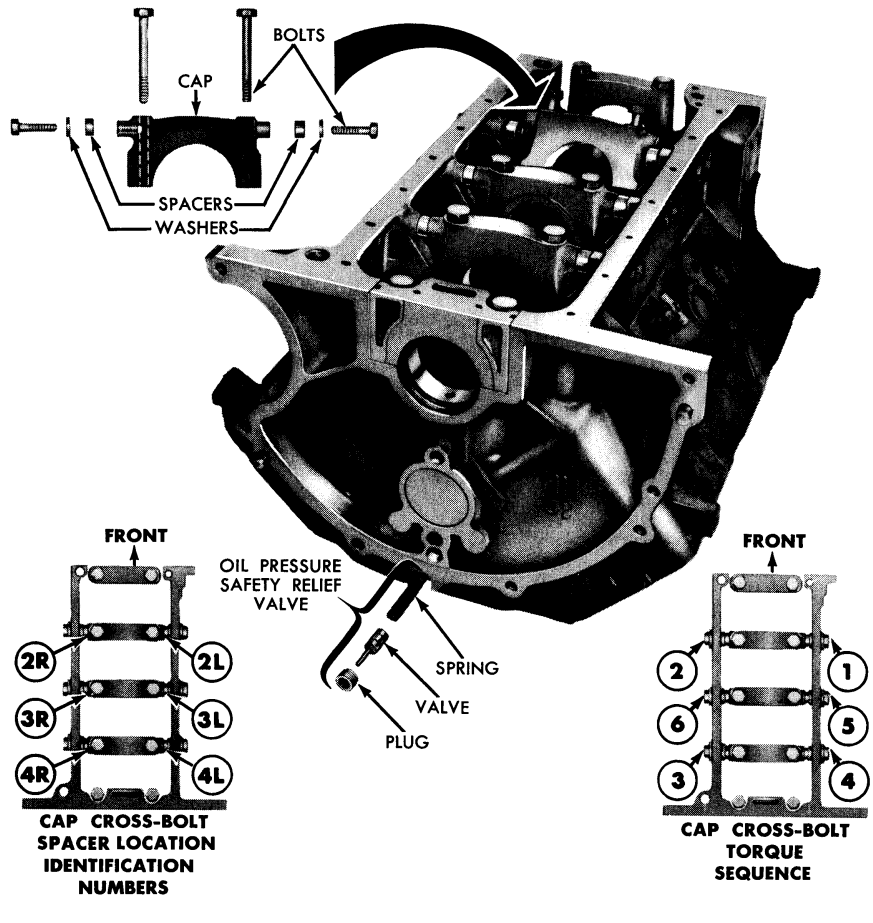



**FIG. 78—427 V-8 Cylinder Block Details**

**26.** Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease.

**27.** Install the crankshaft sleeve with the smallest OD end into the cylinder front cover bore if the sleeve is stepped down (different OD on each end).

**28.** Line up the damper keyway with the key on the crankshaft, then install the damper on the crankshaft (Fig. 47). Install the damper cap screw and washer, and torque the screw to specifications.

On an engine with a separate power steering pulley, install the pulley on the crankshaft damper.

**29.** Clean the water pump gasket surfaces and apply sealer. Position new gaskets on the pump and install the water pump, pulley, and fan as an assembly.

**30.** Using a new gasket, install the fuel pump. Install the generator or alternator brackets, and drive belts.

**31.** Turn the engine on the work stand so that the top of the engine is up.

**32.** Clean the cylinder head and block gasket surfaces. Apply sealer to both sides of a new gasket. Guided by the word "FRONT" on the gasket, install the head gasket over the cylinder head dowels.

**33.** Place the cylinder head on the engine, then remove the holding fixtures. Coat the head bolt threads with water-resistant sealer, and then install the bolts.

**34.** The cylinder head bolt tightening procedure is performed in three progressive steps. Torque the bolts in sequence (Fig. 31) to 70 ft-lbs, then to 80 ft-lbs, and finally to 90 ft-lbs. **After the cylinder head bolts have been torqued to specifications, the bolts should not be disturbed.**

**35.** Coat the mating surfaces of the exhaust manifold with a light film of graphite grease.

**36.** Using a new gasket, install the automatic choke air chamber cover on the right exhaust manifold. **Be sure the cover is securely fastened.**

**37.** Position a new gasket over the muffler inlet pipe studs of the exhaust manifolds.

**38.** Position the exhaust manifolds on the cylinder heads and install the retaining bolts and tab washers.

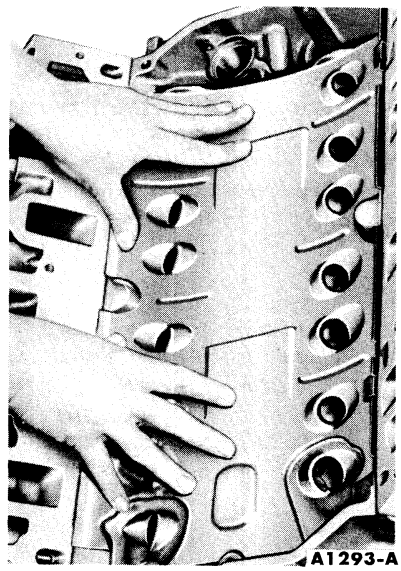



**FIG. 79—Baffle Plate Installation**

**On a 427 V-8, do not install the right exhaust manifold until the engine has been installed in the car. Refer to "Engine Installation."**

Torque the retaining bolts to specifications, working from the center to the ends. Lock the bolts by bending one tab of the washer over a flat on the bolt.

**39.** Install the spark plugs.

**40.** Position the baffle plate in the valve push rod chamber. Press it into place (Fig. 79).

On an engine with hydraulic valve lifters, coat the outside of each valve lifter with engine oil to provide initial lubrication. **Do not fill the lifters with oil. The lifters will fill much faster after the engine is started, if they are free of any oil film which may cause an oil seal between the plunger and the lifter body.** Place each lifter in the bore from which it was removed.

On an engine with mechanical lifters, coat each tappet with engine oil and install them in the bores from which they were removed.

**41.** Clean the mating surfaces of the intake manifold, cylinder heads, and cylinder block.

**42.** Coat the intake manifold and cylinder block seal surfaces with oil-resistant sealer.

**43.** Position new seals on the cylinder block and new gaskets on the cylinder heads. Position the gasket slots in the end tabs over the ribs on the seals. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads. The correct installation of the gaskets and seals is shown in Fig. 23.

**44.** Install the eye bolts in the intake manifold and attach the engine lifting sling and carefully lower the intake manifold on the engine (Fig. 21).

**45.** Position the intake manifold by inserting the distributor in place. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**

**46.** Start the water pump bypass hose on the intake manifold.

**47.** Be sure the holes in the manifold gaskets and manifold are in alignment. Install the manifold retaining bolts and torque them to specifications, in sequence as shown in Fig. 24.

**48.** Remove the distributor and the engine lifting sling and eye bolts.

**49.** Refer to "Valve Rocker Arm Shaft Assembly Installation" and install the valve rocker arm shaft assembly by following steps 1 thru 6 under "Hydraulic Valve Lifters" or steps 1 thru 4 under "Mechanical Valve Lifters."

**50.** Install the automatic choke air heat tube and air inlet tube. Install the crankcase vent tube and gasket (427 V-8).

**51.** Rotate the crankshaft damper until the No. 1 piston is on TDC, then position the distributor in the block with the rotor at the No. 1 firing position and the points open. Install the hold down clamp.

**52.** Connect the distributor vacuum line. Install the distributor cap. Install the valve rocker arm covers.

**On an engine with mechanical lifters, it is necessary to perform a final (hot) valve lash adjustment after the engine is installed in the car.**

**53.** Connect the spark plug wires. Install the carburetor fuel inlet line.

**54.** Invert the engine on the work stand. Position the oil pump drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.

**55.** With the stop properly positioned, insert the oil pump drive shaft into the oil pump.

**56.** Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

**57.** Position a new gasket on the pump housing and install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.**

**58.** Position a new gasket on the oil pan and place the oil pan assembly on the block. Install the retaining screws and torque them from the center outward to specifications.

**59.** Position the flywheel on the crankshaft and install the retaining bolts. Torque the bolts to specifications.

On a flywheel for a manual-shift transmission, use tool 7563 to locate the clutch disc. Install the pressure plate.

**60.** Clean the oil filter adapter gasket surfaces. Apply sealer to a new adapter gasket, and install the adapter assembly and gasket.

**61.** Clean the adapter filter recess. Coat the gasket on a new filter with oil. Place the filter in position on the adapter. Hand tighten the filter until the gasket contacts the adapter face, and then advance it ½-turn.

**62.** Install the engine in the car. Operate the engine and check for oil and coolant leaks. Check the ignition timing, adjust the engine idle speed, idle fuel mixture, and anti-stall dashpot (if applicable).

On a car with an automatic transmission, adjust the transmission control linkage.

On an engine with mechanical lifters, perform a final (hot) valve lash adjustment. Install the valve rocker arm covers.

# PART 8-5 SPECIFICATIONS

NOTE: All specifications are given in inches unless otherwise noted.

## GENERAL ENGINE

**MODEL PREFIX**

| | |
|---|---|
| 223 6 Cyl. | EBP |
| 289 V-8 | EGA |
| 352 V-8 | EDT |
| 390 V-8 | EES |
| 427 V-8 | EGB |

**ENGINE MODELS AND PISTON DISPLACEMENT—Cubic Inches**

| | |
|---|---|
| Mileage Maker Six (1-V) | 223 |
| 289 V-8 (2-V) | 289 |
| 352 V-8 (4-V) | 352 |
| 390 V-8 and 390 Special V-8 (2-V) | 390 |
| 390 V-8 (4-V) | 390 |
| 390 Police Interceptor V-8 (4-V) | 390 |
| 427 High Performance V-8 (4-V) | 427 |
| 427 High Performance V-8 (8-V) | 427 |

**COMPRESSION RATIO**

| | |
|---|---|
| Mileage Maker Six (1-V) | 8.5:1 |
| 289 (2-V) | 9.0:1 |
| 352 V-8 (4-V) | 9.3:1 |
| 390 V-8 and 390 Special V-8 (2-V) | 9.4:1 |
| 390 V-8 (4-V) | 10.1:1 |
| 390 Police Interceptor V-8 (4-V) | 10.1:1 |
| 427 High Performance V-8 (4-V) | 11.5:1 |
| 427 High Performance V-8 (8-V) | 11.2:1 |

**BRAKE HORSEPOWER @ Specified rpm**

| | |
|---|---|
| Mileage Maker Six (1-V) | 138 @ 4200 |
| 289 V-8 (2-V) | 195 @ 4400 |
| 352 V-8 (4-V) | 250 @ 4400 |
| 390 V-8 (2-V) | 250 @ 4400 |
| 390 Special V-8 (2-V) | 266 @ 4600 |
| 390 V-8 (4-V) | 300 @ 4600 |
| 390 Police Interceptor V-8 (4-V) | 330 @ 5000 |
| 427 High Performance V-8 (4-V) | 410 @ 5600 |
| 427 High Performance V-8 (8-V) | 425 @ 6000 |

**TORQUE—Ft-lbs @ Specified rpm**

| | |
|---|---|
| Mileage Maker Six (1-V) | 203 @ 2200 |
| 289 V-8 (2-V) | 282 @ 2400 |
| 352 V-8 (4-V) | 352 @ 2800 |
| 390 V-8 and 390 Special V-8 (2-V) | 378 @ 2400 |
| 390 V-8 (4-V) | 427 @ 2800 |
| 390 Police Interceptor V-8 (4-V) | 427 @ 3200 |
| 427 High Performance V-8 (4-V) | 476 @ 3400 |
| 427 High Performance V-8 (8-V) | 480 @ 3700 |

**BORE AND STROKE**

| | |
|---|---|
| 223 | 3.62 x 3.60 |
| 289 | 4.00 x 2.87 |
| 352 | 4.00 x 3.50 |
| 390 | 4.05 x 3.78 |
| 427 | 4.23 x 3.78 |

**COMPRESSION PRESSURE—Sea Level @ Cranking Speed**

| | |
|---|---|
| 223 and 289 | 130-170 |
| 352, 390 and 427 | 160-200 |
| 390 (4-V) | 170-210 |
| Allowable tolerance between cylinders | ±20 psi |

## GENERAL ENGINE (Continued)

**TAXABLE HORSEPOWER**

| | |
|---|---|
| 223 | 31.54 |
| 289 and 352 | 51.20 |
| 390 | 52.49 |
| 427 | 57.33 |

**FIRING ORDER**

| | |
|---|---|
| 223 | 1-5-3-6-2-4 |
| All V-8's | 1-5-4-2-6-3-7-8 |

**VALVE ARRANGEMENT—Front to Rear**

| | | |
|---|---|---|
| 223 | | E-I-I-E-I-E-E-I-E-I-I-E |
| 289 | Right | I-E-I-E-I-E-I-E |
| | Left | E-I-E-I-E-I-E-I |
| 352, 390 and 427 | | E-I-E-I-I-E-I-E |

**ENGINE IDLE RPM***

**Manual-Shift Transmissions**

| | |
|---|---|
| 223 | 525-550 |
| 289, 352 and 390 | 575-600 |
| 427 | 700-800 |

**Automatic Transmissions—Drive Range**

| | |
|---|---|
| 223 | 525-550 |
| 289, 352 and 390 | 475-500 |
| 390 Police Interceptor V-8 | 550-575 |

*If unit is equipped with air conditioner, it should be operated at least 20 minutes before setting engine idle speed.

**ENGINE IDLE MANIFOLD VACUUM—Minimum Inches of Mercury @ Specified Engine Neutral Idle rpm (Sea Level)**

| | |
|---|---|
| All Engines | 18 |

**INITIAL IGNITION TIMING—BTC****

**Manual-Shift Transmission**

| | |
|---|---|
| 223 and 390 (4-V) | *4° |
| 289 | 6° |
| 352 and 390 (2-V) | *6° |
| 390 Police | 4° |
| 427 | 8° |

**Automatic Transmission**

| | |
|---|---|
| 223 and 352 | *10° |
| 289 | 10° |
| 390 | *6° |

*For altitude operation, and/or to obtain optimum engine performance and fuel economy, the initial ignition timing may be advanced 5° over the "normal" setting. No further improvement in engine performance or fuel economy will be achieved by advancing beyond this point. Advance the timing progressively until engine detonation (spark knock) is evident under actual road test acceleration. Retard the timing until the detonation (spark knock) is eliminated.

**If the individual requirements of the car and/or the use of sub-standard fuels dictate, the initial timing may have to be retarded from the recommended setting to eliminate detonation (spark knock). If retarding is necessary, it should be done progressively and not to exceed 2°BTC.

## GENERAL ENGINE (Continued)

| OIL CAPACITY* | U.S. MEASURE | IMPERIAL MEASURE |
|---|---|---|
| 223 and 289 | 5 quarts | 4 quarts |
| 352, 390 and 427 | 6 quarts | 4¾ quarts |

*Includes one U.S. quart required with oil filter replacement.

**OIL PRESSURE—Hot @ 2000 rpm**

| | |
|---|---|
| 390 Police Interceptor V-8 | 45-70 psi |
| Other Engines | 35-55 psi |

## CYLINDER HEAD

**GASKET SURFACE FLATNESS**

223
0.003 inch in any 6 inches or 0.007 inch overall

Other Engines
0.003 inch in any 6 inches or 0.006 inch overall

**VALVE GUIDE BORE DIAMETER—Standard**

Intake and Exhaust

| | |
|---|---|
| 223 | 0.3433-0.3440 |
| 289 | 0.3433-0.3443 |
| 352, 390 and 427 | 0.3728-0.3735 |

**VALVE SEAT WIDTH**

Intake and Exhaust

| | |
|---|---|
| 289 | 0.060-0.080 |
| Other Engines | 0.070-0.090 |

**VALVE SEAT ANGLE**

Intake

| | |
|---|---|
| 427 | 30° |
| Other Engines | 45° |

Exhaust

| | |
|---|---|
| All Engines | 45° |

**VALVE SEAT RUNOUT**

| | |
|---|---|
| Maximum 289 | 0.0015 |
| Maximum Other Engines | 0.002 |

**COMBUSTION CHAMBER VOLUME—CC**

| | |
|---|---|
| 223 | 67.21-70.21 |
| 289 | 52.60-55.60 |
| 352 and 390 | 73.10-76.10 |
| 427 | 73.00-76.00 |

## VALVE MECHANISM

**VALVE LASH**

Cold

INTAKE AND EXHAUST

| | |
|---|---|
| 390 Police and 427 with Mechanical Lifters | 0.028 |

Hot

INTAKE AND EXHAUST

| | |
|---|---|
| 390 Police and 427 with Mechanical Lifters | 0.025 |

**VALVE CLEARANCE**

| | |
|---|---|
| 223* | 0.025 |
| 289** | 0.082-0.152 |
| 352 and 390** | 0.083-0.183 |

*Silent Lash—Clearance specified is obtained at the valve stem tip with the eccentric spring compressed.

**Hydraulic valve lifters—Clearance specified is obtained at the valve stem tip with the tappet collapsed.

## VALVE MECHANISM (Continued)

**VALVE STEM DIAMETER**

Standard

INTAKE

| | |
|---|---|
| 223 and 289 | 0.3416-0.3423 |
| 352, 390 and 427 | 0.3711-0.3718 |

EXHAUST

| | |
|---|---|
| 223 | 0.3398-0.3405 |
| 289 | 0.3406-0.3413 |
| 352 and 390 | 0.3693-0.3700 |
| 427 | 0.3701-0.3708 |

0.003 Oversize

INTAKE

| | |
|---|---|
| 223 and 289 | 0.3446-0.3453 |
| 352, 390 and 427 | 0.3741-0.3748 |

EXHAUST

| | |
|---|---|
| 223 | 0.3428-0.3435 |
| 289 | 0.3436-0.3443 |
| 352 and 390 | 0.3723-0.3730 |
| 427 | 0.3731-0.3738 |

0.015 Oversize

INTAKE

| | |
|---|---|
| 223 and 289 | 0.3566-0.3573 |
| 352, 390 and 427 | 0.3861-0.3868 |

EXHAUST

| | |
|---|---|
| 223 | 0.3548-0.3555 |
| 289 | 0.3556-0.3563 |
| 427 | 0.3851-0.3858 |

0.030 Oversize

INTAKE

| | |
|---|---|
| 223 and 289 | 0.3716-0.3723 |
| 352, 390 and 427 | 0.4011-0.4018 |

EXHAUST

| | |
|---|---|
| 223 | 0.3698-0.3705 |
| 289 | 0.3706-0.3713 |
| 352 and 390 | 0.3993-0.4000 |
| 427 | 0.4001-0.4008 |

**VALVE FACE ANGLE**

| | |
|---|---|
| 427 (Intake Valve) | 29° |
| Other Intake and Exhaust | 44° |

**VALVE STEM TO VALVE GUIDE CLEARANCE**

Intake

| | |
|---|---|
| 289 | 0.0010-0.0027—Wear Limit 0.0045 |
| Other Engines | 0.0010-0.0024—Wear Limit 0.0045 |

Exhaust

| | |
|---|---|
| 223, 352 and 390 | 0.0028-0.0042—Wear Limit 0.0055 |
| 289 | 0.002-0.0037—Wear Limit 0.0055 |
| 427 | 0.002-0.0034—Wear Limit 0.0055 |

**VALVE HEAD DIAMETER**

Intake

| | |
|---|---|
| 223 | 1.775-1.785 |
| 289 | 1.662-1.677 |
| 352, 390 and 427 | 2.022-2.037 |

Exhaust

| | |
|---|---|
| 223 | 1.505-1.520 |
| 289 | 1.442-1.457 |
| 352 and 390 | 1.551-1.566 |
| 427 | 1.645-1.660 |

**VALVE FACE RUNOUT**

Intake

| | |
|---|---|
| All Engines | 0.002 |

Exhaust

| | |
|---|---|
| 223 | 0.0015 |
| Other Engines | 0.002 |

## VALVE MECHANISM (Continued)

**VALVE SPRING FREE LENGTH—Approximate**

| | |
|---|---|
| 223 | 2.33 |
| 289 | 2.09 |
| 352 | 2.26 |
| 390 | 2.15 |
| 390 Police and 427 | 2.06 |

**VALVE SPRING OUT OF SQUARE—Maximum**

| | |
|---|---|
| All Engines | 0.072 |

**VALVE SPRING PRESSURE—Lbs. @ Specified Length**

| | |
|---|---|
| 223 | 95-105 @ 1.780 |
| | Wear Limit 88 @ 1.780 |
| | 160-178 @ 1.410 |
| | Wear Limit 144 @ 1.410 |
| 289 | 71-79 @ 1.780 |
| | Wear Limit 64 @ 1.780 |
| | 161-177 @ 1.390 |
| | Wear Limit 145 @ 1.390 |
| 352 | 94-104 @ 1.820 |
| | Wear Limit 85 @ 1.820 |
| | 180-198 @ 1.420 |
| | Wear Limit 162 @ 1.420 |
| 390 | 74-84 @ 1.820 |
| | Wear Limit 67 @ 1.820 |
| | 190-208 @ 1.420 |
| | Wear Limit 171 @ 1.420 |
| 390 Police and 427 | 80-90 @ 1.820 |
| | Wear Limit 72 @ 1.820 |
| | 255-280 @ 1.320 |
| | Wear Limit 230 @ 1.320 |

**VALVE SPRING ASSEMBLED HEIGHT**

| | |
|---|---|
| 223 and 289 | $1\frac{3}{4}$-$1\frac{25}{32}$ |
| 352 and 390 | $1\frac{13}{16}$-$1\frac{27}{32}$ |
| 390 Police and 427 | $1\frac{51}{64}$-$1\frac{53}{64}$ |

**VALVE PUSH ROD MAXIMUM RUNOUT**

| | |
|---|---|
| 289 | 0.015 |
| Other Engines | 0.025 |

**VALVE TAPPET DIAMETER—Standard**

| | |
|---|---|
| 223 | 0.4983-0.4989 |
| Other Engines | 0.8740-0.8745 |

**VALVE TAPPET TO TAPPET BORE CLEARANCE**

| | |
|---|---|
| 223 | 0.0011-0.0027—Wear Limit 0.0055 |
| Other Engines | 0.0005-0.0020—Wear Limit 0.005 |

**HYDRAULIC VALVE LIFTER LEAK DOWN RATE**

| | |
|---|---|
| 289, 352 and 390 | 10-100 Sec. |

**ROCKER ARM TO ROCKER ARM SHAFT CLEARANCE**

| | |
|---|---|
| 223 | 0.002-0.004—Wear Limit 0.006 |
| 352, 390 and 427 | 0.003-0.005—Wear Limit 0.006 |

**ROCKER ARM SHAFT O.D.**

| | |
|---|---|
| 223 | 0.780-0.781 |
| 352, 390 and 427 | 0.838-0.839 |

**ROCKER ARM BORE DIAMETER**

| | |
|---|---|
| 223 | 0.783-0.784 |
| 352, 390 & 427 | 0.843-0.844 |

## CAMSHAFT AND TIMING CHAIN

**CAMSHAFT JOURNAL DIAMETER—Standard**

| | |
|---|---|
| 223 | 1.9255-1.9265 |
| 352, 390 & 427 | 2.1238-2.1248 |
| 289—No. 1 | 2.0805-2.0815 |
| No. 2 | 2.0655-2.0665 |
| No. 3 | 2.0505-2.0515 |
| No. 4 | 2.0355-2.0365 |
| No. 5 | 2.0205-2.0215 |

## CAMSHAFT AND TIMING CHAIN (Continued)

**CAMSHAFT JOURNAL TO BEARING CLEARANCE**

| | |
|---|---|
| All Engines | 0.001-0.003—Wear Limit 0.006. |

**CAMSHAFT JOURNAL MAXIMUM OUT-OF-ROUND**

| | |
|---|---|
| 289 | 0.0005 |
| Other Engines | 0.001-0.0005 |

**CAMSHAFT JOURNAL RUNOUT—Maximum**

| | |
|---|---|
| All Engines | 0.0005 |

**TIMING CHAIN MAXIMUM DEFLECTION**

| | |
|---|---|
| All Engines (Except 223 Taxi and Police) | 0.5 |

**CAMSHAFT LOBE LIFT**

Intake

| | |
|---|---|
| 223 | 0.260—Wear Limit 0.255 |
| 289 | 0.2303—Wear Limit 0.2253 |
| 352 | 0.232—Wear Limit 0.227 |
| 390 | 0.2316—Wear Limit 0.2266 |
| 390 Police | 0.2636—Wear Limit 0.2586 |
| 427 | 0.298—Wear Limit 0.293 |

Exhaust

| | |
|---|---|
| 223 | 0.260—Wear Limit 0.255 |
| 289 | 0.2375—Wear Limit 0.2325 |
| 352 | 0.232—Wear Limit 0.227 |
| 390 | 0.2316—Wear Limit 0.2266 |
| 390 Police | 0.2636—Wear Limit 0.2586 |
| 427 | 0.298—Wear Limit 0.293 |

**CAMSHAFT END PLAY**

| | |
|---|---|
| All Engines | 0.001-0.007—Wear Limit 0.012 |

## CAMSHAFT BEARINGS

**INSIDE DIAMETER**

| | |
|---|---|
| 223 | 1.9275-1.9285 |
| 352, 390 & 427 | 2.1258-2.1268 |
| 289—No. 1 | 2.0825-2.0835 |
| No. 2 | 2.0675-2.0685 |
| No. 3 | 2.0525-2.0535 |
| No. 4 | 2.0375-2.0385 |
| No. 5 | 2.0225-2.0235 |

No. 1 bearing is installed with the front edge 0.005 to 0.020 inch toward the rear from the front face of the cylinder block on all engines.

## CRANKSHAFT

**MAIN BEARING JOURNAL DIAMETER**

Standard

| | |
|---|---|
| 223 Coded Red | 2.4984-2.4988 |
| Coded Blue | 2.4980-2.4984 |
| 289 Coded Red | 2.2486-2.2490 |
| Coded Blue | 2.2482-2.2486 |
| 352, 390 & 427 Coded Red | 2.7488-2.7492 |
| Coded Blue | 2.7484-2.7488 |

**MAIN BEARING JOURNAL RUNOUT—Maximum**

| | |
|---|---|
| 223 | 0.003—Wear Limit 0.004 |
| Other Engines | 0.002—Wear Limit 0.003 |

**CONNECTING ROD AND MAIN BEARING JOURNALS MAXIMUM OUT-OF-ROUND**

| | |
|---|---|
| All Engines | 0.0004—Wear Limit 0.0006 |

**CONNECTING ROD AND MAIN BEARING JOURNALS MAXIMUM TAPER**

| | |
|---|---|
| All Engines | 0.0003 per inch |

## CRANKSHAFT (Continued)

| | |
|---|---|
| **THRUST BEARING JOURNAL LENGTH** | |
| 223 | 1.359-1.361 |
| 289 | 1.137-1.139 |
| 352, 390 and 427 | 1.124-1.126 |
| **MAIN BEARING JOURNAL THRUST FACE RUNOUT** | |
| All Engines | 0.001 |
| **CONNECTING ROD JOURNAL DIAMETER** | |
| 223 Coded Red | 2.2984-2.2988 |
| Coded Blue | 2.2980-2.2984 |
| 289 Coded Red | 2.1232-2.1236 |
| Coded Blue | 2.1228-2.1232 |
| 352, 390 & 427 Coded Red | 2.4384-2.4388 |
| Coded Blue | 2.4380-2.4384 |
| **CRANKSHAFT FREE END PLAY** | |
| All Engines | 0.004-0.008—Wear Limit 0.012 |
| **ASSEMBLED FLYWHEEL CLUTCH FACE MAXIMUM RUNOUT** | |
| All Engines | 0.010 |
| **ASSEMBLED FLYWHEEL O.D. MAXIMUM RUNOUT** | |
| **Manual Shift Transmission** | |
| All Engines | 0.007 |
| **Automatic Transmission** | |
| All Engines | 0.020 |
| **ASSEMBLED SPROCKET FACE RUNOUT** | |
| All Engines | 0.006 |

## MAIN BEARINGS

| | |
|---|---|
| **JOURNAL CLEARANCE** | |
| 223 | 0.0009-0.0032 |
| 289 | 0.0007-0.0030 |
| 352 and 390 | 0.0006-0.0027 |
| 390 Police—No. 1 | 0.0008-0.0012 |
| No. 2, 3, 4 and 5 | 0.0006-0.0027 |
| 427 | 0.0010-0.0031 |
| **WALL THICKNESS** | |
| 223 Coded Red | 0.0956-0.0961 |
| Coded Blue | 0.0960-0.0965 |
| 0.002 Undersize | 0.0970-0.0975 |
| 289 Coded Red | 0.0955-0.0958 |
| Coded Blue | 0.0959-0.0962 |
| 0.002 Undersize | 0.0969-0.0972 |
| 350, 390 and 427 | |
| Coded Red | 0.0955-0.0960 |
| Coded Blue | 0.0955-0.0960 |
| 0.002 Undersize | 0.0969-0.0974 |

## CONNECTING ROD

| | |
|---|---|
| **PISTON PIN BUSHING I.D.** | |
| **Standard** | |
| 223 | 0.9122-0.9125 |
| 289 | 0.9107-0.9112 |
| 352 and 390 | 0.9752-0.9755 |
| 427 | 0.9754-0.9757 |
| **PISTON PIN BUSHING OUT-OF-ROUND—Maximum** | |
| 223 | 0.0002 |
| 352, 390 & 427 | 0.0003 |

## CONNECTING ROD (Continued)

| | |
|---|---|
| **BEARING BORE DIAMETER** | |
| 223 Coded Red | 2.423-2.4234 |
| Coded Blue | 2.4234-2.4238 |
| 289 Coded Red | 2.239-2.2394 |
| Coded Blue | 2.2394-2.2398 |
| 352, 390 & 427 Coded Red | 2.5907-2.5911 |
| Coded Blue | 2.5911-2.5915 |
| **BEARING BORE MAXIMUM OUT-OF-ROUND AND TAPER** | |
| All Engines | 0.0004 |
| **CONNECTING ROD LENGTH—Center to Center** | |
| 223 | 6.258-6.262 |
| 289 | 5.154-5.156 |
| 352 | 6.538-6.542 |
| 390 & 427 | 6.486-6.490 |
| **CONNECTING ROD** | |
| **Twist Maximum Total Difference*** | |
| All Engines | 0.012 |
| **Bend Maximum Total Difference*** | |
| All Engines | 0.004 |
| *Pin Bushing and Crankshaft Bearing Bore must be parallel and in the same vertical plane within the specified total difference at ends of 8-inch long bar measured 4-inches on each side of rod. | |
| **CONNECTING ROD ASSEMBLY—Assembled to Crankshaft** | |
| **Side Clearance** | |
| 223 | 0.005-0.011—Wear Limit 0.014 |
| 289, 352, & 390 | 0.006-0.016—Wear Limit 0.019 |
| 427 | 0.014-0.024—Wear Limit 0.027 |

## CONNECTING ROD BEARINGS

| | |
|---|---|
| **BEARING TO CRANKSHAFT CLEARANCE** | |
| 223 and 289 | 0.0009-0.0029 |
| 352 and 390 | 0.0007-0.0028 |
| 427 | 0.0013-0.0032 |
| **WALL THICKNESS** | |
| 223 Coded Red | 0.0614-0.0619 |
| Coded Blue | 0.0618-0.0623 |
| 0.002 Undersize | 0.0628-0.0633 |
| 289 Coded Red | 0.0569-0.0574 |
| Coded Blue | 0.0573-0.0578 |
| 0.002 Undersize | 0.0583-0.0588 |
| 352, 390 and 427 | |
| Coded Red | 0.0751-0.0756 |
| Coded Blue | 0.0755-0.0760 |
| 0.002 Undersize | 0.0765-0.0770 |

## PISTON

| | |
|---|---|
| **PISTON DIAMETER** | |
| **Color Coded Red** | |
| 223 | 3.6236-3.6242 |
| 289 | 3.9984-3.9990 |
| 352 | 3.9982-3.9988 |
| 390 | 4.0477-4.0483 |
| 427 | 4.2284-4.2290 |
| **Color Coded Blue** | |
| 223 | 3.6248-3.6254 |
| 289 | 3.9996-4.0002 |
| 352 | 3.9994-4.0000 |
| 390 | 4.0489-4.0495 |
| 427 | 4.2296-4.2302 |
| **0.003 Oversize** | |
| 223 | 3.6260-3.6266 |
| 289 | 4.0008-4.0014 |
| 352 | 4.0006-4.0012 |
| 390 | 4.0501-4.0507 |
| 427 | 4.2308-4.2314 |

## PISTON (Continued)

| PISTON TO BORE CLEARANCE—¼ inch from Bottom of Skirt | |
|---|---|
| 223 | 0.0008-0.0026—Wear Limit 0.006 |
| 352 | 0.0012-0.003—Wear Limit 0.006 |
| 390 | 0.0017-0.0035—Wear Limit 0.006 |
| 289 | 0.002-0.0038—Wear Limit 0.006 |
| 427 | 0.0038-0.0056 |

## PISTON PIN

| PISTON PIN DIAMETER | |
|---|---|
| Standard | |
| 223 | 0.9120-0.9123 |
| 289 | 0.9118-0.9124 |
| 352, 390 and 427 | 0.9750-0.9753 |
| 0.001 Oversize | |
| 223 | 0.9130-0.9133 |
| 352, 390 and 427 | 0.9760-0.9763 |
| 0.002 Oversize | |
| 223 | 0.9140-0.9143 |
| 352, 390 and 427 | 0.9770-0.9773 |
| **PISTON PIN LENGTH** | |
| 223 and 289 | 3.010-3.030 |
| 352 and 390 | 3.156-3.170 |
| 427 | 3.202-3.212 |
| **PISTON PIN TO PISTON CLEARANCE—Loose** | |
| 289 | 0.0003-0.0005—Wear Limit 0.0008 |
| Other Engines | 0.0001-0.0003—Wear Limit 0.0008 |
| **PISTON PIN TO CONNECTING ROD BUSHING CLEARANCE—Loose** | |
| 223, 352 & 390 | 0.0001-0.0005—Wear Limit 0.001 |
| 427 | 0.0003-0.0005—Wear Limit 0.001 |

## PISTON RINGS

| RING WIDTH | |
|---|---|
| Compression Ring | |
| UPPER | |
| 223 | 0.0929-0.0936 |
| Other Engines | 0.0774-0.0781 |
| LOWER | |
| All Engines | 0.0930-0.0940 |
| **SIDE CLEARANCE** | |
| Compression Ring | |
| UPPER | |
| 223 and 289 | 0.0019-0.0036—Wear Limit 0.006 |
| Other Engines | 0.0024-0.0041—Wear Limit 0.006 |
| LOWER | |
| 223 | 0.0015-0.0035—Wear Limit 0.006 |
| 289 | 0.001-0.004—Wear Limit 0.006 |
| 352, 390 and 427 | 0.002-0.004—Wear Limit 0.006 |
| Oil Ring | |
| All Engines | Snug |
| **RING GAP WIDTH** | |
| Compression Ring—Standard Bore—Upper and Lower | |
| 223 | 0.010-0.031 |
| 289 | 0.015-0.039 |
| 352, 390 and 427 | 0.015-0.036 |
| Oil Ring*—Standard Bore | |
| All Engines (Except 289) | 0.015-0.066 |
| 289 | 0.015-0.069 |
| *Steel spacer | |

## CYLINDER BLOCK

| CYLINDER BORE DIAMETER—Standard Spreads for 8 Grades | |
|---|---|
| 223 | 3.6250-3.6274 |
| 289 | 4.0010-4.0034 |
| 352 | 4.0000-4.0024 |
| 390 | 4.0500-4.0524 |
| 427 | 4.2328-4.2352 |
| **CYLINDER BORE MAXIMUM OUT-OF-ROUND** | |
| All Engines | 0.001—Wear Limit 0.005 |
| **CYLINDER BORE TAPER** | |
| All Engines | 0.001—Wear Limit 0.010 |
| **HEAD GASKET SURFACE FLATNESS** | |
| 223 | 0.003 inch in any 6 inches or 0.007 inch overall |
| Other Engines | 0.003 inch in any 6 inches or 0.006 inch overall |

## OIL PUMP—Rotor Type

| RELIEF VALVE SPRING TENSION—Lbs. @ Specified Length | |
|---|---|
| 289 | 11.15-11.75 @ 1.704 |
| 223, 352 and 390 | 9.0-9.6 @ 1.53 |
| 427 | 8.0-13.0 @ 1.56 |
| **RELIEF VALVE CLEARANCE** | |
| All Engines | 0.0015-0.0029 |
| **DRIVE SHAFT TO HOUSING BEARING CLEARANCE** | |
| All V-8 Engines | 0.0015-0.0029 |
| 223 | 0.0025-0.0039 |
| **ROTOR ASSEMBLY END CLEARANCE** | |
| All Engines | 0.0011-0.0041 |
| **OUTER RACE TO HOUSING—Radial Clearance** | |
| All Engines | 0.006-0.012 |

## TORQUE LIMITS—Ft-Lbs

| MAIN BEARING CAP BOLTS—Oiled Threads | |
|---|---|
| 289 | 60-70 |
| 223, 352, 390 and 427 | 95-105 |
| **CYLINDER HEAD BOLTS—Oiled Threads** | |
| 223 | 105-115 |
| 289 | 65-70 |
| 352 and 390 | 80-90 |
| 427 | 100-110 |
| **OIL PAN TO CYLINDER BLOCK** | |
| 289 | 7-9¼—20<br>9-11⁵⁄₁₆-18 |
| Other Engines | 9-13 |
| **OIL PAN DRAIN PLUG** | |
| All Engines | 15-20 |
| **MANIFOLDS TO CYLINDER HEAD** | |
| Intake | |
| 223 | 23-28 |
| 289 | 14-16 |
| 352 and 390 | 32-35 |
| 427 | 25-28 |
| Exhaust | |
| 223 | 23-28 |
| 289 | 13-18 |
| 352, 390 and 427 | 12-18 |

## TORQUE LIMITS—Ft-Lbs (Continued)

**FLYWHEEL TO CRANKSHAFT**
All Engines ..... 75-85

**OIL PUMP TO CYLINDER BLOCK**
223 ..... 30-35
Other Engines ..... 23-28

**OIL PUMP COVER PLATE**
All Engines—Rotor-Type Pump ..... 6-9

**OIL FILTER ANGLE ADAPTER TO CYLINDER BLOCK**
352, 390 and 427 ..... 12-15

**OIL FILTER ADAPTER TO CYLINDER BLOCK**
223 ..... 10-15
289 ..... 60-100

**OIL FILTER TO ADAPTER OR CYLINDER BLOCK**
All Engines ..... With grease on the gasket surface, hand tighten until gasket contacts adapter face. Then tighten ½ turn more.

**CYLINDER FRONT COVER**
223 ..... 6-9
All V-8 Engines ..... 12-15

**WATER OUTLET HOUSING**
223 ..... 23-28
All V-8 Engines ..... 12-15

**WATER PUMP TO CYLINDER BLOCK OR FRONT COVER**
289 ..... 12-15
Other Engines ..... 23-28

**CAMSHAFT SPROCKET TO CAMSHAFT**
289 ..... 30-35
Other Engines ..... 35-45

**CAMSHAFT THRUST PLATE TO BLOCK**
289 ..... 6-9
Other Engines ..... 12-15

**DAMPER OR PULLEY TO CRANKSHAFT**
All Engines ..... 70-90

**CONNECTING ROD NUTS**
427 ..... 53-58
Other Engines ..... 40-45

## TORQUE LIMITS—Ft-Lbs (Continued)

**VALVE ROCKER ARM COVER**
289 ..... 3-5
Other Engines ..... 4-7

**VALVE ROCKER SHAFT SUPPORT TO CYLINDER HEAD**
223 ..... 50-60
352, 390 and 427 ..... 40-45

**VALVE ROCKER ARM ADJUSTING SCREW**
Self-Locking—Minimum Torque to Rotate
390 Police & 427 ..... 3

**VALVE ROCKER ARM ADJUSTMENT LOCK NUT**
223 ..... 30-35

**VALVE PUSH ROD CHAMBER COVER**
223 ..... 2.0-2.5

**OIL INLET TUBE TO OIL PUMP**
All Engines ..... 12-15

**FUEL PUMP TO CYLINDER BLOCK OR CYLINDER FRONT COVER**
223 ..... 12-15
All V-8 Engines ..... 23-28

**VALVE ROCKER ARM ADJUSTING NUT**
289 ..... 4.5-15

**ENGINE FRONT SUPPORT**
Bracket to Insulator
223 ..... 35-45
Bracket to Engine
223 ..... 35-50
Bracket to Crossmember
All Engines ..... 45-50
Insulator to Frame
All Engines ..... 45-60
Insulator to Engine
All V-8 Engines ..... 35-50

**ENGINE REAR SUPPORT**
Support Retainer to Extension Housing
All Engines ..... 40-50
Support to Frame
All Engines ..... 20-30

**TORQUE LIMITS FOR VARIOUS SIZE BOLTS**

**CAUTION: If any of the torque limits listed in this table disagree with any of those listed in the preceding tables, the limits listed in the preceding tables prevail.**

| Size (Inches) | ¼-20 | ¼-28 | 5/16-18 | 5/16-24 | ⅜-16 | ⅜-24 |
|---|---|---|---|---|---|---|
| Torque (Ft-lbs) | 6-9 | 6-9 | 12-15 | 15-18 | 23-28 | 30-35 |
| Size (Inches) | 7/16-14 | 7/16-20 | ½-13 | ½-20 | 9/16-18 | ⅝-18 |
| Torque (Ft-lbs) | 45-50 | 50-60 | 60-70 | 70-80 | 85-95 | 130-145 |

# IGNITION SYSTEM

# GROUP 9


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# PART 9-1 GENERAL IGNITION SERVICE


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## 1 DIAGNOSIS AND TESTING

### GENERAL INFORMATION

### CONVENTIONAL IGNITION SYSTEM

The ignition system consists of a primary (low voltage) and a secondary (high voltage) circuit (Fig. 1).

The primary circuit consists of the:

1. Battery.
2. Ignition switch.
3. Primary circuit resistance wire.
4. Primary windings of the ignition coil.
5. Breaker points.
6. Condenser.

The secondary circuit consists of the:

1. Secondary windings of the ignition coil.
2. Distributor rotor.
3. Distributor cap.
4. High tension wires.
5. Spark plugs.

When the breaker points are closed, the primary or low voltage current flows from the battery through the ignition switch to the primary windings in the coil, then to ground through the closed breaker points. When the breaker points open, the magnetic field built up in the primary windings of the coil moves through the secondary windings of the coil producing high voltage current. **High voltage current is produced each time the breaker points open.** The high voltage flows through the coil high tension lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap. This process is repeated for every power stroke of the engine.

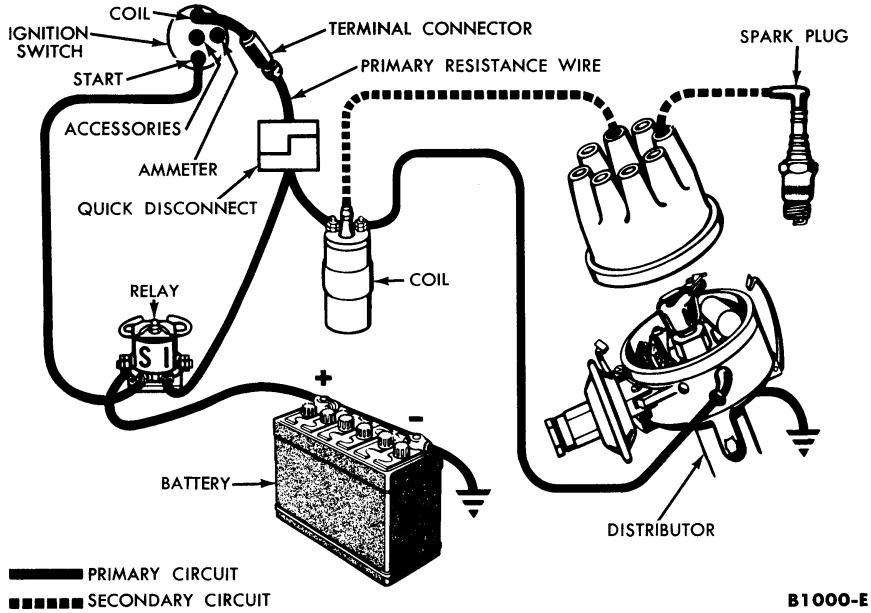



**FIG. 1—Typical Ignition Circuit**

### TRANSISTOR IGNITION SYSTEM

The permatuned transistor ignition system is available on the 427 high performance V-8 engines. Figure 2 shows a schematic of the transistor ignition system.

The ignition coil primary in the transistor system is designed to draw 12 amperes peak current, or approximately 5.5 amperes average current as indicated on a conventional ammeter, in order to provide high spark plug voltage at the higher engine speeds.

The transistor in the system acts as a heavy duty switch or relay. It is similar in action to a horn relay, except that it has no moving parts, and thus acts with very little time

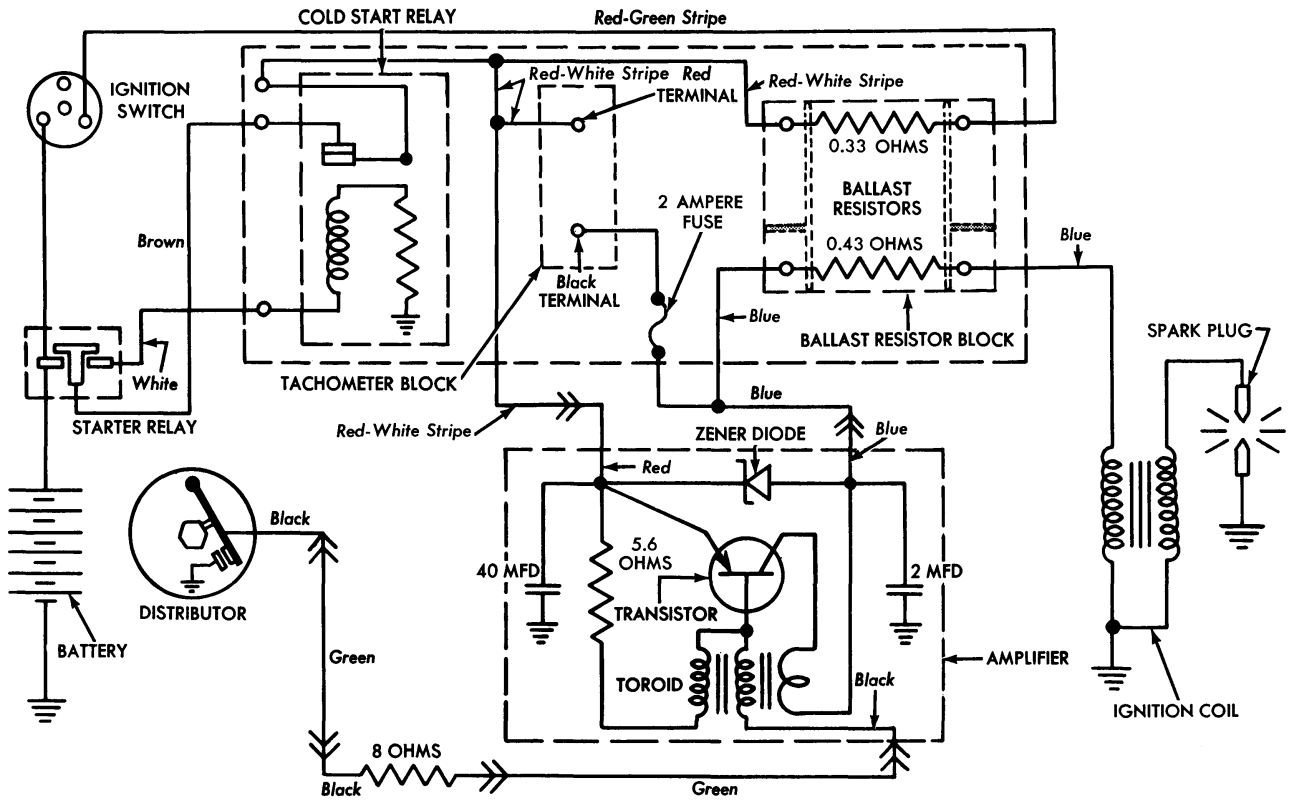



**FIG. 2—Transistor Ignition System Schematic**

lag. The transistor is connected between the battery and the coil, and is used to make and break the coil primary circuit.

The distributor controls the transistor. The 8-ohm resistor, connected between the distributor and the transistor (in the wiring harness), limits the transistor control current (and distributor point current) to 0.5 ampere. The low distributor point current eliminates pitting and gives long distributor point life.

The distributor condenser has been increased in value to 2 mfd, and is located in the amplifier assembly. As in the standard ignition circuit, it absorbs high inductive energy during initial distributor point opening. However, it no longer has any effect on the distributor points as the transistor effectively isolates the points from the coil.

The amplifier assembly (Fig. 3) is mounted under the instrument panel to protect the parts from engine heat.

A ceramic ballast resistor block, a tachometer connector block, and a cold start relay are mounted on a plate in the engine compartment (Fig. 4). A fiber cover encloses the resistor block, tachometer block, and cold start relay.

A 2-ampere fuse in the collector to tachometer block lead prevents the transistor from being damaged by the application of external devices other than normal testing equipment.

The cold start relay contacts are normally closed and they are connected into the circuit only during the start cycle. When the starter relay is closed, the cold start relay is actuated and opens its contacts. If, during starting, the available voltage drops below 10.5 volts, the relay contacts close, thus bypassing the 0.33-ohm resistor in the ballast resistor block, and applying full available voltage to the system.

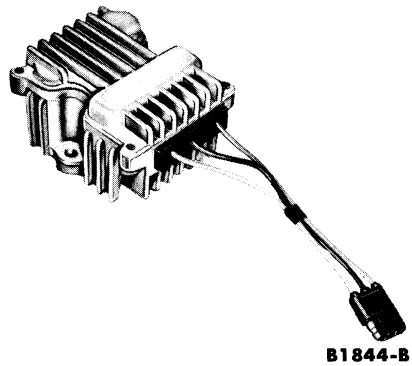



**FIG. 3—Amplifier Assembly**

The tachometer block is used to connect a tachometer or dwell meter into the circuit. **Do not connect a tachometer or dwell meter into the circuit in any other manner, or readings will be inaccurate and damage may occur to the transistor, or change its operating characteristics.**

Connect the tachometer red lead to the tachometer block red terminal (red-white striped lead) and black lead to the black terminal (blue lead).

## TROUBLE ISOLATION

### CONVENTIONAL IGNITION SYSTEM

Ignition system troubles are caused by a failure in the primary and/or the secondary circuit or incorrect ignition timing. If an engine trouble has been traced to the ignition system from the "Engine Trouble Diagnosis Guide", the trouble can be found by performing an ignition system test on a scope or by further isolating the trouble to the

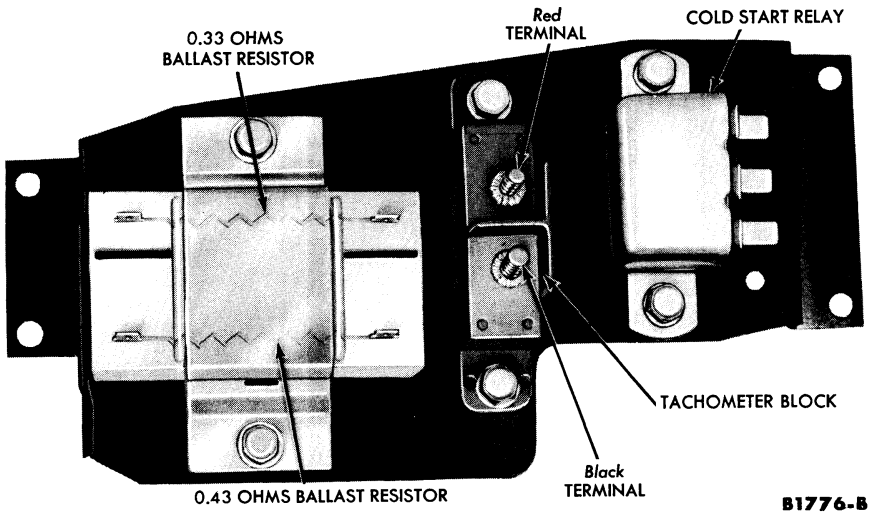



**FIG. 4—Ballast Resistors, Tachometer Block and Cold Start Relay with Cover Removed—Typical**

primary or secondary circuit as follows:

1. Remove the coil high tension lead from the distributor cap.
2. Hold the high tension lead approximately 3/16 inch from the cylinder head.
3. With the ignition switch on, crank the engine and check for a spark.

If the spark is good, the trouble lies in the secondary circuit.

If there is no spark or a weak spark, the trouble is in the primary circuit, coil to distributor high tension lead, or the coil.

**Primary Circuit.** A breakdown or energy loss in the primary circuit can be caused by:

1. Defective primary wiring, corroded or loose terminals.
2. Burned, shorted, sticking, or improperly adjusted breaker points.
3. A defective coil.
4. A defective condenser.

**Secondary Circuit.** A breakdown or energy loss in the secondary circuit can be caused by:

1. Fouled or improperly adjusted spark plugs.
2. Defective high tension wiring.
3. High tension leakage across the coil, distributor cap, or rotor.

### TRANSISTOR IGNITION SYSTEM

**Do not use any other testing procedures or conventional short cuts than those listed below, or extensive damage can result to the system.**

Ignition troubles are caused by a failure in the primary or secondary circuit, or incorrect ignition timing. Isolate the trouble as follows:

1. Remove the coil high tension lead from the distributor cap.
2. Hold the high tension lead approximately 1/4 inch from the cylinder head.
3. With the ignition switch on, crank the engine and check for a spark. The engine may be cranked by the conventional method of runing a jumper wire from the battery positive terminal to the "S" terminal of the starter relay, **after disconnecting the red and blue lead at the relay.**

If the spark is good, the trouble lies in the secondary (high voltage) circuit. If there is no spark or a weak spark, the trouble is in the primary (low voltage) circuit.

**Primary Circuit.** A breakdown or energy loss in the primary circuit can be caused by:

1. Defective primary wiring.
2. Improperly adjusted, contaminated, or defective distributor points.
3. Defective amplifier assembly.

**Secondary Circuit.** A breakdown or energy loss in the secondary circuit can be caused by:

1. Fouled or improperly adjusted spark plugs.
2. Defective high voltage wiring.
3. High voltage leakage across the coil, distributor cap or rotor.

### PRIMARY CIRCUIT TESTS

### CONVENTIONAL IGNITION SYSTEM

A complete test of the primary circuit consists of checking the circuit from the battery to the coil, the circuit from the coil to ground, and the starting ignition circuit.

Excessive voltage drop in the primary circuit will reduce the secondary output of the ignition coil, resulting in hard starting and poor performance.

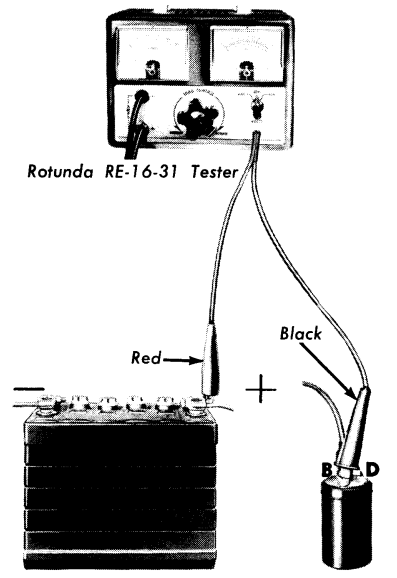



**FIG. 5—Battery to Coil Test—Rotunda Tester**

#### Battery to Coil Test

PROCEDURE

1. Connect the voltage leads as shown in Figs. 5 and 6.
2. Install a jumper wire from the distributor terminal of the coil to a

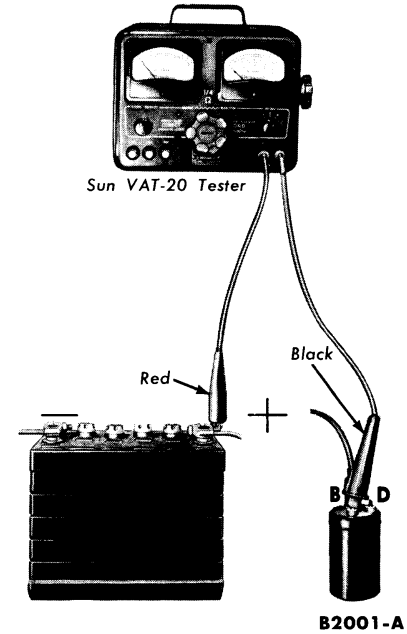



**FIG. 6—Battery to Coil Test—Sun Tester**

good ground on the distributor housing.

3. Turn the lights and accessories off.

4. Turn the ignition switch on.

RESULTS. If the voltmeter reading is 6.9 volts or less, the primary circuit from the battery to the coil is satisfactory.

If the voltmeter reading is greater than 6.9 volts, check the following:

1. The battery and cables for loose connections or corrosion.

2. The primary wiring for worn insulation, broken strands, and loose or corroded terminals.

3. The resistance wire for defects.

4. The relay to ignition switch for defects.

**Ignition Switch Test**

PROCEDURE

1. Connect the voltmeter leads as shown in Figs. 7 and 8.

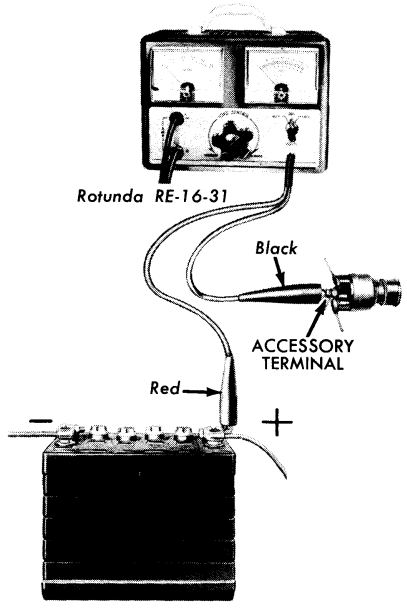
2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor body.

3. Turn all of the accessories and lights off.

4. Turn the ignition switch on.

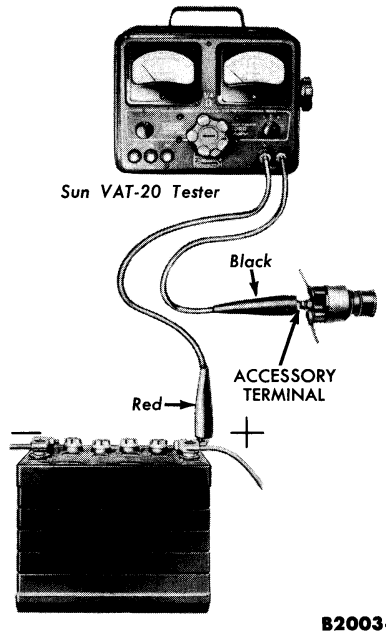
RESULTS. If the voltmeter reading is 0.3 volt or less, the ignition switch and the relay to switch wire are satisfactory.

If the voltmeter reading is greater than 0.3 volt, either the ignition switch and/or the wire are defective.



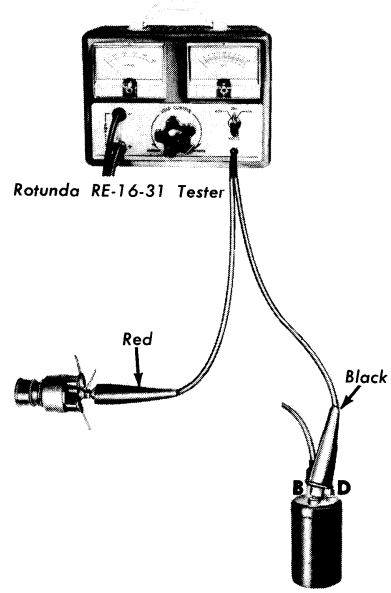

B2002-A

**FIG. 7—Ignition Switch Test—Rotunda Tester**




B2003-A

**FIG. 8—Ignition Switch Test—Sun Tester**




B2004-A

**FIG. 9—Resistance Wire Test—Rotunda Tester**

**Resistance Wire Test**

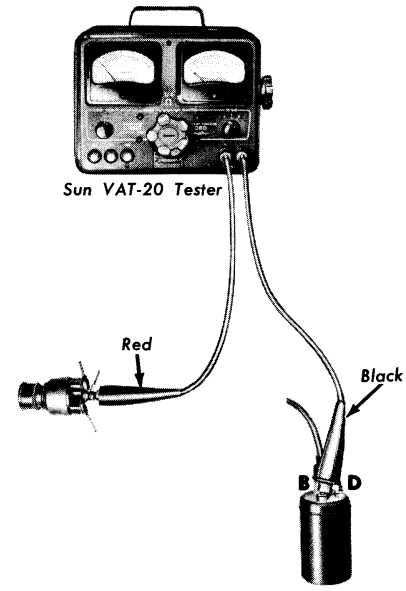
PROCEDURE

1. Connect the voltmeter leads as shown in Figs. 9 and 10.

2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor housing.

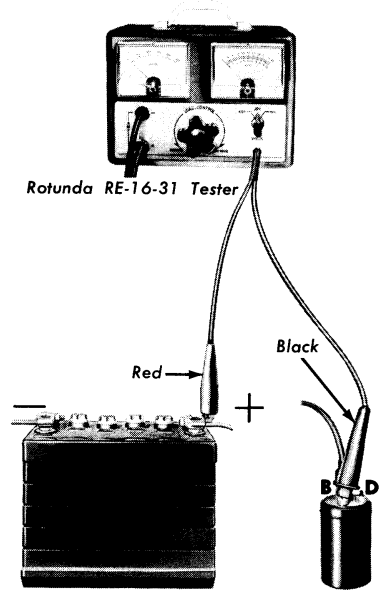
3. Turn all of the accessories and lights off.

4. Turn the ignition switch on.




B2005-A

**FIG. 10—Resistance Wire Test—Sun Tester**




B2006-A

**FIG. 11—Starting Ignition Circuit Test—Rotunda Tester**

RESULTS. If the voltmeter reading is 6.6 volts or less, the resistance wire is satisfactory.

If the voltmeter reading is greater than 6.6 volts, replace the resistance wire.

**Starting Ignition Circuit Test**

PROCEDURE

1. Connect the voltmeter leads as shown in Figs. 11 and 12.

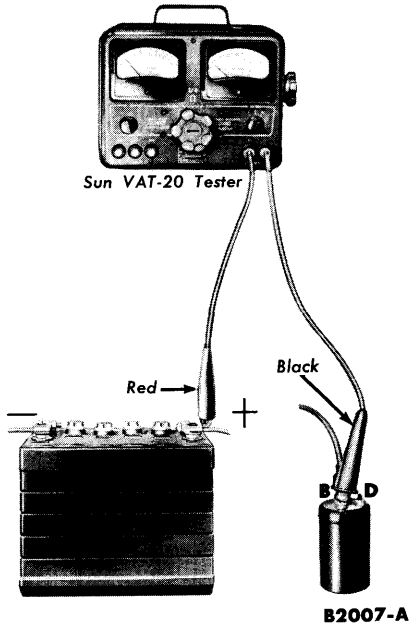



**FIG. 12—Starting Ignition Circuit Test—Sun Tester**

**2.** Disconnect and ground the coil to distributor high tension lead at the distributor.

**3.** With the ignition switch off, crank the engine by jumping a wire between the battery and "S" terminal of the starter relay while observing the voltage drop.

RESULTS. If the voltage drop is 0.1 volt or less, the starting ignition circuit is satisfactory.

If the voltage drop is greater than 0.1 volt, clean and tighten the terminals in the circuit or replace the wiring as necessary.

**Coil to Ground Test**

PROCEDURE

**1.** Connect the voltmeter leads as shown in Figs. 13 and 14.

**2.** Close the breaker points.

**3.** Turn all lights and accessories off.

**4.** Turn the ignition switch on.

RESULTS. If the voltmeter reading is 0.1 volt or less, the primary circuit from coil to ground is satisfactory.

If the voltmeter reading is greater than 0.1 volt, test the voltage drop of each of the following:

**1.** Coil to distributor primary wire.

**2.** The movable breaker point and the breaker plate.

**3.** The breaker plate and the distributor housing.

**4.** The distributor housing and engine ground.

**Breaker Points.** The breaker point assembly consists of the stationary point bracket assembly, breaker arm and the primary wire terminal.

Breaker points should be inspected, cleaned and adjusted as necessary. Breaker points can be cleaned with chloroform and a stiff bristle brush. Replace the breaker point assembly if the contacts are badly burned or excessive metal transfer between the points is evident (Fig. 15). Metal transfer is considered excessive when it equals or exceeds the gap setting.

**Coil.** The coil should be tested following the instructions under "Ignition System Tests".

**Condenser.** The condenser should also be tested following the instructions under "Ignition System Tests".

## TRANSISTOR IGNITION SYSTEM

When diagnosis procedures isolate trouble to the primary circuit, make the following tests to locate the defective item. **Do not use any other procedure, conventional short cut, or connect test equipment in any other manner than that described or extensive damage can be caused to the transistor ignition system.** Figure 16 shows the transistor ignition system in outline form.

Remove the cover from the ballast-resistor relay assembly (Fig. 4), **and disconnect the cold start relay.** Connect a dwell meter to the tachometer block (Fig. 4). Connect the black lead to the black terminal and the red lead to the red terminal. Turn the ignition on and crank the engine. Observe the dwell meter reading.

**0° Dwell.** A dwell reading of 0° indicates:

**1.** The distributor points are contaminated or are not closing.

**0° to 45° Dwell.** A dwell reading between 0° and 45° indicates:

**1.** The transistor and the primary circuit are functioning properly.

**2.** The trouble could be in the secondary circuit.

**45° Dwell.** A dwell reading of 45° indicates:

**1.** No power from ignition switch.

**2.** The distributor points are closed and not opening.

**3.** Defective amplifier assembly.

To determine which of the three items listed are causing the trouble proceed as follows:

Disconnect the distributor lead at the bullet connector, and crank the engine. If the dwell meter indicates 0° dwell, the distributor points are not opening. If 45° dwell is indicated, the amplifier is malfunctioning or there is no power from the ignition switch.

Use a voltmeter or test light to determine if the transistor (amplifier assembly) is at fault. Connect the voltmeter to the red-green lead terminal of the ballast resistor and to ground. Crank the engine. If a

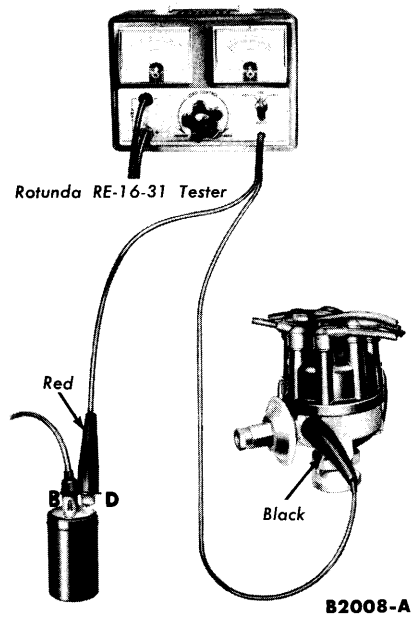



**FIG. 13—Coil to Ground Test—Rotunda Tester**

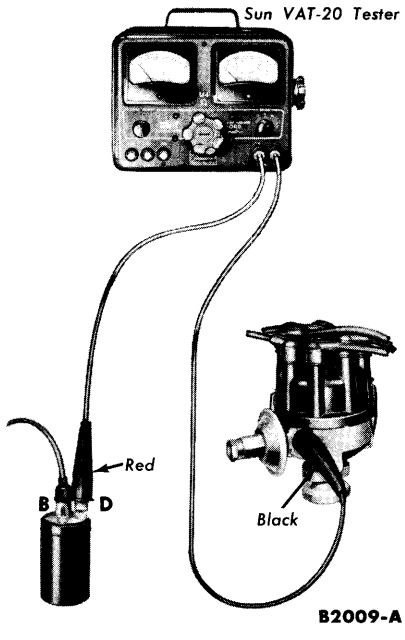
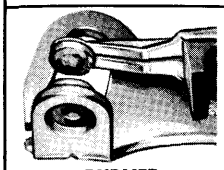
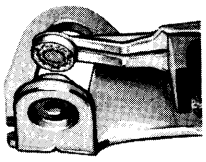
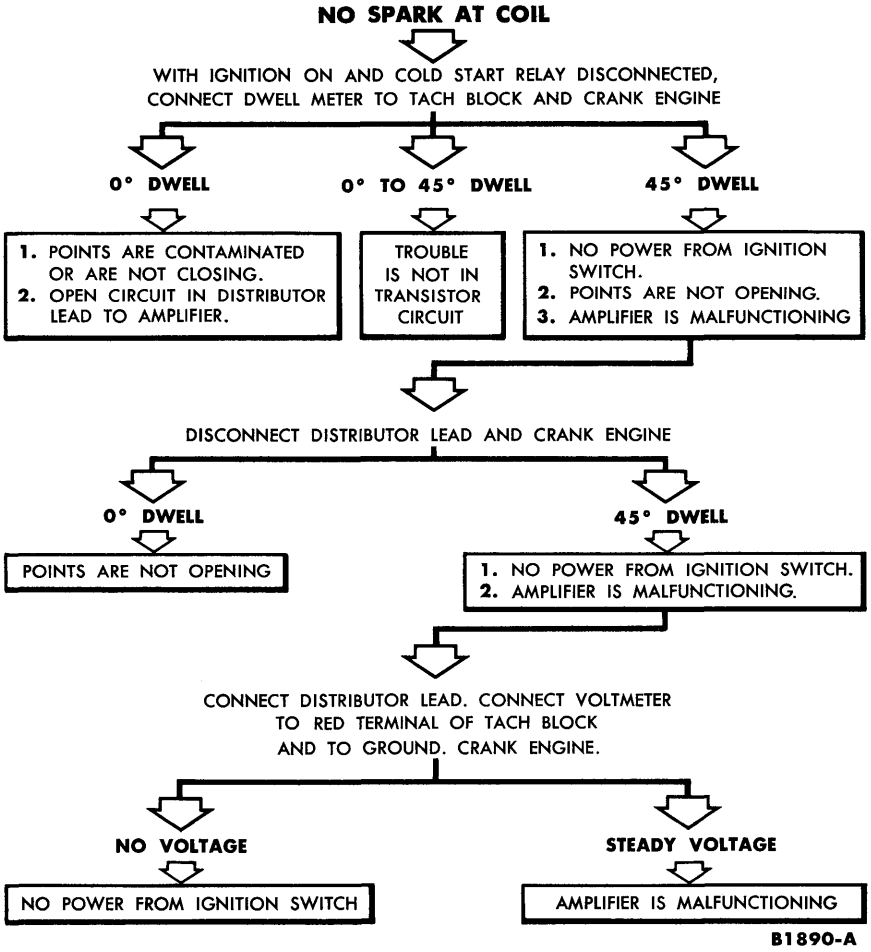



**FIG. 14—Coil to Ground Test—Sun Tester**

| CONDITION | CAUSED BY |
|---|---|
|  BURNED | Any discoloration other than a frosted slate grey shall be considered as burned points. |
|  EXCESSIVE METAL TRANSFER OR PITTING | Incorrect alignment.<br>Incorrect voltage regulator setting.<br>Radio condenser installed to the distributor side of the coil.<br>Ignition condenser of improper capacity.<br>Extended operation of the engine at speeds other than normal. |

B1443-B

**FIG. 15—Breaker Point Inspection**




B1890-A

**FIG. 16—Transistor Ignition System Test Procedures**

steady indication of voltage is obtained, the trouble is in the amplifier. Absence of any voltage indication on the voltmeter shows there is an open circuit, or no power between the ignition switch and the amplifier. The ballast resistor could be defective. Replace it with a known good ballast resistor, and repeat the test.

If the test procedure indicates a defective amplifier, replace it with a known good amplifier, and proceed as follows:

Connect the distributor high tension lead at the bullet connector. Then, with the cold start relay disconnected and the dwell meter connected to the tachometer block, crank the engine and observe the indicated dwell. A reading between 0° and 45° indicates satisfactory ignition; thus, the amplifier is at fault.

If the dwell reading is still 45°, the wiring from the amplifier through the ballast resistor to the coil is defective. Replace the defective item.

## SECONDARY CIRCUIT TESTS

The following procedure is used on both ignition systems.

### PRELIMINARY CHECKS

**1.** Remove the coil to distributor high tension lead and the spark plug wires from the distributor cap and from the spark plugs. Inspect the terminals for looseness and corrosion. Inspect the wires for breaks and cracked insulation. Replace all defective wiring.

**2.** Clean the inside of the distributor cap, and inspect it for cracks, burned contacts, permanent carbon tracks, or a defective center carbon brush electrode. Remove dirt or corrosion from the sockets. Replace the cap if it is defective.

**3.** Inspect the rotor for cracks or defects. Replace the rotor if it is defective.

### SECONDARY (HIGH TENSION) WIRES

The secondary wires include the wires connecting the distributor cap to the spark plugs and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

These wires are the radio resistance-type which filter out the high frequency electrical impulses that are the source of ignition noise interference. The resistance of each wire should not exceed 24,500 ohms. **When checking the resistance of the wires for setting ignition timing, do not puncture the wires with a probe. The probe may cause a separation in the conductor.**

At regular intervals, clean and inspect the wires for cracked insulation and loose terminals. Repair or replace the wires as required. A spark plug wire set is available for service.

**When removing the wires from the spark plugs, grasp the moulded cap only. Do not pull on the wire because the wire connection inside**

**the cap may become separated or the weather seal may be damaged.**

**Spark Intensity**

**1.** Disconnect a spark plug wire. **Check the spark intensity of one wire at a time.**

**2.** Install a terminal adapter in the terminal of the wire to be checked. Hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine, using a remote starter switch. The spark should jump the gap regularly.

**3.** If the spark intensity of all wires is satisfactory, the coil, condenser, rotor, distributor cap and the secondary wires are probably satisfactory.

If the spark is good at only some wires, perform a high resistance test of the faulty leads.

If the spark is equal at all wires, but weak or intermittent, make a high resistance check of the coil, distributor cap and the coil to distributor high tension wire.

**On the transistor ignition, do not test the coil on a coil tester, as inconclusive results will be obtained due to the very low coil primary inductance. Substitute a known good coil and perform the primary circuit tests.**

## SPARK PLUGS

Clean, inspect, and gap the plugs following the instructions in Sections 2 and 3. After the proper gap is obtained, check the plugs on a testing machine. Compare the sparking efficiency of the cleaned and gapped plug with a new plug. Replace the plug if it fails to meet 70% of the new plug performance.

Test the plugs for compression leakage at the insulator seal. Apply a coating of oil to the shoulder of the plug where the insulator projects through the shell, and to the top of the plug, where the center electrode and terminal project from the insulator. Place the spark plug under pressure with the testers high tension wire removed from the spark plug. Leakage is indicated by air bubbling through the oil. If the test indicates compression leakage, replace the plug. If the plug is satisfactory, wipe it clean.

## IGNITION TIMING

Incorrect ignition timing can be caused by:

**1.** Timing incorrectly adjusted.

**2.** Distributor bushing and/or shaft worn, or a bent distributor shaft.

**3.** Defective vacuum advance system.

**4.** Defective centrifugal advance (dual advance or centrifugal advance distributor).

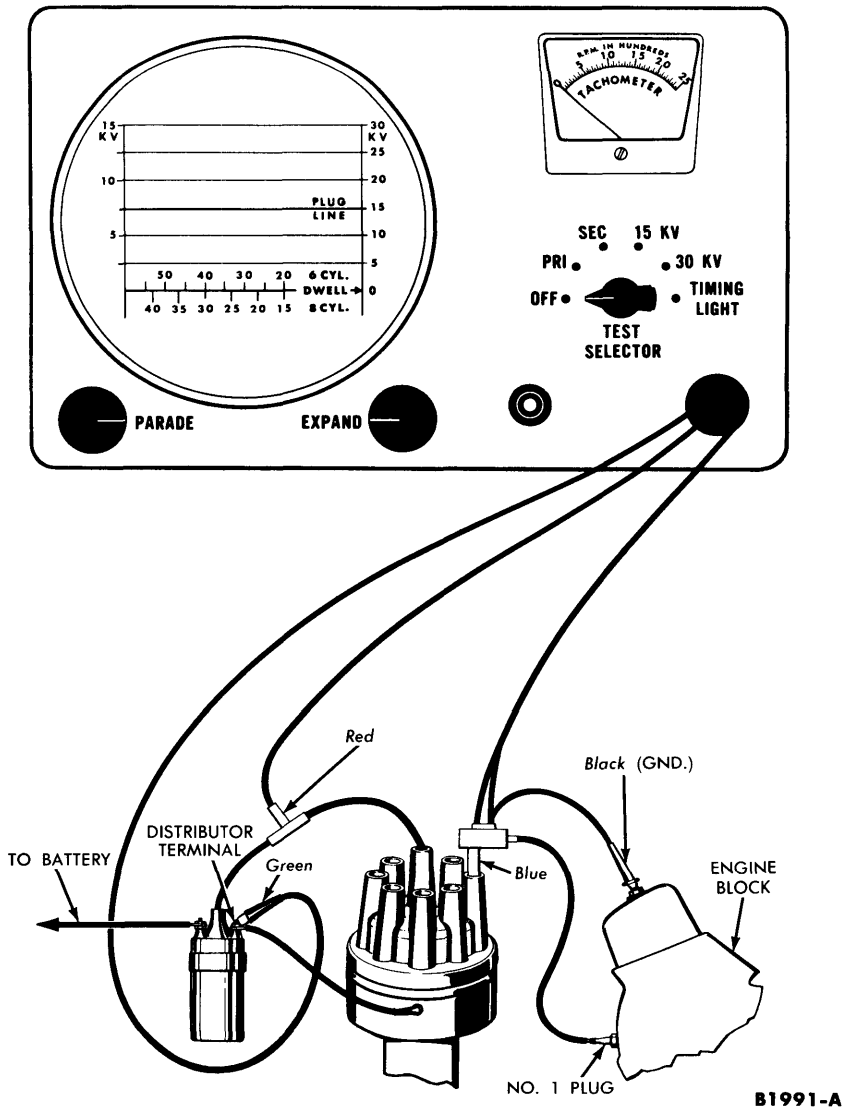



**FIG. 17—Rotunda RE-235 Test Connections**

## IGNITION SYSTEM TESTS—ROTUNDA TESTERS

### TEST CONNECTIONS—RE-235, RE-651 AND RE-881

The test connections for the RE-235 tester are shown in Fig. 17, the test connections for the RE-651 tester are shown in Fig. 18, and the test connections for the RE-881 tester are shown in Fig. 19.

**1.** With the tester turned off, plug the power plug into a proper AC outlet.

**2.** Connect the green lead to the distributor terminal of the coil.

**On a car equipped with a transistor ignition, connect this green lead to the terminal on the red side of the tachometer block.**

**3.** Remove the No. 1 plug wire from the distributor cap, place the blue pickup in the cap and place the plug wire in the pickup.

**4.** Now connect the black lead to a good ground.

**If the car has a transistor ignition, connect the black lead to the terminal on the black side of the tachometer block.**

**5.** Clip the red pickup over the coil-to-distributor high tension wire.

**6.** If the engine timing is to be checked, plug the timing light into its socket.

The following steps pertain to the RE-651 and RE-881 testers only.

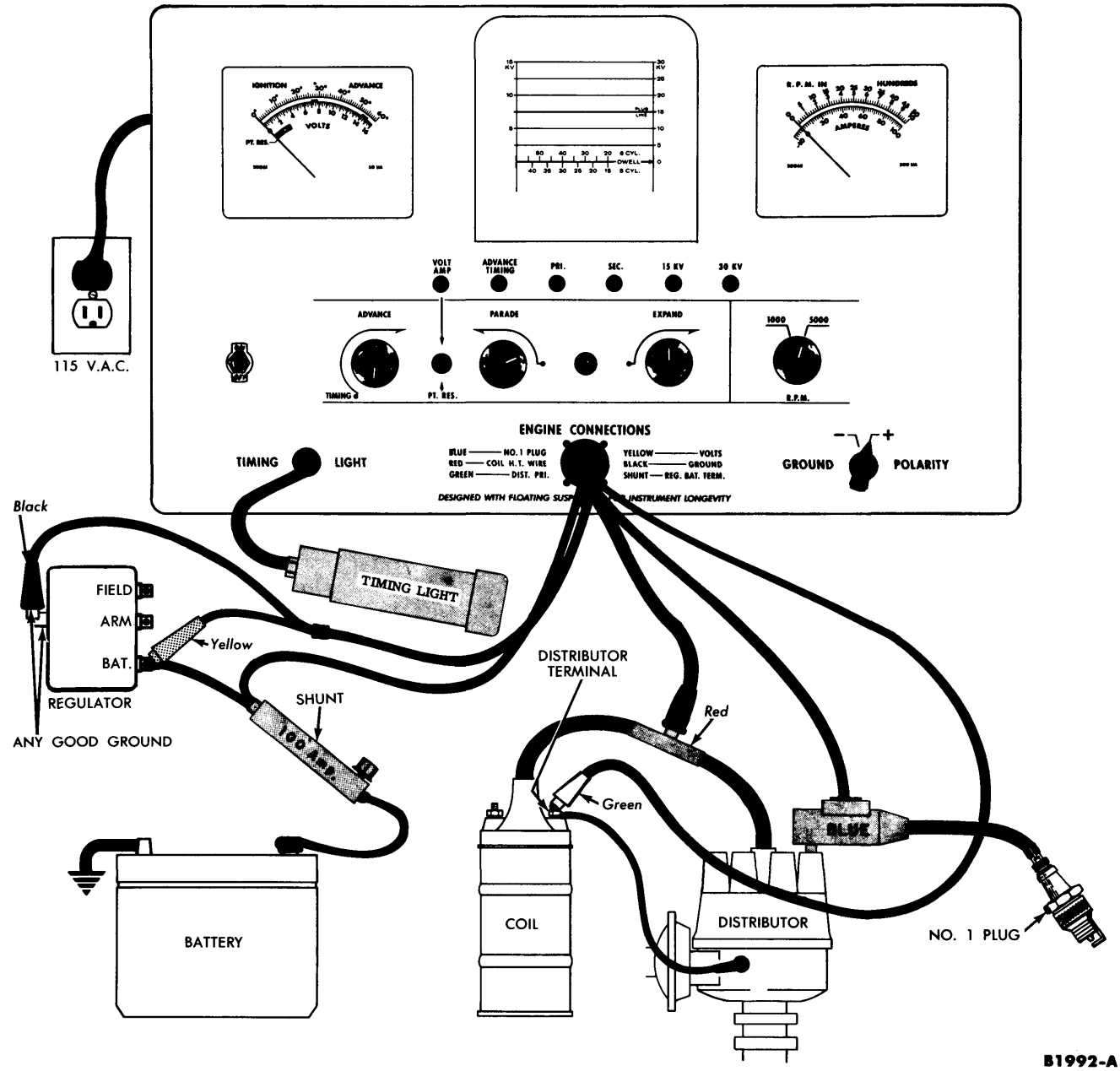



**FIG. 18—Rotunda RE-651 Test Connections**

7. Disconnect the battery wire from the regulator and place it in the knob end of the 100-ampere shunt.

8. Place the spade terminal from the 100-ampere shunt and the yellow lead on the battery terminal of the voltage regulator.

9. Turn the ground polarity switch to the minus position. On the RE-881 tester, turn the volts switch to the 20-volt position.

## POINT RESISTANCE TEST

### RE-651 Tester

1. Remove and ground the high tension wire from the center of the distributor.

2. Turn the volts switch to the point resistance (PT. RES.) position. The points should be closed for this test. If the breaker points are open, the meter will read the battery voltage (0 to 40 scale).

3. "Bump" the starter with the starter switch until the voltmeter pointer decreases to the lowest reading in the black zone. **On a car equipped with a transistor ignition system, this bumping is done by jumping between the "S" terminal of the solenoid and the battery with the ignition switch off and the coil lead (brown wire) disconnected from the solenoid.**

4. Depress the PT. RES. push-button.

5. The voltmeter pointer should read within the 12V area as shown in black on the meter dial. If not, check for incorrect breaker point spring tension or for burned or pitted points.

6. Connect the high tension wire to the distributor.

### RE-881 Tester

1. Remove and ground the high

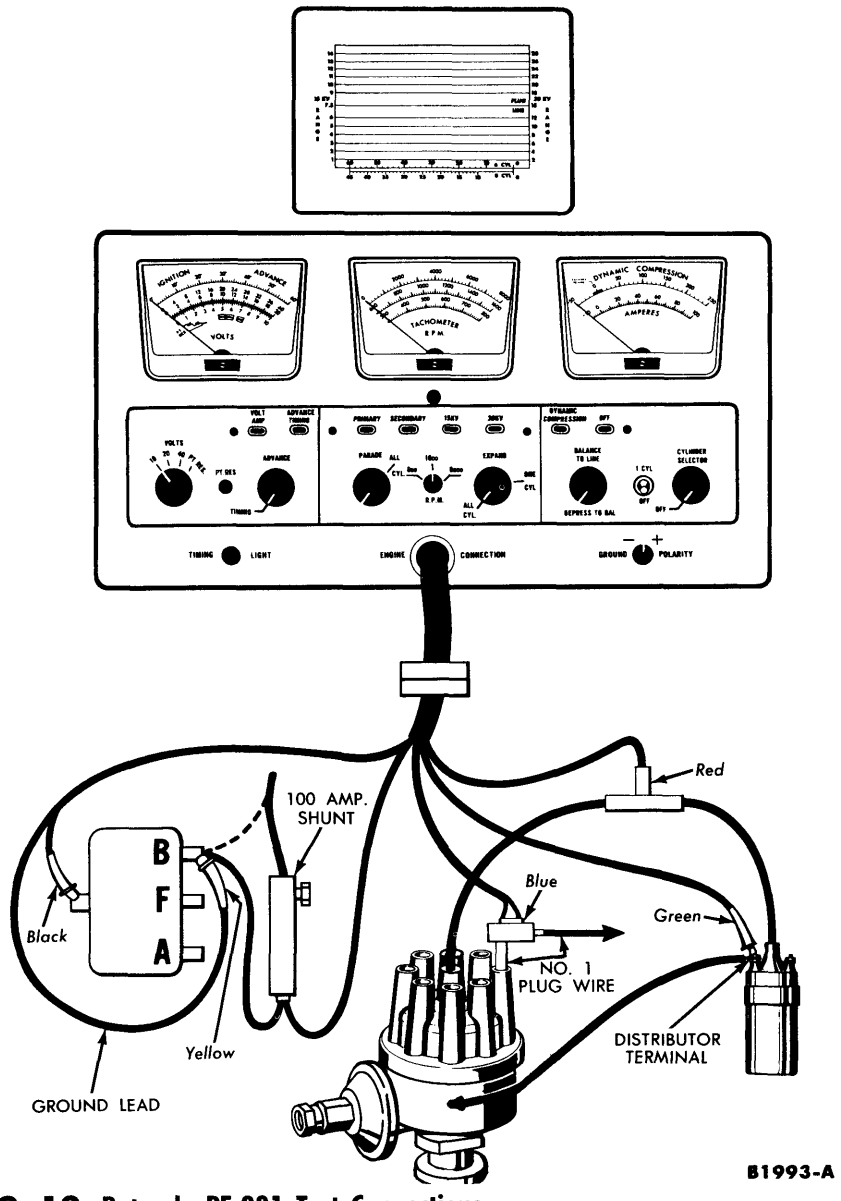



**FIG. 19—Rotunda RE-881 Test Connections**

tension wire from the center of the distributor.

2. "Bump" the starter with the starter switch to close the breaker points. This will be indicated by the lowest reading on the voltmeter. **On a car equipped with a transistor ignition system, the starter is bumped by jumping between the "S" terminal of the solenoid and the battery with the ignition switch off and the coil lead (brown wire) disconnected from the solenoid.**

3. The voltmeter pointer should read in the black, OK PT. RES. area. If it doesn't, check for improper breaker point spring tension or for burned or pitted points.

4. Connect the high tension wire to the distributor.

## IGNITION TIMING

Disconnect the vacuum line. If necessary, clean and mark the desired timing mark.

**RE-235 Tester**

1. Start the engine and allow it to warm up.

2. Operate the engine at the specified idle speed and point the timing light towards the pointer. The desired timing mark should line up with the pointer. If it doesn't, loosen the distributor hold down bolt(s) and rotate the distributor until the mark lines up with the pointer. Now tighten the hold down bolt(s) and check the timing.

**RE-651 Tester**

1. Turn the rpm selector to the 1000 position.

2. Depress the advance timing pushbutton.

3. Start the engine and allow it to warm up.

4. Operate the engine at the specified idle speed.

5. Turn the advance knob until the ignition advance meter reads 0°.

6. Point the timing light towards the timing pointer. The desired timing mark should line up with the pointer. If it doesn't, loosen the distributor hold down bolt(s) and rotate the distributor until the desired timing mark and pointer line up. Tighten the distributor hold down bolt(s) and check the timing.

**RE-881 Tester.** The method of testing is the same as the RE-651 tester with the exception of Step 1 which should (for the RE-881) read "turn the rpm selector to the 800 position".

## SUPERIMPOSED PRIMARY PATTERN

**Procedure**

RE-235 TESTER

1. With the engine running at 1000 rpm, turn the test selector switch to the primary (PRI.) position.

2. Adjust the parade control to position the left end of the pattern at the left vertical line on the screen.

3. Adjust the expand control so that the right end of the pattern is at the right vertical line on the screen.

RE-651 TESTER

1. Turn the rpm selector to the 5000 position. Start the engine and adjust it to 1000 rpm.

2. Depress the PRI. pushbutton on the console panel.

3. Adjust the parade and expand controls to position the left end of the pattern at the left vertical line on

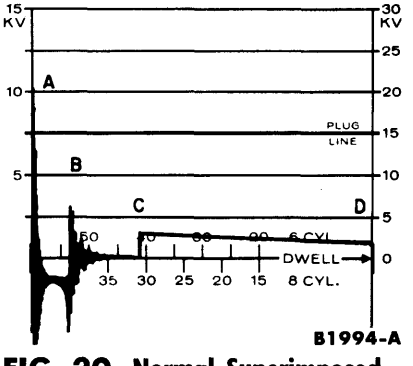



**FIG. 20—Normal Superimposed Primary Pattern**

the screen and the right end of the pattern at the right vertical line on the screen.

RE-881 TESTER. The test procedure for the RE-881 is the same as the test procedure for the RE-651 except for the setting of the rpm selector. For the RE-881 tester, the rpm selector is turned to the 1600 position.

**Results.** A normal test pattern for an eight cylinder engine is shown in Fig. 20. The six cylinder test pattern would be very similar, the only difference would be the dwell value.

Point A indicates the spark plug line which is the time when the points open. At B, the coil energy is used up sufficiently so that the plug no longer fires and only the energy stored in the breaker point condenser remains. This coil/condenser oscillation which is indicated in the pattern between B and C is completely used up at C which is the points close mark. The portion of the pattern between C and D is the points close time, which is cam angle or dwell time. At D, the points again open and the firing cycle repeats.

If points A and C are below the 0 line, the battery polarity is incorrect. This could be caused by a battery that is either installed incorrectly or improperly charged, causing a polarity reversal.

If the firing line is not below the 0 horizontal line and there are no oscillations at point C, there is an open circuit at the coil high tension tower. This could be caused by a broken wire inside the coil tower, or a broken center contact on the distributor rotor.

If the dwell time is too short, the breaker points are incorrectly set (the larger the gap, the smaller the dwell).

If point A is at a reduced height, and the distance to B is short or nonexistent, and the oscillations at point C are reduced in height, there is a high resistance in the coil primary circuit. This could be caused by a fouled plug, defective ignition switch, or a bad wire or connection. If the scope pattern is still the same after the above ignition parts have been checked and proven satisfactory, run the 15 KV test to check for a gasket leak or a lean fuel mixture.

If point A is at a greatly reduced height and there are no oscillations at point B, the coil has a defective primary winding or the condenser

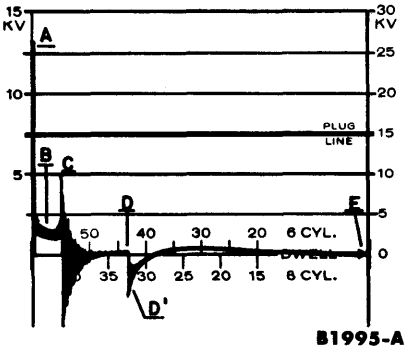



**FIG. 21—Normal Superimposed Secondary Pattern**

has an excessive series resistance.

If there is a variation at points C and D, the cam lobes are uneven, the distributor shaft is bent, or the distributor bushings are worn.

## SUPERIMPOSED SECONDARY PATTERN

**Procedure**

RE-235 TESTER

**1.** With the engine running at 1000 rpm, turn the test selector switch to the secondary (SEC.) position.

**2.** Adjust the parade and expand controls so that the left end of the pattern is at the left vertical line on the screen and the right end of the pattern is at the right vertical line on the screen.

RE-651 AND RE-881 TESTERS. The procedure is the same as the procedure for the primary (superimposed) except, the SEC. pushbutton is depressed instead of the PRI. pushbutton.

**Results.** A normal test pattern for an eight cylinder engine is shown in Fig. 21. The six cylinder test pattern would be very similar, the only difference would be the dwell value.

Point A is the points open time. The height of the pattern at point A indicates the high tension voltage required to overcome the spark plug gap resistance.

Point B is the plug firing line. Notice that this portion of the pattern is quite thick. Remember that this pattern is actually 6 or 8 firing patterns superimposed one on top of the other. This increase in thickness of the pattern at B is caused by slight variations in the plug gap, distributor rotor gap and slight differences in the resistance of the individual spark plug circuits.

The pattern area between points C and D shows the coil/condenser oscillations to be correct. No point bounce at D indicates correct breaker point spring tension.

The few so called damped oscillations appearing at D are normal and are caused by the surge of current through the coil primary winding when the breaker points first close.

This current levels off and decreases slightly toward the points open position at E as indicated by the slight downward slope of the curve at about the 15° mark on the cam angle scale.

To observe the coil/condenser oscillations and the damped oscillations at $D^1$ in greater detail, adjust the expand control so that the pattern area between points C and $D^1$ nearly fills the screen.

If there is erratic action at points C and D, and there is a blotch above point E, the breaker points are burned or badly pitted.

If the length of B is reduced and the pattern between C and D is not superimposed, there is a series gap in the coil high tension tower or wire.

If the line at B is sloping downward greatly (resistor plugs will cause a slight slope), there is a high resistance in the spark plug wires, distributor cap or rotor.

If point $D^1$ is varying erratically, the distributor is badly worn. If this variation is definite instead of erratic, the advance mechanism in the distributor is defective.

If the dwell line between points $D^1$ and E is not the smooth line shown, there is a loose connection in the primary circuit. Check the primary circuit for loose connections, damaged wires or a defective starter switch.

## 15 KV PATTERN

**Procedure**

RE-235 TESTER. With the engine operating at 1000 rpm, turn the test selector switch to the 15 KV

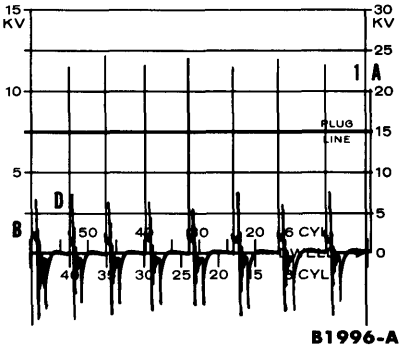



**FIG. 22—15 KV Pattern**

position. Adjust the expand and parade controls to produce the pattern shown in Fig. 22.

RE-651 TESTER. With the rpm selector at the 5000 position and the engine operating at 1000 rpm, depress the 15 KV pushbutton. Adjust the expand and parade controls to produce the pattern shown in Fig. 22.

RE-881 TESTER. With the rpm selector at the 1600 position and the engine operating at 1000 rpm, depress the 15 KV pushbutton. Adjust the expand and parade controls to produce the pattern shown in Fig. 22.

**Results.** A normal eight cylinder engine 15 KV pattern is shown in Fig. 22. The six cylinder pattern would have six similar images. The spark plug line (A) for the No. 1 spark plug is on the extreme right hand side of the screen. The remainder of the No. 1 firing pattern is on the left side of the screen. The remainder of the patterns are shown from left to right in their firing order.

With the exception of the No. 1 spark plug line (which should be shorter than the others), the patterns should be similar. If one of the patterns differs from the others, adjust the expand and parade controls until that pattern fills the screen in the same manner as in the secondary test (Fig. 21).

The following list of symptoms will refer to Fig. 21.

If the points open line (A) is higher than the rest and the plug firing line (B) is sloped downward at an unusually large slope, there is excessive resistance in the high tension wire to that cylinder or in the distributor cap.

If the points open line (A) is low and the firing line (B) is long and nearly straight, the spark plug is shorted out.

If the points open line (A) is low and the firing line (B) is long and wide, the spark plug gap is out of adjustment.

If there are no oscillations at points C or D, the coil primary windings are partially shorted.

If the points open line (A) and the oscillations at point D are both displaced to the right on all cylinders, check the breaker points.

If all of the points open lines (A) are at varied heights, check the idle adjustment of the carburetor (always adjust the idle mixture on the rich side).

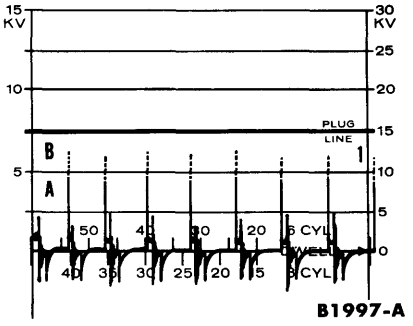



**FIG. 23—30 KV Pattern**

### 30 KV PATTERN

**Procedure**

RE-235 TESTER. With the engine running at 600 rpm, turn the test selector switch to the 30 KV position. Adjust the expand and parade controls to produce the pattern shown in Fig. 23.

RE-651 TESTER. With the rpm selector at the 5000 position and the engine operating at 600 rpm, depress the 30 KV pushbutton. Adjust the expand and parade controls to produce the pattern shown in Fig. 23.

RE-881 TESTER. With the rpm selector at the 1600 position and the engine operating at 600 rpm, depress the 30 KV pushbutton. Adjust the expand and parade controls to produce the pattern shown in Fig. 23.

**Results.** A normal eight cylinder engine 30 KV pattern is shown in Fig. 23. The six cylinder pattern would have six similar images. The spark plug line (A) for the No. 1 spark plug is on the extreme right hand side of the screen. The remainder of the No. 1 firing pattern is on the left side of the screen. The remainder of the patterns are shown from left to right in their firing order.

Notice the average height of the solid part of the points open line. Increase the speed of the engine and notice the height of the dotted lines. The difference is the required ignition output under load. The maximum output should be between 13.5 and 15 KV.

If the maximum for one or more of the plugs is above 15 KV, check the complete circuit(s) of the plug(s) for any trouble that would cause this resistance. If the maximum does not increase during the increase in engine speed, check for a fouled or improperly gapped spark plug or for very low compression.

Remove the high tension wire **at the distributor cap** for any plug except No. 1. Notice the change between the average points open line and the points open line of the cylinder with the high tension wire removed. This height difference is the coil reserve. The coil reserve should be at least 30% of the maximum output. If it is less than 30%, replace the coil.

Remove and do not ground one spark plug wire at the spark plug. If a plug firing line shows up on the scope for that cylinder, check the plug wire and distributor cap for bad insulation.

## IGNITION SYSTEM TESTS—SUN 900 TESTER

### TEST CONNECTIONS

Most of the ignition system can be tested by using the Sun 900 Scope Motor Tester. Make the connections as follows (Fig. 24).

**1.** Plug the power cord into a proper outlet.

**2.** Turn the AC master switch to the ON position.

**3.** Turn the Tach-Dwell selector switch to the calibration (CAL.) position and adjust the dwell calibrator until the meter pointer reads on the SET LINE.

**4.** Turn the Tach-Dwell rpm switch to the 5000 position.

**5.** Connect the Tach-Dwell leads; connect the RED insulator lead to the primary distributor lead at the coil. Connect the BLACK insulator lead to a good ground.

**On a car equipped with a transistor ignition system, connect the RED insulator lead to the RED side of the tachometer block and the BLACK insulator lead to the BLACK side of the tachometer block.**

**6.** Connect the trigger pickup into the circuit of the first spark plug in the firing order.

**7.** Turn the Voltage Leakage unit control counterclockwise to the TIMING position.

**8.** Connect a jumper lead from the distributor primary to a good ground.

**9.** Set the Voltage Leakage switch to the 20 V position.

**10.** Connect the Voltage Leakage test leads; the RED lead is connected to the battery side of the coil and the BLACK lead is connected to a good ground.

**11.** Remove the high tension wire from the coil and leave the wire disconnected.

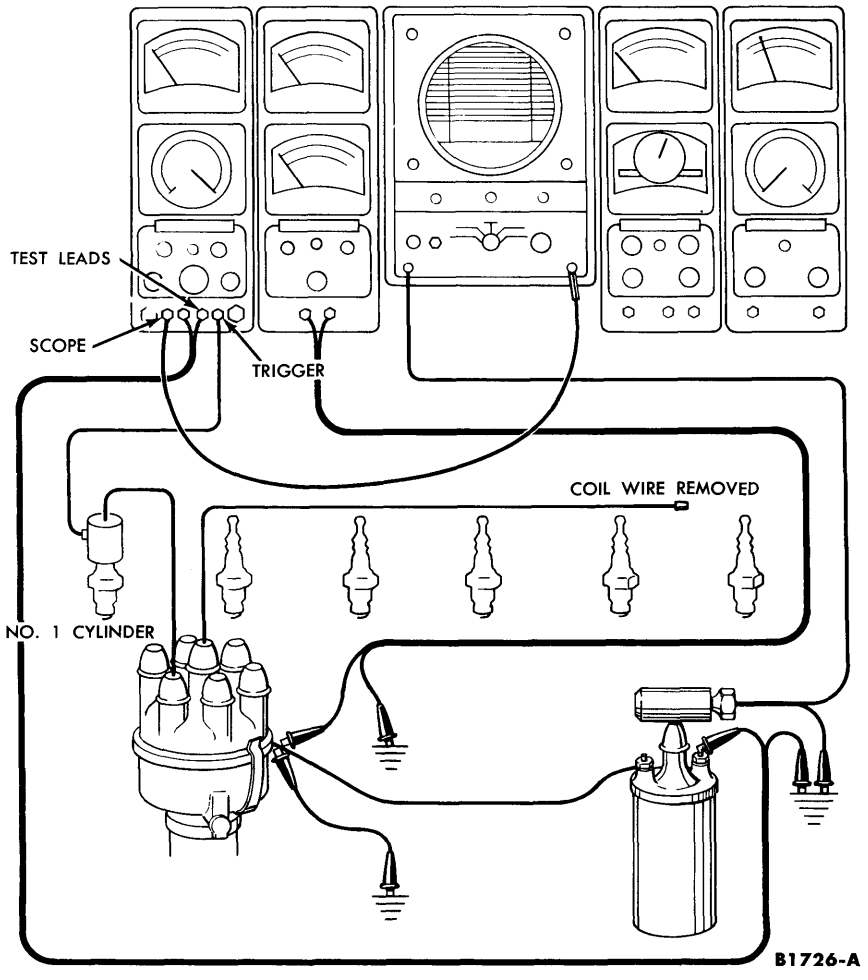



**FIG. 24—Sun 900 Test Connections**

12. Insert the scope pattern pick-up into the coil tower and attach the ground clip to a good ground.

13. Set the scope ground polarity switch to the POSITIVE (+) position.

14. Turn the scope display selector to the SCOPE CHECK position and adjust the horizontal and vertical knobs until the trace appears on the ZERO (0) line (allow about 30 seconds for warm-up before adjustment).

### CRANKING VOLTAGE

1. With the tester connected, turn the ignition switch ON. Make sure that the transmission is in neutral and that the parking brake is set.

2. Crank the engine, observe the speed, and note the reading on the voltmeter.

If the meter reads less than the specified voltage, check for the following: weak battery, defective cables, connections, switch, starter, by-pass circuit, or ignition circuit to coil.

If the speed is uneven or slow, the engine or starting circuit is defective.

### BREAKER POINTS

1. With the motor tester connected, turn the scope display selector to the INDIVIDUAL CYLINDER position.

2. Remove the jumper lead from the distributor to ground.

3. Insert the coil high tension wire into the scope pattern pickup.

4. Operate the engine at 1200 rpm.

5. Observe the point open and point close signals (Fig. 25). If an unusual point close signal is obtained (an unusual point close signal is one that does not have a short straight downward line followed by a series of closely grouped rapidly diminishing oscillations), check for poor point contact, misaligned points, or weak point spring tension.

If an unusual point open signal is obtained (an unusual point open signal is one that does not form a firing line that is straight up and down), check for dirty or burned points, or high series resistance.

### COIL

**Polarity**

1. Remove the jumper lead from the distributor to ground, if it is still connected.

2. Insert the coil high tension lead into the scope pattern pickup.

3. Adjust the engine speed to 1200 rpm.

4. Turn the scope display selector to the ALL CYLINDERS position, and adjust the pattern length control until all cylinders appear between the vertical lines on both sides of the screen.

5. Rotate the pattern shift control counterclockwise until the last pattern on the screen appears complete.

6. Observe the patterns, noting if they are upright or inverted (Fig. 25).

If they are inverted, check for the scope ground polarity switch in

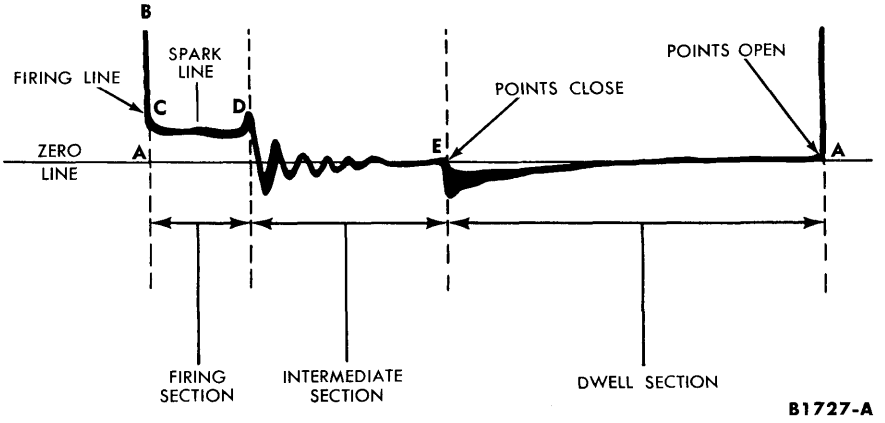



**FIG. 25—Typical Scope Pattern**

the MINUS (—) position, battery polarity reversed, coil improperly connected, or incorrect coil.

**Primary and Secondary Tests.** To check the coil for shorted or open windings and for primary or secondary resistance, calibrate the Condenser-Coil Unit as follows:

1. Turn the AC switch to ON.
2. Set the Condenser-Coil Unit selector switch at the OHMS position.
3. Set the Condenser-Coil ohms switch to the desired range.
4. Connect the test leads together.
5. Adjust the Condenser-Coil calibrator until the meter pointer reads ZERO on the ohms scale.
6. Disconnect the test leads.
7. Disconnect all leads from the coil.

SHORTED OR OPEN WINDINGS

1. Calibrate the Condenser-Coil Unit (the ohm switch should be in the OHMS position).
2. Connect the test leads, one to each coil primary terminal. Observe the polarity.
3. Insert the coil pickup into the secondary tower of the coil and connect the ground lead of the pick-up to a good ground.
4. Turn the Condenser-Coil Unit selector switch to the COIL TEST position and observe the wave pattern visible on the coil test scope.

Refer to Fig. 26 for checking the data obtained.

PRIMARY RESISTANCE

1. Calibrate the Condenser-Coil Unit (set the ohm switch to the OHMS position).
2. Connect the test leads, one to each primary terminal of the coil.
3. Observe the meter reading and compare it with specifications.

SECONDARY RESISTANCE

1. With the ohm switch set at the OHMS x 1000 position, calibrate the Condenser-Coil Unit.
2. Install the coil pickup test lead in the tower of the coil.
3. Connect the ohmmeter test leads, one to either primary terminal and the other to the open (pigtail) end of the coil pickup test lead.
4. Observe the meter reading and compare it with specifications.

If the meter reading exceeds 20,000 ohms, the secondary winding is open.

## CONDENSER

For the condenser tests, calibrate the Condenser-Coil Unit as follows:

1. Set the selector switch to the CONDENSER position.
2. Connect the test leads together.
3. After allowing approximately one minute for the tester to warm up, adjust the calibrator until the meter pointer reads on the set line at the right end of the meter scale. **Do not change this setting during the tests.**

**Resistance**

1. Connect the test leads, one to the primary terminal of the distributor and the others to a ground on the distributor body.
2. With the condenser test switch in the SERIES RESISTANCE position, the meter should read in the black bar at the right end of the scale.
3. Move the condenser pigtail. If a deflection of the meter is noted, the pigtail is making poor contact and the condenser should be replaced.

If the reading is outside the black bar, move the grounded lead to the body of the condenser. If the reading improves, the condenser is not properly grounded to the distributor housing.

**Capacity**

1. Turn the condenser test switch to the CAPACITY position.
2. Read the red scale of the meter (0.5) for the microfarad capacity of the condenser being tested.
3. Refer to the specifications for the recommended condenser capacity.

If the readings are not within specifications, replace the condenser.

**Leakage**

1. Turn the condenser test switch to the LEAKAGE position.
2. The meter should now read in the black bar at the left end of the scale if the condenser leakage is satisfactory.

If the meter pointer reads outside the black bar, the condenser insulation is leaking and the condenser should be replaced.

**If the condenser does not meet specifications while mounted in the distributor, remove the condenser and retest it. The same procedure is followed as above. If the condenser tests bad in the distributor, but tests good when removed, there is a short or ground in the distributor primary circuit. Inspect the insulation of the distributor primary terminal and the internal circuit of the distributor.**

## FIRING VOLTAGE

1. Remove the jumper from the distributor to ground.
2. Insert the coil high tension lead into the scope pickup.
3. Adjust the engine speed to 1200 rpm.
4. Turn the scope display selector to the ALL CYLINDERS position, and adjust the pattern length control until all of the cylinders appear between the vertical lines on the screen.
5. Rotate the pattern shift control counterclockwise until the last pattern on the screen appears complete.
6. Observe the height of each firing line, on the scope, and compare for uniformity and height (Fig. 25).

If the firing voltages are uniform, but high, check for worn spark plugs, late ignition timing, lean fuel mixture, too large a rotor gap, or a break in the coil wire.

If the firing voltages are uneven, check for worn spark plugs, uneven compression, breaks in spark plug wires, or a cocked or worn distributor cap.

## AVAILABLE VOLTAGE

1. Make the same connections and adjustments as for the firing voltage test above.
2. Disconnect a spark plug wire with a pair of insulated pliers.
3. Hold the wire away from a ground and notice the upward extent of the pattern on the scope.

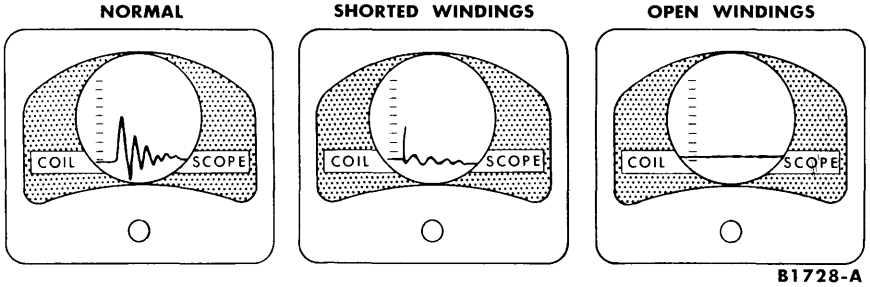



**FIG. 26—Coil Test Patterns**

If the available voltage is less than 20 KV, check for excessive resistance in the primary circuit, low primary input voltage, defective coil, dwell less than specified, or defective secondary insulation.

### SECONDARY INSULATION

**1.** Continue with the same connections and adjustments as in the last two tests.

**2.** Observe the downward extent of the pattern of the spark plug with the wire removed.

**3.** Connect the spark plug wire.

**4.** Perform this test on all of the cylinders (trigger cylinder may be tested in the SCOPE CHECK position).

If the lower extent is not at least half the size of the upper extent, check for insulation leakage in the coil, coil tower, rotor, coil wire, distributor cap, or spark plug wire.

### SECONDARY RESISTANCE

**1.** The connections and adjustments for this test are the same as for the last three tests, except for the scope display Selector switch which is now placed in the ALL CYLINDERS position.

**2.** Observe and compare the spark line (Fig. 25) of the patterns for length, height, angle and oscillations.

If all cylinders are affected, check for high resistance in the coil tower, coil wire, rotor, or distributor cap tower; also check for an accumulation of deposits on the spark plugs, or poor contact between the rotor and distributor cap.

If one or more cylinders are affected, check for high resistance in the distributor cap tower, spark plug wires, or spark plugs.

### SPARK PLUGS

To test the spark plugs on the car, connect the motor tester in the same manner as for the firing voltage test.

**1.** Turn the display selector switch to the ALL CYLINDERS position; rotate the pattern shift control in the FULL CLOCKWISE position.

**2.** Momentarily accelerate the engine to about 2000 rpm and return to 1200 rpm.

**3.** Observe the rise of the firing lines during the momentary engine acceleration.

If one or more of the firing lines is higher than the others, check for wide plug gap, open spark plug resistor wire, or badly deteriorated electrodes.

If one or more of the firing lines is lower than the others, check for spark plug fouling, flashover, or cracked insulators.

## DISTRIBUTOR DIAPHRAGM LEAKAGE AND FREENESS OF OPERATION—LOADOMATIC AND DUAL ADVANCE DISTRIBUTORS

These tests can be made with the distributor installed on the engine. The tests are sufficient for an engine tune-up. However, if there are indications that the spark advance is not functioning properly, remove the distributor from the engine and check it on a distributor test set following the instructions under "Distributor Spark Advance."

Check the vacuum advance mechanism for freeness of operation by manually rotating the breaker plate in the direction of rotation. **Do not rotate the plate by pushing on the condenser or the breaker points. Use a hook or other suitable instrument to rotate the plate.** The breaker plate should turn without binding and return to its original position when released. If the breaker plate binds, remove the plate. Clean, inspect and lubricate it as described for the particular distributor.

To check the diaphragm for leakage:

**1.** Remove the vacuum line from the distributor. Adjust the vacuum pressure of a distributor tester to its maximum position. Hold your hand over the end of the tester's vacuum hose and note the maximum reading obtained. **Do not exceed 25 inches Hg.**

**2.** If the maximum reading is 25 inches Hg or less, connect the tester's vacuum line to the vacuum fitting on the diaphragm **without changing any of the adjustments.** The maximum gauge reading should not be less than it was in step 1. If it is less, the diaphragm is leaking and should be replaced.

## DISTRIBUTOR BREAKER PLATE WEAR—LOADOMATIC AND DUAL ADVANCE DISTRIBUTORS

A worn breaker plate will cause the breaker point gap and contact dwell to change as engine speed and load conditions are varied. Mount the distributor in a distributor tester following the instructions in this section of the manual.

### LOADOMATIC DISTRIBUTOR

There should not be over a 3° variation in dwell between engine idle speed and 2500 rpm. If the contact dwell changes more than 3°, the plate bushing should be replaced.

### DUAL ADVANCE DISTRIBUTOR

Adjust the test set to 0° advance, 0 inches vacuum, and 1000 rpm. Adjust the dwell angle to 26°. Apply vacuum to the distributor diaphragm and increase it very slowly while observing the indicated dwell angle. The maximum dwell angle variation should not exceed 6° when going from zero to maximum vacuum at constant rpm. If the dwell angle variation exceeds this limit, there is excessive wear at the stationary sub-plate pin or the diaphragm rod is bent or distorted.

## DISTRIBUTOR GEAR BACKLASH—LOADOMATIC DISTRIBUTOR

The distributor gear backlash can not be accurately checked on the dual advance or centrifugal advance distributor.

**1.** Mount a dial indicator on the distributor so that the indicator point rests on the rotor, ⅝-inch from the center.

**2.** Turn the rotor as far as it will go and set the indicator on zero.

**3.** Turn the rotor in the opposite direction and note the reading on the dial indicator. This is the backlash.

**4.** The backlash should be 0.003 to 0.005 inch. If the backlash is not to specifications, it indicates an incorrect number of teeth on the distributor or camshaft gear, or excessively worn gears.

## DISTRIBUTOR SHAFT END PLAY

If the shaft end play is not to specifications, check the location of the gear on the shaft (loadomatic distributor), or the distributor shaft collar (dual advance or centrifugal advance distributor).

### LOADOMATIC DISTRIBUTOR

The shaft end play can be checked with the distributor installed on the engine.

**1.** Mount a dial indicator on the distributor so that the indicator tip rests on the top of the distributor shaft.

**2.** Push the shaft down as far as

it will go and set the dial indicator on zero.

3. Pull the distributor shaft upward as far as it will go and read the end play. The end play should be within specifications with the distributor removed or installed.

### DUAL ADVANCE AND CENTRIFUGAL ADVANCE DISTRIBUTOR

1. Remove the distributor from the engine.
2. Place the distributor in the holding tool and clamp it in a vise.
3. Push the distributor shaft upward as far as it will go, and check the end play with a feeler gauge placed between the collar and the distributor base. The end play should be within the specified limits.

## DISTRIBUTOR TESTS—ROTUNDA RE-1416 TESTER

### MOUNTING DISTRIBUTOR

1. Clamp the distributor securely in the distributor support arm clamp so that it will not turn in its mounting.
2. Loosen the hand-operated locking screw on the side of the distributor support arm and adjust the support arm column up or down by turning the crank on the knob at the top of the column until the distributor shaft or adapter shaft can be securely fastened in the driving chuck. Use adapter shafts provided when driving distributors having short shafts.
3. Securely tighten the drive chuck to the distributor drive shaft by means of the chuck key, attached by a chain to the Syncrograph.
4. Rotate the drive chuck by hand to make sure the distributor shaft turns freely and then tighten the locking screw on the distributor support arm.
5. Connect the Syncrograph test lead to the primary or distributor-transistor lead wire of the distributor. Since the transistor ignition distributor does not have a condenser, it will be necessary to install one in the circuit of the tester (Fig. 27).

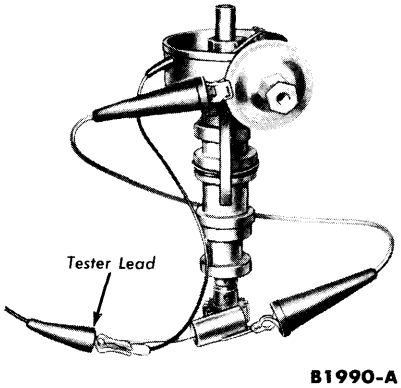



**FIG. 27—Testing Transistor Ignition Distributor**

### BREAKER POINT RESISTANCE

1. Turn the test selector to POINT RES. position.
2. Revolve the chuck by hand until the distributor breaker points are closed.
3. The meter pointer on the cam angle meter should read in the OK zone at the left side of the meter scale. If the meter pointer does not fall in the OK zone, there is excessive resistance caused by a faulty contact across the distributor points, a faulty primary lead or a poorly grounded base plate. A faulty contact across the distributor points indicates improper spring tension or burned or pitted points.

### INSULATION AND LEAKAGE

1. Turn the test selector to the cam angle position and revolve the chuck by hand until the distributor breaker contacts are open.
2. The cam angle meter should show a zero reading. If a zero reading is not obtained, a short circuit to ground exists.

A short could be caused by poor primary or distributor-transistor lead wire insulation, a shorted condenser, or a short between the breaker arm and breaker plate.

### MECHANICAL OPERATION

1. Turn the test selector to the SYNCHRO. position and check to make sure the drive chuck is securely tightened on the distributor shaft.
2. Turn the motor control switch to the left for an eight cylinder car or to the right for a six cylinder car.

**If it is necessary to reverse the rotation of the drive motor, turn the motor control switch to the OFF position and allow the chuck to come to a complete stop before reversing the switch.**

3. Adjust the rpm control to vary the distributor speed between 400 and 4000 engine rpm or at the maximum speed of the engine on which the distributor is used. Erratic or thin faint flashes of light preceding the regular flashes as the speed of rotation is increased can be due to weak breaker arm spring tension or binding of the breaker arm on the pivot pin.
4. Operate the distributor at approximately 2500 engine rpm.
5. Move the protractor scale with the adjustment control so that the zero degree mark on the scale is opposite one of the neon flashes. The balance of all the flashes should come within 1°, plus or minus, evenly around the protractor scale. A larger variation than 1° or erratic or wandering flashes may be caused by a worn cam or distributor shaft or a bent distributor shaft.

### DWELL ANGLE

1. Turn the cylinder selector to the figure corresponding to the number of lobes on the cam of the distributor being tested.
2. Turn the test selector switch to the cam angle position and operate the distributor at approximately 1000 engine rpm.
3. Adjust the distributor breaker point gap to the dwell angle shown in the specifications.

### DISTRIBUTOR SPARK ADVANCE

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

#### Loadomatic Distributor

1. Check the breaker point contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.
2. Check the breaker arm spring tension. Adjust if necessary.

Attach the vacuum adapter fitting to the vacuum unit and attach the vacuum hose between the distributor vacuum control and the vacuum outlet located at the upper right of the front panel. Check the zero setting of the vacuum gauge and, if necessary, adjust the small knob at the lower edge of the dial rim so that the vacuum gauge hand rests on zero.

Turn the vacuum supply switch to the ON position.

MANUAL-SHIFT TRANSMISSION

1. Adjust the test set to 0° advance, 0 inch vacuum and the initial rpm setting listed in the specifications.
2. Check the operation of the

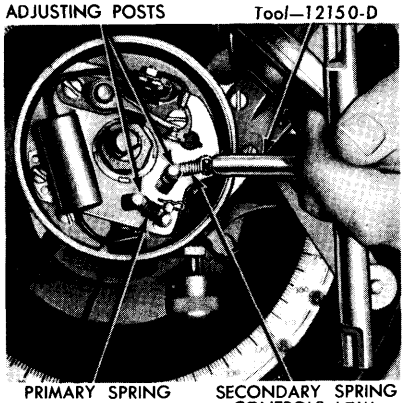



**FIG. 28—Spark Advance Adjustment**

vacuum advance at the lowest and highest vacuum and rpm settings given in the specifications.

If the spark advance is not within the limits under low vacuum, the primary spring adjustment is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring adjustment is at fault.

To adjust the spark advance, release the tension on the retard springs by turning the adjusting posts as required (Fig. 28). Adjust the primary spring (spring farthest from the vacuum chamber) first, for the low vacuum settings. Adjust the secondary spring last, for the high vacuum settings. As a final check, check the advance throughout the entire range.

If it is impossible to adjust both springs to give the correct spark advance throughout the range, one or both springs should be replaced and the spark advance readjusted. If the advance characteristics still cannot be brought within specifications, replace the diaphragm assembly.

AUTOMATIC TRANSMISSION

**1.** Adjust the test set to 0° advance, 0 inch vacuum and the initial rpm setting listed in the specifications.

**2.** Check the advance limit. If the advance limit is not to specifications, add or remove shims between the vacuum chamber spring and the vacuum line connection (Fig. 29). **The addition of a shim will decrease the advance. The removal of a shim will increase the advance.**

**3.** Check the operation of the vacuum advance at the low vacuum and rpm settings. If the advance is not within specifications, the primary spring (spring farthest from the vacuum chamber) adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28).

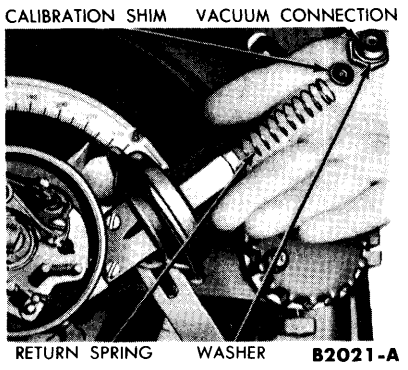



**FIG. 29—Changing Calibration Shims—Automatic Transmission**

**4.** Check the operation of the vacuum advance at the high vacuum and rpm settings. If the advance is not within specifications, the secondary spring adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28). If the spring cannot be adjusted properly, add or remove a calibration washer behind the stop in the diaphragm housing (Fig. 30). **The addition of a washer will decrease the advance. The removal of a washer will increase the advance.** Now check the advance through the entire range.

If it is impossible to adjust the spark advance throughout the entire range, one or both springs should be replaced and the spark advance readjusted. If the advance characteristics still cannot be brought within specifications, replace the diaphragm assembly.

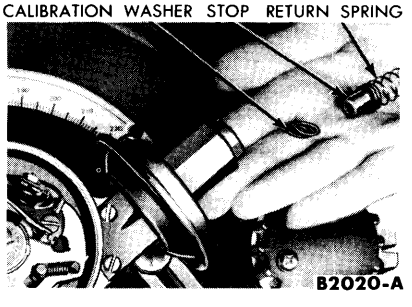



**FIG. 30—Changing Calibration Washers—Automatic Transmission**

**Dual Advance Distributor**

**1.** Check the contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.

**2.** Check the breaker arm spring tension and adjust it if necessary.

The dual advance distributor has two independently operated spark advance systems. Each system is adjusted separately. **Adjust the centrifugal advance before adjusting the vacuum advance.**

CENTRIFUGAL ADVANCE

**1.** Do not connect the test set vacuum line to the diaphragm. Set the test set to 0° advance and the initial rpm setting listed in the specifications.

**2.** Operate the distributor in the direction of rotation (counterclockwise) and slowly increase the rpm to the setting specified for the first advance reading listed in the specifications.

If the correct advance is not indicated at this rpm, stop the distributor and bend one spring adjustment bracket to change its tension (Fig. 31). **Bend the adjustment bracket away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension).** After the adjustment is made, identify the bracket.

**3.** After an adjustment has been made to one spring, check the minimum advance point again.

**4.** Operate the distributor at the specified rpm to give an advance just below the maximum. If this advance is not to specifications, stop the distributor and bend the other spring bracket to give the correct advance.

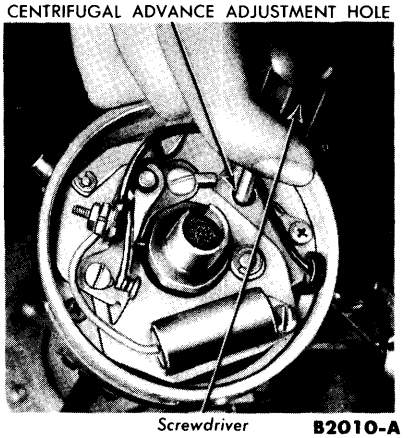



**FIG. 31—Centrifugal Advance Adjustment**

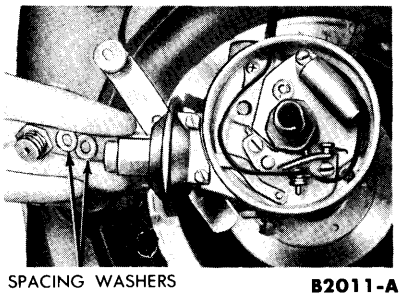



**FIG. 32—Vacuum Advance Adjustment**

**5.** Check the advance at all rpm settings listed in the specifications. Operate the distributor both up and down the rpm range.

VACUUM ADVANCE

**1.** Connect the test set vacuum line to the fitting on the diaphragm and turn the vacuum supply switch on.

**2.** Set the test set to 0° advance, 0 vacuum, and at 1000 rpm.

**3.** Check the advance at the first vacuum setting given in the specifications.

**4.** If the advance is incorrect, change the calibration washers between the vacuum chamber spring and nut (Fig. 32). After installing or removing the washers, position the gasket in place and tighten the nut. **The addition of a washer will decrease advance and the removal of a washer will increase advance.**

**5.** After one vacuum setting has been adjusted, the others should be checked. **Do not change the original rpm setting when going to a different vacuum setting.** If the other settings are not within limits, it indicates incorrect spring tension, leakage in the vacuum chamber and/or line, or the wrong fiber stop has been installed in the vacuum chamber of the diaphragm housing.

**Centrifugal Advance Distributor**

**1.** On a high performance centrifugal advance distributor, check the gap of the breaker point assembly (ies), or the dwell (combined dwell on dual points). If they are not within specifications, adjust the gap.

**2.** Check the breaker arm spring tension and adjust it if necessary.

**3.** Turn the test selector to the SYNCRO. position.

**4.** Operate the distributor at 250 rpm, and move the protractor scale so that one of the flashes is at 0°.

**5.** Increase the distributor speed to correspond with the lowest speed shown in the specifications. Note the number of degrees the neon flash has moved from 0°, and compare with specifications. Check advance degrees at all the speeds shown in the specifications. If the centrifugal advance does not conform with the specifications to within plus or minus 1°, unless otherwise stated, it may be due to improper breaker arm spring tension, faulty or dirty centrifugal advance mechanism or excessive end play in the distributor shaft.

Lack of synchronization, excessive cam wear, worn bearings, or weak breaker arm spring tension causing contact point chatter are all disclosed by uneven or intermittent flashes around the protractor scale.

## DISTRIBUTOR TESTS—ROTUNDA RE-236 TESTER

### MOUNTING DISTRIBUTOR

**1.** Adjust the distributor support arm in relation to the distributor shaft length.

**2.** Set the distributor in the support arm and enter the lower end of the distributor shaft in the Syncrograph chuck.

**3.** Tighten the chuck on the distributor shaft, using the wrench located near the support arm column.

**4.** Align the distributor shaft by shifting the support arm and distributor, and tighten the clamp screw.

**5.** Clamp the distributor securely in the distributor support arm clamp so that it will not turn in its mounting.

### MECHANICAL OPERATIONS

**1.** Turn the OFF, SET, CAM, SYNC. switch to SET.

**2.** Adjust the SET TACH control so the tachometer pointer is on the SET line.

**3.** Turn the OFF, SET, CAM, SYNC. switch to SYNC. position.

**4.** Turn the MOTOR switch to the LEFT for 8 cylinder cars or to the RIGHT for 6 cylinder cars.

**5.** Adjust the speed control to vary the distributor speed between 400 and 4000 engine rpm, or at the maximum speed of the engine on which the distributor is used. Erratic or thin faint flashes of light preceding the regular flashes as the speed of rotation is increased can be due to weak breaker arm spring tension or binding of the breaker arm on the pivot pin.

**6.** Operate the distributor at approximately 2500 engine rpm and move the protractor scale so that the zero degree mark on the scale is opposite one of the neon flashes. The balance of all the flashes should come within 1°, plus or minus, evenly around the protractor scale. A variation larger than 1° or erratic or wandering flashes may be caused by a worn cam or distributor shaft or a bent distributor shaft.

### DWELL ANGLE TEST

**1.** Turn the OFF, SET, CAM, SYNC. switch to the CAM position. Operate the distributor at about 1000 rpm.

**2.** Adjust the breaker point gap until the cam angle is to specifications.

### DISTRIBUTOR SPARK ADVANCE

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

**Loadomatic Distributor**

**1.** Check the breaker point contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.

**2.** Check the breaker arm spring tension. Adjust it if necessary.

MANUAL-SHIFT TRANSMISSION

**1.** Adjust the test set to 0° advance, 0 inch vacuum and the initial rpm setting listed in the specifications.

**2.** Check the operation of the vacuum advance at the lowest and highest vacuum and rpm settings given in the specifications.

If the spark advance is not within the limits under low vacuum, the primary spring adjustment is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring adjustment is at fault.

To adjust the spark advance, release the tension on the retard springs by turning the adjusting posts as required (Fig. 28). Adjust the primary spring (spring farthest from the vacuum chamber) first, for the low vacuum settings. Adjust the secondary spring last, for the high vacuum settings. As a final check, check the advance throughout the entire range.

If it is impossible to adjust both springs to give the correct spark advance throughout the range, one or

both springs should be replaced and the spark advance readjusted. If the advance characteristics still cannot be brought within specifications, replace the diaphragm assembly.

AUTOMATIC TRANSMISSION

**1.** Adjust the test set to 0° advance, 0 inch vacuum and the initial rpm setting listed in the specifications.

**2.** Check the advance limit. If the advance limit is not to specifications, add or remove shims between the vacuum chamber spring and the vacuum line connection (Fig. 29). **The addition of a shim will decrease the advance. The removal of a shim will increase the advance.**

**3.** Check the operation of the vacuum advance at the low vacuum and rpm settings. If the advance is not within specifications, the primary spring (spring farthest from the vacuum chamber) adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28).

**4.** Check the operation of the vacuum advance at the high vacuum and rpm settings. If the advance is not within specifications, the secondary spring adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28). If the spring cannot be adjusted properly, add or remove a calibration washer behind the stop in the diaphragm housing (Fig. 30). **The addition of a washer will decrease the advance. The removal of a washer will increase the advance.** Now check the advance through the entire range.

If it is impossible to adjust the spark advance throughout the entire range, one or both springs should be replaced and the spark advance readjusted. If the advance characteristics still cannot be brought within specifications, replace the diaphragm assembly.

**Dual Advance Distributor**

**1.** Check the contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.

**2.** Check the breaker arm spring tension and adjust it, if necessary.

The dual advance distributor has two independently operated spark advance systems. Each system is adjusted separately. **Adjust the centrifugal advance before adjusting the vacuum advance.**

CENTRIFUGAL ADVANCE

**1.** Do not connect the test set vacuum line to the diaphragm. Set the test set to 0° advance and the initial rpm setting listed in the specifications.

**2.** Operate the distributor in the direction of rotation (counterclockwise) and slowly increase the rpm to the setting specified for the first advance reading listed in the specifications.

If the correct advance is not indicated at this rpm, stop the distributor and bend one spring adjustment bracket to change its tension (Fig. 31). Bend the adjustment bracket away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension). After the adjustment is made, identify the bracket.

**3.** After an adjustment has been made to one spring, check the minimum advance point again.

**4.** Operate the distributor at the specified rpm to give an advance just below the maximum. If this advance is not to specifications, stop the distributor and bend the other spring bracket to give the correct advance.

**5.** Check the advance at all rpm settings listed in the specifications. Operate the distributor both up and down the rpm range.

VACUUM ADVANCE

**1.** Connect the test set vacuum line to the fitting on the diaphragm.

**2.** Set the test set to 0° advance, 0 vacuum, and at 1000 rpm.

Check the advance at the first vacuum setting given in the specifications.

**4.** If the advance is incorrect, change the calibration washers between the vacuum chamber spring and nut (Fig. 32). After installing or removing the washers, position the gasket in place and tighten the nut. **The addition of a washer will decrease advance and the removal of a washer will increase advance.**

**5.** After one vacuum setting has been adjusted, the others should be checked. **Do not change the original rpm setting when going to a different vacuum setting.** If the other settings are not within limits, there is incorrect spring tension, leakage in the vacuum chamber and/or line, or the wrong fibre stop has been installed in the vacuum chamber of the diaphragm housing.

**Centrifugal Advance Distributor**

**1.** On a high performance centrifugal advance distributor, check the gap of the breaker point assembly(ies) or the dwell (combined dwell on dual points).

**2.** Check the breaker arm spring tension and adjust it if necessary.

**3.** Turn the OFF, SET, CAM, SYNC. switch to SYNC. position.

**4.** Operate the distributor at 240 rpm and move the protractor scale so one flash lines up with the zero degree mark.

**5.** Increase distributor speed to correspond with the lowest speed shown in the specifications. Note the number of degrees the neon flash has moved from the zero degrees, and compare with specifications. Check advance degrees at all the speeds shown in the specifications. If the centrifugal advance does not conform with the specifications to within plus or minus 1 degree, unless otherwise stated, it may be due to improper breaker arm spring tension, faulty or dirty centrifugal advance mechanism, or excessive distributor shaft end play.

Lack of synchronization, excessive cam wear, worn bearings, or weak breaker arm spring tension causing contact point chatter are all disclosed by uneven or intermittent flashes around the protractor scale.

## DISTRIBUTOR TESTS— SUN DT-600 TESTER

### MOUNTING

**1.** Using the elevation crank, raise the clamp arms high enough to permit the shaft of the distributor to clear the drive chuck.

**2.** Position the distributor in the clamp with the vacuum diaphragm (if so equipped) pointing towards the right. Tighten the clamp arms securely around the distributor body. Install the proper adapter to the vacuum diaphragm on dual advance and loadomatic distributors.

**3.** Lower the distributor with the elevation crank until the gear or ¾ inch of the tip of the distributor shaft enters the drive chuck, or until the shaft engages the adapter if an adapter is being used. **Do not bottom the distributor shaft in the chuck.**

**4.** Tighten the chuck. **Do not try to raise or lower the distributor after the chuck has been tightened.**

### CONDENSER TESTING

Condensers should be tested for series resistance, capacity, and leakage. The preparation procedure is as follows:

1. Trip the motor switch to the proper position for the rotation of the distributor being tested.
2. Turn the condenser test selector switch to the SERIES RESISTANCE position and connect the condenser test leads together.
3. Turn the condenser calibrate control clockwise from the OFF position.
4. Allow the tester to warm up for approximately 30 seconds and then adjust the calibrate control until the condenser meter reads on the SET LINE.
5. Rotate the distributor shaft until the cam holds the breaker points open.
6. Separate the test leads and connect one to the distributor primary lead and the other to the distributor body.

**Series Resistance.** Turn the condenser test selector switch to the SERIES RESISTANCE position. The condenser meter should read in the black bar on the right end of the scale.

**Capacity.** Turn the condenser test selector switch to the CAPACITY position. The condenser meter will now read the capacity in microfarads. Compare this reading with specifications.

**Leakage.** Turn the condenser test selector switch to the LEAKAGE position. The condenser meter should read in the black bar at the left of the scale.

Turn the test selector switch to the SERIES RESISTANCE position and turn OFF the condenser calibrator before disconnecting the test leads.

## DISTRIBUTOR RESISTANCE

1. With the motor switch in the proper position for the rotation of the distributor being tested and the speed set at ZERO rpm, clip the tester's distributor and ground lead together.
2. Set the tachometer dwell selector switch to the CALIBRATE position and adjust the dwell regulator until the dwell meter reads on the SET LINE.
3. Separate the leads and connect the tester's distributor lead to the distributor primary or distributor-transistor lead. **Since the transistor ignition distributor does not have a condenser, it will be necessary to incorporate one into the test circuit (Fig. 27).** The tester ground lead should now be connected to the distributor body.
4. Rotate the chuck by hand until the points are closed. The dwell meter should read in the black bar at the right end of the scale.

If it does not read in the black bar, move the tester's distributor wire step by step through the circuit toward the ground. When there is a measurable difference between 2 points, check that area for the cause of the resistance.

## CAM LOBE ACCURACY

1. Connect the test leads following the directions in the distributor resistance test.
2. Turn the tachometer dwell switch to the position corresponding to the number of cylinders on the car from which the distributor was removed.
3. Adjust the distributor speed to 1000 rpm.
4. Rotate the degree ring of the tester until the ZERO on the ring lines up with one of the flashes.
5. Observe the positions of the remaining flashes. If the flashes are not evenly spaced (within ±1°), check for a worn cam, worn distributor shaft or a bent distributor shaft.

## DWELL ANGLE

This test has the same connections as the preceding test, therefore they can be done at the same time.

Adjust the speed to 200 rpm and notice the dwell reading. If it is not within specifications, adjust the points until the proper dwell is obtained. Now increase the speed and check the dwell reading. If the reading changes more than 2 degrees, check for a worn distributor shaft or worn bushings.

## DISTRIBUTOR SPARK ADVANCE

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

### Loadomatic Distributor

1. Check the breaker point contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.
2. Check the breaker arm spring tension and adjust it if necessary.

MANUAL-SHIFT TRANSMISSION

1. Adjust the test set to 0° advance, 0 inch vacuum, and the intial rpm setting listed in the specifications.
2. Check the operation of the vacuum advance at the lowest and highest vacuum and rpm settings given in the specifications.

If the spark advance is not within the limits under low vacuum, the primary spring adjustment is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring adjustment is at fault.

To adjust the spark advance, release the tension on the retard springs by turning the adjusting posts as required (Fig. 28). Adjust the primary spring (spring farthest from the vacuum chamber) first, for the low vacuum settings. Adjust the secondary spring last, for the high vacuum settings. As a final check, check the advance throughout the entire range.

If it is impossible to adjust both springs to give the correct spark advance throughout the range, one or both springs should be replaced and the spark advance readjusted. If the advance characteristics still can not be brought within specifications, replace the diaphragm assembly.

AUTOMATIC TRANSMISSION

1. Adjust the test set to 0° advance, 0 inch vacuum, and the initial rpm setting listed in the specifications.
2. Check the advance limit. If the advance limit is not to specifications, add or remove shims between the vacuum chamber spring and the vacuum line connection (Fig. 29). **The addition of a shim will decrease the advance. The removal of a shim will increase the advance.**
3. Check the operation of the vacuum advance at the low vacuum and rpm settings. If the advance is not within specifications, the primary spring (spring farthest from the vacuum chamber) adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28).
4. Check the operation of the vacuum advance at the high vacuum and rpm setting. If the advance is not within specifications, the secondary spring adjustment is at fault. To adjust the spring, turn the adjusting post as required (Fig. 28). If the spring cannot be adjusted properly, add or remove a calibration washer behind the stop in the diaphragm housing (Fig. 30). **The addition of a washer will decrease the advance.**

**The removal of a washer will increase the advance.** Now check the advance through the entire range.

If it is impossible to adjust the spark advance throughout the entire range, one or both springs should be replaced and the spark advance readjusted. If the advance characteristics still cannot be brought within specifications, replace the diaphragm assembly.

**Dual Advance Distributor**

**1.** Check the contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.

**2.** Check the breaker arm spring tension and adjust it if necessary.

The dual advance distributor has two independently operated spark advance systems. Each system is adjusted separately. **Adjust the centrifugal advance before adjusting the vacuum advance.**

CENTRIFUGAL ADVANCE

**1.** Do not connect the test set vacuum line to the diaphragm. Set the test set to 0° advance and the initial rpm setting listed in the specifications.

**2.** Operate the distributor in the direction of rotation (counterclockwise) and slowly increase the rpm to the setting specified for the first advance reading listed in the specifications.

If the correct advance is not indicated at this rpm, stop the distributor and bend one spring adjustment bracket to change its tension (Fig. 31). **Bend the adjustment bracket away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension).** After the adjustment is made, identify the bracket.

**3.** After an adjustment has been made to one spring, check the minimum advance point again.

**4.** Operate the distributor at the specified rpm to give an advance just below the maximum. If this advance is not to specifications, stop the distributor and bend the other spring bracket to give the correct advance.

**5.** Check the advance at all rpm settings listed in the specifications. Operate the distributor both up and down the rpm range.

VACUUM ADVANCE

**1.** Connect the test set vacuum line to the fitting on the diaphragm.

**2.** Set the test set to 0° advance, 0 vacuum, and at 1000 rpm.

**3.** Check the advance at the first vacuum setting given in the specifications.

**4.** If the advance is incorrect, change the calibration washers between the vacuum chamber spring and nut (Fig. 32). After installing or removing the washers, position the gasket in place and tighten the nut. **The addition of a washer will decrease the advance and the removal of a washer will increase the advance.**

**5.** After one vacuum setting has been adjusted, the others should be checked. **Do not change the original rpm setting when going to a different vacuum setting.** If the other settings are not within limits, it indicates incorrect spring tension, leakage in the vacuum chamber and/or line, or the wrong fiber stop has been installed in the vacuum chamber of the diaphragm housing.

**Centrifugal Advance Distributor**

**1.** On a high-performance centrifugal advance distributor, check the gap of the breaker point assembly-(ies) or the dwell (combined dwell on dual points). If they are not within specifications, adjust the gap.

**2.** Check the breaker arm spring tension and adjust it if necessary.

**3.** The equipment should be set the same way that it was for the Cam Lobe Accuracy test.

**4.** Operate the distributor at 250 rpm, and move the protractor scale so one flash lines up with the 0° mark.

**5.** Increase distributor speed to correspond with the lowest speed shown in the specifications. Note the number of degrees the neon flash has moved from the zero degrees and compare with specifications. Check advance degrees at all the speeds shown in the specifications. If the centrifugal advance does not conform to the specifications to within plus or minus 1°, the trouble may be due to improper breaker arm spring tension, faulty or dirty centrifugal advance mechanism or excessive distributor shaft end play.

Lack of synchronization, excessive cam wear, worn bearings or weak breaker arm spring tension causing contact point chatter are all disclosed by uneven or intermittent flashes around the protractor scale.

## 2 COMMON ADJUSTMENTS AND REPAIRS

### BREAKER POINTS

### ADJUSTMENT

**Loadomatic And Dual Advance Distributors**

NEW BREAKER POINTS. New breaker points can be adjusted with a feeler gauge, scope or a dwell meter.

To adjust the breaker points with a feeler gauge:

**1.** Check and adjust breaker point alignment. Rotate the distributor cam until the rubbing block rests on the peak of a cam lobe.

**If the car is equipped with a transistor ignition and the starter is going to be tapped to place the breaker point assembly on the peak of the cam, proceed as follows: connect a jumper between the "S" terminal of the solenoid and the battery with the ignition switch off and the coil lead (brown wire) disconnected from the solenoid.**

**2.** Insert the correct blade of a clean feeler gauge between the breaker points (Fig. 33). The gap should be set to the larger opening because the rubbing block will wear down slightly while seating to the cam.

**3.** Apply a light film of distributor cam lubricant to the cam when new points are installed. **Do not use engine oil to lubricate the distributor cam.**

**4.** Set the ignition timing.

If a scope or a dwell meter is used to adjust new points, be sure the points are in proper alignment. Also, set the contact dwell to the low setting. New points must be set to the low dwell as the rubbing block will wear down slightly while seating to the cam.

**Used Breaker Points.** If the gap of used breaker points is being checked, use a scope or a dwell meter to test the contact dwell. It is not advisable to use a feeler gauge to adjust or to check the gap of used breaker points because the roughness of the points makes an accurate gap reading or setting impossible.

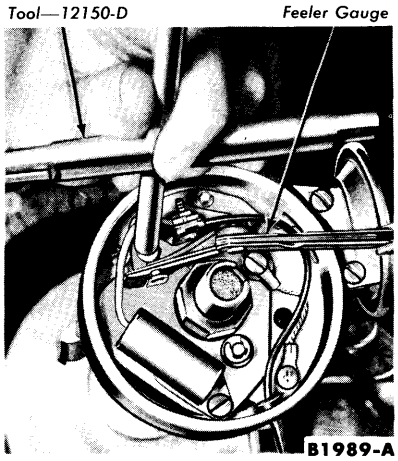



**FIG. 33—Adjusting New Breaker Point Gap**

Clean the breaker points. Check the contact dwell following the instructions under "Ignition System Tests". The contact dwell should be to specifications. Check and adjust the ignition timing.

**Centrifugal Advance Distributor**

NEW BREAKER POINTS. New breaker points can be adjusted with a feeler gauge, scope or a dwell meter.

To adjust the breaker points with a feeler gauge:

1. Check and adjust alignment of the breaker point assembly(ies). Rotate the distributor cam until one of the rubbing blocks rest on the peak of a cam lobe.

**If the car is equipped with a transistor ignition system and the starter is going to be tapped to place a breaker point assembly on the peak of the cam, proceed as follows: connect a jumper between the "S" terminal of the solenoid and the battery with the ignition switch off and the coil lead (brown wire) disconnected from the solenoid.**

2. Insert the correct blade of a clean feeler gauge between the breaker points (Fig. 33). The gap should be set to the larger opening because the rubbing block will wear down slightly while seating to the cam. Now adjust the other set of breaker points (if so equipped).

3. Apply a light film of distributor cam lubricant to the cam when new points are installed. **Do not use engine oil to lubricate the distributor cam.**

4. Set the ignition timing.

If a scope or a dwell meter is used to adjust new points, be sure the points are in proper alignment. Also, set the contact dwell (combined dwell on dual points) to the low setting. New points must be set to the low dwell as the rubbing block will wear down slightly while seating to the cam.

USED BREAKER POINTS. If the gap of used breaker points is being checked, use a scope or a dwell meter to test the contact dwell. It is not advisable to use a feeler gauge to adjust or to check the gap of used breaker points because the roughness of the points make an accurate gap reading or setting impossible. Clean the breaker points. Check the contact dwell following the instructions under "Ignition System Tests". The contact dwell should be to specifications. Check and adjust the ignition timing.

**ALIGNMENT**

The vented-type breaker points must be accurately aligned and strike squarely in order to realize the full advantage provided by this design, and assure normal breaker point life. Any misalignment of the breaker point surfaces will cause premature wear, overheating and pitting.

1. Turn the cam so that the breaker points are closed and check the alignment of the points (Fig. 34).

**If the car has a transistor ignition system, refer to the adjustment of new breaker points for the proper starter tapping procedure.**

2. Align the breaker points to make full face contact by bending the stationary breaker point bracket

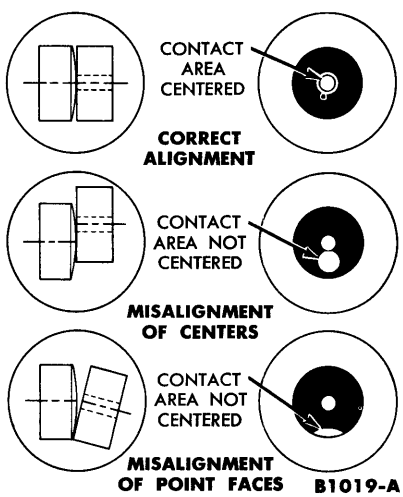



**FIG. 34—Breaker Point Alignment**

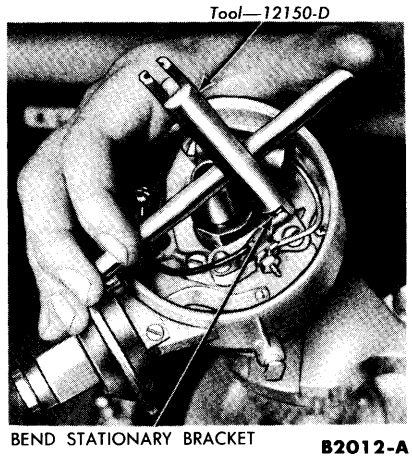



**FIG. 35—Aligning Breaker Points**

(Fig. 35). **Do not bend the breaker arm.**

3. After the breaker points have been properly aligned, adjust the breaker point gap or dwell.

**ADJUSTING SPRING TENSION**

Correct breaker point spring tension is essential to proper engine operation and normal breaker point life. If the spring tension is too great, rapid wear of the breaker arm rubbing block will result, causing the breaker point gap to close up and retard the spark timing. If the spring tension is too weak, the breaker arm will flutter at high engine rpm resulting in an engine miss.

To check the spring tension, place the hooked end of the spring tension gauge over the movable breaker point. Pull the gauge at a right angle (90°) to the movable arm until the

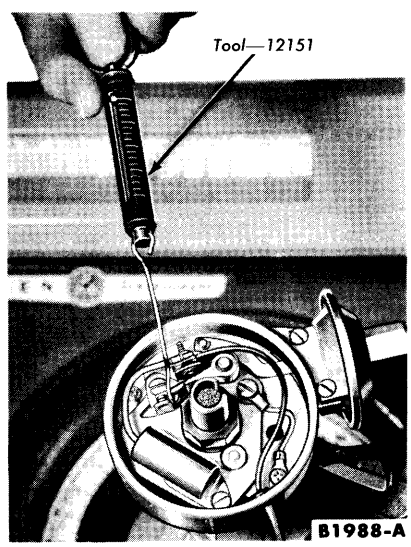



**FIG. 36—Checking Breaker Point Spring Tension**

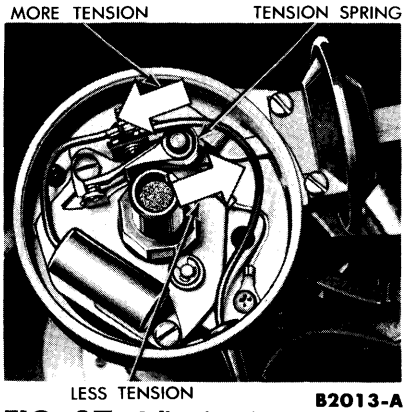



**FIG. 37—Adjusting Spring Tension**

breaker points just start to open (Fig. 36). If the tension is not within specifications, adjust the spring tension.

To adjust the spring tension (Fig. 37):

**1.** Disconnect the primary or distributor-transistor lead wire and the condenser lead if so equipped, and the jumper strap on the centrifugal advance distributor at the breaker point assembly primary terminal.

**2.** Loosen the nut holding the spring in position. **Move the spring toward the breaker arm pivot to decrease tension and in the opposite direction to increase tension.**

**3.** Tighten the lock nut, and then check spring tension. Repeat the adjustment until the specified spring tension is obtained.

**4.** Install the primary or distributor-transistor lead wire, the condenser lead (if so equipped) and the jumper strap on the centrifugal advance distributor with the lockwasher and tighten the nut securely.

On the centrifugal advance distributor with dual breaker points, loosen the lock nut holding the jumper strap to the other breaker point assembly and follow steps 2 and 3. After the adjustment has been completed, connect the jumper strap.

## IGNITION TIMING

### TIMING MARK LOCATIONS

**Mileage Maker Six.** The crankshaft damper (Fig. 38) has 9 timing marks ranging from top dead center (TDC) to 16° before top center (BTC). Refer to specifications for the correct ignition timing.

**V-8 Engines.** The timing pointer

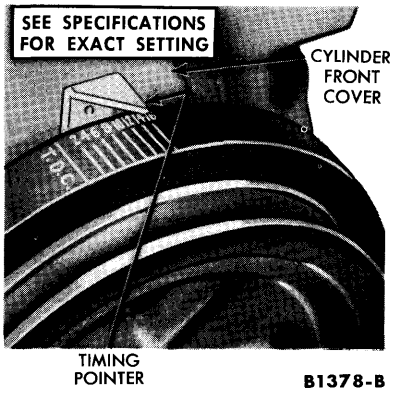



**FIG. 38—Mileage Maker Six Timing Marks**

for the 352, 390, or 427 V-8 engine has 4 timing marks ranging from top dead center (TDC) to 10° before top dead center (BTC). The timing pointer for the 289 V-8 has 4 timing marks ranging from 0° (TDC) to 10° (BTC). To adjust ignition timing, align the pin on the damper or the pointer with the proper timing mark (Fig. 39).

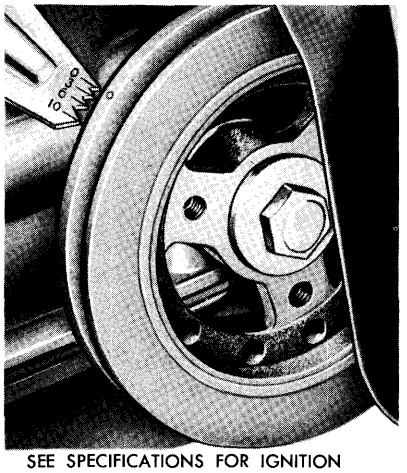



**FIG. 39—Typical V-8 Timing Marks**

### ADJUSTMENT

The procedure for adjusting the ignition timing is covered under "Ignition System Tests."

### SPARK PLUG WIRE REPLACEMENT

When removing the wires from the spark plugs, grasp the moulded cap only. Do not pull on the wire because the wire connection inside the cap may become separated or the weather seal may be damaged.

### MILEAGE MAKER SIX

The ignition wiring installation for this engine is shown in Fig. 40.

**Removal**

**1.** Disconnect the wires at the spark plugs and at the distributor cap.

**2.** Remove the weather seals on the distributor end of the wires and remove the rubber rings.

**3.** Remove the coil high tension lead.

**Installation**

**1.** Install a rubber ring on the No. 3 and 4 wires, and on No. 5 and 6 wires. Connect the wires to the proper spark plugs.

**2.** Install the weather seals on the distributor end of the wires and install the wires in the correct sockets in the distributor cap. Be sure the wires are forced all the way down into their sockets and that they are held firmly in position. The No. 1 socket is identified on the cap. Install the wires in a clockwise direction in the firing order (1-5-3-6-2-4) starting at the No. 1 socket.

**3.** Install the coil high tension lead. Push all weather seals into position.

### ALL V-8 ENGINES

A typical ignition wiring installation is shown in Fig. 41.

**Removal**

**1.** Disconnect the wires from the spark plugs and distributor cap.

**2.** Pull the wires from the brackets on the valve rocker arm covers and remove the wires.

**3.** Remove the coil high tension lead.

**Installation**

**1.** Insert each wire in the proper socket of the distributor cap. Be sure the wires are forced all the way down into their sockets. The No. 1 socket is identified on the cap. Install the wires in a counterclockwise direction in the firing order (1-5-4-2-6-3-7-8) starting at the No. 1 socket. Cylinders are numbered from front to rear; right bank 1-2-3-4, left bank 5-6-7-8.

**2.** Remove the brackets from the old spark plug wire set and install them on the new set in the same relative position. Install the wires in the brackets on the valve rocker arm covers (Fig. 41). Connect the wires to the proper spark plugs. Install the coil high tension lead. **Be sure the No. 7 spark plug wire is positioned in the bracket as shown in Fig. 41.**

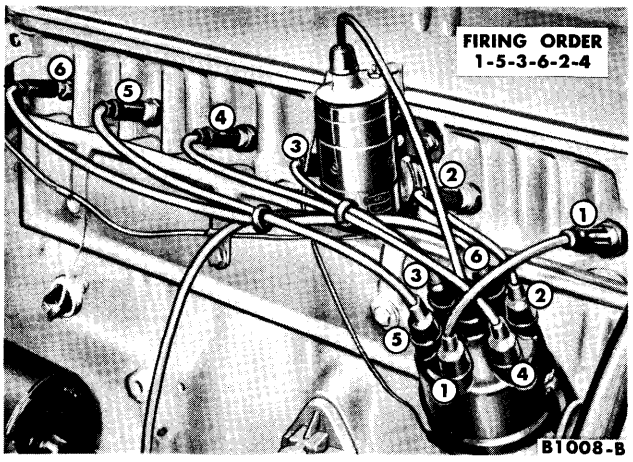



FIG. 40—Mileage Maker Six Ignition Wiring

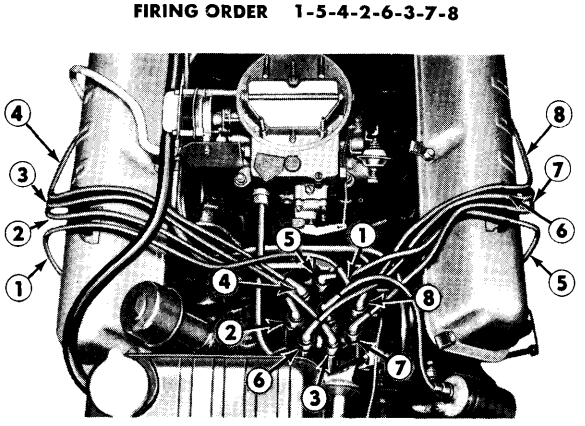



FIG. 41—Typical V-8 Ignition Wiring

### SPARK PLUGS

#### REMOVAL

1. Remove the wire from each spark plug by grasping the moulded cap of the wire only. **Do not pull on the wire because the wire connection inside the cap may become separated or the weather seal may be damaged.**

2. Clean the area around each spark plug port with compressed air, then remove the spark plugs.

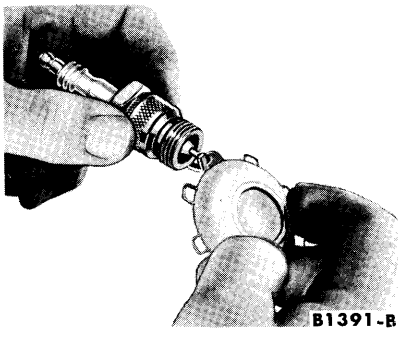



FIG. 42—Gapping Spark Plug

#### ADJUSTMENT

Set the spark plug gap to specifications by bending the ground electrode (Fig. 42).

#### INSTALLATION

1. Install the spark plugs and torque each plug to 15-20 ft-lbs.

When a new spark plug is installed in a new replacement cylinder head, torque the plug to 20-30 ft-lbs.

2. Connect the spark plug wires. Push all weather seals into position.

### RESISTANCE WIRE REPLACEMENT

The primary resistance wire is checked for excessive resistance as outlined under "Resistance Wire Test".

To replace the resistance wire:

1. Cut the brown wire and the red wire (with a green band) from the upper quick disconnect at the dash panel. Cut the wires as close to the quick disconnect as possible.

2. Solder a male bullet-type terminal to the brown wire and to the red wire (with a green band). Make a single terminal of the two wires. Using a female bullet terminal connector, connect the wires to one end of the service replacement resistance wire.

**Do not splice the resistance wire.**

3. Drill a ¾-inch hole through one of the accessory dimples in the dash panel.

4. Install a grommet into the hole drilled in the dash panel.

5. Thread one end of the service replacement resistance wire through the grommet in the dash panel and connect it to the jumper wire at the ignition switch. Make sure the wire is routed through the retaining clips.

6. Cut off and discard (at the point where it enters the taped area) the length of defective resistance wire which is not enclosed in the taped portion of the wiring assembly.

## 3 CLEANING AND INSPECTION

### SPARK PLUGS

Clean the plugs on a sand blast cleaner, following the manufacturer's instructions. **Do not prolong the use of the abrasive blast as it will erode the insulator.** Remove carbon and other deposits from the threads with a stiff wire brush. Any deposits will retard the heat flow from the plug to the cylinder head causing spark plug overheating and pre-ignition.

Clean the electrode surfaces with a small file (Fig. 43). Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.

After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of failure. Replace as required.

Examine the firing ends of the spark plugs, noting the type of deposits and the degree of electrode erosion. Refer to Fig. 44 for the various types of spark plug fouling and their causes.

### DISTRIBUTORS

Soak all parts of the distributor assembly (except the condenser, breaker point assembly, lubricating wick, vacuum diaphragm, distributor base oil seal, and electrical wiring) in a mild cleaning solvent or mineral spirits. Do not use a harsh cleaning solution. Wipe all parts that can not be immersed in a solvent with a clean dry cloth.

After foreign deposits have been loosened by soaking, scrub the parts with a soft bristle brush. **Do not use a wire brush, file, or other abrasive object.** Dry the parts with compressed air.

Examine the bushing surface of the distributor shaft and the bushing for wear. The minimum allowable shaft diameter at the bushing is 0.4675 inch and the maximum allowable inside diameter of the bushing is 0.4690 inch. Replace worn parts.

Inspect the distributor cam lobes for scoring and signs of wear. If any lobe is scored or worn, replace the cam assembly (dual advance and centrifugal advance distributor) or the shaft on a loadomatic distributor.

Inspect the breaker plate assembly for signs of distortion. In addition, on the dual advance distributor, inspect the stationary sub-plate for worn nylon contact buttons. Replace the breaker plate assembly if it is defective.

The breaker point assembly and condenser (if so equipped) should be replaced whenever the distributor is overhauled.

Inspect all electrical wiring for fraying, breaks, etc., and replace any that are not in good condition.

Check the distributor base for cracks or other damage.

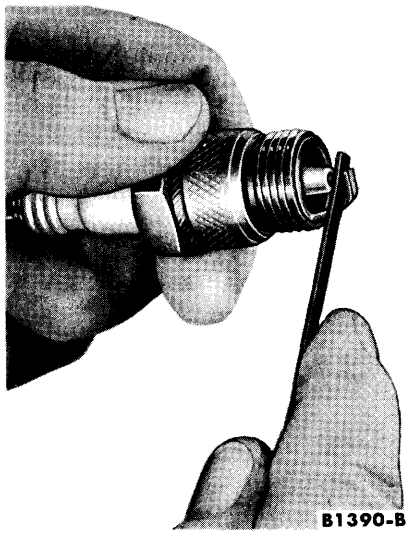



**FIG. 43—Cleaning Plug Electrodes**

On a loadomatic or dual advance distributor, check the diaphragm housing, bracket, and rod for damage. Check the vacuum line fitting for stripped threads or other damage. Test the vacuum fittings, case, and diaphragm for leakage as explained under "Distributor Tests." Replace all defective parts.

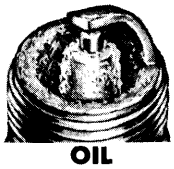
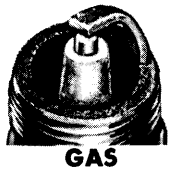
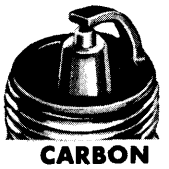
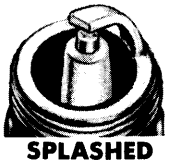
| CONDITION | IDENTIFICATION | CAUSED BY |
|---|---|---|
|  OIL FOULING | Wet, sludgy deposits. | Excessive oil entering combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. |
|  GAS FOULING | Dry, black, fluffy deposits. | Incomplete combustion caused by too rich a fuel-air mixture or by a defective coil, breaker points or ignition cable. |
|  BURNED OR OVERHEATING | White, burned, or blistered insulator nose and eroded electrodes. | Inefficient engine cooling, or engine overheating caused by improper ignition timing, wrong type of fuel, loose spark plugs, or too hot a plug, low fuel pump pressure. |
|  NORMAL CONDITIONS | Rusty brown to grayish-tan powder deposit and minor electrode erosion. | Regular or unleaded gasoline. |
|  NORMAL CONDITIONS | White, powdery deposits. | Highly leaded gasolines. |
|  CARBON FOULING | Hard, baked on black carbon. | Too cold a plug. Weak ignition, defective fuel pump, dirty air cleaner, too rich a fuel mixture. |
|  SILICONE DEPOSIT | Hard and scratchy | Formed when fine sand particles combine with anti-knock compounds in the fuel. Most common industry areas. The plugs cannot be cleaned. |
|  SPLASHED FOULING | | Deposits, accumulated after a long period of misfiring, suddenly loosened when normal combustion chamber deposits are restored after new plugs are installed. During a high speed run these deposits are thrown into the plug. B1005-E |

**FIG. 44—Spark Plug Inspection**

# PART 9-2 LOADOMATIC DISTRIBUTORS


| Section | | Page | Section | | Page |
|---|---|---|---|---|---|
| 1 | Description and Operation | 9-25 | 3 | Removal and Installation | 9-27 |
| 2 | In-Car Adjustment and Repairs | 9-25 | 4 | Major Repair Operations | 9-27 |


## 1 DESCRIPTION AND OPERATION

The direction of distributor rotation is clockwise as viewed from the top of the distributor.

Engine speed and load requirements are satisfied by the action of the breaker plate which is controlled by a vacuum-actuated diaphragm working against the tension of two calibrated breaker plate springs. The breaker plate is free to rotate on the shaft bushing. The diaphragm moves the breaker plate in a counterclockwise direction to advance the spark, and the springs move the plate in a clockwise direction to retard the spark. The degree of spark advance is determined by the strength of the vacuum acting on the diaphragm.

Vacuum is transmitted to the distributor diaphragm from two interconnected passages in the carburetor (Figs. 1 and 2). The opening of one passage is in the throat of the venturi and the opening(s) of the other passage is in the throttle bore just above the closed throttle plate.

All manifold vacuum to the distributor passes through a spark control valve located in the carburetor throttle body or main body. Under steady part throttle operation, the spark valve is held open against the pressure of a calibrated spring. A combination of atmospheric pressure outside of the spark valve diaphragm and manifold vacuum from within holds the spark valve open. When accelerating, manifold vacuum momentarily drops below a predetermined point and the calibrated spring closes the spark valve shutting off the manifold vacuum port. Vacuum from the venturi prevents full spark retard.

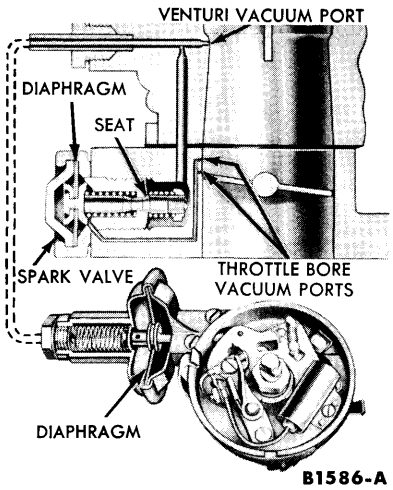



**FIG. 1—Spark Advance Control—Automatic Transmission**

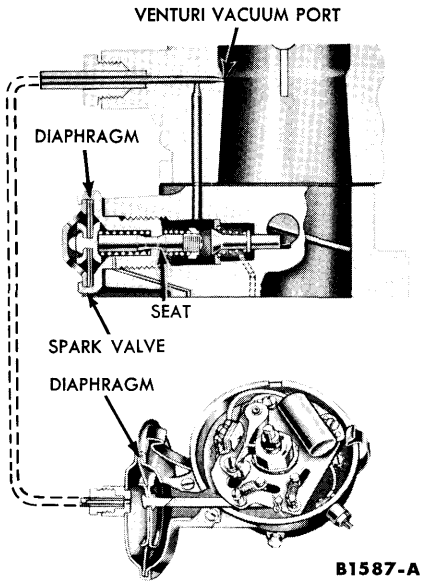



**FIG. 2—Spark Advance Control—Manual Shift Transmission**

As engine speed approaches the throttle setting, manifold vacuum increases sufficiently to open the spark valve and allow a higher vacuum to operate the distributor.

At high engine speed, manifold vacuum falls and the valve closes. This prevents loss of venturi vacuum due to bleed back caused by the lower manifold vacuum. This assures full spark advance at high engine speed.

The spark valve functions in a similar manner to provide an intermediate spark retard whenever the load on the engine is increased to a degree where normal road load spark advance would be too great and the wide-open throttle spark retard would reduce the efficiency of the engine.

## 2 IN-CAR ADJUSTMENT AND REPAIRS

### DISASSEMBLY

BREAKER POINT AND CONDENSER REMOVAL

**1.** Unsnap the distributor cap hold down clips. Lift the cap off of the distributor housing and position it out of the way. Do not pull the spark plug wires out of the cap unless it is necessary to replace the cap.

**2.** Remove the rotor.

**3.** Disconnect the primary and condenser wires from the breaker point terminal (Fig. 3). Remove the condenser retaining screw and lift the condenser off of the breaker plate.

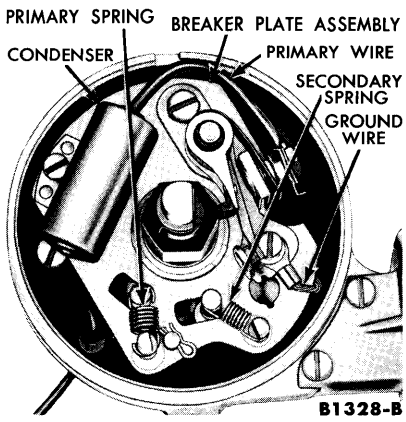



**FIG. 3—Breaker Plate Installation**

Remove the retaining screws and lift the breaker point assembly out of the housing.

VACUUM DIAPHRAGM REMOVAL

**1.** Unsnap the distributor cap hold down clips. Lift the distributor cap off of the distributor housing and position it out of the way. Do not pull the spark plug wires out of the cap unless it is necessary to replace the cap.

**2.** Loosen the vacuum fitting on the diaphragm and pull the vacuum line out.

**3.** On a distributor used with an automatic transmission, remove the vacuum fitting, gasket, calibration shim, spring, stop, and calibration washer(s) from the diaphragm (Fig. 4).

**4.** Remove the vacuum advance hairpin retainer and push the rod out of the breaker plate.

**5.** Remove the screws securing the diaphragm to the distributor housing and remove the diaphragm.

## ASSEMBLY

VACUUM DIAPHRAGM INSTALLATION

**1.** Install the vacuum unit on the distributor body. Insert the tip of the vacuum rod through the breaker plate and attach the rod with the hairpin retainer.

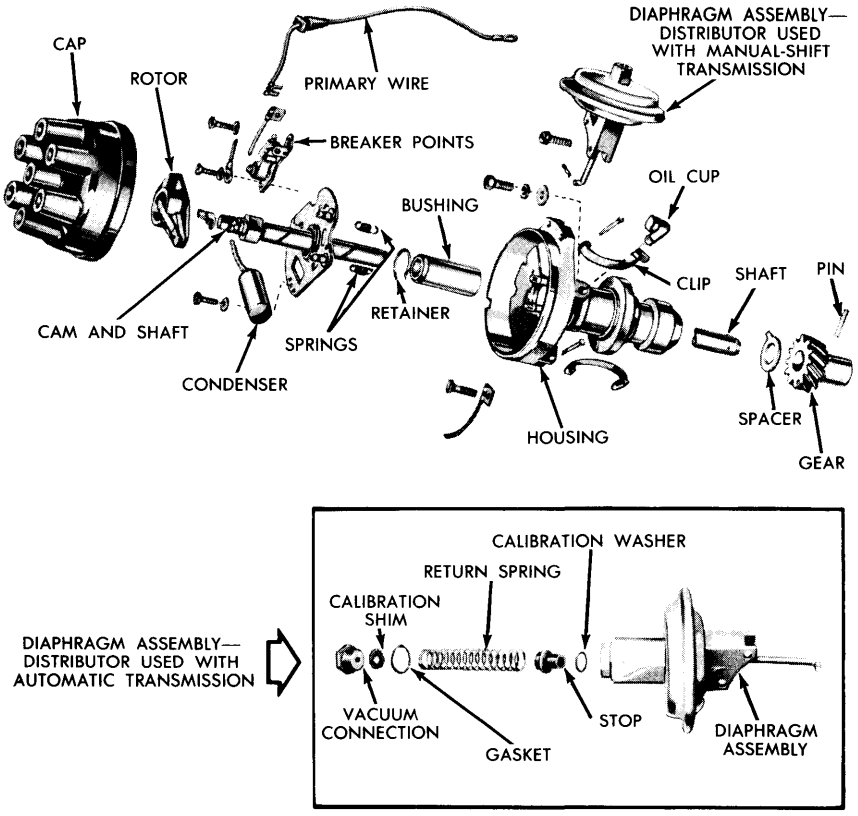



**FIG. 4—Loadomatic Distributor Assembly**

**2.** On a distributor used with an automatic transmission, install the calibration washer(s), stop, spring, calibration shim, gasket, and vacuum fitting.

**3.** Install the vacuum line in the diaphragm assembly and tighten the fitting.

**4.** Check the vacuum advance (Part 9-1).

**5.** Install the rotor and the distributor cap.

BREAKER POINT AND CONDENSER INSTALLATION

**1.** Place the breaker point assembly in position on the breaker plate. Be sure that the pivot pin enters the hole in the breaker plate. Connect the ground wire with the retaining screw to the end of the breaker point farthest from the adjustment slot. Install the other breaker point retaining screw.

**2.** Position the condenser and secure it with the retaining screw (Fig. 3).

**3.** Place the condenser lead, primary lead, lock washer and nut on the breaker point primary terminal. Tighten the nut.

**4.** Lubricate the cam with distributor cam lubricant. **Do not use engine oil on a distributor cam.**

**5.** Adjust the breaker point alignment, spring tension, and gap or dwell (Part 9-1).

**6.** Install the rotor and distributor cap.

## ADJUSTMENTS

Refer to Part 9-1 for the proper procedures for adjusting the breaker points and spark advance.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

1. Disconnect the primary wire at the coil and remove the distributor cap.
2. Disconnect the vacuum line at the distributor.
3. Scribe a mark on the distributor body, indicating the position of the rotor, and scribe another mark on the body and engine block, indicating the position of the body in the block. These lines will be used as guides when installing the distributor in the correctly timed engine.
4. Remove the retaining screw(s) (Fig. 5) and lock washer(s) and lift the distributor out of the block. **Do not rotate the crankshaft while the distributor is removed, or it will be necessary to time the engine.**

### INSTALLATION

1. If the crankshaft has not been rotated while the distributor was removed, position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body.
2. Install the distributor retaining screw(s).
3. Connect the distributor primary wire and install the distributor cap.
4. Start the engine and check the ignition timing with a timing light. Connect the distributor vacuum line, and check the advance with the timing light when the engine is accelerated.

If ignition timing is required, rotate the crankshaft until the No. 1 piston is on TDC after the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position. **Make sure the oil pump intermediate drive shaft is properly seated in the oil pump.** Install, but do not tighten, the distributor retaining screws. Rotate the distributor body clockwise until the breaker points are just starting to open. Tighten the retaining screws and follow steps 3 and 4 above.

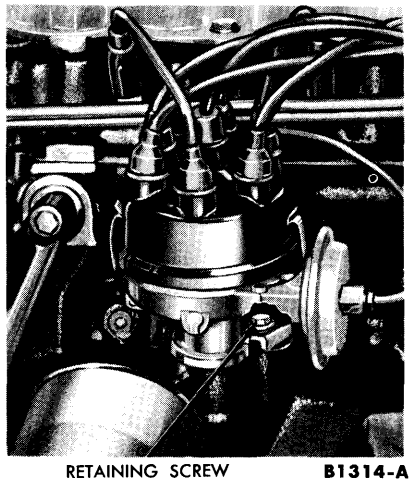



**FIG. 5—Loadomatic Distributor Mounting**

## 4 MAJOR REPAIR OPERATIONS

### BENCH DISASSEMBLY

The distributor assembly is shown in Fig. 4.

1. Install the distributor in a vise.
2. Remove the rotor and retainer. On the distributor used with an automatic transmission, remove the vacuum connection, gasket, and calibration shim from the diaphragm assembly and remove the spring, stop, and calibration washer.
3. Remove the vacuum advance rod hair pin retainer. Push the rod out of the plate. Remove the vacuum unit from the distributor.
4. Disconnect the primary and condenser wires from the breaker point terminal. Pull the primary wire through the opening in the distributor, working from the inside of the distributor.
5. Remove the condenser.
6. Remove the breaker point assembly.
7. Release the tension on the return springs and disconnect the springs. **Do not stretch the springs as distortion may result, making it impossible to obtain an adjustment. If the springs are distorted, discard them.**
8. Remove the distributor from the vise. Remove the distributor cap clamps. Drive out the drive gear pin with a punch (Fig. 6).

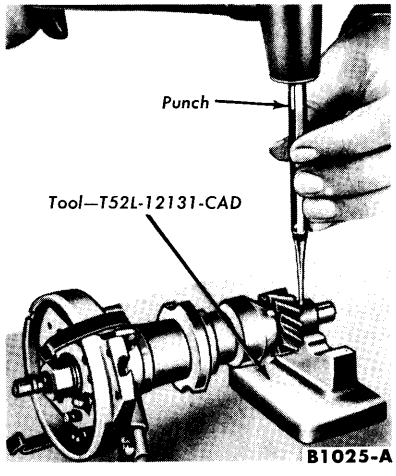



**FIG. 6—Gear Pin Removal or Installation**

9. If the gear and shaft are to be used again, mark them so that the pin holes can be easily aligned for assembly.
10. Press the gear off the shaft (Fig. 7). Slide the distributor shaft out of the body.
11. Position the distributor in a vise.
12. Remove the lock ring attaching the breaker plate to the bushing. Lift the breaker plate from the body.
13. Remove the ground wire.
14. Compress and insert the slotted end of the bushing removal tool in the distributor body. Allow it to expand and butt against the bushing. Drive out the bushing (Fig. 8).

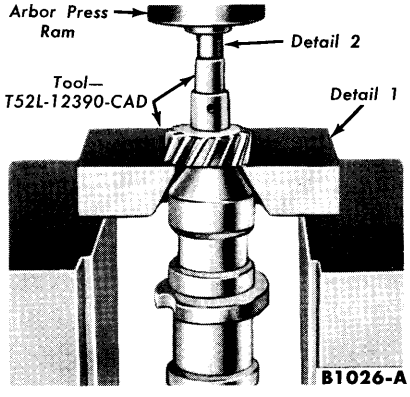



**FIG. 7—Gear Removal**

### BENCH ASSEMBLY

1. Oil the bushing and position it in the body with the lock ring end up. Install the bushing (Fig. 9). Turn the tool until the adapter bottoms firmly against the distributor body.
2. Burnish the bushing to the proper size (Fig. 10).

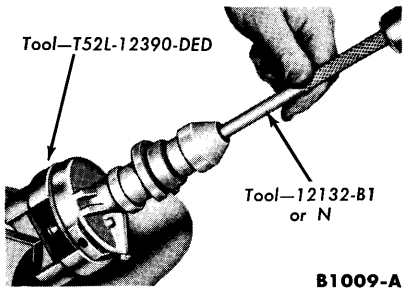



**FIG. 8—Bushing Removal**

**3.** Install the ground wire. Position the breaker plate in the body. Install the lock ring to secure the plate.

**4.** Position a new breaker point assembly on the breaker plate. Be sure the pivot pin enters the hole in the breaker plate.

**5.** Connect the ground wire to the breaker plate at the end furthest from the adjustment slot. Install the other screw and lock washer at the opposite end of the assembly.

**6.** Install a new condenser. Pass the primary wire assembly through the opening in the distributor, working from the inside to the outside of the distributor housing. Pull the wire through the opening until the locating stop is flush with the inside of the distributor. Place the condenser lead, primary lead, lock washer, and nut on the primary terminal.

**7.** Install the return springs on the adjustment and breaker plate posts.

**8.** Install the vacuum unit on the distributor body.

**9.** Insert the tip of the vacuum rod through the breaker plate. Attach the rod with the hair pin retainer.

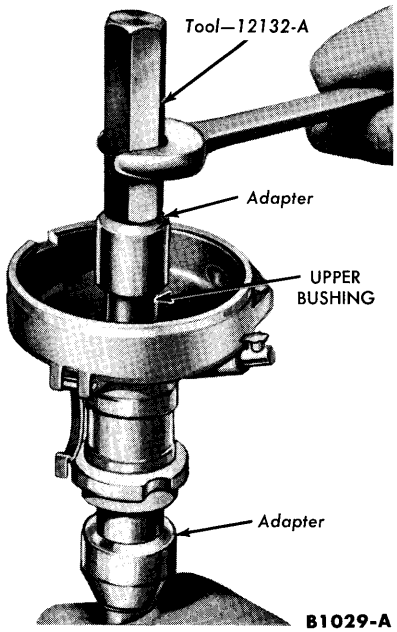



**FIG. 9—Bushing Installation**

On the distributor used with an automatic transmission, install the calibration washer(s), stop, return spring, calibration shim(s) and the vacuum line connection and gasket.

**10.** Slide the shaft into the body using care not to damage the rubbing block on the breaker points.

**The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other.**

**11.** Place the spacer on the gear end of the shaft. Press the gear on the shaft (Fig. 11) until the specified end clearance is obtained. If a new shaft is being installed, drill the shaft with a ⅛-inch drill using the pin hole in the gear shoulder as a guide.

**12.** Install the pin through the gear and shaft (Fig. 6). Install the distributor cap clamps. Lubricate the cam with distributor cam lubricant.

**13.** Refer to Part 9-1 and adjust the breaker point spring tension, align the breaker points, and adjust the gap. Check the vacuum advance, and the breaker point dwell and resistance.

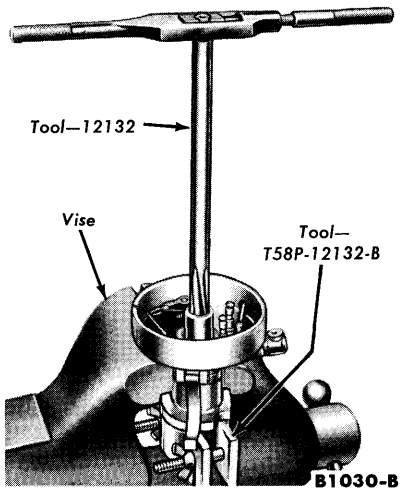



**FIG. 10—Burnishing Bushing**

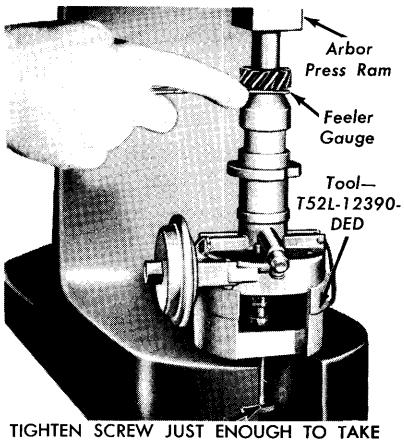



**FIG. 11—Gear Installation**

# PART 9-3 DUAL ADVANCE DISTRIBUTORS


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| 2 | In-Car Adjustment and Repairs | 9-29 | 4 | Major Repair Operations | 9-31 |


## 1 DESCRIPTION AND OPERATION

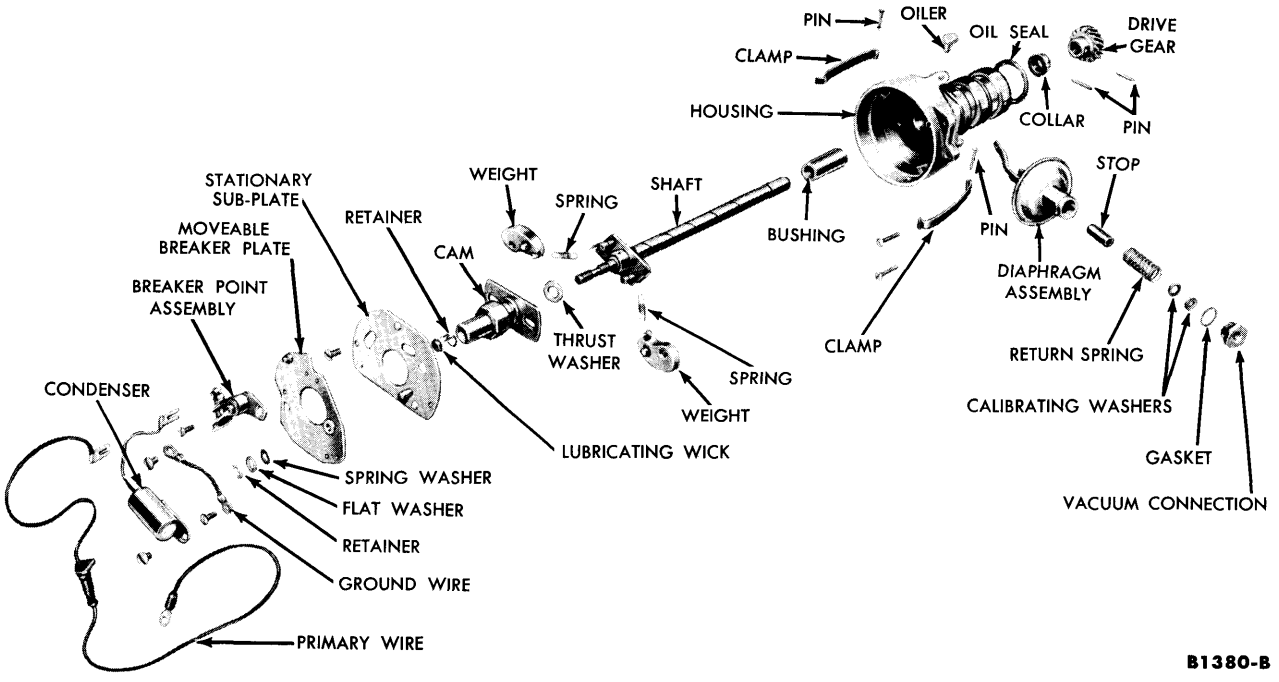



**FIG. 1—Typical Dual Advance Distributor Assembly**

The dual advance distributor (Fig. 1) has two independently operated spark advance systems. A centrifugal advance mechanism is located below the stationary sub-plate assembly, and a vacuum operated spark control diaphragm is located on the side of the distributor base. As speed increases, the centrifugal weights cause the cam to advance or move ahead with respect to the distributor drive shaft. The weights turn the cam by means of a stop plate that has two slots, which fit over pins in the weights. The slots determine the maximum amount of advance, and the rate of advance is controlled by calibrated springs.

The vacuum advance mechanism has a spring-loaded diaphragm which is connected to the breaker plate. The spring-loaded side of the diaphragm is airtight and is connected through a vacuum line to the carburetor throttle bore. When the throttle plates open, the distributor vacuum passage is exposed to manifold vacuum, which causes the diaphragm to move against the tension of the spring. This action causes the movable breaker plate to pivot on the stationary sub-plate. The breaker point rubbing block, which is positioned on the opposite side of the cam from the pivot pin, then moves against distributor rotation and advances the spark timing. As the movable breaker plate is rotated from retard position to full advance position, the dwell decreases slightly. This is because the breaker point rubbing block and the cam rotate on different axes.

## 2 IN-CAR ADJUSTMENT AND REPAIRS

### DISASSEMBLY

### REMOVAL OF COMPONENTS

**1.** Remove the primary wire from the coil or the distributor-transistor lead from the quick disconnect. Unsnap the distributor cap retaining clips, lift the distributor cap off the distributor housing, and position the cap out of the way.

**2.** Loosen the nut and pull the vacuum line out of the diaphragm assembly.

**3.** Lift the rotor off the cam.

**4.** Remove the spring clip securing the diaphragm link to the movable breaker plate. Disconnect the diaphragm assembly from the distributor housing. Lift the diaphragm

link off the pin and remove the diaphragm assembly.

**5.** Working from the inside of the distributor, remove the primary (or distributor-transistor lead) wire by pulling it through the opening in the distributor.

**6.** Remove the two retaining screws and lift the entire breaker plate assembly out of the distributor housing.

**7.** Lift the lubricating wick out of the cam. Using needle nose pliers, remove the cam retainer and lift the cam off the distributor shaft.

**8.** Lift the upper thrust washer off the distributor shaft. Carefully unhook and remove the distributor weight springs. Mark each spring and the adjusting bracket to which it is attached. Lift the weights out of the housing.

### DIAPHRAGM AND BREAKER PLATE ASSEMBLY

**1.** Remove the vacuum connection and gasket. Then remove the calibrating washers, return spring and stop.

**2.** Remove the retaining screw and lift the condenser (if so equipped) off the breaker plate (Fig. 1).

**3.** Remove the retainer and washers securing the moveable breaker plate to the stationary sub-plate.

### ASSEMBLY

### DIAPHRAGM AND BREAKER PLATE ASSEMBLY

**1.** Install the breaker point assembly on the breaker plate. Position a new condenser (if so equipped) and secure it with the retaining screw.

**2.** Install the stop, return spring and calibration washers, then position a new gasket on the vacuum connection. Install and tighten the vacuum connection.

### INSTALLATION OF COMPONENTS

**1.** Install the weights in the housing, and then install the distributor weight springs on the adjusting brackets from which they were removed. Install the upper thrust washer on the distributor shaft.

**2.** Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant. Position the cam on the distributor shaft and install the cam retainer. Apply a light film of distributor cam lubricant to the cam lobes. Install the wick in the cam assembly. Saturate the wick with SAE 10W engine oil.

**3.** Position the stationary sub-plate in the distributor. Install one end of the ground wire under the plate retaining screw closest to the diaphragm mounting flange.

**4.** Position the entire breaker plate assembly in the distributor housing and secure on the sub-plate by installing the washers and retainer. **Be sure the protruding edges of the spring washer are facing upward.**

**5.** Attach the ground wire to the breaker point attaching screw farthest from the breaker point adjustment slot. Working from inside the distributor housing, pass the primary or distributor-transistor lead wire assembly through the opening in the distributor body. From outside the distributor, pull the wire through the opening until the locating stop is flush with the inside of the distributor.

**6.** Connect the condenser wire (if so equipped) and the primary or distributor-transistor lead wire to the breaker points.

**7.** Position the diaphragm assembly and hook the diaphragm link over the pin in the breaker plate. Install the diaphragm assembly retaining screws. Secure the diaphragm link with a spring retainer.

**8.** Adjust the breaker point spring tension, align the breaker points, and adjust the breaker point gap. Check the breaker point dwell and resistance. Check the centrifugal and vacuum advance (refer to "Distributor Tests").

**9.** Install the rotor and distributor cap.

**10.** Connect the primary or distributor-transistor wire.

### ADJUSTMENTS

Refer to Part 9-1 for the proper procedures for adjusting the breaker points and spark advance.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

**1.** On a conventional ignition system, disconnect the primary wire at the coil. (On a transistor ignition system, disconnect the distributor-transistor lead from the quick disconnect.) Disconnect the vacuum advance line at the distributor. Remove the distributor cap.

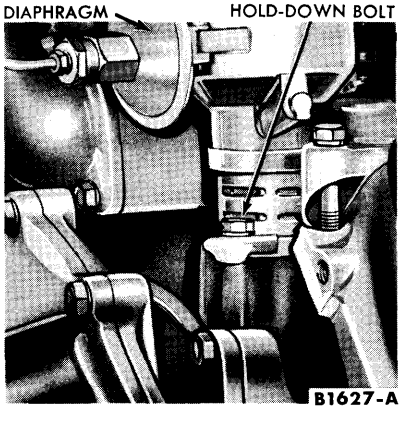



**FIG. 2—289 V-8 Distributor Installation**

**2.** Scribe a mark on the distributor body and engine block indicating the position of the body in the block, and scribe another mark on the distributor body indicating the position of the rotor. These marks can be used as guides when installing the distributor in a correctly timed engine.

**3.** Remove the distributor hold down cap screw and clamp. Lift the distributor out of the block.

### INSTALLATION

The distributor installation for the 289 V-8 is shown in Fig. 2.

The distributor installation for the 352 or 390 V-8 is shown in Fig. 3.

**1.** If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary




**FIG. 3—352 and 390 Distributor Installation**

to time the engine. Rotate the crankshaft until No. 1 piston is on TDC after the compression stroke. Align the TDC mark on the timing pointer with the timing pin on the crankshaft damper. Position the distributor in the block with the rotor at the No. 1 firing position.

**Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, after the distributor drive gear is partially engaged, in order to engage the oil pump intermediate shaft.**

Install, but do not tighten, the retaining clamp and screw. Rotate the distributor body counterclockwise until the breaker points are just starting to open. Tighten the clamp.

**2.** If the crankshaft has not been rotated, position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body, and the marks on the distributor body and engine block in alignment. Install the retaining clamp.

**3.** Install the distributor cap.

**4.** On a conventional ignition system, connect the primary wire to the coil. On a transistor ignition system, connect the distributor - transistor lead to the quick disconnect.

**5.** Check the ignition timing with a timing light and adjust if necessary. Connect the vacuum line, and check the advance with the timing light when the engine is accelerated.

## 4 MAJOR REPAIR OPERATIONS

### BENCH DISASSEMBLY

**1.** Remove the distributor and place it in a vise.

**2.** Remove the rotor. Remove the spring clip securing the diaphragm link to the movable breaker plate. Disconnect the diaphragm assembly from the distributor base.

**3.** Lift the diaphragm link off the pin and remove the diaphragm assembly.

**4.** Disconnect the primary or distributor-transistor lead wire and the condenser wire (if so equipped) from the breaker point terminal.

**5.** Working from the inside of the distributor, remove the primary or distributor-transistor lead wire by pulling it through the opening in the distributor.

**6.** Remove the condenser (if so equipped).

**7.** Remove the breaker point assembly.

**8.** Remove the lubricating wick. Using needle nose pliers, remove the cam retainer.

**9.** Remove the movable breaker plate spring retainer and washers.

**10.** Remove the stationary sub-plate retaining screws. Remove the sub-plate, breaker plate and cam as an assembly.

**11.** Remove the upper thrust washer.

**12.** Carefully unhook and remove the distributor weight springs. Mark each spring, bracket and adjusting post to which it is attached.

**13.** Remove the weights.

**14.** Remove the distributor cap clamps.

**15. If the gear and shaft are to be used again, mark the gear and shaft so that the pin holes can be easily aligned for assembly.** Remove the gear roll pin (Fig. 4), and then remove the gear (Fig. 5).

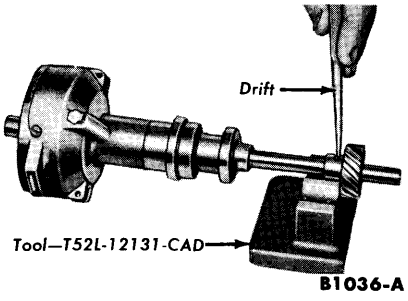



**FIG. 4—Gear Pin Removal or Installation**

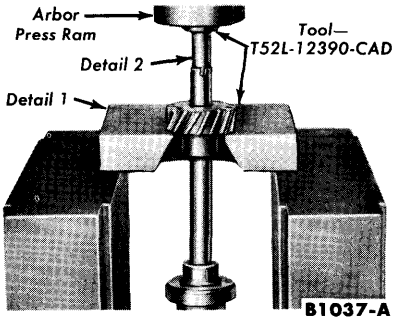



**FIG. 5—Gear Removal**

**16.** Remove the shaft collar roll pin (Fig. 6).

**17.** Invert the distributor and place it on a support plate in a position that will allow the distributor shaft to clear the support plate, and press the shaft out of the collar and the distributor housing (Fig. 7).

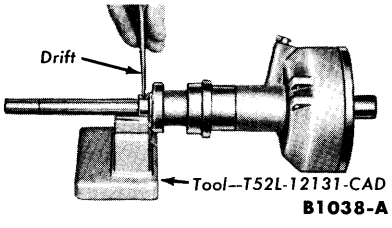



**FIG. 6—Collar Retaining Pin Removal or Installation**

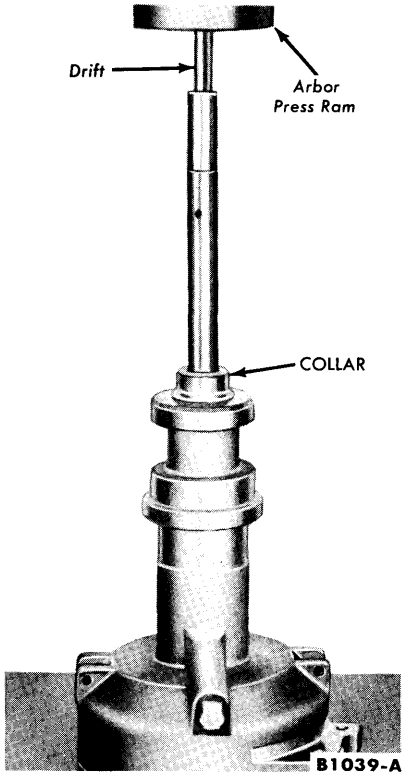



**FIG. 7—Shaft Removal**

**18.** Remove the distributor shaft bushing (Fig. 8).

On the distributor for a 352 or 390 V-8 engine, remove the oil seal from the distributor housing.

### BENCH ASSEMBLY

#### ORIGINAL SHAFT AND GEAR

**1.** Oil the new bushing, and install it on the bushing replacer tool. Install the bushing (Fig. 9). When the tool bottoms against the distributor base, the bushing will be installed to the correct depth.

**2.** Burnish the bushing to the proper size (Fig. 10).

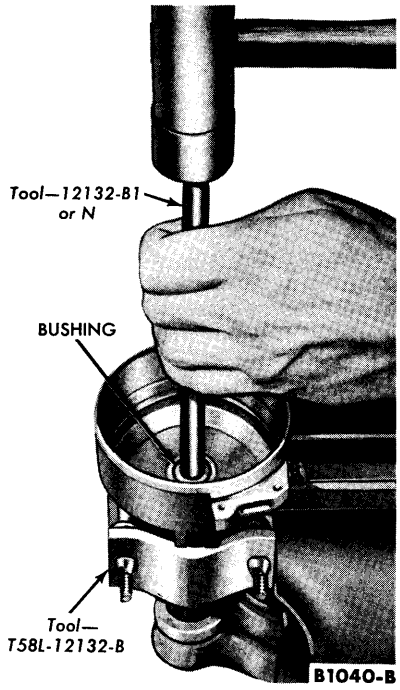



**FIG. 8—Bushing Removal**

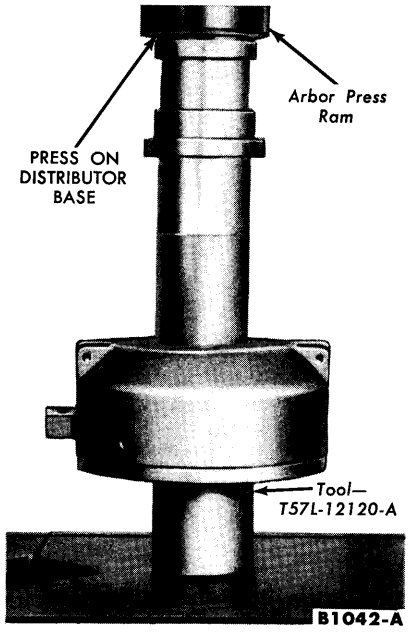



**FIG. 9—Bushing Installation**

3. Oil the shaft and slide it into the distributor body.

4. Place the collar in position on the shaft and align the holes in the collar and shaft, and install a new pin (Fig. 6). Install the distributor cap clamps.

5. Check the shaft end play with a feeler gauge placed between the collar and the base of the distributor. If the end play is not within

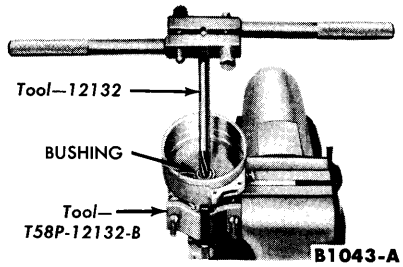



**FIG. 10—Burnishing Bushing**

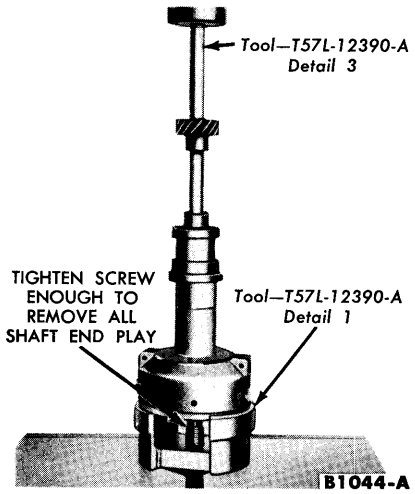



**FIG. 11—Original Shaft and Gear Installation**

specifications, replace the shaft and gear.

6. Attach the distributor shaft supporting tool to the distributor. Tighten the backing screw in the tool enough to remove all shaft end play.

7. Install the assembly in a press. Press the gear on the shaft (Fig. 11), using the marks made on the gear and shaft as guides to align the pin holes.

8. Remove the distributor from the press. Install the gear retaining pin (Fig. 4).

9. Position the distributor in a vise. Fill the grooves in the weight pivot pin with distributor cam lubricant.

10. Position the weights in the distributor.

11. Install the weight springs. Be sure the proper weight, spring, and adjustment bracket are assembled together.

12. Install the upper thrust washer.

13. Fill the grooves in the upper portion of the distributor shaft with a distributor cam lubricant.

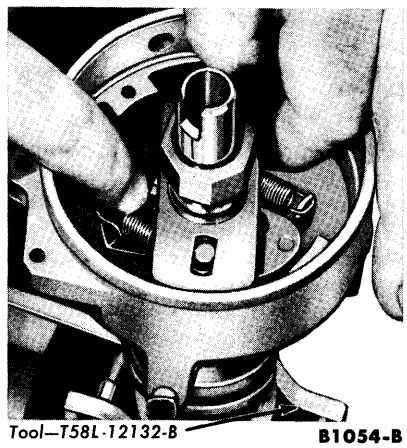



**FIG. 12—Cam Installation**

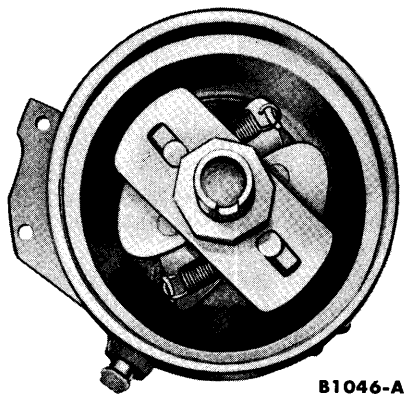



**FIG. 13—Weights, Springs and Cam Installed**

14. Install the cam assembly (Fig. 12). Be sure that the slots in the cam engage the pins in the weights.

15. Install the cam retainer. Apply a light film of cam lubricant to the cam lobes. Saturate the wick with SAE 10W engine oil. Install the wick in the cam assembly. The weights, springs, and cam are shown installed in Fig. 13.

16. Position the stationary sub-plate in the distributor. Install one end of the ground wire under the plate retaining screw closest to the diaphragm mounting flange (Fig. 14).

17. Position the movable breaker plate in the distributor. Install the spring washer on the pivot pin. Place the flat washer on the spring washer. Be sure the protruding edges of the spring washer are facing upward. Install the retainer.

18. Install a new breaker point assembly. Install the ground wire on the breaker point attaching screw furthest from the breaker point adjustment slot.

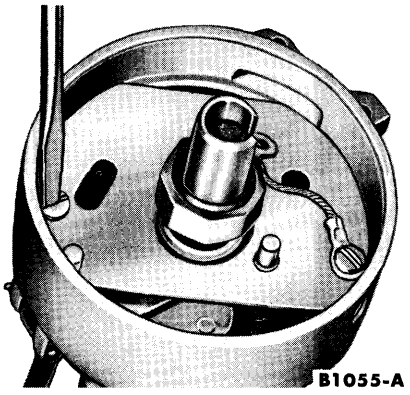



**FIG. 14—Sub-Plate Installation**

**19.** Install a new condenser (if so equipped).

**20.** Working from the inside to the outside of the distributor housing, pass the primary or distributor-transistor lead wire assembly through the opening in the distributor. Pull the wire through the opening until the locating stop is flush with the inside of the distributor.

**21.** Connect the condenser wire, if so equipped, and the primary or distributor-transistor lead wire to the breaker points.

**22.** Position the diaphragm assembly and hook the diaphragm link over the pin on the breaker plate. Install the diaphragm assembly retaining screws. Secure the diaphragm link with a spring retainer.

On the distributor for the 352 or 390 V-8 engine, install the oil seal.

**23.** Refer to part 9-1 and make the following adjustments:

Breaker point spring tension.

Align the breaker points and adjust the gap.

Check the breaker point dwell and resistance.

Centrifugal and vacuum advance.

## NEW SHAFT AND GEAR

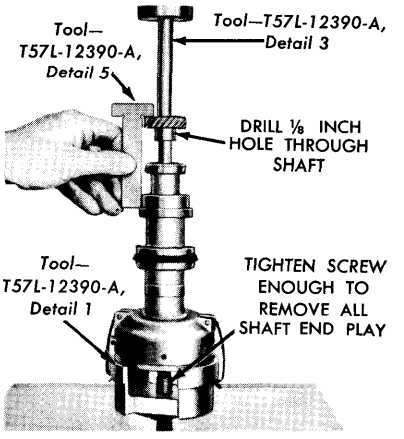
The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other. Refer to Fig. 1 for the correct location of the parts.

**1.** Follow steps 1, 2, and 3 under "Installing Original Shaft and Gear."

**2.** Attach the distributor shaft supporting tool to the distributor and install the assembly in a vise. Insert a 0.002-inch feeler gauge between the backing screw and the shaft. Tighten the backing screw on the tool enough to remove all shaft end play. Remove the feeler gauge and allow the shaft to rest on the backing screw. Slide the collar on the shaft. While holding the collar in place against the distributor base (Fig. 15), drill a ⅛-inch hole through the shaft using the access opening in the collar as a pilot.

**3.** Position the gear on the end of the shaft. Install the assembly in a press.

**4.** With the backing screw on the support tool tightened enough to remove all end play, press the gear




B1387-B

**FIG. 15—New Shaft and Gear Installation**

on the shaft to the specified distance from the bottom face of the gear to the bottom face of the distributor mounting flange (Fig. 15). Drill a ⅛-inch hole through the shaft using the hole in the gear as a pilot.

**5.** Remove the distributor from the press and remove the support tool. Install the collar retaining pin (Fig. 6) and the gear retaining pin (Fig. 4).

**6.** Complete the assembly by following steps 8 thru 23 under "Installing Original Shaft and Gear."

# PART 9-4 CENTRIFUGAL ADVANCE DISTRIBUTORS


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## 1 DESCRIPTION AND OPERATION

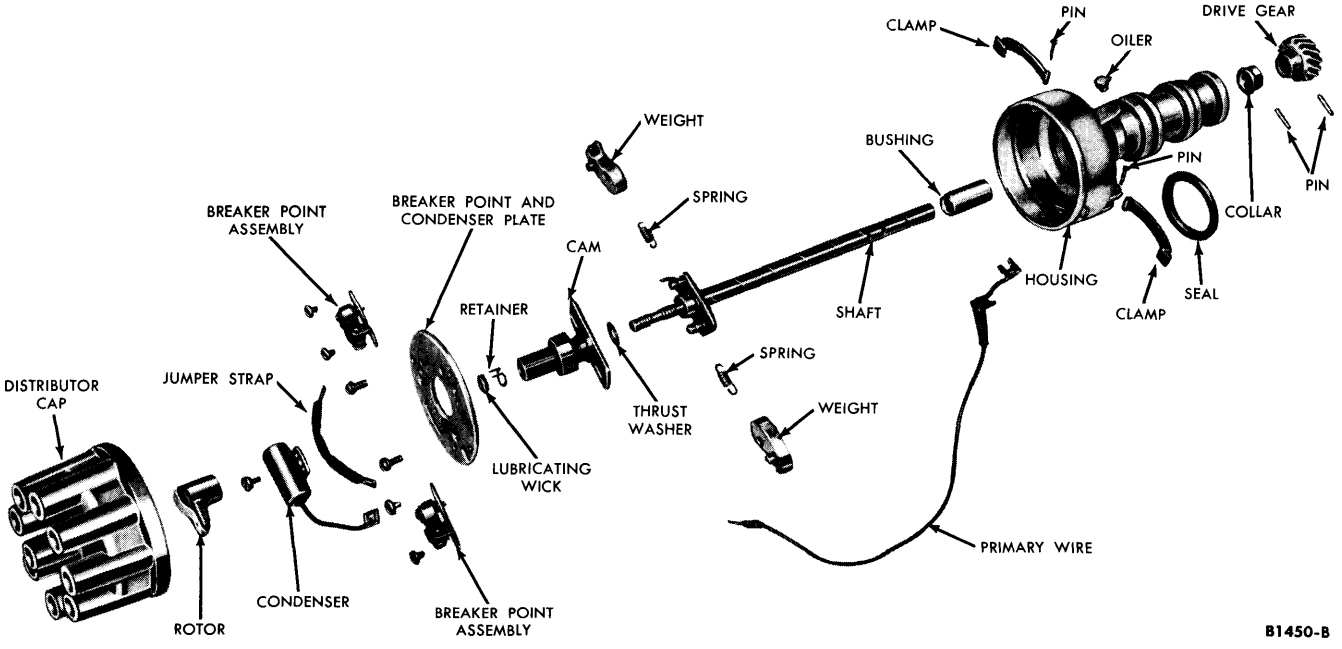



**FIG. 1—Centrifugal Advance Distributor Assembly**

The centrifugal advance distributor (Fig. 1), is a straight mechanical-type unit. A governor-type centrifugal advance is located below the stationary breaker plate. Two centrifugal weights cause the cam to advance or move ahead with respect to the distributor drive shaft. The weights turn the cam by means of a stop plate that has two slots which fit over pins in the weights. The slots determine the maximum amount of advance and the rate of advance is controlled by two calibrated springs.

On a conventional ignition system distributor, the breaker points are located on the stationary breaker plate and are connected in parallel with an insulated jumper strap. One breaker point assembly closes the primary circuit and the other opens the primary circuit. This type of construction results in a greater amount of cam angled well with approximately the same amount of gap spacing as the single breaker point distributor. The breaker arm spring tension is greater than for conventional breaker point assemblies. This increased dwell and breaker arm spring tension assures reserve spark plug voltage for high speed performance.

On a transistorized ignition system, there is only one set of breaker points.

## 2 IN-CAR ADJUSTMENT AND REPAIRS

### DISASSEMBLY

### REMOVAL OF COMPONENTS

**1.** Remove the distributor cap clamps and lift off the distributor cap.

**2.** Lift the rotor off the cam.

**3.** Disconnect the primary or distributor-transistor lead wire, and jumper strap (if so equipped) from the breaker point terminals.

**4.** Working from inside the distributor, remove the primary or distributor-transistor lead wire by pulling it through the opening in the distributor.

**5.** Remove the breaker plate assembly retaining screws and remove the breaker plate assembly.

**6.** Remove the lubricating wick from the cam assembly.

**7.** Using needle nose pliers, remove the cam retainer and lift the cam assembly off the distributor shaft.

**8.** Remove the upper thrust washer.

**9.** Carefully unhook and remove the distributor weight springs. Mark

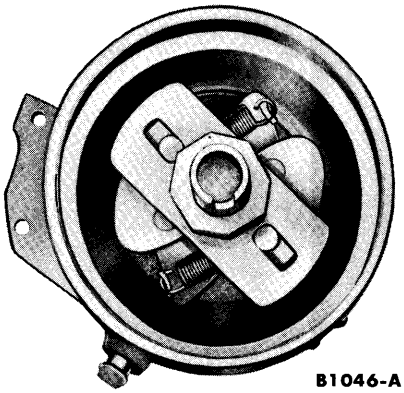

B1046-A

**FIG. 2–Weights, Springs and Cam Installed**

each spring and the adjusting bracket to which it was attached. Remove the distributor weights.

**BREAKER PLATE ASSEMBLY**

Remove the retaining screw and lift the condenser (if so equipped) off the breaker point and condenser plate. Remove the retaining screws and remove the breaker point assembly(ies) from the breaker plate.

### ASSEMBLY

**BREAKER PLATE ASSEMBLY**

Position new breaker point assembly(ies) and a new condenser (if so equipped) on the breaker plate and secure in place with the retaining screws.

**INSTALLATION OF COMPONENTS**

**1.** Fill the grooves in the weight pivot pin with distributor cam grease. Position the weights in the distributor. Install the weight springs. Be sure that the proper springs and adjustment brackets are assembled together.

**2.** Place the upper thrust washer in position on the shaft.

**3.** Fill the grooves in the upper portion of the distributor shaft with distributor cam grease. Place the cam assembly in position (Fig. 2). Be sure that the slots in the cam engage the pins in the weights.

**4.** Install the cam retainer. Apply a light film of distributor cam grease to the cam lobes. Insert the wick in the cam assembly. Saturate the wick with SAE 10W engine oil. The weights, springs, and cams are shown installed in Fig. 2.

**5.** Position the breaker plate assembly in the distributor and install the retaining screws.

**6.** Working from the inside of the distributor housing, push the primary or distributor-transistor lead wire assembly through the opening in the distributor. From the outside of the distributor, pull the wire until the locating stop is flush with the inside of the distributor.

**7.** Connect the condenser wire (if so equipped), primary or distributor-transistor lead wire, and jumper strap (if so equipped) to the breaker point terminal closest to the primary or distributor-transistor lead wire opening in the distributor.

**8.** Connect the other end of the jumper strap to the other breaker point terminal (if so equipped).

**9.** Adjust the breaker point spring tension to specifications, align the breaker points, and adjust the gap.

**10.** Install the rotor.

**11.** Check and adjust the centrifugal advance to specifications.

**12.** Install the distributor cap and secure with the distributor cap clamps.

### ADJUSTMENTS

Refer to Part 9-1 for the proper procedures for adjusting the breaker points and spark advances.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

**1.** Disconnect the primary or distributor-transistor wire at the coil. Remove the distributor cap.

**2.** Scribe a mark on the distributor body and engine block indicating the position of the body in the block, and scribe another mark on the distributor body indicating the position of the rotor. These marks can be used as guides when installing the distributor in a correctly timed engine.

**3.** Remove the distributor held down cap screw and clamp, and then lift the distributor out of the block.

### INSTALLATION

**1.** If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine. Rotate the crankshaft until No. 1 piston is on TDC (after the compression stroke). Align the TDC mark on the timing pointer with the timing pin on the crankshaft damper. Position the distributor in the block with the rotor at the No. 1 firing position.

If the crankshaft has not been rotated, position the distributor in the block with rotor aligned with the mark previously scribed on the distributor body, and the marks on the distributor body and engine block in alignment. Install the retaining clamp.

**Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, after the distributor drive gear is partially engaged, in order to engage the oil pump intermediate shaft.**

**2.** Install, but do not tighten, the retaining clamp and screw. Rotate the distributor body counterclockwise until one set of breaker points are just starting to open. Tighten the clamp.

**3.** Install the distributor cap.

**4.** Connect the primary wire to the coil or the distributor-transistor lead wire to the quick disconnect.

**5.** Check the ignition timing with a timing light and adjust it if necessary.

## 4 MAJOR REPAIR OPERATIONS

### BENCH DISASSEMBLY

**1.** Remove the distributor and place it in a vise.

**2.** Remove the rotor.

**3.** Disconnect the primary or distributor-transistor lead wire, condenser wire (if so equipped) and jumper strap (if so equipped) from the breaker point terminal(s).

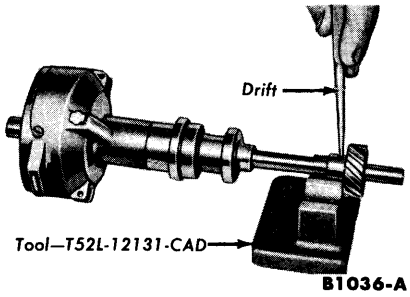



**FIG. 3—Gear Pin Removal or Installation**

**4.** Working from the inside of the distributor, remove the primary or distributor-transistor lead wire by pulling it through the opening in the distributor.

**5.** Remove the condenser (if so equipped) and the breaker point assembly(ies).

**6.** Remove the lubricating wick from the cam assembly. Using needle nose pliers, remove the cam retainer.

**7.** Remove the breaker plate retaining screws, and then remove the breaker plate and the cam assembly. Remove the upper thrust washer.

**8.** Carefully unhook and remove the distributor weight springs. Mark each spring, bracket, and adjusting post to which it is attached. Remove the weights.

**9.** Remove the distributor cap clamps.

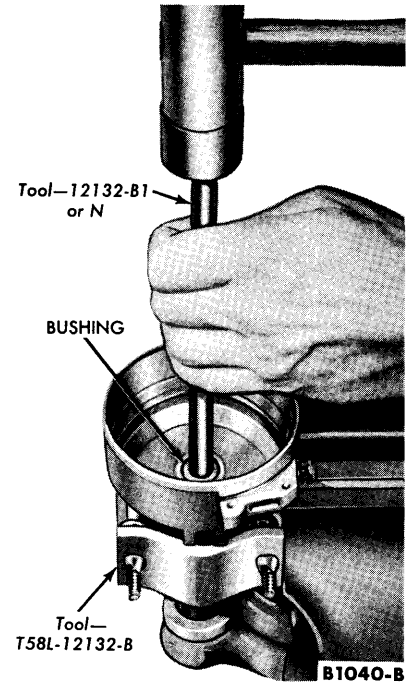



**FIG. 6—Bushing Removal**

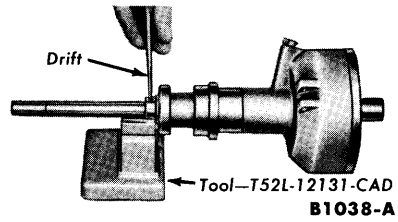



**FIG. 4—Collar Retaining Pin Removal or Installation**

**10.** If the gear and shaft are to be used again, mark the gear and shaft so that the pin holes can be easily aligned for assembly. Remove the gear and shaft collar roll pin (Figs. 3 and 4).

**11.** Invert the distributor and place it on a support plate in a position that will allow the distributor shaft to clear the support plate. Then press the shaft out of the gear, collar, and distributor housing (Fig. 5).

**12.** Remove the distributor shaft bushing (Fig. 6).

**13.** Remove the oil seal from the distributor housing.

### BENCH ASSEMBLY

Refer to Fig. 1 for the correct location of the parts.

### ORIGINAL SHAFT AND GEAR

**1.** Oil the new bushing, and install it on the bushing replacer tool. Then install the bushing (Fig. 7).

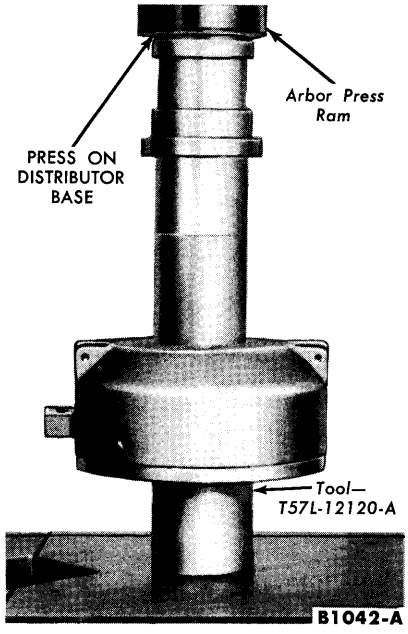



**FIG. 7—Bushing Installation**

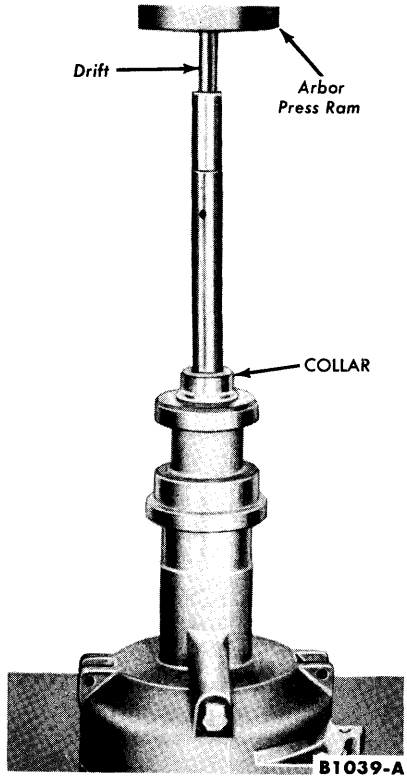



**FIG. 5—Shaft Removal**

When the tool bottoms against the distributor base, the bushing will be installed to the correct depth.

**2.** Burnish the bushing to the proper size (Fig. 8).

**3.** Oil the shaft and slide it into the distributor body.

**4.** Place the collar in position on the shaft and align the holes in the collar and shaft, then install a new pin (Fig. 4). Install the distributor cap clamps.

**5.** Check the shaft end play with a feeler gauge placed between the collar and the base of the distributor. If the end play is not within limits, replace the shaft and gear.

**6.** Attach the distributor shaft supporting tool to the distributor. Tighten the backing screw in the tool enough to remove all shaft end play.

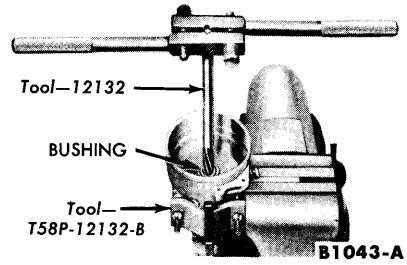



**FIG. 8—Burnishing Bushing**

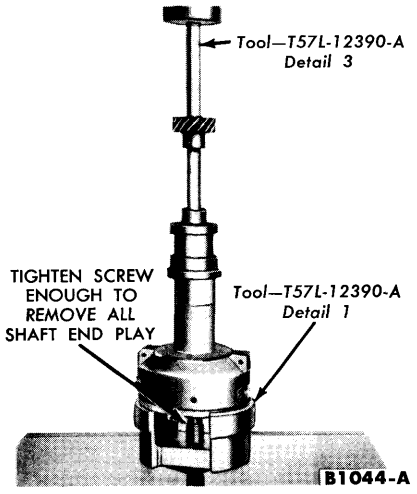



**FIG. 9—Original Shaft and Gear Installation**

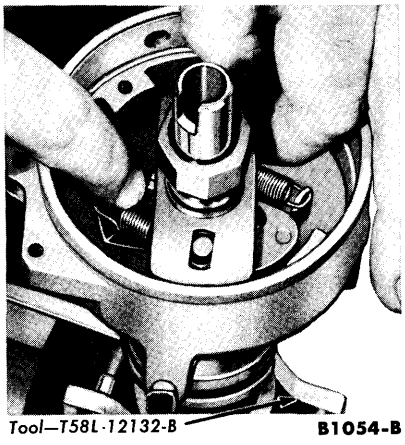



**FIG. 10—Cam Installation**

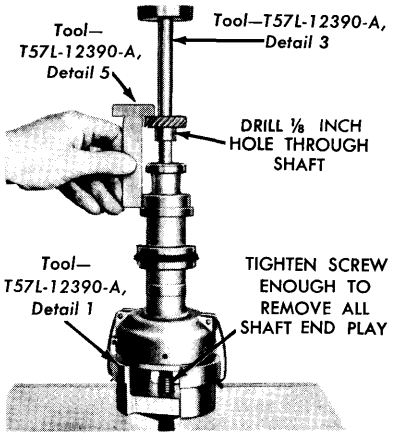



**FIG. 11—New Shaft and Gear Installation**

**7.** Install the assembly in a press. Press the gear on the shaft (Fig. 9), using the marks made on the gear and shaft as guides to align the pin holes.

**8.** Remove the distributor from the press. Install the gear retaining pin (Fig. 3).

**9.** Position the distributor in a vise. Fill the grooves in the weight pivot pin with distributor cam lubricant.

**10.** Position the weights in the distributor.

**11.** Install the weight springs. Be sure the proper weight, spring, and adjustment bracket are assembled together.

**12.** Install the upper thrust washer.

**13.** Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant.

**14.** Install the cam assembly (Fig. 10). Be sure that the slots in the cam engage the pins in the weights.

**15.** Install the cam retainer. Apply a light film of cam lubricant to the cam lobes. Saturate the wick with SAE 10W engine oil. Install the wick in the cam assembly. The weights, springs, and cam are shown installed in Fig. 2.

**16.** Position the breaker plate in the distributor. Install the retaining screws.

**17.** Install new breaker point assembly(ies). Install a new condenser (if so equipped).

**18.** Working from the inside to the outside of the distributor housing, pass the primary or distributor-transistor lead wire assembly through the opening in the distributor. Pull the wire through the opening until the locating stop is flush with the inside of the distributor.

**19.** Connect the condenser wire (if so equipped), primary or distributor-transistor lead wire, and jumper strap (if so equipped) to the breaker point assembly closest to the primary wire opening in the distributor.

**20.** Connect the other end of the jumper strap to the other breaker point assembly (if so equipped). Install the oil seal.

**21.** Refer to Part 9-1 and make the following adjustments:

Breaker point spring tension.

Align the breaker points and adjust the gap(s).

Check the dwell.

### NEW SHAFT AND GEAR

The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other. Refer to Fig. 1 for the correct location of the parts.

**1.** Follow steps 1, 2, and 3 under "Installing Original Shaft and Gear."

**2.** Attach the distributor shaft supporting tool to the distributor and install the assembly in a vise. Insert a 0.002-inch feeler gauge between the backing screw and the shaft. Tighten the backing screw on the tool enough to remove all shaft end play, then remove the feeler gauge and allow the shaft to rest on the backing screw. Slide the collar on the shaft. While holding the collar in place against the distributor base, drill a ⅛-inch hole through the shaft using the access opening in the collar as a pilot.

**3.** Position the gear on the end of the shaft. Install the assembly in a press.

**4.** With the backing screw on the support tool tightened enough to remove all end play, press the gear on the shaft to the specified distance from the bottom face of the gear to the bottom face of the distributor mounting flange (Fig. 11). Drill a ⅛-inch hole through the shaft using the hole in the gear as a pilot.

**5.** Remove the distributor from the press and remove the support tool. Install the collar retaining pin (Fig. 4) and the gear retaining pin (Fig. 3).

**6.** Complete the assembly by following steps 9 thru 21 under "Installing Original Shaft and Gear."

# PART 9-5 SPECIFICATIONS

## DISTRIBUTOR

### GENERAL

| | |
|---|---|
| **Mileage Maker Six** | |
| Breaker Arm Spring Tension (Ounces) | 17-20 |
| Contact Spacing (Inches) | 0.024-0.026 |
| Dwell Angle at Idle Speed | 35°-38° |
| **289, 352 and 390 V-8** | |
| Breaker Arm Spring Tension (Ounces) | 17-20 |
| Contact Spacing (Inches) | 0.014-0.016 |
| Dwell Angle at Idle Speed | 26°-28½° |
| **427 V-8** | |
| Breaker Arm Spring Tension (Ounces) | |
| Conventional Ignition System | 27-30 |
| Transistor Ignition System | 21-24 |
| Contact Spacing (Inches) | |
| Both Ignition Systems | 0.019-0.021 |
| Dwell Angle at Idle Speed | |
| Conventional Ignition System (Combined) | 33°-36° |
| Transistor Ignition System | 22°-24° |

### DIMENSIONS

| | |
|---|---|
| **Shaft End Play—Distributor Removed (Inches)** | |
| Mileage Maker Six | 0.005-0.008 |
| 289 V-8 | 0.024-0.035 |
| 352, 390 and 427 V-8 | 0.022-0.032 |
| **Distance Between Base and Gear** | |
| Mileage Maker Six | 0.005-0.008 |
| **Distance From Bottom of Mounting Flange to Bottom of Gear (Inches)** | |
| 289 V-8 | 4.031-4.038 |
| 352, 390 and 427 V-8 | 3.071-3.077 |

### CONDENSER

| | |
|---|---|
| Capacity (Microfarads) | 0.21-0.25 |
| Minimum Leakage (Megohms) | 5 |
| Maximum Series Resistance (Ohms) | 1 |

### IGNITION TIMING

| Engines | Recommended Setting (BTDC)** | |
|---|---|---|
| | Manual-Shift Transmission | Automatic Transmission |
| Mileage Maker Six | *4° | *10° |
| 289 (2-V) V-8 | 6° | 10° |
| 352 (4-V) V-8 | *6° | *10° |
| 390 (4-V) V-8 | *4° | *6° |
| 390 (2-V) V-8 | *6° | *6° |
| 390 Police Interceptor V-8 | 4° | 6° |
| 427 (4-V and 8-V) V-8 | 8° | — |

*For altitude operation, and/or to obtain optimum engine performance and fuel economy, the initial ignition timing may be advanced 5° over the "normal" setting. No further improvement in engine performance or fuel economy will be achieved by advancing beyond this point. Advance the timing progressively until engine detonation (spark knock) is evident under actual road test acceleration. Retard the timing until the detonation (spark knock) is eliminated.

**If the individual requirements of the car and/or the use of sub-standard fuels dictate, the initial timing may have to be retarded from the recommended setting to eliminate detonation (spark knock). If retiming is necessary, it should be done progressively and not to exceed 2°BTC.

### ADVANCE CHARACTERISTICS

**Note: The advance characteristics given apply to the distributor with the indicated number only. The distributor number is stamped on the distributor housing or on a plate attached to the distributor housing.**

**Mileage Maker Six (Distributor No. C4AF-12127-G used with Manual-Shift Transmission)**

VACUUM ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1¼-2¼ | 0.30 |
| 800 | 6¼-7¼ | 0.80 |
| 1200 | 8-9 | 1.75 |
| 1600 | 9¾-11 | 3.10 |
| 2000 | 10¾-12 | 4.30 |

Maximum Advance Limit ..... 13¼°

**Mileage Maker Six (Distributor No. C4AF-12127-H used with Automatic Transmission)**

VACUUM ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1¼-2¼ | 0.30 |
| 800 | 6¼-7¼ | 0.80 |
| 1200 | 8-9 | 1.75 |
| 1600 | 9¾-11 | 3.10 |
| 2000 | 10¾-12 | 4.30 |

Maximum Advance Limit ..... 13¼°

**223 Taxi Special Six (Distributor No. C4AF-12127-J used with Manual-Shift Transmission)**

VACUUM ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1¼-2¼ | 0.30 |
| 800 | 6¼-7¼ | 0.80 |
| 1200 | 8-9 | 1.75 |
| 1600 | 9¾-11 | 3.10 |
| 2000 | 10¾-12 | 4.30 |

Maximum Advance Limit ..... 13¼°

**223 Taxi Special Six (Distributor No. C4AF-12127-K used with Automatic Transmission)**

VACUUM ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1-2 | 0.45 |
| 800 | 4¼-5¼ | 1.07 |
| 1200 | 6¾-7¾ | 2.43 |
| 1600 | 7-8 | 4.80 |
| 2000 | 7-8 | 6.00 |

Maximum Advance Limit ..... 10¼°

## DISTRIBUTOR (Continued)

**ADVANCE CHARACTERISTICS (Continued)**

**289 V-8 (Distributor No. C4GF-12127-A used with Manual-Shift Transmission)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1¼-2¼ | 0 |
| 600 | 3¼-4¼ | 0 |
| 1000 | 7¾-9 | 0 |
| 1500 | 10¼-11¾ | 0 |
| 2000 | 12¼-14 | 0 |

Maximum Advance Limit.....14°

VACUUM ADVANCE. Set the test stand to 0° at 1000 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 1-4 | 8 |
| 1000 | 5½-8½ | 12 |
| 1000 | 7½-10½ | 16 |
| 1000 | 8-11 | 20 |

Maximum Advance Limit.....11°

**289 V-8 (Distributor No. C4GF-12127-B used with Automatic Transmission)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 600 | 1-2 | 0 |
| 700 | 3-4¼ | 0 |
| 900 | 6-6¾ | 0 |
| 1500 | 8-9¼ | 0 |
| 2000 | 9¼-11 | 0 |

Maximum Advance Limit.....11°

VACUUM ADVANCE. Set the test stand to 0° at 1000 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 2-5 | 8 |
| 1000 | 7-10 | 12 |
| 1000 | 9-12 | 16 |
| 1000 | 9½-12½ | 20 |

Maximum Advance Limit.....12½°

**352 (4-V) V-8 (Distributor No. C4AF-12127-L used with Manual-Shift Transmission)**

CENTRIFUGAL ADVANCE. Set the test set to 0° at 250 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 600 | 1½-2½ | 0 |
| 700 | 3¾-4¾ | 0 |
| 1000 | 6½-7½ | 0 |
| 1500 | 8½-9¾ | 0 |
| 2000 | 10¼-11¾ | 0 |

Maximum Advance Limit.....Not Applicable

VACUUM ADVANCE. Set the test set to 0° at 1000 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 2-5 | 8 |
| 1000 | 3½-6½ | 10 |
| 1000 | 6½-9½ | 14 |
| 1000 | 7½-10½ | 20 |

Maximum Advance Limit.....10½°

**352 (4-V) V-8 (Distributor No. C4AF-12127-M used with Automatic Transmission)**

CENTRIFUGAL ADVANCE. Set the test set to 0° at 250 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 400 | ½-1½ | 0 |
| 500 | 3-4 | 0 |
| 800 | 4-5 | 0 |
| 1200 | 5½-6¾ | 0 |
| 2000 | 8¼-9¾ | 0 |

Maximum Advance Limit.....Not Applicable

VACUUM ADVANCE. Set the test set to 0° at 1000 rpm and 0 inches vacuum

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 2-5 | 8 |
| 1000 | 3½-6½ | 10 |
| 1000 | 6½-9½ | 14 |
| 1000 | 7½-10½ | 20 |

Maximum Advance Limit.....10½°

**390 (2-V) V-8 (Distributor No. C3MF-12127-A)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | 1¼-2¼ | 0 |
| 700 | 5¼-6¼ | 0 |
| 1000 | 8¼-9¼ | 0 |
| 2000 | 13-14½ | 0 |

Advance Limit.....Not Applicable

VACUUM ADVANCE. Set the test stand to 0° at 1000 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 1-4 | 7 |
| 1000 | 3¼-6½ | 10 |
| 1000 | 5-8 | 12 |
| 1000 | 7-10 | 17 |

Advance Limit.....10°

**390 (4-V) V-8 (Distributor No. C3AF-12127-AH)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 400 | 0-1 | 0 |
| 600 | 2¾-3¾ | 0 |
| 800 | 4¼-5¼ | 0 |
| 1200 | 6¼-7½ | 0 |
| 2000 | 10¼-11¾ | 0 |

Advance Limit.....13°

VACUUM ADVANCE. Set the test stand to 0° at 1000 rpm and 0 inches vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 1-3 | 8 |
| 1000 | 2½-5½ | 10 |
| 1000 | 4-7 | 12 |
| 1000 | 4½-7½ | 20 |

Advance Limit.....7½°

## DISTRIBUTOR (Continued)

**ADVANCE CHARACTERISTICS (Continued)**

**390 Police Interceptor V-8 (Distributor No. C4AF-12127-N)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 400 | ½-1½ | 0 |
| 500 | 3½-4½ | 0 |
| 800 | 5¾-7 | 0 |
| 1400 | 8¼-9½ | 0 |
| 2000 | 10¾-12¾ | 0 |

Maximum Advance Limit.....Not Applicable

VACUUM ADVANCE. Set the test stand to 0° at 1000 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 1000 | 2-5 | 8 |
| 1000 | 4-7 | 10 |
| 1000 | 5½-8½ | 15 |
| 1000 | 5½-8½ | 20 |

Maximum Advance Limit.....8½°

**427 V-8 and Conventional Ignition (Distributor No. C3AF-12127-AE)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | ¼-1¼ | 0 |
| 600 | 1½-3 | 0 |
| 800 | 5-6½ | 0 |
| 1200 | 8-9¼ | 0 |
| 2000 | 13½-15¼ | 0 |

Maximum Advance Limit.....Not Applicable

**427 V-8 and Transistor Ignition (Distributor No. C3AF-12127-AF)**

CENTRIFUGAL ADVANCE. Set the test stand to 0° at 250 rpm and 0 inches of vacuum.

| Distributor (rpm) | Advance (Degrees) | Vacuum (Inches of Mercury) |
|---|---|---|
| 500 | ¼-1¼ | 0 |
| 600 | 1½-3 | 0 |
| 800 | 5-6½ | 0 |
| 1200 | 8-9¼ | 0 |
| 2000 | 13½-15¼ | 0 |

Maximum Advance Limit.....Not Applicable

## SPARK PLUGS

| Engines | Type | Size | Gap (Inches) | Torque (Ft-lbs) |
|---|---|---|---|---|
| 223 | BTF6 | 18MM | 0.028-0.032 | 15-20 |
| 223* | BF-82 | 18MM | 0.032-0.036 | 15-20 |
| 289, 352, and 390 | BF-42 | 18MM | 0.032-0.036 | 15-20 |
| 390 Police Interceptor and 427 | BF-32 | 18MM | 0.032-0.036 | 15-20 |

*With economy carburetor

## COIL

**Conventional Ignition System**
Primary Resistance (Ohms)*.....1.40-1.54 (75°F)
Secondary Resistance (Ohms).....8000-8800 (75°F)
Amperage Draw
Engine Stopped.....4.5
Engine Idling.....2.5
*Primary Circuit Resistor.....1.30-1.40 (75°F)

**Transistor Ignition System**
Primary Resistance (Ohms)*.....7.00-9.00 (75°F)
Secondary Resistance (Ohms).....5000-7000 (75°F)
Amperage Draw
Engine Cranking.....4.0
Engine Idling.....5.00
*Primary Circuit Resistor.....7.00-9.00 (75°F)

# FUEL SYSTEM

# GROUP 10


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## 1 DIAGNOSIS AND TESTING

### FUEL TANK, LINES AND FILTER

Water and dirt that accumulate in the fuel tank can cause a restricted fuel line or filter and malfunction of the vapor discharge valve, fuel pump, or carburetor. Condensation, which is the greatest source of water entering the fuel tank, is formed by moisture in the air when it strikes the cold interior walls of the fuel tank.

If the accumulation of sediment in the filter is excessive, the fuel tank should be removed and flushed, and the line from the fuel pump to the tank should be blown out.

Leakage in the fuel inlet line can cause low vacuum, pressure and volume conditions, and loss of fuel.

A restricted fuel tank vent can cause low fuel pump pressure and volume may, in some instances, result in collapsed inlet line hoses or a collapsed fuel tank.

### FUEL PUMP

Incorrect fuel pump pressure and low volume (flow rate) are the two most likely fuel pump troubles that will affect engine performance. Low pressure will cause a lean mixture at high speeds and excessive pressure will cause high fuel consumption and carburetor flooding. Low volume will cause fuel starvation at high speeds.

Two tests: fuel pump static pressure and fuel volume are necessary to determine that the fuel pump is in satisfactory condition.

If both the fuel pump volume and pressure are within specifications and the pump and lines are in satisfactory condition, a vacuum test is not required.

If the pump volume is low, but the pressure is within specifications, a test must be made with the filter removed. If the pump volume meets specifications with the filter removed, replace the filter. If the pump volume is still below specifications, repeat the test, using an auxiliary fuel supply. If the pump still does not meet specifications, replace the pump. If the pump does meet specifications, there is a restriction in the fuel supply from the tank or the tank is not venting properly.

The tests are performed with the fuel pump installed on the engine. **Make certain the replaceable fuel filter element has been changed within the recommended maintenance mileage interval.** When in doubt, install a new filter prior to performing the tests. A clogged or restricted filter is often the cause of fuel system malfunction.

### PRESSURE TEST

**1.** Remove the carburetor air cleaner. Disconnect the fuel inlet line at the carburetor. **Use care to prevent combustion due to fuel spillage.**

2. Connect a pressure gauge, petcock and flexible hose (Fig. 1) between the carburetor inlet connector and the fuel inlet line connector.

3. Position the flexible hose in the restrictor so that the fuel can be expelled into a suitable container (Fig. 1) for the capacity (volume) test.

4. Operate the engine. Vent the system into the container by opening the hose restrictor momentarily before taking a pressure reading.

5. Operate the engine at 500 rpm. After the pressure has stabilized, it should be to specification.

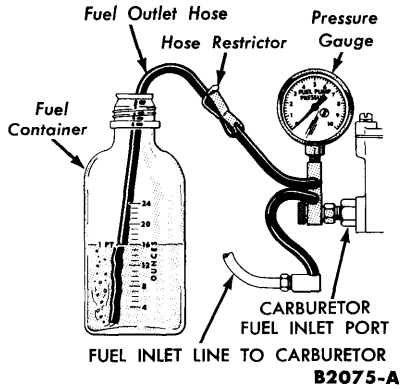



**FIG. 1—Fuel Pump Pressure and Capacity Tests—Typical**

### CAPACITY VOLUME TEST

Perform this test only when the fuel pump pressure is within specifications.

1. Operate the engine at 500 rpm.

2. Open the hose restrictor and expel the fuel into the container (Fig. 1), while observing the time required to expel one pint; then, close the restrictor. One pint of fuel should be expelled within the specified time limit.

3. Remove the test equipment, and connect the fuel inlet line to the carburetor.

### FUEL PUMP, TANK AND LINES DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **LOW FUEL PUMP PRESSURE OR VOLUME** | Diaphragm stretched or leaking.<br>Fuel pump springs weak.<br>Rocker arm or eccentric worn or undersize.<br>Excessive clearance between rocker arm and fuel pump link.<br>Fittings loose or cracked.<br>Fuel filter clogged. | Fuel line cracked or broken.<br>Fuel pump valves improperly seating.<br>Dirt in fuel tank and/or lines.<br>Fuel tank vent restricted.<br>Diaphragm ruptured.<br>Main body retaining screws loose. |
| **HIGH FUEL PUMP PRESSURE OR VOLUME** | Diaphragm spring too strong or improper spring.<br>Diaphragm surface too tight (overtensioned). | Pump link has no free play (frozen). |
| **LOW FUEL PUMP VACUUM** | Diaphragm stretched or leaking.<br>Fuel pump springs weak.<br>Fuel pump valves improperly seating.<br>Diaphragm ruptured. | Rocker arm or eccentric worn.<br>Excessive clearance between rocker arm and fuel pump link.<br>Main body retaining screws loose. |
| **LOW FUEL PUMP VOLUME WITH NORMAL PRESSURE** | Fuel filter clogged.<br>Fuel pump to carburetor inlet line obstructed, crimped or leaks. | Restriction in fuel supply line to fuel pump. |
| **FUEL PUMP LEAKS FUEL** | Main body retaining screws loose.<br>Diaphragm defective.<br>Fittings loose. | Threads on fittings stripped.<br>Body cracked. |
| **FUEL PUMP LEAKS OIL** | Fuel pump retaining bolts loose. | Mounting gasket defective. |
| **FUEL PUMP NOISE** | Rocker arm or eccentric worn.<br>Mounting bolts loose. | Rocker arm springs weak or broken. |
| **FUEL TANK AND/OR INLET LINE HOSES COLLAPSED** | Fuel tank vent cap obstructed. | |

## CARBURETOR

Dirt accumulation in the fuel and air passages, improper idle adjustments, and improper fuel level are the major sources of carburetor troubles.

### TESTS

**Accelerating Pump Discharge**

**1.** Remove the air cleaner.

**2.** Open the primary throttle plates and observe the fuel flow from the accelerating pump discharge nozzles. If the system is operating correctly, a quick steady stream of fuel will flow from the discharge nozzles.

**Power Valve**

**A power valve must not be replaced unless it is leaking sufficiently to cause an unadjustable rough engine idle condition.** Leakage in the power valve area can be caused by an imporperly tightened cover or defective gaskets. Any defect in the gasket sealing qualities must be corrected before the power valve is replaced.

Power valve leakage that causes an unadjustable rough engine idle condition can be diagnosed, in most instances, by the fact that the idle mixture needle(s) must be nearly, or completely seated in order to obtain a relatively smooth engine idle condition. If power valve leakage is suspected, the following test procedure must be performed.

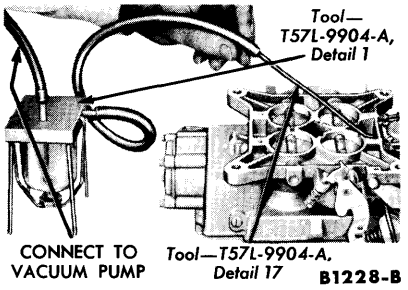



**FIG. 2—Typical Ford 4-Barrel Dual Carburetor Power Valve Test**

**1.** Remove the carburetor from the intake manifold. Invert the carburetor.

**2.** Remove the glass bowl from the fixture (Fig. 2). Fill the bowl half-full of water. Install the bowl on the fixture.

**3.** Connect a line from the vacuum pump to the fitting on top of the fixture. Insert the large OD end of the wand into the tube and attach the other end of the tube to the fitting on the side of the fixture. Slip the rubber gasket (furnished with the tool) over the small OD end of the wand. Hold this end against the power valve vacuum pick-up port (Fig. 2).

**4.** Look for bubble formations in the water in the bowl. A continuous stream of bubbles indicates leakage through the power valve diaphragm or gasket, or the cover or gasket.

If leakage is encountered, the power valve, power valve gasket, the cover, and cover gasket should be replaced one at a time with a new part and the test repeated until the source of leakage has been found. If the source of leakage can not be found, the gasket seats are damaged and the defective parts should be replaced.

A few bubbles may be noticed immediately upon attaching the vacuum line. The bubbling should stop within approximately 15 seconds or after the air has been removed from the system. If no bubbles are seen, the power valve, gaskets and cover are sealing properly.

## CARBURETOR DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **FLOODING OR LEAKING CARBURETOR** | Cracked carburetor body.<br>Defective main body and/or fuel bowl gasket.<br>High fuel level or float setting.<br>Fuel inlet needle not seating properly or worn needle and/or seat. | Ruptured accelerating pump diaphragm.<br>Excessive fuel pump pressure.<br>Defective power valve gasket.<br>Ruptured power valve diaphragm. |
| **HARD STARTING** | Improper starting procedure causing a flooded engine.<br>Improper carburetor fuel level.<br>Improper idle adjustments.<br>Sticking or incorrectly seating fuel inlet needle.<br>Incorrect fuel pump pressure.<br>Improper carburetor gasket and spacer combination. | Incorrect setting of choke thermostatic spring housing.<br>Choke linkage or plate binding.<br>Binding or broken manual choke linkage (223 Six only).<br>Restrictions or air leaks in the choke vacuum or hot air passages.<br>Dirty air cleaner element. |
| **STALLING (ENGINE HOT OR COLD)** | Incorrect idle fuel mixture.<br>Engine idle speed too slow (fast or cold idle adjustments).<br>Dirt, water or ice in fuel filter.<br>Positive crankcase ventilation system malfunctioning.<br>Fuel lines restricted or leaking air.<br>Fuel tank vent restricted.<br>Leaking intake manifold or carburetor gaskets.<br>Carburetor icing (cold, wet or humid weather). | Incorrect throttle linkage adjustment to carburetor.<br>Clogged air bleeds or idle passages.<br>Defective fuel pump.<br>**Hot Only:**<br>Improperly adjusted or defective carburetor dashpot.<br>Idle compensator malfunctioning.<br>Coolant control thermostat defective.<br>Excessive looseness of throttle shaft in bore(s) of throttle body. |

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**CARBURETOR DIAGNOSIS GUIDE—Continued**

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|---|---|
| **ROUGH IDLE** | Positive crankcase ventilation system malfunctioning.<br>Incorrect idle mixture adjustment.<br>Idle compensator malfunction.<br>Idle adjusting needle(s) grooved, worn, or otherwise damaged.<br>Idle air bleeds restricted.<br>Idle air or fuel passages restricted.<br>Idle discharge holes restricted.<br>Idle discharge holes not in proper relation to throttle plate(s).<br>Excessive dirt in air cleaner.<br>High or low fuel level or float setting.<br>Fuel inlet needle not seating properly, or worn needle or seat.<br>Power valve leaking.<br>Restricted air bleeds.<br>Plugged idle fuel channel restrictor.<br>Worn or damaged main metering jet.<br>Accelerating pump discharge ball check and/or weight not seating properly.<br>Fuel pump pressure too low, or excessive.<br>Fuel siphoning from secondary main fuel system (Ford 4-Barrel).<br>Restriction in main fuel passage. |
| **POOR ACCELERATION** | Poor acceleration complaints fall under one of three headings: the engine is sluggish on acceleration, the engine stalls when accelerated, or the engine hesitates or develops a flat spot when accelerated. Poor acceleration is caused by either an excessively lean or rich mixture on acceleration. |
| **A LEAN MIXTURE ON ACCELERATION** | Low fuel pump pressure.<br>Sticking fuel inlet needle.<br>Low fuel level or float setting.<br>Restriction in main fuel passage.<br>Air leak between the carburetor and the manifold caused by loose mounting bolts or defective gasket.<br>Air leak at the throttle shaft caused by a worn throttle shaft.<br>Accelerating pump diaphragm defective.<br>Incorrect accelerating pump stroke adjustment.<br>Accelerating pump fuel inlet valve not seating on acceleration.<br>Restriction in the accelerating pump discharge passage.<br>Accelerating pump discharge ball check or weight not coming fully off its seat, or failing to seat properly on the reverse stroke of the pump diaphragm.<br>Air leak at the accelerating pump cover caused by a defective gasket or warped pump cover.<br>Defective secondary diaphragm.<br>Air leak where secondary vacuum pick-up tube fits into air horn, between air horn and main body, or between the secondary diaphragm housing cover and housing.<br>Secondary throttle plates wedged in barrels.<br>Bent secondary throttle shaft.<br>Secondary throttle plates operating rod binding, or disconnected from secondary diaphragm or secondary throttle lever.<br>Secondary vacuum passage ball check stuck on its seat.<br>Secondary vacuum probe restricted or not properly positioned.<br>Weak power valve spring. |
| **A RICH MIXTURE ON ACCELERATION** | Excessive fuel pump pressure.<br>High fuel level or float setting.<br>Fuel inlet needle not seating properly or worn needle and/or seat.<br>Malfunctioning automatic choke.<br>Excessive dirty air cleaner.<br>Incorrect accelerating pump stroke adjustment.<br>Power valve leakage.<br>Restricted air bleeds.<br>Worn or damaged main metering jet.<br>Accelerating pump ball check and/or weight not seating properly. |
| **INCONSISTENT ENGINE IDLE SPEED** | Fast idle screw contacting low step of cam at curb idle.<br>Incorrect throttle linkage adjustment to carburetor.<br>Binding or sticking throttle linkage or accelerator pedal.<br>Sticking carburetor throttle shaft.<br>Excessive looseness of throttle shaft in bores of throttle body.<br>Improperly adjusted or defective carburetor dashpot.<br>Incorrectly installed throttle plates.<br>Idle compensator malfunctioning.<br>Positive crankcase ventilation system malfunctioning.<br>Sticking fuel inlet needle.<br>Defective spark valve or gasket (223 Six only). |

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**CARBURETOR DIAGNOSIS GUIDE—Continued**

| | | |
|---|---|---|
| **AUTOMATIC CHOKE SLOW WARM-UP, ON TOO OFTEN** | Thermostatic choke setting too rich.<br>Choke linkage sticking or binding.<br>Incorrect choke linkage adjustment.<br>Choke plate misaligned or binding | in air horn.<br>Defective coolant thermostat.<br>Restricted coolant line at carburetor.<br>Restriction or air leak in the choke vacuum or hot air passage. |
| **SEVERE TRANSMISSION ENGAGEMENT AFTER COLD ENGINE START** | Carburetor fast idle speed setting too high.<br>Throttle operating on starting step | (highest step) of fast idle cam.<br>Binding or sticking throttle linkage or accelerator pedal. |
| **SURGING (CRUISING SPEEDS TO TOP SPEEDS)** | Clogged main jets.<br>Improper size main jets.<br>Low fuel level or float setting.<br>Low fuel pump pressure volume.<br>Clogged filter screen. | Distributor vacuum passage clogged.<br>Defective spark valve or gasket (223 Six only). |
| **REDUCED TOP SPEED** | Float setting too high or too low.<br>Fuel pump pressure or volume too high or too low.<br>Improper size or obstructed main jets.<br>Faulty choke operation.<br>Improper throttle linkage adjustment.<br>Air leak where secondary vacuum pick-up tube fits into air horn and main body, or between the secondary | diaphragm housing cover and housing.<br>Secondary diaphragm return spring too stiff.<br>Secondary throttle plates wedged in barrels.<br>Bent secondary throttle shaft.<br>Secondary throttle plate operating rod binding.<br>Secondary vacuum passage ball check sticking on its seat. |

### AIR INTAKE DUCT

Proper operation of the air intake duct thermostatic valve, as used on the 289 V-8 engine, can be determined by the following test:

**1.** Place the air duct assembly in a container of cool water (below 75°F.). Be sure that the thermostat is covered by the water.

**2.** Place a thermometer in the water and observe the temperature.

**3.** With water temperature at 75°F. or below, the valve should be in the heat-on position.

**4.** Using a hot plate or other suitable device, heat the water slowly.

**5.** When the water temperature reaches 85°F., the valve should start to open. **If the valve does not start to open at this time, stabilize the water temperature at 85°F. for eight minutes before condemning the unit.**

**6.** When the water temperature reaches 100°F. or higher, the valve should be in the full heat-off position.

**7.** If the operation of the valve is unsatisfactory, remove the thermostat and spring assembly and check the valve plate shaft for binding.

**8. If the valve plate moves freely,** replace the thermostat and spring assembly. Retest the heat-on and the heat-off temperatures.

**9.** If the valve does not operate correctly, adjust the thermostat rod. By increasing the rod length, the valve plate will be moved toward the heat-off position. By decreasing the rod length the valve plate will be moved toward the heat-on position.

## 2 COMMON ADJUSTMENTS AND REPAIRS

### FORD SINGLE-BARREL CARBURETOR BENCH ADJUSTMENTS

All carburetor adjustments, except the Final Hot Engine Idle and Fuel Mixture Adjustments and the Throttle Linkage Adjustments can be performed prior to installing the carburetor on the car. Refer to Part 10-2, Section 2, "In-Car Adjustments and Repairs" for the proper carburetor adjustment procedures.

### FORD DUAL AND 4-BARREL CARBURETOR BENCH ADJUSTMENTS

The fuel level float adjustment (dry) and the secondary throttle plate adjustments (4-barrel carburetor) are performed only as bench adjustments.

The automatic choke plate clearance (pull-down) adjustment, automatic choke magnet and bracket adjustment (if so equipped) automatic choke housing adjustment, and the accelerating pump stroke adjustment can be performed with the carburetor on the bench or in the car. Refer to "In-Car Adjustments and Repairs" in Part 10-3, for the Ford Dual Carburetor adjustment procedures or refer to "In-Car Adjustments and Repairs" Part 10-4, for the Ford 4-Barrel procedures.

### FLOAT ADJUSTMENT (DRY)– FORD DUAL AND 4-BARREL CARBURETORS

The dry float fuel level adjustment is a preliminary adjustment only. The final fuel level (wet) adjustment must be performed after the carburetor is mounted on the engine, as follows:

1. Remove the air horn.

2. With the float raised and the fuel inlet needle seated, check the distance between the top surface of the main body and the top surface of the float for conformance to specifications. Take this measurement at a point ⅛ inch from the free end of the float and 5/16 inch in from the side of the float adjacent to the inside wall of the fuel bowl. If the cardboard gauge is used, place the float gauge in the corner of the enlarged end section of the fuel bowl (Fig. 3). The gauge should touch the float near the end, but not on the end radius. Depress the float tab to seat the fuel inlet needle. The float height is measured from the gasket surface of the main body with the gasket removed. If necessary, bend the tab on the float to bring the setting within the specified limits. This should provide the proper fuel level.

### SECONDARY THROTTLE PLATE ADJUSTMENT– 4-BARREL CARBURETOR

1. Hold the secondary throttle plates closed.

2. Turn the secondary throttle shaft lever adjusting screw out (counterclockwise) until the secondary throttle plates stick in the throttle bores (Fig. 4).

3. Turn the screw in (clockwise) until the screw just contacts the secondary lever.

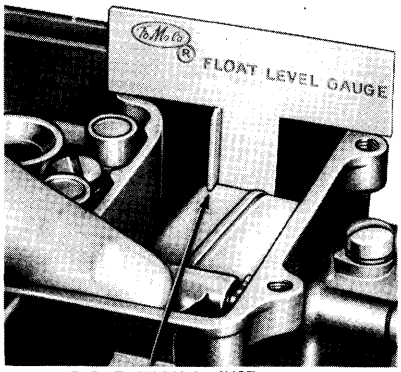



**FIG. 3—Typical Fuel Level Float Adjustment—Dry**

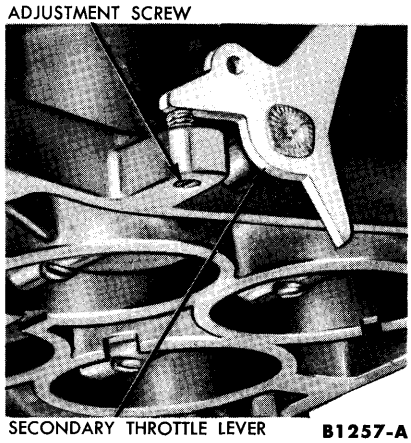



**FIG. 4—Secondary Throttle Plate Adjustment**

4. Finally, turn the screw ¾ turn clockwise for the correct setting.

### FUEL FILTER REPLACEMENT

The fuel filters for the 223 Six Conventional car, and the 289 V-8, 352 V-8, and the 390 V-8 are integrally mounted on the fuel pump.

The Taxi Special and Police Special Six engines, and the 427 V-8 engines use an in-line fuel filter that is located between the fuel pump and the carburetor.

Replace the filter element (Figs. 5 and 6) if it becomes clogged, and also at the recommended maintenance mileage interval.

### MAINTENANCE

Refer to Group 19 for the recommended maintenance mileage interval.

### FILTER REPLACEMENT

1. Unscrew the filter housing

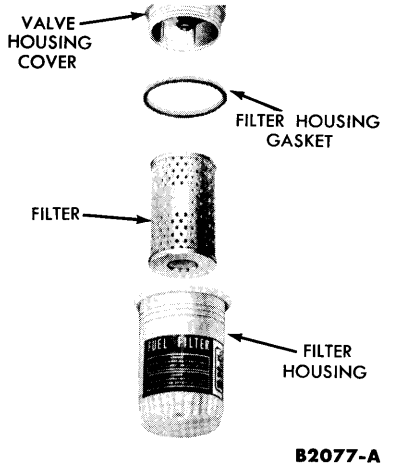



**FIG. 5—Typical Integral Fuel Filter Assembly**

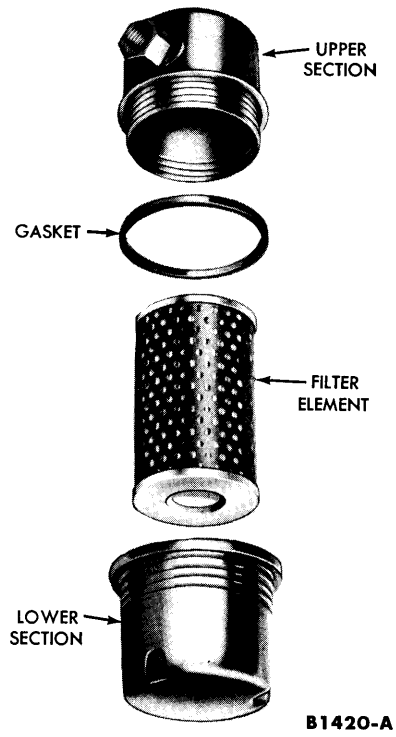



**FIG. 6—Typical In-Line Fuel Filter**

from the fuel pump, if so equipped (Fig. 5), or the upper section of the in-line fuel filter body (Fig. 6). Remove the filter element and gasket. Discard the element and gasket. Clean the filter housing in cleaning solvent.

2. Place a new filter element over the spout in the fuel pump valve housing cover (Fig. 5). Coat a new gasket with light engine oil and position the gasket on the filter housing. Screw the filter housing on the fuel pump. Hand-tighten the filter housing until the gasket contacts the pump, then advance it ⅛ turn.

3. Start the engine and check for leaks.

### AIR INTAKE DUCT ADJUSTMENT

The air intake duct thermostatic valve, is used on the 289 V-8 Engine, can be adjusted to change the air temperature at which the valve opens. Increasing the thermostatic rod length will move the valve toward the heat-off position. Decreasing the rod length will move the valve toward the heat-on position. Adjustments must be verified by testing the opening temperature as detailed in Section 1.

## 3 CLEANING AND INSPECTION

### CARBURETOR

Dirt, gum, water or carbon contamination in the carburetor or the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection of only those parts not included in the carburetor overhaul repair kit are covered here. All gaskets and parts included in the repair kit should be installed when the carburetor is assembled and the old gaskets and parts should be discarded.

Wash all the carburetor parts (except the accelerating pump diaphragm, the power valve or power valve diaphragm, the secondary operating diaphragm, and the anti-stall dashpot assembly) in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, lacquer thinner or denatured alcohol may be used.

Rinse the parts in kerosene to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that can not be immersed in solvent with a clean, soft, dry cloth. Be sure all dirt, gum, carbon, and other foreign matter are removed from all parts.

Force compressed air through all passages of the carburetor. **Do not use a wire brush to clean any parts or a drill or wire to clean out any openings or passages in the carburetor.** A drill or wire may enlarge the hole or passage, changing the calibration of the carburetor.

Check the choke shaft for grooves, wear, and excessive looseness or binding. Inspect the choke plate for nicked edges and for ease of operation and free it if necessary.

Check the throttle shafts in their bores for excessive looseness or binding and check the throttle plates for burrs which prevent proper closure.

Inspect the main body, air horn, nozzle bars and booster venturi assemblies, choke housing and thermostatic spring housing, power valve cover, accelerating pump cover, secondary operating diaphragm cover and the main body for cracks.

Check the floats for leaks by holding them under water that has been heated to just below the boiling point. Bubbles will appear if there is a leak. If a float leaks, replace it. Replace the float if the arm needle contact surface is grooved. If the floats are serviceable, polish the needle contact surface of the arm. Replace the float shafts if they are worn.

Replace all screws and nuts that have stripped threads. Replace all distorted or broken springs.

Inspect all gasket mating surfaces for nicks and burrs. Repair or replace any parts that have a damaged gasket surface.

Inspect the idle tubes in each nozzle bar assembly. If they are plugged, bent, or broken, replace the booster venturi and nozzle bar assembly.

Inspect the rubber boot of the anti-stall dashpot for proper installation in the groove of the stem bushing. Check the stem movement for smooth operation. Do not lubricate the stem. Replace the assembly if it is defective.

### FUEL PUMP

Clean the fuel pump body, valve housing, cover, and filter housing in solvent. Blow out all body, housing, and cover passages. Inspect the pump body, valve housing, and cover for cracks or damage and replace them if necessary. If the fuel valves are not serviceable and replacement is necessary, replace the valve housing and valves as an assembly. Inspect the mounting flange for distortion. Remove the pump body or lap the distorted flange if necessary.

### AIR CLEANER—DRY TYPE

#### MAINTENANCE

Refer to Group 19 for the recommended air cleaner assembly maintenance mileage interval.

#### REMOVAL AND INSTALLATION

Refer to Part 10-3, Section 2 for the air cleaner assembly removal and installation procedures.

#### FILTER ELEMENT

**The filter element must never be cleaned with a solvent or cleaning solution. Also, oil must not be added to the surfaces of the filter element or air cleaner body.**

There are two alternate procedures that can be used to clean the air filter element. One method is performed with the use of compressed air. The other is performed by tapping the element on a smooth horizontal surface.

**Compressed Air Method.** Direct a stream of compressed air through the element in the direction opposite that of the intake air flow, that is from the inside outward. **Extreme care must be exercised to prevent rupture of the element material.**

**Tapping Method.** Hold the element in a vertical position and tap it lightly against a smooth, horizontal surface to shake the dust and dirt out. **Do no deform the element or damage the gasket surfaces by tapping too hard.** Rotate the filter after each tap until the entire outer surface has been cleaned.

**Inspection.** Hold the filter in front of a back-up light and carefully inspect it for any splits or cracks. If the filter is split or cracked, replace it.

#### BODY AND COVER

Clean the air cleaner body and the cover with a solvent or compressed air. Wipe the air cleaner dry if a solvent is used. Inspect the air cleaner body and cover for distortion or damage at the gasket mating surfaces. Replace the cover or body if they are damaged beyond repair.

### AIR CLEANER—OIL BATH TYPE

#### MAINTENANCE

Refer to Group 19 for the recommended air cleaner maintenance mileage interval.

#### CLEANING

Drain the air cleaner reservoir. Wash the air cleaner components in a suitable cleaning solvent and dry them with compressed air. Saturate the filter with engine oil. Fill the oil reservoir to the indicated level with recommended viscosity engine oil.

# PART 10-2 FORD SINGLE-BARREL CARBURETOR


| Section | Page | Section | Page |
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| 1 Description and Operation | 10- 8 | 3 Removal and Installation | 10-15 |
| 2 In-Car Adjustments and Repairs | 10-13 | 4 Major Repair Operations | 10-16 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

The Ford single-barrel carburetor is used on the conventional Mileage Maker Six, the Mileage Maker Six Police Special and Taxi Special engine (Fig. 1).

The carburetor consists of two main assemblies, the main (upper) body and the throttle (lower) body.

The upper body assembly contains the major metering components of the carburetor: the main and idle fuel system, the power valve, float chamber vent, and the fuel inlet system.

The lower body assembly contains: the fuel bowl, the accelerating pump assembly, the idle mixture adjusting screw, and the spark valve. A hydraulic dashpot is also included in the lower body for use on car models that are equipped with an automatic transmission.

A manual choke system is standard equipment on all car models.

This section applies to all carburetors. Differences in carburetor operation are given when they exist.

### OPERATION

The engine speed is regulated and controlled by the proportion of fuel and air delivered to the cylinders for all engine operating conditions. Operation is based on the principle of pressure differences or "vacuum".

Air is drawn into the carburetor air horn by manifold vacuum. As the air passes through the carburetor on its way to enter the cylinders, lower pressure is created at the fuel discharge outlets of the carburetor. The fuel bowl is vented to atmospheric and to carburetor air inlet pressure through a vent hole in the upper body assembly. The higher air pressure exerted on the fuel in the bowl forces the fuel to travel up through the fuel discharge channels and out into the air stream passing through the carburetor. The fuel and air is mixed at this point and distributed into the engine cylinders for burning.

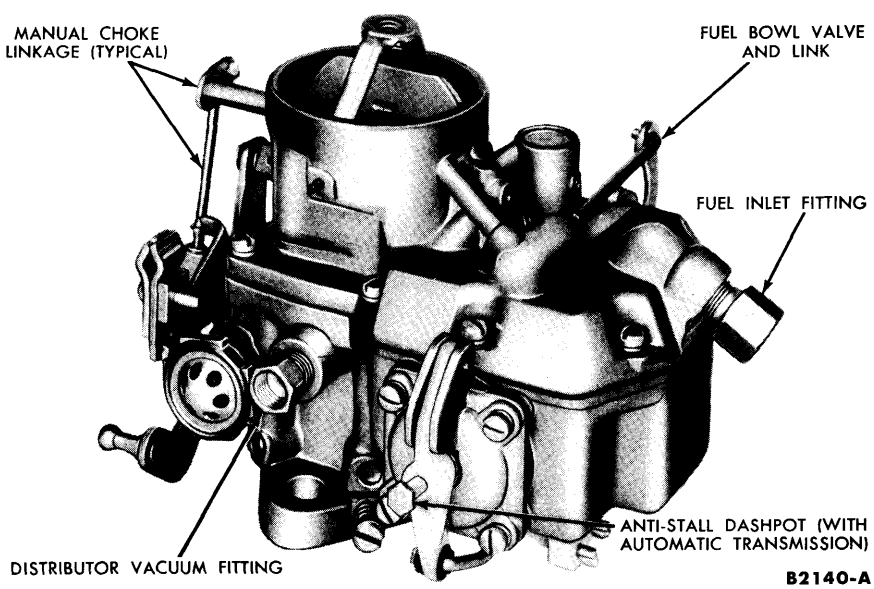



**FIG. 1—Ford Single-Barrel Carburetor**

### FUEL INLET SYSTEM

The fuel inlet system (Fig. 2) of the carburetor maintains a predetermined fuel level in the fuel bowl. **The fuel level in the bowl is extremely important to carburetor calibration.** If the level of the fuel in the bowl is below the specified setting, a lean fuel-air mixture will result. A rich fuel-air mixture will occur from a higher than specified fuel level. The entire calibration of the carburetor is disturbed if the fuel level is not set as specified.

Fuel enters the fuel bowl through the fuel needle valve and seat assembly. The amount of fuel entering is regulated by the distance the needle valve is moved off the seat and by fuel pump pressure. **Correct fuel pump pressure is important if the carburetor fuel level is to be maintained within the specified limits.**

The fuel level is maintained at a predetermined level by the float and lever assembly which controls the movement of the needle valve. The needle valve, riding on the tab of the float and lever assembly, reacts to any change in height of the float and the fuel level.

### IDLE FUEL SYSTEM

The idle system (Fig. 3) functions when the engine is operating at low rpm. It supplies the fuel-air mixture when the air flow past the carburetor

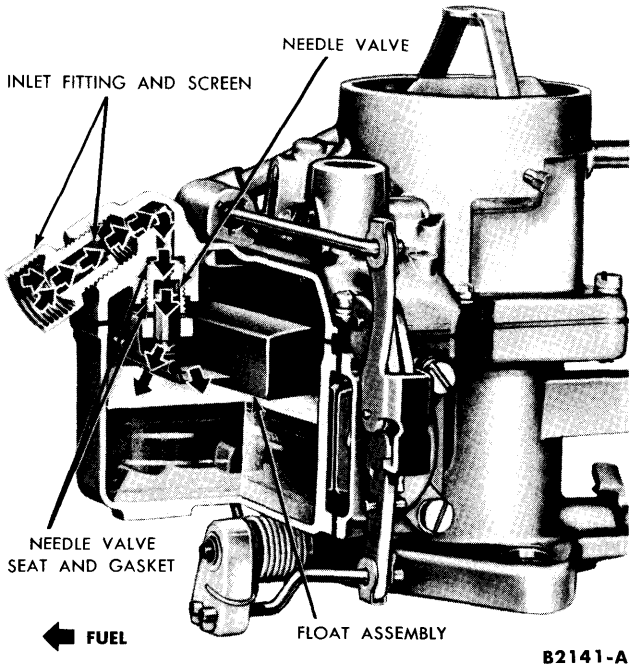



**FIG. 2—Fuel Inlet System**

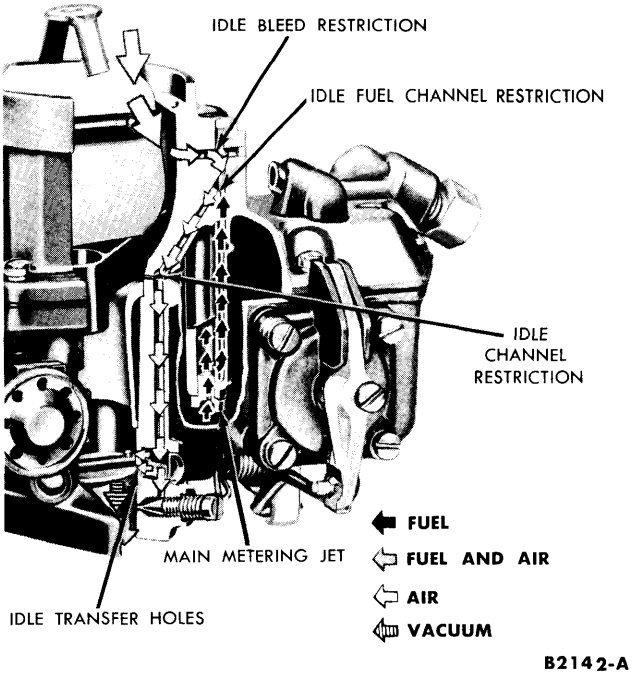



**FIG. 3—Idle Fuel System**

venturi is insufficient to operate the main metering system.

The range of the idle system will extend into the operation of the main metering system. Fuel will flow from the main well up the idle well and through the calibrated idle jet. Filtered air from the carburetor air horn enters the idle air bleed restriction and mixes with the fuel. The air bleed restriction also serves as a vent to prevent syphoning of fuel at high speeds or when the engine is shut off. The fuel-air mixture then passes down through an idle channel restriction and is transferred to the idle channel in the lower body assembly.

The fuel air mixture passes down the idle channel, past two idle transfer holes, to the idle mixture adjusting screw. The idle transfer holes act as additional air bleeds at normal idle. The fuel air mixture flows past the idle adjusting screw needle and seat and is discharged below the throttle plate. The amount of mixture to be discharged is determined by the position of the idle screw needle in relation to the seat in the lower body passage.

During off-idle operation, when the throttle plate is moved past the idle transfer holes, each hole begins discharging fuel as it is exposed to the lower air pressure (manifold vacuum). Continued opening of the throttle plate increases engine rpm and air flow through the carburetor. The greater air flow past the booster venturi causes a pressure drop in the venturi great enough to bring the main fuel metering system into operation as the idle fuel metering system tapers off.

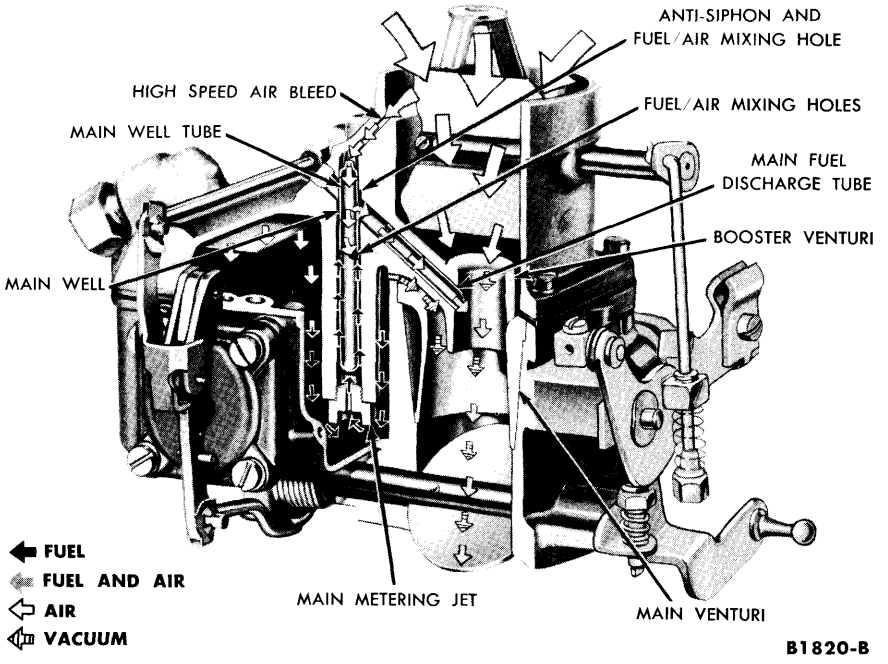



**FIG. 4—Main Metering System**

## MAIN FUEL METERING SYSTEM

The main fuel metering system (Fig. 4) supplies the fuel required for engine operation during the cruise or part-throttle range. The system begins to function when the air flow through the carburetor venturi creates a sufficient vacuum to start fuel flowing in the main system. The vacuum at the discharge nozzle will increase

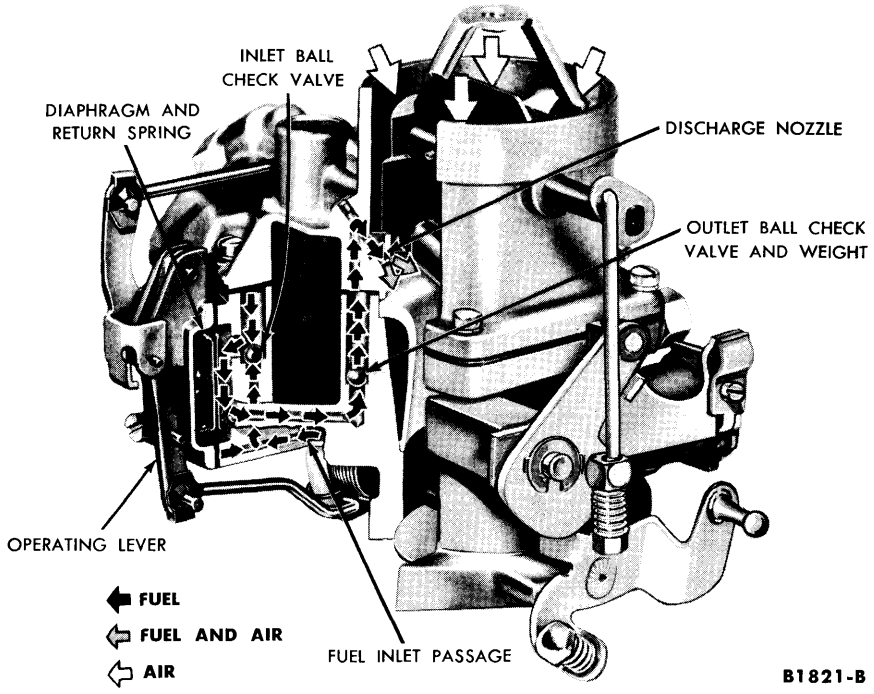



**FIG. 5—Accelerating Pump System**

as the air flow increases. The faster the engine operates, the more fuel will flow through the main fuel system.

Fuel entering the main jet, located at the bottom of the main well, flows up toward the main nozzle. A main well tube is inserted within the main well. Air from the high speed bleed channel enters the main well tube through a calibrated restriction at the top of the tube. The air passes through holes spaced along the tube, mixing with the fuel flowing up the main well. The fuel and air mixture being lighter than solid fuel, responds faster to changes in venturi pressures. The mixture continues flowing up the main well to the anti-syphon bleed. More air is introduced at the anti-syphon bleed to the fuel and air mixture which is then discharged from the main nozzle. The fuel is mixed with the filtered air moving past and through the booster venturi.

The anti-syphon bleed also acts as a vent to prevent syphoning of fuel at low engine speeds.

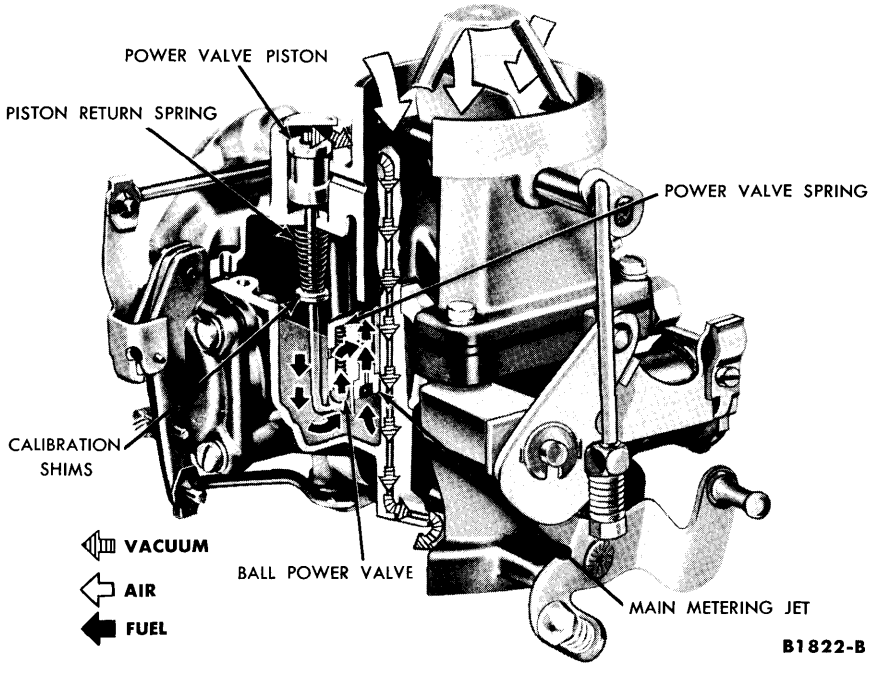



**FIG. 6—Power Valve and Fuel Enrichment System**

## ACCELERATING PUMP SYSTEM

Smooth acceleration requires a momentary increase in the supply of fuel. The air flow through the carburetor responds almost immediately to any increase in carburetor throttle valve opening. The fuel within the metering passages will lag momentarily in its response to the pressure difference created by this increased air flow. This lag in fuel response will cause a temporary leanness in the fuel-air mixture that results in a hesitation in engine acceleration. A mechanically operated accelerating pump system (Fig. 5) supplies added fuel to provide a richer fuel-air mixture for this brief period of time.

The accelerating pump, located on the side of the lower body assembly, is actuated by linkage connected to the throttle shaft. When the throttle is opened on acceleration, the diaphragm forces fuel from the accelerating pump chamber into the discharge channel. The inlet ball check closes to prevent a reverse flow of fuel. Fuel under pressure forces the discharge ball check and the weight off its seat, allowing fuel to pass up to the discharge nozzle. The fuel is sprayed from the nozzle into the air stream above the main venturi.

When the throttle plate is closed on deceleration, a return spring forces the diaphragm back, drawing fuel through the inlet channel. The inlet ball check opens, allowing fuel to pass into the chamber while the discharge ball check closes preventing entry of air. A bleed hole is located in the body casting to allow vapor and excess pressure to escape from the diaphragm chamber.

## POWER FUEL SYSTEM

When the engine is required to deliver more power to meet an increased road load demand or wide-open throttle operation, the carburetor must deliver a richer fuel-air mixture than supplied during the operation of the main fuel system at cruise or part throttle operation.

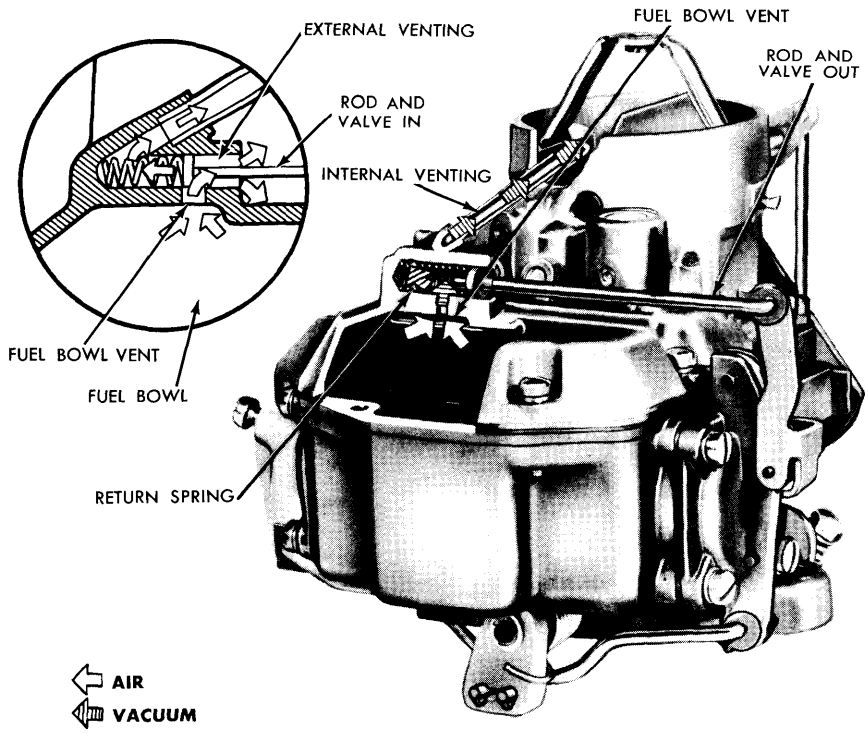



**FIG. 7–Fuel Bowl Venting System**

When the engine is running under a high power demand, intake manifold vacuum is low. The vacuum below the carburetor throttle plate approximates intake manifold vacuum. The carburetor power valve (Fig. 6) will open when the manifold vacuum drops below a predetermined value. The fuel-air mixture is thus automatically enriched to meet the increased engine power demands.

Manifold vacuum is transmitted from an opening below the throttle plate through a channel to the upper body assembly and to the top of the power valve piston. At idle and normal engine speeds, the manifold vacuum is great enough to hold the power valve piston up.

The power valve rod is connected to the piston. The foot of the rod controls the spring - loaded power valve ball check. With the piston held up by manifold vacuum, the ball check closes the power jet inlet channel.

A power valve spring is located on the rod. The spring is shim calibrated to overcome the vacuum above the piston when manifold vacuum drops below a predetermined level. Upon demand for more power, the manifold vacuum drops below this level. The spring tension moves the rod down and allows the power valve ball check to open. Air pressure above the fuel bowl forces fuel to flow through the power jet, adding to fuel in the main fuel system, enriching the fuel-air mixture.

As the demand for power decreases and manifold vacuum increases, the vacuum above the piston overcomes the spring tension. The piston and rod move up and the ball check closes the power jet channel.

## MANUAL CHOKE SYSTEM

The choke plate, located in the air horn above the venturi, when closed provides a high vacuum above as well as below the throttle plate. With a vacuum above the throttle plate, fuel will flow from the main fuel system as well as from the idle fuel system. This provides the extremely rich mixture necessary for cold engine operation.

A rod connects the choke cam and lever to the choke shaft through a spring and a spring tension adjusting nut.

When the choke cam and lever is pulled to a full choke position by the choke cable, the pull-down rod actuates the choke plate through the spring and adjusting nut.

As soon as the engine starts, engine vacuum will partially open the choke plate against pull-down spring tension (the distance present after the initial choke pull-down adjustment) to prevent flooding and engine stalling.

During cold engine starting and the engine warm-up period, the choke plate must be adjusted manually through the choke cable to control the fuel richness for satisfactory engine operation. The choke cable is pushed in as choking requirements are reduced. The choke system is not required after the engine reaches normal operating temperatures and the fuel-air mixture must be returned to normal.

The idle adjusting screw bears against the bottom of the choke cam and lever during idle or closed throttle conditions. The choke cam and lever opens the throttle slightly, through contact of the idle adjusting screw with the cam (when properly adjusted), as the manual choke position is selected. Higher engine idle speeds are automatically provided through contact of the idle adjusting screw with the cam.

## FUEL BOWL VENT SYSTEM

The fuel bowl requires venting (Fig. 7) to provide proper operation for the various systems. Fuel vapors may form in the fuel bowl when a hot engine is stopped, idling, or operating at very low speeds. By venting the fuel bowl to the atmosphere by means of a vent control valve, engine performance is improved. At higher engine speeds, venting to the carburetor air horn prevents calibration changes due to normal air cleaner contamination.

The restriction of air due to air cleaner contamination causes a pressure drop in the carburetor air horn, and a richer air-fuel mixture. The pressure drop will increase as the demand for air (engine speed) is increased.

On all carburetors a valve connected through linkage to the throttle shaft and located in a bore over the fuel bowl, is at the inward position during closed or part throttle operation. In this position, the valve allows venting only to the atmosphere.

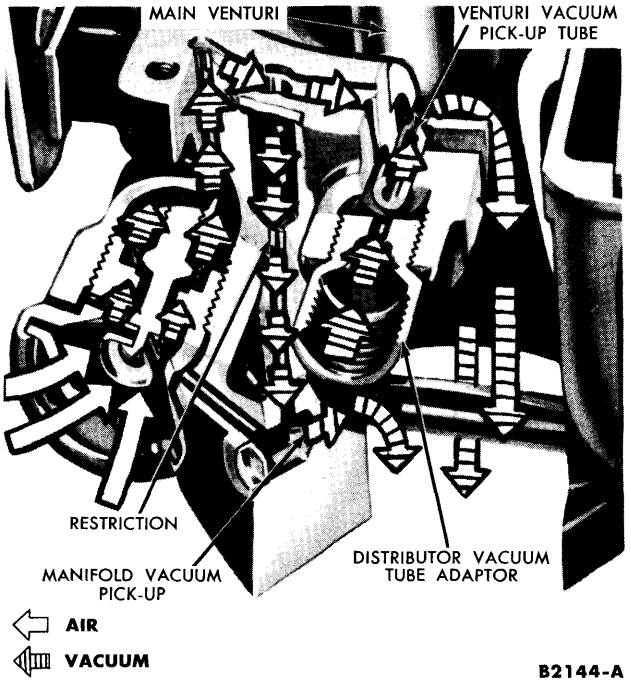



**FIG. 8—Spark (Distributor Vacuum) Control System**

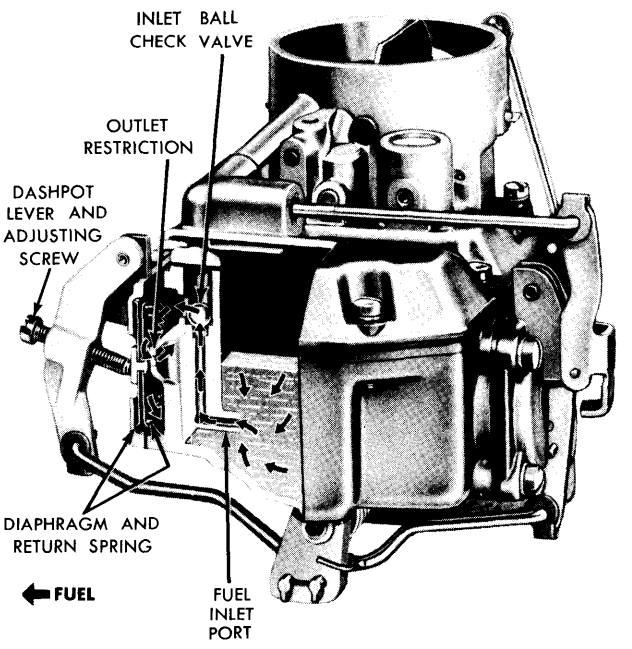



**FIG. 9—Anti-Stall Dashpot**

At normal or wide-open throttle operation, the rod moves outward sealing the external vent and opening the vent to the carburetor throat.

## SPARK (DISTRIBUTOR VACUUM) CONTROL SYSTEM

The degree of spark advance in the distributor is determined by the strength of the vacuum acting on the distributor diaphragm. A high vacuum will increase spark advance. The carburetor is calibrated to provide the required vacuum to the distributor through an interaction of venturi vacuum and manifold vacuum. Venturi vacuum is obtained through the pickup tube in the main venturi and is supplied to the distributor only when it exceeds manifold vacuum (Fig. 8).

Manifold vacuum supplied to the distributor, is obtained from a pickup hole at the throttle plate edge (when the throttle is closed) and metered to the distributor. An additional passage is always open to manifold vacuum. The purpose of the additional passage is to provide a higher spark advance at closed throttle during deceleration to promote complete burning of the fuel and greater efficiency. Metering of the manifold vacuum to the distributor is accomplished through the use of the spark valve and restrictors in the vacuum channels. The spark valve is held open through the combination of vacuum and atmospheric pressure acting on the spark valve diaphragm to overcome the tension of a calibrated spring in the spark valve. Calibrated restrictors in the manifold vacuum channels limit the flow of manifold vacuum to the distributor. Also, during low manifold vacuum periods, the bypass restrictor controls the reduction of venturi vacuum caused by bleed back.

At off-idle engine speeds, vacuum at the throttle edge is high due to a venturi effect created by the position of the throttle plate in the throttle bore. The high vacuum in this area is supplied to the distributor through the manifold vacuum channels for the required increase in spark advance.

Upon acceleration and under wide-open throttle operation, manifold vacuum drops. When the manifold vacuum falls below a predetermined point, the spark valve closes, shutting off the manifold vacuum to the distributor. The drop in distributor vacuum retards the spark advance. Venturi vacuum, now greater than manifold vacuum, supplies vacuum to the distributor, thus preventing a full spark retard.

As the engine load demands decrease, the increase in manifold vacuum will become greater than venturi vacuum. The increased manifold vacuum opens the spark valve and the higher vacuum now supplied to the distributor increases the spark advance for more efficient engine operation.

## DASHPOT SYSTEM

The low idle rpm setting on automatic transmission equipped units requires a means of control to prevent engine stall upon sudden closing of the throttle plate. This is accomplished by hydraulic dampening of the throttle closing rate.

The dashpot, located on the side of the fuel bowl, is actuated by linkage connected to the throttle shaft (Fig. 9). When the throttle is opened, a return spring forces the diaphragm back, drawing fuel through the inlet channel. The inlet ball check opens, allowing fuel to flow into the dashpot chamber.

When the throttle plate is closed, the dashpot actuating lever and adjusting screw moves the diaphragm inward. The diaphragm moving inward seats the inlet ball check, closes the inlet channel and forces fuel through a restriction into the fuel outlet channel into the bowl. The discharge restriction limits the flow of fuel and slows the closing of the throttle plate.

## 2 IN-CAR ADJUSTMENT AND REPAIR

The final idle speed and fuel mixture adjustments, and the throttle linkage adjustments can be performed only with the carburetor installed on the engine.

The procedures for adjusting the carburetor float, accelerating pump, anti-stall dashpot, vent valve, manual choke, initial idle mixture, and the initial curb idle speed can be performed with the carburetor on the bench or in the car.

### IDLE FUEL MIXTURE AND IDLE SPEED ADJUSTMENTS

The engine idle speed is adjusted to settings for a hot engine and a cold engine (fast idle speed). Make the idle and fuel mixture adjustments in the sequence listed.

### INITIAL IDLE MIXTURE SETTING

If necessary, initially set the idle mixture by turning the idle mixture screw inward (clockwise) until it is lightly seated (Fig. 10); then turn the screw outward (counterclockwise) the specified number of turns. **Do not turn the screw needle tightly against its seat as this may groove the end. If the needle is damaged, it must be replaced before a satisfactory fuel mixture can be obtained.**

### INITIAL CURB IDLE ADJUSTMENT

A stop screw at the throttle lever flange of the carburetor (Fig. 11) controls the engine idle speed. Turn the screw outward (counterclockwise) to increase the engine idle speed and inward (clockwise) to decrease the engine idle speed.

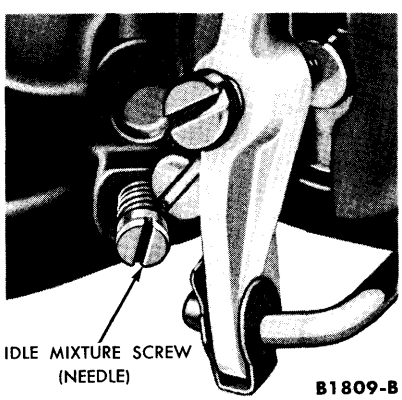



**FIG. 10—Idle Fuel Mixture Adjustment**

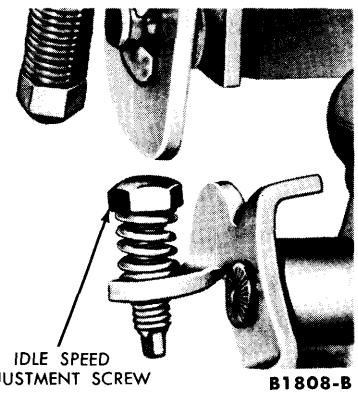



**FIG. 11—Idle Speed Adjustment**

The initial curb idle adjustment will automatically set the initial fast idle rpm required.

Position the choke control lever so that the choke plate is fully open. Seat the throttle plate in the throttle bore. **It may be necessary to back off on the dashpot adjustment screw to seat the throttle plate in the throttle bore.** Set the idle adjusting screw (Fig. 11) to just make contact with the cam contour; then turn the screw outward (counterclockwise) an additional turn.

The "Final (Hot) Engine Idle and Fuel Mixture Adjustments" provide the specified rpm required.

### FINAL (HOT) ENGINE IDLE AND FUEL MIXTURE ADJUSTMENT

**1.** Place the transmission selector lever in neutral position and set the parking brake.

**2.** Operate the engine at fast idle until the temperature has stabilized (approximately 1200 rpm for 30 minutes).

**3.** Attach a tachometer to the engine.

On a car with a manual-shift transmission, turn the idle speed "stop" screw in a direction to obtain the specified rpm. Open the throttle by hand and allow it to close normally. Recheck the engine idle speed.

On a car with an automatic transmission, **be sure the parking brake is on.** Place the transmission selector lever in neutral position. Check the engine idle speed and adjust it to the specified rpm in drive range.

Final engine idle speed may be varied to suit the conditions under which the car is to be operated.

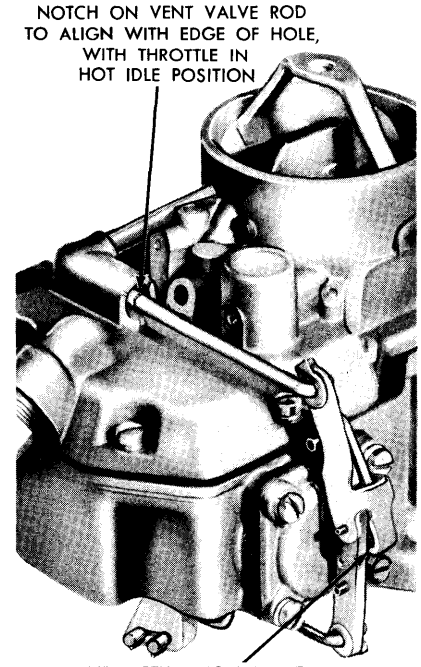



**FIG. 12—Float Bowl Vent Valve Adjustment**

**4.** Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can be checked after the mixture has been adjusted.

### IDLE MIXTURE

The idle fuel mixture is controlled by the idle mixture adjusting needle (Fig. 10). Turn the needle inward to lean the mixture, and outward to enrich the mixture.

**1.** Adjust the engine idle speed.

**2.** Make the initial mixture adjustment, if necessary, by turning the needle screw inward until it lightly seats; then back it off the specified number of turns.

**3.** Be sure the engine is at normal operating temperature.

**4.** Turn the mixture screw inward until the engine rpm begins to drop from the lean mixture. Turn the needle screw outward until the engine rpm increases and begins to drop again from the rich mixture; then turn the screw inward for maximum engine rpm and smoothness.

**Always favor a rich mixture rather than a lean mixture.**

**5.** Check the engine idle speed and adjust it, if necessary.

### VENT VALVE ADJUSTMENT

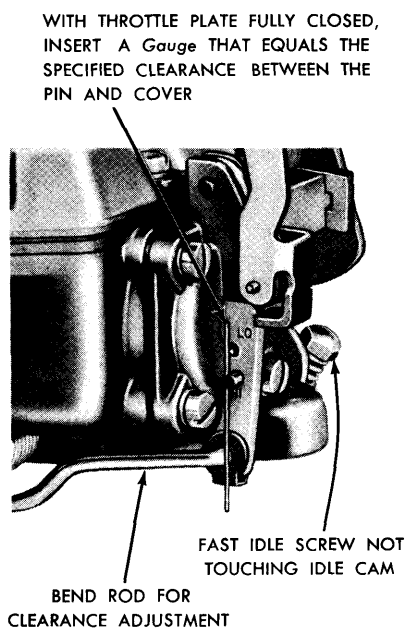
Set the throttle linkage to the hot idle position. The groove in the vent valve rod should now be even with the open end of the vent (Fig. 12). Bend the arm on the vent valve rod actuating lever (where it contacts the accelerating pump lever) to align the groove with the edge of the bore.

### ACCELERATING PUMP ADJUSTMENTS

**1.** Insert the roll pin in the lower hole ("HI") position in the lever stop hole.

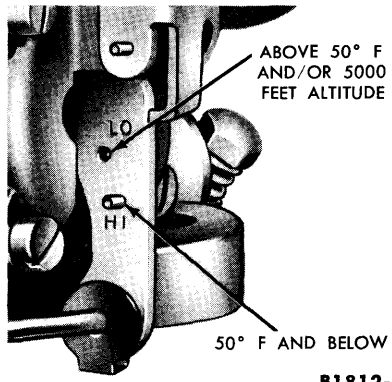
**2.** Position the throttle and choke linkage so that the throttle plate will seat in the throttle bore. Hold the throttle plates in the closed position. Position a gauge or drill of the specified thickness between the roll pin and the cover surface. Bend the accelerating pump actuating rod to obtain the specified gauge or drill clearance between the pump cover and the roll pin in the pump lever (Fig. 13).

Acceleration requirements in various climates are satisfied by controlling the amount of fuel discharged by the accelerating pump. The pump




B1811-B

**FIG. 13—Accelerating Pump Adjustment**




B1812-B

**FIG. 14—Accelerating Pump Lever Adjustment**

stroke is controlled by changing the location of the roll pin in the lever stop hole (Fig. 14).

For operation in ambient temperatures 50°F. and below, place the roll pin in the hole of the pump operating lever marked "HI" (lower hole). For best performance and economy at normal ambient temperatures and high altitude (above 50°F. and/or above 5,000 feet altitude), place the roll pin in the "LO" (upper hole) of the lever.

### ANTI-STALL DASHPOT ADJUSTMENT

**1.** Adjust the throttle position to the hot idle setting. Turn the dashpot adjusting screw outward until it is clear of the dashpot plunger assembly.

**2.** Turn the dashpot adjusting screw (Fig. 15) inward until it initially contacts the dashpot plunger assembly; then, turn the adjusting screw inward (clockwise) the specified number of turns against the dashpot diaphragm plunger assembly.

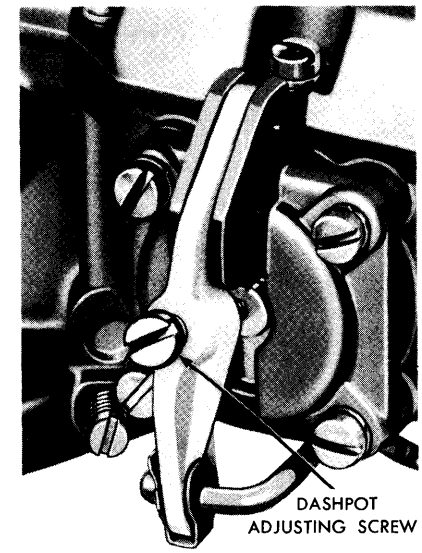
### MANUAL CHOKE (PULL-DOWN) ADJUSTMENT

Place the choke linkage in the full-choke position. Insert a drill or gauge of the specified size between the choke plate and the inside of the air horn; then while maintaining the full-choke position, adjust the choke pull-down nut to just contact the swivel on the cam lever (Fig. 16).

### FLOAT ADJUSTMENT

**1.** With the carburetor upper body and mounting gasket removed from the carburetor assembly, turn the upper-body upside down.

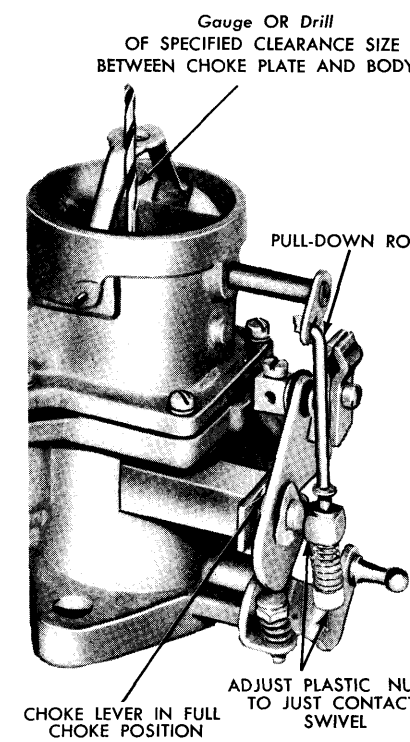
**2.** Measure the distance from the




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**FIG. 15—Anti-Stall Dashpot Adjustment**

gasket surface of the upper body to the crown (extreme top) of the float (Fig. 17). If the float adjustment is not within the specified dimension, bend the float arm tab, as necessary, to obtain the specified dimension. **Do**




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**FIG. 16—Manual Choke (Pull-Down) Adjustment**

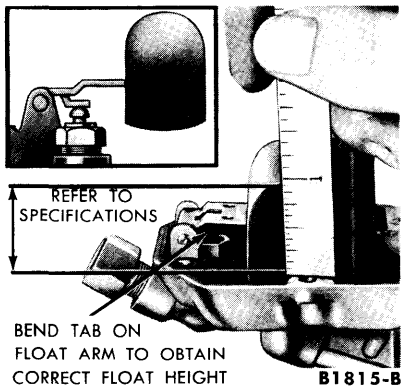



**FIG. 17—Carburetor Float Adjustment**

**not apply pressure on the fuel inlet needle. The viton tip of the fuel inlet needle may be damaged through undue pressure exerted on it and thus cause an improper fuel level within the bowl.**

### THROTTLE LINKAGE ADJUSTMENT

#### MANUAL-SHIFT TRANSMISSION

**1.** Adjust the engine idle speed to specification.

**2.** Loosen the accelerator shaft to bellcrank rod retaining nut (Fig. 18). Adjust the accelerator shaft to bellcrank rod to obtain the specified pedal height (Fig. 18). Tighten the retaining nut.

**3.** Adjust the carburetor connecting linkage, as necessary, to allow a smooth, bind-free operation.

#### OVERDRIVE TRANSMISSION

**1.** Adjust the engine idle speed to specification.

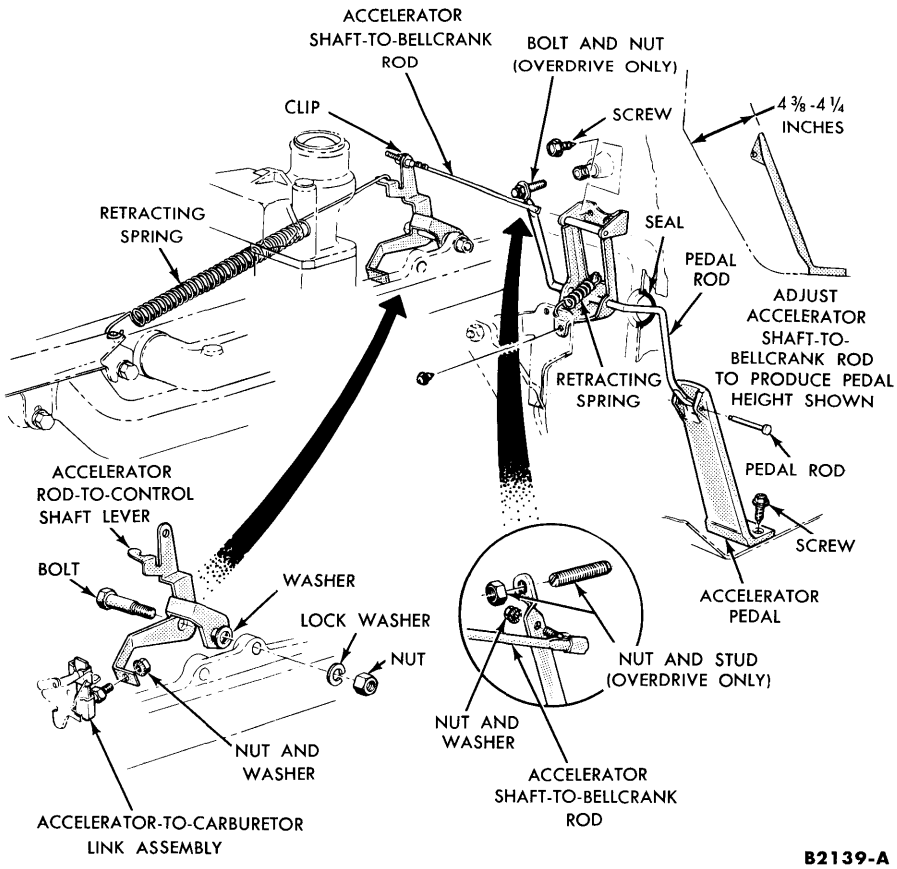



**FIG. 18—Throttle Linkage—223 Six**

**2.** Loosen the accelerator shaft to bellcrank rod retaining nut (Fig. 18). Adjust the accelerator shaft to bellcrank rod to obtain the specified pedal height (Fig. 18). Tighten the retaining nut.

**3.** With the accelerator shaft held in the full throttle position, slide the overdrive control switch up or down on the elongated slots until the accelerator shaft is just touching the switch plunger. If the switch does not touch the shaft when it is in its closest position, an adjustment (not exceeding four turns counterclockwise) may be made at the switch plunger.

**4.** Return the accelerator shaft to its normal position. Turn the switch plunger five turns counterclockwise to adjust for kickdown operation.

#### AUTOMATIC TRANSMISSION

The throttle linkage adjustments for the automatic transmissions are covered in Group 7.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

Flooding, stumble on acceleration, and other performance complaints are, in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl may then be examined for contamination as the carburetor is disassembled.

**1.** Remove the air cleaner from the air horn of the carburetor.

**2.** Disconnect the throttle shaft lever linkage, choke control cable, fuel line, and the distributor vacuum line.

**3.** Remove the carburetor and gasket from the intake manifold. Discard the gasket.

### INSTALLATION

**1.** Clean the gasket surface of the carburetor and the intake manifold. Position a new gasket on the intake manifold.

**2.** Install the carburetor and tighten the retaining nuts, evenly and alternately, to specification.

**3.** Connect the choke cable and throttle linkage to the carburetor. Adjust the cable and linkage, if necessary.

**4.** Connect the fuel inlet line and the distributor vacuum line. Install the air cleaner.

**5.** Adjust the idle fuel mixture, engine idle speed, and the anti-stall dashpot (automatic transmission). Refer to "In-Car Adjustments and Repairs" in Part 10-2, Section 2 for the proper procedures.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

Use a separate container for the component parts of the various assemblies, to facilitate cleaning, inspection and assembly.

The following is a step by step sequence of operations for completely overhauling the carburetor. However, certain components of the carburetor may be serviced without a complete disassembly of the entire unit.

Disassembled views of the carburetor are shown in Figs. 20, 21, 22, and 23.

### MANUAL CHOKE LINKAGE

**1.** Depress the tangs on the fast idle cam lever retainer and remove the retainer from the stud (Fig. 19).

**2.** Remove the fast idle cam lever and the rod assembly from the stud. Move the lever and the rod assembly clockwise and remove it from the choke shaft lever.

**3.** Remove the rod adjusting nut and the spring from the rod. Slide the rod out of the swivel.

**4.** Remove the fast idle cam stud and the choke cable bracket assembly from the body. Scribe an index mark on the cable bracket and lower body for installation purposes.

### FUEL VENT VALVE ROD

**1.** Remove the fuel bowl vent rod to accelerating pump actuating lever retainer (Fig. 20).

**2.** Remove the stake marks at the vent rod opening with a scraper or file.

**3.** Remove the vent rod assembly and spring by pulling the vent rod outward.

### UPPER AND LOWER BODY

**1.** Remove the upper to lower body retaining screws and the carburetor identification tag. Separate the upper body assembly, gasket and lower body assembly (Fig. 20). Discard the gasket.

**2.** Invert the lower body assembly and allow the accelerating pump discharge weight and ball check, the accelerating pump inlet ball check, and the dashpot ball check, if so equipped, to fall into the hand.

### UPPER BODY

**1.** Remove the float retaining pin and the float assembly (Fig. 21).

**2.** Remove the fuel inlet needle valve. Remove the needle valve seat and gasket. Discard the gasket.

**3.** Remove the main jet.

**4.** Remove the fuel inlet fitting and the screen assembly.

**5.** Remove the air cleaner bracket retaining roll pins with pliers. Turn them in a direction that will coil the pins to a smaller diameter. If they offer resistance to turning, turn them in the opposite direction. Pull the bracket out of the retaining channels.

**6.** If it is necessary to remove the choke plate and shaft, lightly scribe the choke along the choke shaft so that the choke plate can be installed in the same position during installation.

Remove the choke plate screws. The retaining screws are staked in the choke shaft. If the tips of the screws are flared excessively, file off the flared portion to avoid damage to the threads in the choke shaft. Be careful not to damage the choke shaft or venturi while filing the screws. Remove the choke plate from the top of the air horn by sliding the plate out of the shaft. Slide the shaft out of the body.

### LOWER BODY

**1.** Depress the tab on the accelerating pump lever and control rod retaining clip and slide the rod out of the lever (Fig. 22). Remove the clip from the lever.

**2.** Remove the accelerating pump

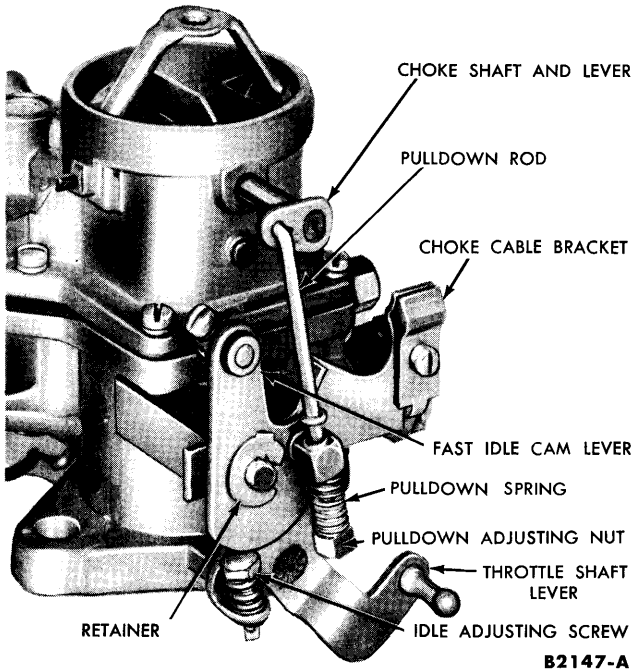



**FIG. 19—Manual Choke Linkage—Installed**

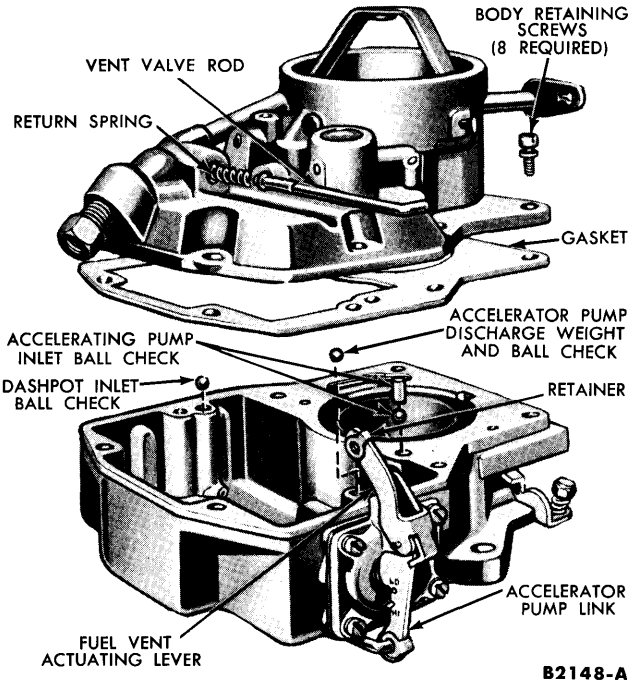



**FIG. 20—Carburetor Partial Disassembly**

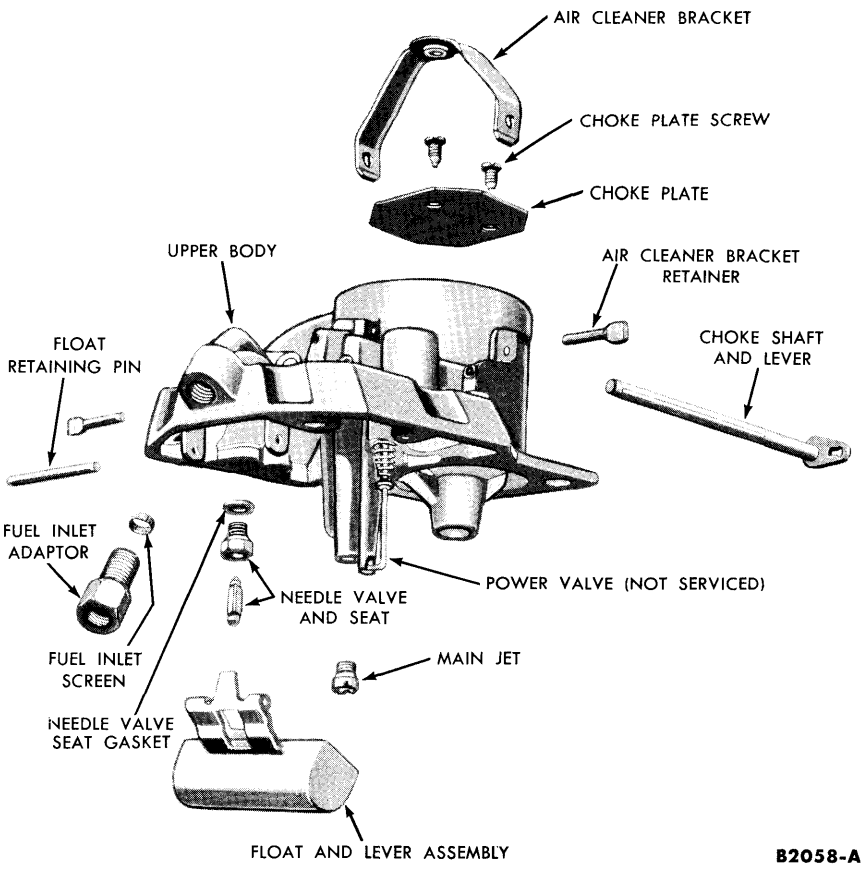



**FIG. 21—Carburetor Upper Body Assembly**

cover retaining screws. Remove the cover assembly from the lower body. Separate the pump diaphragm and spring from the cover or lower body. If necessary, remove the fuel vent rod actuating lever to cover retaining pin and the accelerating pump lever to cover retaining pin. Remove the lever and rod from the cover.

3. If the carburetor is equipped with a dashpot, depress the tab on the dashpot lever and control rod retaining clip, and slide the rod out of the dashpot lever. Remove the dashpot cover retaining screws and remove the cover assembly. Separate the diaphragm and spring from the cover or body. If necessary, remove the lever to cover retaining pin and remove the lever from the cover.

4. Remove the throttle shaft lever and retaining ring and washer. Remove the lever and overtravel spring from the throttle shaft. Remove the accelerator pump and dashpot control rods from the lever.

5. Remove the distributor vacuum outlet adapter.

6. Remove the spark valve and the gasket.

7. Remove the idle mixture adjusting screw and spring.

8. If it is necessary to remove the throttle plate and shaft, lightly scribe the throttle plate along the throttle shaft so that the throttle plates can be installed in the same position during installation.

Remove the throttle plate retaining screws and slide the plate out of the shaft. For assembly purposes, note that the dimple in the throttle plate is located below the throttle shaft. **The retaining screws are staked in the throttle shaft.** If the tips of the screws are flared excessively, file off the flared portion to avoid damage to the threads in the throttle shaft. Be careful not to damage the throttle shaft or venturi while filing the screws.

9. Remove the overtravel spring tension pin from the throttle shaft and slide the shaft out of the body.

## PARTS REPAIR OR REPLACEMENT

Clean and inspect the carburetor component parts. Refer to Part 10-1, Section 3, for the proper procedure. Replace all worn or damaged parts.

## ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets.

During assembly of the carburetor, certain adjustments are required. The details of these adjustments are covered in Part 10-2, Section 2, under "In-Car Adjustments and Repairs".

Disassembled views of the carburetor are shown in Figs. 20, 21, 22, and 23.

## UPPER BODY

1. If the choke plate and the shaft were removed, insert the choke shaft assembly into the air horn with the lever pointing toward the accelerating pump side of the carburetor (Fig. 21).

Refer to the line previously scribed on the choke plate and insert the choke plate into its original position with the plate indentation facing upward and toward the accelerating pump side of the carburetor. Install the choke plate retaining screws snug, but not tight.

Check for proper plate fit, binding in the air horn and free rotation of the shaft by moving the plate from the closed position to the open position. If it moves freely, tighten the choke plate retaining screws while holding the plate in the fully-closed position. Stake the screws. **When staking the screws, support the shaft and plate on a block of wood or a metal bar to prevent bending of the shaft.**

2. Install the fuel inlet screen and adapter in the fuel inlet of the body.

3. Install the main jet in the main fuel well.

4. Install the needle valve seat gasket and the seat within the tapped seat hole. Tighten the needle valve seat firmly. Insert the needle valve into the needle valve seat, with the viton tip toward the seat.

5. Position the float assembly in the body, with the tab on the arm located over the needle valve and the hinge of the arm lined up between the hinge bracket holes in the upper body casting. Insert the float hinge pin through the holes in the upper body and float assembly.

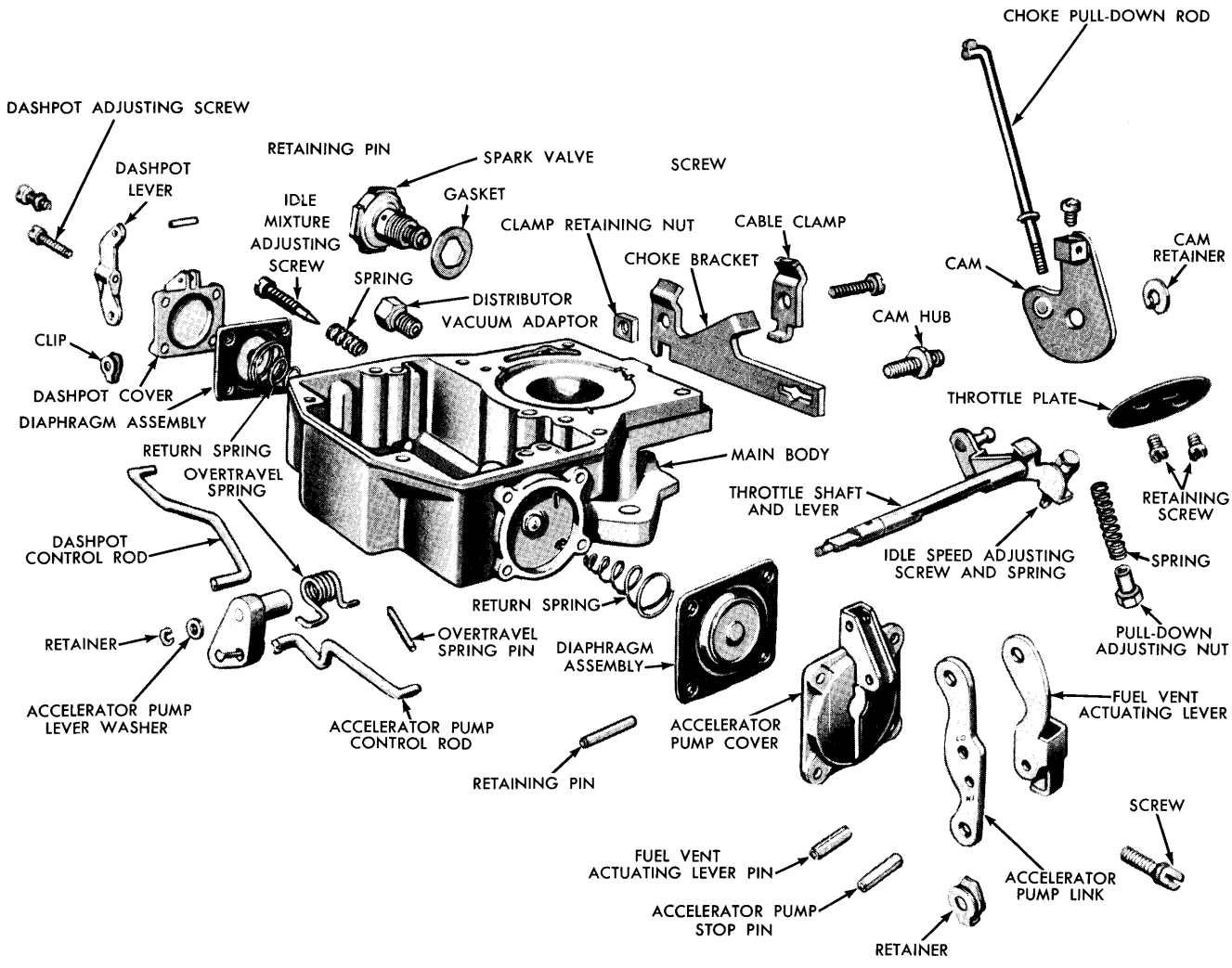



**FIG. 22—Carburetor Lower Body Assembly**

**6.** Check the float setting. Refer to Part 10-2, Section 2 for the proper procedure.

**7.** Insert the air cleaner bracket in the channels of the air horn and install the bracket retaining pins.

### LOWER BODY

**1.** If the throttle plate and shaft were removed, slide the throttle shaft into the lower body, with the lever on the throttle shaft located opposite the fuel bowl and the fast idle adjusting screw facing upward (Fig. 22).

Refer to the line previously scribed on the throttle plate and insert the plate through the slot in the throttle shaft. The plate indentation must face the bottom of the body and point toward the accelerator pump. Install the throttle plate screws snug, but not tight.

Rotate the throttle shaft while lightly tapping the throttle plate within the throttle bore. Check for free rotation of the throttle shaft. Hold the lower body up to the light. **Little, or no light should show between the throttle plate and throttle bore.** When the plate is properly located, hold the throttle plate closed; then, tighten and stake the retaining screws. **When staking the screws, support the shaft and plate on a block of wood or a metal bar to prevent bending of the shaft.**

**2.** Install the distributor vacuum outlet fitting.

**3.** If the lever was removed from the accelerating pump cover, position the top hole of the lever between the top bracket holes in the cover; then, install the retaining roll pin.

Position the vent rod lever over the pump cover bracket. Line up the hole in the lever with the holes in the bracket and install the retaining roll pin.

Install the roll pin in the "HI" (lower) stop hole in the lever.

Position the small diameter end of the diaphragm return spring in the boss in the accelerating pump chamber. Position the diaphragm assembly in the accelerating pump cover and line up the holes. Position the cover and diaphragm over the return spring and onto the body. Install the cover

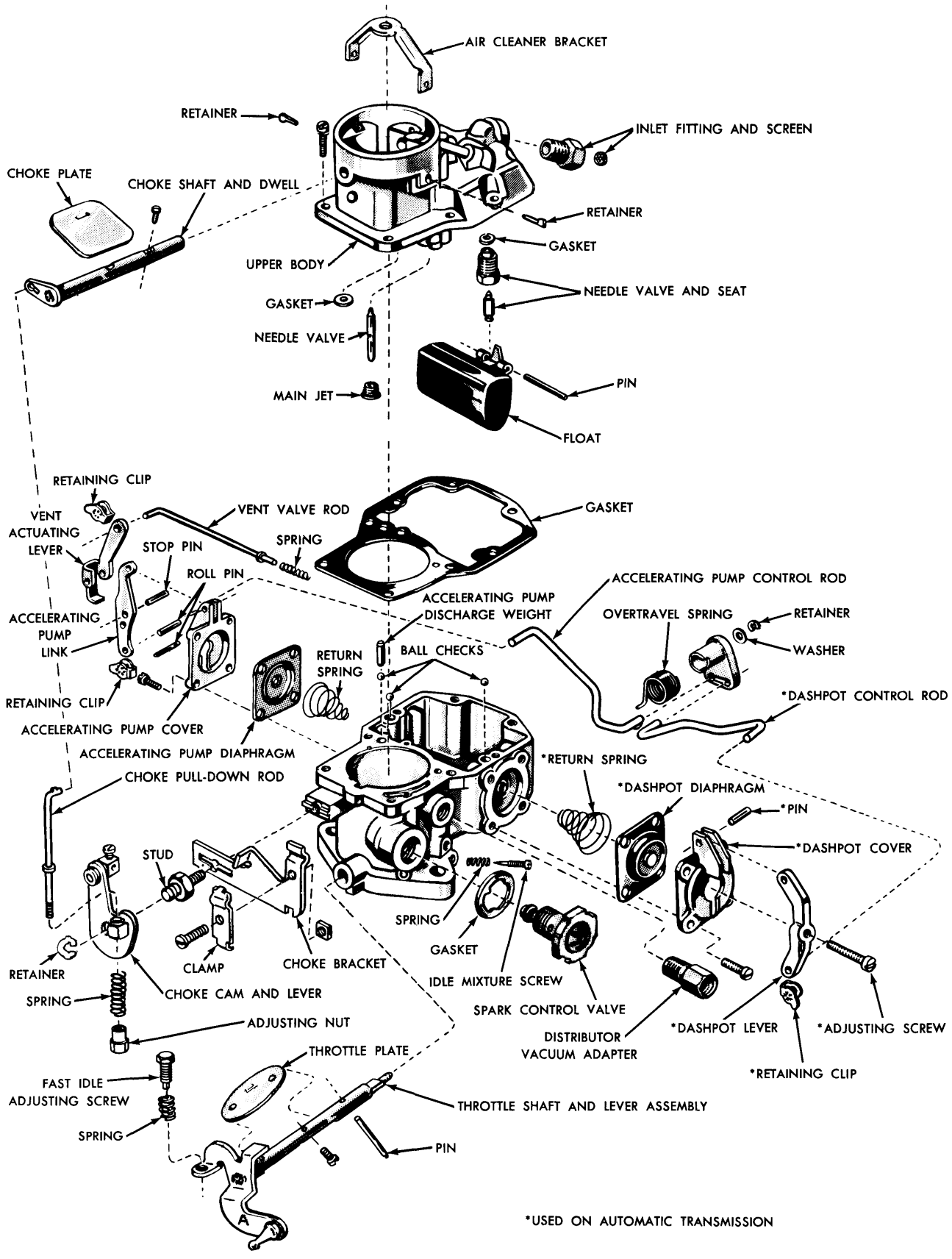



**FIG. 23—Ford Single-Barrel Carburetor—Disassembled**

retaining screws finger-tight. Push the diaphragm assembly inward and tighten the screws.

**4.** If the carburetor is equipped with a dashpot (Fig. 22), proceed with the following steps:

If the lever was removed from the dashpot cover, position the hole in the lever between the holes in the bracket on the cover. Install the lever retaining roll pin. Install the adjusting screw in the lever, if necessary.

Position the small diameter of the diaphragm return spring in the boss in the dashpot chamber. Position the diaphragm in the dashpot cover and line up the holes. Position the cover and the diaphragm over the return spring and onto the body. Install the cover retaining screws finger tight. Push the diaphragm assembly inward and tighten the screws.

**5.** Position the overtravel spring (Fig. 22) on the accelerating pump lever and hook the tang of the spring on the lever. Position the accelerating pump lever and spring on the throttle shaft and insert the accelerating pump actuating rod and dashpot actuating rod, if so equipped, into the two holes in the lever.

**6.** Install the overtravel tension spring retaining pin in the throttle shaft. Pull the arm of the spring over the retaining pin to apply spring tension to the overtravel lever.

**7.** Position the accelerating pump actuating rod retaining clip over the hole in the accelerating lever, with the tab side of the clip toward the carburetor barrel (Fig. 22). Depress the tab and insert the shorter end of the rod through the lever and clip. Release the tab when the rod is inserted. Perform the "Accelerating Pump Adjustments" after the carburetor is assembled.

**8.** If the carburetor is equipped with a dashpot, position the dashpot actuating rod retaining clip over the hole in the dashpot lever, with the tab side of the clip facing toward the carburetor barrel (Fig. 22). Depress the tab and insert the shorter end of the rod through the lever and clip, then release the tab when the rod is inserted. Perform an "Anti-Stall Dashpot Adjustment" after the carburetor is assembled.

**9.** Position the spark valve gasket over the spark valve and install them into the lower body (Fig. 22). Tighten the valve securely. **A loose valve will cause poor engine operation.**

**10.** Install the idle mixture adjusting screw and spring in the lower body (Fig. 22). Perform the "Initial Idle Mixture Setting" after the carburetor is assembled.

## UPPER TO LOWER BODY ASSEMBLY

**1.** Place the ball check and the accelerating pump weight into the lower body accelerating pump outlet passage (Fig. 20). Insert a ball check in the accelerating pump inlet passage.

**2.** If the carburetor is equipped with a dashpot, insert a ball check in the dashpot inlet passage (Fig. 20).

**3.** Install the upper to lower body gasket onto the lower body. **Make certain the word "TOP"** (inscribed on the gasket) is facing upward. Position the upper body on the lower body and gasket. Install the body retaining screws.

## FUEL VENT VALVE ROD

**1.** Insert the fuel vent valve return spring in the fuel vent passage in the upper body (Fig. 20). Insert the piston end of the fuel vent rod in the passage.

**2.** Position the fuel vent valve rod retaining clip over the hole in the actuating lever, with the tab side of the clip toward the carburetor air horn. Depress the tang on the clip and connect the rod to the actuating lever.

**3.** Punch three indentations in the vent valve passage opening with a center punch and a hammer. The indentations must distort the inside edge of the opening sufficiently to act as a stop for the piston end of the vent rod. Perform a "Vent Valve Adjustment" after the carburetor is assembled.

## MANUAL CHOKE

**1.** Position the choke cable bracket assembly onto the lower body assembly (Fig. 22). Align the previously scribed marks on the bracket and lower body and install the stud.

**2.** Insert the threaded end of the choke shaft to cam lever rod through the cam lever swivel. Install the spring and adjusting nut onto the rod (Fig. 22).

**3.** Position the rod end into the keyhole in the choke shaft lever; then insert the rod and turn it counterclockwise (Fig. 19).

**4.** Position the cam lever assembly over the stud and install the retainer (Fig. 19). Perform a "Manual Choke (Pull-down) Adjustment" prior to installation of the carburetor.

## BENCH ADJUSTMENTS

All carburetor adjustments with the exception of the "Final (Hot) Engine Idle and Fuel Mixture Adjustments," can be performed prior to installing the carburetor in the car.

Refer to "In-Car Adjustments and Repairs" in Part 10-2, Section 2 for the proper carburetor adjustment procedures.

# PART 10-3 FORD DUAL CARBURETORS


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| 2 Ford Dual Carburetor | 10-25 | 4 Major Repair Operations | 10-30 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

The Ford dual-carburetors are used on the Challenger 289 V-8 and the 390 V-8, 250 and 266 horsepower engines.

The carburetors for the respective engines are of the same basic design, except for venturi size, calibration, choke linkage and various internal detail changes to suit the function of the engines.

The carburetors (Figs. 1, 2 and 3) have two main assemblies, the air horn and the main body.

The air horn assembly, which serves as the main body cover, contains the choke plate and the vents for the fuel bowl.

The throttle plate, the accelerating pump assembly, the power valve assembly, and the fuel bowl are in the main body. The automatic choke housing is attached to the main body.

The two barrels each contain a main and booster venturi, main fuel discharge, accelerating pump discharge, idle fuel discharge and a throttle plate.

Due to similarity of the carburetors, the description and operating principles apply to all carburetors. Differences in various carburetor items are noted where applicable.

### OPERATION

#### FUEL INLET SYSTEM

The amount of fuel entering the fuel bowl (Fig. 4) is regulated by the distance the fuel inlet needle is raised off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a preset level, the float lowers the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used.

An integral retracting clip is attached to the fuel inlet needle assembly. The clip hooks over the tab of the float assembly. This clip assures reaction of the fuel inlet needle to any downward movement of the float.

A wire-type retainer prevents movement of the float shaft within the guides on each side of the fuel bowl. The retainer fits into a groove on the outside of the fuel inlet needle

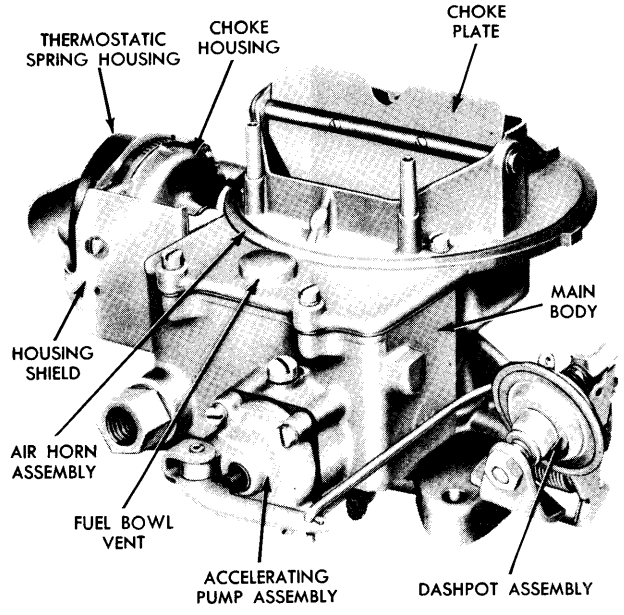



FIG. 1—Ford Dual Carburetor—¾ Left Front View

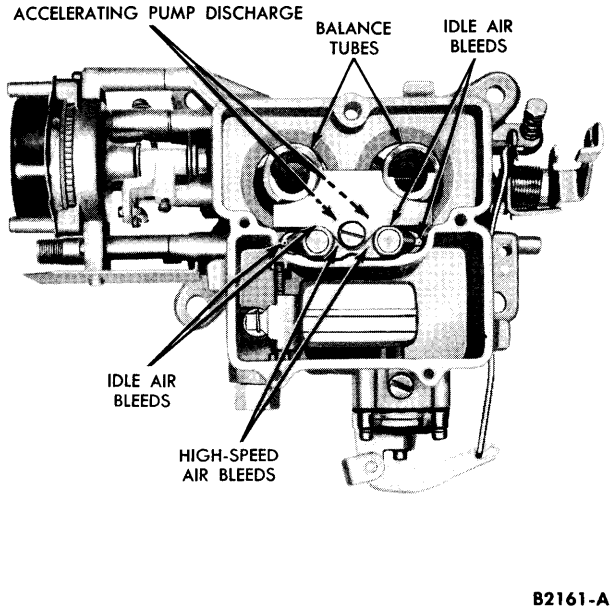



FIG. 2—Ford Dual Carburetor Mechanical Choke—Top View

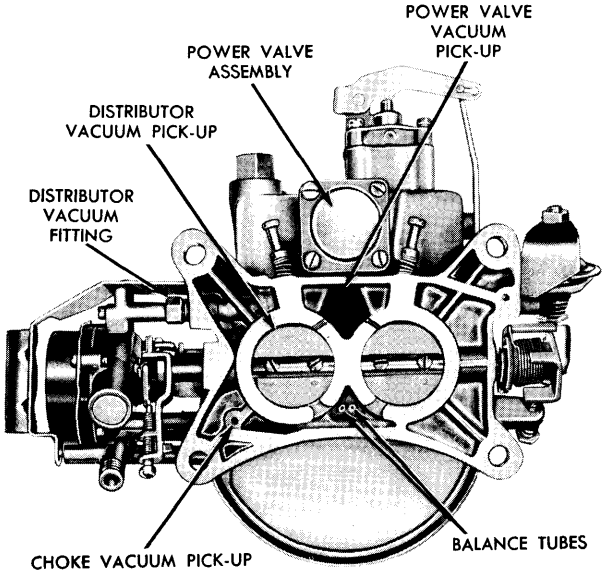



**FIG. 3—Ford Dual Carburetor Vacuum Piston Choke—Bottom View**

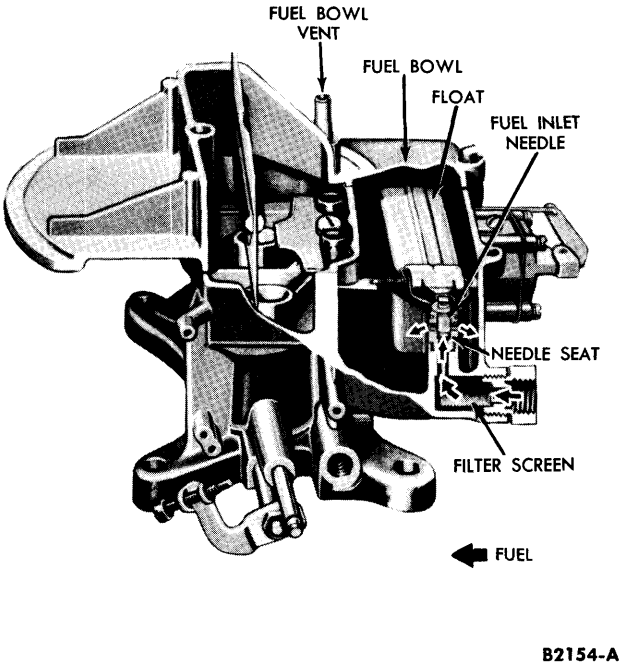



**FIG. 4—Fuel Inlet System**

seat. The ends of the retainer are hooked over grooves on opposite ends of the float shaft.

A torsion (fuel pulsation damper) spring is located on the float shaft, between the inboard end of the float retainer, and the float shaft guide in the fuel bowl. The short end of the spring rests under the float lever, and the long end of the spring rests against the inner face of the fuel bowl.

The torsion spring tension resists and absorbs fuel pump pressure pulsations, and movement of fuel in the bowl due to driving conditions. This assures proper regulation of the fuel inlet needle which rises and falls with the fuel level.

The fuel bowl is internally vented into the air cleaner. It is also externally vented to the atmosphere.

## AUTOMATIC CHOKE SYSTEM

The choke plate, located in the air horn above the barrels, when closed, provides a high vacuum above as well as below the throttle plates. With a vacuum above the throttle plates, fuel will flow from the main fuel system as well as from the idle fuel system. This provides the extremely rich fuel mixture necessary for cold engine operation.

The carburetor choke shaft is linked to a thermostatic choke control mechanism mounted on the main body (Figs. 5 and 6).

**Mechanical Linkage Choke Mechanism.** The bi-metal thermostatic spring mechanism unwinds when cold and winds up when warm (Fig. 5). When the engine is cold, the thermostatic spring, through attaching linkage, holds the choke plate in a closed position. When the engine is started, enough air is drawn around the choke plate to enable the engine to operate and prevent flooding.

As the engine continues to operate, manifold vacuum, channeled through a passage on the bottom of the main body to the choke housing, draws heated air from the exhaust manifold heat chamber. The amount of air entering the choke housing is controlled by restrictions in the air passages in the carburetor.

The warmed air enters the choke housing and heats the thermostatic spring causing it to wind up. The tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to open. The air is exhausted into the intake manifold.

When the engine reaches its normal operating temperature, the spring exerts tension on the choke plate forcing it to the full open position.

The fast idle cam pick-up rod actuates the fast idle cam during choking. One edge of the fast idle cam contacts the fast idle adjusting screw which permits a faster engine idle speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to

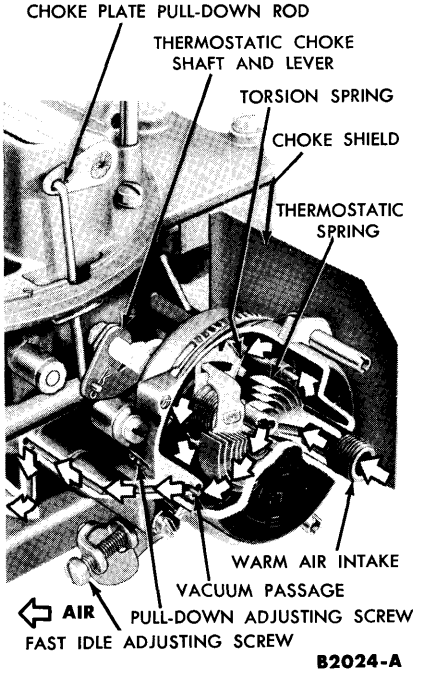
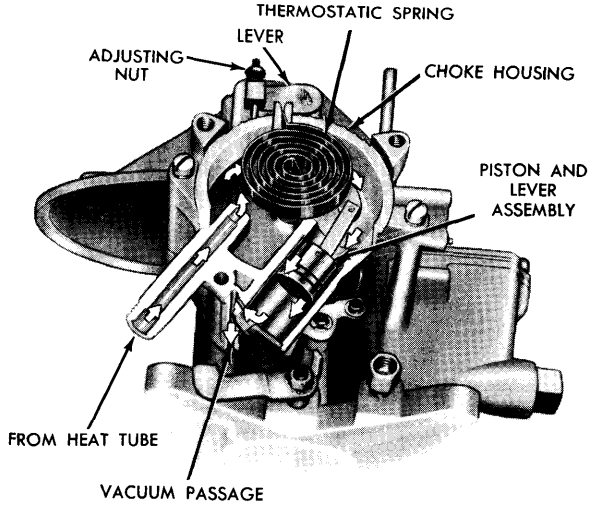
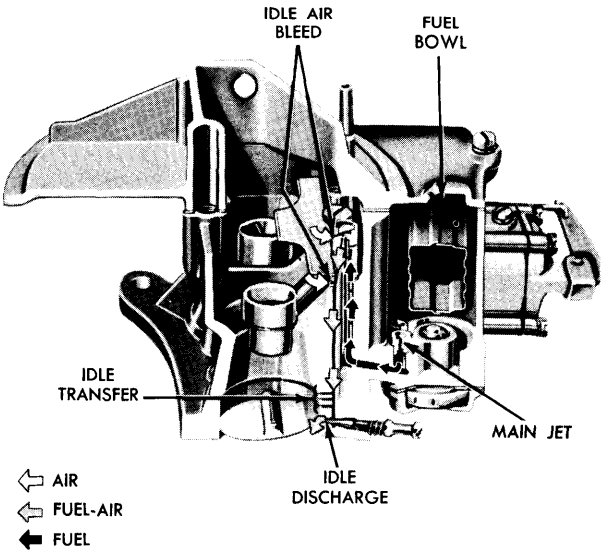



**FIG. 5—Automatic Choke System —Mechanical Linkage Choke**




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**FIG. 6—Automatic Choke System—Vacuum Piston Choke**




B2156-A

**FIG. 7—Idle Fuel System**

the open position, the pick-up lever rotates the fast idle cam. Each position on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

**Vacuum Piston Choke Mechanism.** The linkage between the choke lever and the throttle shaft is designed so that the choke plate will partially open when the accelerator is fully depressed. This permits unloading of a flooded engine.

The automatic choke is equipped with a bi-metal thermostatic spring and a vacuum piston (Fig. 6). The bi-metal thermostatic spring mechanism winds up when cold and unwinds when warm. When the engine is cold, the thermostatic spring, through attaching linkage, holds the choke piston upward and the choke plate in a closed position prior to engine start. Manifold vacuum channeled through a passage in the choke control housing, draws the choke vacuum piston downward, exerting an opening force on the choke plate.

When the engine is started, manifold vacuum, acting directly on the piston located in the choke housing, immediately moves the plate against the tension of the thermostatic spring to a partially open position to prevent stalling.

As the engine continues to operate, manifold vacuum draws heated air from the exhaust manifold heat chamber. The amount of air entering the choke housing is controlled by restrictions in the air passages in the carburetor.

The warmed air enters the choke housing and heats the thermostatic spring causing it to unwind. The tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to open. The air is exhausted into the intake manifold.

When the engine reaches its normal operating temperature, the thermostatic spring exerts tension on the choke plate forcing it to the full open position. In this position, the choke piston it at its lowest point in the cylinder. Slots in the piston chamber wall allow sufficient air to bleed past the piston and into the intake manifold, causing a continual flow of warm air to pass through the thermostatic spring housing. The spring thus remains heated and the choke plate remains fully open until the engine is stopped and allowed to cool.

The choke rod actuates the fast idle cam during choking. Steps on the edge of the fast idle cam contact the fast idle adjusting screw which permits a faster engine idle speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the choke rod rotates the fast idle cam. Each step on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

During the warm-up period, if the engine should reach the stall point due to a lean mixture, manifold vacuum will drop considerably. The tension of the thermostatic spring then overcomes the lowered vacuum acting on the choke piston, and the choke plate will be moved toward the closed position, providing a richer mixture to help prevent stalling.

The linkage between the choke lever and the throttle shaft is designed so that the choke plate will partially open when the accelerator pedal is fully depressed. This permits unloading of a flooded engine.

## IDLE FUEL SYSTEM

The difference in pressure between the fuel bowl and the idle discharge port forces fuel through the idle fuel system. Fuel flows from the fuel bowl through the main jet and into the bottom of the main well (Fig. 7).

From the main well, the fuel flows up through the idle tube and through a short diagonal passage in the booster venturi assembly into the idle passage in the main body. A calibrated restriction, at the upper tip of the idle tube, meters the flow of fuel.

Air enters the idle system from the air bleed which is located directly above the idle tube. The air bleed also acts as a vent to prevent siphoning at off idle or high speeds and when the engine is stopped. Additional air is bled into the system through an air bleed located at the bottom of the diagonal passage in the booster venturi where the fuel enters the idle passage in the main body.

Fuel flows down the idle passage in the main body past three idle transfer holes. The idle transfer holes act as additional air bleeds at curb idle. The fuel then flows past the pointed tip of the adjusting needle which controls the idle fuel discharge. From the adjusting needle chamber, the fuel flows through a short horizontal passage and is discharged below the throttle plates.

During off idle when the throttle plate is moved slightly past the idle transfer holes, each hole begins discharging fuel as it is exposed to manifold vacuum. As the throttle plate is opened still wider and engine speed increases, the air flow through the carburetor is also increased. This creates a vacuum in the booster venturi strong enough to bring the main fuel system into operation. Fuel flow from the idle fuel system begins tapering off as the main fuel system begins discharging fuel.

### ACCELERATING SYSTEM

Upon accelerating, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the fuel, which is heavier than air, can gain speed and maintain the desired balance of fuel and air. During this interval, the accelerating system (Fig. 8) supplies fuel until the other systems can once again provide the proper mixture.

When the throttle is closed, the diaphragm return spring forces the diaphragm toward the cover, drawing fuel into the chamber through the inlet. The inlet has a ball check which opens to admit fuel from the fuel bowl and closes when the accelerating pump is operated to prevent a reverse flow. A discharge weight and ball check prevents air from entering when fuel is drawn into the chamber.

When the throttle is opened, the diaphragm rod is forced inward, forcing fuel from the chamber into the discharge passage. Fuel under pressure forces the pump discharge weight and ball off their seat and fuel passes through the accelerating pump discharge screw and is sprayed into each main venturi through discharge ports.

An air bleed in the wall of the accelerating pump fuel chamber prevents vapor entrapment and pressure build-up in the diaphragm chamber.

An accelerating pump cavity filler, located in the accelerating pump fuel chamber, decreases the volume of the accelerating pump cavity. The filler improves the rate of fuel delivery, and prevents engine stumble and hesitation on acceleration.

### MAIN FUEL SYSTEM

As engine speed increases, the air passing through the booster venturi creates a vacuum. The amount of vacuum is determined by the air flow through the venturi, which in turn is regulated by the speed of the engine. The difference in pressure between the main discharge port and the fuel bowl causes fuel to flow through the main fuel system (Fig. 9).

At a pre-determined venturi vacuum, fuel flows from the fuel bowl, through the main jets, and into the bottom of the main well. The fuel moves up the main well tube past air bleed holes. Filtered air from the high speed air bleed enters the fuel flow in the main well tube through holes in the side of the tube. The high speed air bleed meters an increasing amount of air to the fuel as venturi vacuum increases, maintaining the required fuel-air ratio. The mixture of fuel and air is lighter than raw fuel and responds faster to changes in venturi vacuum. It also vaporizes more readily than raw fuel. The fuel and air continue up the main well tube past another air bleed which also acts as a vent to prevent siphoning when the engine is shut

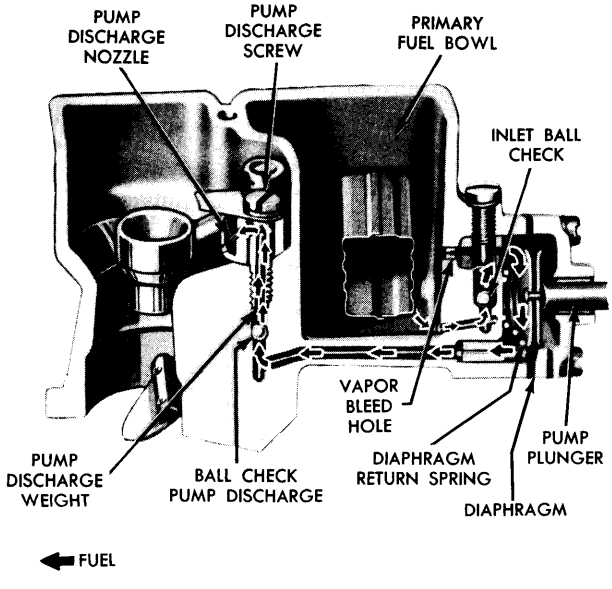



FIG. 8—Accelerating Pump System

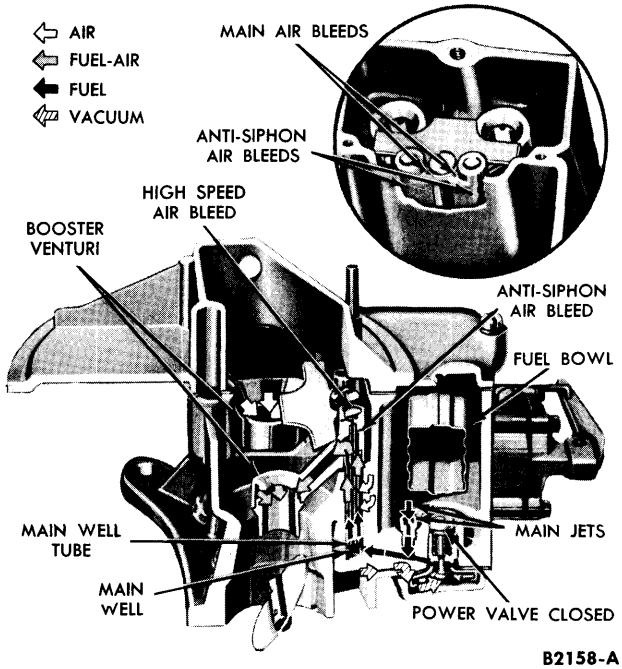



FIG. 9—Main Fuel System

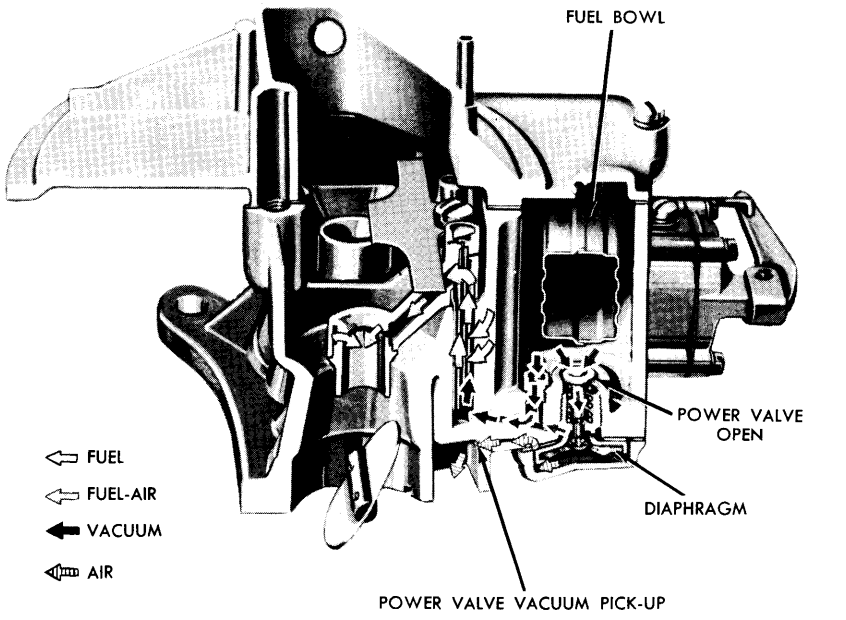



**FIG. 10—Power Fuel System**

down. The fuel is discharged into the booster venturi where it is vaporized and mixed with the air flowing through the carburetor.

The throttle plate controls the amount of the fuel-air mixture admitted to the intake manifold, regulating the speed and power output of the engine.

A balance tube is located in each barrel directly below the booster venturi. When decelerating, the balance tube siphons off any excess fuel droplets remaining around the edge of the booster venturi and discharges the droplets into the equalizing slots in the base of the carburetor where they are mixed with the idle fuel. The balance tube also acts as an additional air bleed during the idle fuel system operation.

### POWER FUEL SYSTEM

During periods of increased road loads or high speed operation, the fuel-air ratio must be increased for added power. The added fuel required during this period is supplied by the power fuel system (Fig. 10).

The power fuel system is controlled by the manifold vacuum.

Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. The manifold vacuum, acting on the power valve at idle speed or normal road load conditions, is great enough to hold the power valve diaphragm down, overcoming the tension of the spring on the valve stem and holding the valve closed. When high power operation places a greater load on the engine and manifold vacuum drops below a predetermined value, the spring opens the power valve. Fuel from the fuel bowl flows through the power valve and into passages leading to the main fuel well. Here the fuel is added to the fuel from the main fuel system, enriching the mixture.

As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the power valve.

## 2 FORD DUAL CARBURETOR

### IN-CAR ADJUSTMENTS AND REPAIRS

The fuel level float adjustment (dry) is performed only as a bench adjustment. Refer to Part 10-1 for the proper float adjustment (dry) procedure. The choke clearance (pull-down) and fast idle cam linkage adjustments are usually performed with the carburetor on the bench; however, they can be performed with the carburetor on the engine.

### FUEL LEVEL FLOAT ADJUSTMENT (WET)

The dry (bench) float level setting is a preliminary adjustment performed during carburetor overhaul procedures on the bench. This setting is used as a guide only; therefore, a final check and adjustment of the wet fuel level should be made as follows:

1. Operate the engine for 30 minutes at 1200 rpm to normalize engine temperatures, and place the car on a flat surface as near level as possible. Stop the engine.
2. Remove the air cleaner assembly, carburetor air horn assembly, and gasket.
3. Temporarily place the air horn gasket in position on the carburetor main body. Let the engine idle for several minutes, then remove the air horn gasket.
4. While the engine is idling, use a standard depth scale to measure the vertical distance from the top machined surface of the carburetor main body to the level of the fuel in the fuel bowl (Fig. 11). The measurement must be made at least ¼ inch away from any vertical surface to assure an accurate reading, because the surface of the fuel is concave (higher at the edges than at the center). Care must be exercised to measure the fuel level at the point of contact with the fuel. Refer to the specifications for the correct fuel level (wet) setting.
5. **If any adjustment is required, stop the engine to minimize the hazard of fire** due to fuel spray when the float setting is disturbed. To adjust the fuel level, bend the float

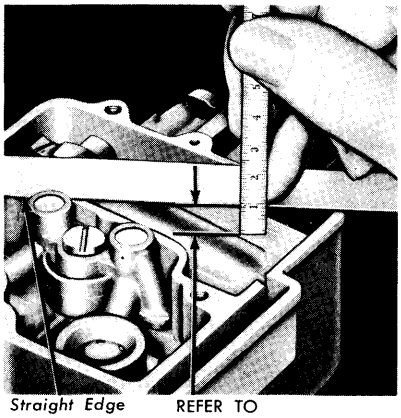



**FIG. 11—Ford Dual Carburetor Fuel Measurement—Typical**

(contacting the fuel inlet valve) upward in relation to the original position to raise the fuel level and downward to lower it. Each time an adjustment is made to the float tab to alter the fuel level, the engine must be started and permitted to idle at least three minutes to stabilize the fuel level. Check the fuel level after each adjustment until the specified level is achieved.

**6.** Install the new horn air gasket and carburetor air horn assembly.

**7.** Check the idle fuel mixture and idle speed adjustments. Adjust the carburetor as required.

**8.** Install the air cleaner assembly.

### AUTOMATIC CHOKE PLATE CLEARANCE (PULL-DOWN) AND FAST IDLE CAM LINKAGE ADJUSTMENT—MECHANICAL LINKAGE CHOKE

**1.** If the heater hose and mounting bracket, and the carburetor air cleaner assembly have not been previously removed, remove them from the carburetor.

**2.** Rotate the choke thermostatic spring housing 90° in the "rich" direction (counterclockwise).

**3.** Open the throttle plates so that the fast idle screw does not contact the fast idle cam.

**4.** Depress the downward (front) side of the choke plate lightly until resistance is felt. **The clearance between the downward side of the choke plate and the air horn wall is the choke plate pull-down clearance** (Fig. 12). Check the clearance by placing a gauge or the shank end of a drill of the specified clearance dimension between the downward (front) edge of the choke plate and the air horn wall (Fig. 12).

If the choke plate clearance is not within specification, turn the pull-down adjusting screw (Fig. 12) clockwise (inward) to increase the clearance, or counterclockwise (outward) to decrease the clearance.

**5.** Set the fast idle (rpm) adjusting screw on the kickdown stop of the fast idle cam. Check the clearance dimension between the downward (front) edge of the choke plate and the air horn wall. If the clearance is not within specification, turn the over-travel lever adjusting screw (Fig. 13) clockwise (inward) to increase the clearance, or counterclockwise (outward) to decrease the clearance.

**6.** Set the choke thermostatic coil housing to the specified index mark and tighten the clamp retaining screws.

**7.** Install the heater hose and mounting bracket on the carburetor and tighten the retaining screws.

**8.** Adjust the engine idle speed and idle fuel mixture.

### AUTOMATIC CHOKE PLATE CLEARANCE (PULL-DOWN) AND FAST IDLE CAM LINKAGE ADJUSTMENT—VACUUM PISTON CHOKE

**1.** Bend a 0.036 inch wire gauge (tool) at a 90° angle, approximately ⅛ inch from its end (Fig. 14).

**2.** Remove the choke thermostatic spring housing if it has not been removed. Block the throttle about half-open so that the fast idle cam does not contact the fast idle adjustment screw.

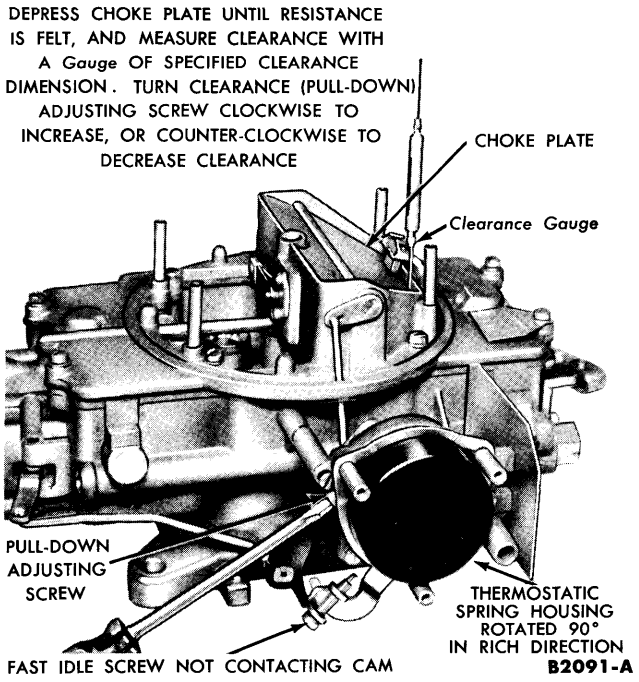



**FIG. 12—Mechanical Linkage Choke Plate Clearance (Pull-Down) Adjustment—Typical**

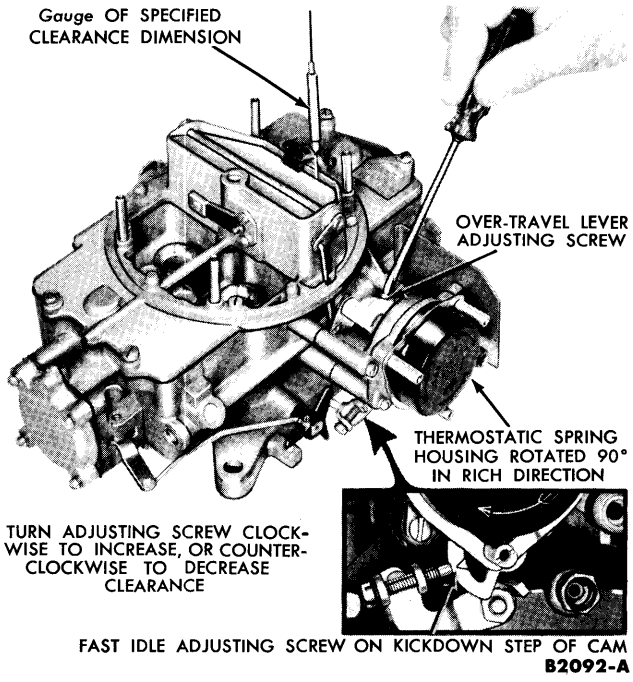



**FIG. 13—Fast Idle Cam Linkage Adjustment—Typical**

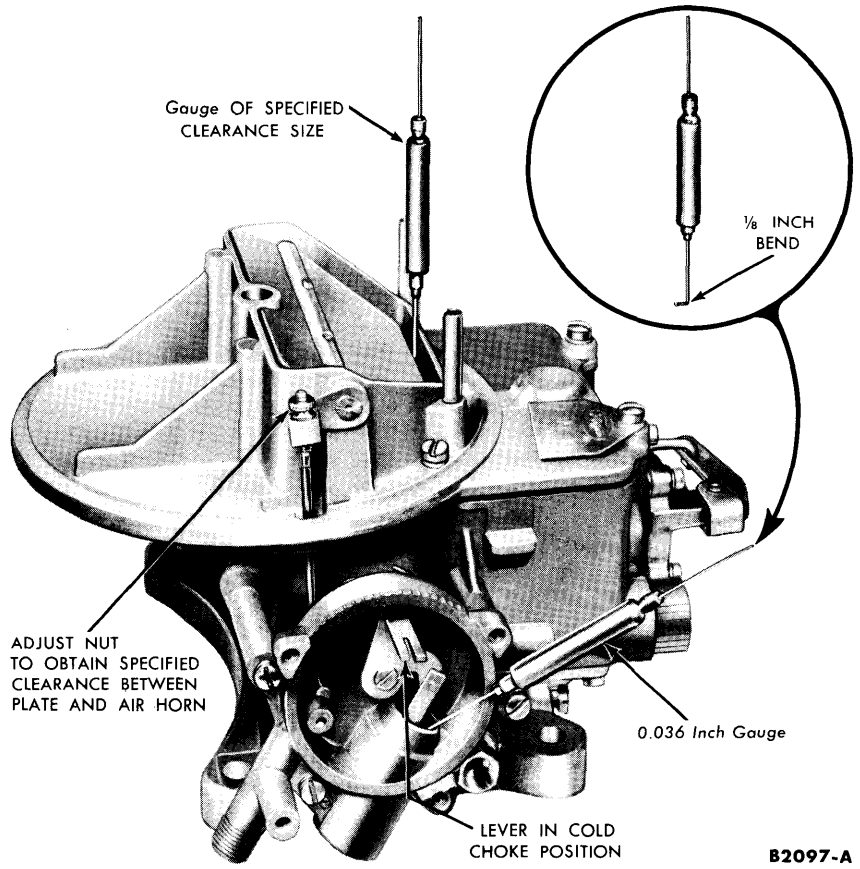



**FIG. 14—Vacuum Piston Choke Plate Clearance (Pull-Down) Adjustment**

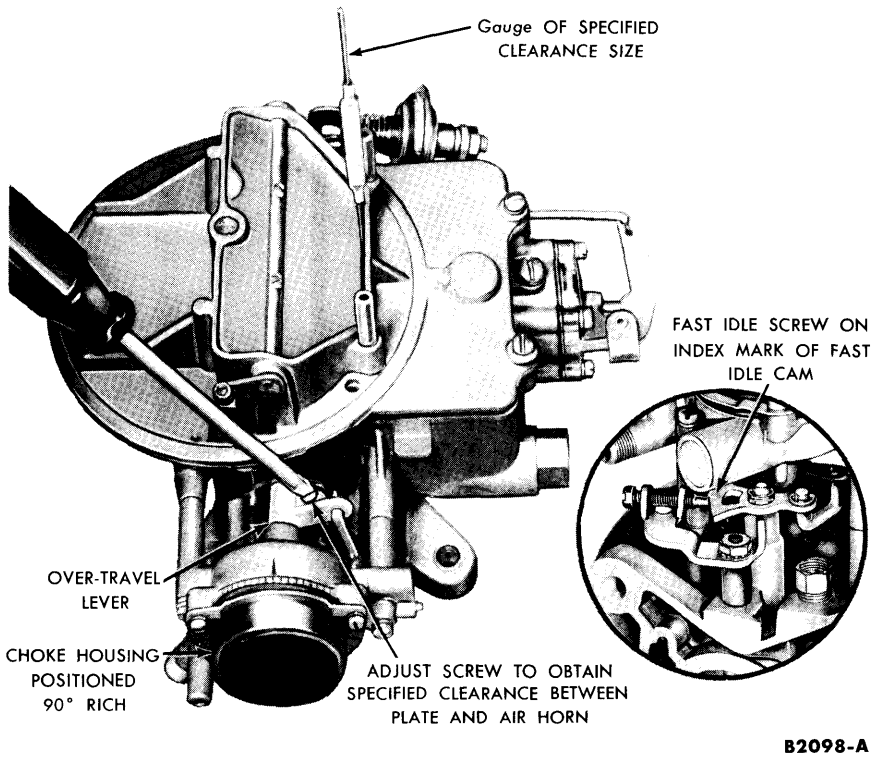



**FIG. 15—Fast Idle Cam Linkage Adjustment**

3. Insert the bent end of the gauge between the lower edge of the piston slot and the upper edge of the right hand slot in the choke housing (Fig. 14), and pull the choke countershaft lever counterclockwise until the gauge is snug in the piston slot. Hold the wire gauge in place by exerting light pressure on the countershaft lever, and adjust the choke plate clevis (pull-down) adjusting nut to obtain the specified clearance between the front of the choke plate and the air horn (Fig. 14).

4. Install the choke thermostatic spring housing and gasket. Install the housing retainer and the retaining screws.

5. Position the fast idle (rpm) adjustment screw on the index mark of the fast idle cam (Fig. 15).

6. Turn the choke thermostatic cover 90° rich (counterclockwise) and check the clearance between the front of the choke plate and the air horn (Fig. 15). Adjust the clearance to specification, if required. **Turn the over-travel lever adjusting screw clockwise (inward) to increase the clearance and counterclockwise (outward) to decrease the clearance. Make certain the fast idle screw remains on the index mark (kickdown step) of the fast idle cam during the adjustment procedure.**

7. Set the choke thermostatic housing to the specified index mark. Tighten the housing clamp retaining screws. Adjust the engine idle speed and idle fuel mixture.

## AUTOMATIC CHOKE THERMOSTATIC SPRING HOUSING ADJUSTMENT

1. If the heater hose and mounting bracket and the carburetor air cleaner assembly have not been previously removed, remove them from the carburetor.

2. Loosen the thermostatic spring housing clamp retaining screws. Set the spring housing to the specified index mark (Fig. 16) and tighten the clamp retaining screws.

3. Install the heater hose and bracket on the carburetor and tighten the bracket retaining screws. If other carburetor adjustments are not required, install the carburetor air cleaner assembly.

## IDLE FUEL MIXTURE AND IDLE SPEED ADJUSTMENTS

The engine idle speed is adjusted to settings for a hot engine, and a cold (fast idle speed) during choke operation. With the air cleaner removed, make the idle adjustments in the following sequence:

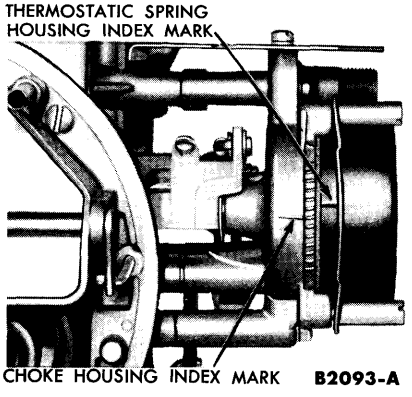



**FIG. 16—Automatic Choke Thermostatic Spring Housing Adjustment—Typical**

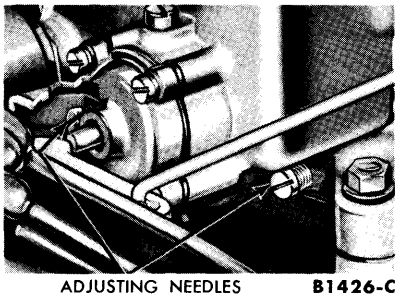



**FIG. 17—Idle Fuel Mixture Adjustment**

**Initial Idle Mixture Setting.** If necessary, initially set the idle mixture by turning the idle mixture screws (needles) inward (clockwise) until lightly seated; then, turn the screws outward (counterclockwise) 1-1½ turns (Fig. 17). **Do not turn the needles tightly against their seats as this may groove the ends.** If the needle(s) is damaged, it must be replaced before a satisfactory fuel mixture can be obtained.

**Engine Idle Speed and Mixture.**

**1.** Operate the engine for 30 minutes at 1200 rpm to stabilize engine temperatures.

On a car with an air conditioner, operate the air conditioner for 20 minutes before setting the engine idle speed.

**2.** Set the parking brake. Attach a tachometer to the engine.

**3. On a car with a manual-shift transmission, the engine idle speed is checked and adjusted with the transmission selector lever in the neutral position. On a car with an automatic transmission, the engine idle speed is checked and adjusted with the transmission selector lever in the drive range position.**

Place the transmission selector lever in neutral position on a car with a manual-shift transmission, or in drive range on a car with an automatic transmission. Check the engine idle speed. Adjust the engine idle speed to specification by turning the engine idle speed adjustment screw (Fig. 18) inward (clockwise) to increase the speed or outward (counterclockwise) to decrease the speed. **When performing this adjustment, be sure the dashpot is not interfering with the throttle lever or the fast idle adjusting screw is not contacting the fast idle cam.**

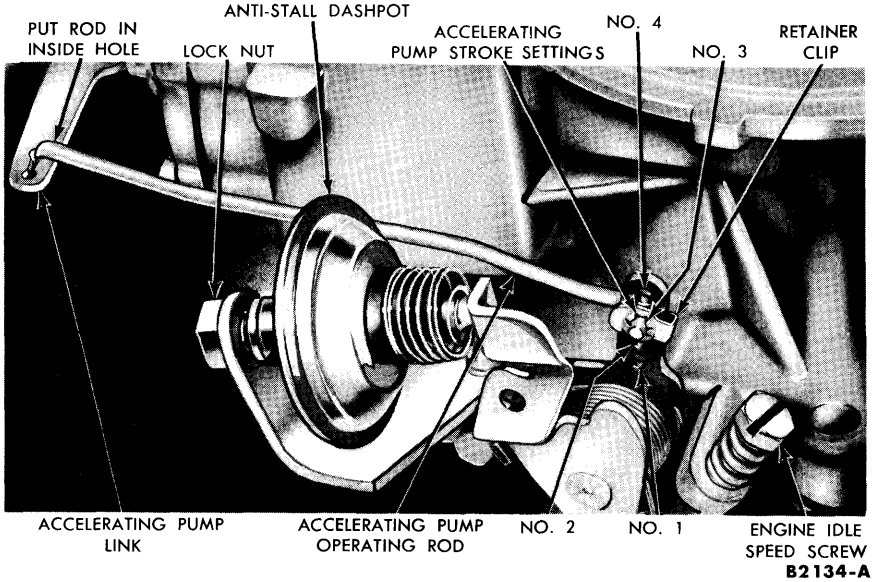



**FIG. 18—Typical Idle Adjustments—Left Side**

**4.** Turn each idle mixture screw (needle) inward (Fig. 17) until the engine rpm begins to drop from the lean mixture and turn each needle outward until engine rpm increases and begins to drop from the rich mixture. Turn the needles inward for maximum engine rpm and smoothness. The needles should be turned approximately the same amount. The final setting may vary approximately ½ turn difference between needles.

**5.** After the correct engine idle fuel mixture has been obtained, it is necessary to check the idle speed. **If the car is equipped with an automatic transmission, place the transmission selector lever in neutral position.** Manually open and close the throttle. **If the car is equipped with an automatic transmission, place the transmission selector lever in drive range.** Check the engine idle speed and adjust it, if necessary.

Final engine idle speed may be varied to suit the conditions under which the carburetor is to be operated.

**Engine Fast (Cold) Idle Speed.** The adjusting screw on the right side of the carburetor (Fig. 19) contacts one edge of the fast idle cam. The cam permits a faster engine idle speed for smoother running when the

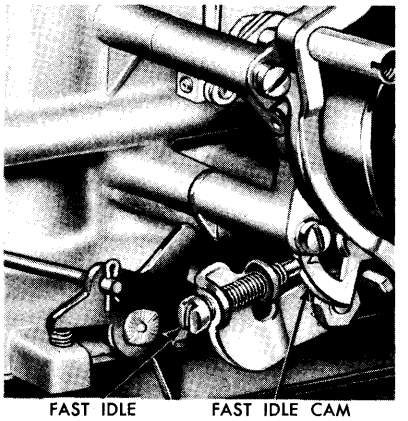



**FIG. 19—Engine Fast (Cold Engine) Idle Speed Adjustment—Typical**

engine is cold during choke operation. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Each position on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

1. Manually rotate the fast idle cam until the fast idle adjusting screw rests adjacent to the shoulder (Fig. 19) of the highest step (align the screw with the mark on the cam).

2. Start the engine, and turn the fast idle adjusting screw inward or outward as required to obtain the specified fast idle rpm.

3. Remove the tachometer if the idle fuel mixture does not require adjustment. If the idle fuel mixture requires adjustment, leave the tachometer installed so that the idle speed can be checked after the idle fuel mixture has been adjusted.

### ANTI-STALL DASHPOT ADJUSTMENT

The anti-stall dashpot adjustment is made with the carburetor air cleaner assembly removed from the carburetor.

1. With the engine idle speed and mixture properly adjusted, and the engine at normal operating temperature, loosen the anti-stall dashpot lock nut (Fig. 20).

2. Hold the throttle in the closed position and depress the plunger with a screwdriver blade. Check the clearance between the throttle lever and the plunger tip with a feeler gauge of the specified clearance dimension. Turn the anti-stall dashpot in its bracket in a direction to provide the specified clearance between the tip of the plunger and the throttle lever. Tighten the locknut to secure the adjustment.

3. Install the air cleaner assembly.

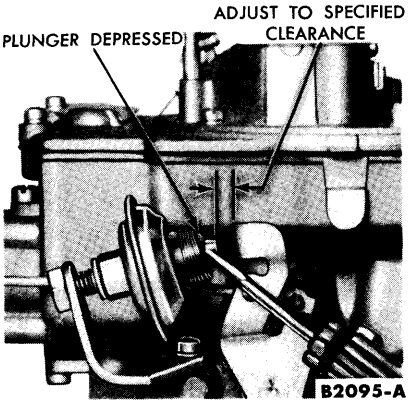



**FIG. 20—Anti-Stall Dashpot Adjustment—Typical**

### ACCELERATING PUMP STROKE ADJUSTMENT

The accelerating pump stroke adjustment is made with the carburetor air cleaner removed from the carburetor.

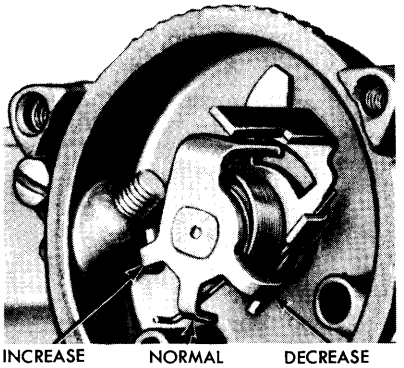



**FIG. 21—Torsion Adjustment—Typical**

The over-travel lever has four holes and the accelerating pump link has two holes (Fig. 18) to control the accelerating pump stroke for various ambient temperatures and operating conditions of the engine.

The correct position for the pump link operating rod for all climatic conditions is in the inboard hole of the link (hole closest to the pump plunger). Refer to specifications, and insert the operating rod in the proper hole of the over-travel lever to suit the climatic conditions in which the car is to be operated.

To release the operating rod from the over-travel lever, retaining clip, press the ends of the clip together; then, at the same time, press the rod away from the clip until it is disengaged. Remove the clip. To install the operating rod in the over-travel lever, install the clip on the over-travel lever. Press the ends of the clip together; then at the same time, insert the rod through the clip and over-travel lever. Release the ends of the clip.

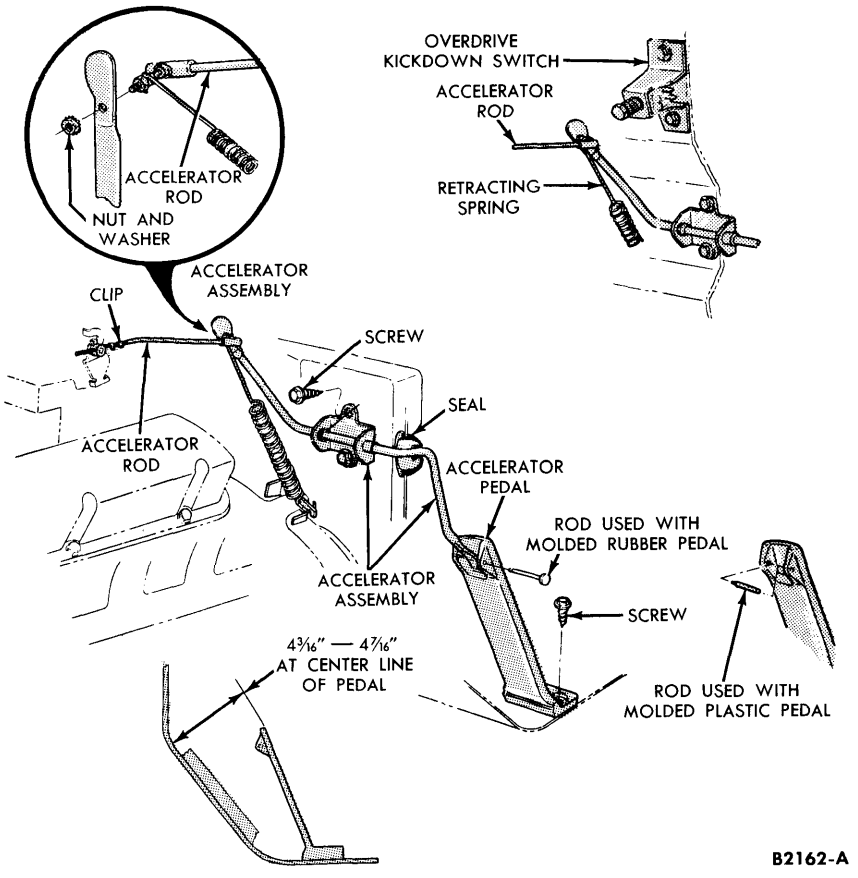



**FIG. 22—Throttle Linkage Adjustment—289 V-8 and 390 V-8**

### AUTOMATIC CHOKE HOUSING TORSION SPRING ADJUSTMENT–MECHANICAL LINKAGE CHOKE

The adjustment of the choke housing torsion spring (Fig. 21) should be made only after it is assured that all other carburetor adjustments are within specifications.

The normal position for the short tang of the choke housing spring is on the center prong of the choke housing shaft lever assembly (Fig. 21). The two remaining prong positions are intended for increasing or decreasing the spring tension to correct for an apparent lean mixture or rich mixture in the automatic choke system during driveaway immediately after a cold start in low ambient temperatures. Engine hesitation or stumble indicates a lean mixture. An engine that runs rough (lopes or gallops) indicates a rich mixture. Decrease the tension to correct for richness. Increase the tension to correct for leanness.

**1.** Remove the carburetor air cleaner assembly. Remove the heater hose and bracket, and the thermostatic spring housing.

**2.** Place the short tang of the spring in the left prong to increase tension, the center prong for normal operation, or the right prong to decrease tension (Fig. 21).

**3.** Install the thermostatic spring housing and set it at the specified index mark. Tighten the housing retaining clamp screws.

**4.** Install the heater hose and mounting bracket on the carburetor. Install the carburetor air cleaner assembly.

### THROTTLE LINKAGE ADJUSTMENTS

**Manual-Shift Transmission.**

**1.** Adjust the engine idle speed to specification.

**2.** Check the accelerator pedal height (Fig. 22). To adjust the pedal height, disconnect the carburetor connecting rod. Lengthen or shorten the accelerator connecting link to obtain the specified accelerator pedal height.

**3.** With the throttle lever against the idle adjusting screw, adjust the carburetor connecting rod until the end of the rod has a free fit into the carburetor throttle lever hole.

**Overdrive Transmission.**

**1.** Adjust the engine idle speed, pedal height and throttle linkage (Fig. 22) as outlined in steps 1 thru 3 under "Manual-Shift Transmission".

**2.** With the accelerator shaft held in the full throttle position, slide the overdrive control switch up or down on the elongated slots until the tang on the accelerator shaft assembly (bellcrank) is just touching the switch plunger. If the switch does not touch the shaft when it is in its closest position, an adjustment (not exceeding four turns counterclockwise) may be made at the switch plunger.

**3.** Return the accelerator shaft to its normal position. Turn the switch plunger five turns counterclockwise to adjust for kickdown operation.

**Automatic Transmission.** The throttle linkage adjustment for the automatic transmissions are covered in Group 7.

## 3 FORD DUAL CARBURETOR REMOVAL AND INSTALLATION

### REMOVAL

**1.** Remove the air cleaner. Remove the choke shield retaining screws and remove the heater hose and shield from the carburetor assembly.

**2.** Remove the throttle rod from the throttle lever. Disconnect the distributor vacuum line, the fuel inlet line and the choke heat tube at the carburetor.

**3.** Remove the carburetor retaining nuts and lockwashers, then remove the carburetor. Remove the spacer and two gaskets from the manifold.

### INSTALLATION

**1.** Clean the gasket surface of the intake manifold spacer, and carburetor. Place the spacer between two new gaskets and position them on the manifold. Position the carburetor on the spacer and secure it with lockwashers and nuts.

**2.** Connect the throttle rod, the choke heat tube, and the distributor vacuum line. Position the heater hose on the choke shield and install the shield and retaining screws.

**3.** Refer to Part 10-3, Section 2, "In-Car Adjustments and Repairs" and adjust the engine idle speed, the idle fuel mixture, and the anti-stall dashpot (if so equipped). If the car is equipped with a power steering pump idle valve assembly, adjust it as required. Refer to Group 3 for the proper procedure. Install the air cleaner.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

To facilitate working on the carburetor, and to prevent damage to the throttle plates, install carburetor legs on the base. If legs are unavailable, install four bolts about 2¼ inches long of the correct diameter and nuts on the carburetor base.

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor for the 289 V-8 engine, or the 390 V-8 engine. However, certain components of either of the carburetors may be serviced without a complete disassembly of an entire unit. For a complete carburetor overhaul, follow all of the steps. To partially overhaul either carburetor or to install a new gasket kit, follow only the applicable steps.

Refer to Fig. 36 for parts identification.

### AIR HORN

**1.** Remove the air cleaner anchor screw.

**2.** Remove the automatic choke

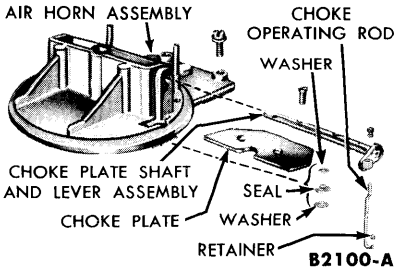



**FIG. 23–Air Horn Assembly–Typical**

control rod retainer.

3. Remove the air horn retaining screws, lock washers and the carburetor identification tag. Remove the air horn and air horn gasket (Fig. 23).

4. On a vacuum piston choke carburetor installation, remove the choke control rod by loosening and turning the choke shaft lever clevis nut counterclockwise. Remove the rod from the air horn. Slide the felt seal and two washers out of the air horn.

If it is necesary to remove the choke plate, remove the staking marks on the choke plate retaining screws and remove the screws. Remove the choke plate by sliding it out of the shaft from the top of the air horn. Slide the choke shaft out of the air horn.

5. On a mechanical linkage choke carburetor installation, remove the choke plate screws and the choke plate from the choke plate lever. **If the tips of the screws are flared excessively, file off the flared portion to prevent damage to the threads in the shaft.**

Rotate the choke plate lever and remove the choke plate rod from the lever. Slide the choke shaft out of the air horn.

Slide the felt seal and two washers out of the choke rod seal retainer.

## MECHANICAL LINKAGE CHOKE

1. Remove the choke shield. Remove the fast idle cam rod retainer. Remove the thermostatic spring housing retaining screws, and remove the clamp, housing and gasket (Fig. 24).

2. Remove the choke housing retaining screws. If the air horn has not been previously removed, remove the choke control rod retainer. Remove the choke housing assembly and gasket, and the fast idle cam.

3. Remove the choke housing shaft lever retaining nut, spacer and lever. Slide the fast idle cam over-travel off the choke housing shaft. Slide the fast idle pick-up rod from the fast idle cam over-travel lever.

4. Remove the retainer from the choke housing shaft and slide the shaft assembly out of the choke housing. Remove the thermostatic spring lever and the torsion spring from the shaft. Remove the nylon liner from the thermostatic spring lever.

## VACUUM PISTON CHOKE

1. Remove the fast idle cam retainer (Fig. 25).

2. Remove the thermostatic choke spring housing retaining screws and remove the clamp, housing and gasket.

3. Remove the choke housing assembly retaining screws. If the air horn was not previously removed,

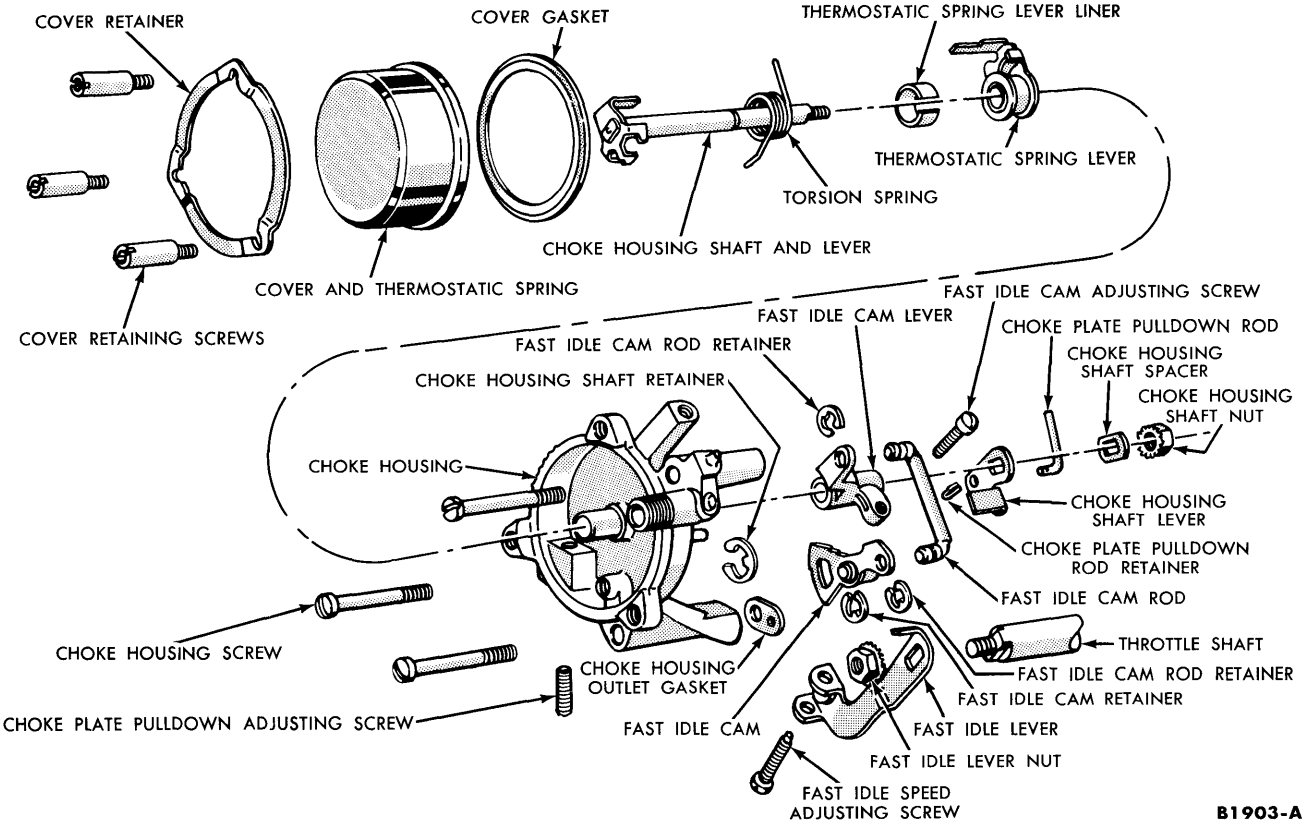



**FIG. 24–Mechanical Linkage Choke–Disassembled**

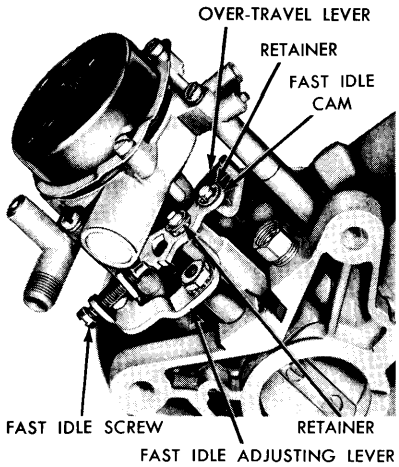



**FIG. 25—Fast Idle Cam and Fast Idle Lever**

remove the choke control rod retainer. Remove the choke housing assembly, gasket and the fast idle cam. Remove the fast idle cam and rod from the choke over-travel lever.

**4.** Remove the automatic choke shaft retaining screw and washer (Fig. 26). Remove the choke thermostat lever from the housing. If necessary, remove the pin securing the choke piston to the choke thermostat lever link. Remove the choke shaft and lever assembly, and the over-travel lever from the choke housing.

### MAIN BODY

**1.** Use a hook to disconnect the float shaft retainer from the float shaft (Figs. 27 and 28). Remove the float, torsion (damper) spring and shaft and the fuel inlet needle and clip assembly from the needle seat.

**2.** Remove the fuel inlet needle seat and the main jets with a jet

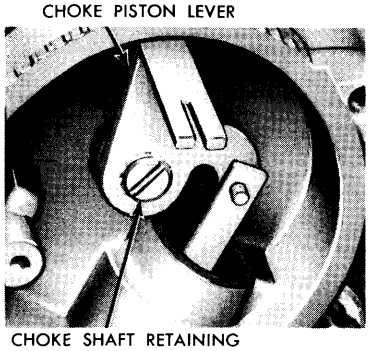



**FIG. 26—Choke Shaft and Lever**

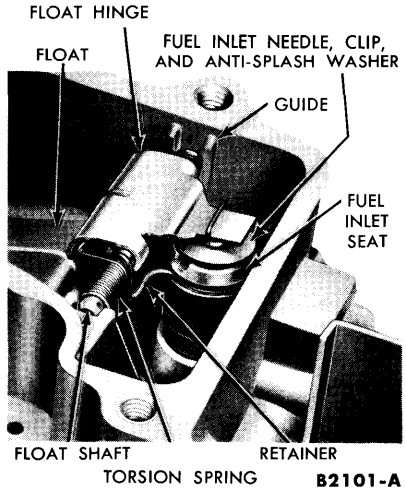



**FIG. 27—Float Assembly**

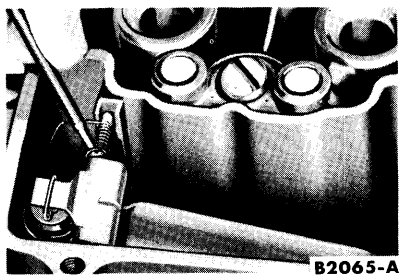



**FIG. 28—Float Shaft Retainer Removal or Installation**

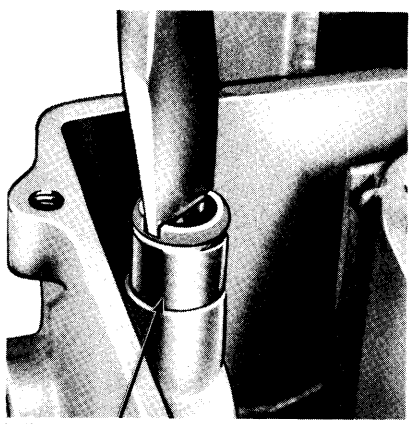



**FIG. 29—Fuel Inlet Needle Seat Removal or Installation**

wrench (Figs. 29 and 30).

**3.** Remove the accelerator pump discharge screw, air distribution plate (if so equipped), booster venturi and gasket (Fig. 31). Invert the main body and let the accelerating pump discharge weight and ball fall into the hand. Remove the fuel inlet fitting.

**4.** Remove the accelerator pump operating rod from the over-travel

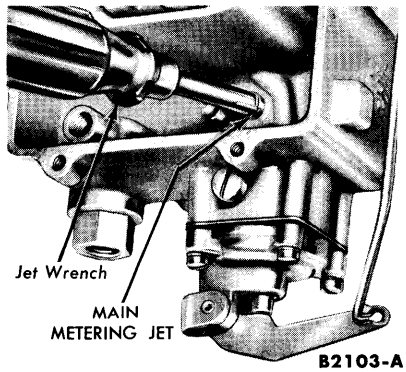



**FIG. 30—Main Jet Removal or Installation**

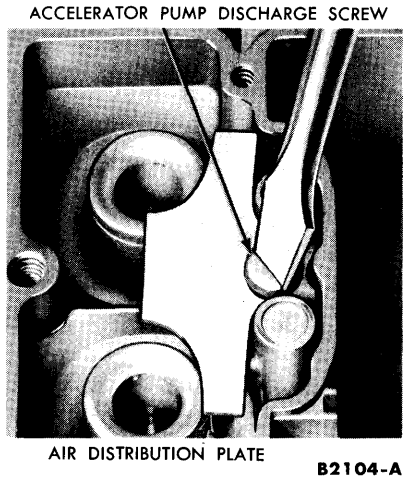



**FIG. 31—Booster Venturi Removal or Installation**

lever and the retainer. **To release the operating rod from the over-travel lever retainer, press the ends of the retainer together; then, at the same time, press the rod away from the retainer until it is disengaged.** Remove the rod and retainer.

**5.** Remove the accelerating pump cover, diaphragm assembly, and the spring (Fig. 32). Remove the inlet ball check retainer screw and the gasket. Remove the cavity filler. Invert the main body and let the inlet ball check fall into the hand.

**6.** Invert the main body and remove the power valve cover and the gasket. Remove the power valve with a box wrench (Fig. 33). Remove the power valve gasket. Discard the gasket.

**7.** Remove the idle fuel mixture adjusting screws (needles) and the springs.

**8.** Remove the nut and washer securing the fast idle adjusting lever assembly to the throttle shaft, and

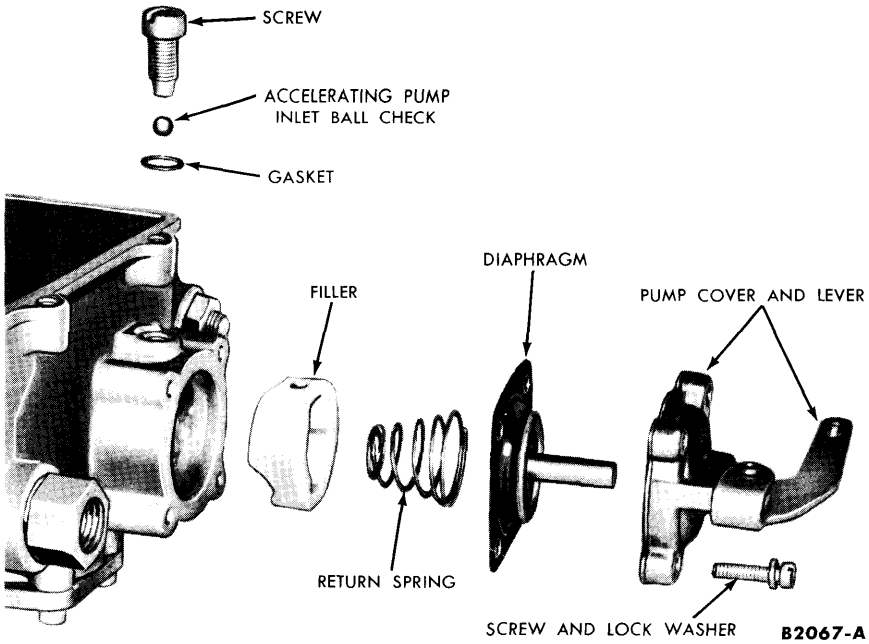



**FIG. 32—Accelerating Pump Assembly**

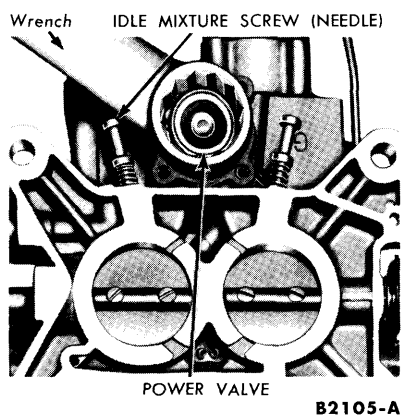



**FIG. 33—Power Valve Removal or Installation**

remove the lever assembly (Fig. 25). If necessary, remove the idle screw and the retainer from the fast idle adjusting lever.

**9.** If necessary, remove the distributor vacuum line fitting. Remove the anti-stall dashpot, if so equipped.

**10.** If it is necessary to remove the throttle plates, lightly scribe the throttle plates along the throttle shaft, and mark each plate and its corresponding bore with a number or letter for proper installation (Fig. 34).

**11.** Slide the throttle shaft out of the main body. Remove the accelerating pump over-travel lever retainer. Slide the anti-friction bearing (bushing), spring and the lever off the throttle shaft (Fig. 35).

## PARTS REPAIR OR REPLACEMENT

Clean and inspect the carburetor component parts. Refer to Part 10-1 for the proper procedure. Replace all worn or damaged parts.

## ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Make sure the accelerating pump diaphragm is not torn or cut.

The carburetor assembly is shown in Fig. 36.

### MAIN BODY

**1.** If the throttle plates were removed, install the over-travel anti-friction bushing over the boss on the over-travel lever. Place the over-travel spring, with the shortest tang end first, over the bushing and boss on the over-travel lever. Place the short tang of the spring under the lug on the accelerator over-travel lever.

**2.** Slide the over-travel lever and spring assembly on the throttle shaft and bushing. Hook the longest tang of the spring under the closed throttle lug of the throttle lever (Fig. 37). Install the over-travel lever retainer. Slide the throttle shaft assembly into the main body.

**3.** Referring to the lines scribed on the throttle plates, install the throttle plates in their proper location with the screws snug, but not tight. Close the throttle plates. Invert the main body, and hold it up to the light. Little or no light should show between the throttle plates and the throttle bores. Tap the plates lightly with a screwdriver handle to seat them. Hold the throttle plates closed and tighten and stake the retaining screws. **When staking the screws, support the shaft and plate on a block of wood or a metal bar to prevent bending of the shaft.**

**4.** If necessary, install the engine idle screw retainer and the screw on the fast idle adjusting lever. Install the distributor vacuum passage fitting.

**5.** Install the anti-stall dashpot, if so equipped.

**6.** Place the fast idle lever assembly on the throttle shaft and install the retaining washer and nut (Fig. 25).

On a mechanical linkage choke carburetor, install the fast idle cam and the fast idle cam retainer.

**7.** Drop the accelerating pump inlet ball check into the inlet passage of the accelerating pump chamber

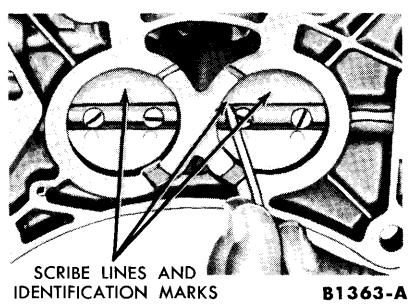



**FIG. 34—Throttle Plate Removal**

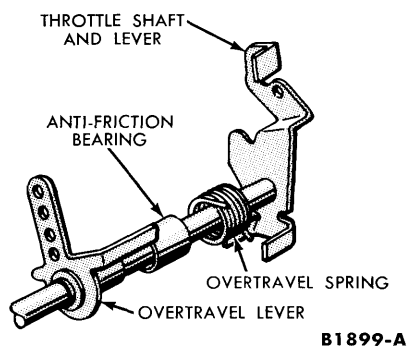



**FIG. 35—Throttle Shaft Assembly**

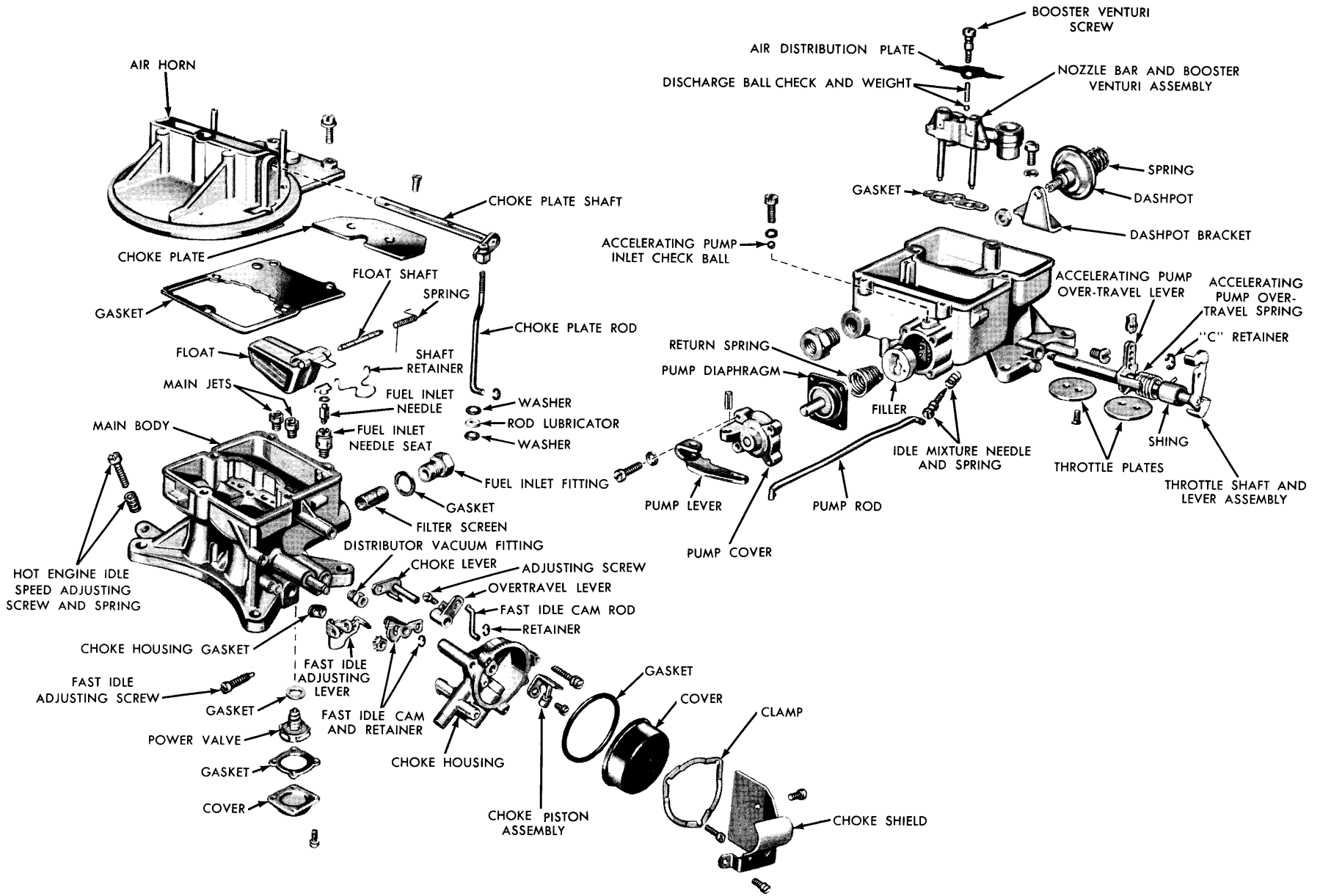



**FIG. 36—Ford Dual Carburetor—Disassembled**

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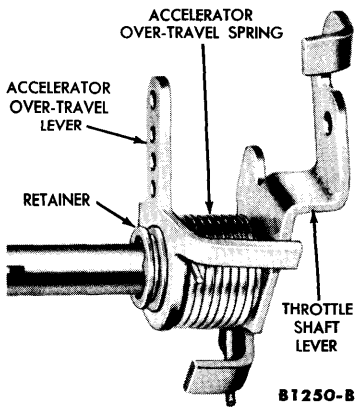



**FIG. 37—Accelerator Over-Travel Spring and Lever Installation**

(Fig. 32). Seat the ball with a brass drift and a light hammer. Make sure the ball is free in the bore. Install the cavity filler in the pump chamber. Install the retaining screw and washer.

**8.** Install the accelerating pump diaphragm return spring on the boss on the chamber (Fig. 32). Insert the diaphragm assembly in the cover and place the cover and diaphragm assembly in position on the main body. Install the cover screws.

**9.** Insert the accelerating pump operating rod into the inboard hole of the accelerating pump actuating lever. Position the accelerating pump operating rod retainer over the specified hole (Refer to "Specifications," Part 10-8) in the over-travel lever to suit the operating, and the climatic conditions under which the car is to be operated. Press the ends of the retainer together; then, at the same time, insert the operating rod through the retainer and the hole in the over-travel lever. Release the ends of the retainer to secure the rod.

**10.** Invert the main body. Install the power valve (economizer valve) and new gasket with a wrench (Fig. 33). **Tighten the valve securely.** Install the power valve cover and gasket.

**11.** Install the idle mixture adjusting screws (needles) and springs (Fig. 17). Turn the needles in gently with the fingers until they just touch the seat, then back them off 1-1½ turns for a preliminary idle fuel mixture adjustment.

**12.** Install the main jets and the fuel inlet seat and new gasket, using a jet wrench (Figs. 29 and 30). **Be sure the correct jets are installed.**

**13.** Position the float shaft retainer in the groove on the fuel inlet needle seat. Install the fuel inlet needle assembly in the fuel inlet seat. The fuel inlet needle and seat are matched assemblies. **Be sure the correct needle and seat are assembled together.**

**14.** Slide the float shaft into the float lever (Fig. 27). Install the torsion (damper) spring on the float shaft and insert the short end of the spring under the flange of the float lever.

**15.** Insert the float assembly into the fuel bowl and hook the float tab under the fuel inlet needle assembly. Insert the float shaft into its guides at the sides of the fuel bowl. Allow the long end of the damper spring to rest against the wall of the fuel bowl.

**16.** Use a hook to position the shaft retainer in the grooves on the shaft (Fig. 28). Refer to Part 10-1, and check the float setting.

**17.** Drop the accelerating pump discharge ball into its passage in the main body. Seat the ball with a brass drift and a light hammer. **Make sure the ball is free in the bore.** Drop the accelerating pump discharge weight on top of the ball. Position the new booster venturi gasket and the booster venturi in the main body. Position the air distribution plate, if so equipped, and install the accelerator pump discharge screw (Fig. 31).

**18.** Install the fuel inlet filter screen, and the fuel inlet fitting and gasket.

## MECHANICAL LINKAGE CHOKE

**1.** Install the torsion spring liner on the hub of the thermostatic spring lever. Position the torsion spring over the liner, then position the thermostatic spring with the long tang against the lug on the lever (Fig. 38 "A").

**2.** Slide the lever and spring assembly on the choke housing hub, with the short tang of the spring resting on the center prong of the lever and the lug on the shaft positioned in the slot in the thermostatic spring lever (Fig. 38 "B").

**3.** Place the assembly into the choke housing (Fig. 38 "C"). Install the retaining clip in the groove on the choke plate shaft.

**4.** Slide the fast idle cam over-travel lever over the choke housing shaft, with the head of the adjusting screw facing upward and toward the front of the carburetor (Fig. 39).

**5.** Place the choke housing shaft lever and spacer on the choke housing shaft, with the top of the lever tang located under the fast idle cam lever adjusting screw (Fig. 39). Install the retaining nut. Install the fast idle cam pick-up rod and retainer on the fast idle cam over-travel lever.

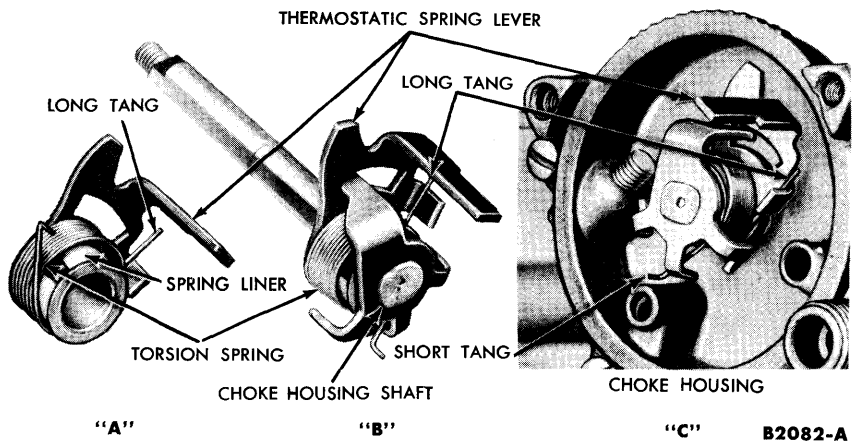



**FIG. 38—Choke Housing Torsion Spring Installation**

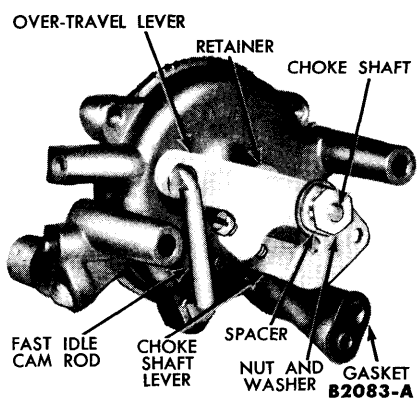



**FIG. 39—Choke Linkage**

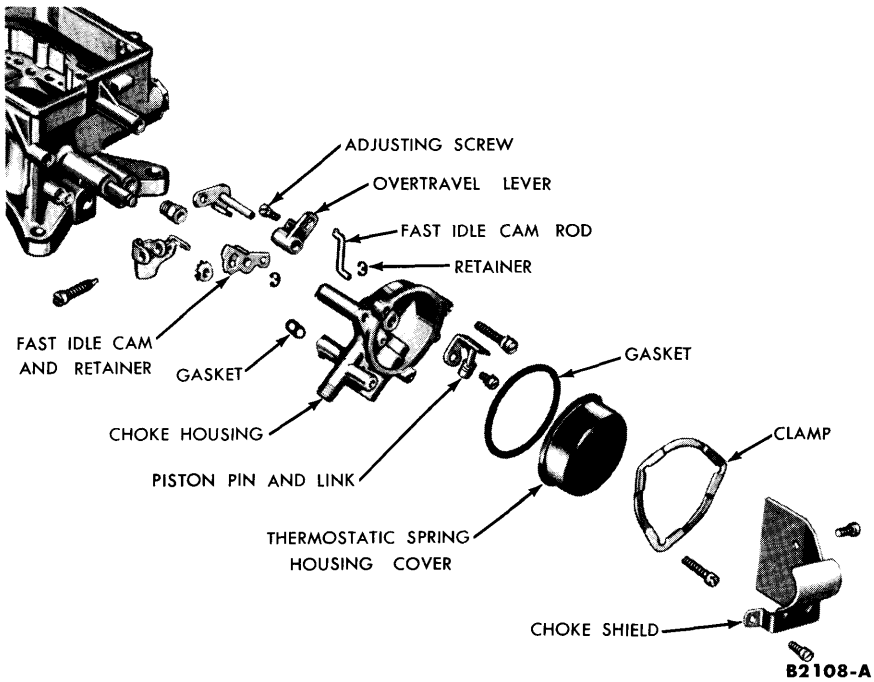



**FIG. 40–Choke Housing Assembly**

**6.** Place the gasket on the vacuum pick-up port of the choke housing (Fig. 39) and install the choke housing on the main body. Insert the fast idle cam pick-up lever into the fast idle cam as the choke housing is positioned into place. Install and tighten the choke housing retaining screws. Install the fast idle cam to pick-up rod retainer (Fig. 24).

**7.** Position the thermostatic spring housing gasket on the choke housing. Install the thermostatic spring housing on the choke housing and gasket with the arm of the thermostatic spring lever inserted into the loop of the thermostatic spring. Position the retainer over the thermostatic spring housing and install the retaining screws.

### VACUUM PISTON CHOKE

**1.** If the choke piston and link was disassembled install the choke piston on the choke thermostatic spring lever link and install the retaining pin (Fig. 40).

**2.** Position the over-travel lever on the thermostatic choke shaft and lever assembly (Fig. 40). **The bottom of the over-travel lever adjusting screw must rest against the tang on the choke shaft lever.** Insert the choke shaft assembly into the rear of the choke housing. Position the choke shaft lever so that the hole in the lever is to the left side of the choke housing.

**3.** Insert the choke piston into the choke housing, and install the choke thermostatic spring lever on the flange of the choke shaft. Install the choke thermostatic spring lever to shaft retaining screw and washer (Fig. 26).

**4.** Install the fast idle cam rod on the over-travel lever. Place the fast idle cam on the fast idle cam rod and install the retainer. Place the choke housing vacuum pick-up port to main body gasket on the choke housing flange. Position the choke housing on the main body and at the same time, install the fast idle cam on the hub on the main body. Position the gasket, and install the choke housing retaining screws. Install the fast idle cam retainer. **The thermostatic spring housing is installed after the choke plate has been adjusted to specification.**

### AIR HORN

Refer to Fig. 23 for the correct location of the parts.

**1.** If the choke plate shaft was removed, position the choke plate shaft in the air horn. Place the choke control rod seal between the two brass washers and slide them into position on the choke control rod seal retainer.

On a mechanical linkage choke carburetor installation, insert the choke control rod through the control rod seal and the air horn. Rotate the choke shaft and insert the rod in the keyhole slot in the choke shaft lever.

On a vacuum piston choke carburetor installation, insert the choke control rod through the control rod seal and the air horn. Insert the choke control rod into the choke shaft lever clevis nut, and turn the nut clockwise to thread the rod onto the nut.

**2.** If the choke plate was removed, insert the choke plate into the choke plate shaft. Install the choke plate screws snug, but not tight. Check for proper plate fit, binding in the air horn and free rotation of the shaft by moving the plate from the closed position to the open position. If necessary, remove the choke plate and grind or file the plate edge where it is binding or scraping on the air horn wall. If the choke plate and shaft moves freely, tighten the choke plate screws while holding the choke in the fully-closed position. Stake the screws. **When staking the screws, support the shaft and plate on a block of wood or a metal bar to prevent bending of the shaft.**

**3.** Position the air horn gasket on the main body, with the fuel bowl vent hole in the gasket located opposite the fuel inlet valve.

**4.** Position the air horn over the main body and insert the end of the choke lever rod into the automatic choke shaft lever. Install the air horn retaining screws and the carburetor identification tag. Tighten the retaining screws. Install the choke lever rod retainer. Install the air cleaner anchor screw.

**5.** Refer to Part 10-3, Section 2, "In-Car Adjustments and Repairs" and perform the automatic choke plate clearance (pull-down) and fast idle cam linkage adjustment. Perform a fuel level float adjustment (wet) after the carburetor has been installed on the car.

# PART 10-4 FORD 4-BARREL CARBURETOR


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| 2 In-Car Adjustments and Repairs | 10-42 | 4 Major Repair Operations | 10-47 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

The Ford 4-barrel carburetor (Figs. 1, 2 and 3) has two main assemblies; the air horn, and the main body.

The air horn assembly, which serves as the main body cover, contains the choke plate, the hot idle compensator, the vents for the fuel bowls, and the secondary throttle control vacuum tube and the choke plate magnet.

The primary and secondary throttle plates, the accelerator pump assembly, the power valve assembly, the secondary operating diaphragm assembly, and the fuel bowls are in the main body. The automatic choke housing is attached to the main body.

The two primary (front) barrels each contain a main and booster venturi, main fuel discharge, accelerating pump discharge, idle fuel discharge, and a primary throttle plate.

The two secondary (rear) barrels each have a main and booster venturi, idle fuel discharge, secondary main fuel discharge, and a vacuum operated throttle plate.

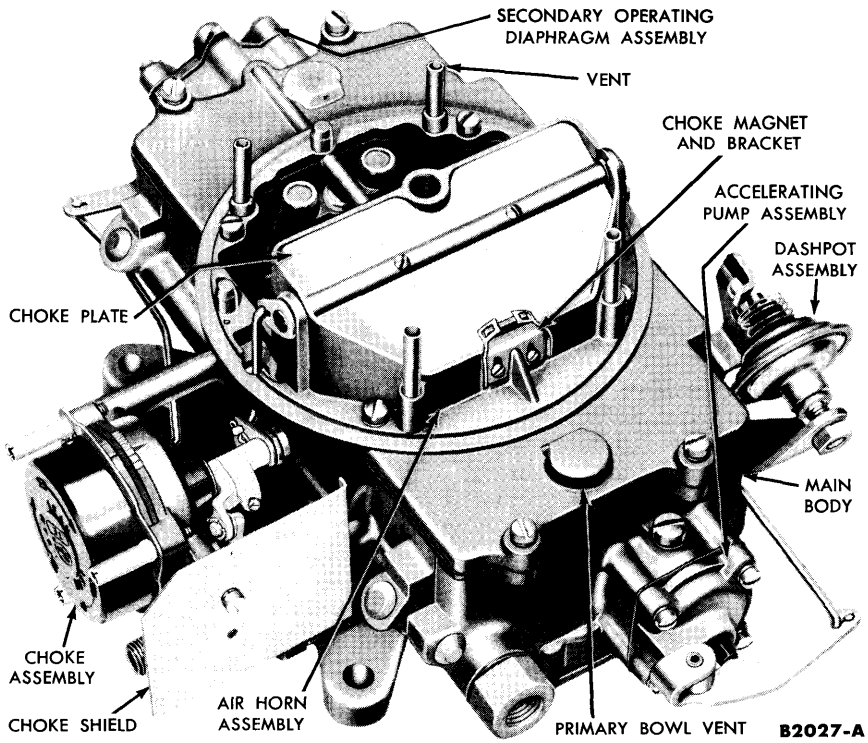



**FIG. 1—Ford 4-Barrel Carburetor—¾ Front View**

### OPERATION

#### FUEL INLET SYSTEM

A separate fuel bowl is provided for the primary and secondary stages (Fig. 4). The fuel first enters the primary fuel bowl through the fuel inlet. A drilled passage through the right side of the main body connects the fuel bowls. The pressure in the two fuel bowls is balanced by means of a pressure equalizing chamber built into the left side of the main body. Two baffles in the internal fuel equalizer passage between the primary and secondary fuel bowls permit proper control and balance of the metering forces within each fuel bowl.

The amount of fuel entering the fuel bowl is regulated by the distance the fuel inlet needle is raised off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a pre-set level, the float lowers the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used.

A retracting clip is attached to the fuel inlet needle and hooks over the tab of the float assembly. This clip assures reaction of the fuel inlet needle to any movement of the float.

An integral anti-splash washer is located on top of each fuel inlet needle.

A wire-type retainer prevents movement of the float shaft within the guides on each side of the fuel bowl. The retainer fits into a groove on the inlet needle seat. The ends of the retainer are hooked over grooves on opposite ends of the float shaft.

A torsion (damper) spring is located on the float shaft, between the inboard end of the float retainer and the float shaft guide in the fuel bowl. The short end of the spring rests under the float lever, and the long end of the spring rests against the inner face of the fuel bowl.

The torsion spring tension resists and absorbs fuel pump pressure pulsations and movement of the fuel in the bowl due to driving conditions. This assures proper regulation of the fuel inlet needle which rises and falls with the fuel level in the bowl.

The primary and secondary fuel bowls are vented externally at all

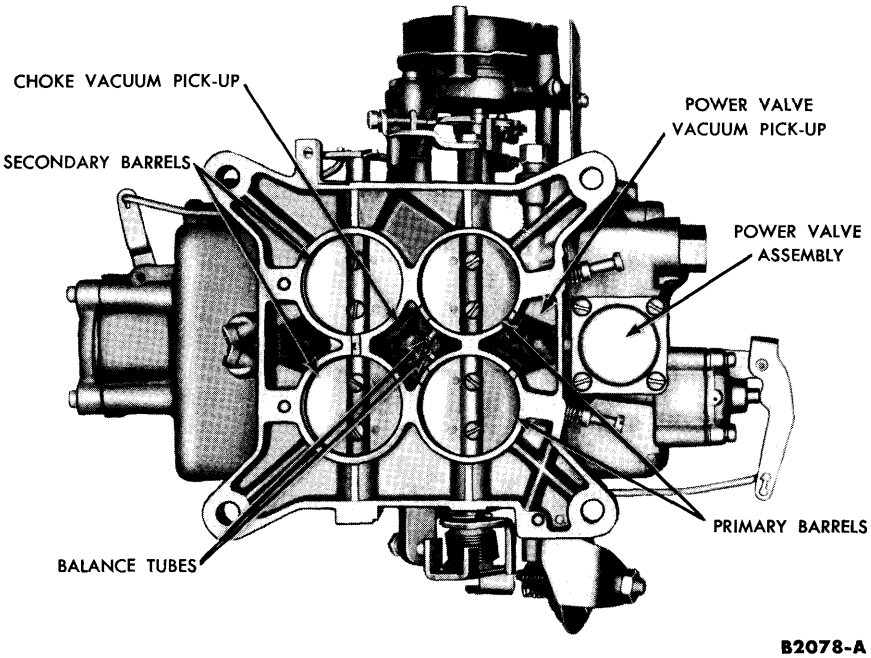



**FIG. 2—Ford 4-Barrel Carburetor—Bottom View**

times. In addition, both the primary and secondary fuel bowls are internally vented into the air cleaner. The standpipe pitot tubes in the primary and secondary internal vent tube openings raise the level of the internal vent openings above the external vent openings. This provides the necessary pressure differential for proper evacuation of the gaseous vapors through the external vent during a hot soak period.

## AUTOMATIC CHOKE SYSTEM

The choke plate, located in the air horn above the primary barrels, when closed, provides a high vacuum above as well as below the throttle plates. With a vacuum above the throttle plates, fuel will flow from the main fuel system as well as from the idle fuel system. This provides the extremely rich fuel mixture necessary for cold engine operation.

The carburetor choke shaft is linked to a thermostatic choke control mechanism mounted on the main body (Fig. 5).

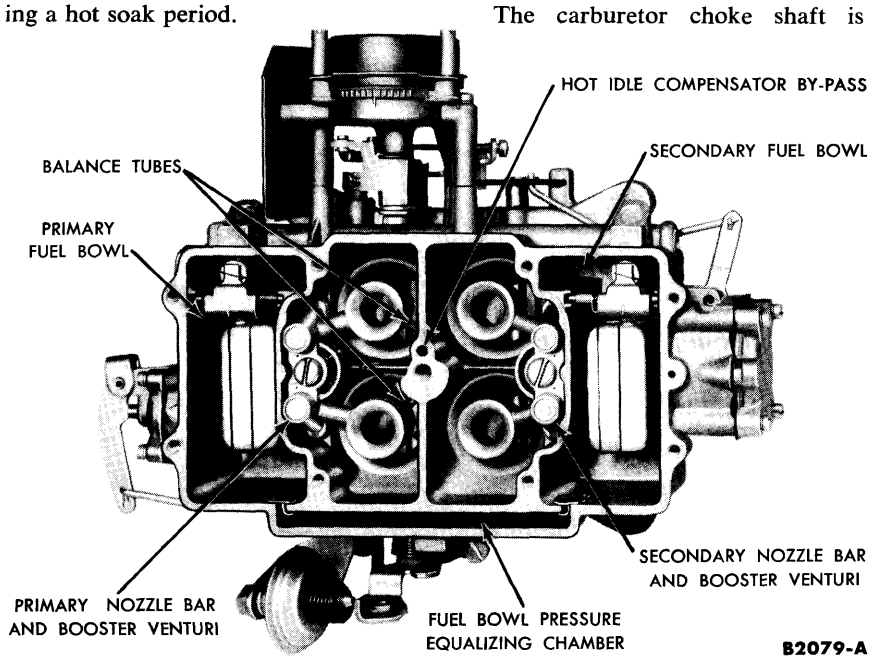



**FIG. 3—Ford 4-Barrel Carburetor—Top View**

The bi-metal thermostatic spring mechanism unwinds when cold and winds up when warm. When the engine is cold, the thermostatic spring, through attaching linkage, holds the choke plate in a closed position. When the engine is started, enough air is drawn around the choke plate to enable the engine to operate and prevent flooding.

As the engine continues to operate, manifold vacuum, channeled through a passage on the bottom of the main body to the choke housing, draws heated air from the exhaust manifold heat chamber. The amount of air entering the choke housing is controlled by restrictions in the air passages in the carburetor.

The warmed air and heat radiated from the attached heater hose enters the choke housing and heats the thermostatic spring causing it to wind up. The tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to open. The air is exhausted into the intake manifold.

When the engine reaches its normal operating temperature, the spring exerts tension on the choke plate forcing it to the full open position.

During the warm-up period, if the engine should reach the stall point due to a lean mixture, manifold vacuum will drop considerably. The tension of the torsion spring then overcomes the lowered vacuum and air velocity acting on the choke plate. The choke plate will be moved toward the closed position, providing a richer mixture to help prevent stalling.

The fast idle cam pick-up rod actuates the fast idle cam during choking. One edge of the fast idle cam contacts the fast idle adjusting screw which permits a faster engine idle speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the pick-up lever rotates the fast idle cam. Each position on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

The linkage between the choke lever and the throttle shaft is designed so that the choke plate will partially open when the accelerator

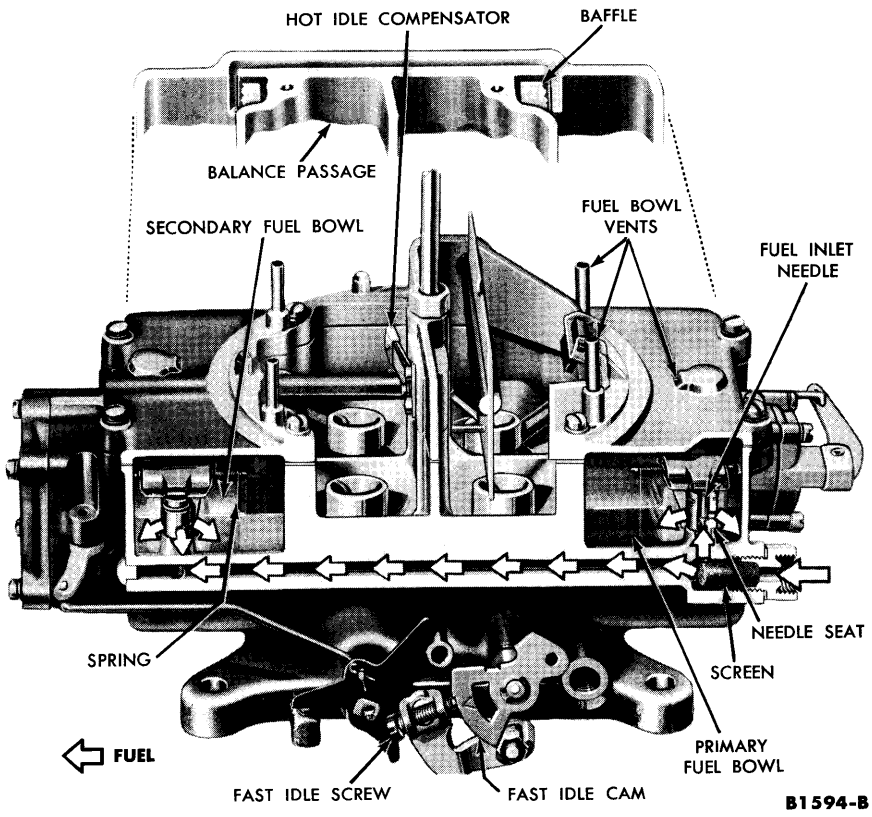



**FIG. 4—Fuel Inlet System**

pedal is fully depressed. This permits unloading of a flooded engine.

### IDLE FUEL SYSTEM

The difference in pressure between the fuel bowls and the idle discharge ports forces fuel through the primary and secondary stage idle fuel systems.

**Primary Stage.** Fuel flows from the primary stage fuel bowl through the main jet and into the bottom of the main well (Fig. 6).

From the main well, the fuel flows up through the idle tube and through a short diagonal passage in the booster venturi assembly into the idle passage in the main body. A calibrated restriction, at the upper tip of the idle tube, meters the flow of fuel.

Air enters the system from the air bleed which is located directly above the idle tube. The air bleed also acts as a vent to prevent siphoning at off-idle or high speeds and when the engine is stopped. The fuel and air pass down a diagonal passage in the booster venturi and through a calibrated restrictor. Additional air is bled into the system through an air bleed located at the bottom of the diagonal passage where the fuel enters the idle passage in the main body.

Fuel flows down the idle passage in the main body past two idle transfer holes. The idle transfer holes act as additional air bleeds at curb idle. The fuel then flows past the pointed tip of the adjusting needle which controls the idle fuel discharge in the primary stage. From the adjusting needle chamber, the fuel flows through a short horizontal passage and is discharged below the primary throttle plates.

During off-idle when the primary throttle plate is moved slightly past the idle transfer holes, each hole begins discharging fuel as it is exposed to manifold vacuum. As the primary throttle plate is opened still wider and engine speed increases, the air flow through the carburetor is also increased. This creates a vacuum in the booster venturi strong enough to

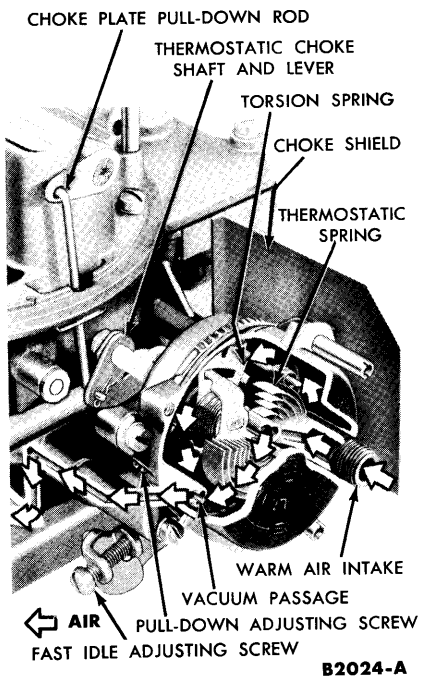



**FIG. 5—Automatic Choke System**

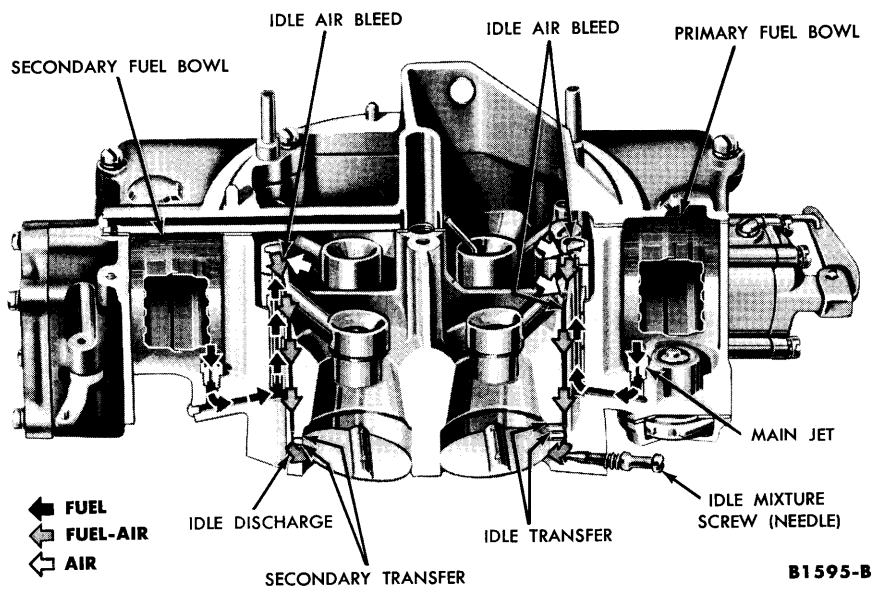



**FIG. 6—Idle Fuel System**

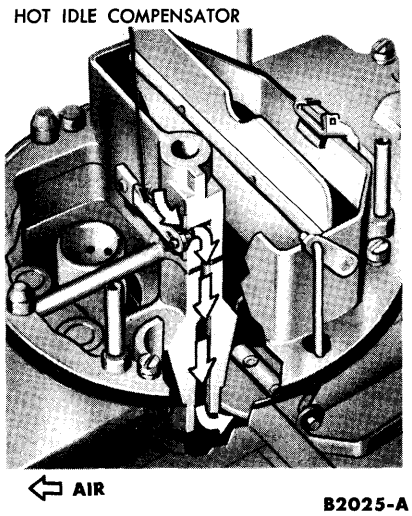



**FIG. 7—Hot Idle Compensator System**

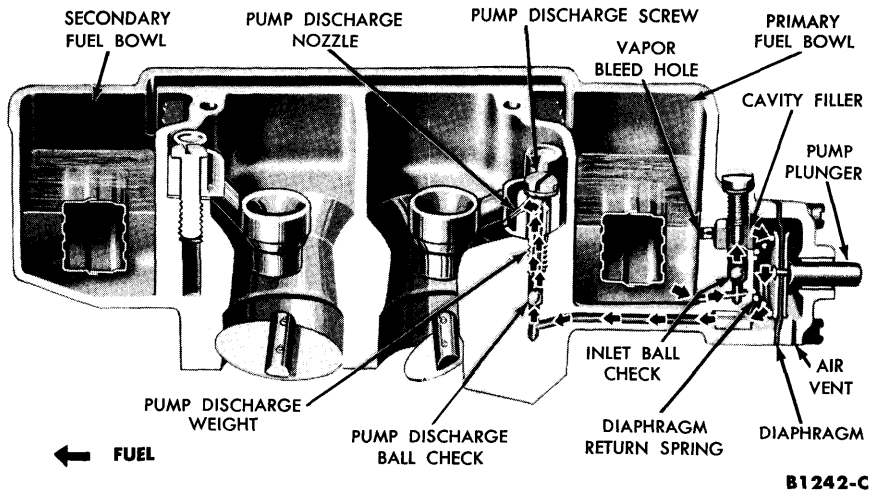



**FIG. 8—Accelerating System**

bring the primary stage main fuel system into operation. Fuel flow from the primary idle fuel system begins tapering off as the main fuel system begins discharging fuel.

A thermostatically controlled hot idle compensator is located on the air horn above the secondary booster venturis (Fig. 7). At carburetor high inlet air temperatures, the hot idle compensator will open and allow air to bypass the throttle plates through a passage in the air horn and main body and enter the intake manifold. This improves idle stability and minimizes the effect of fuel vaporization which results in excessively rich idle mixtures.

**Secondary Stage.** Fuel flows from the secondary stage fuel bowl through the main jet and into the bottom of the main well (Fig. 6).

From the main well, the fuel flows up through the idle tube and through a short diagonal passage in the booster venturi assembly and then into the idle passage in the main body. A calibrated restriction, at the upper tip of the tube, meters the flow of fuel.

Fuel flows down the idle passage in the main body past two transfer holes above the closed throttle plate and flows through a metered restriction into a short horizontal passage and is discharged into the secondary barrel below the closed throttle plate. The transfer holes act as air bleeds at idle. The secondary idle fuel system continues discharging fuel until the secondary main fuel system comes into operation.

Air is introduced into the secondary stage idle fuel system from the idle air bleed which is located directly above the idle tube. The air bleed also acts as a vent to prevent siphoning in the idle fuel system at high speeds and when the engine is stopped.

## ACCELERATING SYSTEM

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the fuel, which is heavier than air, can gain speed and maintain the desired balance of fuel and air. During this interval, the accelerating system (Fig. 8) supplies fuel until the other systems can once again provide the proper mixture.

When the throttle is closed, the diaphragm return spring forces the diaphragm toward the cover, drawing fuel into the chamber through the inlet. The inlet has a ball check which opens to admit fuel from the primary fuel bowl and closes when the accelerating pump is operated to prevent a reverse flow. A discharge weight and ball check prevent air from entering when fuel is drawn into the chamber.

When the throttle is opened, the diaphragm rod is forced inward, forcing fuel from the chamber into the discharge passage. Fuel under pressure forces the pump discharge weight and ball off their seat and fuel passes through the accelerating pump discharge screw and is sprayed into each primary booster venturi through discharge ports.

An air bleed in the wall of the accelerating pump fuel chamber prevents siphoning of fuel when the accelerating pump is not operating.

## PRIMARY STAGE MAIN FUEL SYSTEM

As engine speed increases, the air passing through the booster venturi creates a vacuum. The amount of vacuum is determined by the air flow through the venturi, which in turn is regulated by the speed of the engine. The difference in pressure between the main discharge port and the fuel bowl causes fuel to flow through the main fuel system (Fig. 9).

At a predetermined venturi vacuum, fuel flows from the primary fuel bowl, through the main jets, and into the bottom of the main well. The fuel moves up the main well tube past air bleed holes. Filtered air from the high speed air bleed enters the fuel flow in the main well tube through holes in the side of the tube. The high speed air bleed meters an increasing amount of air to the fuel as venturi vacuum increases, maintaining the required fuel-air ratio. The mixture of fuel and air is lighter than raw fuel and responds faster to changes in venturi vacuum. It also vaporizes more readily than raw fuel. The fuel and air continue up the main well tube past another air bleed which also acts as a vent to prevent siphoning when the engine is shut down. The fuel is discharged into the booster venturi where it is vaporized and mixed with the air flowing through the carburetor.

The throttle plate controls the amount of the fuel-air mixture admitted to the intake manifold, regulating the speed and power output of the engine.

A balance tube is located in each primary barrel directly below the booster venturi. When decelerating, the balance tube siphons off any ex-

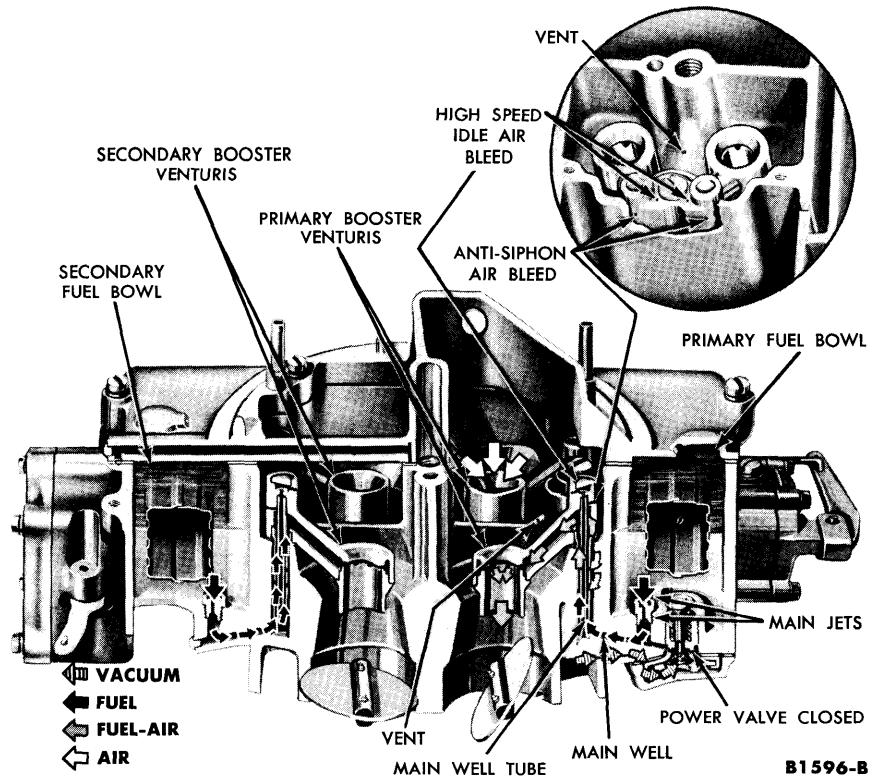



**FIG. 9—Primary Stage Main Fuel System**

cess fuel droplets remaining around the edge of the booster venturi and discharges the droplets into the equalizing slots in the base of the carburetor where they are mixed with the idle fuel. The balance tube also acts as an additional air bleed during the idle fuel system operation.

### POWER FUEL SYSTEM

During periods of increased road loads or high speed operation, the fuel-air ratio must be increased for added power. The added fuel required during this period is supplied by the power fuel system (Fig. 10).

The power fuel system is controlled by manifold vacuum.

Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. A power valve bleed, located above the primary venturis, syphons off fuel vapors pulled through the manifold vacuum passage. The manifold vacuum, acting on the power valve at idle speed or normal road load conditions, is great enough to hold the power valve diaphragm down, overcoming the tension of the spring on the valve stem and holding the valve closed. When high power operation places a greater load on the engine and manifold vacuum drops below a predetermined value, the spring opens the power valve. Fuel from the primary fuel bowl flows through the power valve and into passages leading to both primary stage main fuel wells. Here the fuel is added to the fuel from the primary stage main fuel system, enriching the mixture.

As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the power valve.

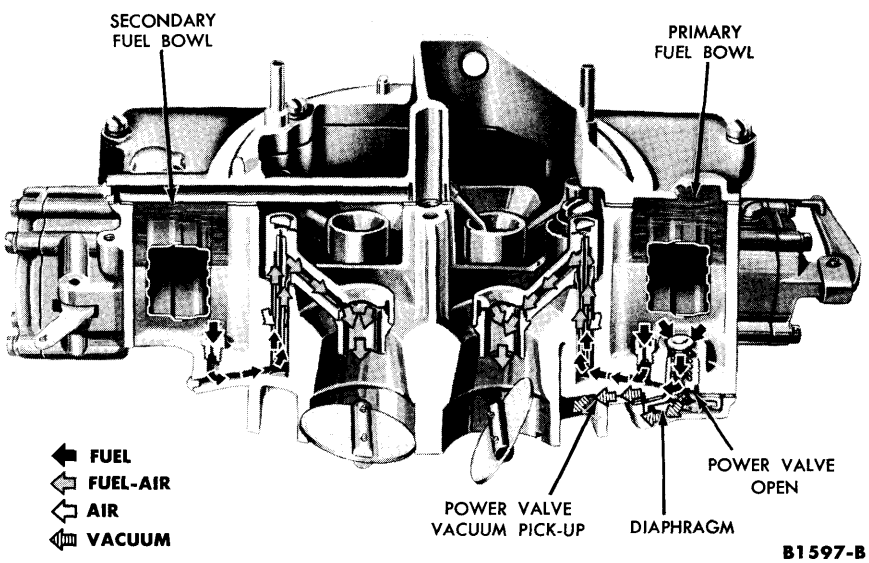



**FIG. 10—Power Fuel System**

### SECONDARY THROTTLE OPERATION AND MAIN FUEL SYSTEM

To provide sufficient fuel-air mixture to operate the engine at maximum power, the power supplied by the primary stage is supplemented by an additional quantity of fuel-air mixture from the secondary stage (Fig. 11).

This additional supply of fuel-air mixture is delivered through the two secondary (rear) barrels of the carburetor. The secondary stage throttle plates are operated by a spring-loaded vacuum diaphragm assembly attached to the main body and linked to the secondary throttle shaft.

Opening of the secondary throttle plates is controlled by vacuum from the left primary booster venturi. The vacuum is transmitted from the secondary throttle control vacuum tube through passages in the air horn, main body, and behind the secondary operating diaphragm.

As the primary throttle plates are opened, primary venturi vacuum increases. When the vacuum reaches a predetermined amount, it starts to act on the secondary stage operating diaphragm, which in turn starts to open the secondary throttle plates.

A ball check, located in the vacuum passage in the diaphragm housing, controls the rate at which the secondary throttle plates are allowed

to open. Any rapid increase in vacuum which would tend to open the secondary throttle plates too suddenly holds the ball check against its seat. The opening of the secondary throttle plates is slowed to a rate governed by the amount of vacuum passing through a bleed in the ball seat.

As the secondary throttle plates begin to open, fuel flows from the secondary fuel bowl through the secondary main jets into the bottom of the main well and up the main well tube past air bleed holes. Air is introduced through an air bleed at the top of the tube. When the secondary throttle plates are moved slightly past the secondary transfer holes, each hole begins discharging fuel as it is exposed to manifold vacuum. As secondary venturi vacuum is increased, the fuel is discharged into the secondary booster venturi. Fuel from the transfer holes tapers off and the holes act as additional air bleeds.

When decelerating, vacuum in the primary venturi decreases, and the secondary throttle plates begin to close. The ball check in the diaphragm housing passage will unseat when the throttle is closed quickly, allowing the low pressure on the vacuum side of the diaphragm to rapidly return to atmospheric pressure. As the vacuum acting on the diaphragm is lessened, the load on the diaphragm spring will start closing the secondary plates.

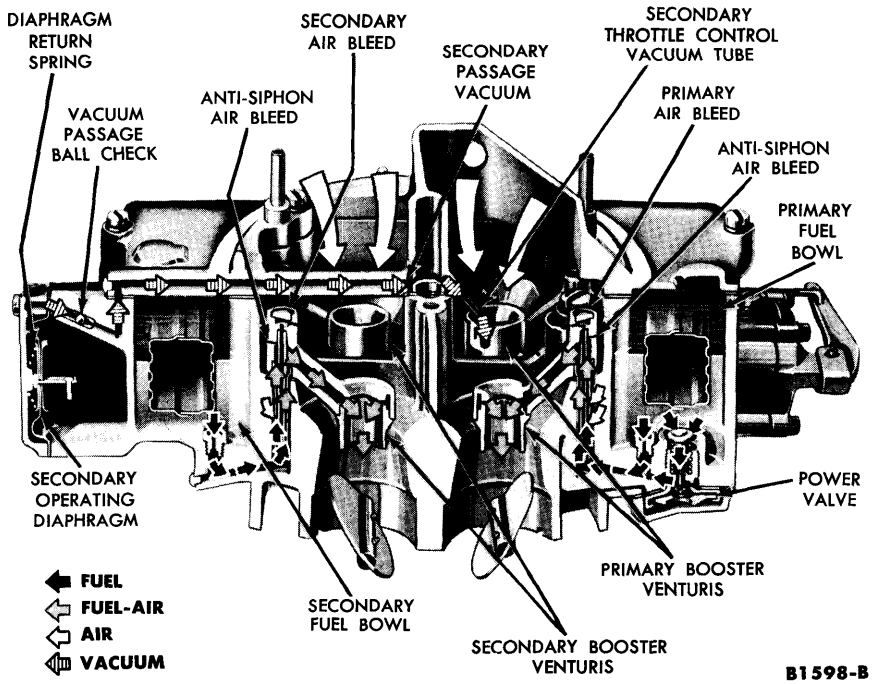



**FIG. 11—Secondary Stage Main Fuel System**

## 2 IN-CAR ADJUSTMENT AND REPAIR

The fuel level float adjustment (dry) and the secondary throttle plate adjustment are performed only as bench adjustments (Part 10-1).

The choke plate clearance (pulldown) and fast idle cam linkage adjustment, the choke magnet and bracket adjustment, the automatic choke thermostatic spring housing adjustment, and the accelerating pump stroke adjustment can be performed with the carburetor on the bench or installed in the car.

### FUEL LEVEL FLOAT ADJUSTMENT—WET

The dry (bench) float fuel level settings are preliminary adjustments performed during carburetor overhaul procedures on the bench. These settings are used as a guide only; therefore, a final check and adjustment of the wet fuel level should be made as follows:

**1.** Operate the engine for 30 minutes at 1200 rpm to normalize engine temperatures, and place the car on a flat surface as near level as possible. Stop the engine.

**2.** Remove the air cleaner assembly, carburetor air horn assembly, and gasket.

**3.** Temporarily place the air horn gasket in position on the carburetor main body and start the engine. Let the engine idle for several minutes, then remove the air horn gasket.

**4.** While the engine is idling, use a standard depth scale to measure the vertical distance from the top machined surface of the carburetor main body to the level of the fuel in the fuel bowl (Fig. 12). The measurement must be made at least ¼ inch away from any vertical surface to assure an accurate reading, because the surface of the fuel is concave (higher at the edges than in the center). Care must be exercised to measure the fuel level at the point of contact with the fuel. Refer to the specifications for the correct fuel level (wet) setting.

**5. If any adjustment is required, stop the engine to minimize the hazard of fire due to fuel spray when the float setting is disturbed.** To adjust the fuel level, bend the float tab (contacting the fuel inlet valve) upward in relation to the original position to raise the fuel level, and downward to lower it. Each time an adjustment is made to the float tab to alter the fuel level, the engine must be started and permitted to idle for at least three minutes to stabilize the fuel level. Check the fuel level after each adjustment until the specified level is achieved.

**6.** Install the new air horn gasket and the carburetor air horn assembly.

**7.** Check the idle fuel mixture and idle speed adjustment. Adjust the carburetor as required.

**8.** Install the air cleaner assembly.

### CHOKE MAGNET AND BRACKET ADJUSTMENT

**1.** Remove the air cleaner assembly. Remove the bracket retaining the heater hose against the automatic choke thermostatic spring housing.

**2.** Rotate the thermostatic spring housing 90° in the "rich" direction (counterclockwise).

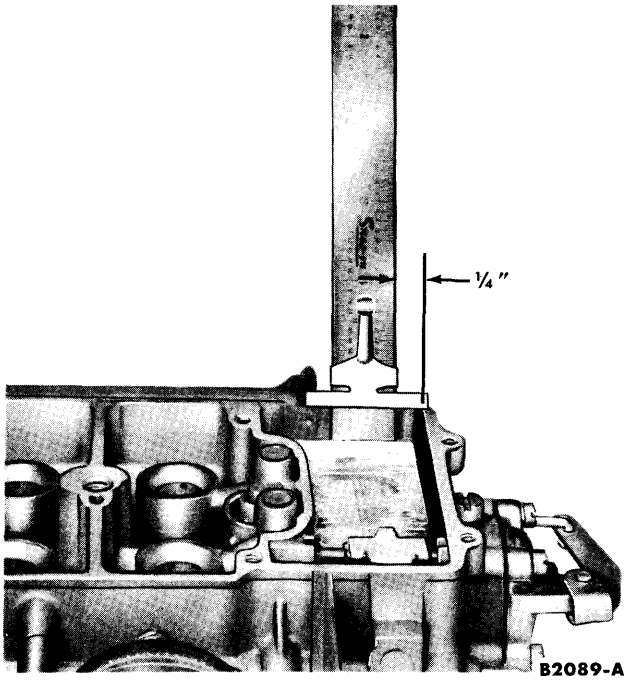



FIG. 12—Fuel Level Float Adjustment—Wet

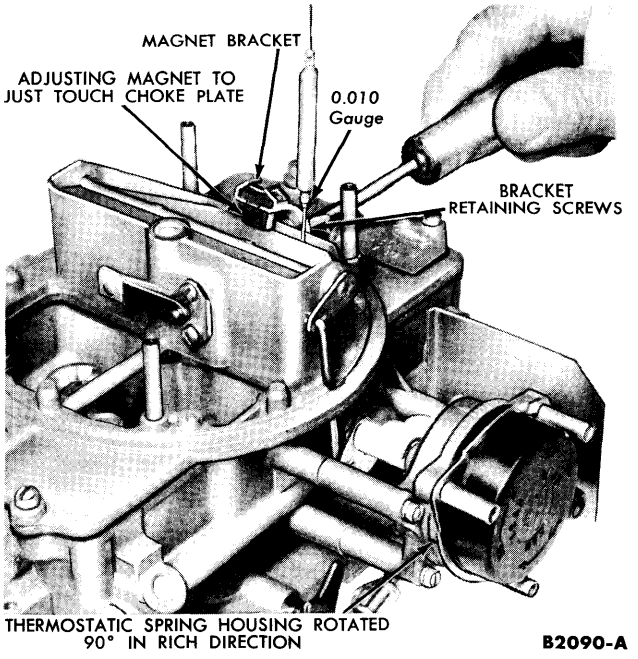



FIG. 13—Magnet and Bracket Adjustment

3. Place a 0.010 inch feeler gauge, or wire between the downward (front) side of the choke plate and the air horn wall (Fig. 13).

4. Loosen the magnet bracket retaining screws and adjust the magnet to just contact the choke plate. Tighten the retaining screws and remove the feeler gauge. Stake the retaining screws.

5. If the choke plate clearance (pull-down) and fast idle cam linkage adjustment is not required, set the thermostatic coil housing to the specified index mark and tighten the retaining clamp screws.

6. Install the heater hose and bracket on the carburetor and tighten the bracket retaining screws.

## AUTOMATIC CHOKE PLATE CLEARANCE (PULL-DOWN) AND FAST IDLE CAM LINKAGE ADJUSTMENT

1. If the heater hose and mounting bracket, and the air carburetor air cleaner assembly have not been previously removed, remove them from the carburetor.

2. Rotate the choke thermostatic spring housing 90° in the "rich" direction (counterclockwise).

3. Open the throttle plates so the fast idle screw does not contact the fast idle cam.

4. Depress the downward (front) side of the choke plate lightly until resistance is felt. **The clearance between the downward side of the choke plate and the air horn wall is the choke plate pull-down clearance** (Fig. 14). Check the clearance by placing a gauge or the shank end of drill of the specified clearance dimension between the downward (front) edge of the choke plate and the air horn wall (Fig. 14).

If the choke plate clearance is not within specification, turn the pull-down adjusting screw (Fig. 14) clockwise (inward) to increase the clearance, or counterclockwise (outward) to decrease the clearance.

5. Set the fast idle (rpm) adjusting screw on the kickdown step of the fast idle cam. Check the clearance dimension between the downward (front) edge of the choke plate and the air horn wall. If the clearance is not within specification, turn the over-travel lever adjusting screw (Fig. 15) clockwise (inward) to increase the clearance, or counterclockwise (outward) to decrease the clearance.

6. Set the choke thermostatic coil housing to the specified index mark and tighten the clamp retaining screws.

7. Install the heater hose and mounting bracket on the carburetor and tighten the retaining screws.

8. Adjust the engine idle speed and idle fuel mixture, if necessary.

9. Install the air cleaner.

## AUTOMATIC CHOKE THERMOSTATIC SPRING HOUSING ADJUSTMENT

1. If the heater hose and mounting bracket, and the carburetor air cleaner assembly have not been previously removed, remove them from the carburetor.

2. Loosen the thermostatic spring housing clamp retaining screws. Set the spring housing to the specified index mark (Fig. 16) and tighten the clamp retaining screws.

3. Install the heater hose and bracket on the carburetor and tighten the bracket retaining screws. If other carburetor adjustments are not required, install the carburetor air cleaner assembly.

## IDLE FUEL MIXTURE AND IDLE SPEED ADJUSTMENTS

The engine idle speed is adjusted to settings for a hot engine, and a cold engine (fast idle speed) during choke operation. With the air cleaner removed make the idle adjustments. in the following sequence:

### INITIAL IDLE MIXTURE SETTING

Initially set the idle mixture by turning the idle mixture screws (needles) inward (clockwise) until lightly seated; then, turn the screws outward (counterclockwise) 1-1½ turns (Fig. 17). **Do not turn the**

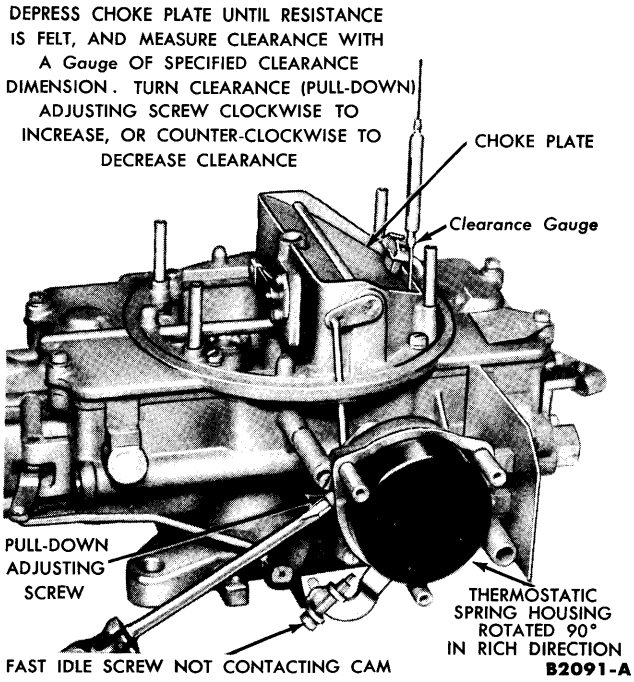



**FIG. 14—Choke Plate Clearance (Pull-Down) Adjustment**

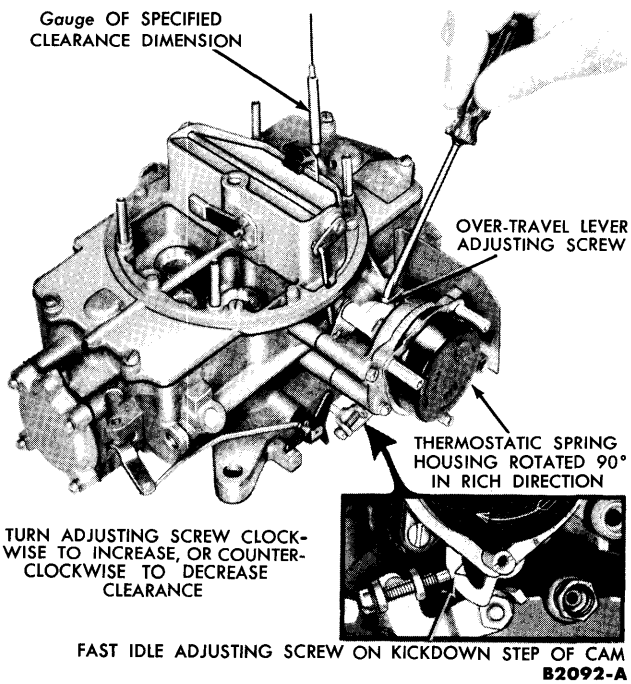



**FIG. 15—Fast Idle Cam Linkage Adjustment**

**needles tightly against their seats as this may groove the ends. If the needle is damaged, it must be replaced before a satisfactory fuel mixture can be obtained.**

### ENGINE IDLE SPEED AND MIXTURE (HOT)

1. Operate th engine for 3 minutes at approximately 1200 rpm to stabilize engine temperatures. **On a car with an air conditioner, operate the air conditioner for 20 minutes before setting the engine idle speed. The engine idle speed is adjusted with the air conditioner operating.**

2. Allow the throttle to drop back to the normal idle speed position. Attach a tachometer to the engine. **Set the parking brake.**

3. Place the transmission selector lever in drive range. Check the engine idle speed. **Be sure the dashpot is not interfering with the throttle lever or the fast idle screw is not contacting the fast idle cam. Also, be sure the hot idle compensator is seated to allow for proper adjustment.**

4. Adjust the engine idle speed to drive range specifications by turning the engine idle speed screw inward to increase the speed or outward to decrease the speed (Fig. 18).

5. Turn each idle mixture needle inward until engine rpm begins to drop, due to the lean mixture (Fig. 18); then turn each needle outward until the rpm increases and then begins to drop, due to the rich mixture, then turn the needles inward for maximum engine rpm and smoothness. **The needles should be turned approximately the same amount. The final setting may vary about ½ turn difference between needles.**

6. After the correct engine idle mixture has been obtained, check the idle speed by placing **the transmission selector lever in neutral and manually opening and closing the throttle.** Position the selector lever in drive range, then check and adjust the idle speed, if necessary. Shut off the engine.

**The final engine idle speed may be varied to suit the conditions under which the car is to be operated.**

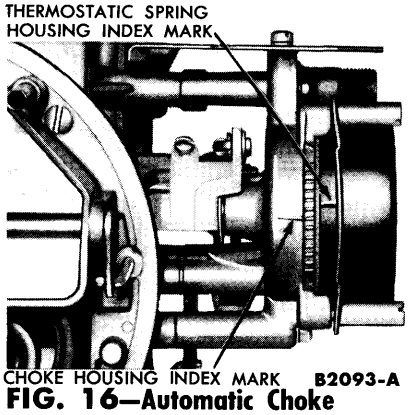



**FIG. 16—Automatic Choke Thermostatic Spring Housing Adjustment**

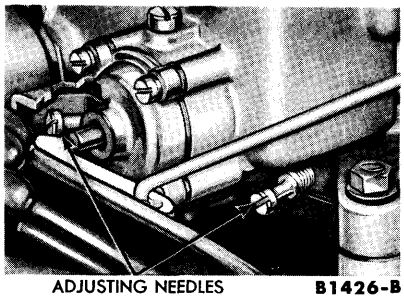



**FIG. 17—Idle Fuel Mixture Adjustment**

### ENGINE FAST (COLD) IDLE SPEED

The adjusting screw on the right side of the carburetor (Fig. 19) contacts one edge of the fast idle cam. The cam permits a faster engine idle speed for smoother running when the engine is cold during choke operation. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Each position on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

1. Manually rotate the fast idle cam until the fast idle adjusting

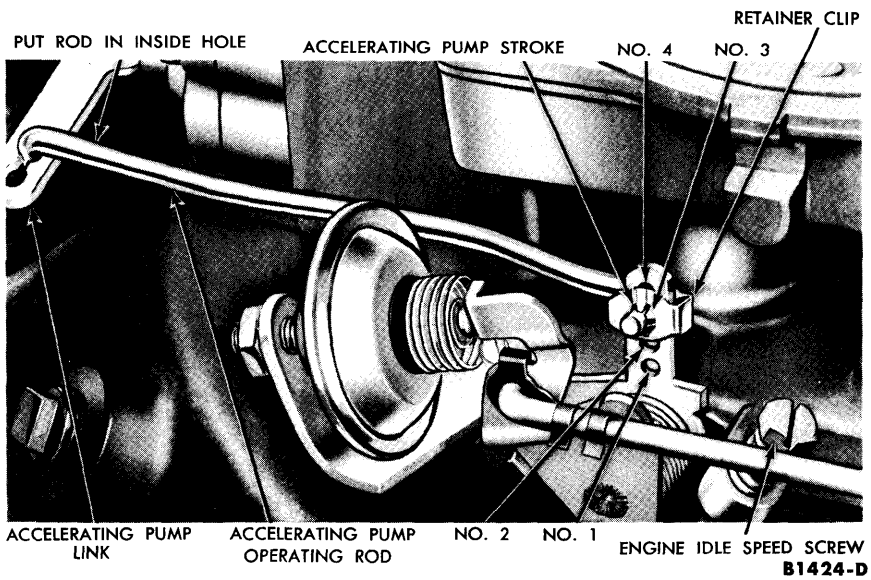



**FIG. 18—Accelerating Pump Stroke and Idle Speed Adjustment**

screw rests adjacent to the shoulder (Fig. 19) of the highest step (align the screw with the arrow mark on the cam).

**2.** Start the engine, and turn the fast idle adjusting screw inward or outward as required to obtain the specified fast idle rpm.

**3.** Remove the tachometer if the idle fuel mixture does not require adjustment. If the idle fuel mixture requires adjustment, leave the tachometer installed so that the idle speed can be checked after the idle fuel mixture has been adjusted.

## ACCELERATING PUMP STROKE

The over-travel lever has four holes and the accelerating pump link has two holes (Fig. 18) to control the accelerating pump stroke for various ambient temperatures and operating conditions of the engine.

The accelerating pump stroke adjustment is made with the carburetor air cleaner assembly removed from the carburetor.

For average ambient temperature operation (40° to 80°F.) place the accelerating pump operating rod in the No. 3 hole (third hole from the throttle shaft) position of the over-travel lever (Fig. 18). To release the rod from the retainer clip, press the tab ends of the clip together; then, at the same time, press the rod away from the clip until it is disengaged.

For low ambient temperature operation (below 40°F) place the pump operating rod in the No. 4 hole (fourth hole from the throttle shaft) position of the over-travel lever.

For high ambient temperature operation (above 80°F and/or above 5000 feet altitude) the pump operating rod may be placed in the No. 2 hole (second hole from the throttle shaft) of the over-travel lever to suit individual operating conditions.

The correct position for the pump operating rod at the accelerating pump link (Fig. 18) for all operating conditions is in the inboard hole (hole closest to the pump plunger).

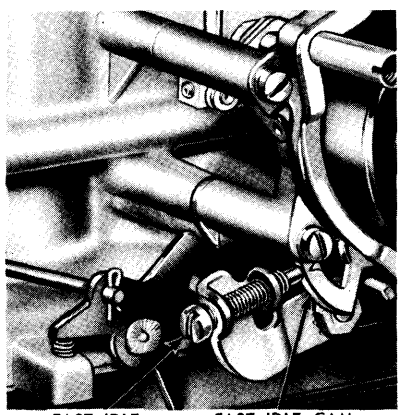



**FIG. 19—Engine Fast (Cold Engine) Idle Speed Adjustment**

## ANTI-STALL DASHPOT

**1.** The anti-stall dashpot adjustment is made with the carburetor air cleaner assembly removed from the carburetor. With the engine idle speed and idle mixture properly adjusted, and the engine at normal operating temperature, loosen the anti-stall dashpot lock nut (Fig. 20).

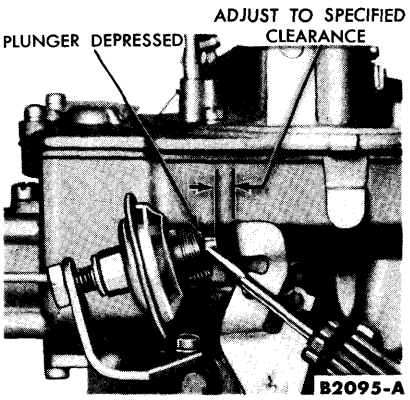



**FIG. 20—Anti-Stall Dashpot Adjustment**

**2.** Hold the throttle in the closed position and depress the plunger with a screwdriver blade. Check the clearance between the throttle lever and the plunger tip with a feeler gauge of the specified clearance dimension. Turn the anti-stall dashpot, in its bracket, in a direction to provide the specified clearance between the tip of the plunger and the throttle lever. Tighten the lock nut to secure the adjustment.

**3.** Place the transmission in neutral, and turn off the engine.

## AUTOMATIC CHOKE TORSION SPRING ADJUSTMENT

The adjustment of the choke torsion spring (Fig. 21) should only be made after it is assured that all other carburetor adjustments are within specifications.

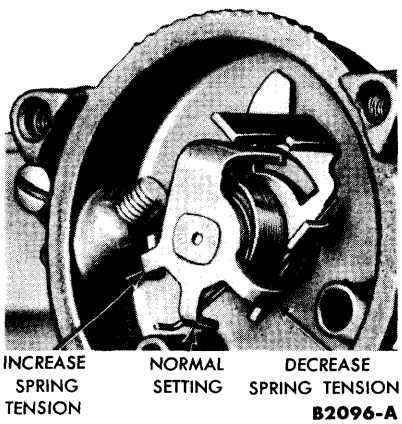



**FIG. 21—Torsion Spring Adjustment**

The normal position for the short tang of the choke housing spring is on the center prong of the choke housing shaft lever assembly (Fig. 21). The two remaining prong positions are intended for increasing or decreasing the spring tension to correct for an apparent lean mixture or rich mixture in the automatic choke system during driveaway immediately after a cold start in low ambient temperatures. Engine hesitation or stumble indicates a lean mixture. An engine that runs rough (lopes or gallops) indicates a rich mixture. Decrease the spring tension to correct for richness. Increase the tension to correct for leanness.

**1.** Remove the carburetor air cleaner assembly. Remove the thermostatic spring housing.

**2.** Place the short tang of the spring in the left prong to increase tension, the center prong for normal operation, or the right prong to decrease tension (Fig. 21).

**3.** Install the thermostatic spring housing and set it at the specified index mark; then, tighten the retaining screws. Install the heater hose and mounting bracket on the carburetor. Install the carburetor air cleaner assembly.

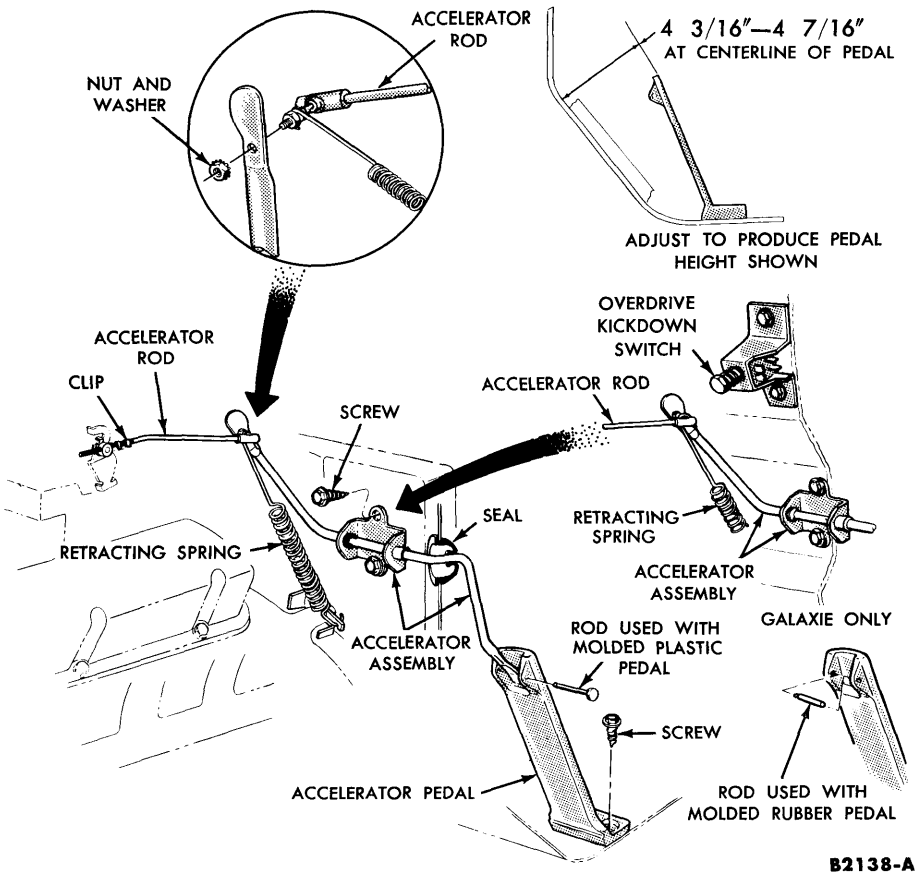



**FIG. 22—Throttle Linkage—352 V-8 and 390 V-8**

### THROTTLE LINKAGE

#### MANUAL-SHIFT TRANSMISSION

**1.** Adjust the engine idle speed to specification.

**2.** Check the accelerator pedal height (Fig. 22). To adjust the pedal height to specification, disconnect the carburetor connecting rod at the accelerator shaft. Remove the clip retaining the carburetor connecting rod to the primary throttle shaft lever.

**3.** With the throttle lever against the idle adjusting screw, adjust the length of the carburetor connecting rod to obtain the specified pedal height (Fig. 22), and install the carburetor connecting rod to primary throttle shaft lever retaining clip.

#### OVERDRIVE TRANSMISSION

**1.** Adjust the engine idle speed, pedal height and throttle linkage as outlined under "Manual Shift Transmission", Steps 1 thru 3.

**2.** With the accelerator shaft (Fig. 22) held in the full throttle position, slide the overdrive control switch up or down on the elongated slots until the accelerator shaft is just touching the switch plunger. If the switch does not touch the shaft when it is in its closed position, an adjustment, not exceeding four turns counterclockwise, may be made at the switch plunger.

**3.** Return the accelerator shaft to its normal position. Turn the switch plunger five turns counterclockwise to adjust for kickdown operation.

#### AUTOMATIC TRANSMISSION

The throttle linkage adjustments for the automatic transmission are covered in Group 7.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

Flooding, stumble on acceleration, and other performance complaints are, in main instances, caused by the pressure of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of a complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowls. The contents of the bowls may then be examined for contamination as the carburetor is disassembled.

**1.** Remove the air cleaner. Remove the bracket that secures the heater hose to the automatic choke. Remove the throttle rod from the throttle lever. Disconnect the distributor vacuum line, the fuel inlet line, and the choke heat tube at the carburetor.

**2.** Remove the carburetor retaining nuts and lock washers; then remove the carburetor. Remove the spacer gasket from the spacer. **Whenever the carburetor is removed from**

**the engine, care must be exercised to prevent damage to the throttle plates. The lower edges of the throttle plates project below the carburetor body whenever they are open.**

### INSTALLATION

1. Clean the gasket surface of the spacer and carburetor. Place the new gasket on the spacer. Position the carburetor on the spacer. To prevent leakage, distortion, or damage to the carburetor body flange, snug the nuts; then, alternately tighten each nut in a criss-cross pattern to the specified torque.

2. Connect the throttle rod, the choke heat tube, the fuel inlet line, and the distributor vacuum line. Refer to "In-Car Adjustments and Repairs" (Part 10-4) and adjust the accelerating pump stroke, the idle fuel mixture and idle speed, and the anti-stall dashpot. Install the air cleaner.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

To facilitate working on the carburetor and to prevent damage to the throttle plates, install carburetor legs on the base. If legs are unavailable, install 4 bolts (about 2¼ inches long of the correct diameter), and nuts on the carburetor base.

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly.

For a complete carburetor overhaul, follow all the steps. To partially overhaul the carburetor or to install a new gasket kit, follow only the applicable steps.

Refer to Fig. 24 for parts identification.

### AIR HORN

1. Remove the air cleaner anchor screw and lock washer.

5. Remove the choke plate rod hairpin retainer.

3. Remove the air horn retaining screws and lock washers. Remove the air horn and the choke plate rod. Remove the air horn gasket.

4. Remove the choke plate screws and the choke plate from the choke plate lever. **If the tips of the screws are flared excessively, file off the flared portion to prevent damage to the threads in the shaft.**

5. Rotate the choke plate lever and remove the choke plate rod from the lever. Slide the choke shaft out of the air horn. Slide the felt seal and two washers out of the choke rod seal retainer.

6. If it is necessary to remove the secondary throttle control vacuum tube, pry it out with needle nose pliers. Discard the tube after removal.

7. If it is necessary to replace the hot idle compensator, remove the staking marks on the retaining screws and remove the hot idle compensator.

8. If it is necessary to replace the choke plate magnet and bracket, remove the staking marks on the retaining screws and remove the choke plate magnet and bracket assembly.

### MAIN BODY

1. Using a hook, disconnect the float shaft retainer from each float (Fig. 23). Remove the float and shaft, and the fuel inlet needle assembly from each fuel bowl. Remove the torsion (damper) spring from the shaft.

2. Using a jet wrench, remove the fuel inlet needle seat from each fuel bowl and the primary stage and secondary stage main jets.

3. Remove the primary stage booster venturi assembly and gasket. Invert the main body and let the accelerating pump discharge weight and ball fall into the hand. Remove the fuel inlet fitting, gasket, and screen.

4. Remove the secondary stage booster venturi assembly and gasket.

5. Remove the accelerating pump operating rod retainer, then remove the rod. Remove the accelerating pump cover, diaphragm assembly, and spring. Remove the inlet ball check retainer screw and gasket. Invert the main body and let the accelerating pump inlet ball check fall into the hand. Remove the accelerating pump cavity filler.

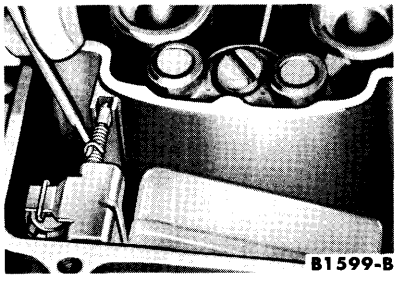



**FIG. 23–Float Shaft Retainer Removal or Installation**

6. Remove the secondary diaphragm operating rod. Remove the diaphragm cover, return spring, and diaphragm. The secondary ball check is not removable.

7. Invert the main body and remove the power valve cover and gasket. Using a box wrench, remove the power valve and gasket. Remove the idle fuel adjusting needles and springs.

8. Remove the choke shield. Remove the fast idle cam retainer. Remove the thermostatic spring housing clamp, and gasket.

9. Remove the choke housing and gasket, and the fast idle cam.

10. Remove the choke housing shaft lever retaining nut, spacer, and lever. Slide the fast idle cam over-travel lever off the choke housing shaft.

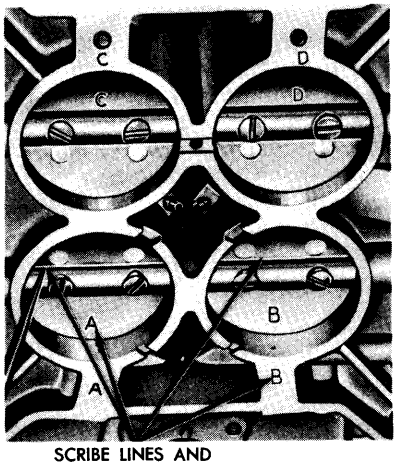
11. Remove the fast idle cam pick-up rod from the fast idle cam over-travel lever.

12. Remove the retainer from the choke housing shaft and slide the shaft assembly out of the choke housing. Remove the thermostatic spring lever and the torsion spring from the shaft. Remove the nylon liner from the thermostatic spring lever.

13. Remove the nut and washer securing the fast idle adjusting lever assembly to the primary throttle shaft and remove the lever assembly.

14. Remove the distributor vacuum line fitting, the anti-stall dashpot, and the hot engine idle adjusting screw and spring.

15. If it is necessary to remove the throttle plate, lightly scribe the primary and secondary throttle plates along the throttle shafts and mark each plate and its corresponding bore with a number or letter for proper installation (Fig. 24).




SCRIBE LINES AND IDENTIFICATION MARKS B1247-A

**FIG. 24—Throttle Plate Removal**

16. Slide the primary and secondary throttle shafts out of the main body.

17. Remove the accelerating pump over-travel lever retainer and slide the bushing spring and the lever off the primary throttle shaft.

## PARTS REPAIR OR REPLACEMENT

Clean and inspect the carburetor component parts. Refer to "Cleaning and Inspection" (Part 10-1) for the proper procedure. Replace all worn or damaged parts.

## ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Make sure the accelerating pump diaphragm and secondary operating diaphragm are not torn or cut. The carburetor assembly is shown in Fig. 25.

### AIR HORN

Refer to Fig. 26 for the correct location of the parts.

1. Position the choke plate shaft in the air horn. Place the choke plate rod seal between the two brass washers and slide them in position on the seal retainer. Slide the choke plate rod through the opening in the air horn assembly and position it in the choke shaft lever.

2. Slide the choke plate into the shaft. Close the choke plate and position it in the shaft, then install the screws. Tighten and stake the screws.

3. If necessary, start a new secondary throttle control vacuum tube into the air horn. **Make certain the tube is installed in a manner that will insure that the pick-up end will face downward toward the primary booster venturi when the air horn is installed.** Drive the tube into the air horn by grasping it lightly below the shoulder with pliers and striking the pliers with a hammer. Drive the tube in until it stops against its shoulder. **Do not crush or bend the tube.**

4. If the hot idle compensator was removed, install the new compensator and stake the retaining screws.

5. If the choke plate magnet and bracket was removed, install the new magnet and bracket assembly. **Do not stake the screws at this time. Adjust the magnet and bracket after the carburetor is assembled, then stake the screws.**

### MAIN BODY

1. If the throttle plates were removed, install the bushing and place the accelerator over-travel spring, with the shortest tang end first, over the boss on the over-travel lever. Place the short tang of the spring under the lug on the lever. Slide the over-travel lever and spring assembly on the throttle shaft and bushing. Hook the longest tang of the spring under the closed throttle lug of the throttle lever (Fig. 27). Install the over-travel lever retainer. Slide the primary throttle shaft assembly into the main body.

Referring to the lines scribed on the throttle plates, install the primary throttle plates in their proper location with the screws snug, but not tight. Invert the main body and hold it up to the light. Little or no light should show between the throttle plates and the throttle bores. Tap the plates lightly with a screwdriver handle to seat them. Tighten and stake the screws.

Slide the secondary shaft into the main body. Referring to the lines scribed on the secondary throttle plates, install the throttle plates in their proper location. To install the plates, follow the procedure given for the primary throttle plates. Adjust the secondary throttle plates (refer to "Carburetor Bench Adjustments" in Part 10-1, Section 2).

2. Install the hot engine idle spring and screw.

3. Install the anti-stall dashpot.

4. Install the distributor vacuum passage fitting. Place the fast idle lever assembly on the primary throttle shaft and install the retaining washer and nut. (Fig. 28). Slide the fast idle cam on the boss on the main body. Do not install the retainer at this time (Fig. 28).

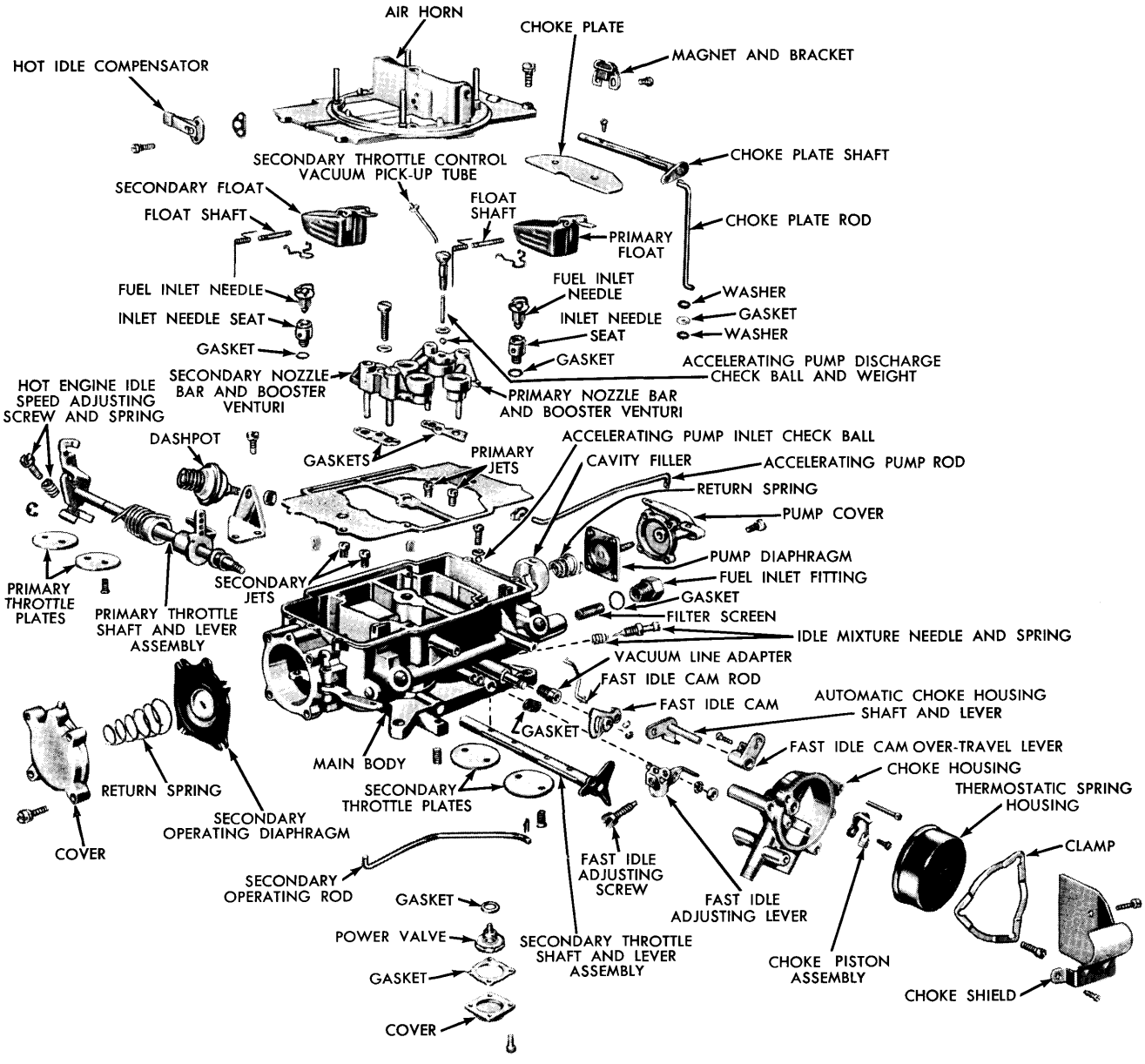
5. Install the torsion spring liner on the hub of the thermostatic spring lever. Position the torsion spring over the liner, then position the thermostatic spring with the long tang against the lug on the lever (Fig. 29). Slide the lever and spring assembly on the choke housing hub with the short tang of the spring resting on the center prong of the lever and the lug on the shaft positioned in the slot in the thermostatic spring lever (Fig. 29). Place the spacer on the choke housing shaft. Slide the assembly into the choke housing (Fig. 29). Install the retaining clip in the groove on the choke plate shaft.

6. Slide the fast idle cam over-travel over the choke housing shaft, with the head of the adjusting screw facing upward and toward the front of the carburetor (Fig. 30).

7. Place the choke housing shaft lever and spacer on the choke housing shaft, with the top of the lever tang located under the fast idle cam lever adjusting screw. Install the retaining nut. Install the fast idle cam pick-up rod and retainer on the fast idle cam over-travel lever. Install the fast idle cam retainer (Fig. 30).

8. Place the gasket on the vacuum pick-up port of the choke housing and install the choke housing on the main body. Insert the fast idle cam pick-up lever into the fast idle cam as the choke housing is positioned into place. Install and tighten the choke housing retaining screws. Install the pick-up lever retainer. Position the thermostatic spring cover gasket on the choke housing. Install the cover on the choke housing and gasket, with the arm of the thermostatic spring lever inserted into the loop of the thermostatic spring. Position the cover retainer over the cover and install the retaining screws.

9. Drop the accelerating pump inlet ball check in the inlet passage of the accelerating pump chamber. Seat the ball check with a brass drift and a light hammer. Make sure the ball is free. Install the accelerating pump cavity filler. Install the washer and




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**FIG. 25—Ford 4-Barrel Carburetor Assembly**

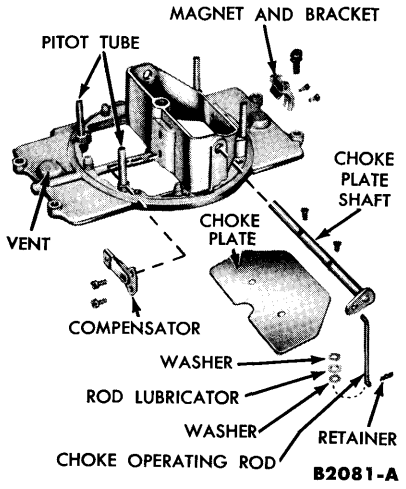



**FIG. 26—Air Horn Assembly**

ball check retaining screw. Install the diaphragm return spring on the boss in the chamber. Insert the diaphragm assembly in the cover and place the cover and diaphragm assembly in position on the main body. Install the cover screws finger-tight. Push the accelerating pump plunger the full distance of its travel and tighten the cover screws. Install the accelerating pump operating rod. Refer to "In-Car Adjustments and Repairs" (Part 10-4, Section 2), and adjust the accelerating pump stroke.

**10.** Invert the main body. Using a socket wrench, install the power valve and gasket. **Tighten the power valve securely.** Install the cover and gasket. Install the idle adjusting needles and springs. Turn the needles in gently with the fingers until they just touch the seat, then back them off 1-1½ turns for a preliminary idle adjustment.

**11.** Install the secondary operating diaphragm on the secondary operating lever. Install the diaphram return spring on the cover. Install the cover with the screws finger-tight. With the diaphragm in the extended position, tighten the cover screws. Install the secondary diaphragm rod.

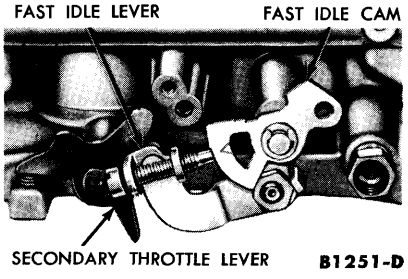



**FIG. 28—Fast Idle Cam and Lever Installation**

**12.** Using a jet wrench, install the primary main jets and the fuel inlet seat. **Be sure the correct jets are installed.** Position the float shaft retainer in the groove on the fuel inlet needle seat. Install the fuel inlet needle assembly in the fuel inlet seat. **The fuel inlet needle and seat are matched assemblies. Be sure the correct needle and seat are assembled together.** Slide the float shaft into the float lever. Install the damper spring on the float shaft and insert the short end of the spring under the flange of the float lever. Insert the float assembly into the fuel bowl and hook the float tab under the clip on the fuel inlet needle assembly. Insert the float shaft into its guides at the sides of the fuel bowl. Allow the long end of the damper spring to rest against the wall of the fuel bowl. Using a hook, position the shaft retainer in the grooves on the shaft. Refer to "Carburetor Bench Adjustments" (Part 10-1, Section 2) and check the float setting.

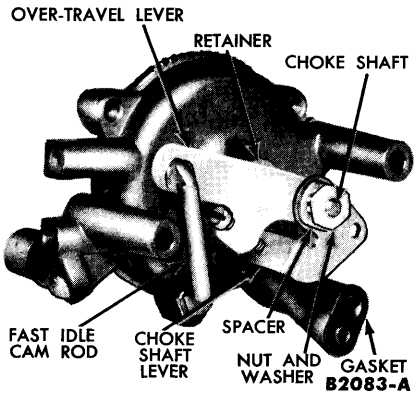



**FIG. 30—Choke Linkage Installation**

**13.** Repeat step 12 on the secondary stage fuel bowl.

**14.** Drop the accelerating pump discarge ball into its passage in the primary side of the main body. Seat the ball with a brass drift and a light hammer. Make sure the ball is free. Drop the accelerating pump discharge weight on top of the ball. Position the primary booster venturi assembly and gasket in the main body. Install the retaining screw. **The primary booster screw is hollow.** Install the screen, and the fuel inlet fitting and gasket.

**15.** Position the secondary booster venturi assembly and gasket in the main body and install the gasket and retaining screw.

**16.** Position the air horn gasket on the main body (Fig. 31). Position the air horn on the main body

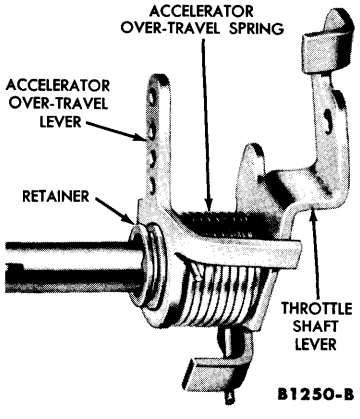



**FIG. 27—Accelerator Over-Travel Spring and Lever Installation**

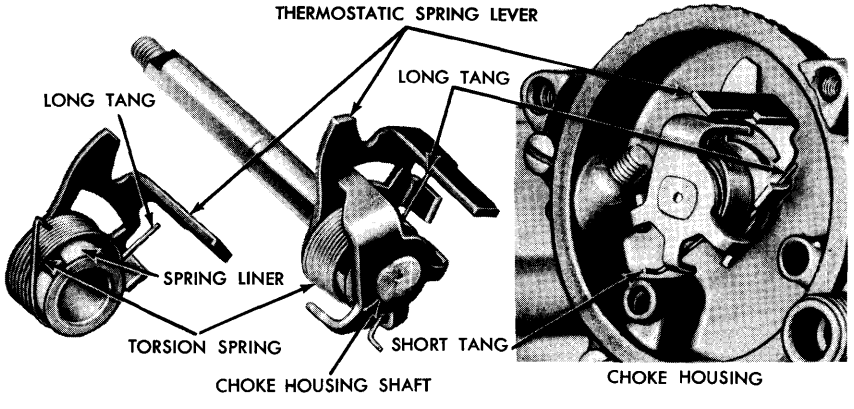



**FIG. 29—Choke Housing Torsion Spring Installation**

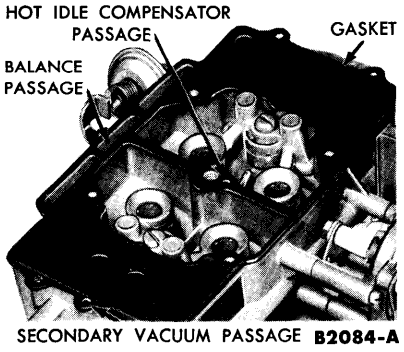



**FIG. 31—Main Body Gasket Installation**

and gasket so that the choke plate rod fits into the opening in the choke housing lever. Install the choke plate rod retainer. **Use care to prevent damage to the secondary throttle control vacuum tube during the air horn installation.** Install the air horn retaining screws, lock washers and the identification tag.

**17.** Refer to Part 10-4, Section 2, "In-Car Adjustments and Repairs" and perform the automatic choke plate clearance (pull-down) adjustment, the fast idle cam linkage adjustment, the automatic choke magnet and bracket adjustment and the automatic choke housing adjustment.

### BENCH ADJUSTMENTS

All carburetor adjustments except the fuel level float adjustment wet, the idle fuel mixture and idle speed adjustments, the anti-stall dashpot adjustment, and the automatic choke torsion spring adjustment can be made with the carburetor removed from the car. Refer to Part 10, Section 2 for the "Carburetor Bench Adjustments."

# PART 10-5 AIR CLEANER


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 10-52 | 2 Removal and Installation | 10-53 |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

#### CONVENTIONAL DRY TYPE

The 352 and 390 V-8 engines and the conventional Mileage Maker Six engine are equipped with a dry-type air cleaner that has a replaceable cellulose fiber filtering element (Fig. 1). On the 352 and 390 V-8 engines a tube attached to the filtered air chamber (Fig. 1) is connected to the automatic choke heat chamber to supply clean air to the automatic choke.

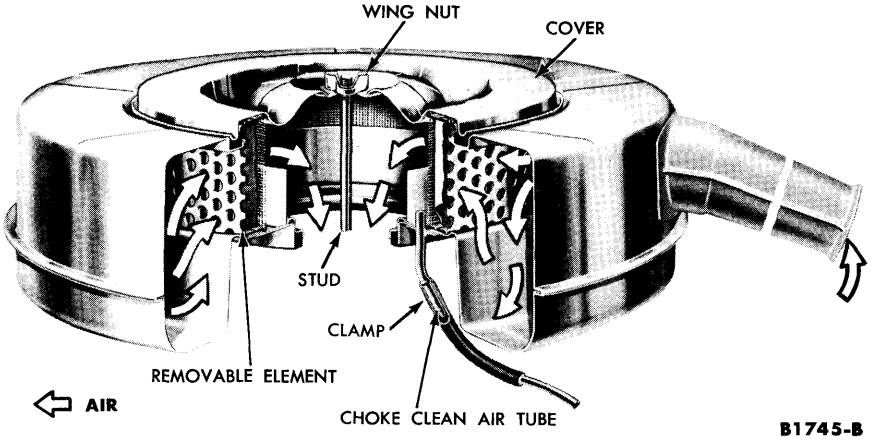



**FIG. 1—Typical Dry Type Air Cleaner Assembly**

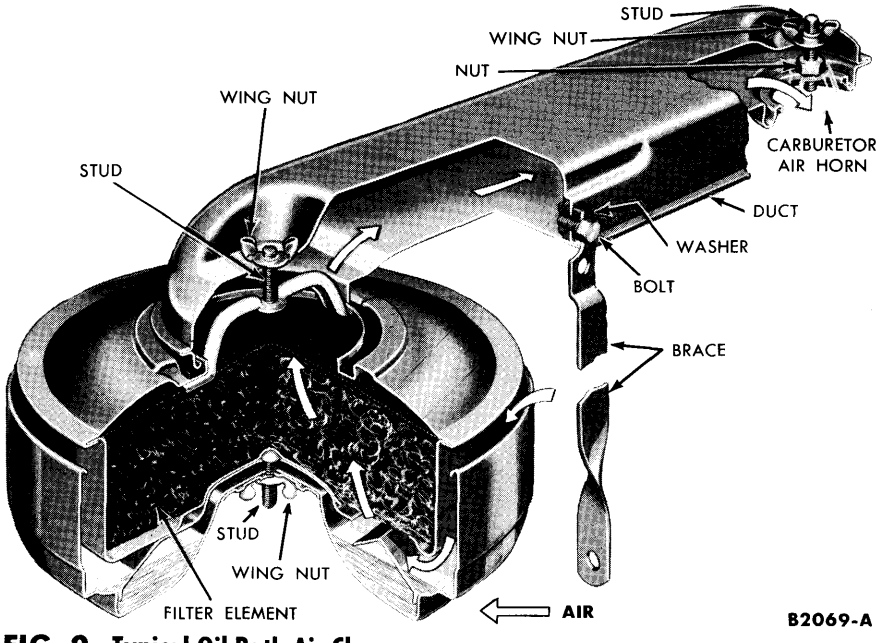



**FIG. 2—Typical Oil Bath Air Cleaner**

#### DRY TYPE—HOT AND COLD AIR INTAKE

The 289 V-8 engine is equipped with a dry-type carburetor air cleaner assembly and thermostatically controlled carburetor air inlet duct assembly.

The air cleaner body is mounted on a sealing gasket located on the carburetor air horn. The air cleaner assembly is retained on the engine by a stud in the carburetor body and a wing nut above the filter cover. The replaceable filter element assembly consists of pleated filter paper encased in a wire mesh screen, with integral plastic gaskets located on the top and bottom of the element. The gaskets prevent entry of dirt and unfiltered air into the engine.

The thermostatically controlled air inlet duct and shroud assembly is attached to the air cleaner body with a wing nut. The shroud is positioned on the left exhaust manifold. The air inlet duct control mechanism consists of a valve plate, thermostat, adjustable thermostat rod, two springs and a retaining clip.

#### OIL BATH TYPE

The Mileage Maker Six Police Special and Taxi Special engines are equipped with an oil bath-type air cleaner (Fig. 2).

### OPERATION

#### CONVENTIONAL DRY TYPE

The air from the engine compartment enters the air cleaner assembly through the opening (horn) on the side of the body, into a silencing chamber and passes through the filter element. Dust particles are trapped in the filter element as the air passes through it. After leaving the filter element, the air is deflected down into the carburetor.

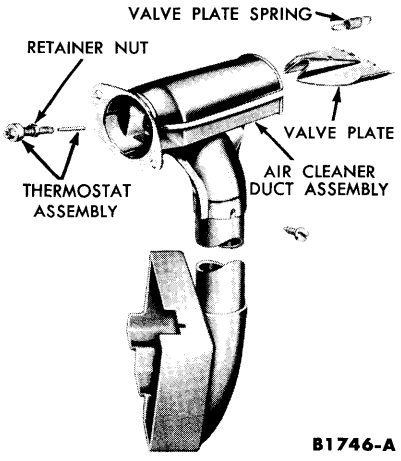



**FIG. 3—Typical Air Inlet Duct—Disassembled**

### DRY TYPE—HOT AND COLD AIR INTAKE

The air received from the air duct passes through a silencing chamber in the air cleaner body and then through the filter element. After leaving the filter element, the air is deflected down into the carburetor. Dust particles and other foreign materials are trapped in the filter element as the air rushes through it.

The temperature of the air entering the air cleaner is thermostatically controlled by the carburetor air duct assembly (Fig. 3). Air from the engine compartment, or heated air from a shroud around the exhaust manifold, is available to the engine.

A thermostatic bulb in the air duct is exposed to the incoming air. A spring-loaded valve plate is connected to the thermostatic bulb through linkage. The valve plate spring holds the valve in the closed position (heat on) until the thermostatic bulb overcomes the valve tension.

During the engine warm-up period when the air temperature entering the air duct is less than 75°F, the thermostat is in the retracted position and the valve plate is held in the up position (heat on) by the valve plate spring, thus shutting off the air from the engine compartment (Fig. 3). All air is then drawn from the shroud around the exhaust manifold.

As the temperature of the air passing the thermostatic bulb approaches 85°F, the thermostat starts to expand, and pulls the valve plate down. This allows cooler air from the engine compartment to enter the air cleaner. When the temperature of the air reaches approximately 105°F, the valve plate will be in the down position (heat off) so that only engine compartment air is allowed to enter the air cleaner.

### OIL BATH TYPE

The air from the engine compartment enters the air cleaner (Fig. 2) and passes down between the outside wall of the filter element and the wall of the oil reservoir. The air is then deflected by a baffle in the bottom of the oil chamber, up through the filter element. After leaving the filter element the air flows into the carburetor.

As the air rushes across the oil in the filter, large heavy particles fall into the oil and are entrapped. The smaller dust particles are trapped in the oil dampened filtering element as the air passes through to the carburetor.

## 2 REMOVAL AND INSTALLATION

### 352 AND 390 V-8 ENGINES

**Removal**

**1.** Remove the wing nut retaining the air cleaner on the carburetor. Disconnect the choke clean air tube, and lift the air cleaner off the carburetor.

**2.** Remove the cover and lift the element out of the air cleaner body.

**Cleaning.** Refer to Group 10-1 for the recommended cleaning and inspection procedure.

**Installation**

**1.** Place the air cleaner body on the carburetor so that the word "FRONT" faces the front of the car. Connect the choke clean air tube to the air cleaner.

**2.** Place the element in the air cleaner body. Install the cover.

### MILEAGE MAKER SIX—EXCEPT POLICE SPECIAL AND TAXI SPECIAL ENGINES

**Removal**

**1.** Remove the bolt retaining the bracket to the air cleaner.

**2.** Remove the wing nut retaining the air cleaner assembly to the carburetor. Remove the air cleaner assembly, then remove the cover and lift the filter element out of the air cleaner body.

**Cleaning.** Refer to Group 10-1 for the recommended cleaning and inspection procedure.

**Installation**

**1.** Position the air cleaner body on the carburetor, and make certain the body is properly seated on the carburetor gasket.

**2.** Position the filter element in the body and install the cover.

**3.** Align the bracket with the retaining bolt hole. Tighten the carburetor air filter retaining wing nut. Install the bracket and tighten the retaining bolt.

### 289 V-8 AIR CLEANER

**Removal**

**1.** To remove the entire air cleaner, remove the two wing-type screws that secure the air duct and thermostat assembly to the air cleaner. Remove the wing nut that secures the air cleaner to the carburetor. Remove the air cleaner assembly.

**2.** Remove the cover and lift the filter element out of the air cleaner body.

**Installation**

**1.** Position the air cleaner body on the carburetor. Connect the air duct to the air cleaner with two wing-type bolts. Tighten the bolts.

**2.** Place the element in the body. Install the cover and wing nut. Tighten the nut.

### 289 V-8 AIR INTAKE DUCT

**Removal**

**1.** Remove the air duct and shroud retaining nut and washer from the exhaust manifold.

**2.** Remove the two wing-type screws that secure the air duct and thermostat assembly to the air cleaner. Carefully lift the air duct, shroud and tube as an assembly from the engine.

**Diagnosis and Testing.** Refer to Part 10-1 for the air duct testing procedures.

**Installation**

**1.** Install the thermostat and air duct assembly, and the shroud and tube assembly on the exhaust manifold as a unit.

**2.** Secure the thermostat and air duct assembly to the air cleaner with

the two wing-type screws. Install the air duct to exhaust manifold retaining nut and washer.

**Disassembly**

**1.** Loosen the retaining screw and separate the shroud and tube assembly from the air cleaner duct and valve assembly (Fig. 3).

**2.** Check the operation of the thermostat and air duct assembly. Refer to "Tests and Adjustments" for the proper procedure. If inspection reveals that the valve plate is binding, or the thermostat is malfunctioning, remove the thermostat and valve plate as follows:

Detach the valve plate tension spring from the valve plate with the use of long-nose pliers. Loosen the thermostat lock nut and unscrew the thermostat from the mounting bracket. Remove the lock nut. Grasp the valve plate and withdraw it from the duct.

**Cleaning.** Refer to Group 10-1 for the recommended cleaning and inspection procedure.

**Assembly**

**1.** If it was necessary to disassemble the thermostat and air duct assembly, assemble the unit as follows:

Install the valve plate. Install the lock nut on the thermostat and screw the thermostat into the mounting bracket. Install the valve plate tension spring on the valve plate and the duct.

**2.** Check the operation of the thermostat and air duct assembly, then adjust the thermostat as required. Refer to "Tests and Adjustments" for the proper procedure.

**3.** Install the air cleaner duct and valve assembly on the shroud and tube assembly. Tighten the retaining screw.

## MILEAGE MAKER SIX– POLICE SPECIAL AND TAXI SPECIAL ENGINES

**Removal**

**1.** To remove the entire air cleaner assembly, remove the wing nut securing the inlet air duct to the carburetor. Remove the bolt securing the inlet duct to the mounting bracket, then remove the air cleaner assembly.

**2.** To remove the filter element and body only, remove the body retaining wing nut. Remove the body, filter assembly, and gaskets.

**Cleaning.** Refer to Group 10-1 for the recommended cleaning and inspection procedure.

**Installation**

**1.** Seat the air cleaner inlet duct on the carburetor. Make certain it is properly seated on the carburetor gasket. Loosely install the inlet air duct support bracket retaining bolt. Install and tighten the inlet air duct to carburetor retaining wing nut. Tighten the inlet duct to bracket retaining bolt.

**2.** Install new air cleaner gaskets, if necessary. Install the air cleaner element in the air cleaner body and secure the body in position with the retaining wing nut. **Make certain the body is properly seated.**

# PART 10-6 FUEL PUMP


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 10-55 | 3 Major Repair Operations | 10-56 |
| 2 Removal and Installation | 10-56 | | |


## 1 DESCRIPTION AND OPERATION

### DESCRIPTION

Single action fuel pumps are standard equipment for all car models.

The fuel pumps for the Mileage Maker Six engines are mounted on the lower, right-center of the engine cylinder block.

On all V-8 engines, the fuel pumps are mounted on the left-side of the cylinder front cover.

An AC design fuel pump (Fig. 1) with a long-life, disposable type fuel filter integrally mounted on the top side of the fuel pump body is used on the conventional Mileage Maker Six engine.

A Carter design fuel pump (Fig. 2) with a separate in-line replaceable element type fuel filter is used on the Taxi Special Six and Police Special Six engines.

A Carter design fuel pump (Fig. 3) with a long-life, disposable type integrally mounted fuel filter on the pump body is used on the 289, 352 and 390 V-8 engines.

An AC design fuel pump (Fig. 4) with a separate in-line, replaceable element type filter is used on the 427 V-8 engines.

### OPERATION

The fuel pumps are mechanically actuated by means of the fuel pump rocker arm and an eccentric on the camshaft.

A flexible fuel pump diaphragm is operated by a combination of rocker arm action and calibrated spring tension.

On the fuel intake stroke, the camshaft eccentric causes the rocker arm to force the fuel pump diaphragm against the diaphragm spring pressure. This action draws fuel through the intake valve into the pump chamber and closes the outlet valve. At the same time, fuel is drawn from the fuel tank through

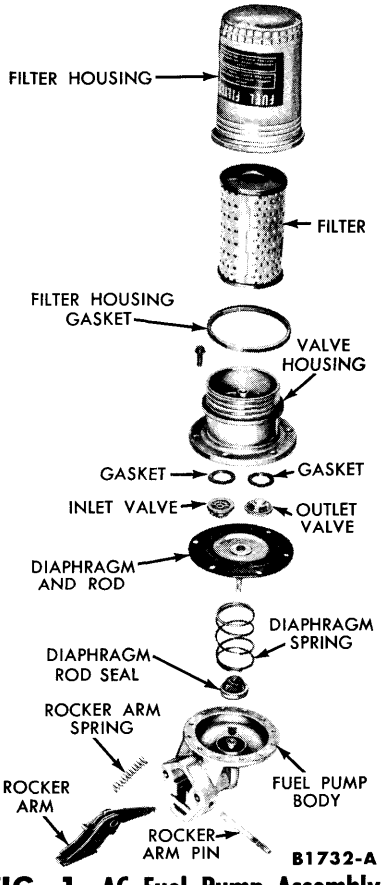



**FIG. 1—AC Fuel Pump Assembly 6-Cylinder Engine**

the fuel intake line to replace the fuel drawn into the chamber.

As the camshaft eccentric continues to rotate, the rocker arm relieves the pressure on the diaphragm spring and allows the spring to move the diaphragm toward the inlet and outlet valves, against the pressure of the fuel built up in the fuel inlet chamber. This action causes the pump inlet valve to close and opens the outlet valve. The fuel is then forced through the pump outlet to the carburetor. **Fuel is delivered to**

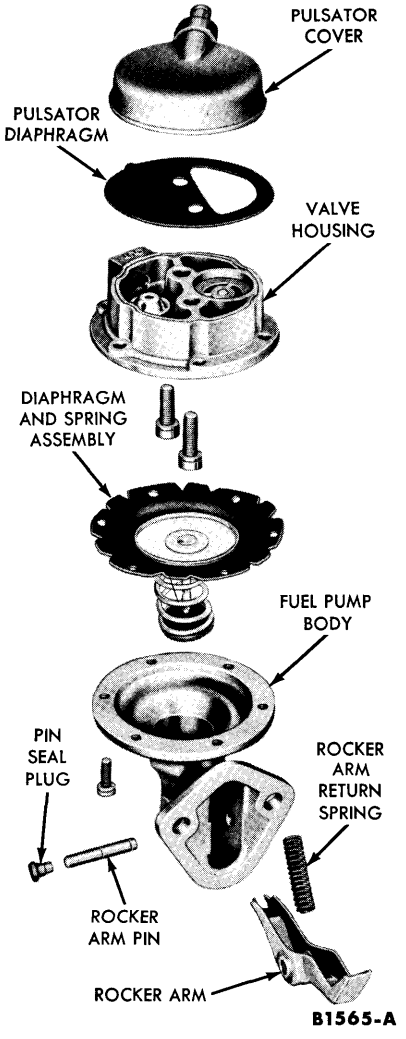



**FIG. 2—Carter Fuel Pump Assembly—6-Cylinder Engine**

**the carburetor only when the fuel inlet valve in the carburetor is open. The carburetor inlet valve is closed by pressure of fuel on the float when the specified fuel level in the carburetor float chamber is reached.**

The fuel pump rocker arm serves only to lift the diaphragm against

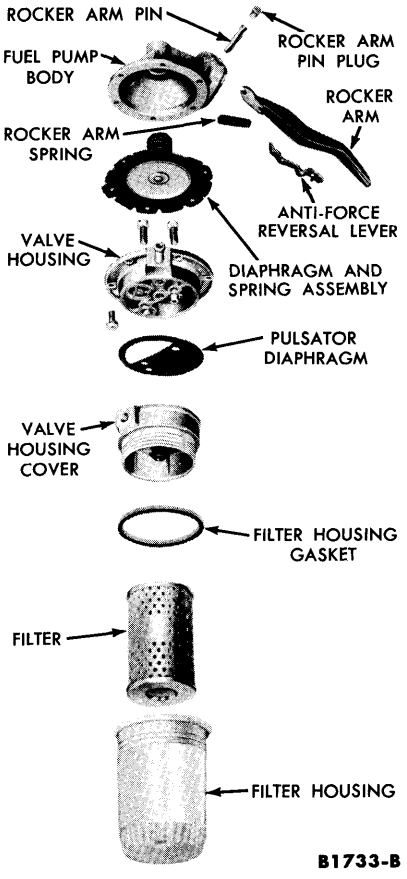



**FIG. 3—Typical Carter Fuel Pump Assembly—V-8 Engine**

the diaphragm spring pressure during the fuel inlet stroke. When there is no demand for fuel from the carburetor, the diaphragm spring tension is not strong enough to force the diaphragm downward against the fuel pressure built up in the inlet chamber of the pump. Thus, the up and down rocker arm action continues, but the diaphragm remains stationary until pressure against the carburetor float is relieved by a demand for fuel at the carburetor.

The pulsator diaphragm in the fuel pumps (except AC Mileage Maker Six fuel pump) dampens the effect of fuel pump pressure pulsations on the carburetor fuel inlet needle valve.

Pressure leak down bleed holes are incorporated in the intake and outlet valve assemblies of all fuel pumps.

An air vent is located in the fuel pump bodies to relieve air pressure build up on the spring side of the diaphragm.

The fuel pump for the 390 V-8 (2V) engine has a constant bleed adapter connection in the pump body for the return of fuel vapors to the gas tank. The purpose of the vapor return system is to reduce the possibility of vapor lock at the fuel pump.

The AC design fuel pumps contain a diaphragm rod seal to prevent the entrance of engine oil into the fuel pump.

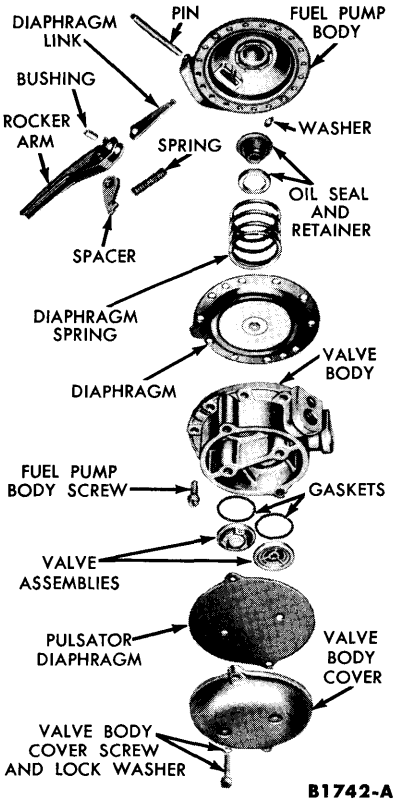



**FIG. 4—AC Fuel Pump Assembly —V-8 Engines**

## 2 REMOVAL AND INSTALLATION

### REMOVAL

1. Disconnect the inlet and outlet lines at the fuel pump.

2. On a 390 V-8 (2V) engine, remove the tank return line from the valve housing cover.

3. Remove the pump retaining screws, then remove the pump and the gasket. Discard the gasket.

### INSTALLATION

1. Remove all the gasket material from the mounting pad and pump flange. Apply oil-resistant sealer to both sides of a new gasket.

2. Position the new gasket on the pump flange, and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric.

3. Press the pump tight against the pad, install the retaining screws, and alternately torque them to specifications.

4. Connect the fuel inlet and outlet lines.

5. On a 390 V-8 (2V) engine, connect the tank return line to the valve housing cover.

6. Operate the engine and check for leaks.

## 3 MAJOR REPAIR OPERATIONS

### MILEAGE MAKER SIX ENGINES

### CARTER FUEL PUMP

#### Disassembly

1. Scribe marks on the fuel pump body, valve housing, and pulsator cover so that these parts can be assembled in their original position.

2. Remove the valve housing assembly. Separate the valve housing from the pulsator cover and note the position of the pulsator diaphragm so that it can be assembled in its proper position. **Do not remove the fuel valves from the housing. The valve housing is replaced as an assembly.**

3. Remove the rocker arm return spring.

4. Remove the rocker arm pin seal plug (Fig. 5).

5. Press the fuel pump diaphragm into the fuel pump body to release the tension on the rocker arm and allow the rocker arm pin to fall out. If the pin does not come out freely,

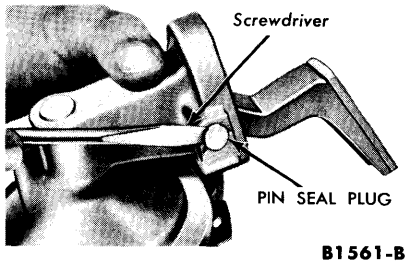



**FIG. 5—Rocker Arm Pin Seal Plug Removal or Installation**

use needle nose pliers (Fig. 6). Pull the rocker arm out to unhook it from the diaphragm stem.

**6.** Remove the fuel pump diaphragm assembly. **Do not disassemble.** The diaphragm and spring are serviced as an assembly.

**Cleaning and Inspection.** Refer to Part 10-1, Section 3, for the cleaning and inspection procedures.

**Testing.** Tests and diagnosis procedures are covered in Part 10-1.

**Assembly**

**1.** Position the fuel pump diaphragm assembly into the pump body. Apply pressure on the diaphragm spring so that the rocker arm can be installed on the stem as shown in Fig. 7.

**2.** Align the rocker arm pin holes by applying slight pressure on the diaphragm spring, then install the rocker arm pin (Fig. 6).

**3.** Install a new rocker arm pin seal plug.

**4.** Position the rocker arm return spring on the boss in the pump body. Compress the spring and slip it over the tang in the rocker arm.

**5.** Place a new pulsator diaphragm on the valve housing in the position previously noted on disassembly (opening in the diaphragm

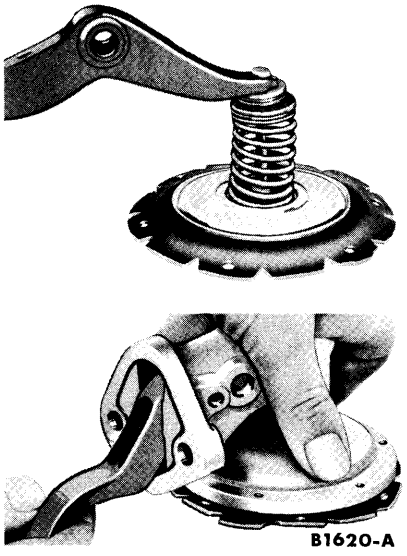



**FIG. 7—Rocker Arm Installation**

over the fuel inlet valve(s) as shown in Fig. 8). Position the cover on the valve housing, aligning the scribed lines on the cover with the line on the valve housing. Be sure the pulsator diaphragm extends evenly around the edge of the cover. Install and tighten to specifications the two retaining screws and lockwashers inside the valve housing.

**6.** Align the scribe lines. Hold the valve housing assembly tight against the fuel pump body and install the six screws and lockwashers. Be sure the fuel pump diaphragm extends evenly around the edge of the valve housing before tightening the retaining screws to specifications.

**AC FUEL PUMP**

**Disassembly**

**1.** Remove the filter housing, gasket and filter element. Discard the filter element.

**2.** Scribe a line on the flanges of

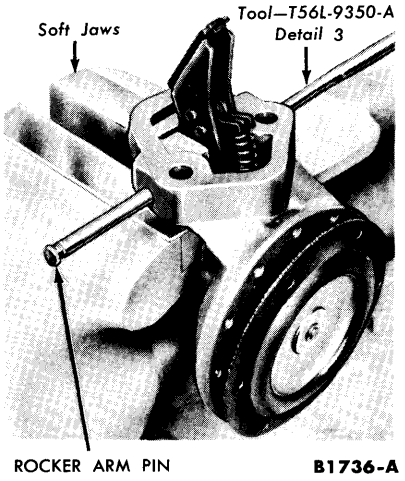



**FIG. 9—Rocker Arm Pin Removal or Installation**

the pump body and valve housing to identify their original position.

**3.** Remove the valve housing from the fuel pump body.

**4.** Remove the staking marks from around the valves, remove both valves and their gaskets from the valve housing. **Carefully note the position of the valves in the valve housing cover, so that new valves can be correctly installed.**

**5.** Using a blunt punch or tool T56L-9350-A, Detail 3, drive the rocker arm pin out of the pump body (Fig. 9).

**6.** Press the pump diaphragm into the fuel pump body and pull the rocker arm outward to unhook the diaphragm actuating rod from the rocker arm and link assembly (Fig. 10).

**7.** Remove the diaphragm and diaphragm return spring, rocker arm and link assembly, and the rocker arm return spring from the pump body.

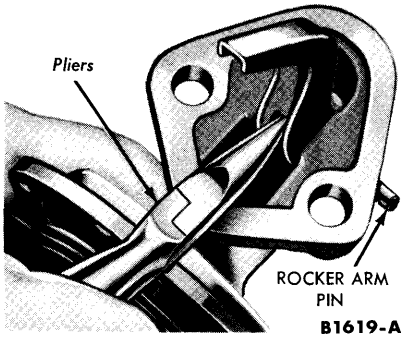



**FIG. 6—Rocker Arm Pin Removal or Installation**

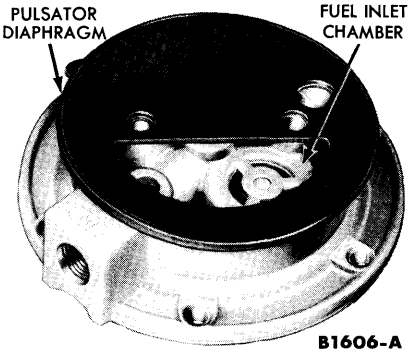



**FIG. 8—Typical Pulsator Diaphragm Installation**

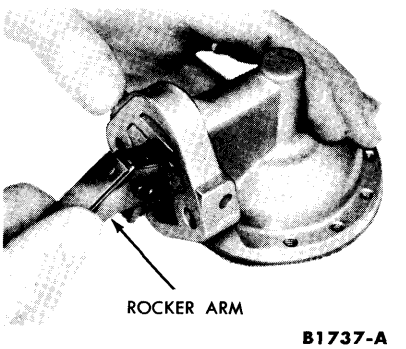



**FIG. 10—Fuel Pump Diaphragm Removal**

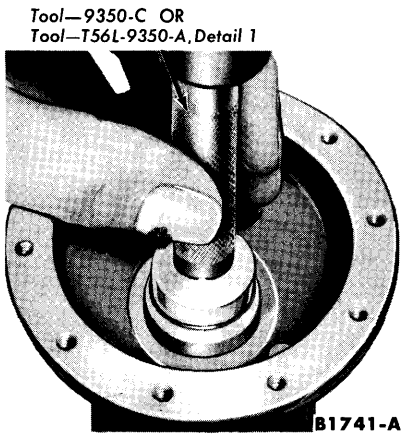



**FIG. 11—Seating the Oil Seal**

**8.** Remove the diaphragm actuating rod oil seal from the pump body (Fig. 1).

**Cleaning and Inspection.** Refer to Part 10-1 for the cleaning and inspection procedures.

**Testing.** Tests and diagnosis procedures are covered in Part 10-1.

**Assembly**

**1.** Install the diaphragm actuating rod oil seal and retainer so that the seal protrudes towards the diaphragm mounting flange (Fig. 1).

**2.** Seat the oil seal, using tool 9350-C or T56L-9350-A, Detail 1 (Fig. 11).

**3.** Install the valves, and their gaskets, in the valve body so that the valve positions are as shown in Fig. 1.

**4.** Seat the valves firmly in the valve body, using tool 9350-D or T56L-9350-A. Detail 2. Stake the valves in place.

**5.** Lubricate the diaphragm actuating rod with grease.

**6.** Position the fuel pump diaphragm and spring assembly into the pump body as shown in Fig. 12.

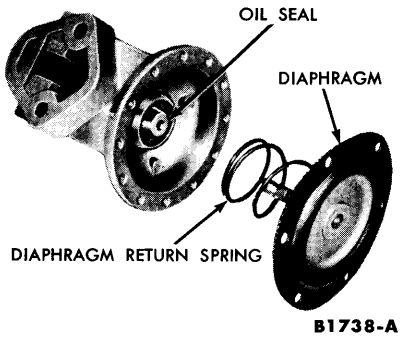



**FIG. 12—Diaphragm Installation**

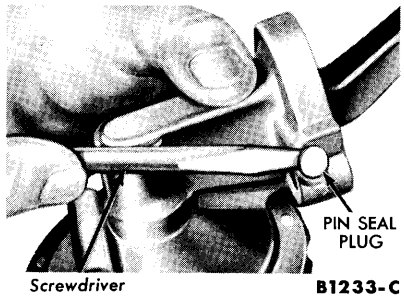



**FIG. 13—Rocker Arm Seal Plug Removal**

**7.** Hold the diaphragm assembly in the pump body; position the pump body so that the mounting flange faces up. Apply slightly more pressure to the lower edge of the diaphragm, and insert the rocker arm link assembly with the cam shoe facing away from the diaphragm. Hook the rocker arm link to the diaphragm actuating rod.

**8.** Install the rocker arm return spring and hold it in place by cocking the rocker arm slightly.

**9.** Install the rocker arm pin in the pump body.

**10.** Position the valve body and pump body so that the previously scribed marks are aligned.

**11.** Install all the screws and the lockwashers until the screws just engage the fuel pump body. **Make sure that all of the screws pass through the holes in the diaphragm without tearing the fabric.**

**12.** Alternately and evenly tighten all of the screws.

**13.** Place a new filter element over the spout in the valve housing cover. Lightly lubricate and position the gasket, then screw the filter housing onto the pump. Hand tighten the filter housing until the gasket contacts the pump, then advance it ⅛ turn.

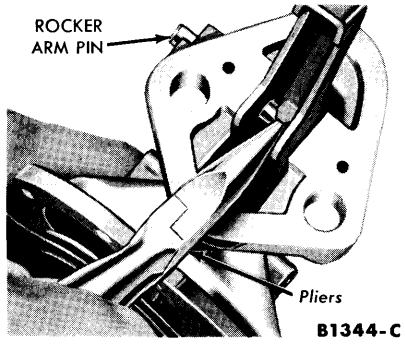



**FIG. 14—Rocker Arm Pin Removal or Installation**

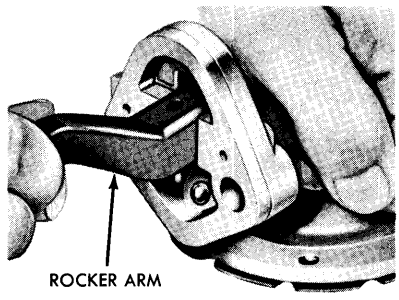



**FIG. 15—Fuel Pump Diaphragm Removal or Installation**

## V-8 ENGINES

### CARTER FUEL PUMPS

**Disassembly**

**1.** Remove the filter housing, gasket, and filter element. Discard the filter element.

**2.** Scribe marks on the fuel pump body, valve housing, and valve housing cover so that these parts can be assembled in their original position.

**3.** Remove the valve housing assembly. Separate the valve housing from the cover and note the position of the pulsator diaphragm so that it can be assembled in its proper position. **Do not remove the fuel valves from the valve housing. The valve housing is replaced as an assembly.**

**4.** Remove the rocker arm return spring.

**5.** Scrape away the staking mark and remove the rocker arm pin seal plug as shown in Fig. 13.

**6.** Press the fuel pump diaphragm into the fuel pump body to release the tension on the rocker arm and allow the rocker arm pin to fall out.

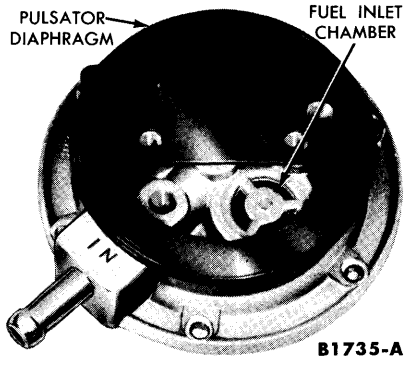
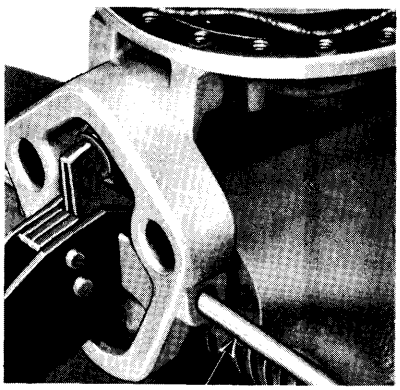



**FIG. 16—Pulsator Diaphragm Installation**



Tool—T56L-9350-A, Detail 3 B1468-A

**FIG. 17—Rocker Arm Pin Removal or Installation**

If the pin does not come out freely, use needle nose pliers (Fig. 14).

**7.** Press the diaphragm into the fuel pump body and pull the rocker arm out to unhook the rod from the rocker arm link (Fig. 15).

**8.** Remove the fuel pump diaphragm assembly. Do not disassemble as the diaphragm and spring are serviced as an assembly.

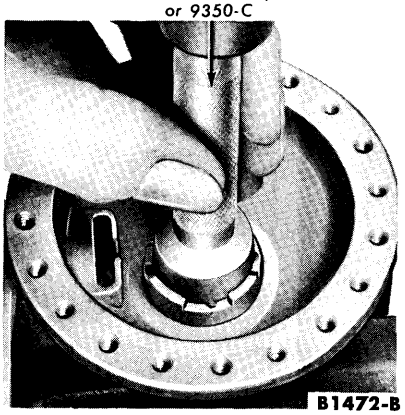
**Cleaning and Inspection.** Refer to Part 10-1, Section 3 for the cleaning and inspection procedures.

**Testing.** Tests and diagnosis procedures are covered in Part 10-1, Section 2.

**Assembly**

**1.** Position the fuel pump diaphragm assembly into the pump body, then apply pressure on the diaphragm spring so that the rocker arm can be hooked on the rod as shown in Fig. 15.

Tool—T56L-9350-A, Detail 1 or 9350-C



B1472-B

**FIG. 18—Oil Seal and Retainer Installation**

**2.** Align the rocker arm pin holes by applying slight pressure on the diaphragm spring, then install the rocker arm pin (Fig. 14).

**3.** Install a new rocker arm pin seal plug. Stake the plug in position.

**4.** Position the rocker arm return spring on the boss in the pump body. Compress the spring and slip it over the tang in the rocker arm.

**5.** Place a new pulsator diaphragm on the valve housing in the position previously noted on disassembly (opening in the diaphragm over the fuel inlet chamber as shown in Fig. 16). Position the cover on the valve housing, aligning the scribed lines on the cover with the line on the valve housing. Be sure the pulsator diaphragm extends evenly around the edge of the cover. Install and tighten the two retaining screws and lock washers inside the valve housing.

**6.** Align the scribe line on the valve housing and the line on the fuel pump body. Hold the valve housing assembly tight against the fuel pump body and install the six screws and lockwashers. Be sure the fuel pump diaphragm extends evenly around the edge of the valve housing before tightening the retaining screws.

**7.** Place a new filter element over the spout in the valve housing cover. Lightly lubricate and position the gasket, then screw the filter housing on the pump. Hand tighten the filter housing until the gasket contacts the pump, then advance it ⅛ turn.

## AC FUEL PUMP

**Disassembly**

**1.** Scribe marks on the fuel pump body, valve body, and cover so that these parts can be assembled in their original position.

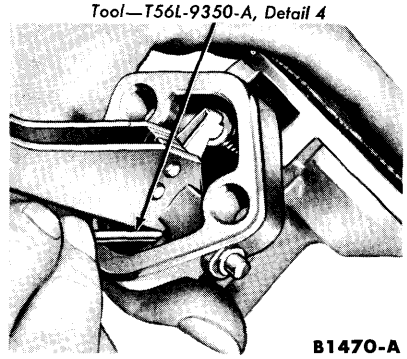
**2.** Separate the fuel pump body and the valve body.

**3.** Remove the fuel pump body cover and pulsator diaphragm.

**4.** Remove the staking marks around the valves, and flip the valves out with a screwdriver. **Note the position of the inlet and outlet valves so that the new valves can be installed in the same manner.**

**5.** Remove the upset on the end of the rocker arm pin. Remove the retaining washer, then drive the pin out using a blunt punch or tool T56L-9350-A, Detail 3, (Fig. 17). Work the fuel pump link out of the diaphragm stem.

Tool—T56L-9350-A, Detail 4



B1470-A

**FIG. 19—Fuel Pump Diaphragm Installation**

**6.** Remove the diaphragm and spring. Remove the diaphragm stem retainer and seal. Discard the seal.

**7.** Remove the rocker arm and link assembly.

**Cleaning and Inspection.** Refer to Part 10-1, Section 3 for the cleaning and inspection procedures.

**Testing.** Tests and diagnosis procedures are covered in Part 10-1.

**Assembly**

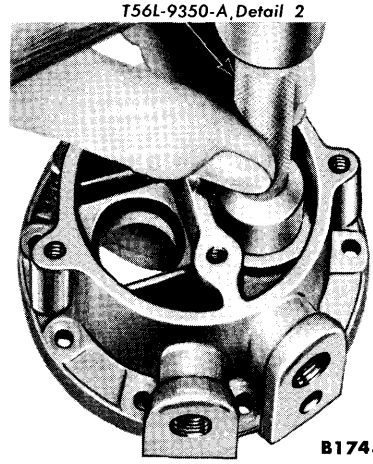
**1.** Install the diaphragm rod oil seal and retainer in the fuel pump body (Fig. 18).

**2.** Place the link, with the hook up, inside the return spring retainer spacer. Place these parts inside the rocker arm, and install the bushing. The cam contact surface of the rocker arm faces up.

**3.** Install a washer on each end of the bushing.

**4.** Place the rocker arm return

9350-D or T56L-9350-A, Detail 2



B1743-A

**FIG. 20—Fuel Pump Valve and Gasket Installation**

spring over the boss in the pump body. Place the rocker arm and link assembly in the pump body and hold them in place (Fig. 17).

**5.** Install the rocker arm pin. Place the retainer washer on the end of the pin. Peen the pin.

**6.** Lubricate the fuel pump diaphragm rod with grease. Position the spring on the fuel pump diaphragm rod. Insert the rod through the diaphragm stem oil seal, and hook the stem slot over the short link (Fig. 19).

**7.** Install the gaskets and fuel valves in the valve body (Fig. 20), then stake them in place.

**8.** Position the pulsator diaphragm and cover on the valve body using the identifying marks made on disassembly as guides. Hold the cover against the valve body and install the cover retaining screws. Make sure the diaphragm extends evenly around the edge of the cover. Tighten the screws.

**9.** Place the fuel pump body on the valve body, aligning the scribed line on the valve body with the line on the fuel pump body. Be sure the diaphragm extends evenly all around the edge of the valve body. Compress the spring with the rocker arm, and install the retaining screws. Tighten the screws evenly, then release the rocker arm.

# PART 10-7 FUEL TANK AND LINES


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 10-61 | 2 Removal and Installation | 10-61 |


## 1 DESCRIPTION AND OPERATION

All car models are equipped with a 20-gallon fuel tank and all station wagons are equipped with a 21-gallon fuel tank (Figs. 1 and 2).

The tanks are held in a vertical position by two steel support straps. On car models, an insulating pad is positioned between the top of the tank and the underside of the luggage compartment floor pan.

The fuel sender unit is located on the front side of the tank and is accessible from underneath the car.

The fuel outlet line and fuel return line (Mercury with a 390 2V only) is fastened to a connecting hose that is attached to a line which enters the fuel tank through the sender unit assembly. A filter is located in the tank on the fuel line pick-up tube. **This filter does not require servicing.**

On cars, the fuel tank filler pipe opening is located in the center of the lower back panel.

On station wagons, the fuel tank filler pipe is located behind a door in the left, rear quarter panel, just above and rearward of the wheel house opening. The tank is vented through the fuel filler pipe cap. On station wagons, the filler pipe is attached to the tank with a hose and hose clamps. The fuel line is routed from the fuel tank, passing beneath the left side (V-8 engines) or right side (6-cylinder engine) of the underbody; then, under the left fender (V-8) or right fender (6-cylinder) and through the forward part of the fender apron. The complete fuel line or fuel return line are replaceable as a unit. However, only the damaged segments are usually replaced.

## 2 REMOVAL AND INSTALLATION

### FILLER PIPE

The fuel filler pipe is removable on station wagons and Mercury cars with a 390 2V engine. On the other car models the filler pipe is not removable.

#### REMOVAL

1. Partially drain the fuel tank with a siphon to a level below the filler pipe connection in the tank.
2. Remove the retaining screws securing the filler pipe to the filler pipe housing. Loosen the hose clamp and loosen the hose from the filler pipe. Rotate the filler pipe and pull it outward to remove it from the fuel tank and filler pipe housing.

#### INSTALLATION

1. Position the filler pipe in the filler pipe housing and slide the hose onto the filler pipe. Install and tighten the filler pipe retaining screws.
2. Fill the fuel tank and install the filler cap. Check for fuel leaks.

### FUEL TANK

The fuel tank installations are shown in Figs. 1 and 2.

#### REMOVAL

1. Remove the filler cap. Using necessary precautions, drain the fuel into a suitable container.

On a station wagon, remove the tank flexible hose. Attach a rubber tube on the outlet pipe and extend the tube below the tank to promote siphoning.

2. Disconnect the fuel gauge sending unit wire at the sending unit. Remove the wire and retaining clip from the tank.
3. Disconnect the fuel line and return line (Mercury with 390 2V engine) at the tank sending unit.
4. On a station wagon, disconnect the fuel tank vent and disconnect the filler pipe at the fuel tank.
5. Remove the two nuts retaining the tank support straps to the body floor pan at the rear of the tank. Remove the straps and lower the tank.
6. Remove the sending unit from the old tank if a new tank is to be installed.

#### INSTALLATION

1. If a new tank is to be installed, install the fuel gauge sending unit with a new gasket in the new tank. Install the drain plug.
2. Install the tank insulator on top of the tank.
3. Hold the tank in position against the body floor pan. Hook the support straps to the retainers in the floor pan at the front of the tank. Position the straps over the studs, then install the nuts retaining the straps to the body floor pan at the rear of the tank.
4. Connect the fuel line and the return line (Mercury with a 390 2V engine).

On a station wagon, connect the filler pipe and vent tube to the fuel tank.

5. Connect the fuel gauge sending unit wire and install the wire retaining clip to the tank.
6. Fill the tank and check all connections for leaks.

### FUEL LINES

The various fuel lines (Figs. 1 and 2) are not serviced as assemblies. They must be cut, squared and formed out of rolls of fuel system service tubing and hose material available at dealerships.

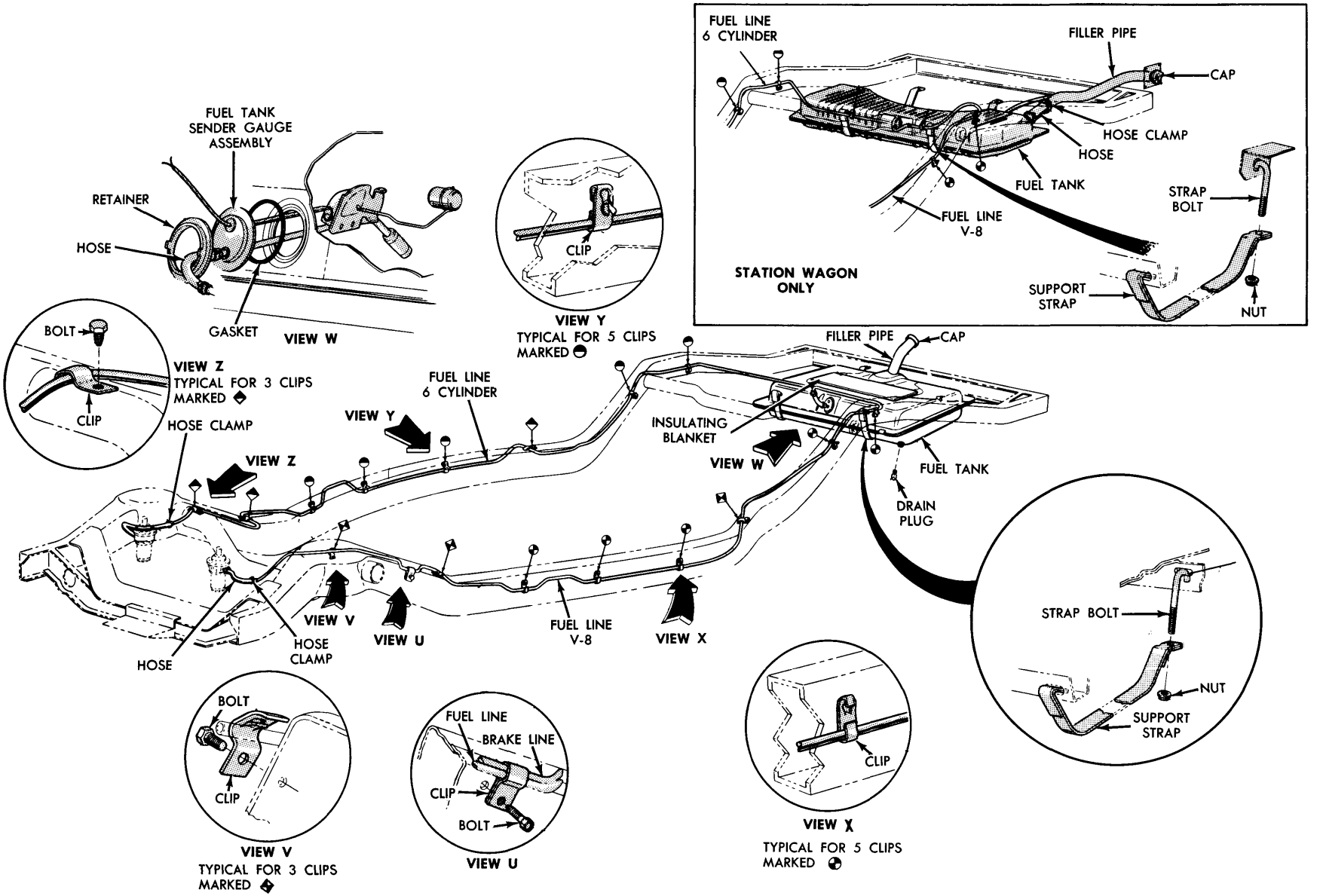



**FIG. 1—Fuel Systems—Ford and Mercury**

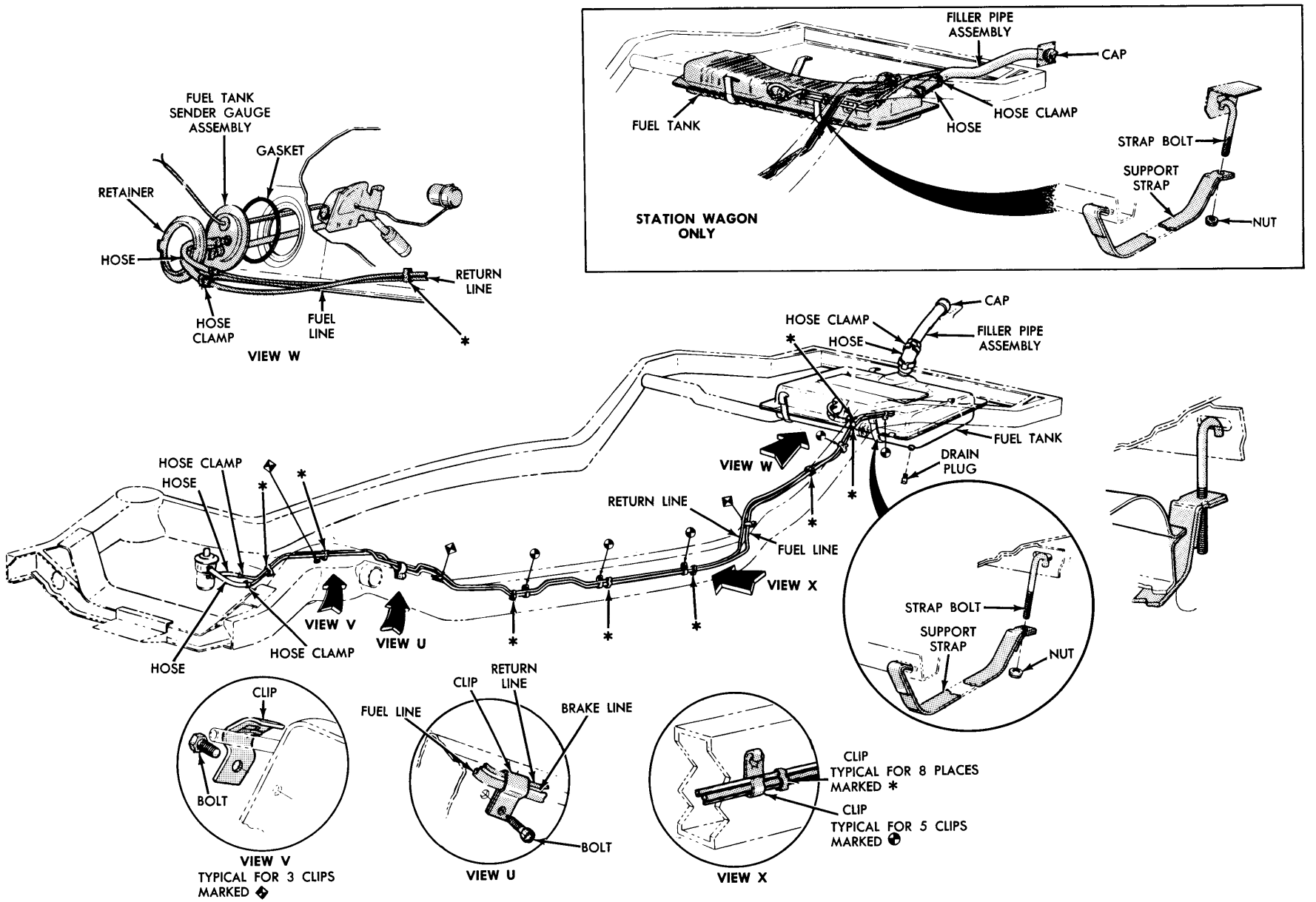



**FIG. 2—Fuel System—Mercury 390 2V Engine**

A damaged section of **tubing** longer than 12 inches can be cut out of the existing line and replaced by a comparable service **tubing section,** spliced into the line by means of connecting hoses and retaining clamps.

A damaged section of tubing shorter than 12 inches can be cut out of the line and replaced by a length of **service hose** and two retaining clamps. **All replacement hoses must be cut to a length that will insure proper clamp retention beyond the flared ends of the connecting tubing.**

## REMOVAL

**1.** Drain the fuel from the tank.

**2.** Disconnect the line at the fuel gauge sender unit and the fuel pump. Remove the lines from the holding clips along the underbody. Remove all damaged hose sections and tube sections.

## INSTALLATION

**1.** Cut a new section of tubing to approximately the same length as the section to be replaced. **Allow extra length for flaring the ends of the tubing.** Square the ends of the cut tubing with a file.

**2.** Ream the inside edges of the cut tubing with the reamer blade on the tube cutter. **Be sure metal chips are removed from inside the tube(s).** Flare the ends of the cut tubing, as required, with a standard tube flaring kit and tool (Fig. 3).

**3.** Bend the tube section to conform to the contour of the original tube. Cut an ample length of hose to form a coupling between the flared ends of the fuel lines. Connect the hose couplings to the tubing and install the retaining clamps.

**4.** Position the lines in the underbody clips and tighten the clips. Connect the line to the fuel gauge sender unit and the fuel pump. Fill the tank and check for leaks.

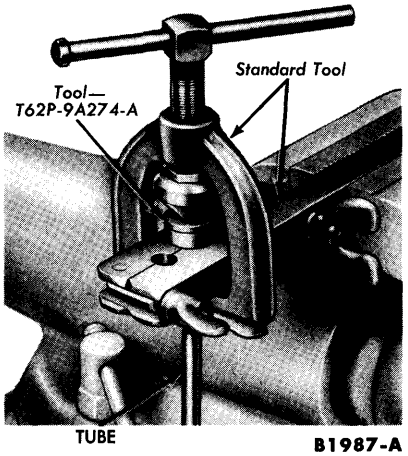



**FIG. 3—Fuel Line Tube Die**

# PART 10-8 SPECIFICATIONS

## FUEL PUMP

| | |
|---|---|
| **FUEL PUMP STATIC PRESSURE—Psi @ 500 Engine rpm** | |
| 223 Six | 3.5-5.5 |
| 289 V-8 | 4.0-6.0 |
| 352 V-8, 390 V-8 and 427 V-8 | 4.5-6.5 |
| **MINIMUM FUEL PUMP VOLUME—Flow @ 500 Engine rpm** | |
| 223 Six | 1 pint in 30 seconds |
| 289 V-8, 352 V-8, 390 V-8 and 427 V-8 | 1 pint in 20 seconds |
| **MINIMUM INTAKE STATIC VACUUM—Inches of Mercury @ 500 Engine rpm** | |
| All Engines | 6.0 |
| **ECCENTRIC TOTAL LIFT** | |
| 223 Six | 0.290-0.310 |
| 289 V-8 | 0.340-0.360 |
| 352 V-8, 390 V-8, 427 V-8 | 0.690-0.710 |

## FORD SINGLE BARREL CARBURETORS

**The basic part number of all carburetors is 9510. The part number prefix and suffix appears on the identification tag mounted on the air horn.**

| | |
|---|---|
| **CARBURETOR PART NO. C3AF-9510-BL** | |
| Engine | 223 Six (EBP) |
| Transmission | Manual Shift |
| **CARBURETOR PART NO. C3AF-9510-BM** | |
| Engine | 223 Six (EBP) |
| Transmission | Automatic |
| **CARBURETOR PART NO. C3AF-9510-BS (Economy)** | |
| Engine | 223 Six (EBP) |
| Transmission | Manual Shift |
| **CARBURETOR PART NO. C3AF-9510-BT (Economy)** | |
| Engine | 223 Six (EBP) |
| Transmission | Automatic |
| **THROTTLE BORE DIAMETER—Inches** | |
| C3AF-9510-BL and BM | 5/16 |
| C3AF-9510-BS and BT | 17/16 |
| **VENTURI DIAMETER—Inches** | |
| C3AF-9510-BL and BM | 1.200 |
| C3AF-9510-BS and BT | 1.100 |
| **MAIN METERING JET IDENTIFICATION NO.** | |
| **0-5,000 Feet** | |
| C3AF-9510-BL | 65F |
| C3AF-9510-BM | 65F |
| C3AF-9510-BS | 62F |
| C3AF-9510-BT | 60F |
| **5,000-10,000 Feet** | |
| C3AF-9510-BL | 63F |
| C3AF-9510-BM | 63F |
| C3AF-9510-BS | 60F |
| C3AF-9510-BT | 58F |
| **10,000-15,000 Feet** | |
| C3AF-9510-BL | 61F |
| C3AF-9510-BM | 61F |
| C3AF-9510-BS | 58F |
| C3AF-9510-BT | 56F |

## FORD SINGLE BARREL CARBURETORS (Continued)

| | |
|---|---|
| **SPARK CONTROL VALVE IDENTIFICATION COLOR** | Plain |
| **SPARK CONTROL VALVE CLOSES @ Inches of Mercury** | 5.5-6.5 |
| **CHOKE PLATE PULL-DOWN CLEARANCE—Inches** | |
| C3AF-9510-BL and BM | 5/16 |
| C3AF-9510-BS and BT | 3/8 |

**FLOAT SETTING—Dry**
1 ± 1/64 inch from bottom of float to air horn machined surface—with air horn inverted.

**ANTI-STALL DASHPOT***
**C3AF-9510-BM and BT**—3½ turns in after initial contact of adjusting screw with diaphragm.
*Distance from pump cover to pin in "HI" position (throttle plate seated in throttle bore).

| | |
|---|---|
| **INITIAL IDLE MIXTURE ADJUSTMENT** | |
| All Carburetors | 1-1½ turns open* |

*Turns back from bottomed needle.

## FORD DUAL CARBURETORS

**The basic part number of all the carburetors is 9510. The part number prefix and suffix appears on the identification tag mounted on the air horn.**

| | |
|---|---|
| **CARBURETOR PART NO. C4AF-9510-B** | |
| Engine | 289 V-8 (EGA) |
| Transmission | Manual-Shift |
| **CARBURETOR PART NO. C4AF-9510-C** | |
| Engine | 289 V-8 (EGA) |
| Transmission | Automatic |
| **CARBURETOR PART NO. C4MF-9510-A (266 H.P.)** | |
| Engine | 390 V-8 (EES) |
| Transmission | Automatic |
| **CARBURETOR PART NO. C4MF-9510-D (250 H.P.)** | |
| Engine | 390 V-8 (EES) |
| Transmission | Manual-Shift |
| **CARBURETOR PART NO. C4MF-9510-E (250 H.P.)** | |
| Engine | 390 V-8 (EES) |
| Transmission | Automatic |
| **THROTTLE BORE DIAMETER—Inches** | |
| C4AF-9510-B, C | 17/16 |
| C4MF-9510-A | 1⅝ |
| C4MF-9510-D, E | 19/16 |
| **VENTURI DIAMETER—Inches** | |
| C4AF-9510-B, C | 1.028 |
| C4MF-9510-A | 1.330 |
| C4MF-9510-D, E | 1.231 |

## FORD DUAL CARBURETORS (Continued)

**MAIN METERING JET IDENTIFICATION NO.**

**0-5,000 Feet**

| | |
|---|---|
| C4AF-9510-B | 46F |
| C4AF-9510-C | 43F |
| C4MF-9510-A | 59F |
| C4MF-9510-D | 58F |
| C4MF-9510-E | 57F |

**5,000-10,000 Feet**

| | |
|---|---|
| C4AF-9510-B | 44F |
| C4AF-9510-C | 41F |
| C4MF-9510-A | 57F |
| C4MF-9510-D | 56F |
| C4MF-9510-E | 55F |

**10,000-15,000 Feet**

| | |
|---|---|
| C4AF-9510-B | 42F |
| C4AF-9510-C | 39F |
| C4MF-9510-A | 55F |
| C4MF-9510-D | 54F |
| C4MF-9510-E | 53F |

**POWER VALVE IDENTIFICATION NO. OR COLOR**

**0-5,000 Feet**

| | |
|---|---|
| C4AF-9510-B, C | Green (#75) |
| C4MF-9510-A, D, E | Red (#95) |

**5,000-10,000 Feet**

| | |
|---|---|
| C4AF-9510-B, C | Yellow (#65) |
| C4MF-9510-A, D, E | Plain (#85) |

**10,000-15,000 Feet**

| | |
|---|---|
| C4AF-9510-B, C | Black (#65) |
| C4MF-9510-A, D, E | Green (#75) |

**POWER VALVE TIMING** ..... open @ inches of Mercury

| | |
|---|---|
| C4AF-9510-B, C | 6.5-8.5 |
| C4MF-9510-A, D, E | 8.5-10.5 |

**ACCELERATOR PUMP SETTING**

**C4AF-9510-B, C4MF-9510-A, D, E**

Link in the inboard hole of the pump lever and
#4 hole (40°F and below)
#3 hole (40°F to 80°F)
#2 hole (80°F and above) in the overtravel lever.

**C4AF-9510-C**

Link in the inboard hole of the pump lever and
#4 hole (—15°F and below)
#3 hole (40°F to —15°F)
#2 hole (40°F to 80°F)
#1 hole (80°F and above) in the overtravel lever.

**FLOAT SETTING—Dry**

| | |
|---|---|
| C4AF-9510-B, C, C4MF-9510-A | 5/8 ± 1/64 inch* |
| C4MF-9510-D, E | 21/32 ± 1/16 inch* |

*From the machined surface of the main body to the top of the free end of the float, with the float in the uppermost position.

**FUEL LEVEL SETTING—Wet**

| | |
|---|---|
| C4AF-9510-B, C, C4MF-9510-A | 7/8 ± 1/32 inch* |
| C4MF-9510-D, E | 29/32 ± 1/32 inch* |

*Below the top machined surface of the main body.

**INITIAL IDLE MIXTURE ADJUSTMENT** ..... 1-1½ turns open*

*After screw bottoms lightly in seat.

**THERMOSTATIC SPRING IDENTITY**

| | |
|---|---|
| C4AF-9510-B, C4MF-9510-A | TN |
| C4AF-9510-C | TO |
| C4MF-9510-D, E | TK |

**CHOKE THERMOSTATIC SPRING HOUSING INITIAL SETTING**

**C4AF-9510-B, C**
Set at two digits in the rich direction.

**C4MF-9510-A**
Set at two digits in the lean direction.

**C4MF-9510-D, E**
Set at one digit in the lean direction.

## FORD DUAL CARBURETORS (Continued)

**CHOKE PLATE PULLDOWN CLEARANCE—Inches**

| | |
|---|---|
| C4AF-9510-B, C | 7/64 |
| C4MF-9510-A, D | 3/16 |
| C4MF-9510-E | 5/32 |

**FAST (COLD) IDLE ADJUSTMENT**

| | |
|---|---|
| C4AF-9510-B, C4MF-9510-D | 1300 R.P.M.* |
| C4MF-9510-A, E | 1500 R.P.M.* |
| C4AF-9510-C | 1600 R.P.M.* |

*With fast idle screw on the kickdown step of the fast idle cam. (Hot engine.)

**DECHOKE CLEARANCE** ..... 1/16 inch*

*Minimum clearance between the choke plate and air horn wall, with the throttle plates in the wide open position.

**FAST IDLE CAM SETTING**

| | |
|---|---|
| C4AF-9510-B, C | 3/32 inch* |
| C4MF-9510-A | 9/64 inch* |
| C4MF-9510-D, E | 1/16 inch* |

*Clearance between the choke plate and the air horn wall, with the fast idle screw on the kickdown step of the fast idle cam.

**ANTI-STALL DASHPOT CLEARANCE—Inches**

| | |
|---|---|
| C4AF-9510-C, C4MF-9510-A, E | 1/16-3/32 |

**BOOSTER VENTURI CODE LETTER**

| | |
|---|---|
| C4AF-9510-B | DE |
| C4AF-9510-C | DD |
| C4MF-9510-A | C |
| C4MF-9510-D, E | F |

## FORD FOUR BARREL CARBURETORS

The basic part number of all the carburetors is 9510. The part number prefix and suffix appears on the identification tag mounted on the air horn.

**CARBURETOR PART NO. C4AF-9510-N**

| | |
|---|---|
| Engine | 352 V-8 (EDT) |
| Transmission | Manual-Shift |

**CARBURETOR PART NO. C4AF-9510-R**

| | |
|---|---|
| Engine | 352 V-8 (EDT) |
| Transmission | Automatic |

**CARBURETOR PART NO. C3AF-9510-BU**

| | |
|---|---|
| Engine | 390 V-8 (EES) |
| Transmission | Manual-Shift |

**CARBURETOR PART NO. C3AF-9510-BV**

| | |
|---|---|
| Engine | 390 V-8 (EES) |
| Transmission | Automatic |

**CARBURETOR PART NO. C3AF-9510-BY (Police)**

| | |
|---|---|
| Engine | 390 V-8 (EES) |
| Transmission | Manual-Shift |

**CARBURETOR PART NO. C3AF-9510-BZ (Police)**

| | |
|---|---|
| Engine | 390 V-8 (EES) |
| Transmission | Automatic |

**THROTTLE BORE DIAMETER—Inches**

| | |
|---|---|
| Primary and Secondary | 1 9/16 |

**VENTURI DIAMETER—Inches**

| | |
|---|---|
| Primary | 1 1/8 |
| Secondary | 1 3/16 |

## FORD FOUR BARREL CARBURETORS (Continued)

**MAIN METERING JET IDENTIFICATION NO.**

Primary

0-5,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY | 56 |
| C3AF-9510-BV, BZ | 54 |
| C4AF-9510-N | 50F |
| C4AF-9510-R | 49F |

5,000-10,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY | 54 |
| C3AF-9510-BV, BZ | 52 |
| C4AF-9510-N | 48F |
| C4AF-9510-R | 47F |

10,000-15,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY | 52 |
| C3AF-9510-BV, BZ | 50 |
| C4AF-9510-N | 46F |
| C4AF-9510-R | 45F |

Secondary

0-5,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY, BZ | 63 |
| C3AF-9510-BV | 62 |
| C4AF-9510-N, R | 58F |

5,000-10,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY, BZ | 61 |
| C3AF-9510-BV | 60 |
| C4AF-9510-N, R | 56F |

10,000-15,000 Feet

| | |
|---|---|
| C3AF-9510-BU, BY, BZ | 59 |
| C3AF-9510-BV | 58 |
| C4AF-9510-N, R | 54F |

**POWER VALVE IDENTIFICATION NO. OR COLOR**

| | |
|---|---|
| 0-5,000 Feet | Plain (#85) |
| 5,000-10,000 Feet | Green (#75) |
| 10,000-15,000 Feet | Yellow (#65) |

**POWER VALVE TIMING** ..... Open at 7.5-9.5 Inches of Mercury

**ACCELERATOR PUMP SETTING**

**C3AF-9510-BU, BV, BY, BZ, C4AF-9510-R**
Link in the inboard hole of the pump lever and
#4 hole (40°F and below)
#3 hole (40°F to 80°F)
#2 hole (80°F and above) in the overtravel lever.

**C4AF-9510-N**
Link in the inboard hole of the pump lever and
#3 hole (—15°F and below)
#2 hole (—15°F to 40°F)
#1 hole (40°F and above) in the overtravel lever.

**FLOAT SETTING—Dry**

Primary and Secondary ..... $^{21}/_{32} \pm {}^{1}/_{64}$ inch*

*From the machined surface of the main body to the top of the free end of the float, with the float in the uppermost position.

**FUEL LEVEL SETTING—Wet**

Primary and Secondary ..... $^{29}/_{32} \pm {}^{1}/_{32}$ inch*

*Below the top machined surface of the main body.

**INITIAL IDLE MIXTURE ADJUSTMENT** ..... 1-1½ turns open*

*After screw bottoms lightly in seat.

**THERMOSTATIC SPRING IDENTITY** ..... TK

**CHOKE THERMOSTATIC SPRING HOUSING INITIAL SETTING**

**C3AF-9510-BU, BY**
Set at one digit in the rich direction.

**C3AF-9510-BY, BZ, C4AF-9510-N**
Set at one digit in the lean direction.

**C4AF-9510-R**
Set at three digits in the lean direction.

**CHOKE PLATE PULLDOWN CLEARANCE—Inches**

| | |
|---|---|
| C3AF-9510-BU, BY, C4AF-9510-N | $^{3}/_{16}$ |
| C3AF-9510-BV, BZ, C4AF-9510-R | $^{5}/_{32}$ |

## FORD FOUR BARREL CARBURETORS (Continued)

**FAST (Cold) IDLE ADJUSTMENT**

| | |
|---|---|
| C3AF-9510-BU, BY, C4AF-9510-N | 1300 R.P.M.* |
| C3AF-9510, BV, BZ, C4AF-9510-R | 1500 R.P.M.* |

*With fast idle screw on the kickdown step of the fast idle cam. (hot engine)

**DECHOKE CLEARANCE** ..... $^{1}/_{16}$ inch*

*Minimum clearance between the choke plate and air horn wall, with the primary throttle plates in the wide open position.

**FAST IDLE CAM SETTING** ..... $^{1}/_{16}$ inch*

*Between choke plate and air horn wall with the fast idle screw on the kickdown step of the fast idle cam.

**ANTI-STALL DASHPOT CLEARANCE—Inches**

C3AF-9510-BV, BZ, C4AF-9510-R ..... $^{1}/_{16}$-$^{3}/_{32}$

**BOOSTER VENTURI CODE LETTER**

Primary

| | |
|---|---|
| C3AF-9510-BU, BY | S |
| C3AF-9510-BV, BZ | T |
| C4AF-9510-N | Z |
| C4AF-9510-R | G |
| Secondary | B |

**SECONDARY THROTTLE PLATE SETTING** ..... ¾ turn in*

*After adjusting screw initially contacts the secondary throttle lever.

## HOLLEY 4-BARREL CARBURETORS

**The basic part number of all the carburetors is 9510. The part number prefix and suffix appears on the identification tag mounted on the air horn.**

**CARBURETOR PART NO. C3AE-9510-B**

| | |
|---|---|
| Engine | 4V 427 (EGB) |
| Transmission | Manual-Shift |

**CARBURETOR PART NO. C3AF-9510-BJ (Primary)**

| | |
|---|---|
| Engine | 8V 427 (EGB) |
| Transmission | Manual-Shift |

**CARBURETOR PART NO. C3AF-9510-BK (Secondary)**

| | |
|---|---|
| Engine | 8V 427 (EGB) |
| Transmission | Manual-Shift |

**THROTTLE BORE DIAMETER—Inches**

Primary

| | |
|---|---|
| C3AE-9510-B | $1^{5}/_{16}$ |
| C3AF-9510-BJ | $1^{9}/_{16}$ |
| C3AF-9510-BK | $1^{9}/_{16}$ |

Secondary

| | |
|---|---|
| C3AE-9510-B | $1^{3}/_{8}$ |
| C3AF-9510-BJ | $1^{9}/_{16}$ |
| C3AF-9510-BK | $1^{9}/_{16}$ |

**VENTURI DIAMETER—Inches**

Primary and Secondary

| | |
|---|---|
| C3AE-9510-B | 1.688 |
| C3AF-9510-BJ | |
| C3AF-9510-BK | |

**MAIN METERING JET IDENTIFICATION NO.**

Primary

| | |
|---|---|
| C3AE-9510-B | 67 |
| C3AF-9510-BJ | 66 |
| C3AF-9510-BK | 66 |

Secondary

| | |
|---|---|
| C3AE-9510-B | 77 |
| C3AF-9510-BJ | 2007-11 |
| C3AF-9510-BK | 2007-11 |

## HOLLEY 4-BARREL CARBURETORS (Continued)

**POWER VALVE IDENTIFICATION NO.**
C3AE-9510-B ..... 65
C3AF-9510-BJ ..... 65
C3AF-9510-BK ..... 65

**FUEL ENRICHMENT VALVE NO.**
C3AE-9510-B .....
C3AF-9510-BJ .....
C3AF-9510-BK .....

**POWER VALVE TIMING** ..... Opens at 5.5-6.5 Inches of Mercury

**ACCELERATOR PUMP SETTING** ..... #1 hole in lever

**ACCELERATOR PUMP CLEARANCE**
0.010-0.015 inch clearance between pump lever and pump adjusting screw with throttle plates in the wide open position and the pump lever fully depressed.

**FLOAT SETTING—Dry**
Top of float parallel with top of float bowl (bowl inverted).

**FUEL LEVEL SETTING—Wet**
Bottom edge of sight plug ± 1/32 inch.

**INITIAL IDLE MIXTURE ADJUSTMENT** ..... 1-1½ turns open*
*After screw bottoms lightly in seat.

**THERMOSTATIC SPRING IDENTITY**
C3AE-9510-B, C3AF-9510-BJ ..... 58L1

**CHOKE THERMOSTATIC SPRING HOUSING INITIAL SETTING**
Set at the center index mark.

## HOLLEY 4-BARREL CARBURETORS (Continued)

**FAST (Cold) IDLE ADJUSTMENT**
C3AE-9510-B, C3AF-9510-BJ ..... 1800 R.P.M.*
With fast idle screw on the top step of the cam. (hot engine)

**SECONDARY THROTTLE PLATE SETTING** ..... ½ turn in*
*After adjusting screw initially contacts secondary throttle lever.

## FUEL TANK CAPACITY

**CAR**
U.S. Measure ..... 20 gallons
Imperial Measure ..... 16½ gallons

**STATION WAGON**
U.S. Measure ..... 21 gallons
Imperial Measure ..... 17½ gallons

## AIR CLEANERS

**TYPE**
223 Six—Except Police ..... Dry
223 Six—Police ..... Oil Bath
Capacity ..... 1 pint
Oil Viscosity
Above + 32°F ..... SAE-30
Below + 32°F ..... SAE-20

# COOLING SYSTEM

# GROUP 11


**PART 11-1** PAGE
GENERAL COOLING SYSTEM SERVICE ..... 11-1
**PART 11-2**
WATER PUMP ..... 11-4
**PART 11-3** PAGE
RADIATOR AND THERMOSTAT ..... 11-9
**PART 11-4**
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# PART 11-1 GENERAL COOLING SYSTEM SERVICE


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Diagnosis and Testing | 11-1 | 3 Common Adjustments and Repairs | 11-2 |
| 2 Maintenance | 11-2 | 4 Cleaning and Inspection | 11-3 |


## 1 DIAGNOSIS AND TESTING

### DIAGNOSIS

Engine overheating and slow engine warm-up are the two engine troubles most commonly attributed to the cooling system.

Loss of coolant, thermostat stuck in the closed position, restricted air flow through the radiator, or the accumulation of rust and scale in the system are the main causes of overheating. Coolant loss may be due to external leakage at the radiator, radiator pressure cap, water pump, hose connections, heater, or core plugs. Coolant loss may also be caused by internal leakage due to a defective cylinder head gasket, improper tightening of the cylinder head bolts, or warped cylinder head or block gasket surfaces.

Internal leakage can be detected by operating the engine at fast idle and looking for the formation of bubbles in the radiator. Oil in the radiator may indicate leakage in the engine block or a leak in the automatic transmission oil cooler. Water formation on the oil level dipstick could also be an indication of internal leakage.

Rust and scale that form in the engine water passages are carried into the radiator passages by the circulation of the coolant. This clogs the radiator passages and causes overheating. Rust can be detected by the appearance of the coolant. If the coolant has a rusty or muddy appearance, rust is present.

A defective thermostat that remains open will cause slow engine warm-up.

### DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **ENGINE OVERHEATS** | Insufficient coolant.<br>Belt tension incorrect.<br>Radiator fins obstructed. | Thermostat stuck closed.<br>Cooling system passages blocked by rust, scale, or other foreign matter.<br>Water pump inoperative. |
| **ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE** | Thermostat stuck open, or of incorrect heat range.<br>Temperature sending unit defective (causing gauge to indicate low engine temperature). | Temperature gauge defective (not indicating true engine temperature). |
| **LOSS OF COOLANT** | Leaking radiator or transmission oil cooler.<br>Loose or damaged hose connections.<br>Water pump leaking.<br>Cylinder head gasket defective.<br>Improper tightening of cylinder head bolts. | Cylinder block core plugs leaking.<br>Cracked cylinder head or block, or warped cylinder head or block gasket surface.<br>Radiator cap defective, or wrong type. |

### TESTING

#### COOLING SYSTEM PRESSURE TEST

It is recommended that a cooling system pressure test gauge be used to properly test the system for:

**1.** Blown or leaking cooling system sealing gaskets.

**2.** Internal or external coolant leakage.

**3.** Pressure cap malfunction.

Many types of pressure gauges are available for use. Therefore, it is recommended that the gauge manufacturer's instructions be followed when performing the test. **Never exceed the rated pressure indicated on the pressure cap when performing the pressure test.**

#### THERMOSTAT TEST

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open more than ¼ inch.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to a lighted background. Light leakage around the thermostat valve (thermostat at room temperature) is unacceptable and the thermostat should be replaced. It is possible, on some thermostats, that a slight leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

#### FAN DRIVE CLUTCH TEST

**1.** Run the engine at approximately 1000 rpm until normal operating temperature is reached. This process can be speeded up by blocking off the front of the radiator with cardboard.

**2.** Stop the engine and, using a cloth to protect the hand, immediately check the effort required to turn the fan. If considerable effort is required, it can be assumed that the coupling is operating satisfactorily. If very little effort is required to turn the fan, it is an indication that the coupling is not operating properly, and it should be replaced.

## 2 MAINTENANCE

### COOLANT

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes keeping the radiator fins clean and a periodic inspection of the cooling system for leakage.

**Use care when removing the radiator cap to avoid injury from escaping steam or hot water.**

In production, the cooling system is filled with a new long-life coolant. This coolant protects to −35°F. It will not be necessary to provide special anti-freeze protection except in areas where temperatures fall below this level. For year round protection from corrosion and overheating, and for low-temperature protection to −35°F, all coolant added should be a mixture of 50% Ford Rotunda coolant concentrate and water. **Use of greater than a 50-50 concentrate should be avoided to prevent possible overheating during warm weather. Do not mix permanent-type anti-freeze with the methanol type.**

In areas where protection to −35°F is not required, but some protection is necessary, refer to the coolant mixture chart on the Ford Rotunda coolant can for the recommended mixture proportions.

A standard ethylene glycol hydrometer can be used to check the protection level of the long-life coolant.

Refer to Group 19 for the recommended cooling system drain interval.

### DRAINING AND FILLING THE COOLING SYSTEM

To drain the radiator, open the drain cock located at the bottom of the radiator. The cylinder block of the V-8 engines have a drain plug located on both sides of the block (Fig. 1). The six cylinder engine has one drain plug located at the left rear of the cylinder block.

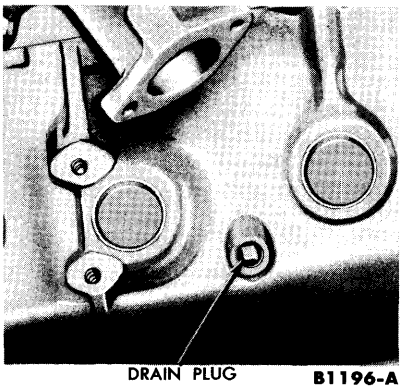



**FIG. 1—Typical Cylinder Block Drain Plug**

To fill the cooling system, close the drain cocks or install the plugs in the block and close the radiator drain cock. Fill the system to one inch just below the filler neck of the radiator supply tank. Disconnect the heater outlet hose at the water pump to bleed or release trapped air in the system. When the coolant begins to escape, connect the heater outlet hose. Operate the engine until normal operating temperature has been reached. **After the initial fill, the coolant level may drop approximately 1 quart after the engine has been operated about 20 minutes at 2000 rpm. This is due to the displacement of entrapped air.** Add more coolant to fill the radiator supply tank.

### FAN DRIVE BELTS

If the fan drive belt(s) are noisy, check the tension of the belts to make certain they are within specifications. Also, check for misaligned pulleys. If the drive belts are worn or frayed, replace them following the procedures in Part 11-1, Section 3.

## 3 COMMON ADJUSTMENTS AND REPAIRS

### ADJUSTMENTS

### DRIVE BELTS

The fan drive belt(s) should be properly adjusted at all times. Loose drive belt(s) cause improper generator or alternator, fan and water pump operation. A belt that is too tight places a severe strain on the water pump and the generator or alternator bearings.

Properly tensioned drive belts minimize noise and also prolong the service life of the belt. Therefore, it is recommended that a belt tension gauge be used to check and adjust the belt tension. **Any belt that has operated for a minimum of 10 minutes is considered a used belt, and, when adjusted, it must be adjusted to the reset tension shown in the specifications.**

**Belt Tension**

**1.** Install the belt tension tool on the drive belt (Fig. 2) and check the tension following the instructions of the tool manufacturer.

**2.** If adjustment is necessary, loosen the generator or alternator mounting bolts and the generator or alternator adjusting arm bolt. Move the generator or alternator toward or away from the engine until the correct tension is obtained. Remove the gauge. Tighten the generator or alternator adjusting arm bolt and the mounting bolts. Install the tension gauge and check the belt tension.

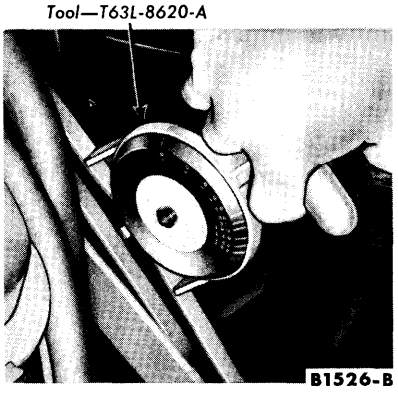



**FIG. 2—Checking Drive Belt Tension**

### REPAIRS

### FAN REPLACEMENT

**6-Cylinder Engine**

**1.** Remove the capscrews and lock washers retaining the fan to the water pump hub. Remove the fan.

**2.** Position the fan on the water pump hub. Install the lock washers and capscrews and torque the capscrews to specifications.

**V-8 Engines.** On a car with an air conditioner or extra-extra-cooling radiator, a fan drive clutch may be used (see Specifications). Cars without air conditioning utilize a pulley-to-fan spacer.

**1.** Remove the radiator upper support and fan guard. Remove the capscrews and lock washers retaining the fan and spacer (or drive clutch) to the water pump hub. Remove the fan and spacer (or drive clutch).

**2.** If equipped with a fan drive clutch, remove the retaining capscrews and lock washers and separate the fan from the drive coupling. Position the replacement fan on the drive clutch and install the lock washers and capscrews. Torque the capscrews to specifications.

**3.** Position the fan and spacer (or drive clutch) on the water pump hub and install the lock washers and capscrews. Torque the capscrews to specifications. Install the radiator upper support and fan guard.

### FAN DRIVE BELT REPLACEMENT

**6-Cylinder and 289 V-8 Engine**

**1.** Loosen the alternator or generator mounting bolts and the alternator or generator adjusting arm bolt. Move the alternator or generator toward the engine. Remove the belt from the alternator or generator and crankshaft pulleys, and lift it over the fan.

**2.** Place the belt over the fan and insert it in the water pump pulley, and alternator or generator pulley groove. Adjust the belt tension to specifications.

**352, 390 and 427 V-8**

**1.** On a car with power steering, loosen the power steering pump bracket at the water pump and remove the drive belt.

On a car with an air conditioner, remove the compressor drive belt.

**2.** Loosen the alternator or generator mounting bolts and the alternator or generator adjusting arm bolt. Move the alternator or generator toward the engine. Remove the belt(s) from the alternator or generator and crankshaft pulleys, and lift them over the fan.

**3.** Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley and alternator or generator pulley grooves. Adjust the belt tension to specifications.

**4.** On a car with an air conditioner, install and adjust the compressor drive belt to specifications.

**5.** On a car with power steering, install the power steering pump drive belt and tighten the pump bracket to the water pump. Adjust the drive belt tension to specifications.

### RADIATOR HOSE REPLACEMENT

Radiator hoses should be replaced whenever they become cracked, rotted or have a tendency to collapse.

**1.** Drain the radiator, and loosen the clamps at each end of the hose to be removed. Slide the hose off the radiator connection and the radiator supply tank connection (upper hose) or the water pump connection (lower hose).

**2.** Position the clamps on each end of the hose. Slide the hose on the connections. **Make sure the clamps are beyond the bead on the connections.** Tighten the clamps firmly. Fill the radiator with coolant. Operate the engine for several minutes, then check the hoses and connections for leaks. Check for proper coolant level after the engine has reached normal operating temperature.

# 4 CLEANING AND INSPECTION

## CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use either FoMoCo Regular Cooling System Cleanser or in severe cases use Heavy Duty Cleanser. Removal of such material restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head bolts are properly tightened to prevent possible water leakage into the cylinders.

**Always remove the thermostat prior to pressure flushing.**

A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

## RUST INHIBITOR

If water without anti-freeze is added to the cooling system after it has been cleaned, use FoMoCo Rust Inhibitor to prevent additional corrosion or rust. Rust inhibitor does not remove or dissolve rust. It is a preventive only and not a cleaner.

Rotunda anti-freeze contains an anti-rust additive. Therefore, the addition of rust inhibitor is not necessary when anti-freeze is used in the cooling system.

## WATER PUMP

1. Clean the gasket mounting surfaces of the water pump and cylinder block.
2. Clean and inspect the seal seating surface of the water pump.
3. Clean the pump housing and inspect it for cracks, sand holes, improper machining, and damaged surfaces. If the water pump housing is damaged beyond repair, replace the complete water pump.

## FAN DRIVE CLUTCH

Check the control piston (Fig. 3) for free movement in the coupling. If the control piston sticks, remove the piston and clean it with emery cloth.

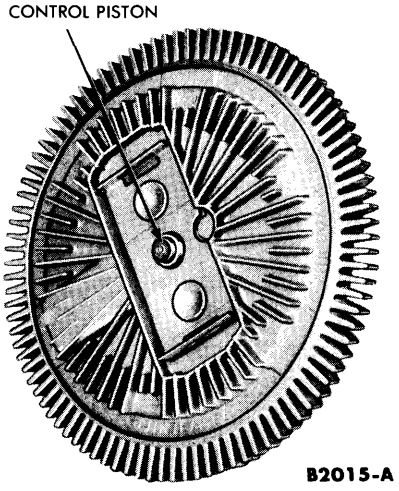



**FIG. 3—Control Piston Installed**

For fan drive clutch test procedures, refer to Part 11-1, Section 1.

Check the bi-metallic strip, and, if it is damaged, replace the complete fan drive clutch assembly. Bi-metallic strips are not interchangeable.

After the fan drive clutch is assembled, clean the drive with a clean cloth and solvent. **The fan drive clutch should not be dipped in any liquid.**

# PART 11-2 WATER PUMP


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 11-5 | 3 Major Repair Operations | 11-6 |
| 2 Removal and Installation | 11-5 | | |


## 1 DESCRIPTION AND OPERATION

A centrifugal-type water pump is mounted on the front of the cylinder block. On the 289 V-8, the water pump is mounted on the cylinder front cover. The water pump inlet port is connected to the radiator lower header tank to draw coolant from the radiator when the thermostat is open. On the V-8 engines, a bypass port on the water pump is connected to the coolant outlet housing to permit coolant circulation within the engine when the thermostat is closed, bypassing the radiator. On the 6-cylinder engine, the water pump bypass passage is aligned with a bypass passage in the cylinder block for coolant circulation in the engine when the thermostat is closed.

A vane-type, cast-iron impeller supplies coolant through centrifugal action to the water pump outlet port on a 6-cylinder engine. On the V-8 engines, the water pump has two outlet ports, one for each cylinder bank, to provide uniform coolant circulation in both banks of the engine.

The water pumps have a sealed bearing integral with the water pump shaft. The bearing requires no lubrication. A bleed hole in the water pump housing allows water that may leak past the seal to be thrown out by the slinger. **This is not a lubrication hole.**

The cooling fan hub is pressed a specified distance onto the water pump shaft.

## 2 REMOVAL AND INSTALLATION

### MILEAGE MAKER SIX, TAXI SPECIAL AND SPECIAL POLICE

#### REMOVAL

1. Drain the cooling system.

On a car with power steering, remove the power steering drive belt.

On a car with air conditioning, remove the compressor drive belt.

2. Disconnect the radiator lower hose and heater hose at the water pump. Remove the fan, pulley and drive belt.

3. Remove the water pump back plate bolt retaining the generator bracket.

4. Remove the three bolts retaining the water pump to the block; then remove the pump and the gasket.

#### INSTALLATION

1. If a new water pump is to be installed, remove the heater hose fitting from the old pump and install it on the new pump. Clean all the gasket material from the mounting surfaces of the cylinder block and the water pump.

2. Position a new gasket, coated on both sides with sealer, on the cylinder block. Install the pump body on the block. Torque the retaining bolts to specifications.

3. Position the generator bracket to the water pump back plate and install the retaining bolt.

On a car with power steering, install and adjust the power steering drive belt.

On a car with air conditioning, install the compressor drive belt. Adjust the belt tension to specifications.

4. Install the pulley and fan. Install the drive belt and adjust the belt tension. Connect the radiator hose and heater hose. Fill and bleed the cooling system. Operate the engine and check for leaks.

### 289 V-8 ENGINE

#### REMOVAL

1. Drain the cooling system.

On a car with power steering, remove the power steering drive belt.

On a car with an air conditioner, remove the compressor drive belt.

2. Disconnect the radiator lower hose and heater hose at the water pump. Remove the drive belt, fan, fan spacer or fan drive clutch and pulley.

3. Remove the bolts retaining the pump to the cylinder front cover. Remove the pump and gasket. Discard the gasket.

#### INSTALLATION

1. Remove all the gasket material from the mounting surfaces of the cylinder front cover and the water pump.

2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover; then, install the pump.

3. Install the retaining bolts and torque them to specifications.

On a car with power steering, install the power steering drive belt, and adjust the tension to specifications.

On a car with an air conditioner, install the compressor drive belt, and adjust the belt tension to specifications.

4. Install the pulley, spacer or fan drive clutch and fan. Install and adjust the drive belt to the specified belt tension. Connect the radiator hose and heater hose.

5. Fill and bleed the cooling system. Operate the engine until normal operating temperatures have been reached and check for leaks.

### 352, 390 AND 427 V-8

#### REMOVAL

1. Drain the cooling system.

On a car with power steering, remove the power steering drive belt.

On a car with an air conditioner, remove the compressor drive belt.

2. Disconnect the radiator lower hose and heater hose at the water pump. Remove the radiator upper support and fan guard. Remove the fan belt(s), fan, fan spacer or fan drive clutch and pulley.

3. Remove the four bolts retaining the pump to the block. Remove the pump and gasket(s).

#### INSTALLATION

1. If a new water pump is to be installed, remove the heater hose fitting from the old pump and install it on the new pump. Remove all the gasket material from the mounting surfaces of the cylinder front cover or block and the water pump.

2. Position new gasket coated on both sides with sealer, on the cylinder block; then install the pump.

3. Install the retaining bolts and torque them to specifications.

On a car with power steering, install and adjust the power steering drive belt.

On a car with an air conditioner, install and adjust the compressor drive belt.

4. Install the pulley, spacer or fan drive clutch and fan. Install the belt(s) and adjust the belt tension. Connect the radiator hose and heater hose. Install the radiator upper support and fan guard.

5. Fill and bleed the cooling system. Operate the engine until normal operating temperatures have been reached and check for leaks.

## 3 MAJOR REPAIR OPERATIONS

### MILEAGE MAKER SIX, TAXI SPECIAL AND SPECIAL POLICE

#### DISASSEMBLY

1. Remove the back plate and gasket from the water pump. Remove the hub from the impeller shaft (Fig. 4).

2. Position the pump on an arbor press and press the shaft off the impeller and out of the housing (Fig. 5).

3. Press the inner seal assembly from the pump (Fig. 6).

#### CLEANING AND INSPECTION

Refer to Part 11-1 for the cleaning and inspection procedures.

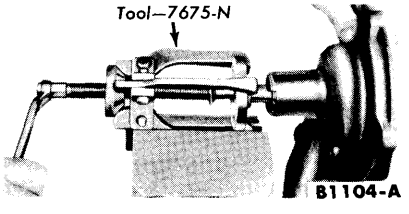



**FIG. 4—Removing Hub From Shaft**

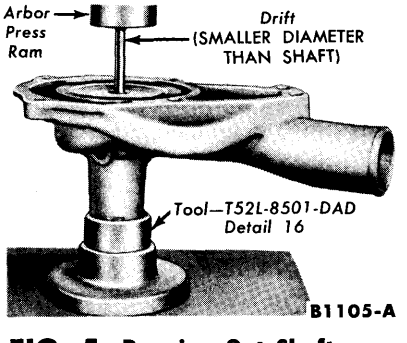



**FIG. 5—Pressing Out Shaft**

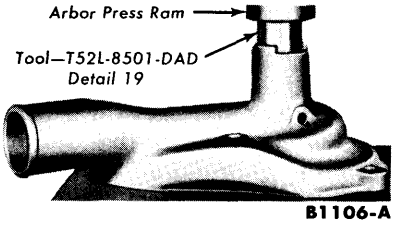



**FIG. 6—Pressing Out Seal**

#### ASSEMBLY

The water pump assembly is shown in Fig. 7.

1. Clean all the gasket material from the pump and back plate.

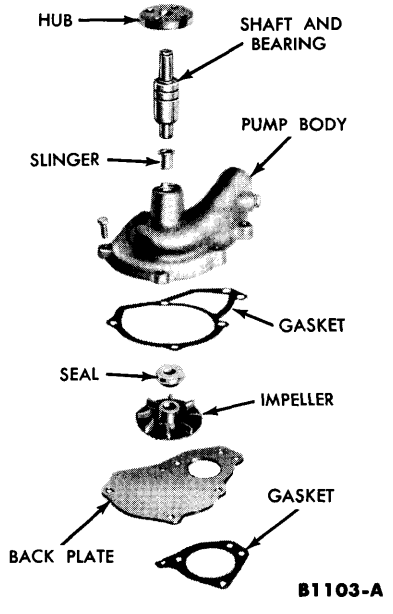



**FIG. 7—Water Pump Assembly —Mileage Maker Six, Taxi Special and Special Police**

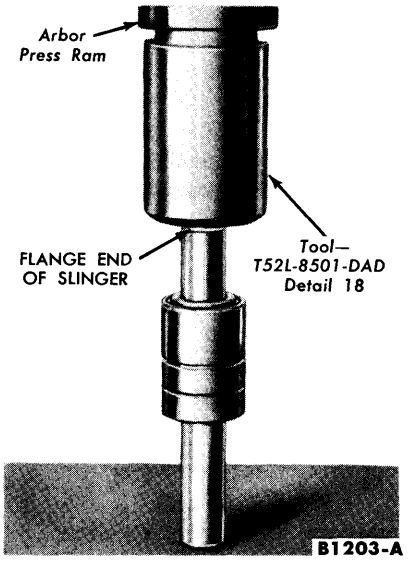



**FIG. 8—Replacing Slinger**

2. Install the new slinger on the new bearing and shaft assembly furnished in the repair kit (Fig. 8). Locate the slinger in the same relative position as the slinger on the old shaft.

3. Apply a light film of water-

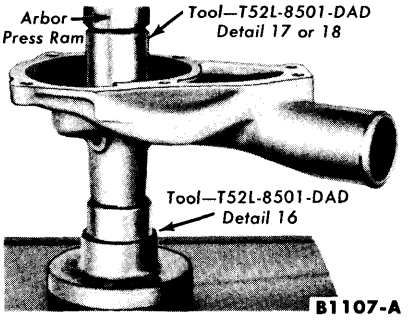



**FIG. 9—Seal Installation**

proof sealer on a new seal and press the seal into the housing (Fig. 9).

**4.** Coat the bearing outer diameter with grease, and position the shaft assembly and press it into the housing (Fig. 10).

**5.** Replace the impeller if it is damaged. Lightly coat the seal rubbing face of the impeller with grease.

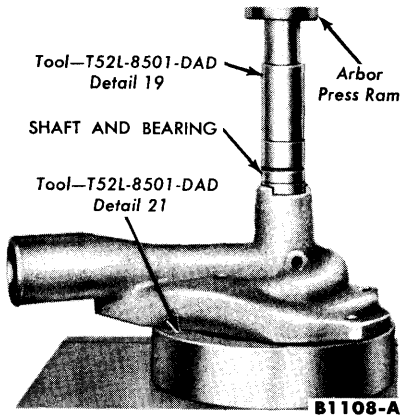



**FIG. 10—Shaft Installation**

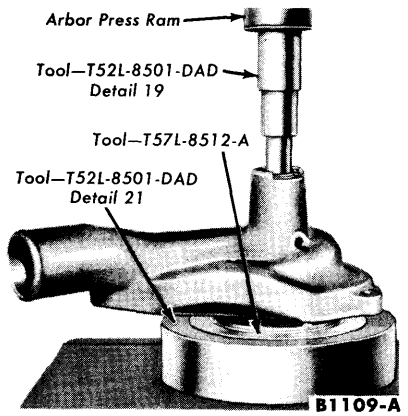



**FIG. 11—Pressing Shaft Into Impeller**

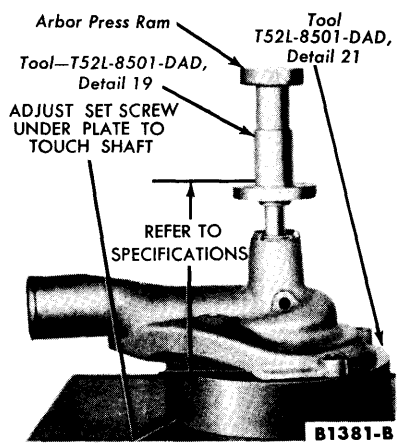



**FIG. 12—Hub Installation**

Press the shaft into the impeller (Fig. 11). **Press the shaft into the impeller until the pump housing lightly touches the face of the adapter ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the adapter ring, the pump bearing will be damaged. Impeller to pump housing clearance is as shown in the specifications.**

**6.** Reverse the insert ring in the holding fixture and adjust the set screw in the holding fixture until the pump shaft is supported. Position the fan hub over the shaft and press it into place holding the specified distance from the housing mounting face to the hub front face (Fig. 12).

**7.** Coat a new gasket on both sides with sealer and install the gasket on the pump housing, then install the back plate.

## 289 V-8 ENGINE

### DISASSEMBLY

**1.** Position the pump on an arbor press and press the hub off the shaft (Fig. 13).

**2.** Press the shaft and impeller and seal out of the housing (Fig. 14).

### CLEANING AND INSPECTION

Refer to Part 11-1 for the cleaning and inspection procedures.

### ASSEMBLY

The water pump assembly is shown in Fig. 15.

**1.** Install the new slinger on the new bearing and shaft assembly furnished in the repair kit (Fig. 16). Press the slinger on until the tool bottoms.

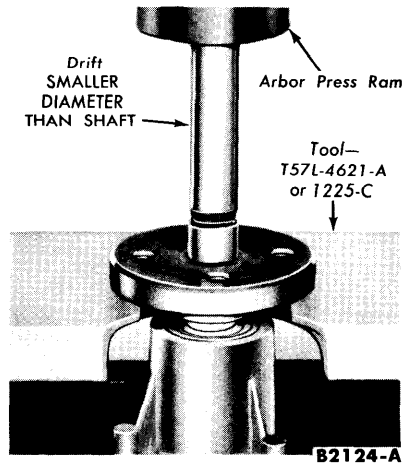



**FIG. 13—Hub Removal**

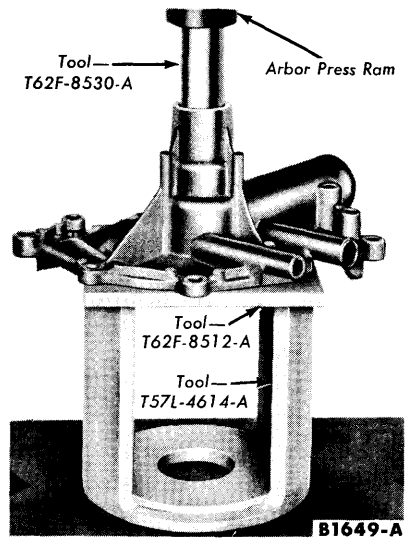



**FIG. 14—Shaft, Seal and Impeller Removal**

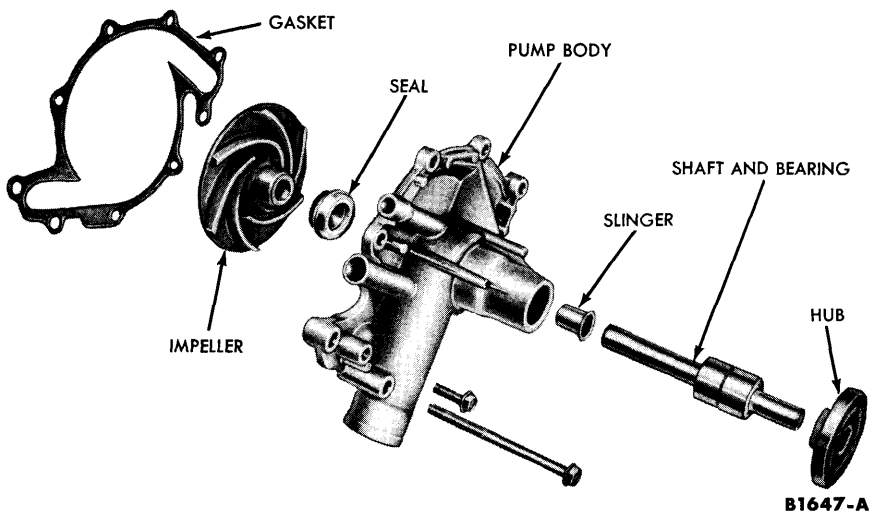



**FIG. 15—Water Pump Assembly—289 V-8**

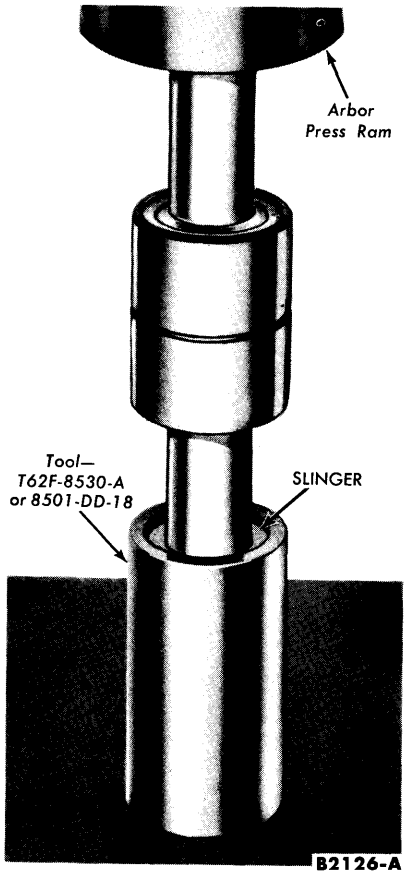



**FIG. 16—Slinger Installation**

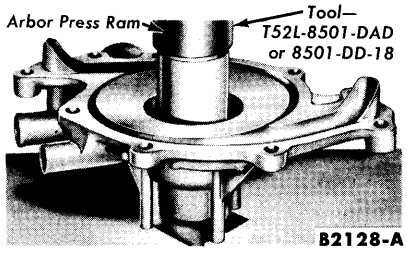



**FIG. 17—Seal Installation**

2. Apply a light film of waterproof sealer on a new seal and press the seal into the housing (Fig. 17).

3. Coat the bearing outer diameter lightly with grease, and press the shaft and bearing into the pump housing (Fig. 18) until the bearing is flush with the neck of the housing.

4. Replace the impeller if it is damaged. Coat the seal rubbing face of the impeller lightly with grease. Press the shaft into the impeller (Fig. 19).

**Press the shaft into the impeller until the pump housing bottoms on the face of the adapter ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the adapter ring, the pump bearing will be damaged. Impeller to pump housing clearance is as shown in the specifications.**

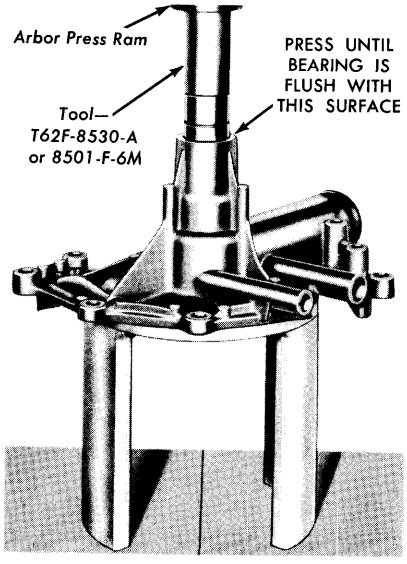



**FIG. 18—Bearing and Shaft Installation**

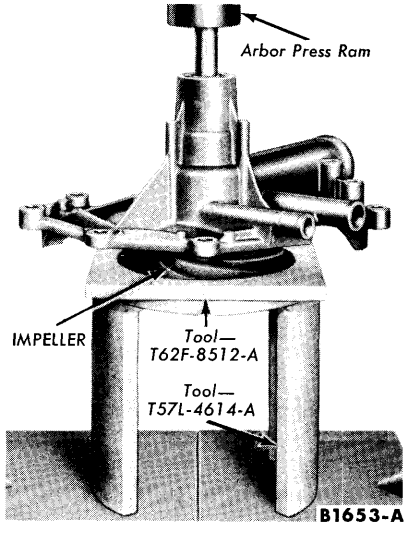



**FIG. 19—Impeller Installation**

5. Position the shaft over the fan hub and press it into place, holding the specified distance from the housing mounting face to the front face of the hub (Fig. 20).

## 352, 390 AND 427 V-8

### DISASSEMBLY

1. Remove the back plate and gasket from the water pump. Remove the hub from the impeller shaft (Fig. 21).

2. Position the pump on an arbor press and press the shaft off the impeller and out of the housing (Fig. 22).

3. Press out the pump seal (Fig. 23).

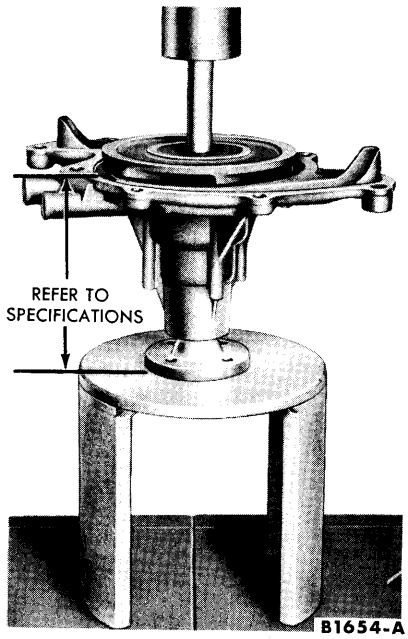



**FIG. 20—Hub Installation**

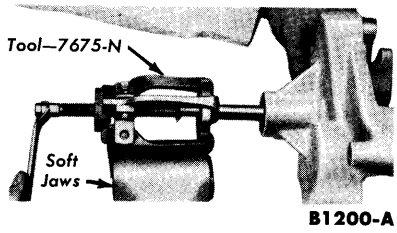



**FIG. 21—Hub Removal**

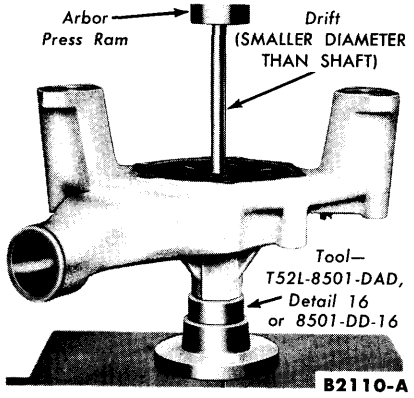



**FIG. 22—Shaft Removal**

### CLEANING AND INSPECTION

Refer to Part 11-1 for the cleaning and inspection procedures.

### ASSEMBLY

The water pump assembly is shown in Fig. 24.

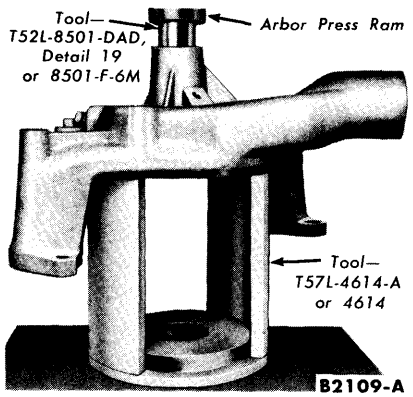



**FIG. 23—Seal Removal**

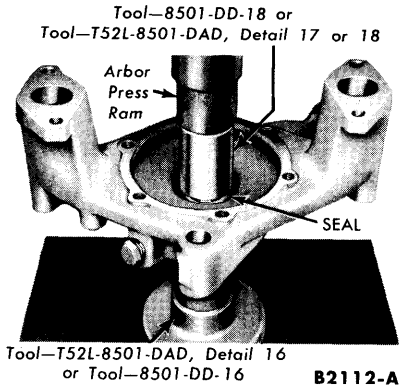



**FIG. 26—Seal Installation**

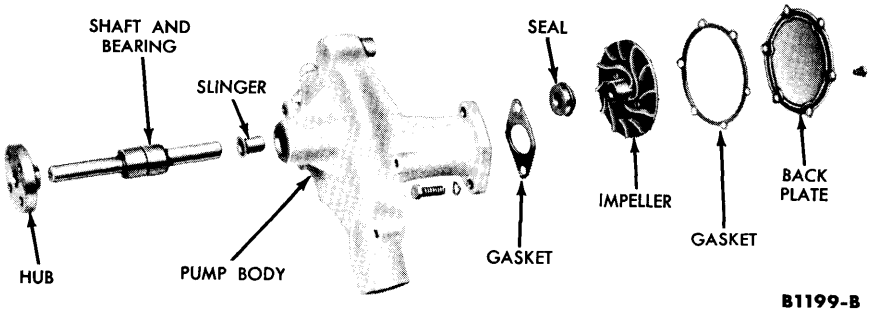



**FIG. 24—Water Pump Assembly—352, 390 and 427 V-8**

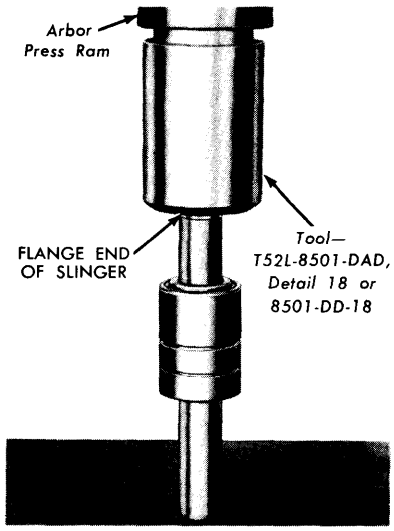



**FIG. 25—Replacing Slinger**

1. Remove all gasket material from the mounting faces of the pump and the block.

2. Install the new slinger on the new bearing and shaft assembly furnished in the repair kit (Fig. 25). Locate the slinger in the same relative position as the slinger on the old shaft.

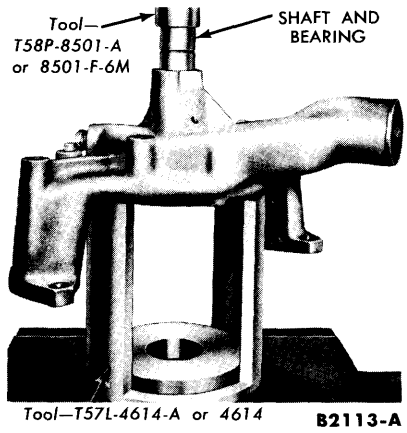



**FIG. 27—Shaft Installation**

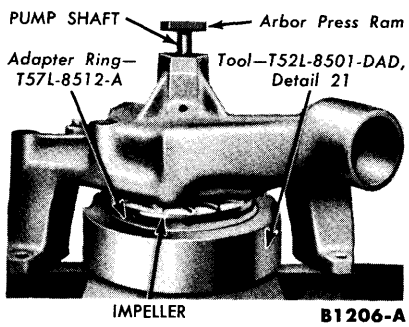



**FIG. 28—Impeller Installation**

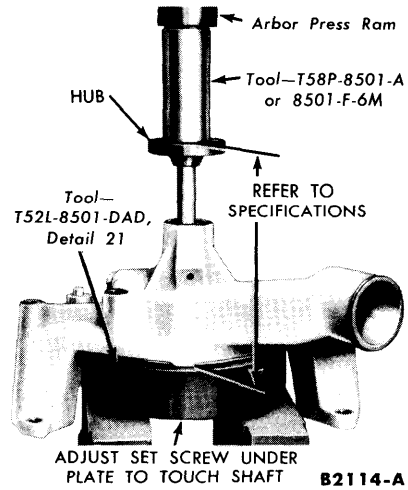



**FIG. 29—Hub Installation**

3. Apply a light film of waterproof sealer on a new seal and press the seal into the housing (Fig. 26).

4. Coat the bearing outer diameter lightly with grease. Press the shaft and bearing into the pump housing until the outer face of the bearing is flush with the outer face of the pump housing (Fig. 27).

5. On a Ford engine, replace the impeller if it is damaged. Coat the seal rubbing face of the impeller lightly with grease. Press the shaft into the impeller (Fig. 28). **Press the shaft into the impeller until the pump housing lightly touches the face of the adapter ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the adapter ring, the pump bearing will be damaged. Impeller to pump housing clearance is as shown in the specifications.**

Tighten the set screw in the bottom of the fixture plate until the screw touches the end of the shaft. Position the fan hub over the shaft and press it into place, holding the specified distance from the housing mounting face to the front face of the hub (Fig. 29).

6. On a Mercury engine, position the fan hub over the shaft. Support the pump end of the shaft on a steel block on an arbor press. Press it into place with Seal Remover and Bearing Replacer Tool 8501F-6-M while holding the specified distance from the housing mounting face to the front face of the hub.

Coat the impeller to seal rubbing

surfaces with grease. Position the water pump assembly on an arbor press with the hub end of the shaft resting on a steel plate. Carefully press the impeller onto the shaft assembly with the Seal Remover and Bearing Replacer, Tool 8501F-6-M, until it sets the specified distance below the back cover mounting face of the water pump housing.

The dimension can be checked by placing a straight-edge against the water pump back cover mounting face and across the impeller opening. Insert a feeler gauge of the correct size between the flat face of the impeller and the underside of the straight-edge.

**7.** Coat a new back plate gasket with sealer. Install the back plate and gasket.

# PART 11-3 RADIATOR, SUPPLY TANK AND THERMOSTAT


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 11-11 | 2 Removal and Installation | 11-12 |


## 1 DESCRIPTION AND OPERATION

### RADIATOR

Standard and extra-cooling radiators are available with all engines.

### 6-CYLINDER AND 289 V-8 ENGINES

The radiators (Figs. 30 and 31) are of the tube and corrugated-fin-core type with the tubes arranged for vertical flow of the coolant. Two header tanks, one on the top and one on the bottom of the radiator, provide uniform distribution of the coolant to the tubes. The radiator outlet port (lower header tank) is connected to the water pump inlet port. The radiator inlet port (upper header tank) is connected to the coolant outlet housing of the engine, thereby permitting coolant circulation through the radiator when the thermostat is open. The radiator bottom header tank on automatic transmission cars contains a heat exchanger for cooling the transmission oil.

### 352, 390 AND 427 V-8

The radiator is of the tube and corrugated-fin-core type with the tubes arranged horizontally for cross-flow of the coolant. Two header tanks, one on each side of the radiator (Fig. 32), provide uniform distribution of the coolant to the cross-flow tubes. The header tank, or chamber, on the left side of the radiator contains a heat exchanger for cooling the transmission fluid. The radiator outlet port (lower left side) is connected to the water pump inlet port.

### SUPPLY TANK

On the 352, 390 and 427 V-8 radiators, a separate radiator supply tank (Fig. 32) is connected to the radiator inlet port to serve as an expansion chamber and supply reservoir. The inlet port of the supply tank is connected to the intake manifold coolant passage at the thermostat, thereby permitting coolant circulation through the supply tank and radiator when the thermostat is open.

### THERMOSTAT

A thermostat is mounted in a recess in the coolant outlet passage of the intake manifold. When the thermostat is closed, coolant flows to the water pump through a bypass passage at the front of the intake manifold.

The high-temperature thermostat used in production is for use with water or permanent-type anti-freeze. A low-temperature thermostat is available for use with non-permanent-type anti-freeze or water. For operating temperatures, refer to specifications.

**Do not attempt to repair the thermostat. It must be replaced if it is not operating properly.**

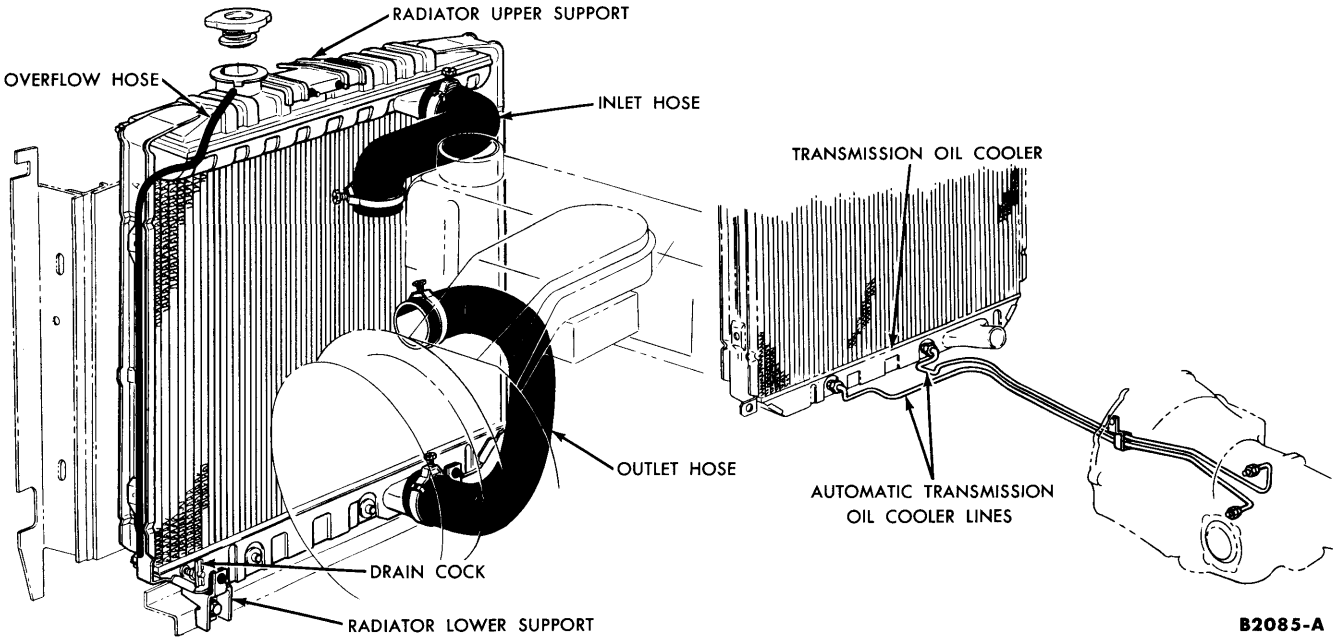



**FIG. 30—6-Cylinder Radiator Installation**

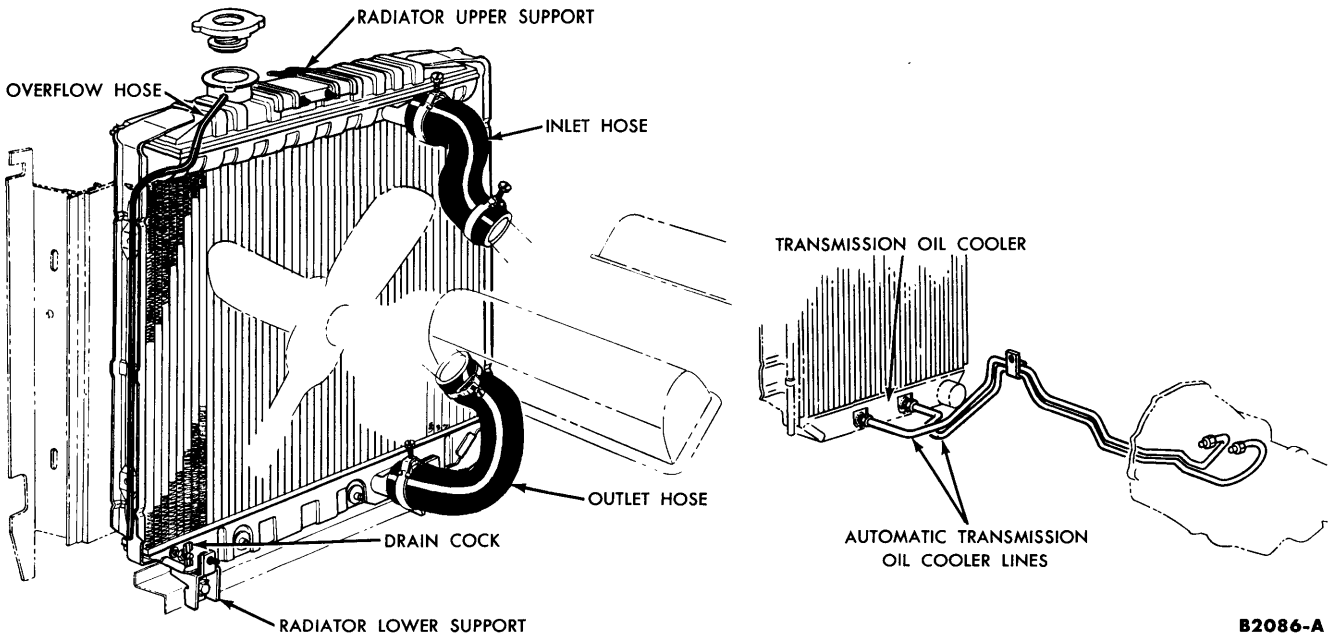



**FIG. 31—289 V-8 Radiator Installation**

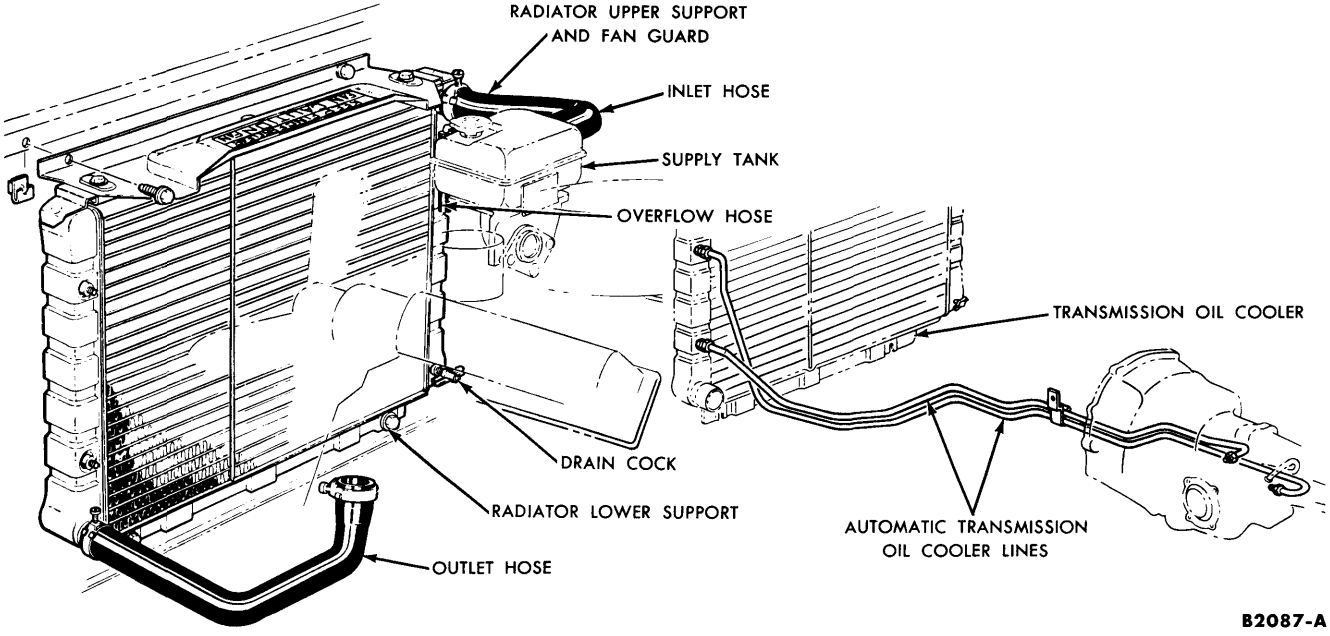



**FIG. 32—352, 390 and 427 V-8 Radiator and Supply Tank Installation**

## 2 REMOVAL AND INSTALLATION

### RADIATOR

The radiator installations are shown in Figs. 30, 31 and 32.

### REMOVAL

**1.** Drain the cooling system. Disconnect the radiator upper and lower hoses from the radiator.

On a car with an automatic transmission, disconnect the automatic transmission fluid cooler inlet and outlet lines from the radiator.

**2.** Remove the radiator upper support retaining bolts and remove the upper support. Remove the radiator.

On a car equipped with an air conditioner, remove the bolts retaining the radiator shroud lower half to the radiator. Remove the radiator upper retaining bolts. Remove the upper support retaining bolts. Remove the radiator and radiator shroud upper half. Then lift the radiator shroud lower half from the engine compartment.

### INSTALLATION

**1.** If a new radiator is to be installed, remove the drain cock from

the old radiator and install it on the new radiator.

On a car equipped with an automatic transmission, transfer the fluid cooler line fittings to the new radiator, using sealer M-4G-11.

On a car equipped with an air conditioner, transfer the radiator shroud upper half to the new radiator.

**2.** Position the radiator assembly and install (but do not tighten on a car with an automatic transmission) the radiator upper support and bolts.

On a car with an automatic transmission, connect the automatic transmission fluid cooler lines; then tighten the radiator upper support bolts.

On a car with an air conditioner, position the radiator shroud lower half in the engine compartment. Position the radiator assembly and install the upper support and bolts. Tighten the support bolts and install the shroud lower half to the radiator.

**3.** Connect the radiator upper and lower hoses. Close the drain cock. Fill and bleed the cooling system.

**4.** Operate the engine and check for leaks at the hose connections and the automatic transmission fluid cooler lines. Check the automatic transmission fluid level.

## RADIATOR SUPPLY TANK

### REMOVAL

**1.** Drain the cooling system so that the coolant level is below the radiator supply tank. Disconnect the radiator upper hose from the radiator supply tank (Fig. 33).

**2.** Remove the supply tank retaining screws. Remove the supply tank. Remove the thermostat and gasket from the supply tank.

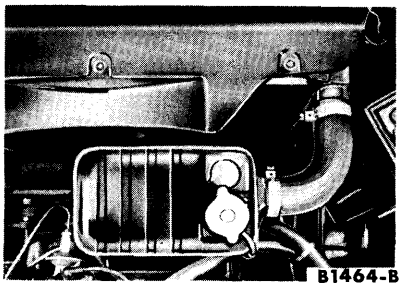



**FIG. 33—Radiator Supply Tank**

### INSTALLATION

**1.** Remove all the gasket material from the mounting surfaces of the supply tank and the intake manifold. Coat a new supply tank gasket with sealer, then position the gasket on the intake manifold opening. **The supply tank gasket must be positioned on the manifold before the thermostat is installed.**

**2.** Install the thermostat in the manifold opening with the copper pellet or element toward the engine. **If the thermostat is improperly installed, it can cause a retarded flow of coolant.**

**3.** Position the supply tank against the manifold, then install and torque the retaining screws to specifications.

If a new tank is installed, remove the overflow hose from the old tank and install it on the new tank.

**4.** Connect the radiator upper hose. Fill and bleed the cooling system. Check for leaks and proper coolant level after the engine has reached normal operating temperature.

## THERMOSTAT REPLACEMENT

Check the thermostat before installing it, following the procedure under "Thermostat Test."

**Do not attempt to repair the thermostat. It should be replaced if it is not operating properly.**

### 6-CYLINDER ENGINES AND 289 V-8

**1.** Drain the radiator so that the coolant level is below the thermostat.

**2.** Remove the coolant outlet housing retaining bolts. Pull the elbow away from the cylinder head sufficiently to provide access to the thermostat. Remove the thermostat and gasket.

**3.** Clean the coolant outlet housing and cylinder head gasket surfaces. Coat a new gasket with water-resistant sealer. Position the gasket on the cylinder head opening. **The gasket must be positioned on the cylinder head before the thermostat is installed.**

**4.** Install the thermostat in the cylinder head opening with the copper pellet or element toward the engine and the thermostat flange positioned in the recess. **If the thermostat is improperly installed, it will cause a retarded flow of coolant.**

**5.** Position the coolant outlet housing against the cylinder head. Install and torque the retaining bolts to specifications.

**6.** Fill the cooling system. Check for leaks and proper coolant level after the engine has reached normal operating temperatures.

### 352, 390 AND 427 V-8

To remove or install the thermostat, refer to "Radiator Supply Tank Removal or Installation."

Check the thermostat before installing it, following the procedure under "Thermostat Test."

# PART 11-4 FAN DRIVE CLUTCH


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 11-14 | 3 Major Repair Operations | 11-14 |
| 2 Removal and Installation | 11-14 | | |


## 1 DESCRIPTION AND OPERATION

The fan drive clutch (Fig. 34) is a fluid coupling containing silicone oil. Fan speed is regulated by the torque-carrying capacity of the silicone oil. The more silicone oil in the coupling the greater the fan speed, and the less silicone oil the slower the fan speed.

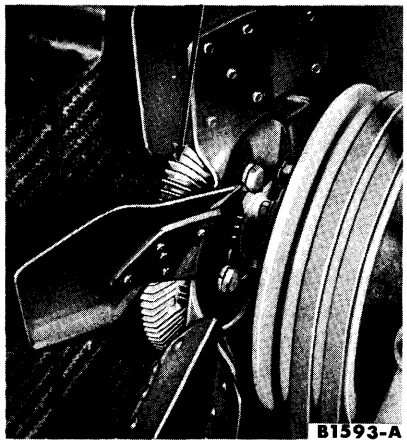



**FIG. 34—Typical Fan Drive Clutch Installation**

A bi-metallic strip and control piston on the front of the fluid coupling regulates the amount of silicone oil entering the coupling. The bi-metallic strip bows outward with an increase in surrounding temperature and allows a piston to move outward. The piston opens a valve regulating the flow of silicone oil into the coupling from a reserve chamber. The silicone oil is returned to the reserve chamber through a bleed hole when the valve is closed. Therefore, when the air passing through the radiator becomes hotter, the fan speed increases, and as the temperature decreases, the fan slows down.

The input side of the coupling is attached to the water pump hub and the fan is attached to the output side. Fins are cast integrally on the exterior of the fluid coupling to dissipate the heat generated by the shearing action of the silicone oil.

## 2 REMOVAL AND INSTALLATION

### REMOVAL

**1.** Remove the radiator upper support and fan guard.

**2.** Remove the capscrews retaining the fan drive clutch to the water pump hub (Fig. 34). Remove the fan drive clutch and fan as an assembly.

**3.** Remove the retaining capscrews and separate the fan from the drive clutch.

### INSTALLATION

**1.** Position the fan on the drive clutch and install the retaining capscrews.

**2.** Position the fan drive clutch and fan assembly to the water pump hub (Fig. 34). Install and tighten the retaining capscrews.

**3.** Install the radiator upper support.

## 3 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

**1.** Remove the bi-metallic strip (Fig. 35) by pushing one end of the strip toward the fan clutch body so that it clears the retaining bracket. Then push the strip to the side so

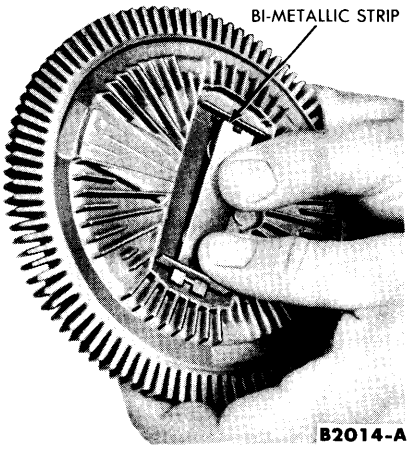



**FIG. 35—Bi-Metallic Strip Removal or Installation**

that the opposite end of the strip will spring out of the bracket.

**2.** Remove the control piston.

## CLEANING AND INSPECTION

For cleaning and inspection procedures, refer to Part 11-1.

## ASSEMBLY

The fan drive clutch is shown in Fig. 36.

**1.** Install the control piston (Fig. 3) so that the projection on the end of the piston will contact the bi-metallic strip.

**2.** Install the bi-metallic strip with the identification stamp "B-1" facing the fan drive clutch.

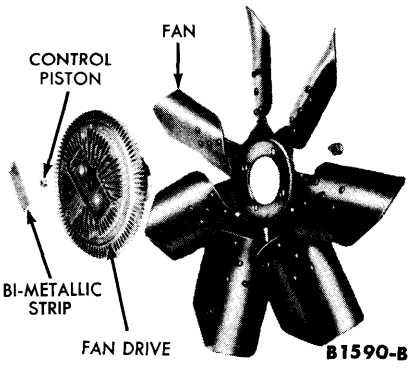



**FIG. 36—Fan and Drive Clutch**

# PART 11-5 SPECIFICATIONS

## COOLING FAN

| | OUTSIDE DIAMETER | NO. OF BLADES |
|---|---|---|
| **Standard** | | |
| 223 | 18.25 | 4 |
| 289 | 17.50 | 4 |
| 352 and 390 (2V) | 18.50 | 6 |
| 390 (4V) | 18.50 | 6 |
| 427 | 18.50 | 6 |
| 427 Super High Performance | 14.00 | 4 |
| **Extra Cooling** | | |
| 223 | 18.00 | 5 |
| 289 | 17.50 | 5 |
| 352 and 390 | 18.50 | 6 |
| **Extra Extra Cooling with Drive Clutch** | | |
| 352 and 390 | 18.00 | 5 |
| **Air Conditioning—Economy** | | |
| 223 | 18.00 | 5 |
| 289 | 17.00 | 5 |
| 352 and 390 | 18.50 | 6 |
| **Air Conditioning with Drive Clutch** | | |
| 289 | 18.00 | 7 |
| 352 and 390 | 19.25 | 7 |

## WATER PUMP

**WATER PUMP DRIVE ARRANGEMENT**

Water pump, fan and generator or alternator belt driven from crankshaft damper.

**WATER PUMP PULLEY TO ENGINE RATIO**

| | |
|---|---|
| **Standard Cooling and Air-Conditioner-Equipped** | |
| 223 | 0.95:1 |
| 289 | 1.05:1 |
| 352, 390 and 427 | 0.90:1 |

**WATER PUMP ASSEMBLY DIMENSIONS**

| | |
|---|---|
| **Front Face of Pulley Hub to Pump Housing Face** | |
| 223 | 4.320 |
| 289 | 5.150 |
| 352, 390 and 427 | 7.569 |
| **Impeller to Housing Cover Mounting Surface Clearance** | |
| 223 | 0.015-0.025 |
| 289 | 0.030-0.050 |
| 352, 390 and 427 | 0.070-0.080 |

## DRIVE BELT TENSION

| | |
|---|---|
| **BETWEEN GENERATOR OR ALTERNATOR AND WATER PUMP PULLEY (SINGLE BELT)** | |
| **New** | |
| 223 | 90-120 |
| Other Engines | 110-140 |
| ***Used** | |
| 223 | 60-90 |
| Other Engines | 80-110 |
| **BETWEEN GENERATOR OR ALTERNATOR AND WATER PUMP PULLEY (DUAL BELTS)†** | |
| **New—Front** | |
| 223 | 90-120 |
| Other Engines | 110-140 |
| **Rear** | |
| 223 | 85-135 |
| Other Engines | 105-155 |
| ***Used—Front** | |
| 223 | 60-90 |
| Other Engines | 80-110 |
| **BETWEEN GENERATOR OR ALTERNATOR AND WATER PUMP PULLEY (DUAL BELTS)† (Continued)** | |
| **Rear** | |
| 223 | 55-110 |
| Other Engines | 75-120 |

*Belt operated for a minimum of 10 minutes is considered a used belt.
†Dual belts used when equipped with air conditioner.

## COOLING SYSTEM CAPACITY

| Cooling System | Approximate Capacity* (Quarts) (U.S. x .8325 = Imp.) U. S. Measure | Imperial Measure |
|---|---|---|
| **Standard** | | |
| 223 | 9.5 | 7.91 |
| 289 | 15.0 | 12.49 |
| 352, 390 and 427 | 20.5 | 17.07 |

*Add 1 quart extra for heater.

## RADIATOR

| | |
|---|---|
| Pressure Cap—All Engines | 12-15 psi |

## THERMOSTATS

| | |
|---|---|
| **LOW TEMPERATURE** | |
| Opens °F (All Engines) | 155°-162° |
| Fully Open (All Engines) | 182° |
| **HIGH TEMPERATURE** | |
| Opens °F (All Engines) | 185°-192° |
| Fully Open | |
| 223, 289 and 352 | 210°-212° |
| 390 and 427 | 212° |

## TORQUE VALUES

**NOTE: All specifications are given in ft-lbs unless otherwise noted.**

| | |
|---|---|
| **Water Pump to Cylinder Block (or Cylinder Front Cover)** | |
| 289 | 12-15 |
| Other Engines | 23-28 |
| **Water Outlet Housing** | |
| 223 | 12-15 |
| Other Engines | 23-28 |
| **Fan and Pulley to Pulley Hub** | |
| 223, 289, 352, 390 and 427 | 12-18 |
| **Fan to Fan Clutch (with a/c)** | |
| 289, 352 and 390 | 10-15 |
| **Fan Shroud Assembly to Radiator** | |
| 352 and 390 | 5-7 |
| **Radiator Shroud Lower Half to Upper Half** | |
| 352 and 390 | 14-20 in-lbs |
| **Upper Support or Fan Guard to Radiator** | |
| 223, 289, 352, 390 and 427 | 5-7 |
| **Radiator Brace Rod to Radiator Support** | |
| Applicable Installations | 20-30 in-lbs |
| **Radiator to Engine Hose Clamps** | |
| 223, 289, 352, 390 and 427 | 1.0-2.5 |
| **Transmission Oil Cooler Tubes to Oil Cooler** | |
| 223, 289, 352, 390 and 427 | 9-12 |
| **Radiator Inlet and Outlet Hose Clamps** | |
| 223, 289, 352, 390 and 427 | 1.0-2.5 |

# EXHAUST SYSTEMS

# GROUP 12


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PART 12-2 SPECIFICATIONS ..... PAGE 12-8


# PART 12-1 EXHAUST SYSTEMS


| Section | | Page |
|---|---|---|
| 1 | Description | 12-1 |
| 2 | In-Car Adjustment and Repairs | 12-2 |
| 3 | Removal and Installation | 12-3 |


## 1 DESCRIPTION

The exhaust systems for the various car models are listed in Table 1, and are shown in Figs. 1 thru 6.

The single exhaust system on conventional cars with a Mileage Maker Six engine (Fig. 2) consists of a muffler inlet pipe, muffler inlet extension pipe and a muffler with an integral outlet pipe.

The single exhaust system for Convertible Models with a Mileage Maker Six engine (Fig. 1) consists of a muffler inlet pipe, resonator, muffler inlet extension pipe and a muffler with an integral outlet pipe.

**TABLE 1—Exhaust System Application**

| Car Line | Engine | | | Type System | | | Resonator | Exhaust Control Valve |
|---|---|---|---|---|---|---|---|---|
| | Cyl. | C.I.D. | Carb. | Sedan | Convertible | Station Wagon | | |
| Ford | 6 | 223 | 1V | Single | Single | Single | Yes* | Yes |
| | 6 | 223†† | 1V | Single | — | — | No | Yes |
| | 8 | 289 | 2V | Single | Dual | Single | Yes* | — |
| | 8 | 352 | 4V | Dual | Dual | Dual | Yes* | — |
| | 8 | 390 | 4V | Dual | Dual | Dual | Yes* | — |
| | 8 | 390† | 4V | Dual | — | Dual | No | — |
| | 8 | 427 | 4V | Dual | Dual | — | Yes* | Yes |
| | 8 | 427 | 8V | Dual | Dual | — | Yes* | Yes |
| Mercury | 8 | 390 | 2V | Single | Dual | Single | Yes | — |
| | 8 | 390 | 4V | Dual | Dual | Dual | Yes* | — |
| | 8 | 390† | 4V | Dual | — | Dual | No | — |
| | 8 | 427 | 4V | Dual | Dual | — | Yes* | Yes |
| | 8 | 427 | 8V | Dual | Dual | — | Yes* | Yes |

*Convertible Models Only
†Police Interceptor
††Taxi Cab

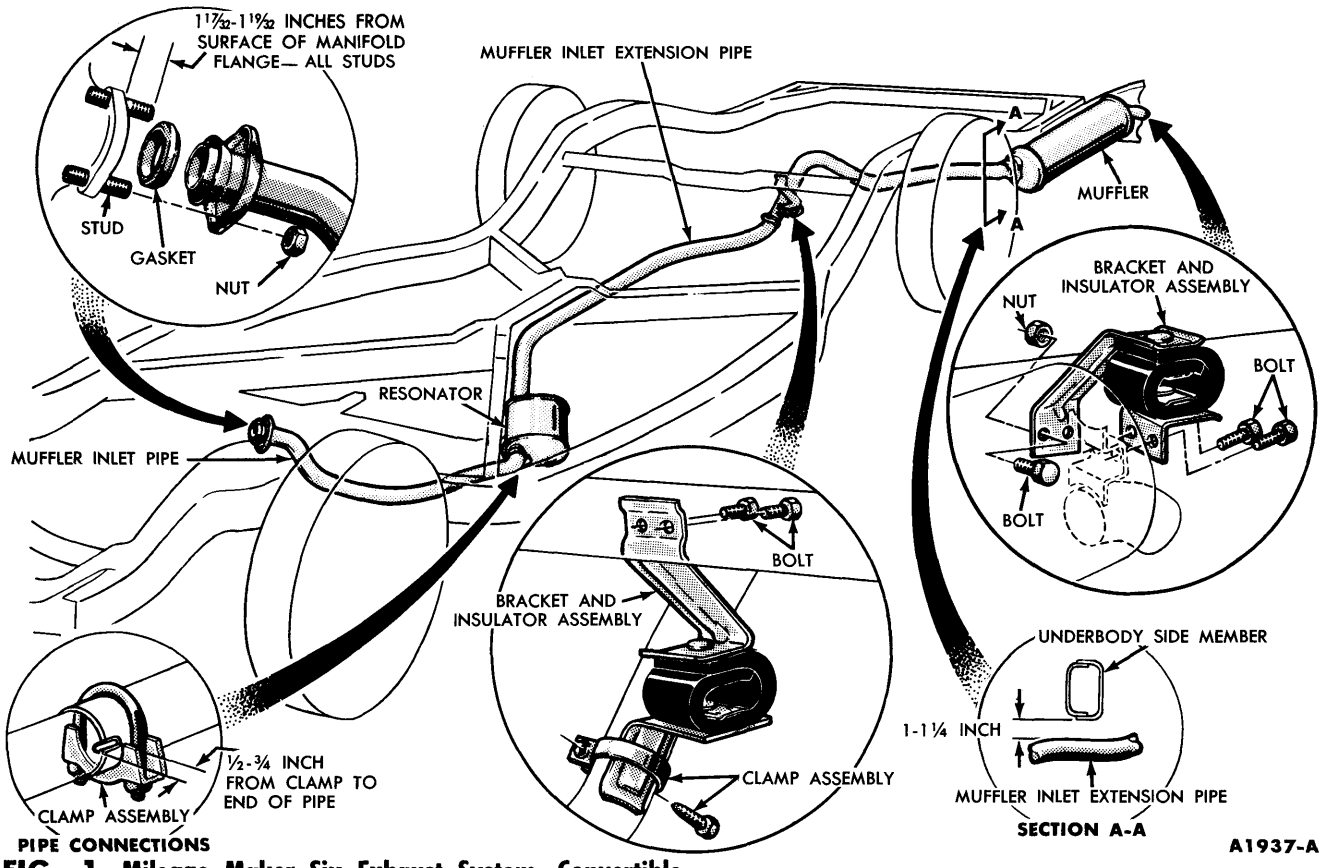



**FIG. 1—Mileage Maker Six Exhaust System—Convertible**

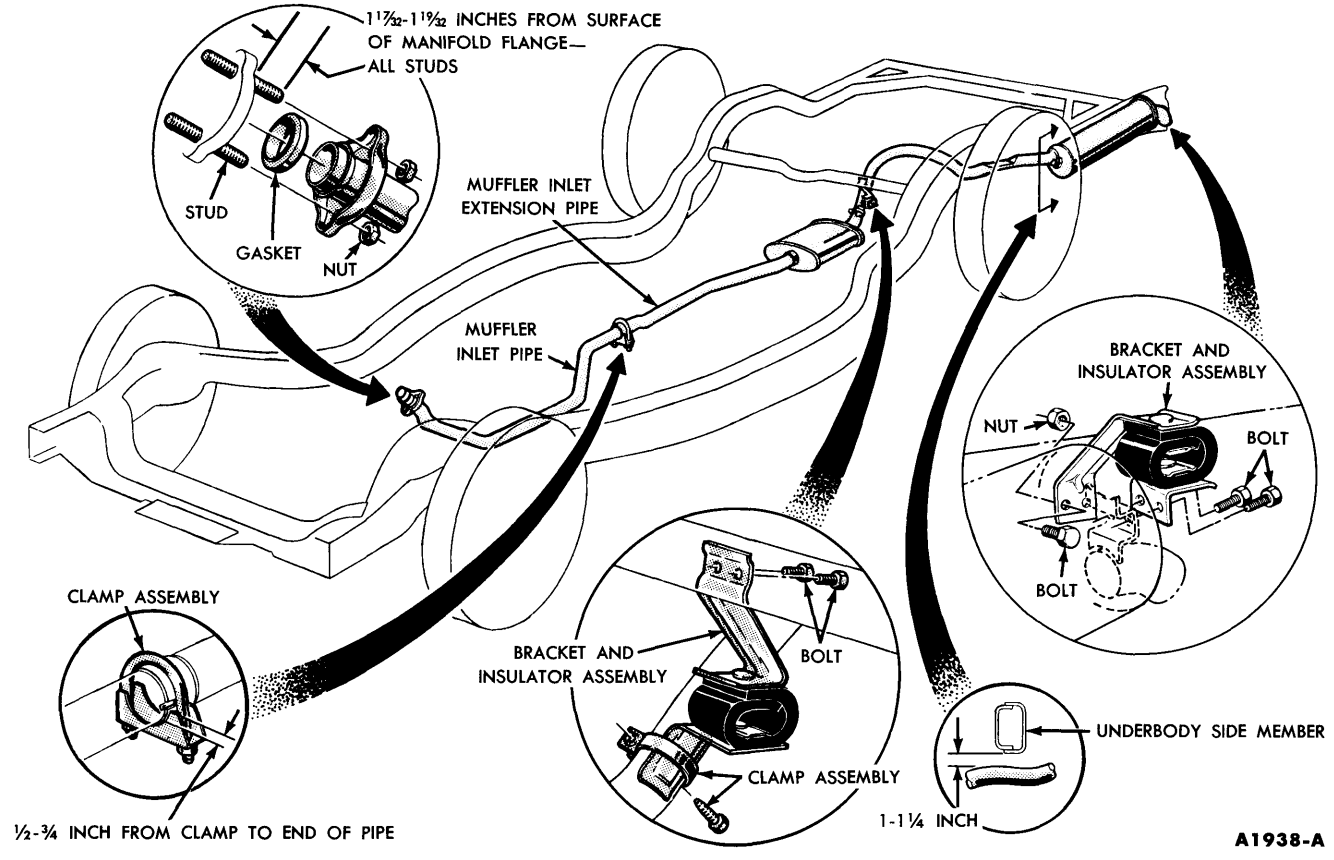



**FIG. 2—Mileage Maker Six Exhaust System—Except Convertible**

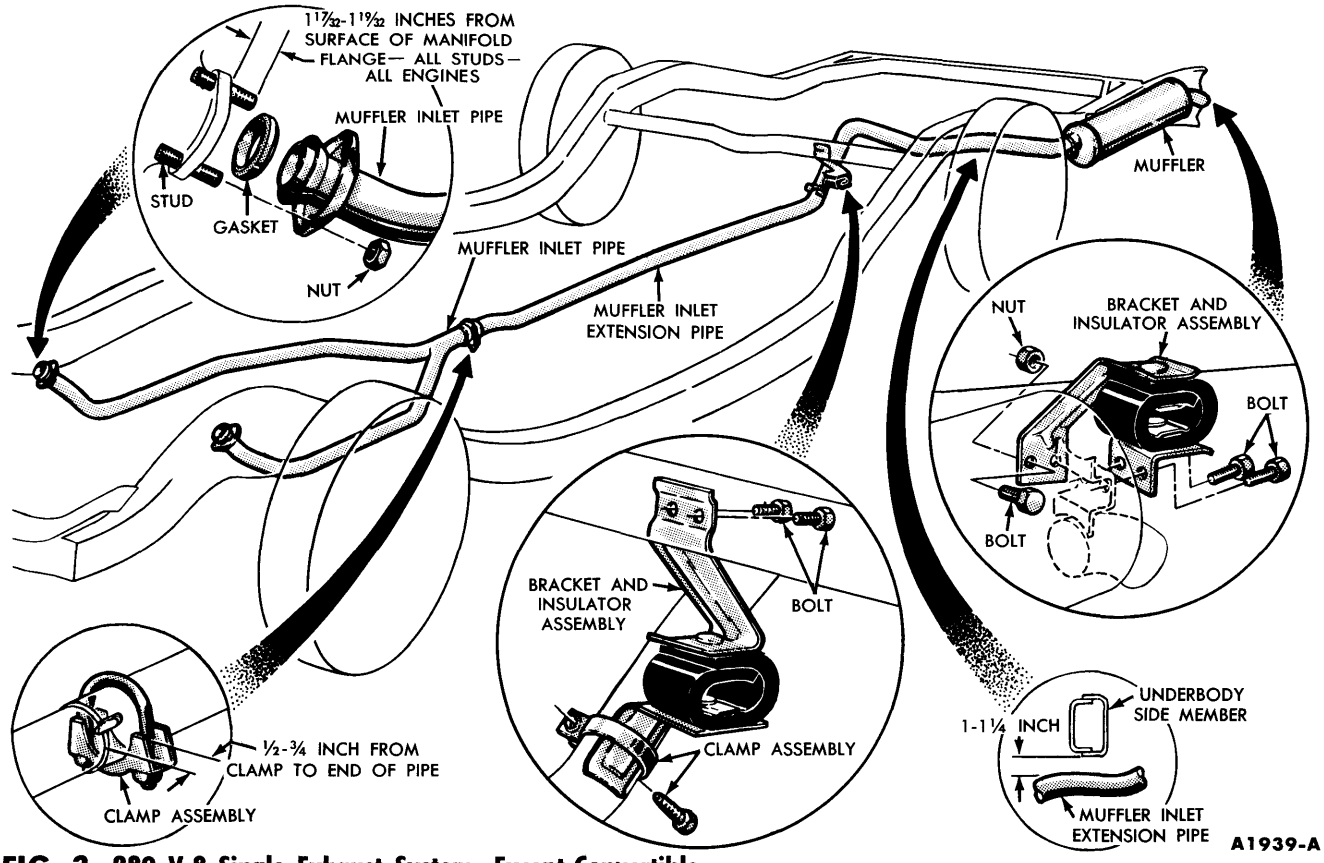



**FIG. 3—289 V-8 Single Exhaust System—Except Convertible**

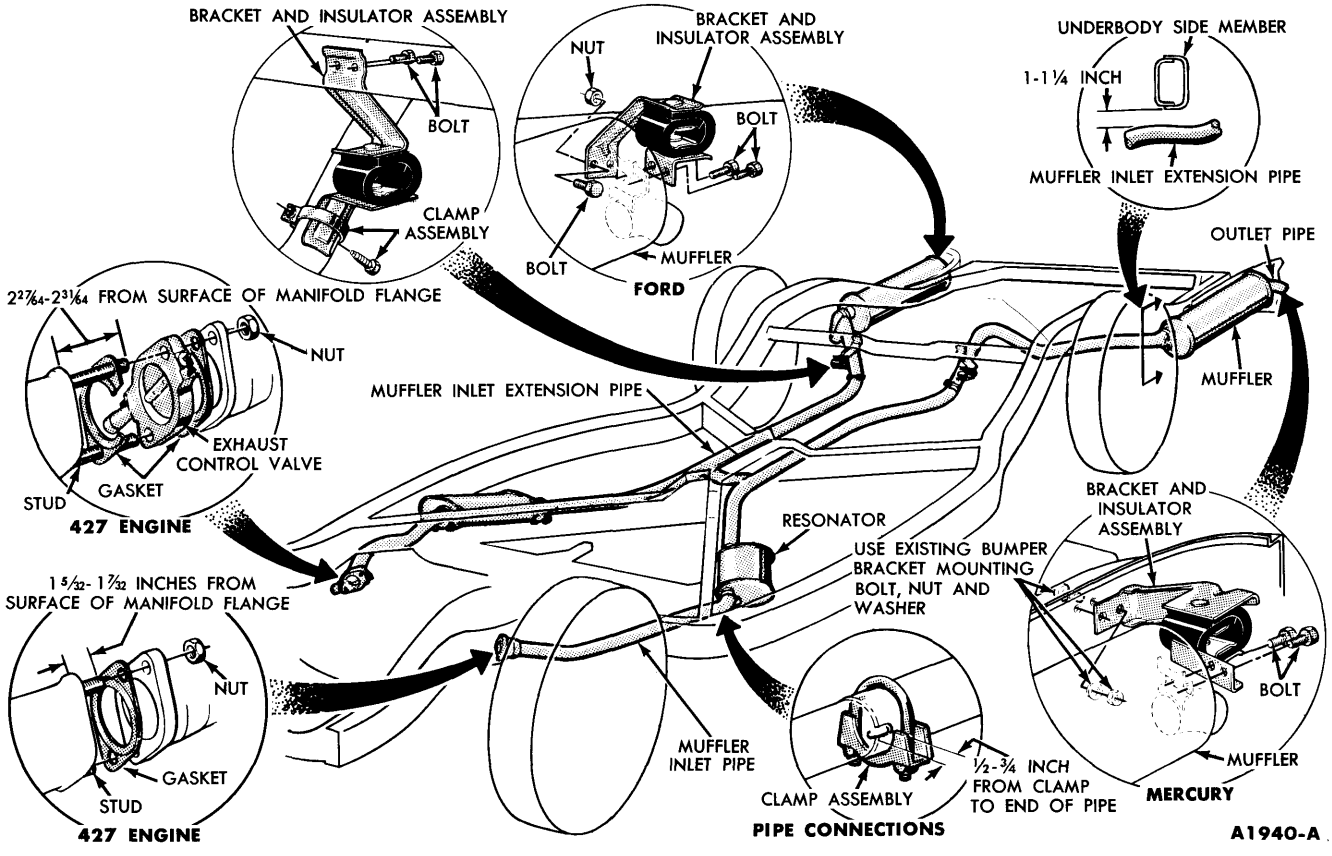



**FIG. 4—Typical V-8 Dual Exhaust Systems—Convertible**

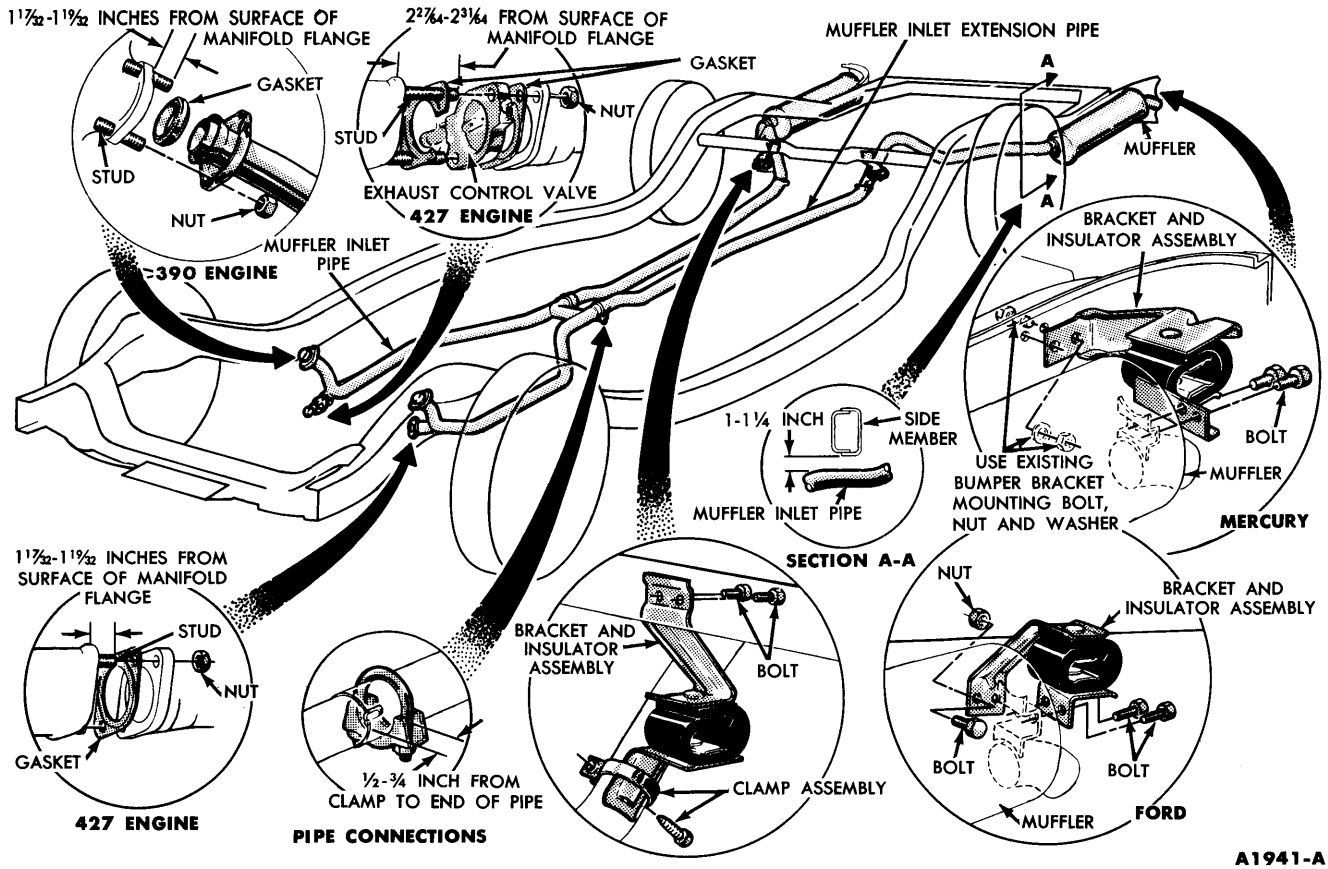



**FIG. 5—Typical 352, 390 and 427 V-8 Dual Exhaust Systems—Except Convertible**

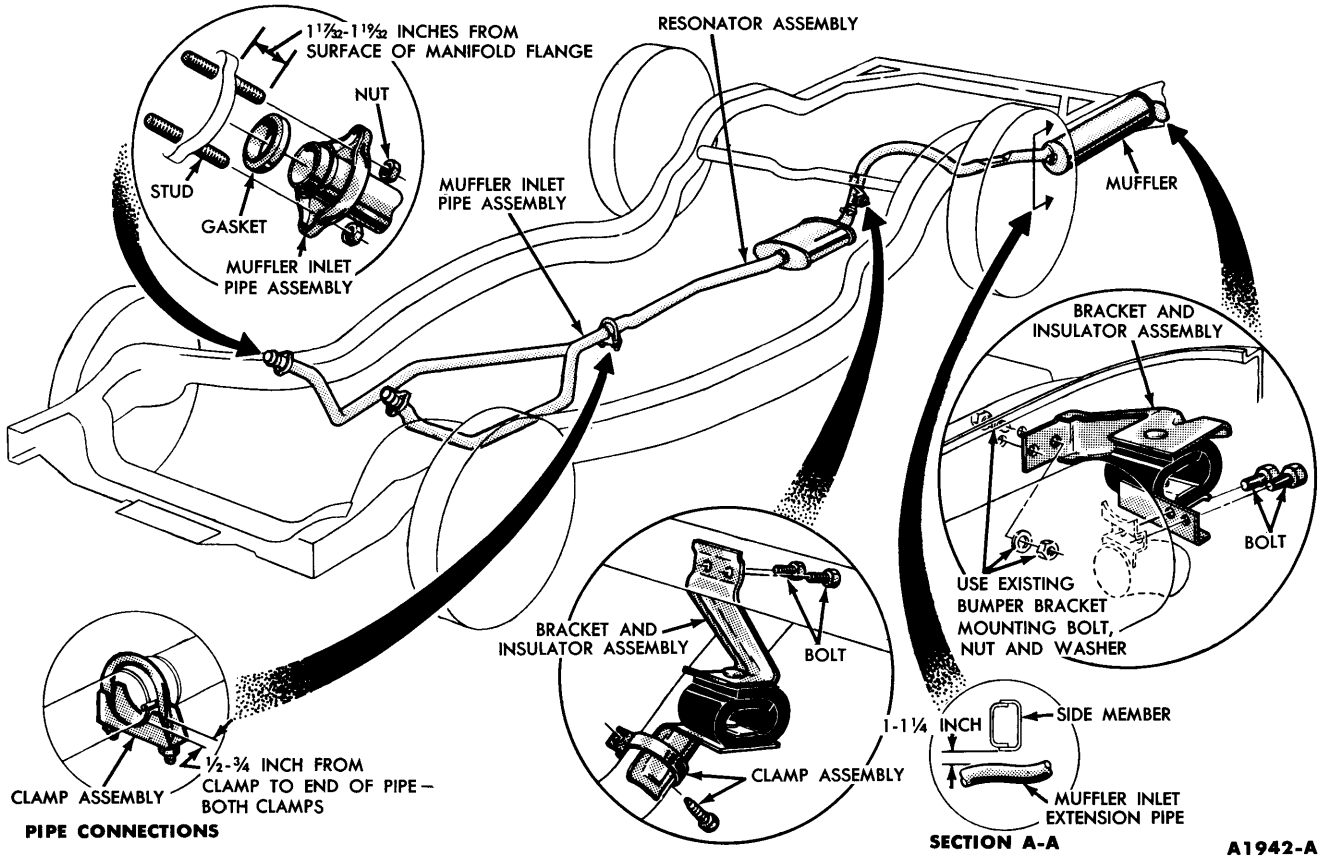



**FIG. 6—Mercury 390 V-8 Single Exhaust System—Except Convertible**

The single exhaust system on the Mercury Models with a 390 V-8 engine and a two-barrel carburetor (Fig. 6) consists of a Y-type muffler inlet pipe, a resonator assembly with integral inlet and outlet extension pipes and a muffler with an integral outlet pipe.

The single exhaust system on the conventional Ford Models with a 289 V-8 engine and a two-barrel carburetor (Fig. 3) consists of a Y-type muffler inlet pipe, inlet extension pipe and a muffler with an integral outlet pipe.

The dual exhaust system on Convertible Models with a V-8 engine (Fig. 4) has a separate muffler inlet pipe, resonator, muffler inlet extension pipe and a muffler with an integral outlet pipe for each exhaust manifold.

The dual exhaust system (Fig. 5) for cars with a 352, 390 or 427 V-8 engine (except Convertible Models) consists of an inlet pipe with an integral crossover balance tube, and separate muffler inlet extension pipes and mufflers for each exhaust manifold. The mufflers contain integral outlet pipes.

The exhaust control valve for cars with a 427 V-8 engine is located between the right exhaust manifold and the attached muffler inlet pipe (Figs. 4 and 5).

On the Mileage Maker Six engine equipped cars, the exhaust gas control valve is integral with the exhaust manifold.

The location and type of exhaust system gaskets, retaining clamps, and loop-type support brackets are shown in the respective exhaust system illustrations (Figs. 1 thru 6). The loop-type support bracket insulators eliminate tension on the hangers due to thermal expansion of the system.

## 2 IN CAR ADJUSTMENT AND REPAIRS

The exhaust system must be free of leakage, binds, grounding and excessive vibration.

Exhaust system vibration, grounding, or binds are usually caused by: loose, broken or improperly aligned clamps or brackets, or improperly connected pipes. Any of the aforementioned conditions may cause changes to clearances of the exhaust system components. If any of these conditions exist, the exhaust system components must be checked, adjusted and neutralized (strain relieved), or replaced to make certain the specified clearances (Figs. 1 thru 6) are maintained.

The exhaust control valve, if the car is so equipped, should be periodically checked to make certain it is operating properly. A valve that is stuck in the open position will result in poor engine performance during initial warm-up, because insufficient heat for proper fuel vaporization will pass through the intake manifold heat riser.

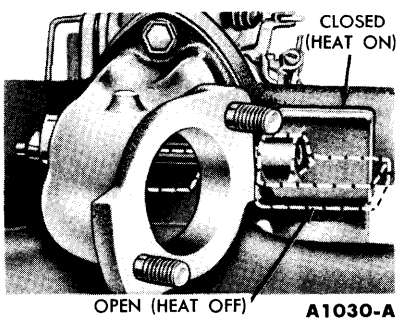



**FIG. 7—Mileage Maker Six Exhaust Control Valve**

If the valve is stuck in the closed position, the intake manifold will be supplied with excessive heat after the initial warm-up period. This will cause poor acceleration, a lack of power, and will cause poor high speed performance in general.

### EXHAUST CONTROL VALVE MAINTENANCE

Refer to Group 19 for the recommended maintenance mileage interval.

Check the thermostatic spring of the valve to make sure it is hooked on the stop pin. The spring stop is at the top of the valve housing when the valve is properly installed. The action of the valve is illustrated in Fig. 7 or 8.

To check the exhaust control valve on the car, make sure the spring holds the valve closed. Actuate the counterweight by hand to make sure it moves freely through approximately 90° of rotation without binding.

The valve is closed when the engine is cold. However, a properly operating valve will open when very light finger pressure is applied to the counterweight. Rapidly accelerate the engine to make sure the valve momentarily opens. The valve is designed to open when the engine is at normal operating temperature and is operated at high rpm.

Lubricate the valve with FoMoCo Exhaust Control Valve Solvent (COAA-19A501-A).

### EXHAUST SYSTEM ALIGNMENT

Refer to Fig. 1, 2, 3, 4, 5, or 6 and perform the following procedure to adjust and neutralize the exhaust system components:

**1.** Loosen the pipe connection clamps, and the inlet extension pipe support bracket clamp(s).

**2.** On all engines except the 427 V-8, torque the exhaust manifold to inlet pipe retaining nuts evenly and alternately to specification, to obtain an equal distance from the bot-

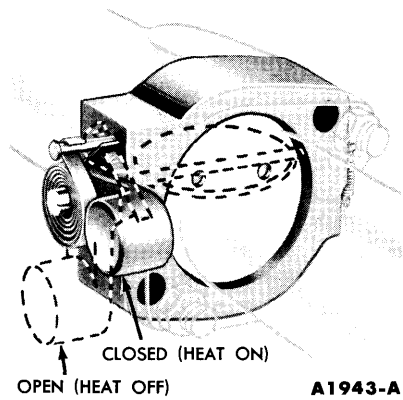



**FIG. 8—427 V-8 Exhaust Control Valve**

tom of the inlet pipe flange(s) to the tips of the mounting studs.

On a 427 V-8 engine, torque the exhaust manifold to muffler inlet pipe retaining nuts to specification.

3. Work from the front of the car toward the rear and progressively adjust the exhaust system components and clamps at the various pipe connections to relieve binds, improper pipe connections or clearance conditions, and torque the clamps to specification.

4. Check the exhaust system for leaks.

## 3 REMOVAL AND INSTALLATION

The replacement procedures given apply to all car models and to right and left assemblies on dual and single exhaust systems unless otherwise noted. Typical exhaust systems for the various car models are shown in Figs. 1 thru 6.

### EXHAUST CONTROL VALVE

Normally, the exhaust control valve does not require replacement unless it becomes inoperative due to excessive corrosion or damage.

#### REMOVAL AND INSTALLATION–223 SIX

The exhaust control valve on this engine is integral with the exhaust manifold. For the removal and installation procedure, refer to Group 8, Part 8-2.

#### REMOVAL–427 V-8

1. On Convertible Models, remove the right muffler to support bracket retaining bolts.

On all models except the Convertible, remove the retaining bolts securing the left and right mufflers to the support brackets.

2. Loosen the inlet extension pipe(s) to support bracket clamp(s) and temporarily support the exhaust system in position with soft-wire.

3. On Convertible Models, remove the retaining nuts that secure the right inlet pipe to the exhaust manifold. Pull the inlet pipe rearward and remove the exhaust control valve and mounting gaskets. Discard the gaskets. Temporarily support the exhaust system in position with soft-wire.

On all models except Convertibles, remove the nuts securing the inlet pipes to both exhaust manifolds. Pull the inlet pipe rearward and remove the exhaust control valve and all mounting gaskets. Discard the gaskets. Temporarily support the exhaust system in position with soft-wire.

4. Clean the exhaust control valve and the flange(s) of the inlet pipe and the exhaust manifold(s). Replace all worn or damaged parts.

#### INSTALLATION–427 V-8

1. Place new gaskets on both sides of the exhaust control valve and position it over the studs of the right exhaust manifold.

On all models except the Convertible, position a new gasket on the left exhaust manifold.

2. Install the muffler inlet pipe on the exhaust manifold(s); then, install the retaining nuts and torque them to specification.

3. Install the muffler(s) on the rear support bracket(s) and torque the retaining nuts to specification.

4. Position the inlet extension pipe support bracket and clamp on the pipe and torque the clamp screw to specification. Remove the temporary support wires.

5. Adjust the clamps and neutralize the exhaust system, if required. Check the exhaust system for leaks.

### MUFFLER AND OUTLET PIPE ASSEMBLY

#### REMOVAL

1. Remove the inlet extension pipe clamp at the muffler and slide the clamp forward.

2. Remove the bolts that retain the muffler assembly to the rear support bracket.

3. Separate the muffler from the inlet extension pipe and remove the muffler and outlet pipe assembly.

4. Replace all worn or damaged parts.

#### INSTALLATION

1. Position the inlet extension pipe clamp, and slide the new muffler and outlet pipe assembly on the muffler inlet extension pipe.

2. Position the muffler and outlet pipe assembly onto the rear support bracket. Install the muffler to support bracket retaining bolts and torque them to specification.

3. Position the muffler to inlet extension pipe retaining clamp the specified distance from the end of the pipe connection, and torque the clamp bolts to specification. Check the exhaust system for leaks.

### INLET EXTENSION PIPE

#### REMOVAL

1. Remove the muffler and outlet pipe assembly by following steps 1 thru 3 under "Muffler and Outlet Pipe Assembly."

2. Loosen the clamp at the inlet pipe or resonator (if so equipped) connection. Loosen the clamp at the inlet extension pipe support bracket.

3. Remove the inlet extension pipe. Replace all worn or damaged parts.

#### INSTALLATION

1. Place the retaining clamps on the inlet extension pipe. Slide the

extension pipe onto the inlet pipe or resonator (if so equipped).

**2.** Position the inlet pipe (or resonator) to extension pipe clamp on the connected pipes, and secure the inlet extension pipe to the support bracket with the retaining clamp. Tighten the clamps snug, but not tight.

**3.** Install the muffler and outlet pipe assembly by following steps 1 and 2 under "Muffler and Outlet Pipe Assembly."

**4.** Adjust and neutralize the exhaust system, and properly position the retaining clamps. Torque the retaining clamps to specification.

**5.** Check the exhaust system for leaks.

## RESONATOR—CONVERTIBLE MODELS EXCEPT MERCURY 390 2V ENGINE

### REMOVAL

**1.** Loosen the clamps at the front and rear of the resonator. Loosen the inlet extension pipe clamps at the muffler and the support bracket.

**2.** Remove the resonator from the inlet pipe and inlet extension pipe by adjusting the connected pipes to provide clearance.

**3.** Replace all worn or damaged parts.

### INSTALLATION

**1.** Place a resonator retaining clamp on the inlet pipe and the inlet extension pipe. Slide the resonator onto the inlet pipe and the inlet extension pipe.

**2.** Adjust and neutralize the exhaust system. Properly position the resonator and inlet pipe retaining clamps and torque them to specification.

**3.** Check the exhaust system for leaks.

## RESONATOR—MERCURY 390 2V ENGINE

The resonator assembly contains integral, long-length inlet and outlet pipes that are welded to the resonator.

### REMOVAL

**1.** Remove the muffler and outlet pipe assembly by following steps 1 thru 3 under "Muffler and Outlet Pipe Assembly."

**2.** Loosen the clamps securing the resonator to the inlet pipe and the resonator pipe support bracket.

**3.** Remove the resonator from the inlet pipe.

**4.** Replace all worn or damaged parts.

### INSTALLATION

**1.** Position the resonator assembly retaining clamps on the resonator assembly.

**2.** Slide the new resonator assembly onto the inlet pipe. Loosely install the retaining clamps on the pipes and support bracket.

**3.** Install the muffler and outlet pipe assembly by following steps 1 and 2 under "Muffler and Outlet Pipe Assembly."

**4.** Adjust and neutralize the exhaust system. Properly position and torque all retaining clamps to specification.

## INLET PIPE

### REMOVAL

**1.** Loosen the inlet pipe clamp(s) at the inlet extension pipe(s) or resonator(s) (if so equipped). Loosen the inlet extension pipe support bracket clamp(s).

**2.** Remove the muffler(s) to support bracket(s) retaining bolts. Temporarily support the inlet pipe(s), muffler(s), and resonator(s) (if so equipped) in position with soft-wire.

**3.** Remove the retaining nuts securing the inlet pipe(s) to the exhaust manifold(s).

**4.** Slide the inlet pipe(s) out of the inlet extension pipe or resonator (if so equipped). Remove the inlet pipe(s) from the exhaust manifold(s).

On a car with a 427 V-8 engine, remove the exhaust control valve from the right exhaust manifold.

**5.** Clean the gasket surfaces of the exhaust manifold(s), inlet pipe(s) and exhaust control valve, if so equipped.

**6.** Discard the gasket(s) and replace any worn or damaged parts.

### INSTALLATION

**1.** On all cars except those with a 427 V-8 engine, install a new gasket(s) on the inlet pipe flange(s).

On a car with a 427 V-8 engine (except Station Wagons) place a new gasket on each side of the exhaust gas control valve and install it on the right exhaust manifold. Install a new gasket on the left exhaust manifold (if required).

**2.** Install the inlet pipe(s) on the exhaust manifold(s) and loosely install the retaining nuts on the studs of the manifold(s).

**3.** Place the retaining clamp(s) on the inlet pipe(s). Connect the inlet pipe to the inlet extension pipe (or resonator).

**4.** Position the muffler(s) on the support bracket(s) and install the retaining bolts. Loosely install the inlet extension pipe or resonator outlet pipe support bracket clamp.

**5.** On all cars except those with a 427 V-8 engine, torque the inlet pipe to exhaust manifold retaining nuts evenly and alternately to specification to obtain an equal distance from the bottom of the inlet pipe flange(s) to the tips of the mounting studs.

On a 427 V-8 engine, torque the inlet pipe to exhaust manifold nuts to specification.

**6.** Work from the front of the car toward the rear and progressively adjust and neutralize the exhaust system. Properly position the retaining clamps and torque them to specification.

**7.** Check the exhaust system for leaks.

# PART 12-2 SPECIFICATIONS

| TORQUE LIMITS | Ft-lbs |
|---|---|
| Inlet Pipe(s) to Exhaust Manifold(s)—427 V-8 | 40-53 |
| Inlet Pipe(s) To Exhaust Manifold(s)—All Except 427 V-8 | 25-35 |
| Inlet Pipe to Inlet Extension Pipe Clamp | 17-22 |
| Inlet Pipe to Resonator Clamp | 17-22 |
| Inlet Extension Pipe or Resonator Pipe to Muffler Clamp | 17-22 |
| Resonator to Inlet Extension Pipe Clamp | 17-22 |
| Muffler Support Bracket To Side Member | 12-20 |
| Muffler Support Bracket to Muffler | 12-20 |
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# CHARGING SYSTEM

# GROUP 13


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## 1 DIAGNOSIS AND TESTING

### GENERATING SYSTEM TROUBLE DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **BATTERY LOW IN CHARGE** | Indications of a battery low in charge are slow cranking, hard starting, and headlights dim at engine idle speed. Causes are:<br>**1.** The generator (or alternator) belt worn, or loose and slipping over the pulley.<br>**2.** The battery in such poor condition that it will not hold or take a charge.<br>**3.** The generator (or alternator) not producing its rated output.<br>**4.** Regulator units out of adjustment, and excessive resistance in the generator-to-battery circuit or in the battery-to-ground circuit.<br>First check the belt adjustment and condition. | **RECHARGE OR REPLACE BATTERY**<br>Perform a battery Before Charge Test (Page 13-12). Replace the battery if the test indicates it is worn out or under capacity. If the battery capacity is normal, proceed as follows:<br>**TEST GENERATOR OR ALTERNATOR OUTPUT**<br>Test the generator (or alternator) output (Page 13-10) to determine if the generator (or alternator) is at fault. If the output is normal or greater than the rating of the unit, proceed with regulator test, if the unit is a generator. If the unit |

CONTINUED ON NEXT PAGE

**GENERATING SYSTEM TROUBLE DIAGNOSIS GUIDE (Continued)**

| | | |
|---|---|---|
| **BATTERY LOW IN CHARGE (Continued)** | is an alternator, first check the external circuit to determine the circuit resistance (Page 13-9). If the output is low proceed as follows:<br><br>**OUTPUT LOW**<br><br>Connect a heavy jumper wire from the battery ground post to the generator (or alternator) ground terminal. Repeat the output test. If the output now reaches or exceeds rated output, either the generator (or alternator) or the battery is not properly grounded to the engine frame. Replace the battery-to-ground cable if it is corroded or partially broken. Clean the cable connections at the battery and engine, and tighten the connections. Tighten the generator (or alternator) mounting bracket bolts.<br>If the output is still less than normal, the output could be low due to an open or short circuit in the field, armature, brushes, or brush holders, or the generator brushes can be worn too short or may be sticking in the brush holder and not making good contact on the commutator. Remove the unit for repair.<br><br>**TEST REGULATOR**<br><br>If the generator output is normal, test the regulator to determine if it is properly adjusted. If the unit is an alternator, first check the external | circuit to determine the circuit resistance (Page 13-9).<br>After checking all regulator units, adjust or replace the regulator as necessary. If the regulator is not at fault, test the circuit resistance.<br><br>**TEST CIRCUIT RESISTANCE**<br><br>Check the generator external circuit to determine the circuit resistance (Page 13-4).<br><br>**RESISTANCE EXCESSIVE**<br><br>If the generator resistance (voltage drop) is greater than that specified for the vehicle, locate the trouble by performing a complete external circuit resistance test (Page 13-4). Repair or replace the defective part.<br><br>**RESISTANCE NORMAL**<br><br>If the resistance (voltage drop) is equal to or less than that specified for the car, the battery is low in charge due to improper operation such as:<br>**1.** Excessive use of accessories.<br>**2.** Short trips.<br>**3.** Accidental discharge of battery.<br>**4.** Incorrect engine lubricant for ambient temperature encountered.<br>**5.** Regulator calibration set too close to low limit for vehicle operating conditions. |
| **HIGH CHARGING RATE** | Indications of a high charging rate are:<br><br>**1.** Generator, lights, or fuses burn out repeatedly.<br><br>**2.** Battery requires too frequent refilling.<br><br>**3.** The ignition contacts have a short life.<br><br>To determine the possible cause of the high charging rate, check the following items:<br><br>**1.** Make certain that all connections, including the regulator ground, are tight.<br><br>**2.** Check the voltage limiter. If the voltage limit is high, check the contacts and replace the regulator if the contacts are burned.<br><br>**3.** If the contacts are in good condition, adjust the regulator to the specified limits (see Part 13-10).<br><br>In cases where a generator burns out, in addition to the high voltage, a high setting of the current limiter could account for the failure. | |

## GENERATOR TESTS— FORD CAR ONLY

Fig. 1 shows the generator system schematic.

### GENERATOR OUTPUT TEST

When a generator output test is conducted off the car, a generator-regulator test bench must be used. In this case, the generator is placed on the test bench and driven by a motor. Follow the procedure given by the manufacturer.

To test the output of the generator on the car, proceed as follows:

Disconnect the regulator armature and field wires at the generator. Connect a jumper wire from the generator armature terminal to the generator field terminal and the positive lead of a 0-100 ammeter to the generator armature terminal (Fig. 2). Start the engine and while it is idling, connect the ammeter negative lead to the positive terminal of the battery.

Run the engine at 1500 rpm, and

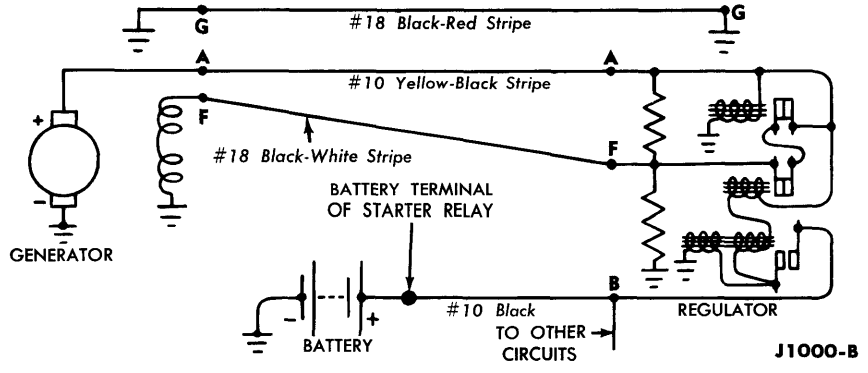



**FIG. 1—Generator System Schematic**

read the current output on the ammeter. The generator should reach or exceed its rated output. **Disconnect the test leads as soon as the test is completed to prevent overheating the generator, and then stop the engine.**

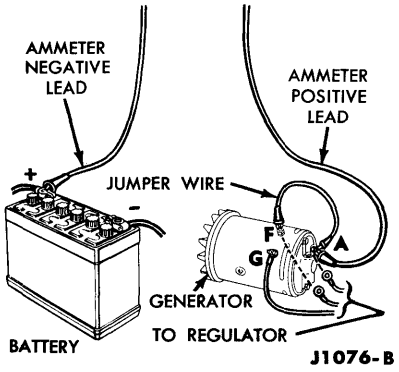



**FIG. 2—Generator Output Test**

## ARMATURE TESTS

Checking the armature for open, short, or grounded circuits must be done off the car.

**Open Circuit Test.** An open circuit in the armature can sometimes be detected by examining the commutator for evidence of bad burning. A badly burned spot on the commutator is caused by an arc formed every time the commutator segment connected to the open circuit passes under a brush.

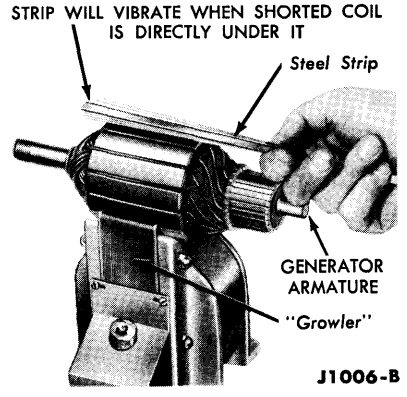



**FIG. 3—Growler Test For Shorted Armature**

**Short Circuit Test.** To test the armature for a short circuit in the windings, a "growler" must be used as shown in Fig. 3. Rotate the armature slowly. When the shorted winding is under the steel strip, it will cause the strip to vibrate.

**Grounded Circuit Test.** To determine if the armature windings are grounded, make the connections as shown in Fig. 4. If the voltmeter indicates any voltage, the armature windings are grounded to the frame.

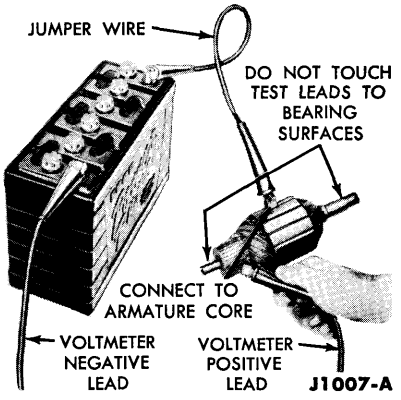



**FIG. 4—Armature Grounded Circuit Test**

## FIELD TESTS

Only two tests are necessary for checking the field. Both open and short circuits can be tested in one operation. The second test is for a grounded circuit.

**Open or Short Circuit Test.** Disconnect the field lead from the generator terminal. Connect a 0-5 ammeter from the battery to the field terminal as shown in Fig. 5. The normal current draw, as indicated by the ammeter, should be 1.5 to 1.6 amperes. If there is little or no current flow, the field has a high resistance or is open. A current flow, considerably higher than that specified above, indicates shorted or grounded turns.

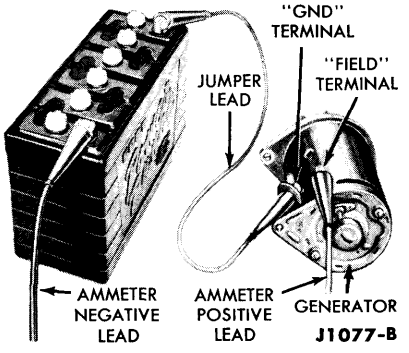



**FIG. 5—Field Open Circuit Test**

**Grounded Circuit Test.** Remove the ground terminal stud from the generator frame. Make the voltmeter and battery connections as shown in Fig. 6. If the voltmeter indicates any voltage, the field coils are grounded. **Be sure that the ground terminal stud is not touching the housing.**

## GENERATOR, REGULATOR AND CIRCUIT TESTS

The four tests presented here are outlined for on-the-car operation and should be conducted in the sequence

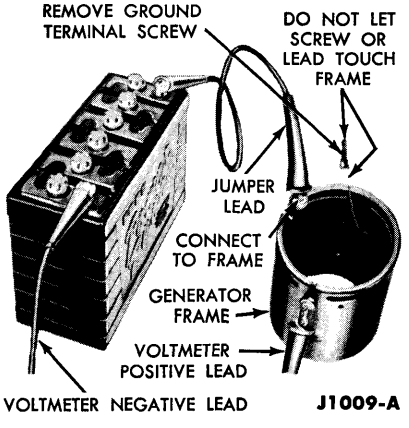



**FIG. 6—Field Grounded Circuit Test**

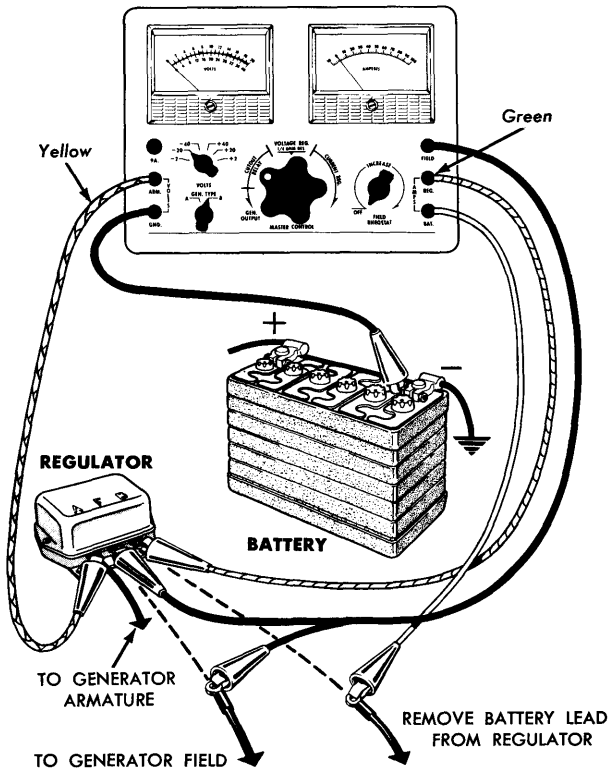



**FIG. 7—Generator Regulator Test Connections**

indicated. Be sure that the regulator is at "normal" operating temperature (equivalent to the temperature after 20 minutes of operation on the car with the hood down). Connect the test equipment as shown in Fig. 7.

**Always be careful when making any test connections to the regulator, so as not to short the battery lead or terminal to the regulator field terminal. To do so will burn the regulator contacts. Disconnect a battery cable while making these connections.**

**Cutout Test.** Start the engine and run it at approximately 1500 rpm. Decrease the resistance in the field circuit (rotate the field rheostat clockwise), and the voltage output of the generator, indicated by the voltmeter, will increase until the cutout closes. The cutout closing will be indicated by a rise of the ammeter needle and a "dip" of the voltmeter needle. The maximum voltage at the time the voltmeter needle dips or drops back will be the closing voltage of the cutout relay. This operation should be repeated to accurately determine the closing voltage of the cutout.

**Voltage Limiter Test.** Rotate the field rheostat to the maximum clockwise position to reduce the resistance in the field circuit to zero. Rotate the center control to the ¼ Ohm position. The ammeter should show an approximate 10 ampere load. Read the voltage regulation on the voltmeter scale. Speed the engine momentarily to see if the voltage remains regulated.

**Current Limiter Test.** With the field rheostat at the maximum clockwise position, rotate the center control to the current regulator position. Continue rotating the control until the voltmeter reading drops to 13 volts. The ammeter will indicate the setting of the current limiter.

Remove all test leads except the voltmeter leads. Install the battery and field leads on the regulator terminals. Run the engine at 1500 rpm, and read the voltage regulation (under battery load) on the voltmeter. **The voltage reading will usually be low when the engine is first started because the battery is partially discharged. After a few moments of operation, the voltage will rise to the original value.**

**External Circuit Resistance Test.** For the purpose of this test, the resistance values of the circuit have been converted to voltage drop readings for a current flow of 30 amperes. Connect the test equipment as shown in Fig. 8 to measure voltage drop around the circuit.

Crank the engine for 30 seconds with the ignition switch OFF to partially discharge the battery. Then start the engine and run it at approximately 1500 rpm.

Touch the voltmeter negative lead to the center of the battery positive post (Fig. 8, connections marked ①) to check the generator to battery circuit. The voltage drop should be less than 0.7 volt.

If the voltage drop in the generator to battery circuit exceeds 0.7 volt, locate the exact part of the circuit wiring causing the trouble, by contacting the voltmeter negative lead to other points of the circuit. Connect the lead to the armature terminal of the regulator (connections marked ②). The voltage drop should be less than 0.2 volt. Connect the lead to the battery terminal of the regulator (connections marked ③). The voltage reading should be less than 0.4 volt. If both these readings are within limits, the excessive resistance is in the regulator to battery wires or their connections.

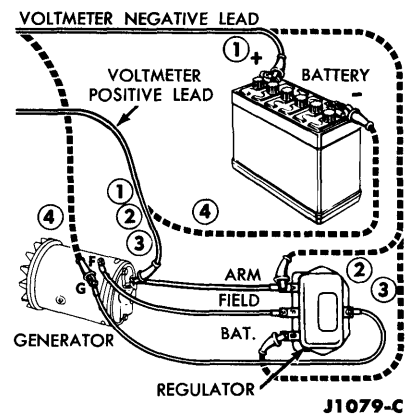



**FIG. 8—Regulator External Circuit Test Connections**

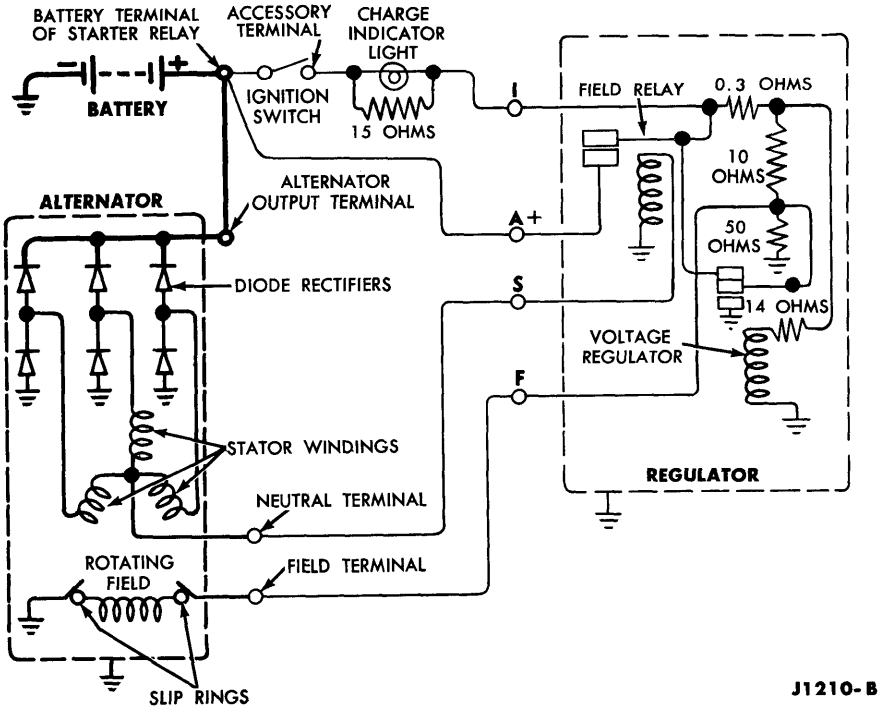



**FIG. 9—Alternator System Schematic—Ford**

Check the battery to generator ground circuit by connecting the voltmeter at shown in Fig. 8 (connections marked ④). The voltage reading should be less than 0.1 volt.

## FORD ALTERNATOR TESTS

Figs. 9 and 10 show the alternator charging circuit schematics. Fig. 11 shows the alternator output connector block. Use care when connecting any test equipment to the alternator system, as the alternator output terminal is connected to the battery at all times.

## ALTERNATOR OUTPUT TEST

When an alternator output test is conducted off the car, a test bench must be used. Follow the procedure given by the test bench manufacturer.

To test the output of the alternator on the car, proceed as follows:

**1.** Make the connections as shown in Fig. 12 or 13. Be sure that the field resistance control is at the OFF position at the start of this test.

**2.** Close the battery adapter switch. Start the engine, then open the battery adapter switch.

**3.** Gradually increase the engine speed to exactly 2900 rpm (2500 rpm on Mercury with air conditioning).

**4.** Adjust the field resistance control until the voltmeter reads exactly 15 volts. Observe the ammeter reading. Add 5 amperes to this reading to obtain total alternator output. The 5-ampere factor represents the field current and the ignition system current, and must be added to the ammeter reading as these currents are not indicated on the ammeter. Any additional continuously operating equipment, or ignition system drawing more current, will have to be taken into account.

If the battery was fully charged, it might not be possible to obtain maximum current output. If specified current is not obtained, make the following test before condemning the alternator:

**5.** Turn the field resistance control knob to the maximum counterclockwise position. Rotate the center control knob to the LOAD or CURRENT REG. position. Maintain the

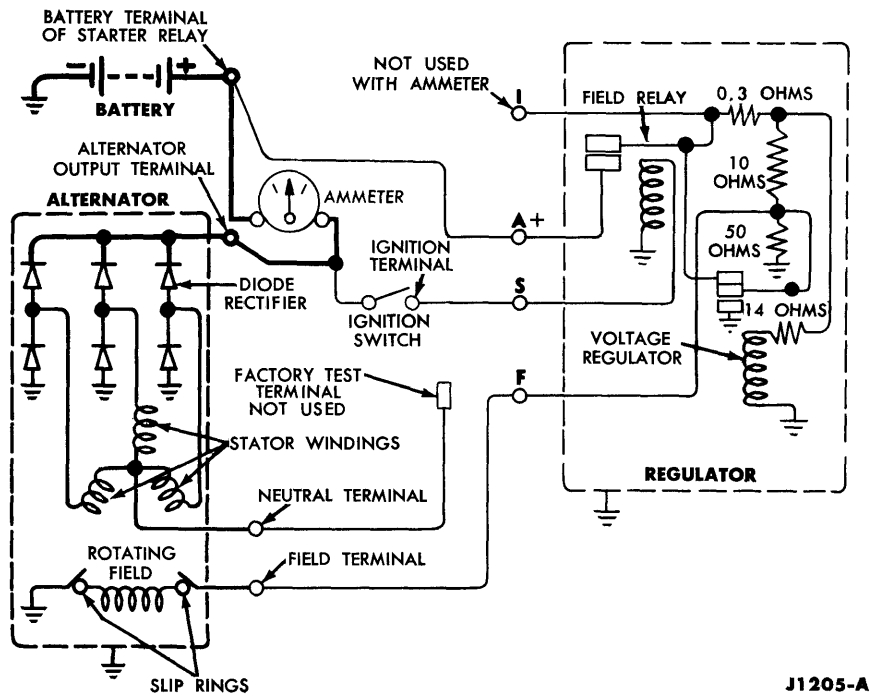



**FIG. 10—Alternator System Schematic—Mercury**

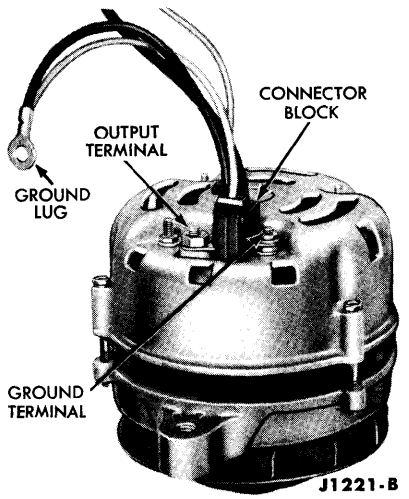



**FIG. 11—Alternator Electrical Connections**

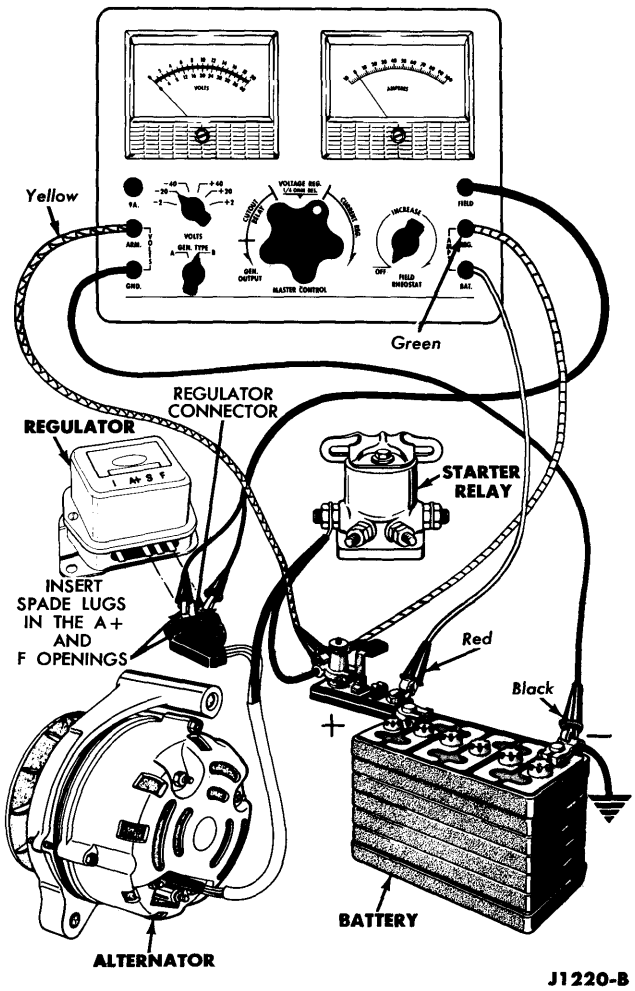



FIG. 12—Alternator Output Test—Ford

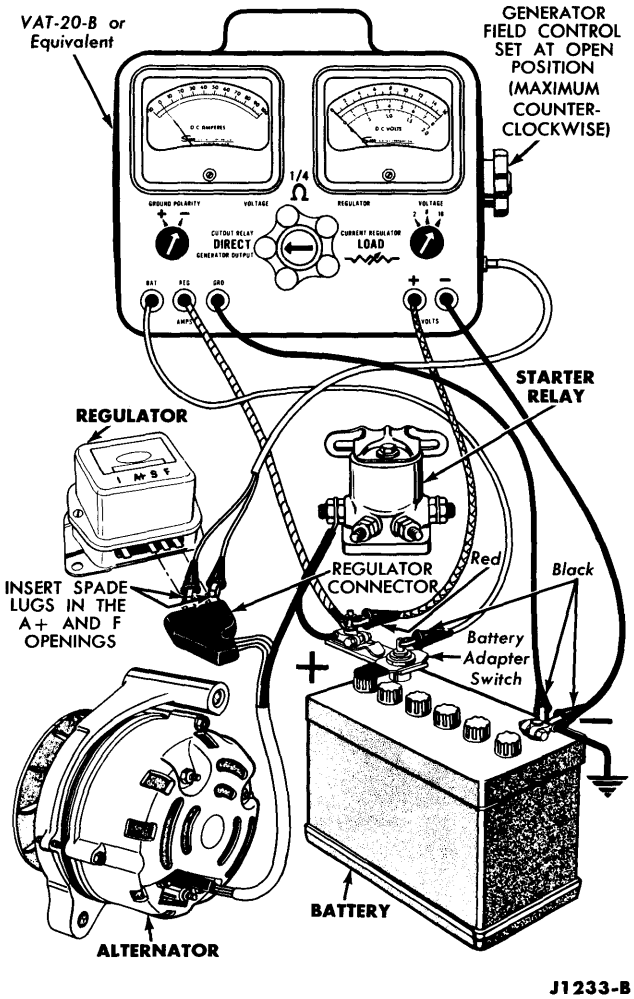



FIG. 13—Alternator Output Test—Mercury

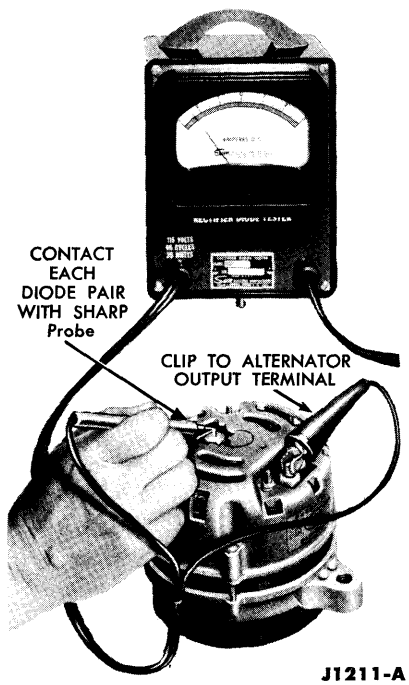



FIG. 14—Positive Diode Test

engine speed at 2900 rpm (2500 rpm on Mercury with air conditioning).

**6.** Turn the field resistance control and the center control clockwise, maintaining a voltmeter reading of 15 volts maximum, until the field resistance control is at its maximum clockwise position.

**7.** Readjust the center control until the voltmeter reads exactly 15 volts. Observe the ammeter reading. Add 5 amperes to this reading to obtain total alternator output.

**8.** Stop the engine, return the field resistance control to the maximum counterclockwise position and disconnect the test equipment.

An output of 2 to 5 amperes below specifications usually indicates an open diode rectifier. An output of approximately 10 amperes below specifications usually indicates a shorted diode rectifier. An alternator with a shorted diode will usually whine, which will be most noticeable at idle speed.

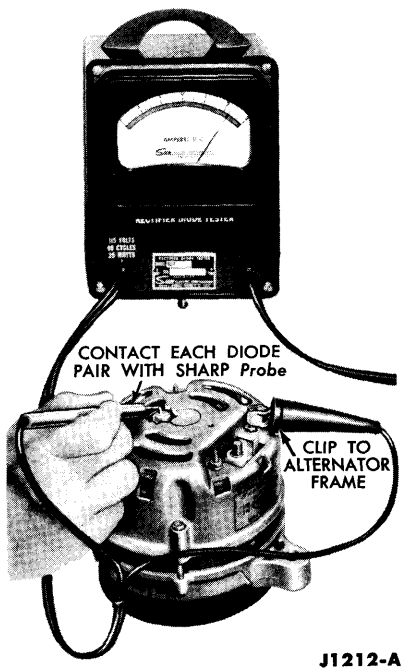



FIG. 15—Negative Diode Test

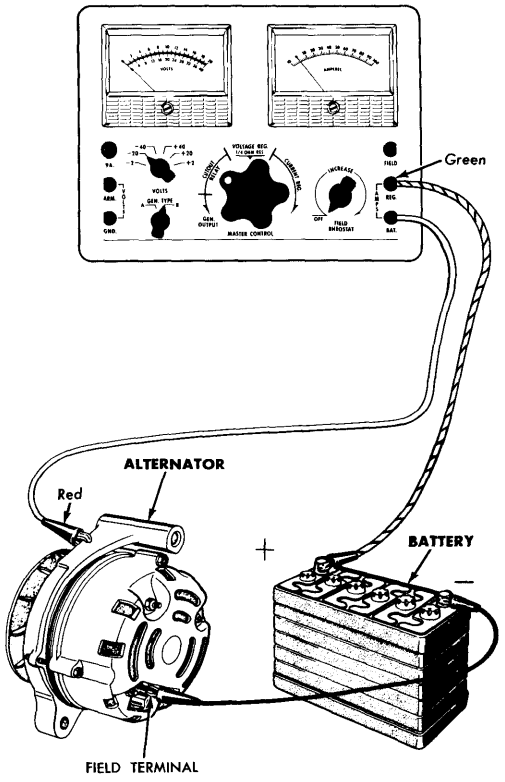



FIG. 16—Field Open or Short Circuit Test—Ford

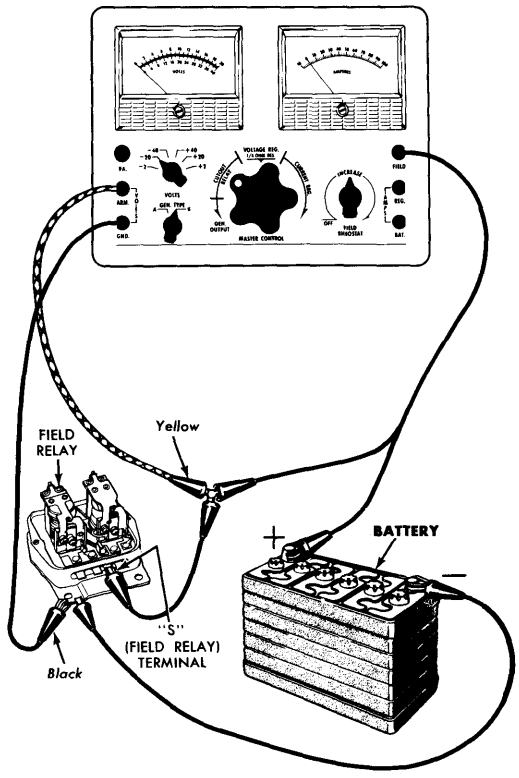



FIG. 17—Field Open or Short Circuit Test—Mercury

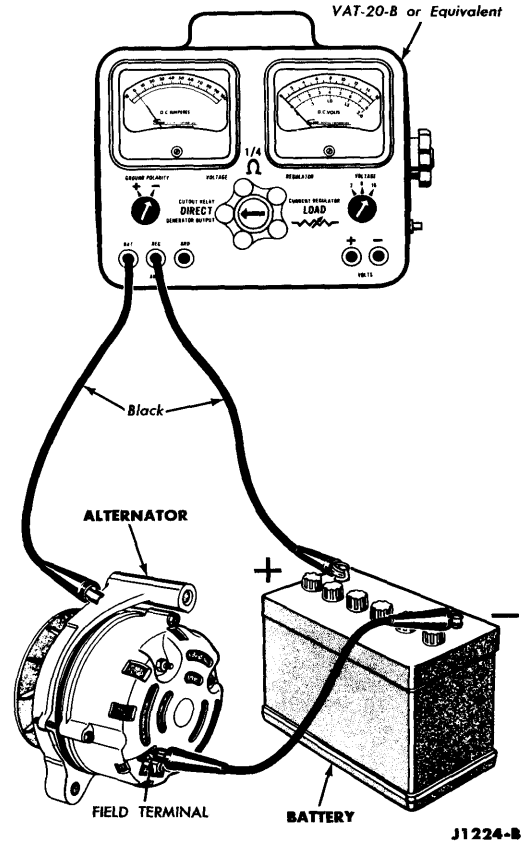



FIG. 18—Field Relay Test—Ford

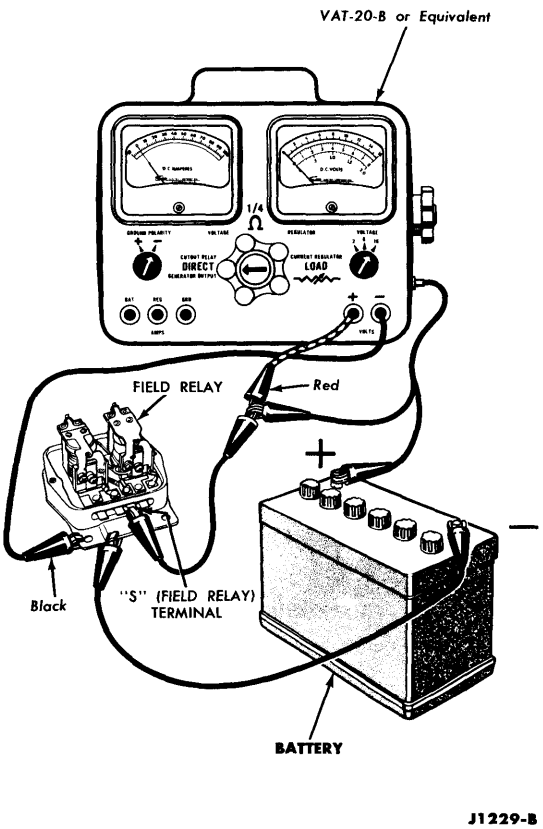



FIG. 19—Field Relay Test—Mercury

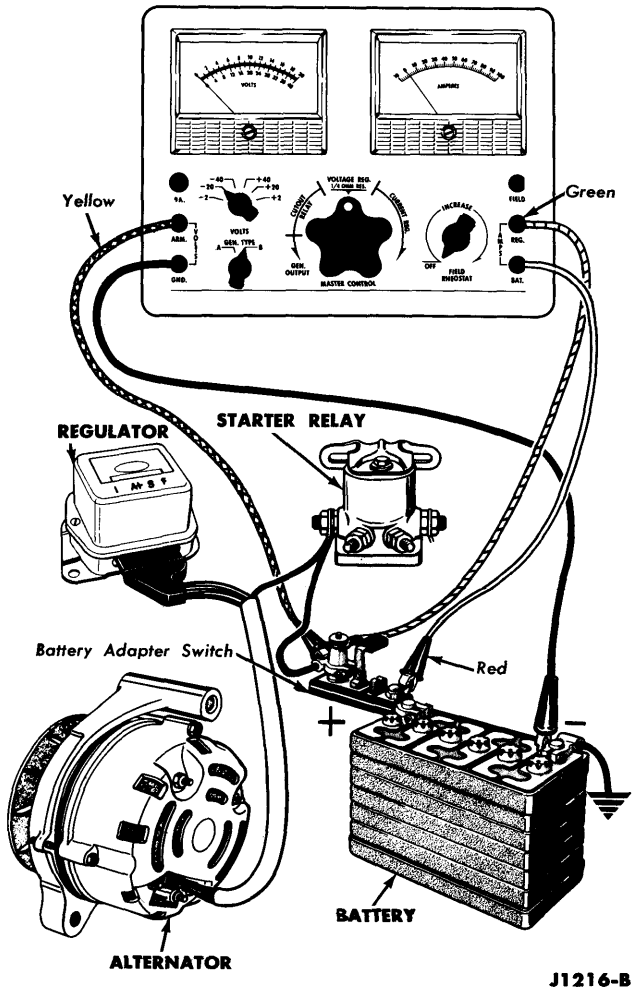



FIG. 20—Voltage Limiter Test—Ford

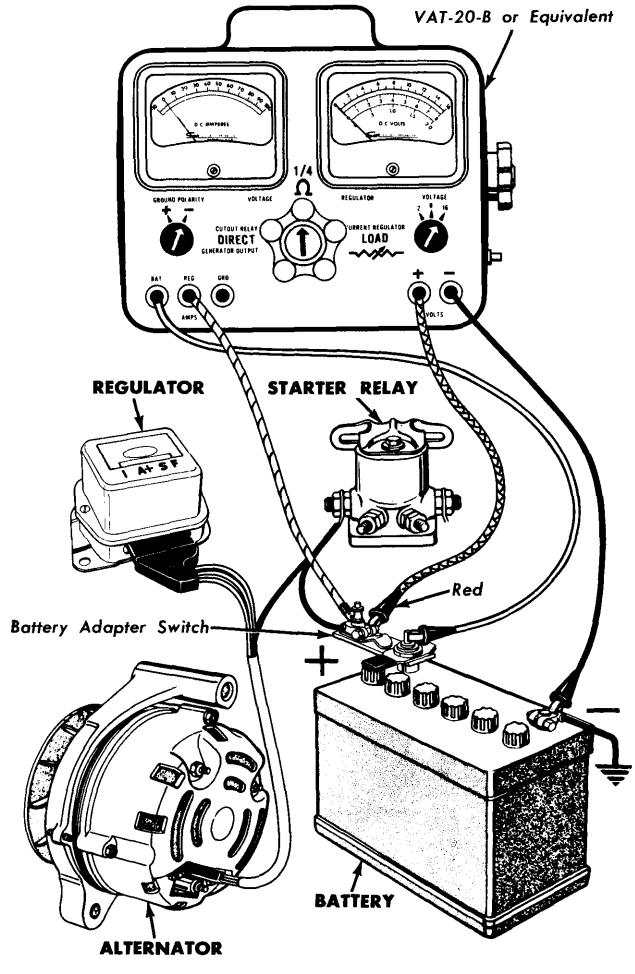



FIG. 21—Voltage Limiter Test—Mercury

### DIODE TEST

To test the positive diodes, make the connections shown in Fig. 14. Contact the probe to each diode lead. Make sure that the tip of the probe is sharp and that it penetrates the varnish at the diode terminal.

To test the negative diodes, make the connections shown in Fig. 15. Follow the same procedure as for the positive diodes.

Good diodes will be indicated as on the meter in Figs. 14 and 15 (2 amps or more and readings alike within 2 scale divisions).

### FIELD OPEN OR SHORT CIRCUIT TEST

Make the connection as shown in Fig. 16 or 17. The current draw, as indicated by the ammeter, should be to specifications. If there is little or no current flow, the field or brushes have a high resistance or are open. A current flow considerably higher than that specified above, indicates shorted or grounded turns or brush leads touching. If the test shows that the field is shorted or open and the field brush assembly or slip rings are not at fault, the entire rotor must be replaced.

### ALTERNATOR REGULATOR AND CIRCUIT TESTS

The tests presented are outlined for on-the-car operation. Be sure that the regulator is at normal operating temperature (equivalent to the temperature after 20 minutes of operation of the car with the hood down).

**Field Relay Test.** Disconnect the regulator connector plug, and remove the regulator cover. Make the connections as shown in Fig. 18 or 19. Slowly rotate the field resistance control clockwise from the maximum counterclockwise position until the field relay contacts close. Observe the voltmeter reading at the moment that the relay closes. This is the relay closing voltage. If the relay closes immediately, even with the field resistance close to the maximum counterclockwise position, use a 6-volt battery for this test. If the closing voltage is not to specifications, adjust the relay (Fig. 2, Part 13-5).

**Voltage Limiter Test.** For test purposes, the lower stage (armature vibrating on the lower contact) regulation is used. Voltage limiter calibration tests must be made with the regulator cover in place and the regulator at normal operating temperature (equivalent to the temperature after 20 minutes of operation on the car with the hood down).

Make the test connections as shown in Fig. 20 or 21. Turn all accessories off, including door operated dome lights. Close the battery adapter switch, start the engine, then open the adapter switch. Attach the voltage regulation thermometer (T56L-10505-A or M-183-RTG-5), to the regulator cover. Operate the engine at 2000 rpm for 5 minutes.

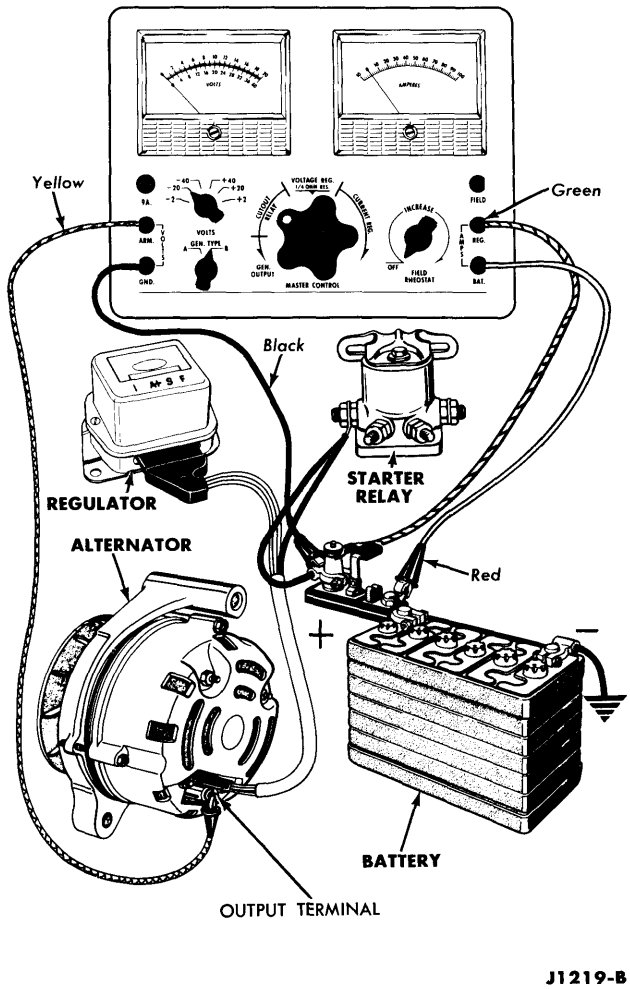



**FIG. 22—Voltage Drop Test—Alternator to Battery Positive Terminal—Ford**

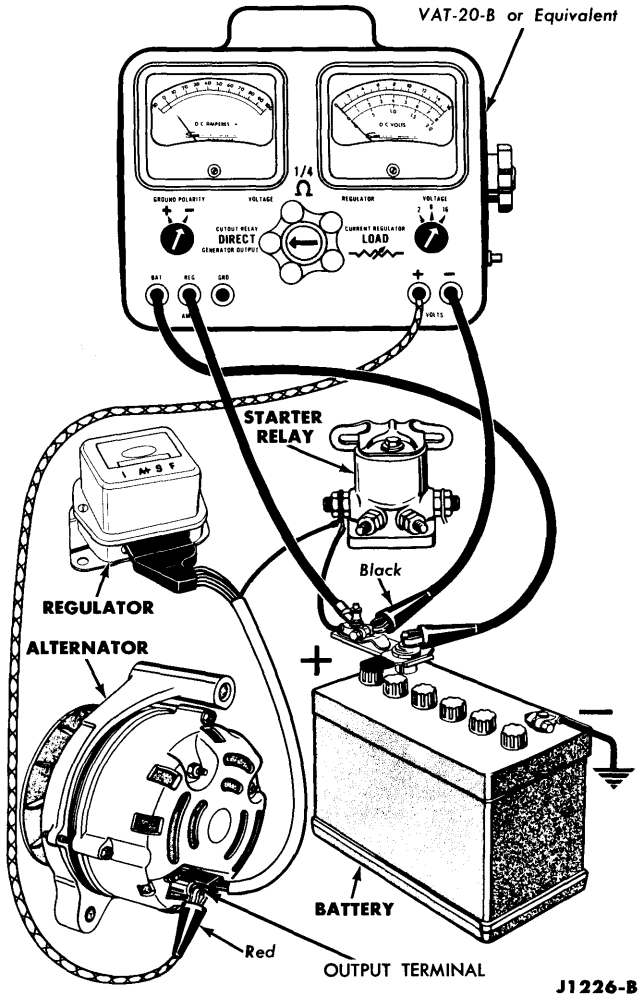



**FIG. 23—Voltage Drop Test—Alternator to Battery Positive Terminal—Mercury**

Turn the center control to the cut-out relay position. If the ammeter indicates more than 10 amperes, stop the engine, remove the battery cables and charge the battery.

When the battery is charged, and the voltage regulator has been temperature stabilized, rotate the center control to the ¼ Ohm position. The ammeter should indicate approximately 2 amperes.

Cycle the regulator as follows: stop the engine, close the adapter switch, start the engine, and open the adapter switch. Allow the battery to normalize for a few seconds, then read the voltmeter. Read the thermometer, and compare the voltmeter reading with the voltage given in Table 1 for the ambient temperature indicated on the thermometer. If the regulated voltage is not within specifications, make a voltage limiter adjustment. After each adjustment, be sure to cycle the regulator before each reading. The readings must be made with the cover in place.

**TABLE 1—Voltage Regulator Setting Versus Ambient Air Temperature**

| Ambient Air Temperature °F. | Voltage Regulation Setting (Volts) |
|---|---|
| 50 | 14.3-15.1 |
| 75 | 14.1-14.9 |
| 100 | 13.9-14.7 |
| 125 | 13.8-14.6 |
| 150 | 13.6-14.4 |
| 175 | 13.5-14.3 |

**Circuit Resistance Tests.** For the purpose of this test, the resistance values of the circuits have been converted to voltage drop readings for a current flow of 20 amperes.

ALTERNATOR TO BATTERY POSITIVE TERMINAL. To check the alternator to battery positive terminal voltage drop, make the connections as shown in Fig. 22 or 23. Turn off all electrical accessories and lights. Close the battery adapter switch, start the engine, then open the battery adapter switch. Slowly increase the engine speed until the ammeter reads 20 amperes. Note the voltmeter reading at this point. The voltage reading should be no greater than 0.3 volt.

These voltage drops have been computed for a standard car. The current used by any auxiliary, continuously operating, heavy-duty equipment will not show on the am-

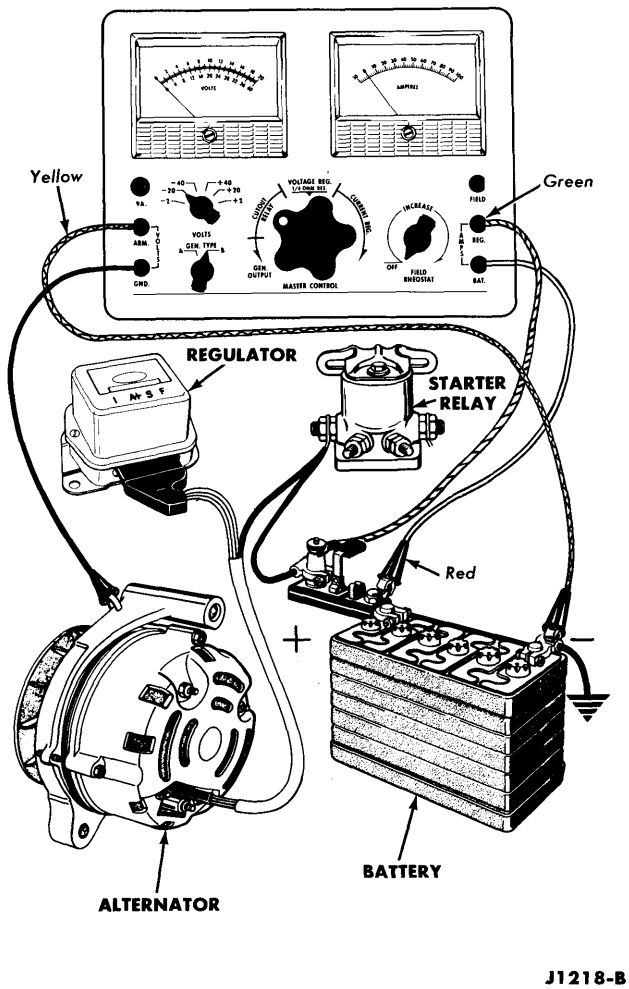



**FIG. 24—Voltage Drop Test—Alternator to Battery Ground Terminal—Ford**

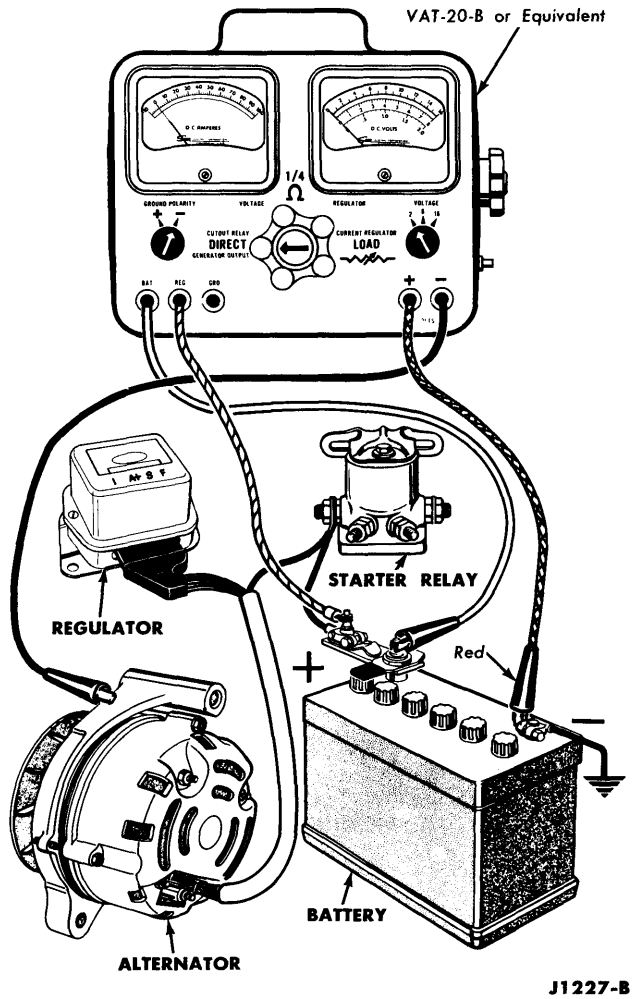



**FIG. 25—Voltage Drop Test—Alternator to Battery Ground Terminal—Mercury**

meter and will have to be taken into account when making this test.

If the battery is fully charged it may not be possible to read the 20 amperes required for the test. Disconnect the regulator cable connector and run a jumper from the A+ terminal to the F terminal of the cable connector, and repeat the test.

ALTERNATOR TO BATTERY GROUND TERMINAL. To check the alternator to battery ground terminal voltage drop, make the connections as shown in Fig. 24 or 25. Close the battery adapter switch, start the engine and open the adapter switch. Slowly increase the engine speed until the ammeter reads 20 amperes. The voltage indicated on the voltmeter should be less than 0.1 volt.

## LEECE NEVILLE ALTERNATOR TESTS—40 AND 60 AMPERE

Figs. 26, 27 and 28 show the Leece Neville alternator system schematics.

### ALTERNATOR OUTPUT TEST

When an alternator output test is conducted off the car, a test bench must be used. In this case, the alternator is placed on the test bench and driven by a motor. Follow the procedure given by the manufacturer.

To test the output of the alternator on the car, proceed as follows:

Disconnect the regulator "F" or "field" lead at the regulator. Disconnect the regulator "B" lead from the regulator. Connect a jumper wire from the regulator "field" lead to the "B" lead, and the positive lead of an ammeter to the "B" lead. Start the engine, and while it is idling, connect the ammeter negative lead to the battery positive post. Run the engine at 1600 rpm, and read the current output on the ammeter. The alternator output should reach or exceed the alternator rating. **Make this test in the minimum amount of time, and stop the engine and disconnect the test leads as soon as the test is completed, to prevent overheating the alternator.**

### FIELD OPEN OR SHORT CIRCUIT TEST

Disconnect the field lead from the alternator terminal. Connect the negative lead of an ammeter to the alternator field terminal and the positive lead of the ammeter to the positive battery terminal. The normal current draw, as indicated by the ammeter, should be to specification. If there is little or no current flow, the field has a high resistance or is open. A current flow consider-

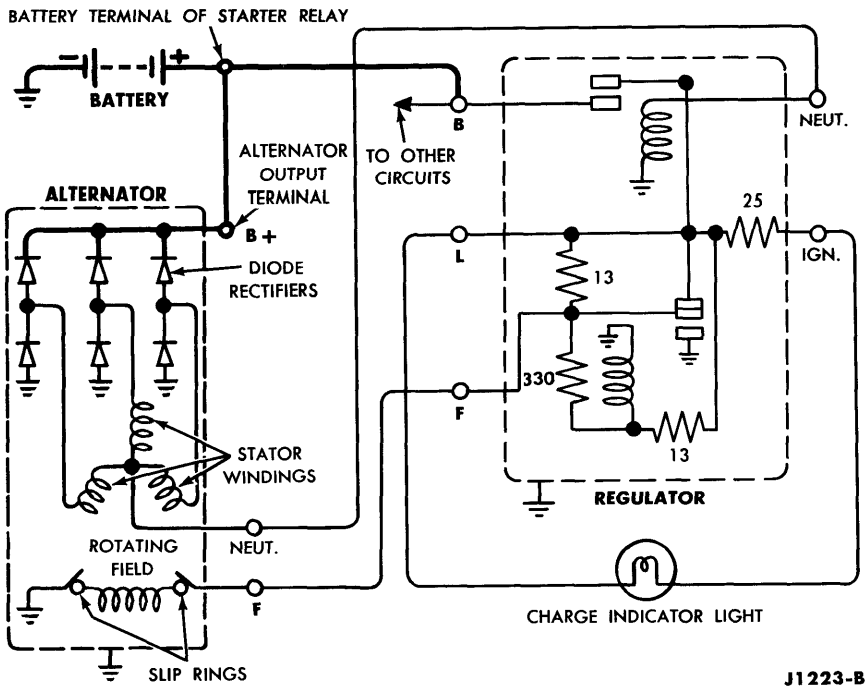



**FIG. 26—40-Ampere Leece Neville Alternator System Schematic—Ford**

ably higher than that specified indicates shorted or grounded turns. If the test shows that the field is shorted and the field brush assembly is not at fault, the entire rotor must be replaced.

## RECTIFIER TEST

Remove the alternator from the car. Disassemble the slip-ring end housing and stator assembly from the alternator. Remove the stator from the slip-ring end housing.

Connect the test equipment as shown in Fig. 29 or 30. Connect one test lead to one of the heat sinks. Connect the other test lead to the terminal of each diode rectifier attached to that heat sink. Use the same procedure for the other heat sink.

Good diodes will indicate 2 amperes or more and readings should be alike within two scale divisions.

## REGULATOR AND CIRCUIT TESTS

Be sure that the regulator is at "normal" operating temperature (equivalent to the temperature after 30 minutes of operation on the car with the hood down).

**Field Relay Test.** Make the test connections as shown in Fig. 31. Starting with full resistance in the rheostat, slowly decrease the resistance until the load relay closes. Observe the voltmeter at the instant that the relay closes. This is the field relay closing voltage and should be to specification.

**Voltage Limit Test.** Make the test connections as shown in Fig. 20 or 21.

Close the battery adapter switch, start the engine, then open the battery adapter switch.

Slowly increase the engine speed to 1600 rpm. The voltmeter reading will increase to a peak value and will then drop back slightly and will hold steady. The steady reading is the operating voltage setting of the regulator. **To retest the operating voltage setting, stop the engine and turn the ignition key to "OFF" momentarily. Close the battery adapter switch, start the engine, open the battery adapter switch, and increase the speed to 1600 rpm.**

**Circuit Resistance Tests.** For the purpose of this test, the resistance values of the circuits have been converted to voltage drop readings for a current flow of 20 amperes.

ALTERNATOR TO BATTERY POSITIVE TERMINAL. To check the alternator to battery positive terminal voltage drop, make the connections as shown in Figs. 22 or 23 Turn off all electrical accessories and lights. Close the battery adapter switch, start the engine, then open the battery adapter switch. Slowly increase the engine speed until the ammeter reads 20 amperes. Note the voltmeter reading at this point. The voltage reading should be no greater than 0.3 volt.

These voltage drops have been computed for a standard car. The current used by any auxiliary, continuously operating, heavy-duty equipment will not show on the ammeter and will have to be taken into account when making this test.

If the battery is fully charged, it may not be possible to reach the 20

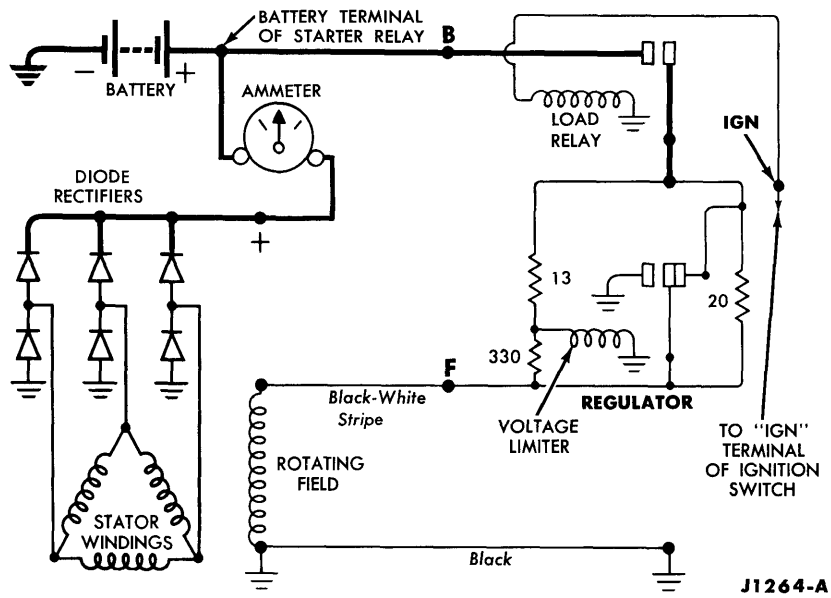



**FIG. 27—40-Ampere Leece Neville Alternator System Schematic—Mercury**

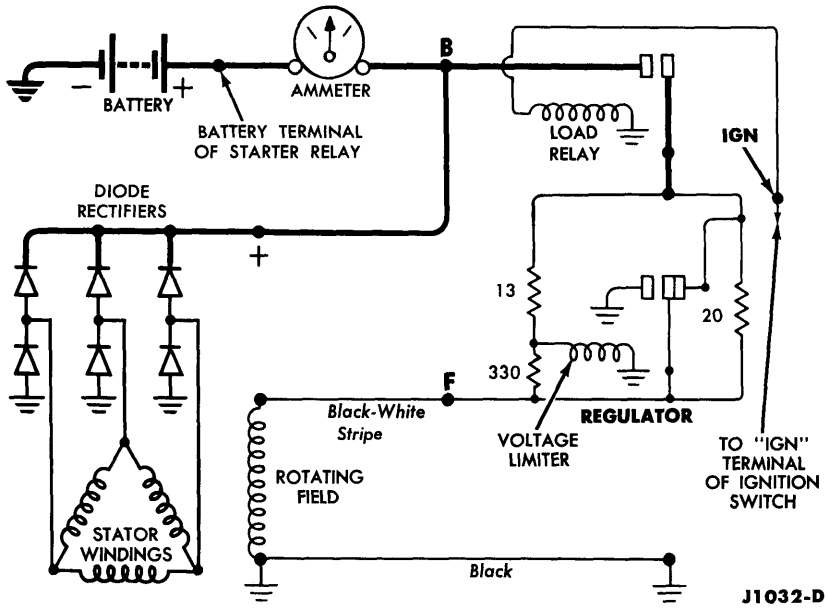



**FIG. 28—60-Ampere Leece Neville Alternator System Schematic**

amperes required for the test. Disconnect the field lead from the regulator "F" terminal and connect a jumper wire from the field lead to the regulator "B" terminal and repeat the test.

ALTERNATOR TO BATTERY GROUND TERMINAL. To check the alternator to battery ground terminal voltage drop, make the connections as shown in Figs. 24 or 25. Close the battery adapter switch, start the engine and open the adapter switch. Slowly increase the engine speed until the ammeter reads 20 amperes. The voltage indicated on the voltmeter should be less than 0.1 volt.

## BATTERY TESTS AND CONCLUSIONS

Tests are made on a battery to determine the state of charge and also the condition. The ultimate result of these tests is to show that the battery is good, needs recharging, or must be replaced.

If a battery has failed, is low in charge, or requires water frequently, good service demands that the reason for this condition be found. It may be necessary to follow trouble shooting procedures to locate the cause of the trouble (Page 13-1).

Some battery test equipment combines the necessary instruments and controls in a single unit. Be sure to follow the directions of the manufacturer when using such combined equipment.

**Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames or sparks are brought near the vent openings of the battery. The sulphuric acid in the battery electrolyte can cause a serious burn if spilled on the skin or spattered in the eyes. It should be flushed away with large quantities of clear water.**

### BEFORE CHARGE TESTS

**Battery Capacity Test.** A high rate discharge tester in conjunction with a voltmeter is used for this test. **If the battery solution is not within 60° F. to 100° F., let it stand until warm before making this test.** Add water if necessary to bring the battery solution to the proper level. **Fill only to the narrow ring near the bottom of each vent well.** Fig. 32 shows the battery capacity test in outline form.

**1.** Connect the high rate discharge tester and the appropriate voltmeter to the battery terminals.

**2.** Adjust the discharge tester to draw three times the ampere hour rating of the battery. After 15 seconds and with the battery still under load, read the battery terminal voltage. **The voltage clips must contact the battery posts and not the high rate discharge tester clips. Unless this is done the actual battery terminal voltage will not be indicated.**

**3.** If the terminal voltage is 9.6 volts or more, the battery has good output capacity and will accept a normal charge. Test the specific gravity if water has not been recently added, and recharge if necessary.

**4.** If the terminal voltage is below

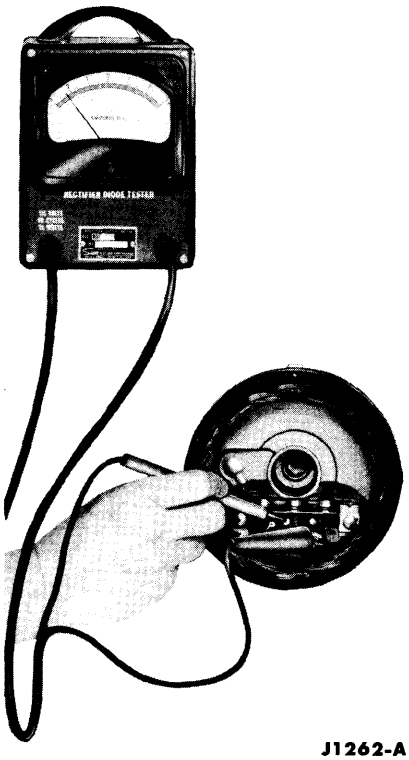



**FIG. 29—40-Ampere Leece Neville Rectifier Test**

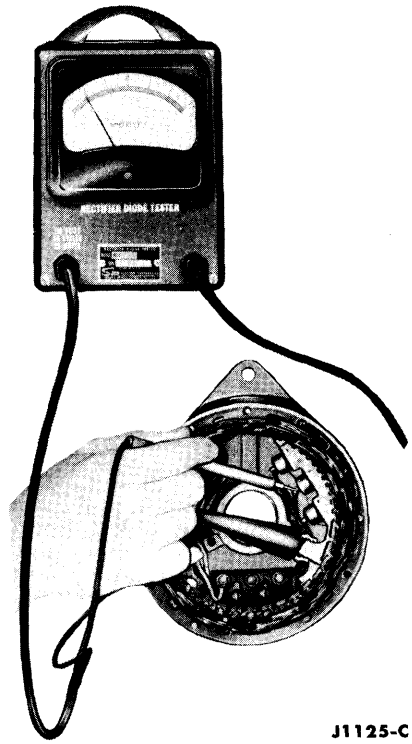



**FIG. 30—60-Ampere Leece Neville Rectifier Test**

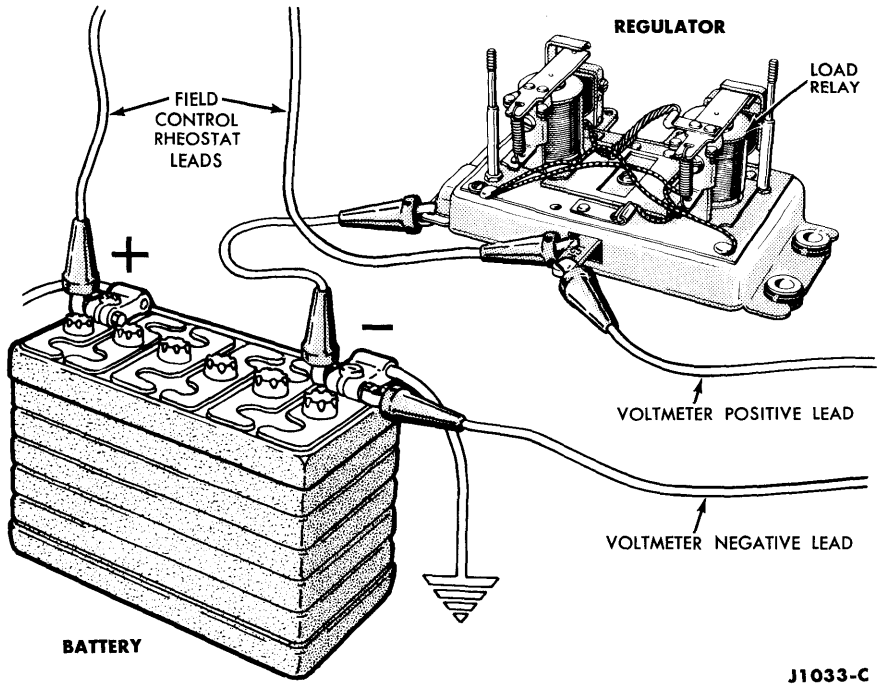



**FIG. 31—Leece Neville Regulator Field Relay Test**

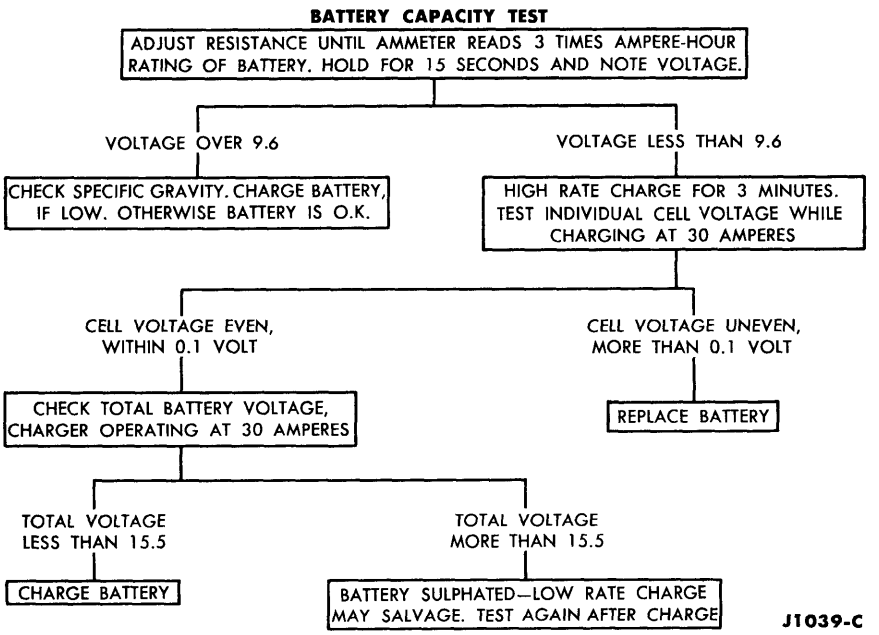



**FIG. 32—Battery Capacity Test Outline**

9.6 volts, make a test charge on the battery.

**Battery Test Charge.** The condition of a discharged battery may be tested by passing current through it.

**1.** Connect a high rate charger to the battery and charge the battery for 3 minutes at a rate of 30 amperes.

**2.** After 3 minutes of high rate charge, and with the charger still operating, test the individual cell voltages of the battery.

**3.** If the cell voltages vary more than 0.1 volt, replace the battery. If the cell voltages are even within 0.1 volt, test the total battery voltage (charger still operating).

**4.** If the total battery voltage is now under 15.5 volts, the battery is satisfactory and may be safely charged at a high rate (see Part 13-10). **Always follow the high rate charge with a sufficient low rate charge to bring the battery to a full charge.**

**5.** If the total battery voltage is over 15.5 volts, the battery is probably sulphated. Place the battery on continued low rate charge.

### AFTER CHARGE TESTS

When the battery is fully charged (check with a hydrometer or battery charge tester) make a capacity test. If the terminal voltage is 9.6 volts or above, place the battery back in service. If the terminal voltage is below 9.6 volts, replace the battery.

**Battery Charge Tests.** Battery charge may be tested by measuring the battery electrolyte solution specific gravity (hydrometer) or by measuring the voltage of the battery cells on open circuit (no current flow) with a battery charge tester (open circuit voltage tester).

**A discharged 12-volt battery can freeze during cold weather. The specifications (Part 13-10), show the temperatures at which batteries of various specific gravities will begin to freeze.**

## BATTERY CHARGING

A battery that is not sulphated may be charged by either a high rate charging or low rate charging method. Most fast charge units may be adjusted for making a slow charge.

### HIGH RATE CHARGING

Follow the instructions of the charger manufacturer, as high rate chargers vary slightly with different manufacturers.

Test the battery cells for specific gravity. Then, fast charge the battery at 30 to 40 amperes maximum for the length of time shown in the specifications (Part 13-10), corresponding to the specific gravity condition of the battery.

### LOW RATE CHARGING

Always follow a high rate charge with a low rate charge at 3 amperes for 12-volt batteries of less than 70-ampere-hour capacity. Batteries of 70-ampere-hour capacity or higher require a 4 ampere low rate charge. Continue the low rate charge until the battery is fully charged. A battery is considered fully charged when the specific gravity readings of all the cells, taken at hourly intervals, do not increase over a 3-hour period.

## 2 COMMON ADJUSTMENTS AND REPAIRS

### BELT ADJUSTMENT— GENERATOR

1. Loosen the generator-to-mounting bracket bolts and the adjusting arm bolts.
2. Apply pressure between the generator and the engine block, and tighten the adjusting arm bolt.
3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.
4. Tighten all mounting bolts.

### BELT ADJUSTMENT— ALTERNATOR

1. Loosen the alternator mounting bolt and the adjusting arm bolts.
2. Apply pressure on the alternator front housing only and tighten the adjusting arm to alternator bolt.
3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.
4. Tighten all mounting bolts.

## 3 CLEANING AND INSPECTION

### ALTERNATOR

1. The rotor, stator, and bearings must not be cleaned with solvent. Wipe these parts off with a clean cloth.
2. Rotate the front bearing on the drive shaft. Check for any scraping noise, looseness or roughness that will indicate that the bearing is excessively worn. Look for excessive lubricant leakage. If any of these conditions exist, replace the bearing.
3. Inspect the rotor shaft at the rear bearing surface for roughness or severe chatter marks. Replace the rotor assembly if the shaft is not smooth.
4. Place the rear end bearing on the slip-ring end of the shaft and rotate the bearing on the shaft. Make the same check for noise, looseness or roughness as was made for the front bearing. Inspect the rollers and cage for damage. Replace the bearing if these conditions exist, or if the lubricant is lost or contaminated.
5. Check both the front and rear housings for cracks. Check the front housing for stripped threads in the mounting ear. Replace defective housings.
6. A pulley is not suitable for reuse if more than ¼ of the shaft length will enter the pulley bore with light pressure. Replace any pulley that is bent out of shape.
7. Check all wire leads on both the stator and rotor assemblies for loose soldered connections, and for burned insulation. Resolder poor connections. Replace parts that show burned insulation.
8. Check the slip rings for nicks and surface roughness. Nicks and scratches may be removed by turning down the slip rings. Do not go beyond the minimum diameter limit of 1.22 inches. If the slip rings are badly damaged, the entire rotor will have to be replaced, as they are serviced as a complete assembly.
9. Replace any parts that are burned or cracked. Replace brushes and brush springs that are not to specification.

### GENERATOR

1. Wash all parts except the armature, field coils, and ball bearings in solvent and dry the parts thoroughly.
2. Wipe off the armature and field windings, the commutator, and the armature shaft.
3. Check the condition of the bearings. If the ball bearings are worn, or have lost their lubricant, they must be replaced.
4. Check the armature winding for worn insulation, overheating, and unsoldered connections.
5. Check the armature for shorts, opens or grounds.
6. Check the field windings for worn insulation and unsoldered connections at the terminal screws. Check the current draw with a 12-volt supply, if the current draw is not within specification, replace the field winding. Resolder any connections as required.
7. Replace the armature or the field coils if the insulation is worn or if an open short or grounded circuit is indicated.
8. Check the commutator for runout and uneven or scored surfaces. Turn down the commutator and undercut the mica if necessary.
9. Inspect the brush end plate for poor insulation or loose rivets. Replace the end plate if the positive brush insulation is broken or cracked. Tighten any loose brush holder rivets.
10. Check the brush spring tension. If the tension is not within specifications, replace the springs.

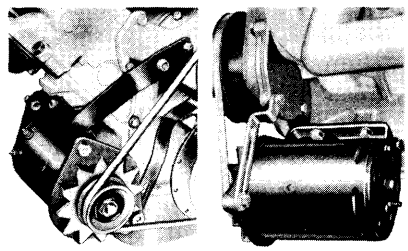
# PART 13-2 GENERATOR


| Section | Page | Section | Page |
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| 1 Description and Operation | 13-15 | 3 Removal and Installation | 13-15 |
| 2 In-Car Adjustment and Repair | 13-15 | 4 Major Repair Operations | 13-15 |


## 1 DESCRIPTION AND OPERATION

The D.C. generating system is a negative (—) ground system. Output is controlled by a regulator which is connected between the armature and field. The field is grounded internally (Fig. 1, Part 13-1).

The armature shaft is supported by permanently-lubricated ball bearings which fit into the end plates (Fig. 2). The shaft is keyed to an integral pulley and cooling-fan assembly which is belt driven from the engine. The generator mounting is shown in Fig. 1.



8 CYLINDER MOUNTING — 6 CYLINDER MOUNTING

J1075-B

**FIG. 1—Generator Mountings**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### BELT ADJUSTMENT

1. Loosen the generator-to-mounting bracket bolts and the adjusting arm bolts.

2. Apply pressure between the generator and the engine block, and tighten the adjusting arm bolt.

3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.

4. Tighten all mounting bolts.

### POLARIZING GENERATORS

Normally, it is only necessary to polarize a generator when a generator has been rebuilt and if new pole shoes have been installed. Generators are polarized during manufacture, and normally, there is enough residual magnetism left to allow the generator to start charging.

To polarize a rebuilt generator mounted on the vehicle, disconnect the field wire and the battery wire from the regulator. With the engine turned off, momentarily connect the two wires together.

**Do not polarize a generator by any method that applies battery voltage to the field terminal of the regulator, such as shorting from the battery terminal to the field terminal of the regulator, or by connecting a jumper wire directly from the battery to the generator field terminal. This action causes excessive current to flow from the battery through the regulator contacts to ground, thus burning the points.**

## 3 REMOVAL AND INSTALLATION

1. Disconnect the armature field, and ground wires at the generator terminals.

2. Remove the adjustment arm to generator bolt, the generator belt, and the two pivot bolts from the mounting bracket. Then remove the generator (Fig. 1).

3. To install the generator, clean the mating surfaces of the generator frame and mounting bracket.

4. Install the generator in the bracket with the two pivot bolts and lockwashers.

5. Install the generator belt, and the adjustment arm to generator bolt. Adjust the belt tension using tool T63L-8620-A, and tighten all bolts securely.

6. Connect the armature, field, and ground leads on the generator terminals. Start the engine and check the generator operation.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

Fig. 2 shows a disassembled view of the generator.

1. Remove the two generator through bolts and the brush end plate. Slide the armature assembly out the other end of the frame. Do not lose the locating dowel if it drops out of the front end plate.

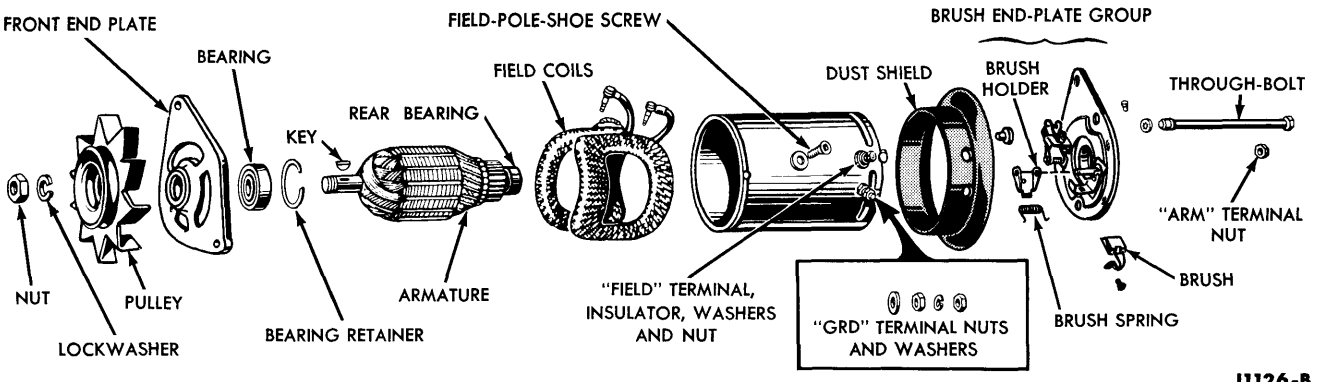



**FIG. 2—Disassembled Generator**

Remove the brushes, brush arms and springs from the brush end plate.

**2.** Clamp the armature in a vise equipped with soft jaws, and remove the retaining nut, lockwasher, pulley and woodruff key from the armature shaft.

**3.** Slide the front end plate off the armature shaft. **Remove any burrs from the keyway before removing the front end plate.** Remove the bearing retainer and remove the bearing from the front end plate.

**4.** Remove the field and ground terminal screws from the generator frame, and unscrew the field pole shoe screws as shown in Fig. 3.

**5.** Slide the pole shoes and field windings out of the frame, and separate the windings and shoes.

## PARTS REPAIR OR REPLACEMENT

### COMMUTATOR TURNING AND UNDERCOATING

Check the commutator runout as shown in Fig. 4. If the surface of the commutator is rough or more than 0.002 inch out of round, turn it down.

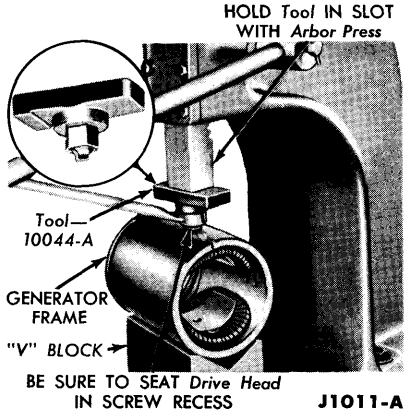



**FIG. 3—Pole Shoe Screw Removal**

### BRUSH REPLACEMENT

Replace the generator brushes if they are not within wear limits. Always change both brushes when replacement is required. If the brush wear has been excessive, check the condition of the commutator, turn it down and undercut it if necessary.

**1.** Remove the two through bolts from the generator frame.

**2.** Remove the brush end plate and the armature and front end plate assembly from the generator frame.

**3.** Disconnect the brush terminals and remove the brushes.

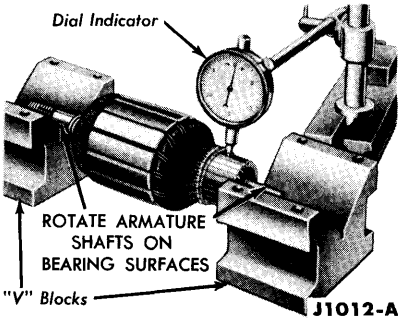



**FIG. 4—Commutator Runout Check**

**4.** Clean the carbon and dirt from the brush end plate. Repair or replace the insulation between the brush holders and end plate and the armature terminal and end plate if it is worn or cracked. Clean the commutator with sandpaper.

**5.** Make sure that the new brushes slide freely in the brush holders. Seat the new brushes by sanding them in as shown in Fig. 5. Attach the brush terminals.

**6.** Retract the brushes until the brush springs ride against the side of the brushes, to retain them in the retracted position.

**7.** Install the armature and front end plate assembly and the brush end plate (aligning the dowel and locating boss and the frame slots).

**8.** Install the through bolts with lockwashers.

**9.** Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush arms on top of the brushes.

### ARMATURE REPLACEMENT

**1.** Remove the two through bolts and the brush end plate, and then slide the armature and front end plate assembly out of the frame. On the Delco Remy generator, remove the through bolts and slide the front end plate and armature out of the frame.

**2.** Clamp the armature in a vise equipped with soft jaws, and remove the retaining nut, lockwasher, pulley, and woodruff key.

**3.** Remove any burrs or scratches from the keyway or shaft, and slide the front end plate off the shaft.

**4.** Install the front end plate on the new armature.

**5.** Install the woodruff key, pulley, lockwasher, and retaining nut.

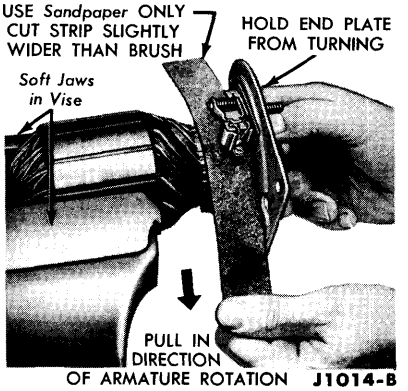



**FIG. 5—Generator Brush Seating**

6. Install new brushes in the brush end plate, retract the brushes, until the brush springs ride against the side of the brushes, to retain them in the retracted position.

7. Slide the armature and front end plate assembly into the frame, aligning the dowel with the frame slot.

8. Install the end plate (aligning the dowel and the frame slot) and install the through bolts with lockwashers and nuts.

9. Use a piece of stiff wire with a hooked end to reach through the ventilating slots, and position the brush springs on top of the brushes.

## ASSEMBLY

1. Install the field coils on the pole shoes, and mount the shoe and coil assemblies in the frame.

2. Tighten the field pole shoe screws (Fig. 3). **As the screws are tightened, strike the frame several sharp blows with a soft faced hammer to seat and align the pole shoes. Stake the screws.**

3. Install the field and ground terminal screws, washers, and nuts in the frame.

4. Install the brush arms and springs. Insert new brushes in the brush holders and seat them (Fig. 5).

5. Move the brushes back in the holders until the brush springs ride against the side of the brushes to retain them in the retracted position.

6. Install the bearing in the front end plate and install the bearing retainer.

7. Slide the plate on the armature shaft (with the retainer toward the armature windings,) and install the woodruff key, pulley, lockwasher, and retaining nut.

8. Install the armature and front end plate assembly in the frame, locating the dowel in the frame groove.

9. Install the brush end plate (aligning the locating boss and frame groove), and install the through bolts with lockwashers and nuts.

10. Use a piece of stiff wire with a hooked end to reach through the ventilating slots, and position the brush springs on top of the brushes.

# PART 13-3 GENERATOR REGULATOR


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| 1 Description and Operation | 13-18 | 3 Removal and Installation | 13-19 |
| 2 In-Car Adjustment and Repair | 13-19 | | |


## 1 DESCRIPTION AND OPERATION

The generator regulator is composed of three control units mounted as an assembly (Fig. 1). Each unit has a set of contact points and an energizing coil for operating the points, and each of the units performs a separate function to maintain control of the generator.

### CUTOUT RELAY

When the engine is not operating, the contact points on the cutout relay (Fig. 1), are held open by spring tension.

At approximately 12 volts, the coil is energized sufficiently to overcome the spring tension and close the cutout points, connecting the generator to the external load.

### VOLTAGE LIMITER RELAY

The voltage limiter holds the generator voltage below a predetermined setting by controlling the amount of voltage applied to the field coils. The voltage limiter thus protects the battery, lights, ignition system etc., from high voltage when the system load demand is low.

### CURRENT LIMITER RELAY

The current limiter relay protects the generator armature windings by limiting the maximum amount of current supplied by the generator. Like the voltage limiter, the current limiter performs its function by controlling the amount of current that is supplied to the generator field coils. The current limiter thus protects the generator when the system load demand is high.

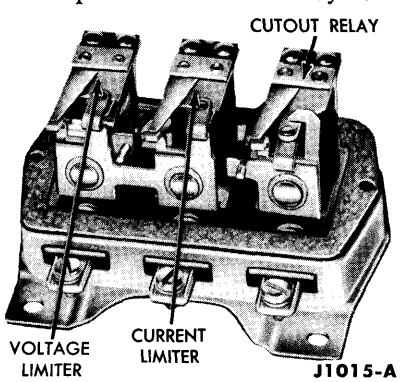



**FIG. 1—Generator Regulator**

### TEMPERATURE COMPENSATION

The generator regulator has been designed to exercise automatic control over the generating system, and also to compensate for seasonal temperature changes. In cold weather a higher voltage output is required to handle the load. In warm weather, the voltage must be reduced to avoid over charging the battery. The temperature compensation is built into the regulator unit by making the armature hinge of bi-metal. The temperature sensitivity of the bi-metal causes the regulator voltage setting to change according to temperature.

Therefore, it is necessary to establish a "normal" or stabilized regulator operating temperature to coincide with the specified voltage setting of 14.6 to 15.4 volts. The standard ambient air temperature established for this setting is 70° to 80° Fahrenheit. The regulator temperature for this or any setting, is defined as the temperature of the regulator after ½ hour of operation in the car or, after the regulator has been heated until it becomes stabilized.

**For correct voltage regulation adjustment, first be sure that the regulator has reached "Normal" operating temperature as defined above; then make the voltage adjustment setting to coincide with the prevailing, ambient air temperature. The specifications section shows the proper voltage limits for various ambient air temperatures.**

### ON THE CAR

On the car, ambient air temperature will be the temperature of the engine compartment air. To measure the air temperature, first clip the voltage regulation setting thermometer onto the regulator cover (Fig. 2).

**When checking or adjusting the heavy-duty regulators, observe the temperature indicated by the thermometer and refer to the Specifications Section for the correct voltage setting.**

Run the engine to stabilize the regulator. The engine fan will cause the air in the engine compartment to circulate past the regulator until the regulator has stabilized at the ambient air temperature. After the regulator and thermometer have stabilized, the thermometer will show the voltage setting at which the regulator should be operating.

### ON THE TEST BENCH

When the regulator is mounted on a regulator test bench, the ambient air temperature will be the room temperature. Clip the voltage regulator setting thermometer onto the regulator cover (Fig. 2). Mount a small fan on the regulator test bench about 12 to 15 inches from the regulator. Operate the fan and regulator to stabilize the regulator. The fan will provide sufficient air flow to ensure stabilization of the regulator at the temperature indicated by the thermometer. After stabilization, the thermometer will show the voltage setting at which the regulator should be operating.

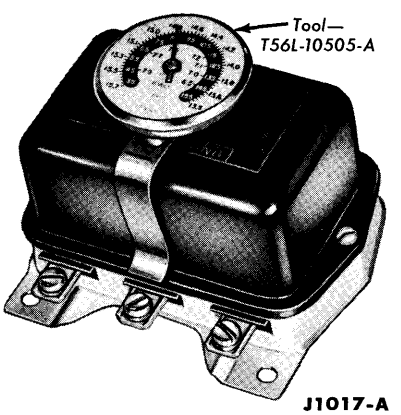



**FIG. 2—Voltage Regulation Setting Thermometer**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### REGULATOR ELECTRICAL ADJUSTMENT

The adjustment of the regulator must be checked with the regulator at normal operating temperature, the battery fully charged, and the engine operating at 1500 rpm.

### ADJUST CUT-IN VOLTAGE

The regulator cut-in voltage is increased by bending the adjusting arm upward, or decreased by bending it downward (Fig. 3).

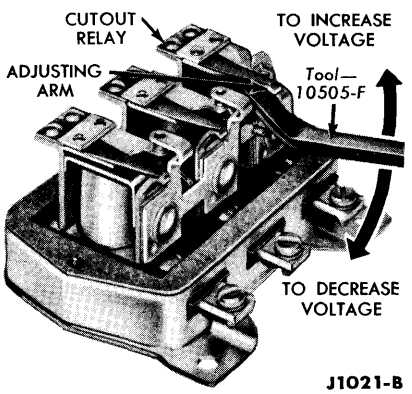



**FIG. 3—Cut-In Voltage Adjustment**

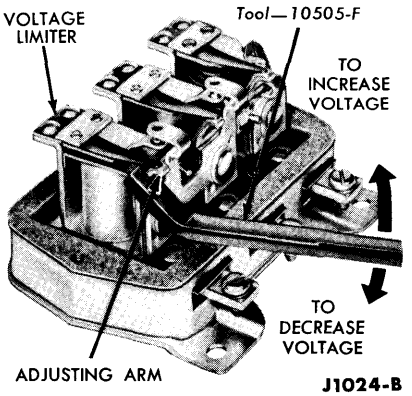



**FIG. 4—Voltage Limiter Adjustment**

### ADJUST VOLTAGE LIMITER

Make a regulator voltage setting test with the cover on. If the regulator voltage is not within the limits as shown in the specifications, for the ambient temperature involved, compute the difference as a positive or negative correction. Remove the regulator cover and make a new regulator voltage limit test. Adjust the new setting either up or down by the amount of the correction just computed.

To increase the voltage setting, increase the spring tension by bending the adjusting arm upward (Fig. 4). To decrease the voltage, bend the adjusting arm downward. Check the voltage setting with the regulator cover replaced.

### ADJUST CURRENT LIMITER

If the current limit is less than that specified, increase the spring tension by bending the current limiter adjusting arm upward (Fig. 5). To decrease the current limit, bend the adjusting arm downward. Install the cover.

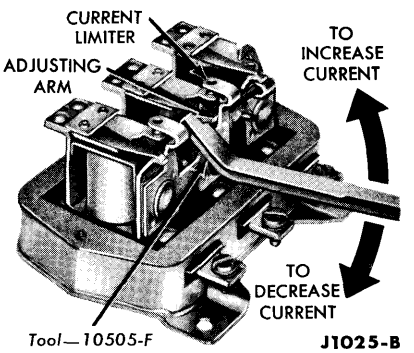



**FIG. 5—Current Limiter Adjustment**

## 3 REMOVAL AND INSTALLATION

### REGULATOR REPLACEMENT

Disconnect the battery ground cable. Disconnect the armature, field and battery leads at the regulator terminals. Remove the mounting screws and the regulator. **Always disconnect a battery cable when working on the regulator to prevent an accidental short circuit of the battery lead to ground.**

To install the regulator, place it in position and install the mounting screws. Mount the ground wire terminal under the mounting screw at the back of the regulator. Connect the aramture, field, battery, and radio supression condenser leads to the regulator terminals. Connect the battery ground cable.

# PART 13-4 40 AND 42-AMPERE FORD ALTERNATOR


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| 2 In-Car Adjustment and Repair | 13-20 | 4 Major Repair Operations | 13-21 |


## 1 DESCRIPTION AND OPERATION

The alternator charging system is a negative (–) ground system, and consists of an alternator, a regulator, a charge indicator, a storage battery and associated wiring.

### ALTERNATOR

An alternator with an integral pulley and cooling fan assembly is belt driven from the engine. The alternator mounting is shown in Fig. 1.

The mechanical construction of the alternator differs from a generator in that the field rotates, and the generating windings are stationary. Energy is supplied from the system to the rotating field through two brushes to two slip rings. The slip rings are mounted on the rotor shaft (Fig. 2).

The alternator produces power in the form of alternating current. The alternating current is rectified to direct current by six diodes (Fig. 2) for use in charging the battery and supplying power to the electrical system.

## 2 IN-CAR ADJUSTMENT AND REPAIR

### BELT ADJUSTMENT

1. Loosen the alternator mounting bolts and the adjusting arm bolts.
2. Apply pressure on the alternator drive end housing only and tighten the adjusting arm to alternator bolt.
3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.
4. Tighten all mounting bolts.

## 3 REMOVAL AND INSTALLATION

### REMOVAL

1. Disconnect the battery ground cable.
2. Loosen the alternator mounting bolts and remove the adjustment arm to alternator bolt (Fig. 1).
3. Disengage the alternator belt. Remove the alternator mounting bolt, disconnect the alternator wiring harness plug, and remove the alternator.

### INSTALLATION

1. Attach the alternator wiring harness plug. Position the alternator to the engine, and install the alternator mounting bolt finger-tight (Fig. 1).
2. Install the adjustment arm to alternator bolt.

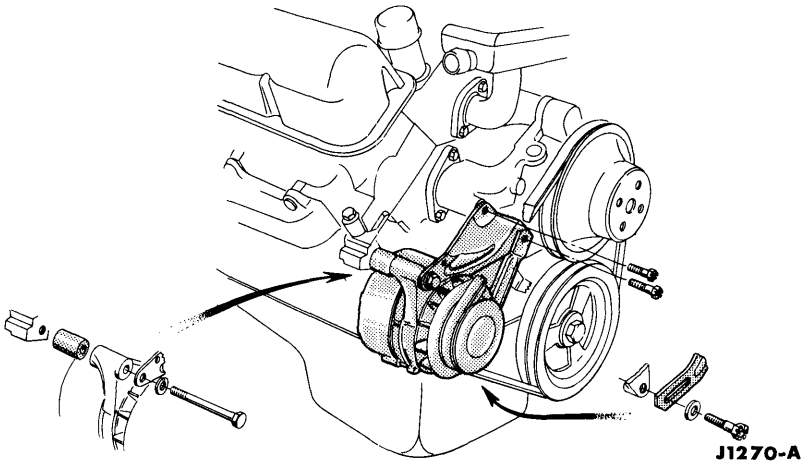



**FIG. 1—Alternator Mounting**

3. Adjust the belt tension using tool T63L-8620-A. Apply pressure on the alternator front housing only. Tighten the adjusting arm bolts and the mounting bolt.
4. Connect the battery ground cable.

## 4 MAJOR REPAIR OPERATIONS

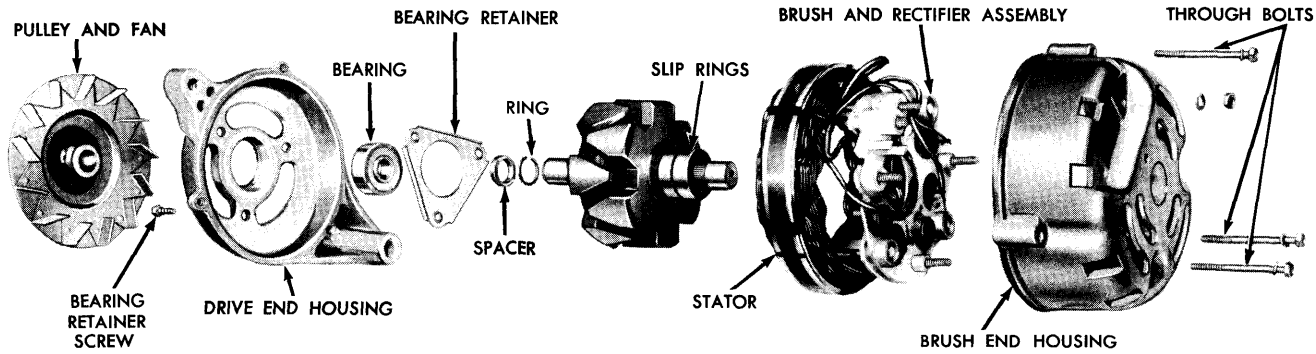



**FIG. 2—Disassembled Alternator**

### DISASSEMBLY

Fig. 2 shows a disassembled view of the Ford alternator.

**1.** Mark both end housings with a scribe mark for assembly. Reach through a ventilation slot, raise both brushes off the slip rings, and install a short length of ⅛-inch rod or stiff wire through the hole in the brush end housing, to hold the brushes off the slip rings (Fig. 3).

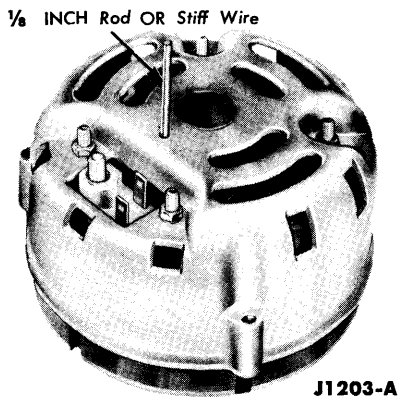



**FIG. 3—Retracting Alternator Brushes**

**2.** Remove the three housing through bolts.

**3.** Separate the drive end housing and rotor from the stator and brush end housing. Make certain that the brushes do not contact the greasy rotor shaft.

**4.** Remove the nuts from the rectifier to brush end housing mounting studs, and remove the brush end housing. Remove the two spacer sleeves from the rectifier plate studs.

**5.** If replacement is necessary, press the bearing from the brush end housing (Fig. 4).

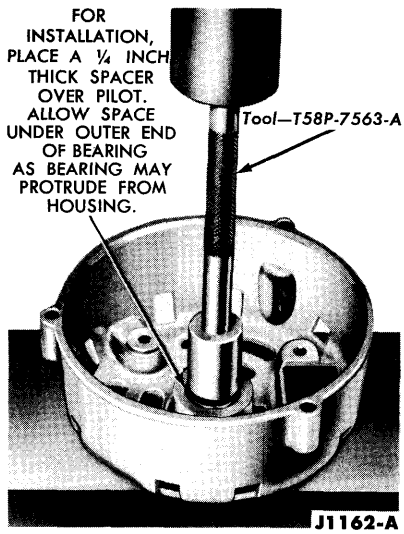



**FIG. 4—Rear Bearing Replacement**

**6.** Remove the terminal spacer from the studs and unsolder the neutral wire from the spacer block neutral terminal.

**7.** If the brushes are being replaced, straighten the field brush terminal blade locking tabs, with a pair of pliers, and remove the terminal blade from the terminal spacer block. Remove the brushes and holders from the assembly.

**8.** If either diode plate is being replaced, carefully unsolder the leads from the diodes (Fig. 5). Use only a 100-watt soldering iron. Leave the soldering iron in contact with the diode terminals only long enough to remove the wires. Both pliers are used as temporary heat sinks in order to protect the diodes. Excess heat can damage a good diode.

**9.** Remove the three insulated diode plate screws and the insulators, and separate the diode plates.

**10.** Remove the drive pulley (Fig. 6).

**11.** Remove the three screws that hold the drive end bearing retainer, and remove the drive end housing.

**12.** If the bearing is being replaced, pull the bearing using a bearing puller (Fig. 7). Remove the bearing retainer and spacer. It will not be necessary to remove the stop-ring, unless it has been damaged.

### PARTS REPAIR OR REPLACEMENT

Nicks and scratches may be removed from the rotor slip rings by turning down the slip rings. Do not go beyond the minimum diameter limit of 1.22 inches. If the slip rings

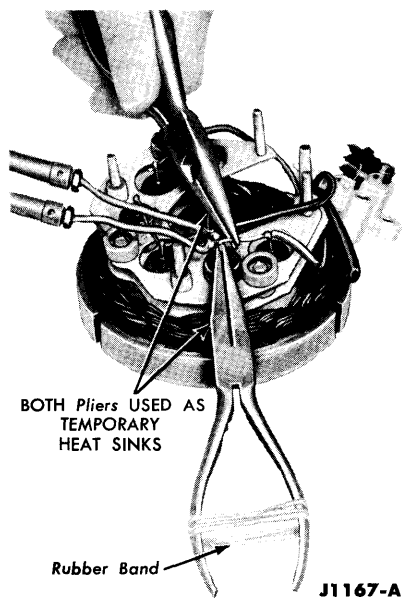



**FIG. 5—Soldering Diode Leads**

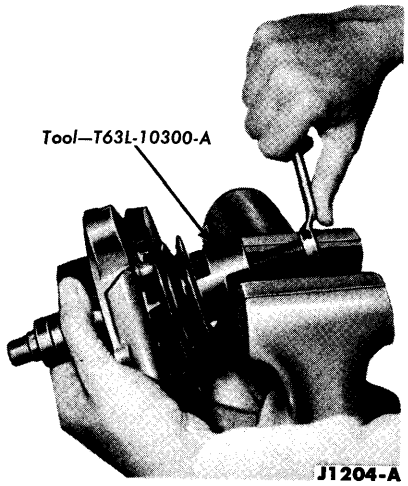



**FIG. 6—Pulley Removal**

are badly damaged, the entire rotor must be replaced as it is serviced as an assembly. All other assemblies are to be replaced rather than repaired.

### ASSEMBLY

1. If the stop-ring on the drive shaft was damaged, install a new stop-ring. Push the new ring on the shaft and into the groove. **Do not open the ring with snap ring pliers.**

2. Position the drive end bearing spacer on the drive shaft against the stop-ring, and position the bearing retainer on the shaft with the flat surface of the retainer outward.

3. Putting pressure on the inner race only, press the new bearing on the shaft until it contacts the spacer.

4. Place the drive end housing over the shaft, with the bearing positioned in the front housing cavity. Install the bearing retainer mounting screws.

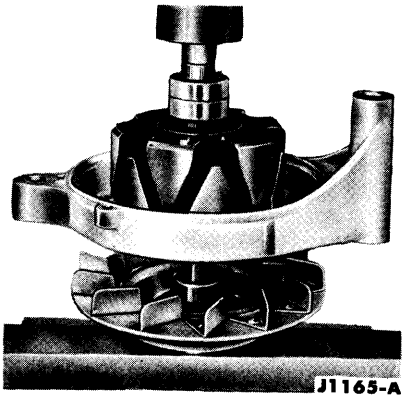



**FIG. 8—Pulley Installation**

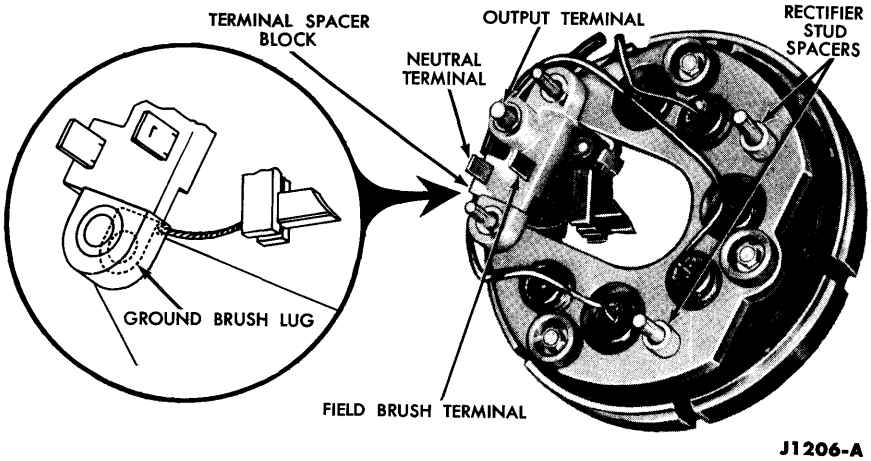



**FIG. 9—Stator, Heat Sink, and Terminal Spacer Block Assembly**

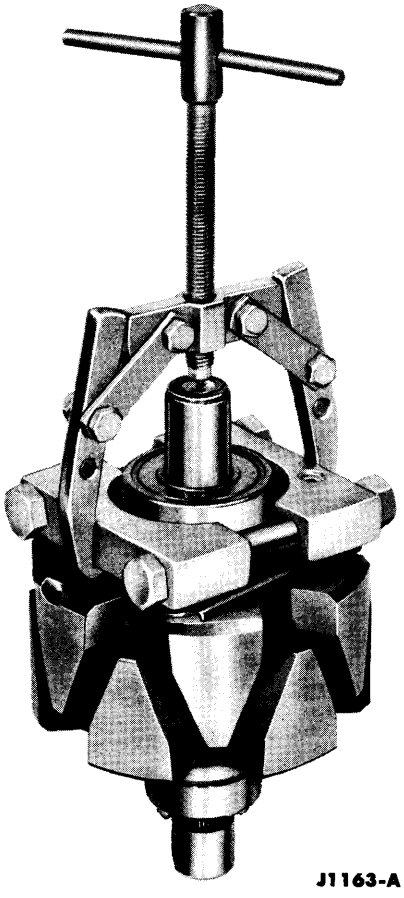



**FIG. 7—Front Bearing Removal**

5. Press the pulley onto the shaft until the hub just touches the inner race of the front bearing (Fig. 8). **A new pulley must be installed if more than ¼ of the shaft length will enter the old pulley bore with light pressure.**

6. If a new diode plate is being installed, mount the two plates together so that they are insulated from each other (insulating spacer between the plates and cupped insulator under the screw head) as shown in Fig. 9. Do not tighten the screws at this time. Place a ¼-inch thick wood spacer between the stator coils and the rectifier plate, to obtain proper lead wire position. Solder the wire leads to the diodes as shown in Fig. 5 in order to avoid excessive heat to the diode. Use only a 100-watt iron.

7. Insert the new field brush terminal blade into the slot in the terminal spacer block, with the brush pigtail extending toward the brush holder pivots (Fig. 9).

8. Install the brush holders and brush spring to the terminal spacer block, then position the brushes in the brush holders (Fig. 9).

9. Solder the neutral wire to the neutral terminal. Position the terminal spacer block assembly on the rectifier plate mounting studs, with the ground brush lug over the mounting stud farthest from the output terminal as shown in Fig. 9. Tighten the diode plate assembly screws.

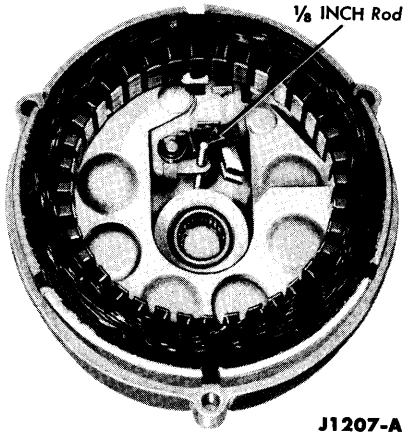



**FIG. 10—Brushes Retracted For Assembly**

**10.** Place the spacers on the rectifier mounting studs farthest from the terminal block (Fig. 9).

**11.** Install the rear bearing so that the open end of the bearing is flush with the inner surface of the housing boss (Fig. 4). Allow space under the outer end of the bearing during installation.

**12.** Place the rectifier plate and stator assembly in the brush end housing and mount the rectifier plates to the housing.

**13.** Retract the brushes and insert a short length of ⅛-inch rod or stiff wire through the hole in the brush end housing to hold the brushes in the retracted position (Fig. 10).

**14.** Wipe clean the brush end bearing surface of the rotor shaft.

**15.** Position the brush end housing and stator assembly over the rotor and align the scribe marks made during disassembly. Seat the machined portion of the stator core into the step in both end housings. Install the housing through bolts. Remove the brush retracting rod.

# PART 13-5 40 AND 42-AMPERE FORD ALTERNATOR REGULATOR


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## 1 DESCRIPTION AND OPERATION

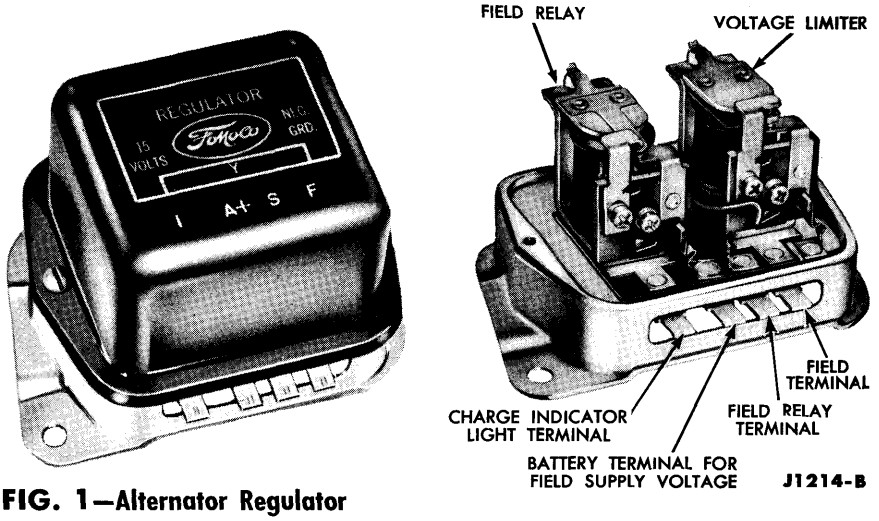



**FIG. 1—Alternator Regulator**

The alternator regulator is composed of two control units, a field relay and a voltage limiter, mounted as an assembly (Fig. 1). Because the reverse current through the rectifier is small, a reverse current cutout relay is not needed. The alternator is self current limiting, thus a current limiter is not needed.

### FIELD RELAY

The field relay serves to connect the battery and alternator output to the field circuit when the engine is running.

### AMMETER CIRCUIT

When the ignition switch is closed, the field relay is energized. Closing of the relay contacts connects the battery and alternator output to the field through the voltage limiter contacts.

### VOLTAGE LIMITER

**Voltage Limiter.** The temperature compensated voltage limiter is a double contact unit. Limiting is accomplished by controlling the amount of current supplied to the rotating field.

When the upper contacts are closed (Fig. 9 or 10, Part 13-1), full system voltage is applied to the field and maximum field current will flow. When the limiter armature floats between the contacts, field current is reduced by flowing through the field resistor. When the limiter lower contacts are closed, zero current flows to the field. At low engine speed and with a load applied, the armature vibrates on the upper contact. At high engine speed and light or no load, the armature vibrates on the lower contact.

A 50-ohm resistor is connected from the field terminal to ground to absorb electrical surges in the alternator circuits as the voltage limiter armature vibrates on the contacts.

### INDICATOR LIGHT CIRCUIT

When the ignition switch is closed, battery current flows through the charge indicator light and 15-ohm parallel resistor, and through the regulator voltage limiter contacts to the field (Fig. 9). This small current is enough to allow the alternator to start generating, and is necessary, as residual magnetism in the alternator is usually too small to start voltage build-up. The charge indicator light is shunted with a 15-ohm resistor to supply adequate starting field current.

When the alternator builds up enough voltage to close the field relay contacts, full voltage is applied to the field, and the charge indicator light goes out.

## 2 IN-CAR ADJUSTMENT AND REPAIR

### REGULATOR ADJUSTMENTS

Erratic operation of the regulator, indicated by erratic movement of the voltmeter during a voltage limiter test, may be caused by dirty or pitted regulator contacts. Use a very fine abrasive paper such as silicon carbide, 400 grade, to clean the field relay and the voltage limiter contacts. Wear off the sharp edges of the abrasive by rubbing it against another piece of abrasive paper. Fold the abrasive paper over and pull the paper through the contacts to clean them. Keep all oil or grease from contacting the points. Do not use compressed air to clean the regu-

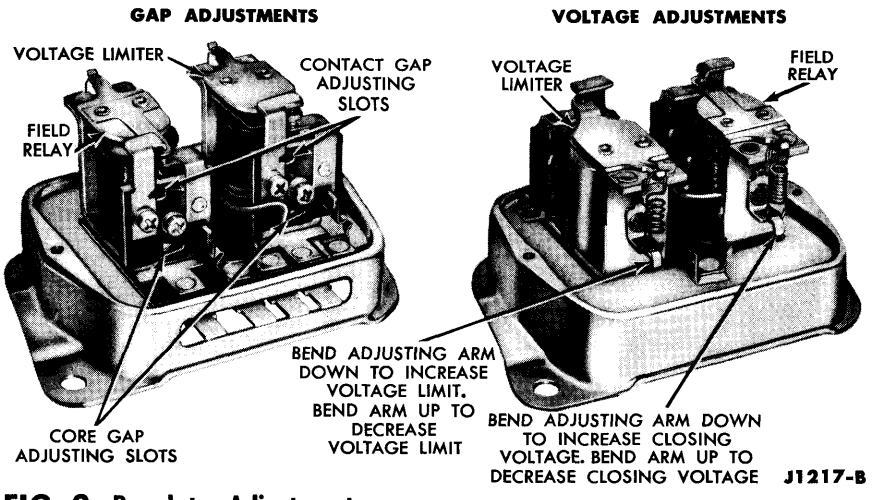



**FIG. 2—Regulator Adjustments**

lator. When adjusting the gap spacing use only hospital clean feeler gauges.

### REGULATOR GAP ADJUSTMENTS

**Voltage Limiter.** The difference between the upper stage and lower stage regulation (0.3 volt), is determined by the voltage limiter point and core gaps. Make the gap adjustments with the regulator removed from the car.

Adjust the point gap first. Loosen the left side lock screw ¼ turn. Use a screw driver blade in the adjustment slot above the lock screw. Adjust the upper contact until there is 0.010 to 0.015-inch gap between the lower contacts. Tighten the lock screw and recheck the contact gap.

Adjust the core gap with the upper contacts closed. Loosen the center lock screw ¼ turn. Use a screwdriver blade in the adjustment slot under the lock screw. Adjust the core gap for 0.045 to 0.052-inch clearance between the armature and the core at the edge of the core closest to the contact points. Tighten the lock screw and recheck the core gap.

**Field Relay.** Adjust the core gap first. Loosen the center lockscrew ¼ turn. Use a screwdriver blade in the adjustment slot below the lock screw, and lower the contact carrier. Place a 0.025 inch feeler gauge on top of the coil core closest to the contact points. Hold the armature down on the gauge. Do not push down on the contact spring arm. Use a screwdriver blade in the adjustment slot below the lock screw, and move the contact carrier up until the bottom contact just touches the armature contact. Tighten the lock screw and recheck the core gap.

Loosen the left side lock screw ¼ turn. Use a screwdriver blade in the adjustment slot above the lock screw and raise or lower the armature stop to obtain a 0.015 to 0.022-inch contact gap. Tighten the lock screw and recheck the contact gap.

### REGULATOR VOLTAGE ADJUSTMENTS

Final adjustment of the regulator must be made with the regulator at normal operating temperature.

The field relay closing voltage is adjusted by bending the spring arm (Fig. 2). To increase the closing voltage, bend the spring arm down. To decrease the closing voltage, bend the spring arm up.

The voltage limit is adjusted by bending the voltage limiter spring arm (Fig. 2). To increase the voltage setting, bend the adjusting arm downward. To decrease the voltage setting, bend the adjusting arm upward.

**Before setting the voltage and before making a final voltage test, the alternator speed must be reduced to zero and the ignition switch opened momentarily, to cycle the regulator.**

## 3 REMOVAL AND INSTALLATION

1. Remove the battery ground cable.
2. Remove the regulator mounting screws.
3. Remove the cable disconnect from the regulator.
4. Attach the cable disconnect to the new regulator.
5. Mount the regulator to the radiator left air deflector. The radio suppression condenser mounts under the upper mounting screw (Fig. 3).
6. Connect the battery ground cable, and test the system for proper voltage regulation.

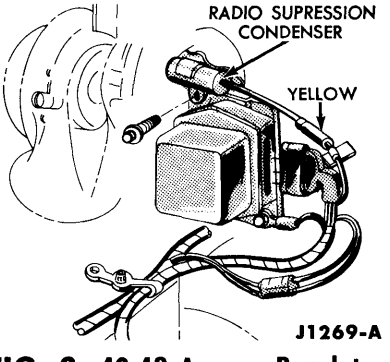



**FIG. 3—40-42 Ampere Regulator Mounting**

# PART 13-6 40-AMPERE LEECE NEVILLE ALTERNATOR


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| 1 Description and Operation | 13-26 | 3 Removal and Installation | 13-26 |
| 2 In-Car Adjustment and Repair | 13-26 | 4 Major Repair Operations | 13-26 |


## 1 DESCRIPTION AND OPERATION

The operation and general mechanical description of the Leece Neville 40-ampere alternator is similar to that for the Ford 40-ampere alternator (Part 13-4). The field brushes are mounted in an insulated brush holder which is mounted in the brush end housing (Fig. 2).

The drive end bearing is a sealed ball bearing. The brush end bearing is a needle type bearing and is not sealed. The alternator mountings are shown in Fig. 1.

## 2 IN-CAR ADJUSTMENT AND REPAIR

### BELT ADJUSTMENT

1. Loosen the alternator mounting bolt and the adjusting arm bolts.
2. Apply pressure on the alternator drive end housing only and tighten the adjusting arm to alternator bolt.
3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.
4. Tighten all mounting bolts.

## 3 REMOVAL AND INSTALLATION

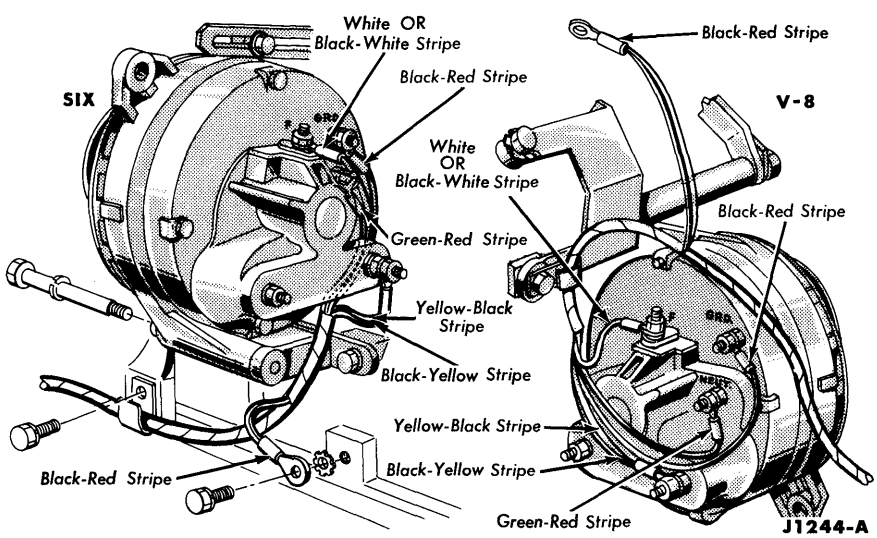



**FIG. 1—Alternator Mounting**

### REMOVAL

1. Disconnect the battery ground cable.
2. Loosen the alternator mounting bolts and remove the adjustment arm to alternator bolt.
3. Disengage the alternator belt. Remove the alternator mounting bolt, disconnect the alternator wiring and remove the alternator.

### INSTALLATION

1. Attach the alternator wiring. Position the alternator to the engine, and install the alternator mounting bolt finger-tight.
2. Install the adjustment arm to alternator bolt.
3. Adjust the belt tension using tool T63L-8620-A. Apply pressure on the alternator drive end housing only. Tighten the adjusting arm bolts and the mounting bolt.
4. Connect the battery ground cable.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

1. Remove the brush holder and the brushes (Fig. 2). Scribe the end housings for reference in assembly.
2. Remove the alternator housing through bolts, and separate the drive end housing and rotor from the stator and brush end housing.
3. Press the rotor shaft out of the drive end housing only if the rotor or bearing are being replaced. Remove the drive shaft spacer.

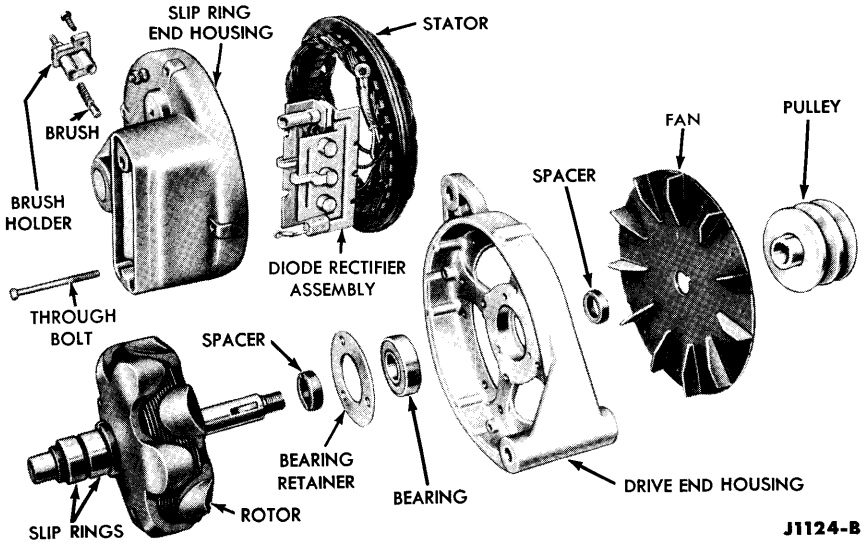



**FIG. 2—Disassembled 40-Ampere Leece Neville Alternator**

4. Remove the bearing retainer, and press the bearing from the drive end housing.

5. Remove the BT, Neut., and ground terminal nuts and washers, and remove the brush end housing from the stator and diode assembly.

6. If the diode plates or stator are being replaced, carefully unsolder the three stator leads from the diode connector eyelets, and separate the leads from each other. Clean the solder from the eyelets.

7. Press the brush end housing bearing from the housing only if it is being replaced.

## PARTS REPAIR OR REPLACEMENT

Nicks and scratches may be removed from the rotor slip rings by turning down the slip rings. Remove only enough to clean up the surface. If the slip rings are badly damaged, they should be replaced. All other assemblies are to be replaced rather than repaired.

## ASSEMBLY

1. If the drive end bearing was removed, press the new bearing into the drive end housing putting pressure on the outer race only. Install the bearing retainer.

2. Place the spacer on the drive end shaft and press the drive end bearing spacer on the shaft tight

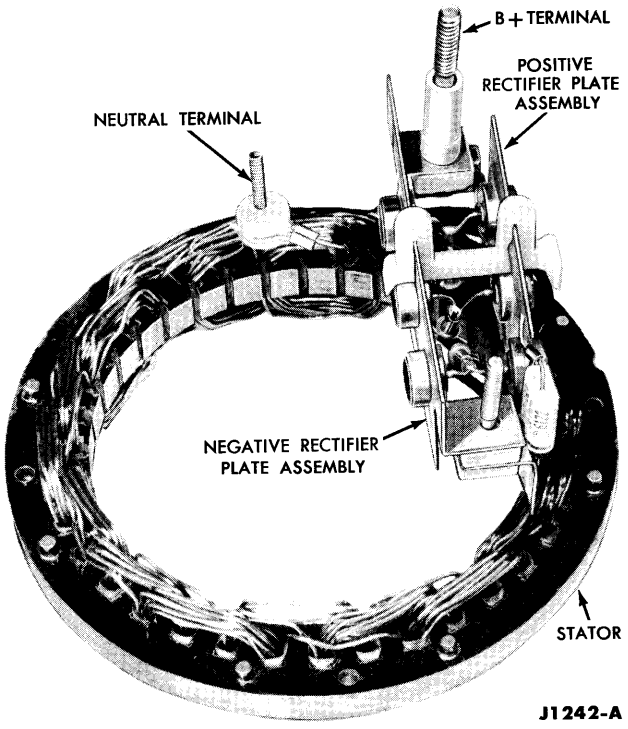



**FIG. 3—Diode Plate and Stator Assembly**

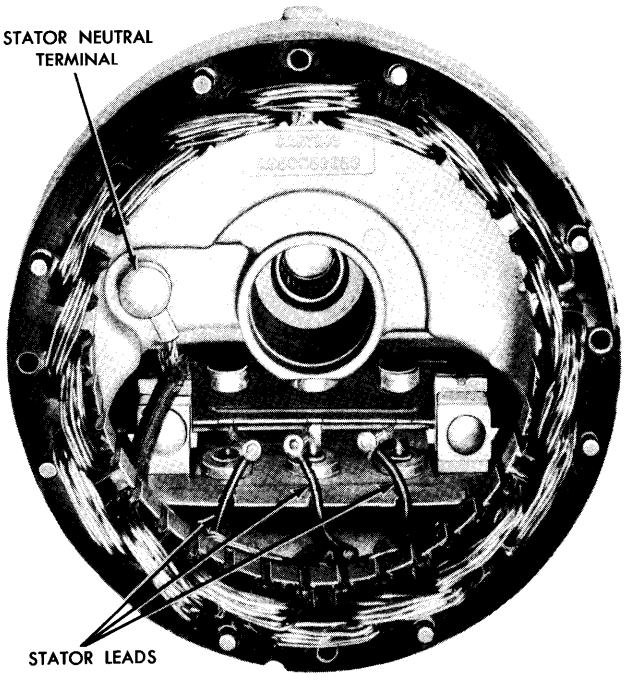



**FIG. 4—Stator Lead Dress**

against the spacer. Put pressure on the inner race only.

**3.** If the brush end housing bearing was removed, press a new bearing into the housing flush with the outer surface of the housing.

**4.** Position the two diode plate assemblies together with the insulators and terminal bolts as shown in Fig. 3. The positive diode plate is positioned closest to the outside.

**5.** Position the eyelets over the diode leads, insert the three stator leads in the eyelets and solder them in position.

**6.** Position the brush end housing over the diode plate assembly and install the insulators, washers and terminal nuts. The condenser ground lug is mounted under the ground terminal nut. Make certain that the stator leads are positioned out of the way of the rotor (Fig. 4).

**7.** Position the rotor and drive end housing and the stator and brush end housing together. Align the housing scribe marks and install the housing through bolts.

**8.** Install the slip ring brushes and brush holder.

# PART 13-7 40-AMPERE LEECE NEVILLE ALTERNATOR REGULATOR


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## 1 DESCRIPTION AND OPERATION

The alternator regulator is composed of two control units mounted as an assembly (Fig. 1). The units are similar in operation to those used on the standard generator regulator. Because the reverse current through the diode rectifiers is small, a reverse current cut out relay is not needed.

### FIELD RELAY

When the ignition switch is closed, battery current flows through the charge indicator light and 25-ohm parallel resistor, and through the regulator voltage limiter contacts to the field (Fig. 26). This small current is enough to allow the alternator to start generating, and is necessary, as residual magnetism in the alternator is usually too small to start voltage build-up. The charge indicator light is shunted with a 25-ohm resistor to supply adequate starting field current.

When the alternator builds up enough voltage to close the field relay contacts, full voltage is applied to the field, and the charge indicator light goes out.

### VOLTAGE LIMITER

The voltage limiter holds the alternator voltage within a predetermined range by controlling the amount of current supplied to the rotating field.

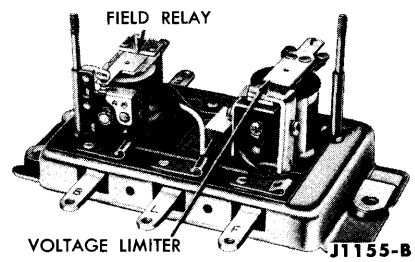



**FIG. 1—40-Ampere Leece Neville Alternator Regulator**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### 40-AMPERE ALTERNATOR REGULATOR ADJUSTMENTS

Final checking of the regulator must be made with the regulator at normal operating temperature and the cover in place. For any of the adjustments given below, remove the cover by removing the two wing nuts.

### ADJUST FIELD RELAY CUT-IN VOLTAGE

The field relay cut-in voltage is increased by bending the adjusting arm downward, or decreased by bending the adjusting arm upward (Fig. 2).

### ADJUST VOLTAGE LIMIT

Make a voltage limit test. Adjust the voltage setting either up or down to bring the voltage limit to within the specified values (14.0 to 14.3 volts). To increase the voltage setting, bend the adjusting arm downward (Fig. 2). To decrease the voltage setting, bend the adjusting arm upward (Fig. 2). **Before setting the voltage, and before making a final voltage test, the alternator speed must be reduced to zero and the ignition switch opened momentarily. This procedure must be repeated each time an adjustment is made.**

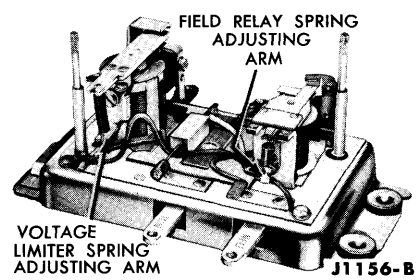



**FIG. 2—Alternator Regulator Adjustment**

## 3 REMOVAL AND INSTALLATION

1. Disconnect the battery ground cable.

2. Remove the wires from the regulator.

3. Remove the regulator mounting screws and the regulator.

4. Position the regulator and install the mounting screws. Mount the black-red stripe ground wire lug under the single mounting screw (Fig. 3).

5. Connect the remaining regulator wires (Fig. 3).

6. Connect the battery ground cable and check the regulator operation.

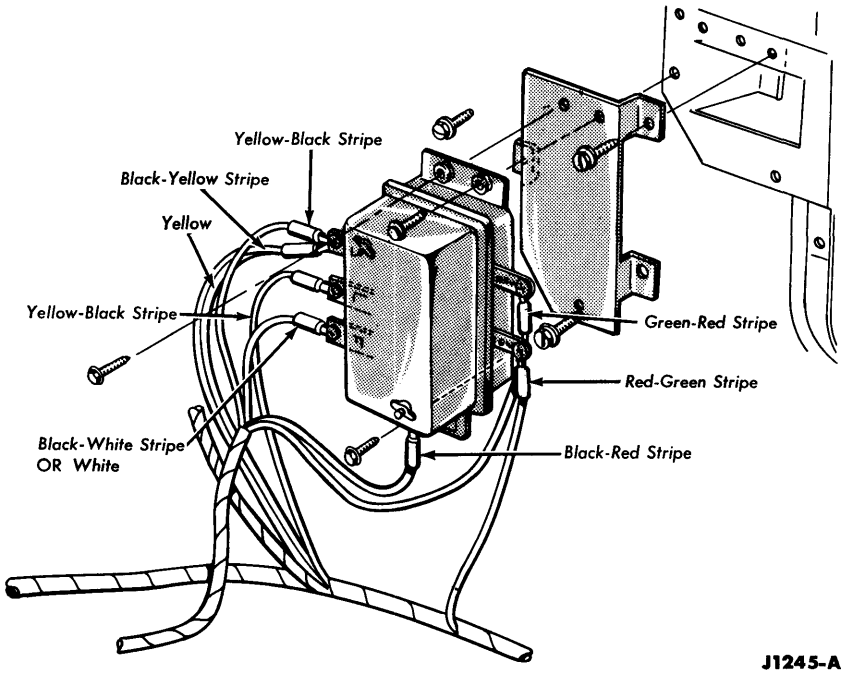



**FIG. 3—Alternator Regulator Mounting**

# PART 13-8 60-AMPERE ALTERNATOR


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 13-31 | 3 Removal and Installation | 13-31 |
| 2 In-Car Adjustment and Repair | 13-31 | 4 Major Repair Operations | 13-31 |


## 1 DESCRIPTION AND OPERATION

The operation and general mechanical description of the 60-ampere alternator is the same as that for the 42-ampere alternator (Part 13-4).

The field brushes of the 60-ampere alternator are mounted in a sealed brush holder on the brush end housing (Fig. 2).

Two completely sealed bearings support the rotor in the end housings.

## 2 IN-CAR ADJUSTMENT AND REPAIR

### BELT ADJUSTMENT

1. Loosen the alternator-to-mounting bracket bolts and the adjusting arm bolts.
2. Apply pressure between the alternator drive end housing and the engine block, and tighten the adjusting arm bolt.
3. Check the belt tension using tool T63L-8620-A. Adjust the belt for specified tension.
4. Tighten all mounting bolts.

## 3 REMOVAL AND INSTALLATION

1. Disconnect the battery ground cable.
2. Loosen the mounting bolts and the adjusting arm to alternator bolt, and remove the drive belt.
3. Remove the mounting bolts and the adjusting arm bolt, disconnect the alternator wires and remove the alternator.
4. Connect the alternator wires (Fig. 1), position the alternator in the mounting bracket and install the mounting bolts and adjusting bracket bolt finger-tight.
5. Adjust the belt tension (page 13-31) and check the operation of the alternator.

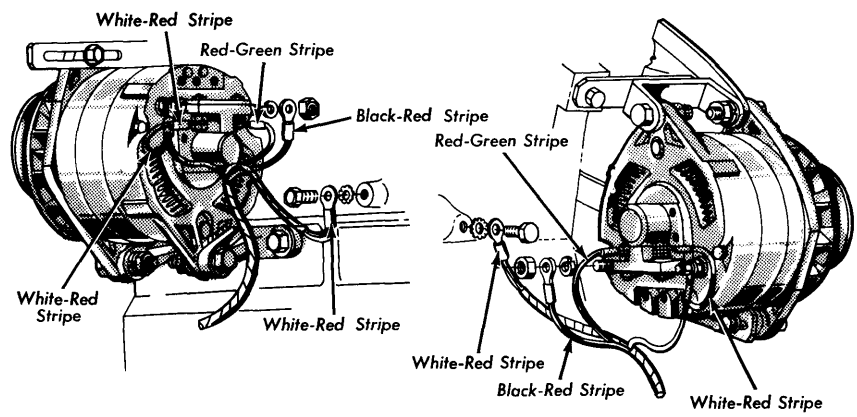



**FIG. 1—Alternator Mounting**

## 4 MAJOR REPAIR OPERATIONS

A disassembled view of the alternator is shown in Fig. 2.

### DISASSEMBLY

1. Remove the pulley nut and washer, remove the pulley with a gear puller, and remove the shaft key and spacer.
2. Remove the brush holder assembly from the brush end housing, and remove the brushes.
3. Separate the brush end housing and stator assembly from the alternator.
4. Remove the nuts from the three AC terminals. Remove the stator from the end housing.
5. Remove the three end-housing screws. Remove the terminal cover.
6. Remove the rotor from the drive-end housing using a gear puller or an arbor press. Remove the slip rings and the bearing from the slip ring end of the rotor shaft, only if the bearing is loose or has lost its

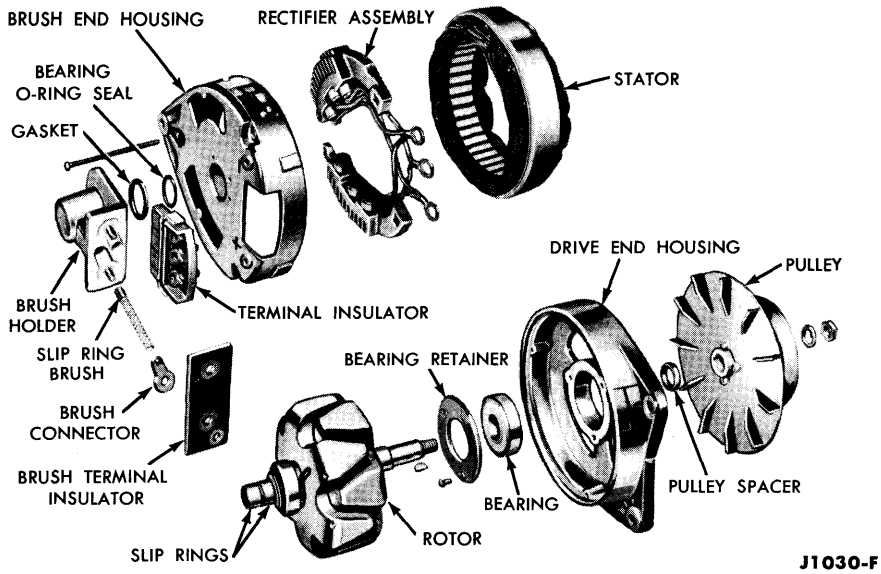



**FIG. 2—Disassembled 60-Ampere Leece Neville Alternator**

lubricant. Use a gear puller. **Use care in removing the slip rings, so as not to damage them. If they are cracked or broken during disassembly, they must be replaced.**

**7.** Remove the bearing retainer from the drive-end housing and press out the old bearing from the housing, only if the bearing is loose or has lost its lubricant.

**8.** Remove the rectifier assembly mounting bolts, terminals, and insulators and remove the rectifier assemblies. Remove the stator terminal insulator.

## PARTS REPAIR OR REPLACEMENT

Nicks and scratches may be removed from the rotor slip rings by turning down the slip rings. Remove only enough to clean up the surface. If the slip rings are badly damaged, they should be replaced. All other assemblies are to be replaced rather than repaired.

## ASSEMBLY

**1.** Press the new bearing onto the slip-ring end of the rotor shaft. **Put pressure on the inner race only.** Heat the slip rings so that the insulation will not split, carefully press the slip rings on the shaft, and solder the field wires to the rings.

**2.** Press the new bearing into the drive end housing, and install the bearing retainer. **Put pressure on the outer race only.**

**3.** Place the slip-ring end of the shaft firmly on a flat plate in an arbor press, and assemble the drive end housing and bearing on to the drive end of the shaft. **Use a tube or pipe so as to put pressure on the bearing inner race only.**

**4.** Install the stator insulator. Put the rectifier insulators in position. Place the rectifier asemblies in the housing and install the mounting screws and terminals (Fig. 3). Make certain that the rectifier assemblies are insulated from the end frame.

**5.** Place the stator in position (Fig. 1), and line up the end-housing screw holes to match those in the stator. Position the three stator terminals over the three rectifier terminals, and install the AC terminal nuts.

**6.** Place the brush end housing and stator assembly into position over the rotor. Use the end housing screws to line up the two housings and the stator. Apply pressure to the center of the brush end housing in an arbor press. Tighten the end housing screws.

**7.** Install the brush holder with the "O"-ring between the holder and the frame (Fig. 2). Place the brushes and springs in the holder with the extruded portion of the brush connectors against the terminal screw shoulders. Hold the brush connectors in position with a "U" shaped spring clip until the terminal insulator is installed. Install the brush terminal insulator.

**8.** Use a spacer that will provide 1/16 inch clearance between the fan fins and the drive end housing. Install the pulley spacer, shaft key, pulley, and lock washer and nut. Tighten the mounting nut to 40 ft-lbs. torque.

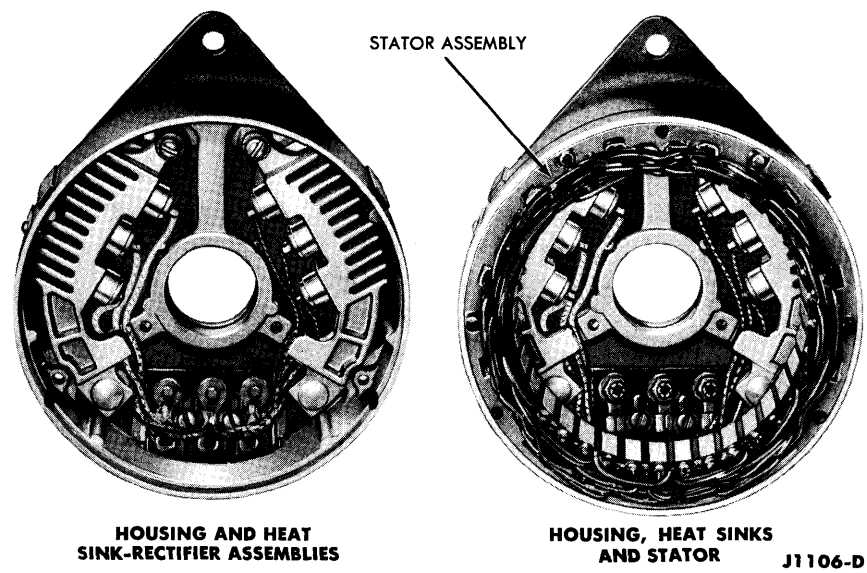



**FIG. 3—Slip-Ring End Housing, Rectifier, and Stator Assembly**

# PART 13-9 60-AMPERE ALTERNATOR REGULATOR


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 13-33 | 3 Removal and Installation | 13-33 |
| 2 In-Car Adjustment and Repair | 13-33 | | |


## 1 DESCRIPTION AND OPERATION

The alternator regulator is composed of two control units mounted as an assembly (Fig. 1). The units are similar in operation to those used on the standard generator regulator. Because the reverse current through the diode rectifiers is small, a reverse current cut out relay is not needed.

### FIELD RELAY

A field relay (Fig. 1), controlled by the ignition switch, connects the battery to the alternator field through the voltage limiter contacts.

### VOLTAGE LIMITER

The voltage limiter holds the alternator voltage within a predetermined range by controlling the amount of current supplied to the rotating field.

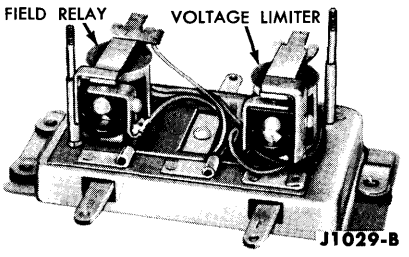



**FIG. 1—60-Ampere Leece Neville Alternator Regulator**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### 60-AMPERE ALTERNATOR REGULATOR ADJUSTMENTS

Final checking of the regulator must be made with the regulator at normal operating temperature and the cover in place. For any of the adjustments given below, remove the cover by removing the two wing nuts.

### ADJUST FIELD RELAY CUT-IN VOLTAGE

The field relay cut-in voltage is increased by bending the adjusting arm downward, or decreased by bending the adjusting arm upward (Fig. 2).

### ADJUST VOLTAGE LIMIT

Make a voltage limit test. Adjust the voltage setting either up or down to bring the voltage limit to within the specified values (14.0 to 14.3 volts). To increase the voltage setting, bend the adjusting arm downward (Fig. 2). To decrease the voltage setting, bend the adjusting arm upward (Fig. 2). **Before setting the voltage, and before making a final voltage test, the alternator speed must be reduced to zero and the ignition switch opened momentarily.**

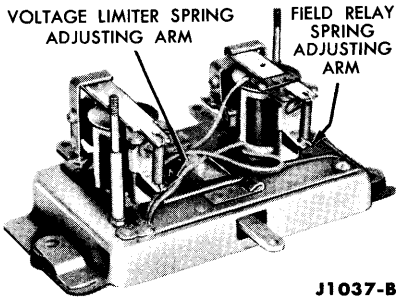



**FIG. 2—Alternator Regulator Adjustments**

**This procedure must be repeated each time an adjustment is made.**

## 3 REMOVAL AND INSTALLATION

**1.** Disconnect the battery ground cable.

**2.** Remove the wires from the regulator.

**3.** Remove the regulator mounting screws and the regulator.

**4.** Position the regulator and install the mounting screws. Mount the black ground wire lug under the single mounting screw (Fig. 3).

**5.** Connect the remaining regulator wires (Fig. 3).

**6.** Connect the battery ground cable and check the regulator operation.

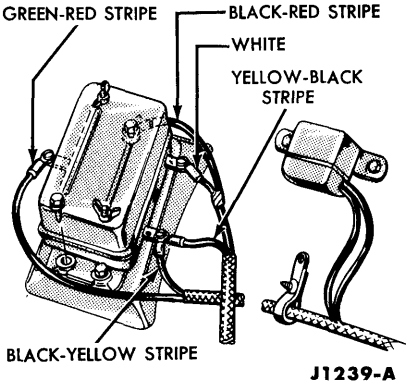



**FIG. 3—Alternator Regulator Mounting**

# PART 13-10 SPECIFICATIONS

## ALTERNATOR AND GENERATOR

| Vendor | Amperes (@ 15V.) | Watts (@ 15V.) | Field Current (Amps. @ 12V. 75°F.) | Cut-In-Speed (Alternator rpm)* | Rated Output Speed (Alternator rpm)* | Belt Width (Inches) | Belt Tension (Pounds)† | BRUSHES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Number Used | Original Length (Inches) | Wear Limit (Inches) | Spring Tension (Ounces) |
| Ford Generator | 30 | 450 | 1.0-1.5 | 950 | 3400 Cold 6500 Hot | 3/8 | 80-110 | 2 | 7/8 | 3/8 | 20-26 |
| Ford‡ Alternator | 40 | 600 | 2.4-2.6 | 950 | 6500 Hot 3700 Cold | 3/8 | 80-110 | 2 | 5/8 | 3/8 | 7-12 |
| Ford‡ Alternator | 42 | 630 | 2.4-2.6 | 850 | 6500 Hot 3500 Cold | 3/8 | 80-110 | 2 | 5/8 | 3/8 | 7-12 |
| Leece-Neville Alternator | 40 | 560 | 2.5 | 950 | 5030 Hot 4080 Cold | 3/8 | 80-110 | 2 | 5/16 | 5/32 | 8-10 |
| Leece-Neville Alternator | 60 | 840 | 2.0-2.5 | 760 | 3300 Cold 4100 Hot | 3/8 | 80-110 | 2 | 1/2 | 9/32 | 8-10 |

*To find the equivalent engine rpm, divide the alternator pulley diameter by the crankshaft pulley diameter and then multiply by the alternator rpm.
†Used Belt on all engines except 6-cyl. which is 60-90 lbs. New Belt Tension is 110-140 lbs. on all engines except 6-cyl. which is 90-120 lbs.
A used belt is one that has been in operation for more than 10 minutes.
‡Minimum Slip-Ring Turn-Down Diameter 1.22 inches.

## REGULATOR

| Vendor | Current Rating | Voltage Regulation | CURRENT LIMITER | | | VOLTAGE LIMITER | | FIELD RELAY | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Amperes | Contact Gap (Inches) | Air Gap (Inches) | Contact Gap (Inches) | Air Gap (Inches) | Contact Gap (Inches) | Air Gap (Inches) | Closing Volts |
| Ford | Used with 30 Amp. Ford Generator | 14.6-15.4 | 28-32 | — | 0.033-0.036 | — | 0.033-0.036 | 0.017-0.022 (Cut-out) | 0.008-0.012 (Cut-out) | 12.2-13.2 (Cut-out) |
| Ford | Used with 30, 40, 42, & 52 Amp. Ford Alternator | Within 0.3 Volt (Higher or Lower) of 14.1-14.9 Volts at 75°F. | — | — | — | 0.010-0.015 | 0.045-0.052 | 0.015-0.022 | 0.015-0.025 | 3-4 |
| Leece-Neville | Used with 40 Amp. Leece-Neville Alternator | 14.0-14.3 | — | — | — | 0.018-0.020 | 0.038-0.043 | 0.018-0.020 | 0.009-0.011 | 1.9-2.3 |
| Leece-Neville | Used with 40 & 60 Amp. Leece-Neville Alternator | 13.7-13.9 | — | — | — | 0.018-0.020 | 0.035-0.043 | 0.018-0.020 | 0.018-0.020 | 5.8-6.2 |

## BATTERY FREEZING TEMPERATURES

| Specific Gravity | Freezing Temp. |
|---|---|
| 1.280 | −90°F. |
| 1.250 | −62°F. |
| 1.200 | −16°F. |
| 1.150 | + 5°F. |
| 1.100 | +19°F. |

## VOLTAGE REGULATION SETTING

| Ambient Temperature °F. | Standard Ford Generator Regulator | Ambient Temperature °F. | Standard Ford Alternator Regulator |
|---|---|---|---|
| 25 | 15.1-15.9 | 25 | 14.4-15.0 |
| 35 | 15.0-15.8 | 50 | 14.3-14.9 |
| 45 | 14.9-15.7 | 75 | 14.1-14.7 |
| 55 | 14.8-15.6 | 100 | 13.9-14.5 |
| 65 | 14.7-15.5 | 125 | 13.8-14.4 |
| 75 | 14.6-15.4 | 150 | 13.6-14.2 |
| 85 | 14.5-15.3 | 175 | 13.5-14.1 |

## VOLTAGE REGULATION SETTING (Cont'd)

| Ambient Temperature °F. | Standard Ford Generator Regulator | Ambient Temperature °F. | Standard Ford Alternator Regulator |
|---|---|---|---|
| 95 | 14.3-15.1 | | |
| 105 | 14.2-15.0 | | |
| 115 | 14.1-14.9 | | |
| 125 | 13.9-14.7 | | |
| 135 | 13.8-14.6 | | |
| 145 | 13.6-14.4 | | |

## BATTERY

| Filler Cap Color | Number of Plates | Amp. Hours |
|---|---|---|
| Red | 54 | 55 |
| Red | 66 | 55 |
| Gray | 66 | 65 |
| Gray | 78 | 65 |
| Yellow | 66 | 70 |

# STARTING SYSTEM — GROUP 14


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**PART 14-2**
FORD INERTIA STARTER ..... 14- 8
**PART 14-3** PAGE
FORD POSITIVE ENGAGEMENT STARTER ..... 14-10
**PART 14-4**
SPECIFICATIONS ..... 14-12


# PART 14-1 GENERAL STARTING SYSTEM SERVICE


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| 2 Common Adjustments and Repairs | 14- 5 |
| 3 Cleaning and Inspection | 14- 7 |


## 1 DIAGNOSIS AND TESTING

If the engine cranks but will not start, the trouble is in the engine (fuel, or ignition system) and not in the starting system. If the engine will not crank even with a booster battery connected, engine parts may be seized or the starter may be faulty. **Do not push or tow a car equipped with an automatic transmission for more than 12 miles, without raising the rear wheels off the ground, or disconnecting the driveshaft.**

**STARTER TROUBLE DIAGNOSIS GUIDE**

| | |
|---|---|
| **ENGINE WILL NOT CRANK AND STARTER DOES NOT CLICK** | **1.** The battery may be discharged.<br>**2.** The ignition switch, starter neutral switch or starter relay may be inoperative.<br>**3.** The circuit may be open or contain high resistance.<br>**CHECK BATTERY**<br>Perform a Battery Capacity Test. If the battery does not test as having good capacity, make a Battery Test Charge. Replace the battery if the test indicates that it is worn out or under capacity.<br>**CHECK STARTER RELAY**<br>**1.** Disconnect and ground the high tension lead from the spark coil so that the engine cannot start. On cars with a transistor ignition, also disconnect the brown wire from the starter relay I terminal. Place the transmission lever in the N or P position.<br>**2.** With a fully charged battery, operate the starter switch to crank the engine. If the engine will not crank and the relay does not click, connect a jumper lead from the battery terminal of the relay to the starter switch terminal of the relay (Fig. 1, connection ①). If the engine does not crank, the starter relay is probably defective.<br>**3.** If the engine cranks in Step 2, remove the quick disconnect from the starter neutral switch. Connect a jumper wire between the quick disconnect terminals that are connected to the two red-blue stripe wires. Operate the starter switch to crank the engine.<br>**4.** If the engine cranks in Step 3, the starter neutral switch is defective or out of adjustment.<br>**5.** If the engine does not crank in Step 3, there are three possible defects:<br>The wire from the battery terminal of the ignition switch to the battery terminal of the starter relay is loose or broken.<br>The ignition switch starter terminal is defective.<br>The wire from the starter switch to the automatic transmission neutral switch or from the neutral switch to the starter relay is loose or broken. |

CONTINUED ON NEXT PAGE

**STARTER TROUBLE DIAGNOSIS GUIDE (Continued)**

| | | |
|---|---|---|
| **ENGINE WILL NOT CRANK BUT STARTER RELAY CLICKS** | If the relay clicks when the ignition switch is operated, connect a heavy jumper from the relay battery terminal to the relay starter motor terminal (Fig. 1, connection ②). If the engine cranks, replace the relay. If the engine does not crank, observe the spark when connecting and disconnecting the jumper. If there is a heavy spark, see "Check Engine and Starter Drive" below. If the spark is weak or if there is no spark at all, proceed as follows:<br>**CHECK CABLES AND CONNECTIONS**<br>If the spark at the relay is weak when the jumper is connected, inspect the battery starter cables for corrosion and broken conductors. Check the ground cable to see if it is broken or badly corroded. Inspect all cable connections. Clean and tighten them if necessary. Replace any broken or frayed cables. If the engine still will not crank, the trouble is in the starter, and it must be repaired or replaced.<br>**CHECK ENGINE AND STARTER DRIVE**<br>If a heavy spark is obtained when the jumper wire is connected, loosen the starter mounting bolts to free the starter pinion.<br>If the starter drive is locked, remove the starter from the engine, and examine the starter drive pinion for burred or worn teeth. Examine the teeth on the flywheel ring gear for burrs and | wear. Replace the pinion or the flywheel ring gear if they are worn or damaged.<br>If the starter drive is not locked, remove the starter from the engine, and perform the no-load current test. The starter should run freely.<br>If the current reading at no-load speed is below specifications, the starter has high resistance and should be repaired.<br>If the current reading is above normal, and the starter is running slower than it should at no-load, it is probably due to tight or defective bearings, a bent shaft, or the armature rubbing the field poles. A shorted coil in the starter also causes the current reading to be high. Disassemble the starter and determine the cause. Repair it if possible, or replace the starter.<br>If the no-load current reading of the starter is normal, install the starter and remove all the spark plugs, and attempt to crank the engine with the starter.<br>If the engine cranks with the spark plugs removed, water has probably leaked into the cylinders causing a hydrostatic lock. The cylinder heads must be removed, and the cause of internal coolant leakage eliminated.<br>If the engine will still not crank, the engine is seized and cannot be turned by the starter. Disassemble the engine and repair or replace the defective parts. |
| **STARTER SPINS BUT DOES NOT CRANK THE ENGINE** | If the starter spins but will not crank the engine, the starter drive is worn or dirty and is sticking on the | starter shaft, or is broken.<br>Clean or repair the starter drive as required. |
| **ENGINE CRANKS SLOWLY** | Several causes may result in this symptom:<br>**1.** The battery may be low in charge.<br>**2.** There may be excessive resistance in the starter circuit.<br>**3.** The starter may be faulty.<br>**4.** The engine may have excessive friction.<br>**CHECK BATTERY**<br>Test the state of charge of the battery. If the battery is discharged, recharge the battery, and check the starter relay for possible internal shorts to ground that may have caused the battery to discharge. Perform a Battery Capacity Test (Group 13, Page 13-6). If the battery does not test as having good capacity, make a Battery Test Charge (Group 13, Page 13-6). | Replace the battery if the test indicates it to be worn out or under capacity.<br>**CHECK EXTERNAL CIRCUIT VOLTAGE DROP**<br>If the battery was fully charged in the previous test, test the starter cranking circuit voltage drop. The voltage drop will be either excessive or normal.<br>**VOLTAGE DROP (RESISTANCE) EXCESSIVE**<br>Locate the exact part of the circuit with the excessive resistance.<br>To correct excessive resistance in the battery to starter relay cable, starter relay to starter cable or battery to ground cable, clean and tighten the |

CONTINUED ON NEXT PAGE

**STARTER TROUBLE DIAGNOSIS GUIDE (Continued)**

| | | |
|---|---|---|
| **ENGINE CRANKS SLOWLY (Continued)** | cable connections. Recheck the voltage drop. If it is still excessive, replace the cables.<br>To correct excessive resistance of the starter relay contacts, replace the starter relay.<br>**VOLTAGE DROP (RESISTANCE) NORMAL**<br>If the voltage drop (resistance) is normal, make a starter load test. If the starter current is below specifications, proceed as follows: | **Cranking Current Low.** Remove the starter from the engine, and repair or replace it.<br>**Cranking Current Normal or High.** Test the starter current draw at no-load. If the no-load current draw is above or below specifications, repair or replace the starter.<br>If the current draw at no-load is normal, the starter is not at fault. The engine has excessive friction, and the cause must be determined. Repair or replace faulty parts. |

### STARTER LOAD TEST

Connect the test equipment as shown in Figs. 2 or 3. Be sure that no current is flowing through the ammeter and heavy-duty carbon-pile rheostat portion of the circuit (rheostat at maximum resistance).

Crank the engine with the ignition OFF, and determine the exact reading on the voltmeter. This test is accomplished by disconnecting and grounding the high tension lead from the spark coil, and by connecting a jumper from the battery terminal of the starter relay to the ignition switch terminal of the relay.

Stop cranking the engine, and reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load.

### NO-LOAD TEST

The starter no-load test will uncover such faults as open or shorted windings, rubbing armature, and bent armature shaft.

The starters can be tested, at no-load, either on the engine or test bench, except the Ford positive engagement starter, which must be tested on the test bench only.

#### ON ENGINE

To test the inertia starter on the engine, the engine must be running at idle speed to prevent the starter drive from engaging the flywheel.

Connect the test equipment as shown in Figs. 2 or 3. Be sure that no current is flowing through the ammeter and heavy-duty carbon-pile rheostat portion of the circuit (Battery Load Control at maximum counterclockwise position).

Crank the engine until it starts, but do not release the ignition switch from the start position once the engine has started. The starter will then run at no-load. Determine the exact reading on the voltmeter. Do not keep the ignition switch in the start position longer than is necessary to take the voltmeter reading.

Stop the engine, and reduce the resistance of the carbon pile (rotate the control clockwise), until the voltmeter indicates the same reading as that obtained while the starter was running. The ammeter will indicate the starter current draw under no-load.

#### ON TEST BENCH

Connect the starter to a battery with an ammeter in the circuit as shown in Figs. 4 or 5. The starter will run at no-load, and the current draw indicated on the ammeter should be 110 amperes maximum at 12 volts.

### ARMATURE AND FIELD OPEN CIRCUIT TEST—ON TEST BENCH

An open circuit armature may sometimes be detected by examining the commutator for evidence of burning. The spot burned on the commutator is caused by an arc formed every time the commutator segment connected to the open-circuit winding passes under a brush.

An open circuit test of the field can be made on the test bench by connecting a voltmeter and battery as shown in Fig. 6. Since the starter has three field windings, it will be necessary to check each of the windings separately. If no voltmeter reading is obtained, the coil is open.

### ARMATURE AND FIELD GROUNDED CIRCUIT TEST—ON TEST BENCH

This test will determine if the winding insulation has failed, permitting a conductor to touch the frame or armature core.

To determine if the armature windings are grounded, make the connections as shown in Figs. 7 or 8. If the voltmeter indicates any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections as shown in Figs. 9 or 10. If the voltmeter indicates any voltage, the field windings are grounded.

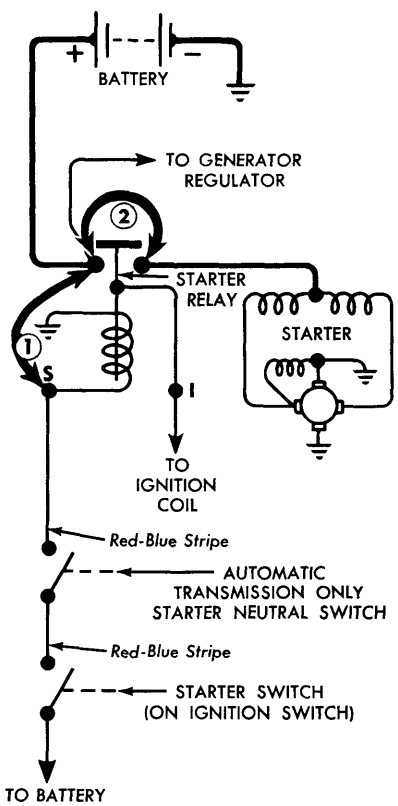



**FIG. 1—Typical Starting Control Circuit Test**

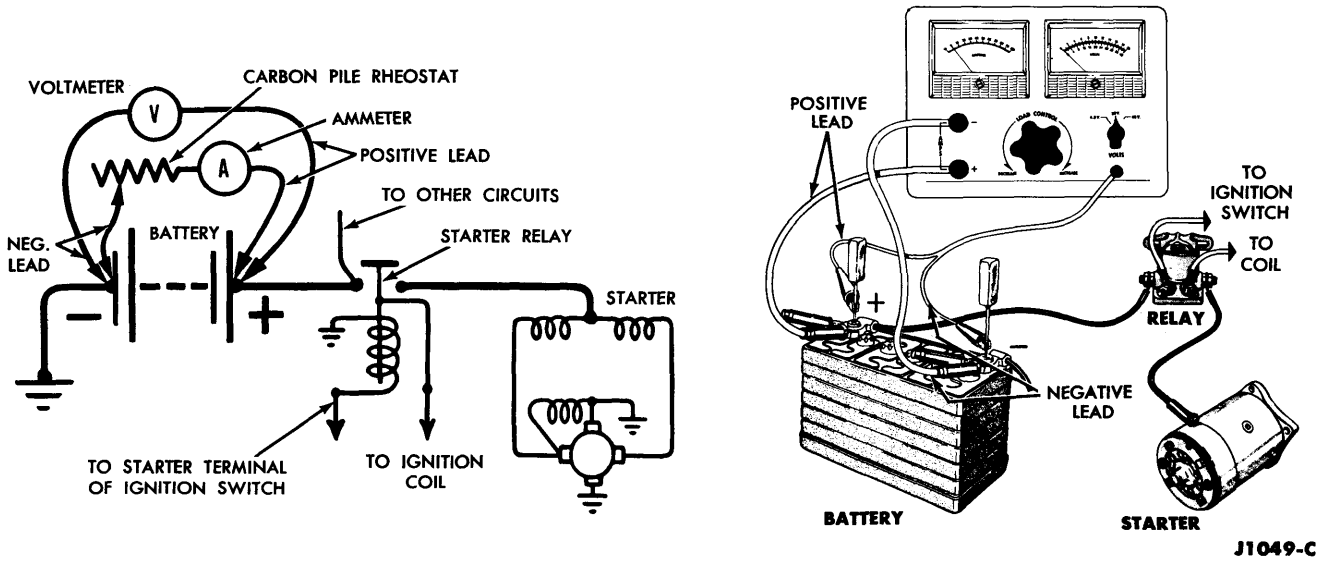



**FIG. 2—Inertia and Positive Engagement Starter Load Test, and Inertia Starter No-Load Test—Typical Ford**

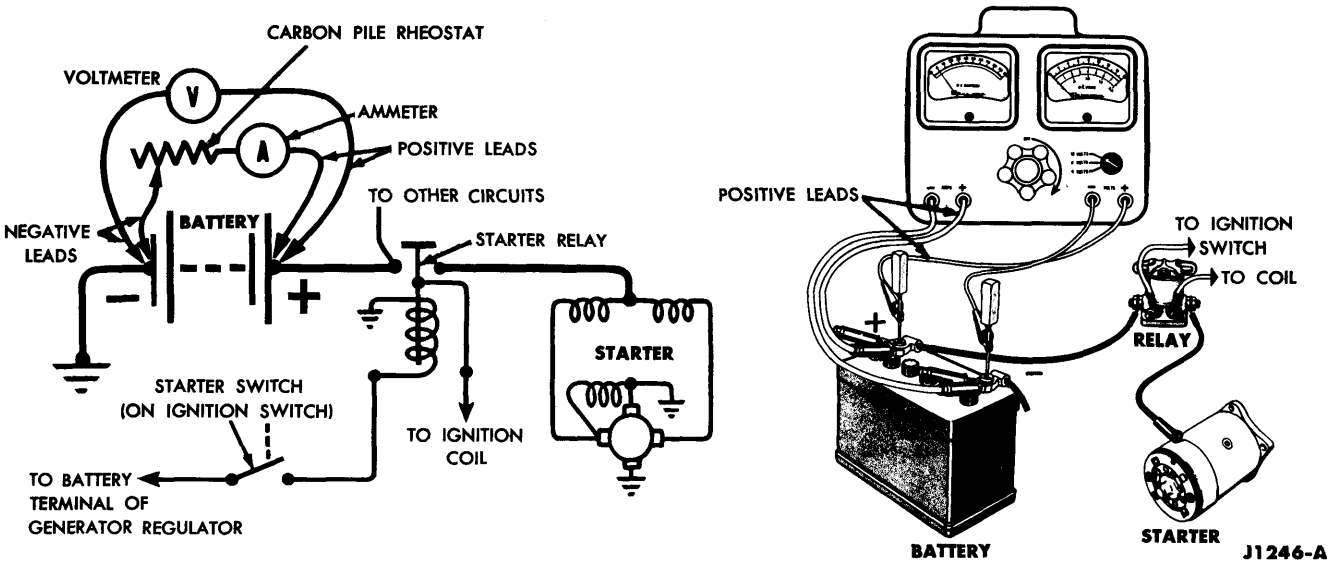



**FIG. 3—Inertia and Positive Engagement Starter Load Test, and Inertia Starter No-Load Test—Typical Mercury**

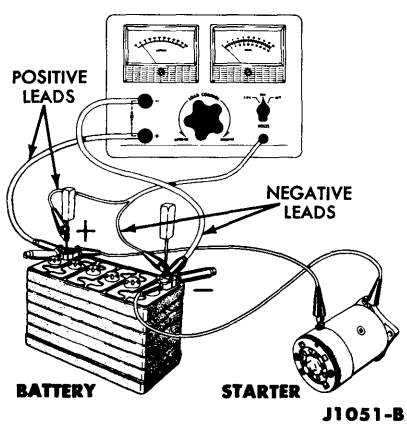



**FIG. 4—Starter No-Load Test on Test Bench—Typical Ford**

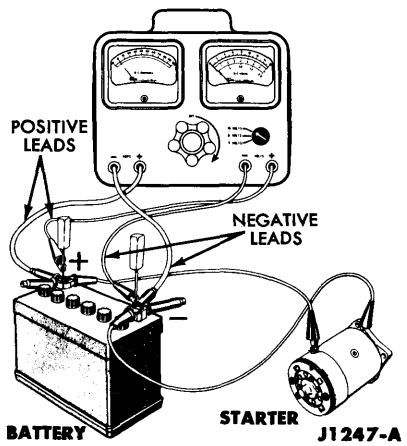



**FIG. 5—Starter No-Load Test on Test Bench—Typical Mercury**

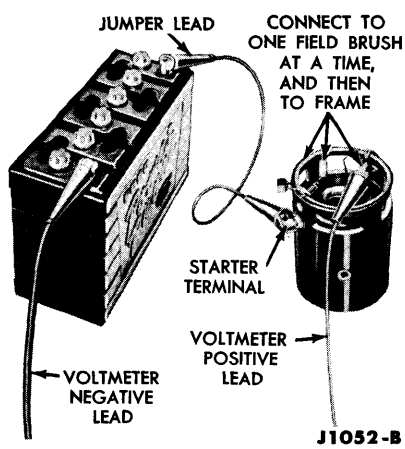



**FIG. 6—Field Open Circuit Test—Ford Inertia**

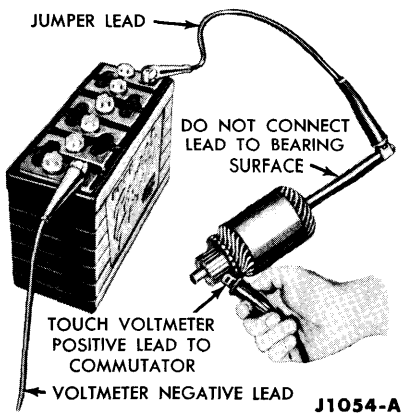



**FIG. 7—Armature Grounded Circuit Test—Ford Inertia**

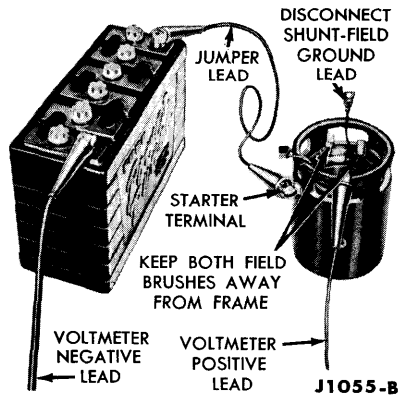



**FIG. 9—Field Grounded Circuit Test—Ford Inertia**

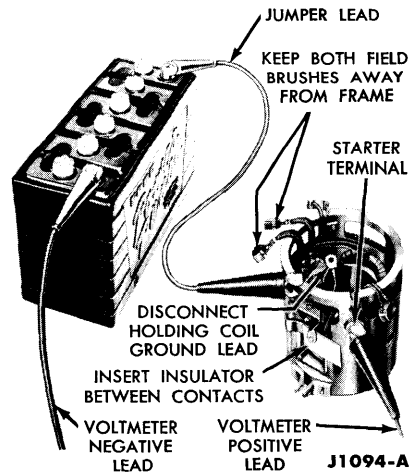



**FIG. 10—Field Grounded Circuit Test—Ford Positive Engagement**

### STARTER CRANKING CIRCUIT TEST

Excessive resistance in the starter circuit can be determined from the results of this test. Make the test connections as shown in Fig. 11. Crank the engine with the ignition OFF. This is accomplished by disconnecting and grounding the high tension lead from the spark coil and by connecting a jumper from the battery terminal of the starter relay to the ignition switch terminal of the relay.

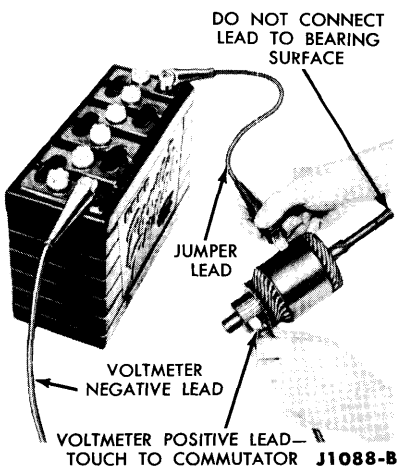



**FIG. 8—Armature Grounded Circuit Test—Ford Positive Engagement**

The voltage drop in the circuit will be indicated by the voltmeter (0 to 1 volt range). Maximum allowable voltage drop should be:

1. With the voltmeter negative lead connected to the starter terminal and the positive lead connected to the battery positive terminal (Fig. 11, connection ①) .....0.5 volt.
2. With the voltmeter negative lead connected to the battery terminal of the starter relay and the positive lead connected to the positive terminal of the battery (Fig. 11, connection ②) .....0.1 volt.
3. With the voltmeter negative lead connected to the starter terminal of the starter relay and the positive lead connected to the positive terminal of the battery (Fig. 11, connection ③) .....0.3 volt.
4. With the voltmeter negative lead connected to the negative terminal of the battery and the positive lead connected to the engine ground (Fig. 11, connection ④)....0.1 volt.

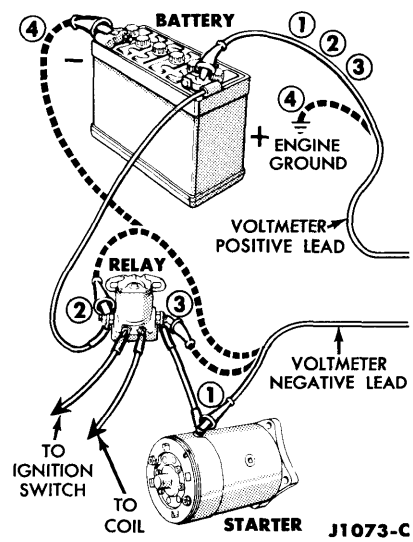



**FIG. 11—Starter Cranking Circuit Test—Typical**

## 2 COMMON ADJUSTMENTS AND REPAIRS

### STARTER DRIVE REPLACEMENT

#### FORD INERTIA STARTER

To remove the "Folo-Thru" drive, place the end of the drive in a vise, with the shoulder of the drive tight against the end of the vise jaws (Fig. 12). Press down on the end of the starter to compress the rubber cushion. This exposes the lower end of the drive pin, which may be driven out from above (Fig. 12).

To install the drive assembly, place the end of the drive in a vise, with the shoulder of the drive tight against the end of the vise jaws (Fig. 13). Position the starter shaft in the drive so that the drive pin holes are aligned. Lift up on the outer end of the starter to compress the rubber cushion and expose the drive pin hole. Install the drive pin.

#### FORD POSITIVE ENGAGEMENT STARTER

1. Loosen and remove the brush cover band and the starter drive actuating lever cover.
2. Loosen the through bolts enough to allow removal of the drive

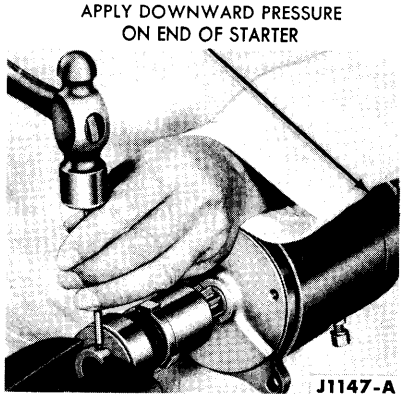



**FIG. 12—Starter Drive Removal —Ford Inertia**

gear housing and the starter drive actuating lever return spring.

3. Remove the pivot pin retaining the starter drive actuating lever and remove the lever.

4. Remove the drive gear stop ring retainer and stop ring from the end of the armature shaft and remove the drive gear assembly.

5. Apply a thin coating of Lubriplate 777 on the armature shaft splines. Install the drive gear assembly on the armature shaft and install a new stop ring.

6. Position the starter gear actuating lever on the starter frame and install the retaining pivot pin. **Be sure that the actuating lever properly engages the starter drive assembly.**

7. Install a new retaining clip retainer. Position the starter drive actuating return spring and drive gear housing to the starter frame, and then tighten the through bolts to specification.

8. Position the starter drive actuating lever cover and brush cover band, with gasket, on the starter. Tighten the brush cover band retaining screw.

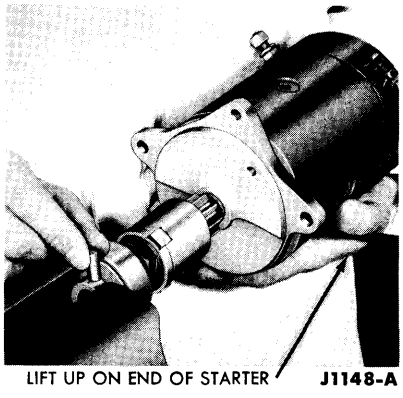



**FIG. 13—Starter Drive Installation—Ford Inertia**

## BRUSH REPLACEMENT

### FORD INERTIA STARTER

Replace the starter brushes when they are worn to 5/16 inch in length. Always install a complete set of new brushes.

1. Loosen and remove the cover band.

2. Remove the two through bolts from the starter frame.

3. Remove the brushes from their holders.

4. Remove the brush end plate and the armature rear end plate assembly.

5. Unsolder the brush leads from the field coils.

6. Unscrew the ground brush terminal screws, and remove the ground brushes.

7. Clean the carbon and dirt from the brush end plate. Replace the brush end plate if the insulation between the field brush holder and the end plate is cracked or broken.

8. Make sure that the new brushes slide freely in the holders, then seat the new brushes by sanding (Fig. 14).

9. Solder the new field brushes to the field coils.

10. Position the shunt coil ground lug under the ground brush terminal farthest from the starter terminal. Connect the new ground brushes to the starter frame with the mounting screws.

11. Install the brush end plate.

12. Slide the armature rear end plate assembly in place. **Make sure that the locating boss in the brush end plate and the dowel in the rear end plate are located in the slots in the starter frame.**

13. Replace the two through bolts in the starter end plates.

14. Place the brushes in their holders. Be sure to center the brush springs on the brushes.

15. Install the cover band and tighten the clamp screw.

### FORD POSITIVE ENGAGEMENT STARTER

Replace the starter brushes when they are worn to half size. Always install a complete set of new brushes.

1. Loosen and remove the brush cover band and starter drive actuating lever cover. Remove the brushes from their holders.

2. Remove the two through bolts from the starter frame.

3. Remove the drive gear housing, and the actuating lever return spring.

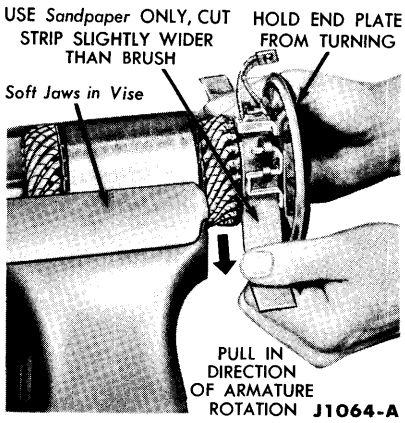



**FIG. 14—Starter Brush Seating—Typical**

4. Remove the starter drive actuating lever pivot retaining pin and lever, and remove the armature.

5. Remove the brush end plate.

6. Remove the ground brush retaining screws from the frame and remove the brushes (cut the ground brush nearest the starter terminal) from the brush terminal block, as close to the brush lead terminal as possible.

7. Unsolder (or cut) the insulated brush leads from the field coils, as close to the field connection point as possible.

8. Clean and inspect the starter motor.

9. Replace the brush end plate if the insulator between the field holder brush and the end plate is cracked or broken.

10. Solder the new field brushes to the field coils using rosin core solder (Fig. 6). Use a 300-watt iron.

11. Install the ground brush leads to the frame with the retaining screws.

12. Clean the commutator with #00 or #000 sandpaper.

13. Position the brush end plate to the starter frame, with the end plate boss in the frame slot.

14. Position the fiber washer on the commutator end of the armature shaft and install the armature in the starter frame.

15. Install the starter drive gear actuating lever to the frame and starter drive assembly, and install the pivot pin.

16. Position the return spring on the actuating lever and the drive-gear housing to the starter frame. Install the through bolts and tighten to specified torque. Be sure that the

snap-ring retainer is seated properly in the drive-gear housing.

**17.** Install the commutator brushes in the brush holders. Center the brush springs on the brushes.

**18.** Position the actuating lever cover and the brush cover band with gasket on the starter. Tighten the band retaining screw.

**19.** Check the starter no-load current draw.

### ARMATURE REPLACEMENT

#### FORD INERTIA STARTER

**1.** Remove the starter drive.

**2.** Remove all burrs from the shaft to prevent scoring the rear end plate bushing.

**3.** Remove the through bolts, rear end plate, and cover band and remove the brushes from their holders. Remove the armature.

**4.** Pull the brushes from their holders. Slide in the new armature, and install the rear end plate and through bolts. Be sure that the end plate dowel is aligned with the slot in the starter frame.

**5.** Place the brushes in their holders. Center the brush springs on the brushes, and install the cover band.

**6.** Install the starter drive.

**7.** Check the starter no-load current draw.

#### FORD POSITIVE ENGAGEMENT STARTER

**1.** Loosen the brush cover band retaining screw and remove the brush cover band and the starter drive actuating lever cover. Remove the brushes from their holders.

**2.** Remove the through bolts, starter drive gear housing, and the starter drive actuating lever return spring.

**3.** Remove the pivot pin retaining the starter gear actuating lever and remove the lever.

**4.** Remove the armature. If the starter drive gear assembly is being reused, remove the stop ring retainer and stop ring from the end of the armature shaft and remove the assembly.

**5.** Place the starter drive gear assembly on the new armature with a new stop ring.

**6.** Install the fiber thrust washer on the commutator end of the armature shaft and install the armature.

**7.** Position the starter gear actuating lever on the frame and drive gear assembly and install the retaining pivot pin.

**8.** Position the starter drive actuating lever return spring, starter drive gear housing, and brush plate to the starter frame, and then install and tighten the through bolts to specification. Be sure that the stop ring retainer is seated properly in the drive gear housing.

**9.** Place the brushes in their holders, and center the brush springs on the brushes.

**10.** Position the actuating lever cover and brush cover band, with gasket, and then tighten the retaining screw.

## 3 CLEANING AND INSPECTION

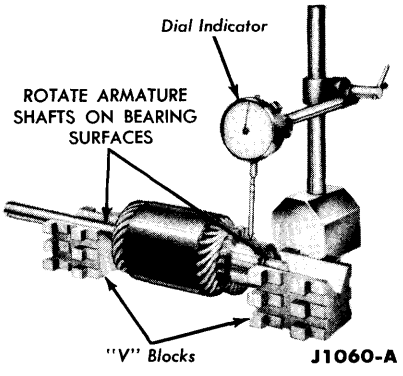



**FIG. 15—Commutator Runout Check—Typical**

**1.** Use a brush or air to clean the field coils, armature, commutator, and armature shaft. Wash all other parts in solvent and dry the parts.

**2.** Inspect the armature windings for broken or burned insulation and unsoldered connections.

**3.** Check the armature for open circuits and grounds.

**4.** Check the commutator for runout (Fig. 15), and inspect the armature shaft and the two bearings for scoring and excessive wear. If the commutator is rough, or more than 0.005 inch out-of-round, turn it down.

**5.** Check the brush holders for broken springs and the insulated brush holders for shorts to ground. Tighten any rivets that may be loose. Replace the brushes if worn to 5/16 inch in length.

**6.** Check the brush spring tension. Replace the springs if the tension is not within specified limits.

**7.** Inspect the field coils for burned or broken insulation and continuity. Check the field brush solder connections and lead insulation.

A sticking starter drive can be cleaned in kerosene. Use a brush or air to remove grease and dirt from the worm threads, until all grit is removed. **Do not oil the starter drive. It should work freely after cleaning in kerosene and wiped dry.**

**The "Folo-Thru" drive has a lock pin which holds the pinion from rotating when it is in the extended position. Once the pin has dropped into place, it will not disengage unless the starter is mounted on the car and the engine speed reaches 310-390 rpm. It cannot be forced out of position by hand.**

Inspect the pinion for burrs and broken or badly worn teeth. Check the action of the pinion on the worm threads. It should slide freely on the threads. If any of the pinion teeth are badly worn, burred or broken, it will be necessary to replace the drive.

# PART 14-2 FORD INERTIA STARTER


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| 2 Removal and Installation | 14- 8 |
| 3 Major Repair Operations | 14- 9 |


## 1 DESCRIPTION AND OPERATION

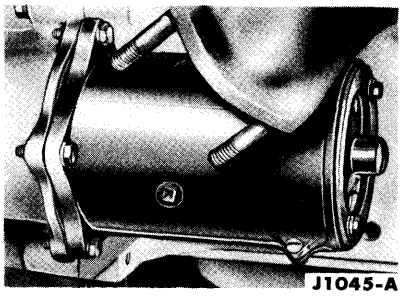



**FIG. 1—Typical 8-Cylinder Engine Starter Mounting**

Heavy cables, connectors, and switches are used in the starting system because of the high current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. Loose connections, corroded relay contacts, and partially broken or undersized cables will result in slower than normal cranking speed, and may even prevent the starter from cranking the engine fast enough to start.

The starter is a four-brush, series-parallel wound unit. The circuit to the starter is completed by means of a relay, controlled by a switch which is part of the ignition switch.

Figure 1 shows the starter mounted on a V-8 engine. Figure 2 shows the starter mounted on a 6-cylinder engine. Figure 3 shows the starting circuit schematic.

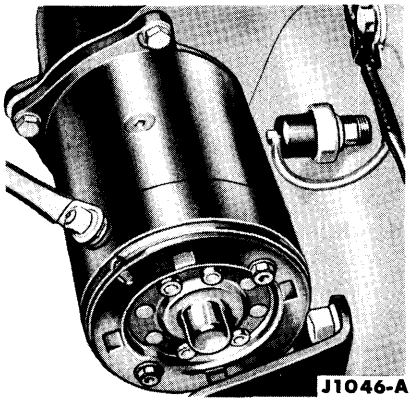



**FIG. 2—6-Cylinder Engine Starter Mounting**

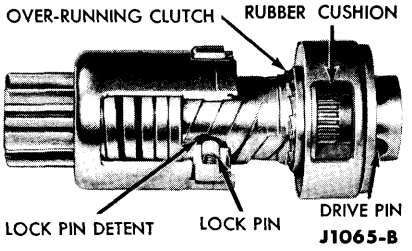



**FIG. 4—Folo-Thru Starter Drive**

The starter drive is the "Folo-Thru" type shown in Fig. 4. The "Folo-Thru" drive is serviced only as a complete unit, because of the calibration requirements on the lock pin and anti-drift pin springs.

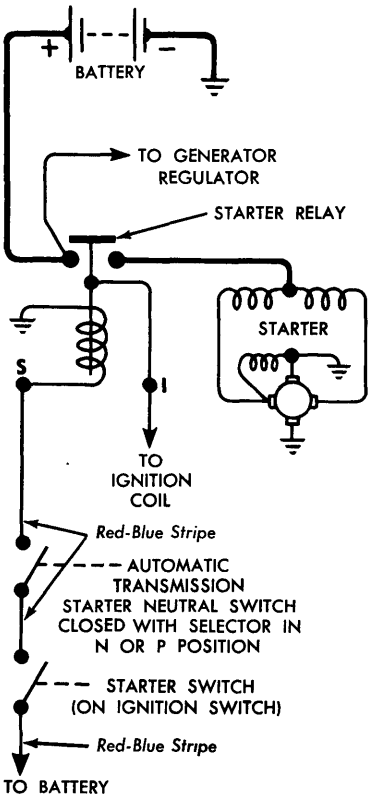



**FIG. 3—Starting Circuit Schematic**

## 2 REMOVAL AND INSTALLATION

**1.** Disconnect the starter cable at the starter terminal.

**2.** Remove the starter mounting bolts, then remove the starter assembly. **It may be necessary to tilt the starter slightly to clear the starter drive around the flywheel.** On the high performance engine remove the right hand exhaust manifold first.

**3.** Transfer or replace the starter drive.

**4.** Position the starter assembly to the flywheel housing, and start the mounting bolts. On a car with the high performance engine and with an automatic transmission, the transmission dipstick tube bracket is mounted under the starter side mounting bolt.

**5.** Snug all bolts and then torque them to 15 to 20 foot-pounds, tightening the middle bolt first.

**6.** Connect the starter cable.

## 3 MAJOR REPAIR OPERATIONS

Use the following procedure when it becomes necessary to completely overhaul the starter. Figure 5 illustrates the starter completely disassembled.

### DISASSEMBLY

**1.** Remove the starter drive (Fig. 12, Part 14-1) and the cover band, and remove the brushes from their holders.

**2.** Remove the through bolts and the brush end plate.

**3.** Remove the armature and rear end plate; remove any burrs from the shaft to prevent scoring the rear end plate, and remove the end plate from the shaft.

**4.** Unscrew the ground brush screws, and remove the ground brushes.

**5.** Unscrew the three field pole shoe screws as shown in Fig. 6. The arbor press prevents the wrench from slipping out of the screw.

**6.** Unsolder the field coil leads from the terminal screw, and remove the pole shoes and field coils from the frame.

**7.** Remove the nut and washers from the terminal and remove the terminal. Remove any excess solder from the terminal slot. Use a 300-watt soldering iron for soldering operations on the starter terminal.

### PARTS REPAIR OR REPLACEMENT

Nicks and scratches may be removed from the commutator by turning it down. All other assemblies are to be replaced rather than repaired.

### ASSEMBLY

**1.** Install the terminal screw with insulator washers and terminal nut. Be sure to position the slot in the screw parallel to the frame end surface.

**2.** Position the series field coils with the leads in the terminal screw slot and the shunt coil, as shown in Fig. 7.

**3.** Install the field pole shoes and screws. As the pole shoe screws

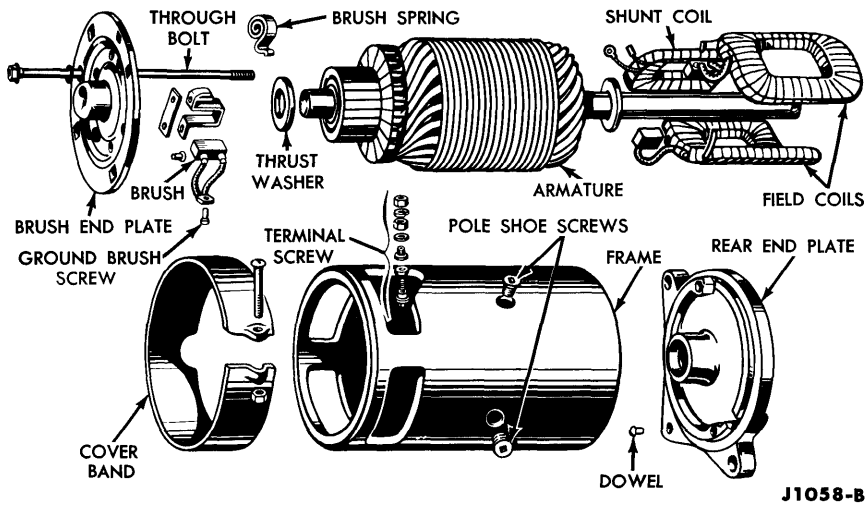



**FIG. 5—Disassembled Starter Motor**

are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes, then stake the screws.

**4.** Solder all leads using rosin core solder. Use a 300-watt iron.

**5.** Position the shunt coil ground lead under the ground brush terminal farthest from the starter terminal (Fig. 7). The other shunt coil lead is soldered to the series field coil lead farthest from the starter terminal.

**6.** Install the screws that connect the ground brushes to the starter frame.

**7.** Install the brush end plate making sure that the brush-plate boss is located in the slot in the starter frame.

**Do not pinch the brush leads between the end plate and the frame.**

**8.** Place a thrust washer on each end of the shaft, slide the armature in place, and install the rear end plate with the end plate dowel located in the starter frame slot.

**9.** Install the through bolts.

**10.** Install the brushes in their holders, being sure to center the brush springs on the brushes.

**11.** Place the cover band on the starter, and tighten the clamp screw.

**12.** Install the starter drive.

**13.** Check the starter operation and no-load current draw.

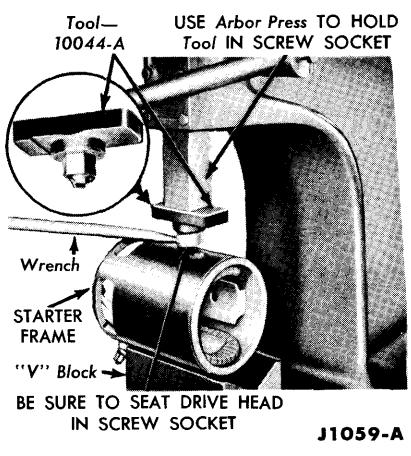



**FIG. 6—Pole Shoe Screw Removal**

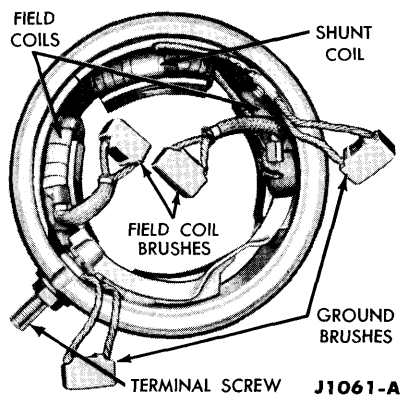



**FIG. 7—Field Coil Assembly**

# PART 14-3 FORD POSITIVE ENGAGEMENT STARTER


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## 1 DESCRIPTION AND OPERATION

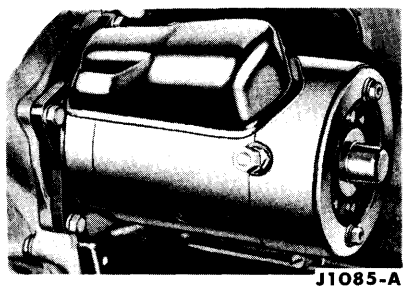



**FIG. 1—Starter Mounting**

The function of the starting system is to crank the engine at high enough speed to permit it to start. The system includes the starter motor and drive, the battery, a remote control starter switch, and heavy circuit wiring.

The starter mounting is shown in Fig. 1. Figure 2 shows the starting circuit schematic.

The starter utilizes an integral positive-engagement drive (Fig. 3). When the starter is not in use, one of the field coils is connected directly to ground through a set of contacts (Fig. 2). When the starter is first connected to the battery a large current flows through the grounded field coil, actuating a movable pole shoe. The pole shoe is attached to the starter drive actuating lever and thus the drive is forced into engagement with the flywheel.

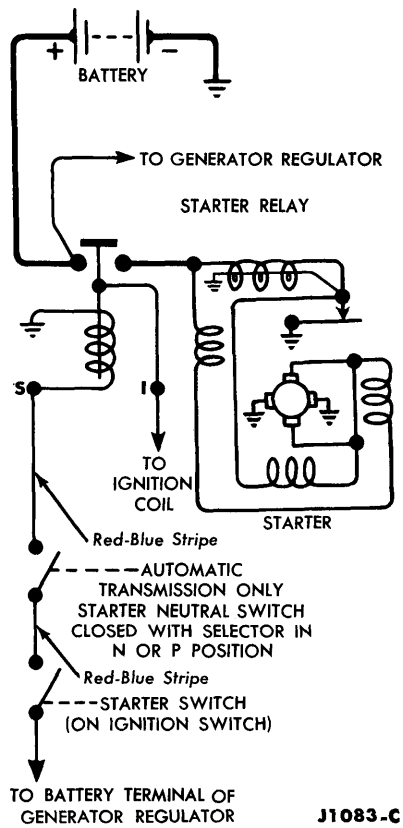



**FIG. 2—Starting Circuit Schematic**

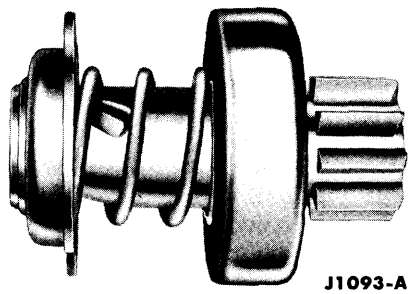



**FIG. 3—Starter Drive**

When the movable pole shoe is fully seated, it opens the field coil grounding contacts and the starter is then in normal operation. A holding coil is used to maintain the movable pole shoe in the fully seated position, during the time that the starter is turning the engine.

Cars equipped with an automatic transmission have a starter neutral switch, in the starter control circuit, which prevents operation of the starter if the selector lever is not in the N (neutral) or P(park) position.

## 2 REMOVAL AND INSTALLATION

1. Disconnect the starter cable at the starter terminal.
2. Remove the flywheel housing to starter retaining screws. Remove the starter assembly.
3. Position the starter assembly to the flywheel housing, and start the mounting bolts.
4. Snug all bolts, then torque them to 12-15 ft.-lbs, tightening the middle bolt first.
5. Connect the starter cable.

## 3 MAJOR REPAIR OPERATIONS

Use the following procedure when it becomes necessary to completely overhaul the starter. Figure 4 illustrates a partially disassembled starter.

### DISASSEMBLY

1. Loosen the brush cover band retaining screw and remove the brush cover band and the starter drive actuating lever cover. Observe the lead dress for assembly and then remove the commutator brushes from the brush holders.
2. Remove the through bolts, starter drive gear housing, and the starter drive actuating lever return spring.
3. Remove the pivot pin retaining the starter gear actuating lever and remove the lever and the armature.
4. Remove the stop ring retainer.

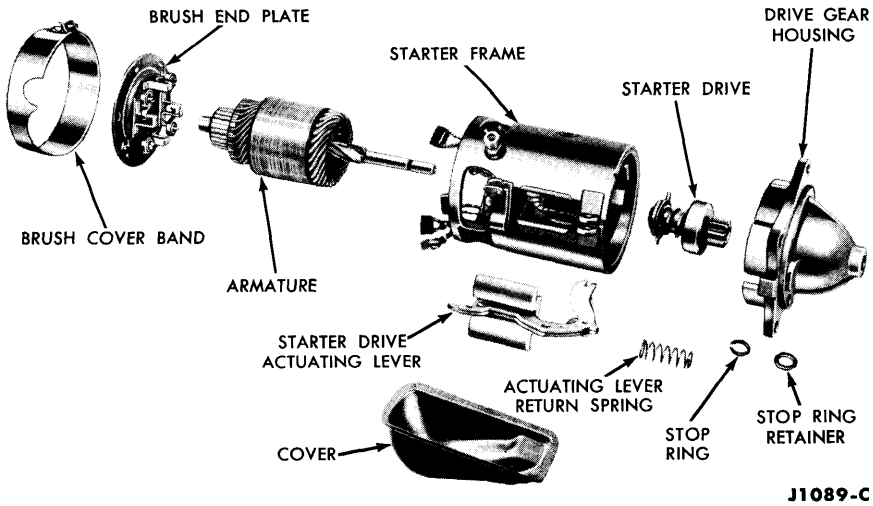



**FIG. 4—Starter Disassembled**

Remove and discard the stop ring retaining the starter drive gear to the end of the armature shaft, and remove the starter drive gear assembly.

**5.** Remove the brush end plate.

**6.** Remove the two screws retaining the ground brushes to the frame.

**7.** On the field coil that operates the starter drive gear actuating lever, bend the tab up on the field retainer and remove the field coil retainer.

**8.** Remove the three coil retaining screws, using tool 10044-A and an arbor press (Fig. 5). The arbor press prevents the wrench from slipping out of the screw. Unsolder the field coil leads from the terminal screw, and remove the pole shoes and coils from the frame (use a 300-watt iron).

**9.** Remove the starter terminal nut, washer, insulator and terminal from the starter frame. Remove any excess solder from the terminal slot.

## PARTS REPAIR OR REPLACEMENT

Nicks and scratches may be removed from the commutator by turning it down. All other assemblies are to be replaced rather than repaired.

## ASSEMBLY

**1.** Install the starter terminal, insulator, washers, and retaining nut in the frame (Fig. 6). Be sure to position the slot in the screw perpendicular to the frame end surface.

**2.** Position the coils and pole pieces, with the coil leads in the terminal screw slot, and then install the retaining screws. As the pole shoe screws are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes, then stake the screws.

**3.** Install the solenoid coil and retainer and bend the tabs to retain the coils to the frame.

**4.** Solder the field coils and solenoid wire to the starter terminal using rosin core solder. Use a 300-watt iron.

**5.** Check for continuity and grounds in the assembled coils.

**6.** Position the solenoid coil ground terminal over the nearest ground screw hole.

**7.** Position the ground brushes to the starter frame and install the retaining screws (Fig. 6).

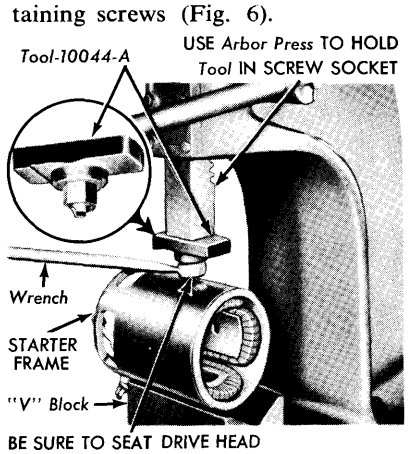



**FIG. 5—Pole Shoe Screw Removal**

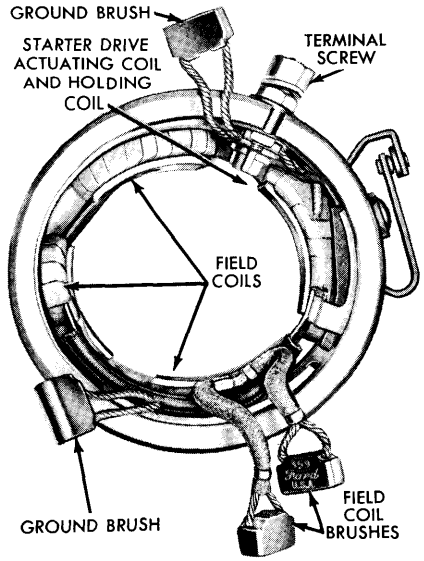



**FIG. 6—Field Coil Assembly**

**8.** Position the starter brush end plate to the frame, with the end plate boss in the frame slot.

**9.** Apply a thin coating of Lubriplate 777 on the armature shaft splines. Install the starter motor drive gear assembly to the armature shaft and install a new retaining stop ring. Install the stop ring retainer.

**10.** Position the fiber thrust washer on the commutator end of the armature shaft and position the armature in the starter frame.

**11.** Position the starter drive gear actuating lever to the frame and starter drive assembly, and install the pivot pin.

**12.** Position the starter drive actuating lever return spring and the drive gear housing to the frame and install and tighten the through bolts to specification. **Do not pinch the brush leads between the brush plate and the frame.** Be sure that the stop ring retainer is seated properly in the drive housing.

**13.** Install the brushes in the brush holders. **Be sure to center the brush springs on the brushes.**

**14.** Position the drive gear actuating lever cover on the starter and install the brush cover band with a gasket. Tighten the band retaining screw.

**15.** Check the starter no-load amperage draw.

# PART 14-4 SPECIFICATIONS

## STARTERS

| Vendor | Current Draw Under Normal Load (Amperes) | Normal Engine Cranking Speed (rpm) | Minimum Stall Torque @ 5 Volts (Foot Pounds) | Maximum Load (Amperes) | No Load Amperes | Mfg. Length (Inches) | Brushes Wear Limit (Inches) | Brush Spring Tension (Ounces) |
|---|---|---|---|---|---|---|---|---|
| Ford Positive Engagement 4½ Inch Diameter | 250 Max. | 250-290 | 15.5 | 670 | 70 | 0.5 | 0.25 | 40 |
| Ford Inertia | 155-190 | 150-180 | 14.8 | 580 | 110 | 0.5 | 0.25 | 45 |

Maximum Commutator run out in inches is 0.005.
Maximum starting circuit voltage drop (battery + terminal to starter terminal) @ normal engine temperature 0.5 volt.

# LIGHTING SYSTEM, HORNS, AND INSTRUMENTS

# GROUP 15


**PART 15-1** PAGE
GENERAL LIGHTING SYSTEM, HORNS AND INSTRUMENTS SERVICE ..... 15-1

**PART 15-2**
LIGHTING SYSTEM AND HORNS .. 15-5

**PART 15-3** PAGE
SWITCHES, CIRCUIT BREAKERS, AND FUSES ..... 15-12

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# PART 15-1 GENERAL LIGHTING SYSTEM, HORNS AND INSTRUMENTS SERVICE


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Diagnosis and Testing | 15-1 | 2 Cleaning and Inspection | 15-4 |


## 1 DIAGNOSIS AND TESTING

### LIGHTING TROUBLE DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **ALL HEADLIGHTS DO NOT LIGHT** | **1.** Loose battery cable.<br>**2.** Loose quick disconnect or broken wire from the battery to the headlight switch (Figs. 1 or 2).<br>**3.** Defective headlight switch (Page 15-3).<br>**4.** Disconnected or broken wire from the headlight switch to the beam selector switch. | **5.** Loose or broken wire to the bulbs.<br>**6.** Defective beam selector switch.<br>**7.** All headlight bulbs burned out. This may be caused by a defective or improperly adjusted generator or alternator voltage regulator (Group 13). |
| **INDIVIDUAL LIGHTS DO NOT LIGHT** | **1.** Burned out bulb.<br>**2.** Loose or broken wires to the | bulb.<br>**3.** Poor ground. |
| **LIGHTS BURN OUT REPEATEDLY** | **1.** Loose or corroded electrical connections.<br>**2.** Excessive vibration. | **3.** Improperly adjusted or defective generator or alternator voltage regulator (Group 13). |
| **BOTH LOW BEAM HEADLIGHTS DO NOT LIGHT** | **1.** Defective beam selector switch.<br>**2.** Loose or broken wire to the | bulbs.<br>**3.** Both low beam bulbs burned out. |

### INSTRUMENT TROUBLE DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **OIL PRESSURE INDICATOR LIGHT INOPERATIVE—FORD** | **1.** Indicator bulb burned out.<br>**2.** Loose or broken wire from the light to the indicator switch. | **3.** Defective oil pressure indicator switch (page 15-3). |
| **CHARGE INDICATOR LIGHT INOPERATIVE—FORD** | **1.** Burned out bulb.<br>**2.** Loose or broken wires to the armature terminal of the voltage regulator, or to the accessory terminal of the ignition switch. | **3.** Generator armature not grounded.<br>**4.** Generator regulator malfunction. |

CONTINUED ON NEXT PAGE

**INSTRUMENT TROUBLE DIAGNOSIS GUIDE (Continued)**

| | | |
|---|---|---|
| **OIL PRESSURE INDICATOR GAUGE INOPERATIVE—MERCURY** | **1.** Loose or broken wire from the constant voltage regulator to the oil gauge.<br>**2.** Grounded or broken wire from | the engine oil pressure sending unit.<br>**3.** Defective gauge (page 15-3).<br>**4.** Defective oil pressure sending unit (page 15-3). |
| **CHARGE INDICATOR GAUGE INOPERATIVE—MERCURY** | **1.** Defective gauge (page 15-3).<br>**2.** Loose or broken wires. | **3.** Alternator system malfunction. |
| **FUEL GAUGE ERRATIC OR INOPERATIVE** | **1.** Loose or broken wire from the constant voltage regulator to the fuel gauge.<br>**2.** Defective fuel gauge (page 15-3).<br>**3.** Loose, broken, or shorted wire from fuel gauge to the fuel tank | sending unit.<br>**4.** Defective constant voltage regulator.<br>**5.** Defective fuel tank sending unit.<br>**6.** Poor ground between fuel tank and body. |
| **TEMPERATURE GAUGE ERRATIC OR INOPERATIVE** | **1.** Loose or broken wire from constant voltage regulator to the temperature gauge.<br>**2.** Defective temperature gauge (page 15-3). | **3.** Loose or broken wire from the temperature sending unit to the temperature gauge.<br>**4.** Defective temperature sending unit. |
| **BOTH FUEL AND TEMPERATURE GAUGES ERRATIC** | **1.** Loose or corroded constant voltage regulator ground.<br>**2.** Defective constant voltage regulator (page 15-3). | **3.** Broken or loose wire from or to the constant voltage regulator.<br>**4.** Defective ignition switch. |

**HORN TROUBLE DIAGNOSIS GUIDE**

| | | |
|---|---|---|
| **HORNS DO NOT SOUND** | **1.** Loose connection at horn button contact.<br>**2.** Open wire (blue-yellow stripe) from horn relay to horn button.<br>**3.** Open wire (yellow) from battery to horn relay. | **4.** Inoperative relay.<br>**5.** Horns defective or out of adjustment.<br>**6.** Open wire (yellow-green stripe) from horn relay to high- or low-pitch horn. |
| **ONE HORN FAILS TO OPERATE** | **1.** Broken or loose wire to the horn. | **2.** Horn defective or out of adjustment. |
| **HORNS OPERATE CONTINUOUSLY** | **1.** Shorted wire to horn button (blue-yellow stripe).<br>**2.** Shorted relay. | **3.** Horn ring insulation improperly installed. |

**TURN INDICATOR TROUBLE DIAGNOSIS GUIDE**

| | | |
|---|---|---|
| **TURN INDICATOR LIGHTS INOPERATIVE** | **1.** Burned out fuse.<br>**2.** Loose or broken wire from ignition switch to flasher.<br>**3.** Defective flasher.<br>**4.** Loose or broken wire from flasher to turn indicator switch. | **5.** Defective turn indicator switch.<br>**6.** Broken, shorted, or loose wires from switch to lights.<br>**7.** Burned out bulbs, or loose sockets. |
| **TURN INDICATOR LIGHTS OPERATE INCORRECTLY** | **1.** Loose, broken, or shorted wires from switch to light.<br>**2.** Defective indicator switch. | **3.** Defective flasher.<br>**4.** Burned out bulb. |
| **TURN INDICATOR CANCELS IMPROPERLY** | **1.** Cam improperly positioned on steering wheel hub. | **2.** Coil spring on switch plate assembly loose or weak. |

### HORN TEST ADJUSTMENT

The only test necessary on the horns is for current draw. The current adjustment also adjusts the tone of the horn.

### CURRENT DRAW TEST

Connect a voltmeter and ammeter to the horn and to a voltage supply as shown in Fig. 1. The nomal current draw for the horns at 12 volts is 9.0-10.0 amperes.

**Always connect the positive battery lead to the horn terminal as shown in Fig. 2. If this is not done, damage may result to the horn.**

### ADJUSTMENT

Tone and current are adjusted by changing the contact tension (Fig. 1). Connect the horn as shown in Fig. 2. Turn the self locking tone-adjusting nut until the current is within the limits for the horn being adjusted. Replace the cover and recheck the current draw.

### HEADLIGHT AND BEAM SELECTOR SWITCH TESTS

The following tests may be made to determine whether a headlight switch or a beam selector switch is defective:

Set the headlight switch to the headlight position, and operate the beam selector switch. If none of the headlights turn on when the beam selector switch is operated, yet the instrument panel lights operate, the headlight switch or the red-yellow stripe wire from the headlight switch to the beam control switch is probably defective. Substitute a known good switch for the suspected switch to determine whether the switch or the wiring is at fault.

If the headlights operate only with the beam control switch in one position, the switch or the wiring from the switch to the headlight is defective. Substitute a known good switch for the suspected switch to determine whether the switch or the wiring is at fault.

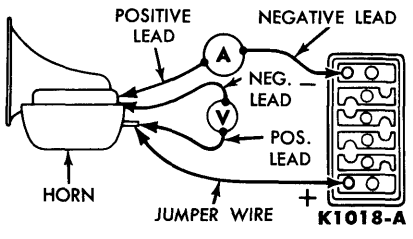



**FIG. 1—Horn Current Draw Test**

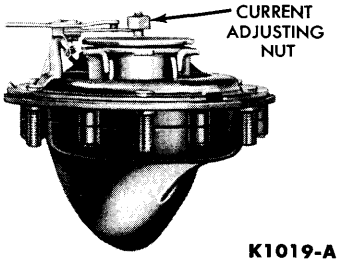



**FIG. 2—Horn Adjustment**

### OIL PRESSURE INDICATOR LIGHT TEST—FORD

To test the indicator light, turn on the ignition switch. Do not start the engine. The light should come on. Start the engine. The light should go out, indicating that the oil pressure has built up to a safe value.

To test the oil pressure switch on the engine, turn the ignition switch on, engine not running, the indicator light should come on. If the indicator light does not come on, short the terminal of the oil pressure switch unit to ground (Fig. 8, Part 15-4). If the light now comes on, the oil pressure switch is defective. If the light still does not come on, the bulb is burned out or the wires from the bulb to the ignition switch and oil pressure switch are defective.

### CHARGE INDICATOR LIGHT TEST

To test the charge indicator light, turn the ignition switch on with the engine stopped. The light should come on. If it does not, the bulb is burned out, the wiring to the light is defective or the generator armature is not grounding.

### CONSTANT VOLTAGE REGULATOR TEST

Turn the ignition switch ON. Check for voltage at the gauge feed wire (Black with green stripe) at one of the gauges. The voltage should oscillate between zero and about 10 volts. If it does not, the constant voltage regulator is defective, or there is a short to ground between the voltage regulator and the gauges.

If the gauge unit is inaccurate or does not indicate, replace it with a new unit. If the gauge unit still is erratic in its operation, the sending unit or wiring to the sending unit is faulty.

**If the fuel gauge, the temperature gauge and the oil pressure gauge indicate improperly and in the same direction, the constant voltage regulator could be defective, as it supplies the three gauges.**

### FUEL GAUGE AND FUEL LEVEL SENDING UNIT TEST

Disconnect the wire at the fuel level sending unit and connect it to a known good sending unit. Connect a jumper wire from the sending unit mounting plate to the car frame. Raise the float arm to the upper stop. The instrument panel gauge should read full. Lower the float arm to the bottom stop, the gauge should read empty.

If the gauge reads properly the sending unit in the gas tank is defective.

If the gauge unit still indicates improperly or is erratic in its operation, the gauge unit or the wiring to the gauge unit is faulty, repair the wire or replace the gauge unit.

### TEMPERATURE GAUGE TEST

Place the ignition switch in the OFF position, and connect the terminals of two, series connected, flashlight cells to the gauge terminals. Three volts should cause the gauge to read approximately full scale.

### TEMPERATURE SENDING UNIT TEST

The sending unit can be tested by first making a temperature gauge test to check the accuracy of the gauge. Start the engine and allow it to warm up to normal temperature. If no reading is indicated on the gauge, check the sending unit to gauge wire by removing the wire from the sending unit and momentarily grounding the wire. If the gauge still does not indicate, the wire is defective. Repair or replace the wire. If the gauge now indicates, the sending unit is faulty.

### OIL PRESSURE INDICATOR GAUGE TEST—MERCURY

Perform the same test as described for the temperature gauge. The oil gauge pointer should read approximately full scale.

### OIL PRESSURE SENDING UNIT TEST—MERCURY

The sending unit can be tested by making a gauge unit test to determine whether the gauge unit is good. If the

gauge unit is good, start the engine to determine if the gauge registers oil pressure. If no reading is obtained, check the sending unit to gauge wire. If the wire is not broken and all connections are tight, replace the sending unit (Fig. 8, Part 15-4).

### AMMETER TEST—MERCURY

To test the ammeter, turn the headlights ON with the engine stopped. The meter pointer should move toward the D or discharge scale. If no movement of the needle is observed, check the loop on the rear of the meter housing to see if the battery to circuit breaker wire passes inside the loop. If the wire is in the loop, and the meter does not indicate a discharge, the meter is inoperative. **If the meter pointer moves toward the C or charge scale when the headlights are turned ON, the wire passes through the loop in the wrong direction or the battery is reversed. Feed the wire through in the opposite direction to correct this condition after checking first to make sure that the battery is not reversed.**

### SPEEDOMETER TESTS

To test the odometer accuracy, drive the car over a "measured mile." Speedometer accuracy can be checked by comparing the speedometer in question against one known to be accurate, while two cars are moving at the same speed, or by timing the car on a "measured mile."

Specifications (Part 15-5) shows the proper speedometer gears to use for various rear axle and tire size combinations.

### SINGLE-SPEED ELECTRIC WIPER MOTOR TROUBLE DIAGNOSIS AND ADJUSTMENT

When checking an inoperative or sluggish windshield wiper, first examine the linkage under the instrument panel for obstructions. Disconnect the linkage at the motor and check for ease of operation, with the arms and blades removed.

Disconnect the wiring harness connector plug from the motor, turn the wiper switch and ignition switch to the ON position and check for voltage at the center opening of the plug (Fig. 3). No voltage indicates a defective circuit breaker, switch or wiring. With the switch at the OFF position, check for voltage between the two outside openings of the plug. If there is no voltage, replace the defective parts.

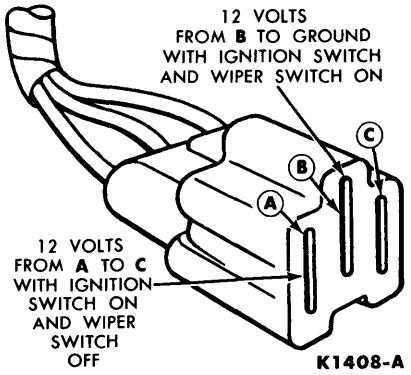



**FIG. 3—Windshield Wiper Connector Plug Test Points**

## 2 CLEANING AND INSPECTION

### SINGLE-SPEED ELECTRIC WIPER MOTOR

**1.** Clean the gear housing of all old grease. **Do not allow any cleaning fluid to contact the armature shaft and output shaft bearings.**

**2.** Wipe all other parts with a clean cloth.

**3.** Cover the motor housing bearing, and blow out any dust from the housing with compressed air.

**4.** Inspect the armature for burned commutator bars and loose connections. Check all shafts, bushings, and gears for scored surfaces. Check the thrust ball for pitting or discoloration due to heat. Make sure that the output gear is not loose on the output shaft, and that the cam surface is not worn. Replace any defective parts.

**5.** Check the armature for grounds with a test light. Replace the armature if it is grounded.

**6.** Inspect the brush plate assembly for cracks or distortion. The brush holders should be securely fastened to the brush plate. Inspect the contact points for burned or pitted surfaces. Replace defective parts.

**7.** Inspect the motorhousing and magnet assembly. Replace the assembly if it has a cracked magnet, or if the thrust button is hollowed out to a diameter greater than 1/32 inch.

**8.** Replace the brushes if they are worn to 5/16 inch. Replace distorted or burned brush springs.

# PART 15-2 LIGHTING SYSTEM AND HORNS


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 15-5 | 3 Removal and Installation | 15-8 |
| 2 In-Car Adjustment and Repair | 15-8 | | |


## 1 DESCRIPTION AND OPERATION

### HEADLIGHTS

Four sealed-beam headlights are used. The two outboard lights have two filaments each for low beam and high beam, and are marked by a numeral 2 molded in the glass lens. Locating tabs molded in the glass allow the mounting of the No. 2 lights in the outboard headlight support frames only. The low beams are used for city driving, when meeting oncoming traffic on the highway, and for No. 2 headlight alignment.

The inboard headlights with a numeral one molded in the glass lens have only one filament and are used for highway driving along with the high beams of the No. 2 headlights. Locating tabs molded in the glass allow the mounting of the No. 1 lights in the inboard headlight support frames only. A conventional beam control switch is located on the floor board near the left cowl trim panel.

Quick disconnect terminals are provided at the left and right of the radiator support assembly. The terminals are color coded. Like colored terminals are connected together. The green wire with a black stripe supplies current to the headlight high beams. The red wire with a black stripe supplies the low beam filaments. The black wire with a yellow stripe supplies the parking lights. Figures 1 and 2 show the schematic diagrams for Group 15.

### HORNS

All cars are equipped with a pair of tuned horns controlled by a relay. The horn button closes the relay contacts, completing the circuit to the horns. One of the horns has a high-pitched tone; the other has a low-pitched tone.

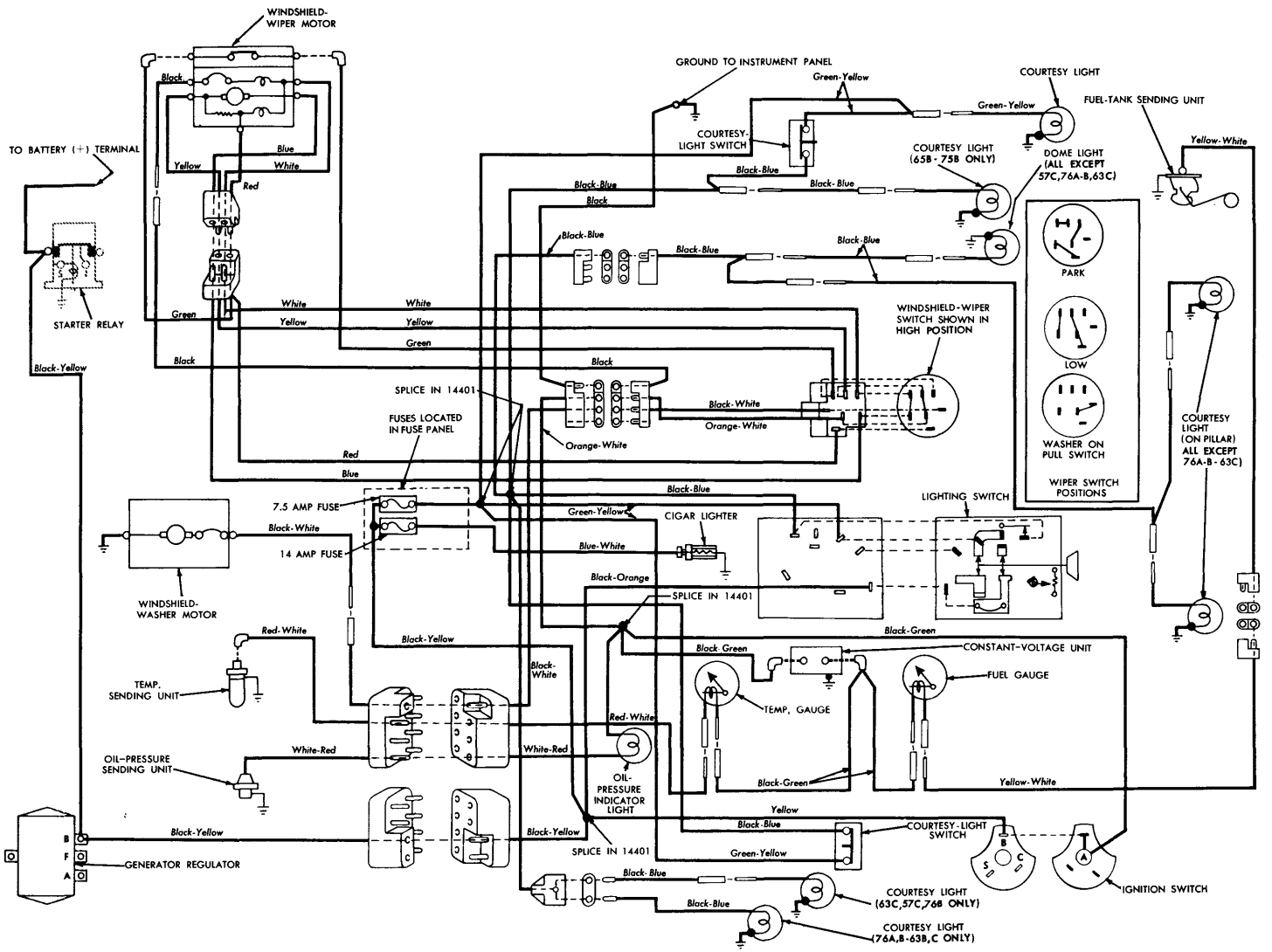



**FIG. 1—Exterior Lighting, Horns and Turn Signals Schematic—Ford**

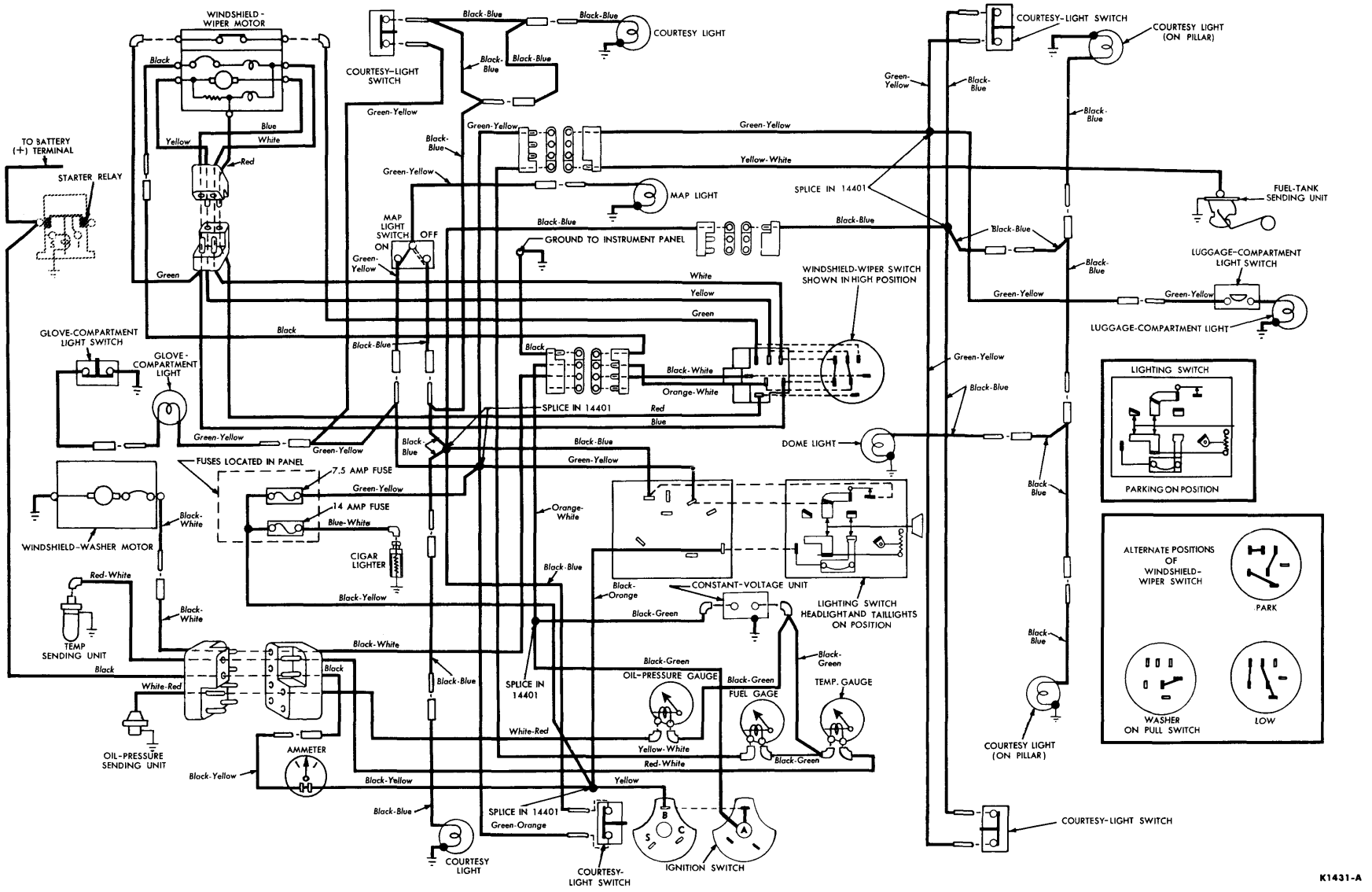



**FIG. 2—Exterior Lighting, Horns and Turn Signals Schematic—Mercury**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### HEADLIGHT ALIGNMENT

All headlight adjustments are to be made with a half-full fuel tank, plus or minus one gallon, with a person seated in the driver's seat, the car unloaded and the trunk empty except for the spare tire and jacking equipment, and recommended pressure in all tires. Before each adjustment, bounce the car by pushing on the center of both the front and rear bumpers, to level the car.

To align the No. 1 headlights (inboard lights) by means of a wall screen, select a level portion of the shop floor. Lay out the floor and wall as shown in Fig. 3.

Establish the headlight horizontal centerline by subtracting 20 inches from the actual measured height of the headlight lens center from the floor and adding this dimension (dimension B, upper diagram Fig. 4) to the 20-inch reference line obtained by sighting over the uprights. Draw a horizontal line 2 inches below, and parallel to, the headlight horizontal centerline. Then draw the headlight vertical centerlines on the screen as measured on the car (dimension A, upper diagram Fig. 4).

### NO. 1 HEADLIGHT ADJUSTMENT (INNER LIGHTS)

Adjust each No. 1 headlight (inner light) beam as shown in Fig. 4. **Cover the No. 2 lights when making this adjustment.**

### NO. 2 HEADLIGHT ADJUSTMENT (OUTER LIGHTS)

To align the No. 2 headlights (outer lights), a different wall chart (lower diagram Fig. 3) is used. Dimension B for the No. 2 lights is the same as B for the No. 1 lights, dimension A is as measured on the car. **Note that the line of adjustment of the No. 2 lights is the horizontal centerline of the No. 2 lights.** Turn the headlights to low beam and adjust each No. 2 light as shown in Fig. 4.

Each headlight is adjusted by means of two screws located under the headlight trim ring as shown in Fig. 5. Always bring each beam into final position by turning the adjusting screws clockwise so that the headlights will be held against the tension springs when the operation is completed.

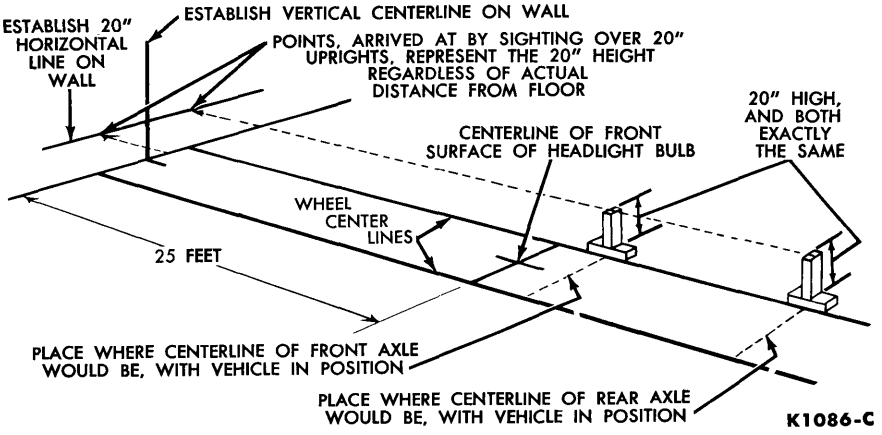



**FIG. 3—Floor and Wall Layout**

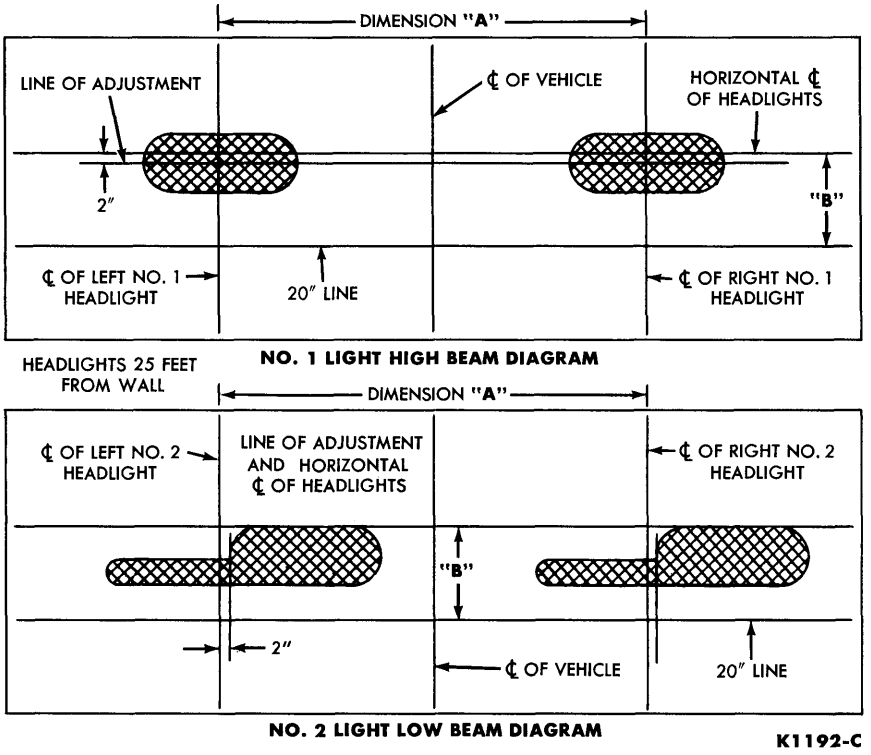



**FIG. 4—Headlight Wall Screens**

NOTE: **Some states may not approve of the 2-inch dimension for the No. 1 headlights. Check the applicable state law, as a 3-inch dimension may be required.**

## 3 REMOVAL AND INSTALLATION

### HEADLIGHTS

**1.** Remove the retaining screws and headlight trim ring.

**2.** Loosen the retaining ring screws (Fig. 5), rotate the retaining ring counter-clockwise, and remove it.

**3.** The headlight bulb may now be pulled forward far enough to disconnect the wiring assembly plug.

**4.** Plug in the new bulb, and place it in position, making sure that the locating tabs are placed in the positioning slots.

**5.** Install the headlight bulb retaining ring, rotating it clockwise under the screws, and tighten the screws.

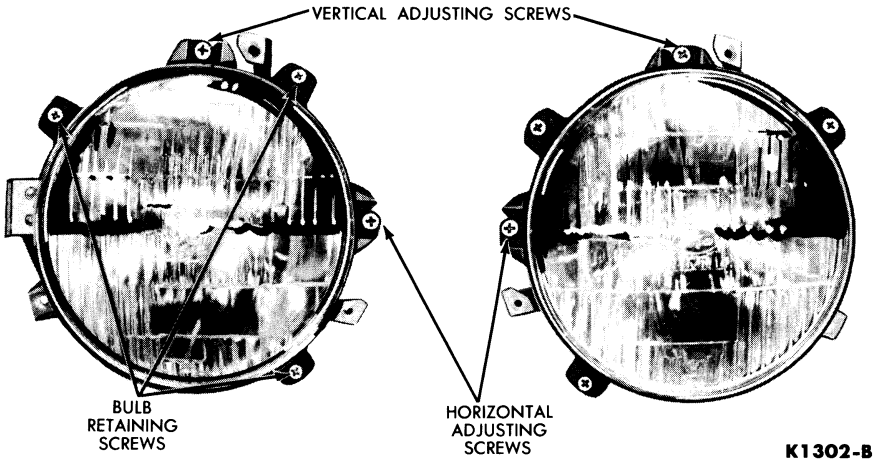



**FIG. 5—Headlight Adjustment**

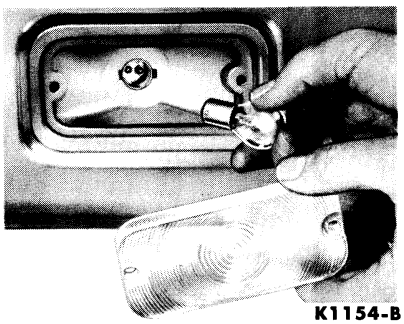



**FIG. 6—Typical Parking Light**

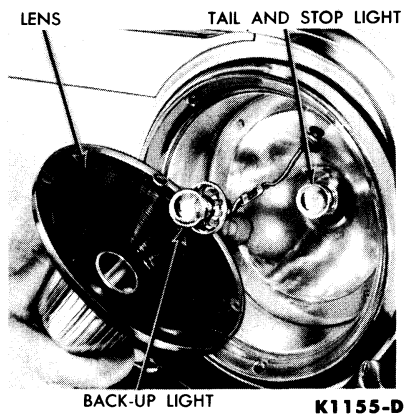



**FIG. 7—Tail and Stop Light—Ford**

6. Place the trim ring into position, and install the retaining screws.

### PARKING LIGHTS

To replace the bulb in the parking light, remove the retaining screws, lens, and bulb (Fig. 6). After the bulb is replaced, install the lens and retaining screws.

### TAIL AND STOP LIGHT, BACK-UP LIGHT, AND LICENSE PLATE LIGHTS—FORD

The tail and stop light and back-up light are shown disassembled in Fig. 7. To replace the tail and stop light bulb, remove the retaining screws, and lens.

To replace the back-up light bulb, remove the retaining screws and lens and remove the back-up light assembly from the lens socket.

The license plate light is shown in Fig. 8. Remove the bezel retaining screw, bezel and lens. Remove the bulb.

### TAIL AND STOP LIGHT, BACK-UP LIGHT, AND LICENSE PLATE LIGHTS—MERCURY

The tail and stop light, and back-up light are shown disassembled in Fig. 10. To replace the bulbs, remove the retaining screws and lens.

The license plate light is replaced by removing the shield retaining screws, and pulling the socket assembly from behind the mounting bracket.

### DOME LIGHT

Remove the two screws retaining the dome light lens and bezel. Remove the lens and bezel, then replace the bulb.

### INSTRUMENT LIGHTS

The instrument panel light bulbs can be replaced by pulling out the individual light sockets from the rear of the instrument panel (Figs. 11 or 12).

### MAP LIGHT AND SWITCH—MERCURY

The map light is shown in Fig. 9. To replace the light or switch, remove the two lens retaining screws, the lens, and the two light assembly mounting screws, then remove the assembly from the instrument panel.

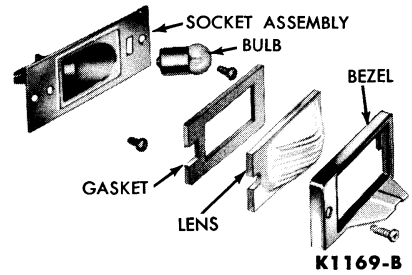



**FIG. 8—License Plate Light—Ford**




**FIG. 9—Map Light and Switch—Mercury**

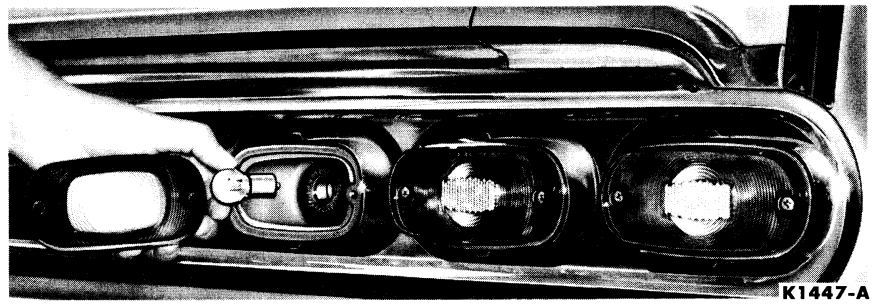



**FIG. 10—Tail, Stop and Back-Up Lights—Mercury**

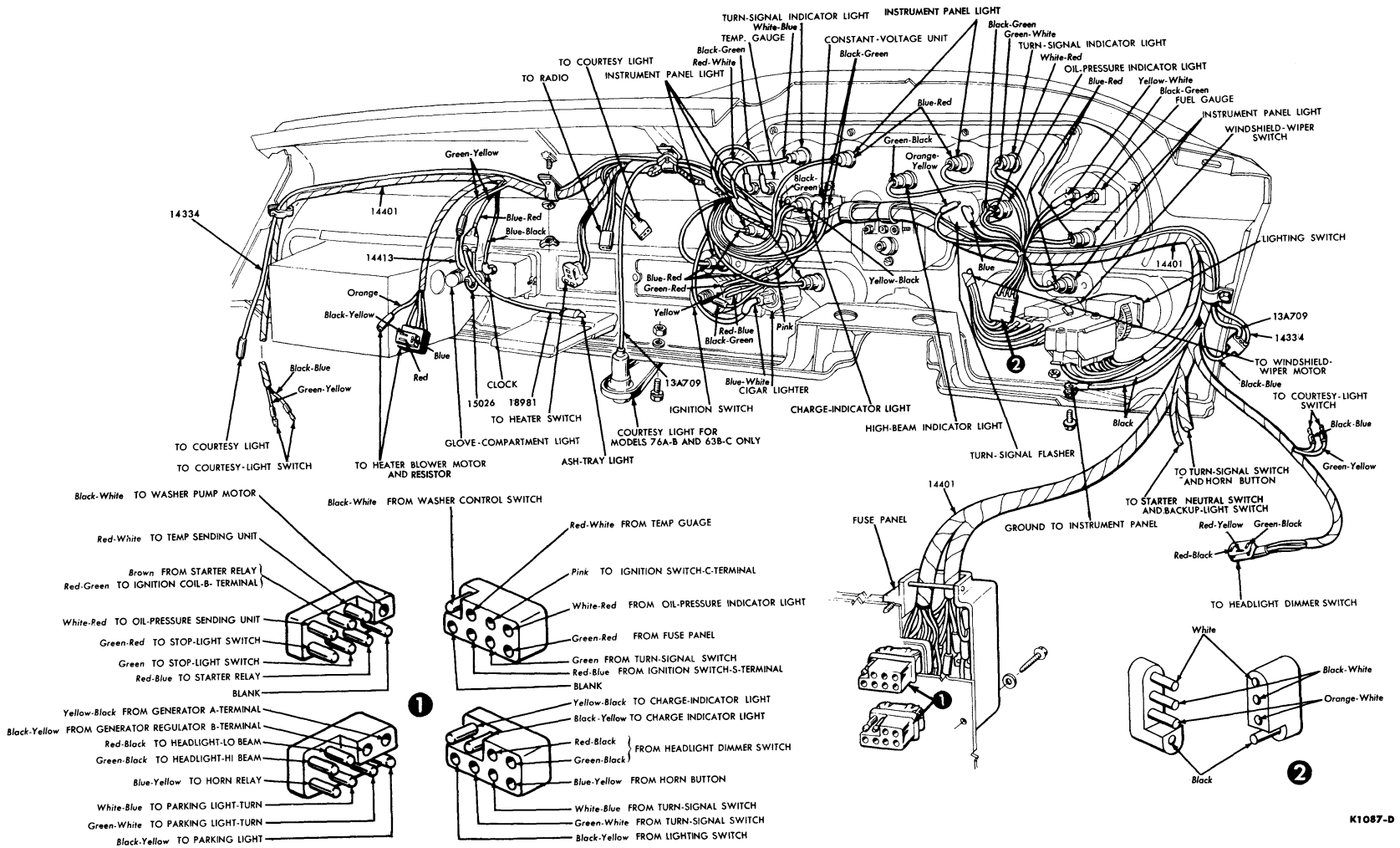



**FIG. 11—Instrument Panel Lights—Ford**

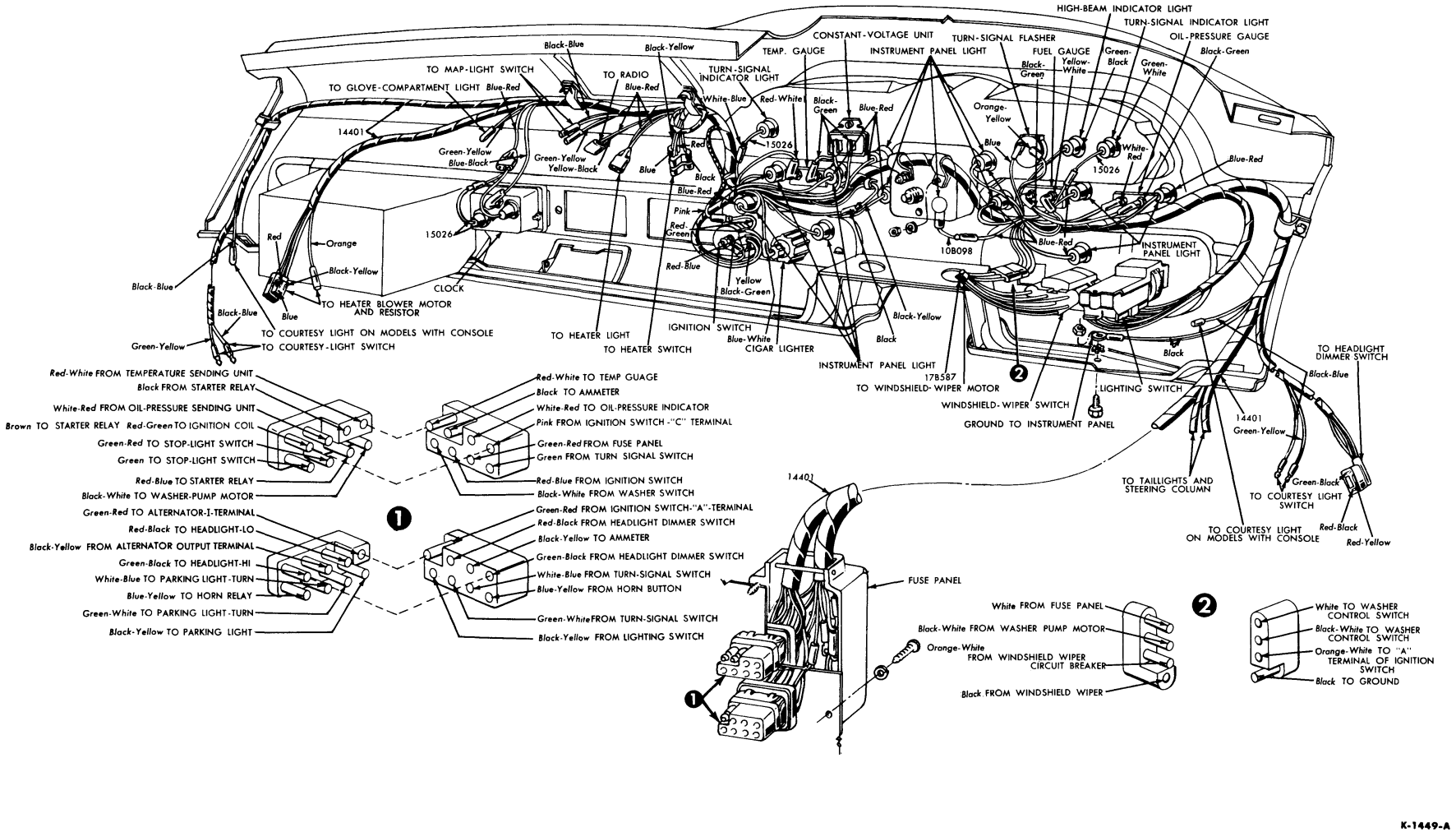



**FIG. 12—Instrument Panel Lights—Mercury**

# PART 15-3 SWITCHES, CIRCUIT BREAKERS AND FUSES


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Description and Operation | 15-12 | 2 Removal and Installation | 15-12 |


## 1 DESCRIPTION AND OPERATION

### HEADLIGHT SWITCH

A combination headlight switch, dome light switch, and circuit breaker is used (Fig. 1). The circuit breaker protects the headlight circuit.

### FUSES

The fuse panel, mounted on the dash panel above the brake pedal, contains the following fuses: parking, rear, dome and instrument light fuse, clock, radio, turn indicator and back-up light, and heater fuses. Fuse values and locations are shown in Fig. 2.

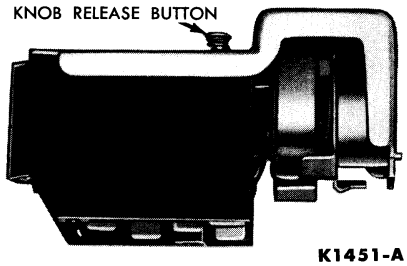
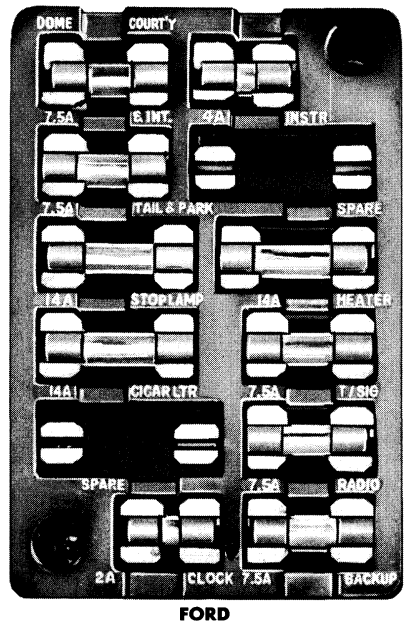



**FIG. 1—Headlight Switch**



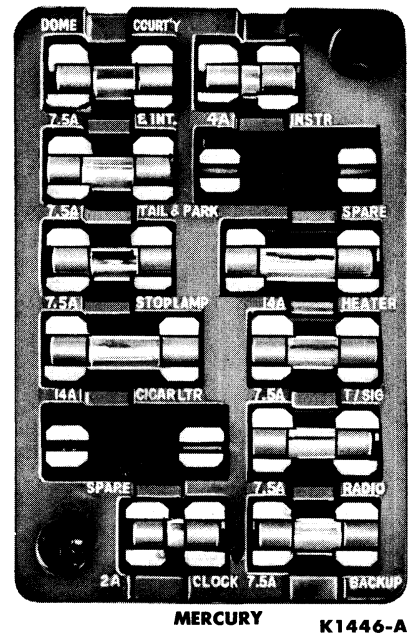




**FIG. 2—Fuse Panel**

## 2 REMOVAL AND INSTALLATION

### SWITCHES

Before removing any switch, disconnect the battery ground cable from the battery.

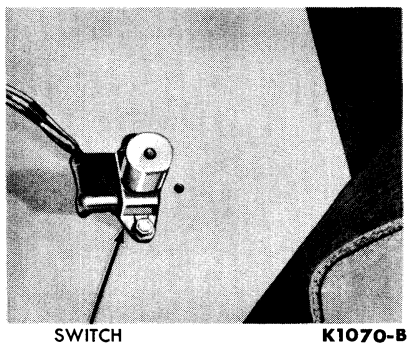



**FIG. 3—Headlight Beam Selector Switch**

### HEADLIGHT SWITCH

**1.** Remove the control knob and shaft by pressing the knob release button on the switch housing (Fig. 1), with the knob in the full ON position. Pull the knob out of the switch.

**2.** Unscrew the mounting nut, remove the switch and disconnect the wiring connector.

**3.** To install the switch, attach the wiring connectors, insert the switch in the instrument panel, and install the mounting nut.

**4.** Install the knob and shaft assembly by inserting it all the way into the switch until a distinct click is heard. In some instances it may be necessary to rotate the shaft slightly until it engages the switch-contact carrier.

### HEADLIGHT BEAM SELECTOR SWITCH

Lay the floor mat back from the area of the switch, and remove the mounting screws (Fig. 3). Disconnect the wire terminal block from the switch.

To install the switch, connect the terminal block to the switch and install the switch to the floor. Replace the floor mat.

### STOP LIGHT SWITCH

Disconnect the wires at the bullet connectors, and unscrew the switch from the brake master cylinder (Fig. 4).

### DOME LIGHT SWITCH

The dome light switch is a part of the headlight switch. It is actuated

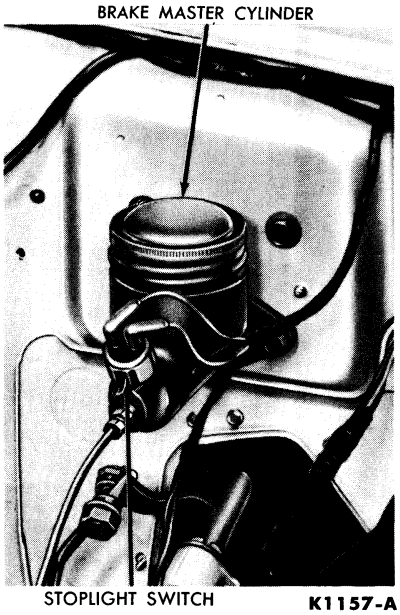



**FIG. 4—Typical Stop Light Switch**

by rotating the switch control knob to the maximum counter-clockwise position. The dome light and headlight switch is replaced as a unit (Fig. 1).

**IGNITION SWITCH AND LOCK CYLINDER**

**1.** Disconnect the negative cable from the battery.

**2.** Turn the ignition key to the accessory position. Slightly depress the pin shown in Fig. 5, turn the key counter-clockwise, and pull the key and lock cylinder out of the switch assembly. If only the lock cylinder is to be replaced, proceed to step 8.

**3.** Press in on the rear of the switch and rotate the switch ⅛ turn counter-clockwise (as viewed from the terminal end). Remove the bezel and switch.

**4.** Remove the insulated plug and wires from the rear of the switch.

**5.** If a new ignition switch as well as the lock cylinder is to be installed, insert a screwdriver into the lock opening of the ignition switch and turn the slot in the switch to a full counter-clockwise position.

**6.** Connect the insulated plug and accessory wires to the back of the ignition switch.

**7.** Place the bezel and switch in the switch opening, press the switch toward the instrument panel, and rotate it ⅛ turn to lock it in position.

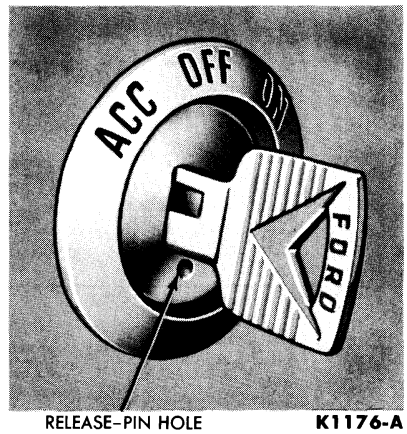



**FIG. 5—Typical Ignition Switch Removal**

**8.** If a new lock cylinder is to be installed, insert the key in the cylinder and turn the key to the accessory position. Place the lock and key in the ignition switch, depress the pin slightly (Fig. 5), and turn the key counter-clockwise. Push the lock cylinder into the switch. Turn the key to check the lock cylinder operation.

**9.** Connect the battery cable and check the ignition switch operation.

# PART 15-4 INSTRUMENTS


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| 2 | In-Car Adjustment and Repair | 15-18 |
| 3 | Removal and Installation | 15-18 |
| 4 | Major Repair Operations | 15-21 |


## 1 DESCRIPTION AND OPERATION

### GAUGES

The gauges and indicator lights are shown in Figs. 10 and 11, Part 15-2. Figures 3 and 4 show the gauge circuits. The instrument cluster for the Ford includes a charge indicator light, fuel gauge, temperature gauge, oil pressure indicator light, speedometer, high-beam indicator light, right and left turn signal indicator lights, and provision for an electric clock.

The instrument cluster for the Mercury includes the same components except that an oil pressure indicator gauge and a charge indicator gauge are used instead of indicator lights.

A constant voltage regulator maintains a constant voltage supply to the fuel and temperature gauge circuits in the Ford and the fuel gauge, temperature gauge, and oil pressure gauge circuits in the Mercury.

All of the instruments are electrically operated except the speedometer. Illumination is provided by four lights controlled by a rheostat on the lighting switch. Front views of both instrument panels are shown in Figs. 1 and 2.

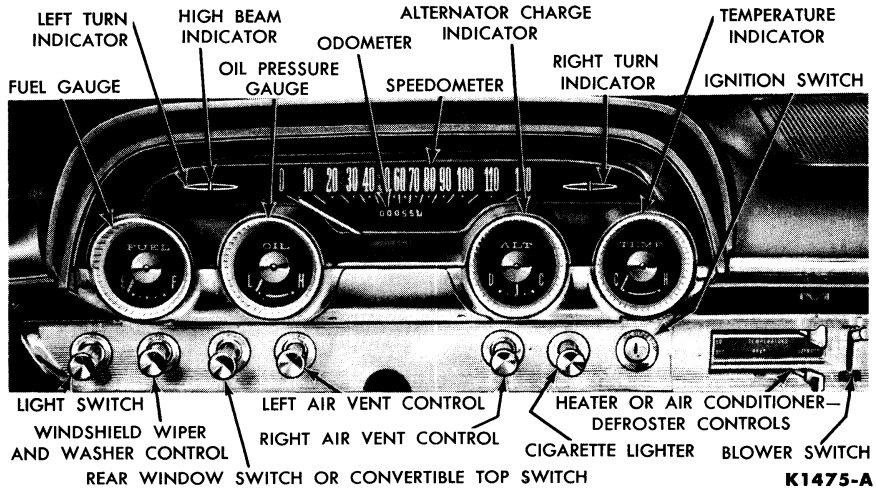



**FIG. 2—Instrument Panel Front View—Mercury**

### CONSTANT VOLTAGE REGULATOR

The constant voltage regulator (Fig. 5) used with the fuel, temperature, and oil pressure gauges maintains an average value of 5.0 volts at the gauge terminals.

### FUEL GAUGE

The fuel gauge consists of a sending unit, located on the gas tank, and a remote register unit (fuel gauge) mounted in the instrument cluster. The remote register unit pointer is controlled by a bimetallic arm and heating coil. The sending unit is a rheostat that varies its resistance depending on the amount of fuel in the tank. The fuel gauge circuit is shown in Figs. 3 and 4.

### TEMPERATURE GAUGE

The temperature gauge consists of a sending unit mounted in the cylinder head, and a remote register unit, (temperature gauge) mounted on the instrument panel. The principle of operation is similar to the fuel gauge except that the resistance of the sending unit is varied by engine temperature. The temperature gauge circuit is shown in Figs. 3 and 4.

### OIL PRESSURE INDICATOR GAUGE—MERCURY

A meter-type oil pressure gauge is used. The gauge consists of a sending unit on the engine and a remote register unit in the instrument cluster. The meter-type oil gauge circuit is shown in Fig. 4.

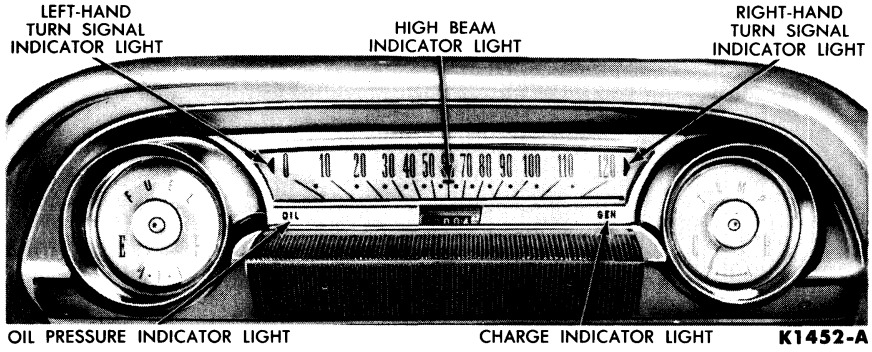



**FIG. 1—Instrument Panel Front View—Ford**

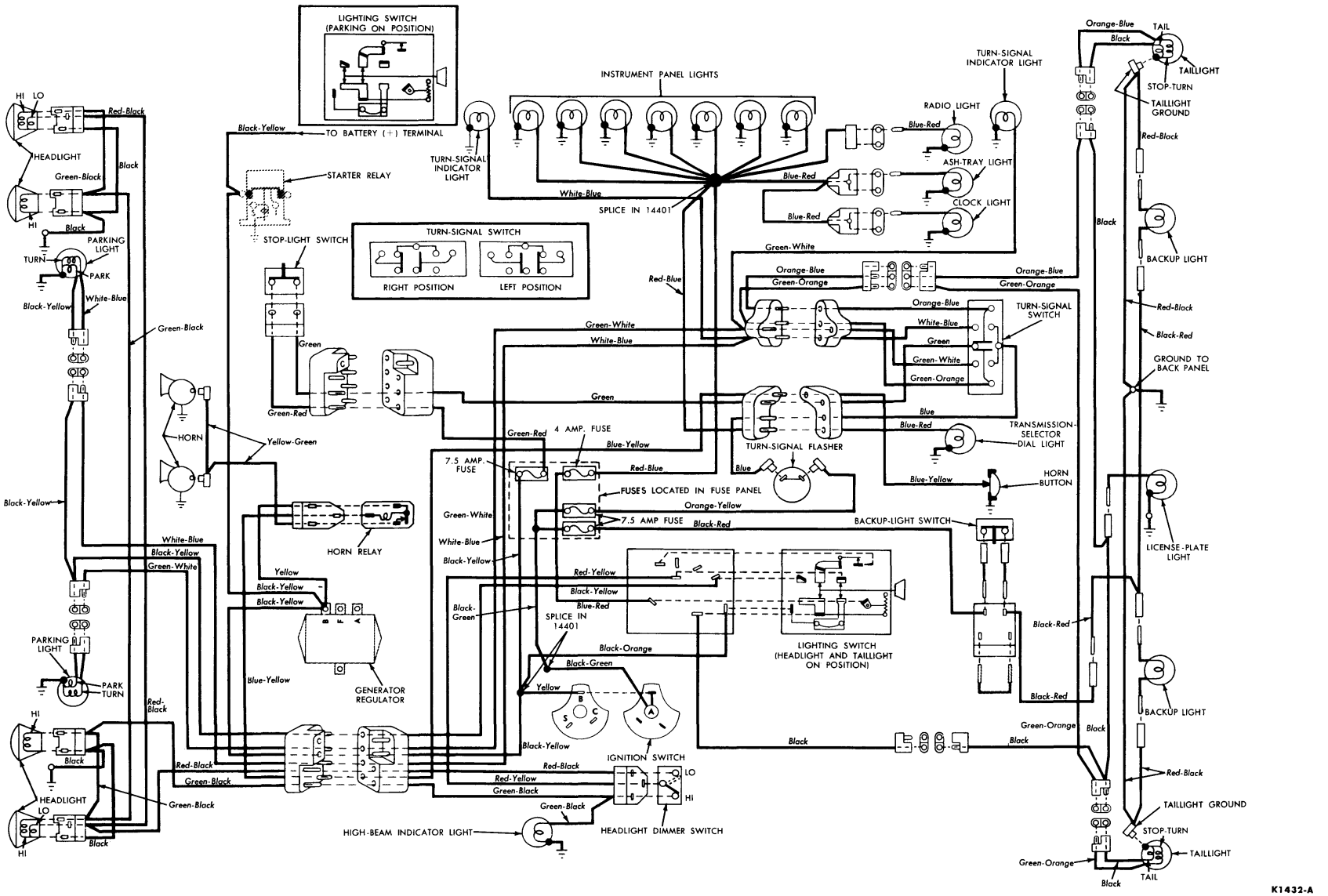



**FIG. 3—Interior Lighting, Windshield Wiper, Gauges, and Heater Schematic—Ford**

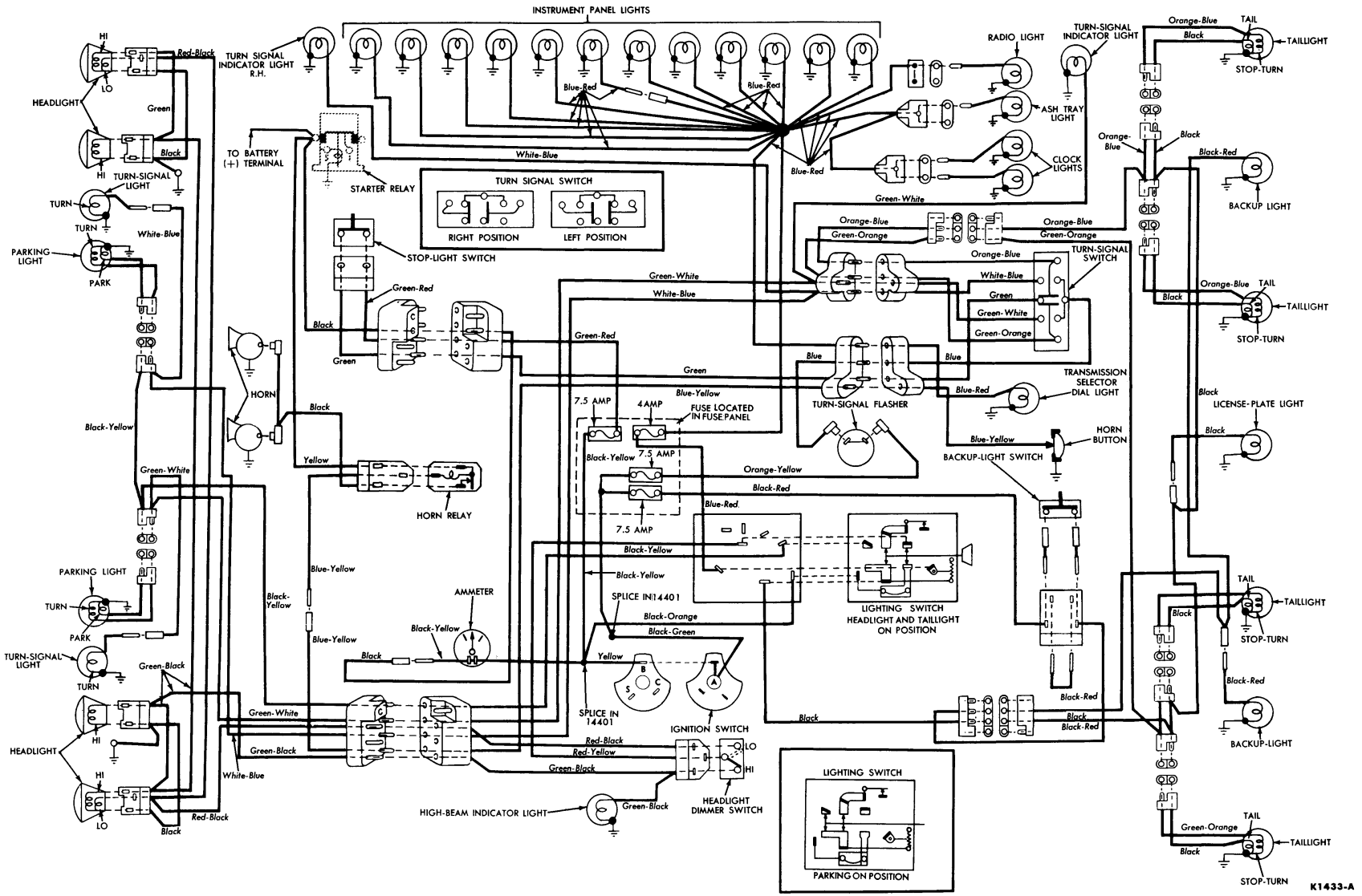



**FIG. 4—Interior Lighting, Windshield Wiper, Gauges, and Heater Schematic—Mercury**

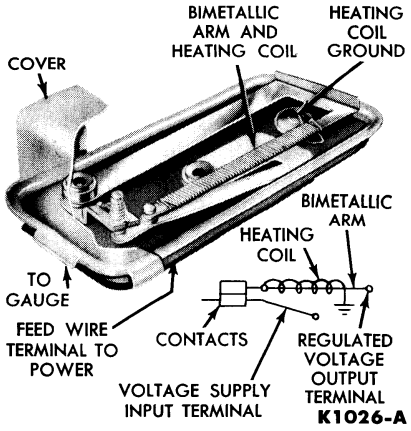



**FIG. 5—Constant Voltage Regulator**

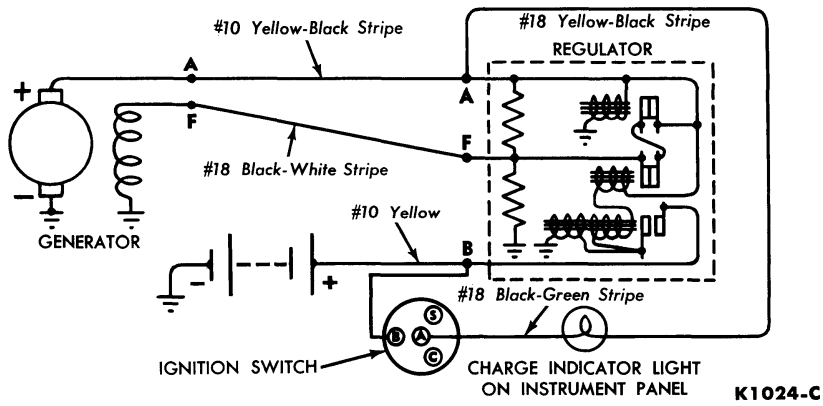



**FIG. 6—Generator Charge Indicator Light Circuit—Ford**

### CHARGE INDICATOR LIGHT —FORD

A red generator charge indicator light is used. This light flashes on if the battery is discharging and the generator is not supplying current. The indicator light is connected between the armature terminal of the generator regulator and the accessory terminal of the ignition switch. This actually places the light in parallel with the regulator cut-out contacts. If the ignition switch is on, and the cut-out contacts are open, the charge indicator light will light up, indicating that the generator is not connected to the battery. The circuit for the light is from the battery, through the light, and through the generator armature, to ground (Fig. 6). As soon as the generator comes up to speed, the cut-out contacts close. This by-passes the warning light which then goes out and thus indicates that the battery is connected to the generator.

### CHARGE INDICATOR GAUGE—MERCURY

The charge indicator used is a magnetic-loop type ammeter.

### OIL PRESSURE INDICATOR LIGHT—FORD

All models are equipped with a red indicator light which flashes on when the oil pressure is below a safe value. The light should come on when the ignition switch is first turned on, and it should go out when the engine comes up to speed. The light is connected between the oil pressure switch unit and the accessory terminal of the ignition switch.

### TURN INDICATOR

Figs. 1 and 2, Part 15-2, show the turn indicator wiring diagrams.

### SPEEDOMETER

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft, and a drive gear located inside the transmission. The flexible shaft drives the speedometer which registers speed in miles per hour and also drives an odometer which records distance traveled in miles and tenths of a mile.

### CLOCK

Adjustment of the clock is automatic. If the clock runs slow or fast, merely reset the clock to the proper time. This action adjusts the clock automatically.

The clock fuse is in the fuse panel which is mounted on the dashboard above the brake pedal.

### WINDSHIELD WIPER

A single-speed and a two-speed electric wiper motor are available. Figure 7 shows the single-speed electric wiper motor circuit. Figures 3 and 4 show the two-speed electric wiper motor circuit.

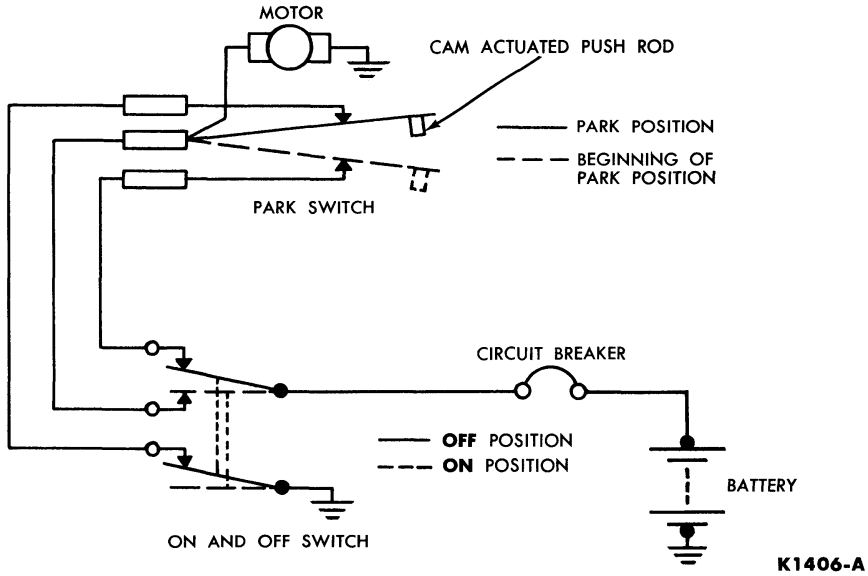



**FIG. 7—Single Speed Wiper Motor Circuit**

## 2 IN-CAR ADJUSTMENT AND REPAIR

### WINDSHIELD WIPER BLADE ADJUSTMENT

#### SINGLE-SPEED WIPER

The park position adjustment is made during assembly after overhaul. Follow the procedure outlined in the section covering assembly. Figure 7 shows a schematic diagram of the single-speed electric motor circuit.

#### TWO-SPEED WIPER

Turn the ignition switch to the accessory position momentarily, with the wiper control off. After bringing the pivot shafts to their rest positions, install the wiper blades so that they lie flat against the lower edge of the windshield.

## 3 REMOVAL AND INSTALLATION

### INSTRUMENT CLUSTER—FORD

1. Disconnect the battery cable.
2. Disconnect the speedometer cable at the speedometer head.
3. Remove the two nuts retaining the main wiring harness at the rear of the instrument panel.
4. Remove the cluster front cover.
5. Disconnect the instrument cluster wiring harness from the two retaining clips at the rear of the instrument panel.
6. Place a shop cloth on the steering column.
7. Remove the five instrument cluster assembly retaining screws from the instrument panel. Pull out the cluster and place it on the steering column.
8. Disconnect the wires to the fuel and temperature gauges, turn signal flasher, and constant voltage regulator.
9. Remove the lights from the instrument cluster.
10. Remove the cluster assembly.
11. Position the instrument cluster on the steering column and connect the fuel and temperature gauge leads, the constant voltage regulator leads, and the turn signal flasher leads (Fig. 10, Part 15-2). Install the instrument panel lights.
12. Install the instrument cluster assembly to the instrument panel.
13. Install the cluster front cover.
14. Install the instrument cluster wiring harness to the back of the instrument panel.
15. Connect the speedometer cable and the battery cable.
16. Check the operation of all gauges, lights, and signals.

### INSTRUMENT CLUSTER—MERCURY

1. Disconnect the battery cable.
2. Disconnect the speedometer cable at the speedometer head.
3. Place a shop cloth on the steering column.
4. Remove nine screws retaining the instrument cluster assembly to the instrument panel. Pull out the cluster and place it on the steering column.
5. Remove two nuts retaining the main wiring loom in the clips at the back of the cluster.
6. Remove the nut and disconnect the main wiring loom lead and the ammeter lead at the junction block in the center of the instrument cluster. Pull the ammeter lead out of the ammeter loop.
7. Disconnect the wires to the fuel, temperature, and oil pressure gauges, constant voltage regulator, and turn signal flasher.
8. Remove the lights from the instrument cluster.
9. Remove the cluster assembly.
10. Position the instrument cluster on the steering column. Connect the fuel, temperature, and oil pressure gauge leads, the constant voltage regulator leads, and the turn signal flasher leads. Install the instrument cluster lights.
11. Working beneath the instrument panel, run the ammeter lead through the ammeter loop in the direction shown in (Fig. 11, Part 15-2). Connect the ammeter lead and the main wiring loom lead at the junction block with one nut.
12. Install the main wiring harness in the clips at the back of the cluster and install the two retaining nuts.
13. Install the instrument cluster to the instrument panel with nine retaining screws.
14. Connect the speedometer cable and the battery cable.
15. Check the operation of all gauges, lights, and signals.

### GAUGES

To replace the fuel gauge, temperature gauge, oil pressure gauge, charge indicator gauge, speedometer, and cluster dial, it is necessary to remove the instrument cluster assembly.

### CONSTANT VOLTAGE REGULATOR

1. Disconnect the plug-on-type wire connectors at the constant voltage regulator.
2. Remove the regulator retaining screw and remove the regulator.
3. Install the constant voltage regulator in place with two retaining screws.
4. Connect the wires to the regulator. If the car is equipped with an FM-AM radio, make certain that the suppression choke is connected to the input terminal of the regulator.
5. Check the operation of the gauges.

### FUEL GAUGE—FORD

1. Remove the instrument cluster from the instrument panel and lay the instrument cluster assembly on the steering column.
2. Disconnect the fuel gauge wires and the two lights from the fuel gauge housing (Fig. 10, Part 15-2).
3. Remove the fuel gauge retaining screws and remove the fuel gauge assembly from the instrument cluster.
4. Position the fuel gauge to the instrument cluster, and install and tighten the retaining screws.
5. Install the lights and wires to the fuel gauge housing (Fig. 10, Part 15-2).
6. Install the instrument cluster assembly to the instrument panel.

### FUEL GAUGE—MERCURY

1. Remove the instrument cluster assembly.
2. Remove the five nuts retaining the front cluster bezel and remove the bezel.
3. Remove the two fuel gauge retaining nuts and remove the fuel gauge assembly from the instrument cluster.
4. Position the fuel gauge to the instrument cluster and install the two retaining nuts.

5. Position the front cluster bezel and install the five retaining nuts.
6. Install the instrument cluster assembly to the instrument panel.

### FUEL SENDING UNIT

1. Remove the fuel tank filler cap and siphon the fuel from the tank.
2. Disconnect the fuel gauge sending unit wire at the sending unit.
3. Loosen the hose clamp and disconnect the tank line at the sending unit.
4. Remove any dirt that has accumulated around the sending unit so that it will not enter the tank.
5. Turn the sending unit retaining ring counterclockwise and remove the unit, retaining ring, and mounting gasket.
6. Clean the fuel gauge sending unit mounting surface at the fuel tank.
7. Position the sending unit and mounting gasket to the fuel tank and secure with the retaining ring.
8. Connect the sending unit wire and fuel tank line.
9. Fill the tank with the fuel removed and install the filler cap.
10. Check the fuel gauge operation and check for leaks.

### TEMPERATURE GAUGE—FORD

1. Remove the instrument cluster from the instrument panel and lay the instrument cluster assembly on the steering column.
2. Disconnect the two lights and the wires from the temperature gauge housing (Fig. 10, Part 15-2).
3. Remove the temperature gauge to cluster retaining screws and remove the gauge assembly.
4. Position the temperature gauge assembly to the instrument cluster and install the retaining screws.
5. Connect the gauge wires and lights to the tempertaure gauge.
6. Install the instrument cluster to the intsrument panel.

### TEMPERATURE GAUGE—MERCURY

1. Remove the instrument cluster assembly.
2. Remove the five nuts retaining the front cluster bezel and remove the bezel.
3. Remove the two temperature gauge retaining nuts and remove the temperature gauge assembly from the instrument cluster.
4. Position the temperature gauge to the instrument cluster and install the two retaining nuts.
5. Position the front cluster bezel and install the five retaining nuts.
6. Install the instrument cluster assembly to the instrument panel.

### TEMPERATURE SENDING UNIT

1. Disconnect the temperature sending unit wire at the sending unit.
2. Prepare the new temperature sending unit for installation by applying a small amount of water resistant sealer C3AZ-19554-B to the threads.
3. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit.
4. Connect the wire to the temperature sending unit.
5. Start the engine and check the sending unit operation.

### CHARGE INDICATOR GAUGE —MERCURY

1. Remove the instrument cluster assembly.
2. Remove the five nuts retaining the front cluster bezel and remove the bezel.
3. Remove the two charge indicator gauge retaining screws and remove the charge indicator gauge assembly from the instrument cluster.
4. Position the charge indicator gauge to the instrument cluster and install the two retaining screws.
5. Position the front cluster bezel and install the five retaining nuts.
6. Install the instrument cluster assembly to the instrument panel.

### OIL PRESSURE SWITCH—FORD

The oil pressure switch used with the indicator light unit is mounted to the rear of the oil filter on the 289 engine, on top of the oil filter on the 352, 390, and 427 engines (Fig. 8), and on the right side of the engine just above the starter on the Mileage Maker Six engine. Torque to specifications.

### OIL PRESSURE SENDER—MERCURY

The oil pressure sender used with the oil pressure gauge is mounted on the left side of the engine to the rear of the fuel pump (Fig. 9).

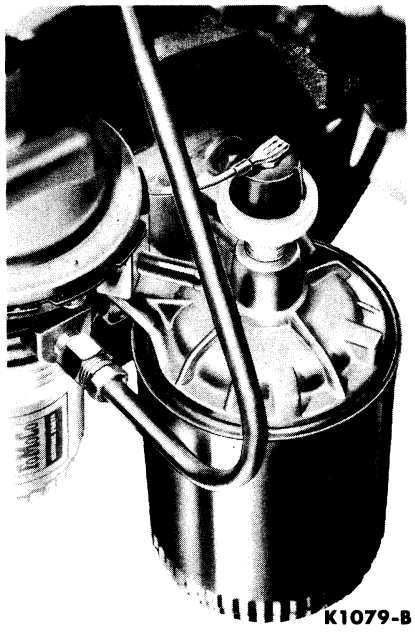



**FIG. 8—Oil Pressure Switch—Ford**

### OIL PRESSURE INDICATOR GAUGE—MERCURY

1. Remove the instrument cluster assembly.
2. Remove the five nuts retaining the front cluster bezel and remove the bezel.
3. Remove the two oil pressure gauge retaining nuts and remove the oil pressure gauge assembly from the instrument cluster.
4. Position the oil pressure gauge to the instrument cluster and install the two retaining nuts.

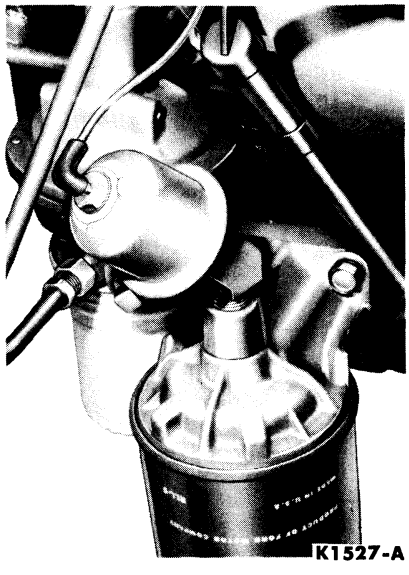



**FIG. 9—Oil Pressure Sender Mercury**

5. Position the front cluster bezel and install the five retaining nuts.

6. Install the instrument cluster assembly to the instrument panel.

### TURN INDICATOR

To remove the turn indicator switch, the steering wheel and horn contact ring must first be removed.

1. Remove the actuating lever mounting screw, and remove the actuating lever.

2. Remove the switch mounting bracket screws and remove the switch and bracket from the steering column.

3. Remove the conical tension spring, and remove the switch actuating arm.

4. Disconnect the switch wires at the bullet connectors, remove the wire protector from the side of the steering column, remove the switch to mounting bracket screws, and remove the switch and wires.

When installing the new switch, make certain that the canceling cam on the steering wheel makes contact with the canceling pawls on the switch. The clearance between the steering wheel hub and the steering shaft housing flange should not be more than 1/16 inch for proper switch canceling. Reposition the steering shaft housing if necessary. Torque the actuating lever attaching screw to specification.

### TURN INDICATOR FLASHER

The turn indicator flasher is located behind the instrument cluster (Figs. 10 or 11 Part 15-2). Disconnect the wires from the flasher unit terminals and pull the flasher from its retaining clip.

### HORN REPLACEMENT

The horns are mounted on the radiator left air deflector in the engine compartment. Disconnect the horn wire at the terminal, remove the horn to mounting bracket retaining nut and remove the horn from the mounting bracket.

To install, place the horn in position, and install the mounting nut. Install the horn wire.

### HORN RING REMOVAL—FORD

The horn button or horn ring can be removed by pressing down evenly and turning the button counterclockwise until it lifts out. It is advisable to disconnect the bullet connector (blue-yellow stripe), under the instrument panel to the left of the steering column, to prevent the horn from sounding during this operation.

To remove the horn contact and wire assembly, first remove the horn ring spring, the horn ring contact brush, and the steering wheel. Remove the wire cover on the left side of the steering column, remove the two contact retaining screws and remove the contact and wire assembly. When assembling the contact assembly to the steering column, position the assembly so that the wire clears the cut-away portion of the turn indicator assembly.

### HORN RELAY

The horn relay is mounted on the radiator left support assembly. Remove the mounting screws and disconnect the wiring plug from the relay.

### HORN RING REMOVAL—MERCURY

It is advisable to disconnect the bullet connector under the instrument panel to prevent the horn from sounding during this operation.

1. Remove the center steering wheel cover by pressing down and rotating counterclockwise.

2. Remove the two retaining screws in the center of the steering wheel and the one screw retaining the three horn wires.

3. Remove the three screws under the steering wheel retaining the horn ring and remove the horn ring.

4. Position the new horn ring and install the three retaining screws under the steering wheel.

5. Install the two retaining screws in the center of the steering wheel and the one screw retaining the three horn wires.

6. Install the center steering wheel cover and connect the bullet connector.

### SPEEDOMETER—FORD

1. Disconnect the battery cable.

2. Remove the instrument cluster assembly.

3. Remove the speedometer assembly retaining screws and remove the assembly from the instrument cluster.

4. Remove the speedometer assembly to housing retaining screws and remove the speedometer head.

5. Position the new speedometer head to the housing and install the two retaining screws.

6. Install the speedometer assembly in the instrument cluster.

7. Install the instrument cluster assembly.

8. Connect the battery cable.

### SPEEDOMETER—MERCURY

1. Remove the instrument cluster assembly.

2. Remove eight screws retaining the back of the instrument cluster to the front of the cluster and remove the back of the cluster.

3. Remove three retaining screws in the front of the speedometer head and two retaining screws in the rear and remove the speedometer head.

4. Position the new speedometer head in the back of instrument cluster and install two retaining screws in the rear and three retaining screws in the front.

5. Position the back of the instrument cluster to the front of the cluster and install the eight retaining screws.

6. Install the instrument cluster assembly to the instrument panel.

### SPEEDOMETER CABLE REPLACEMENT

To replace the speedometer drive cable, disconnect the cable housing at the speedometer, and pull the cable out of the housing. Wipe off all of the old lubricant. Lubricate the new cable with cable lubricant B5A-19581-A (do not over lubricate), insert it all the way into the housing, and twist it slightly to make sure that the squared drive is engaged in the speedometer driven gear. **If a speedometer cable is broken, it will be necessary to disconnect both ends of the cable housing in order to remove the broken sections. Tighten the mounting bolt to 20-25 foot-pounds torque.**

The speedometer driven gear is held on to the speedometer cable housing by a retainer clip (Fig. 10).

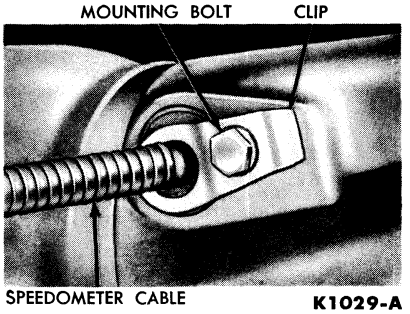



**FIG. 10—Speedometer Cable Mounting**

When replacing the driven gear, make certain that the gear is secure by placing the gear in position before inserting the retainer clip through the gear slots.

### CLOCK REPLACEMENT

1. Disconnect the clock dial light from the back of the clock.
2. Disconnect the clock feed wire at the clock.
3. Remove the clock assembly retaining nuts and remove the clock.
4. Position the new clock assembly on the instrument panel and install two of the retaining nuts.
5. Install the clock dial light.
6. Connect the clock feed wire.

### WINDSHIELD WIPER MOTOR

When removing the windshield wiper motor, note the sequence in which the wiper links and washers are installed on the motor output arm pins. Assemble them in the same position when installing the motor. This will eliminate binding or noisy wiper linkage after the motor has been installed.

To remove the wiper motor, proceed as follows:

1. Disconnect the wiper links at the motor output arm pins.
2. Remove the bolts retaining the wiper motor and lower the motor.
3. Disconnect the motor harness connector and remove the motor.
4. Connect the motor harness connector to the new motor.
5. Position the motor and install the retaining bolts.
6. Connect the wiper links at the motor output arm pins.
7. Check the wiper operation.

### WINDSHIELD WIPER SWITCH

1. Loosen the wiper swtich knob retaining screw and remove the knob.
2. Remove the wiper switch retaining bezel nut using tool 17470-N-51.
3. Remove the wiper switch assembly from the instrument panel.
4. Disconnect the wiper harness plug from the wiper switch.
5. Connect the wiper harness plug to the new wiper switch.
6. Place the wiper switch assembly in the instrument panel and install the retaining bezel nut using tool 17470-N-51.
7. Install the wiper switch knob and tighten the retaining screw.
8. Check the wiper switch operation.

### WINDSHIELD WIPER PIVOT SHAFT AND LINK

1. Remove the windshield wiper arm and blade.
2. Disconnect the wiper link at the motor output arm pin. **Be sure to note the sequence in which the link and washers are installed on the pin for assembly.**
3. Remove the wiper pivot shaft nut and washer and remove the pivot shaft and link assembly.
4. Install the wiper pivot shaft and link assembly and install the washer and nut.
5. Install the link and washer to the motor output arm pin in the same position from which they were removed.
6. Install the windshield wiper blade and arm.

## 4 MAJOR REPAIR OPERATIONS

### DISASSEMBLY

### SINGLE-SPEED ELECTRIC WIPER MOTOR

A disassembled view of the single-speed wiper motor is shown in Fig. 11.

1. Remove the gear cover retaining screws, ground terminal and cover.
2. Remove the idler gear retainer, thrust washer and idler gear.
3. Remove the motor through bolts, motor housing, switch terminal insulator sleeve, and armature.

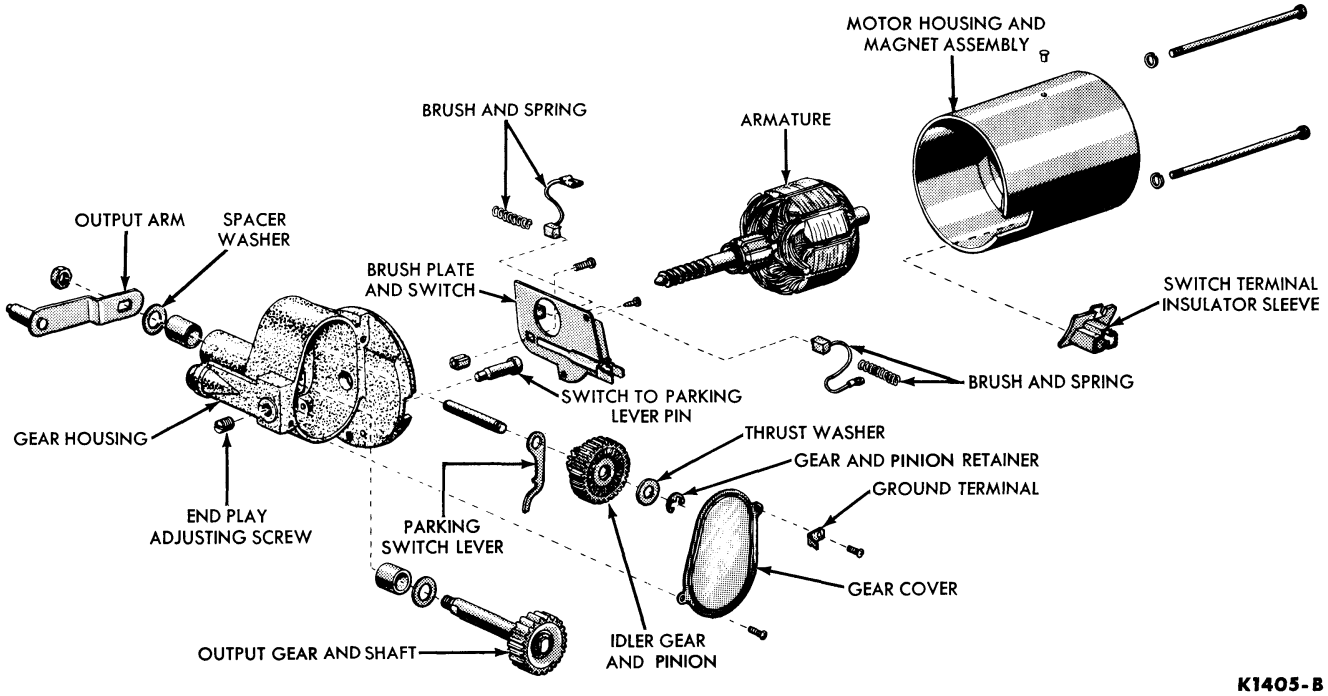



**FIG. 11—Disassembled Single-Speed Wiper Motor**

**Do not pound the motor housing magnet assembly as the ceramic magnets may be damaged.**

4. Remove the armature end play adjusting set screw.

5. Mark the position of the output arm with respect to the output shaft, for assembly. Remove the output arm retaining nut, output arm flat washer, output gear and shaft assembly, thrust washer, and parking switch lever.

6. Remove the brushes and brush springs.

7. Remove the brush plate and switch assembly, and remove the switch contact to parking lever pin from the gear housing.

### TWO-SPEED ELECTRIC WIPER MOTOR–FORD

The two-speed electric motor may be disassembled for service of the drive mechanism parts.

1. Remove the gear housing cover plate and gasket (Fig. 12).

2. Remove the output shaft retainer and spacer washer.

3. Remove the crankpin bearing retainer and remove the spacer washer and cam return spring assembly.

4. Remove the arm and link assembly.

5. Remove the crankpin bearing cam.

6. Remove the input gear retainer and outer spacer shim, and remove the input gear and inner spacer shim.

7. Remove the wiper arm lever nut and lock washer.

8. Remove the wiper arm lever and spacer, and remove the output shaft and gear assembly from the housing.

9. The output gear may be removed from its shaft by tapping with a fiber hammer. Be careful not to damage the end of the shaft.

The worm drive gear and armature assembly is not serviced.

### PARTS REPAIR OR REPLACEMENT

All serviced parts on both the single speed and two-speed wipers are replaced and not repaired.

### ASSEMBLY

### SINGLE-SPEED ELECTRIC WIPER MOTOR

1. Install the parking switch lever on the idler gear shaft with the cam rider pointing toward the gear housing output shaft hole. Make certain that the lever bottoms against the casting.

2. Apply a film of Sun Prestige grease to the output gear teeth and shaft bearing surface. Place the thrust washer on the shaft and insert the shaft in the bearing. Make certain that the parking switch lever is clear of the cam and gear assembly.

3. Place the spacer washer on the shaft, position the output arm on the shaft in the marked position from which it was removed, and install the mounting nut.

4. Position the brush springs and brushes in the holders and wrap wire around them to hold them in the fully retracted position. Push the insulated brush connector onto the switch terminal.

5. Place the switch-contact to parking-lever pin in the gear housing. Position the brush plate assembly to the housing and install the mounting screws. Adjust the switch contact points by turning the adjusting screw clockwise until the inner contact points just open. Then back off the adjusting screw (counterclockwise) one and one half turns. Make this adjustment with the parking lever riding on the lower part of the output gear cam. Then insert a 0.030-inch feeler gauge between the center and outer contact points. Bend the outer arm to attain the 0.030-inch gap.

6. Apply Sun Prestige grease to the ball bearing in the end of the armature shaft. Position the armature shaft in the gear housing and remove the brush retracting wires.

7. Holding the armature in position, install the terminal insulating sleeve, motor housing and magnet assembly, and through bolts. Seal the area where the terminal insulator sleeve seats against the motor and gear housings.

8. Apply Sun Prestige grease to the worm gear and idler gear, and install the idler gear, thrust washer and retainer.

9. Install the armature shaft end play adjusting screw and adjust the end play to 0.003-inch.

10. Apply a generous amount of Sun Prestige grease to the area around the end of the armature shaft. Install the gear housing cover and ground terminal.

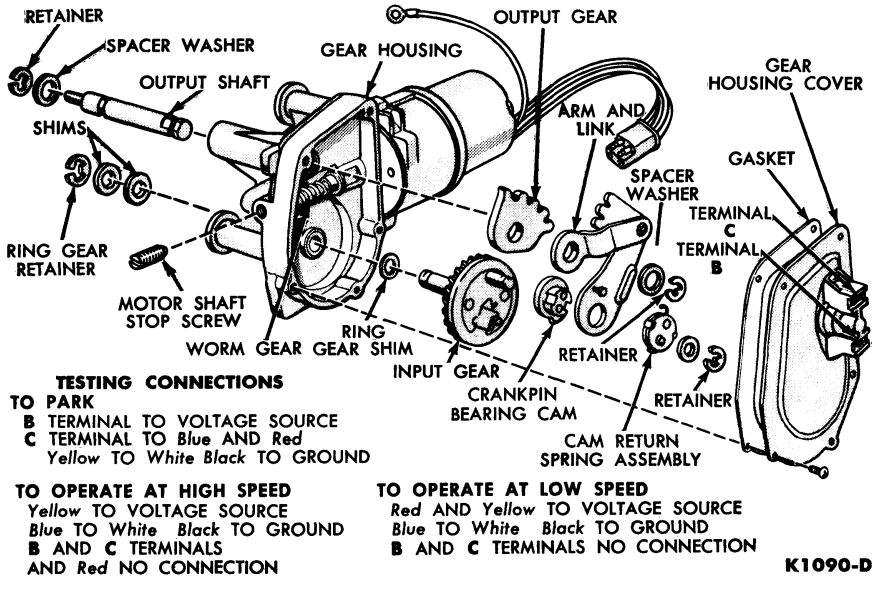



**FIG. 12–Two-Speed Wiper Motor**

### TWO-SPEED ELECTRIC WIPER MOTOR–FORD

1. Tighten the motor cover. Adjust the motor shaft end play to 0.000-0.005 inch by turning the shaft stop screw. Measure with a feeler gauge between the stop screw and the motor shaft.

2. Install the input gear shim on the input gear shaft and install the gear in the housing. Adjust the end play to 0.005 to 0.010 inch by adding or removing shims under the input gear retainer. Install the retainer.

3. Install the output gear on the output shaft. Make sure that the gear is bottomed on the shaft.

4. Install the output shaft and

gear assembly into the housing with the gear teeth facing the motor. Install one spacer washer to the outside end of the output shaft and assemble the wiper arm lever to the output shaft, with the linkage studs facing away from and above the shaft. Secure the lever with a lock washer and nut.

**5.** Place the bearing cam on the crankpin with the small diameter portion of the cam facing outward.

**6.** Install the arm and link assembly to the bearing cam. As the arm is placed on the shaft, the gears must be meshed and the link which is riveted to the arm must be installed to the output shaft at the same time. Proper gear indexing is obtained when the bottom tooth of the arm and gear segment will be in mesh with the bottom valley of the output shaft gear.

**7.** Install the output shaft spacer washer and retainer. Check the end play of the output shaft (0.005-0.010 inch). Remove or install spacer washers under the shaft retainer to adjust the end play.

**8.** Install the cam return spring assembly.

**9.** Install the bearing spacer and retainer. If the retainer cannot be installed, one or more coils of the spring clutch are probably out of place. If the bearing has excessive end play on the crankpin, the projection of the bearing may ride out of the semi-circle slot in the end plate. Add spacer washers under the retainer if necessary.

**10.** Apply generous amounts of Sun Prestige grease to all moving parts. Install the gear housing cover plate.

**When operating the unit on the bench, do not place hands or fingers between the wiper lever and the case, or inside the gear housing, as considerable power is developed by the gear reduction.**

# PART 15-5 SPECIFICATIONS

## FORD CIRCUIT PROTECTION

| Circuit | Protective Device | Location |
|---|---|---|
| Headlights | Circuit Breaker | Incorporated in Lighting Switch |
| Instrument Panel, Dome, and All Exterior Lights, Except Headlight | 3AG-15 or AGC-15 Fuse | Fuse Panel on Lighting Switch |
| Turn Signals and Back-up | SFE-7.5 Fuse | Fuse Panel on Lighting Switch |
| Radio | SFE-7.5 Fuse | Fuse Panel on Lighting Switch |
| Heater Blower | SFE-14 Fuse | Fuse Panel on Lighting Switch |
| Electric Windshield Wiper (Single Speed)<br>(Dual Speed) | Circuit Breaker<br>Circuit Breaker | On Edge of Instrument Panel—<br>Left of Steering Column |
| Cigar Lighter | 14 Amp. Fuse | On Back of Cigar Lighter Socket |
| Air Conditioner | 3AG-15 or AGC-15 Fuse | Cartridge in Feed Wire |
| Spot Light | SFE-7.5 | Cartridge in Feed Wire |
| Overdrive | AGC-15 or 3AG-15 Fuse | On Overdrive Relay |
| Instrument Panel Light Rheostat | SFE-4 Fuse | Cartridge in Feed Wire |
| Clock | 1AG-2 or AGA-2 | Fuse Panel on Lighting Switch |

## MERCURY CIRCUIT PROTECTION

| Circuit | Protective Device | Location |
|---|---|---|
| Headlights | Circuit Breaker | Incorporated in Lighting Switch |
| Instrument Panel, Dome, and All Exterior Lights, Except Headlight | 3AG-15 or AGC-15 Fuse | Fuse Panel on Lighting Switch |
| Turn Signals and Back-up | SFE-14 Fuse | Fuse Panel on Lighting Switch |
| Radio | SFE-7.5 Fuse | Fuse Panel on Lighting Switch |
| Heater Blower | SFE-14 Fuse | Fuse Panel on Lighting Switch |
| Electric Windshield Wiper (Single Speed)<br>(Dual Speed) | Circuit Breaker<br>Circuit Breaker | On Edge of Instrument Panel—<br>Left of Steering Column |
| Cigar Lighter | Reset Circuit Breaker | |
| Air Conditioner | 3AG-15 or AGC-15 Fuse | Cartridge in Feed Wire |
| Spot Light | SFE-7.5 | Cartridge in Feed Wire |
| Overdrive | AGC-15 or 3AG-15 Fuse | On Overdrive Relay |
| Instrument Panel Light Rheostat | SFE-4 Fuse | Cartridge in Feed Wire |
| Clock | 1AG-2 or AGA-2 | Fuse Panel on Lighting Switch |

## FORD BULB CHART

| Unit | Candle Power or Wattage | Trade Number |
|---|---|---|
| Headlight No. 1 (Inner) | 37.5 W. | 4001 |
| Headlight No. 2 (Outer) | 37.5/50 W. | 4002 |
| Front Turn Signal/Parking | 4/32 C.P. | 1157 |
| Rear Turn Signal & Stop/Tail | 4/32 C.P. | |
| License Plate | 4 C.P. | 1155 |
| Back-up Lights | 21 C.P. | 1141 |
| Spot Light | 30 W. | 4405 |
| Dome Light | 15 C.P. | 1003 |
| Instrument Panel Indicators: | | |
| Hi Beam | 2 C.P. | 1895 |
| Oil Pressure | 2 C.P. | 1895 |
| Generator | 2 C.P. | 1895 |
| Turn Signal | 2 C.P. | 1895 |
| Parking Brake Warning | 2 C.P. | 1895 |
| Illumination | | |
| Speedometer | 1.5 C.P. | 1445 |
| Cluster | 2 C.P. | 1895 |
| Heater Control | 2 C.P. | 158 |
| Clock | 2 C.P. | 1895 |
| Radio Dial | 2 C.P. | 1891 |
| Courtesy and/or Map (Door Mounted) | 15 C.P. | 1003 |
| Automatic Transmission Control | 1 C.P. | 161 |

## MERCURY BULB CHART

| Unit | Candle Power or Wattage | Trade Number |
|---|---|---|
| Headlight No. 1 (Inner) | 37.5 W. | 4001 |
| Headlight No. 2 (Outer) | 37.5/50 W. | 4002 |
| Front Turn Signal/Parking | 4/32 C.P. | 1157 |
| Rear Turn Signal & Stop/Tail | 4/32 C.P. | 1157 |
| License Plate | 4 C.P. | 1155 |
| Back-up Lights | 21 C.P. | 1141 |
| Spot Light | 30 W. | 4405 |
| Dome Light | 15 C.P. | 1003 |
| Instrument Panel Indicators: | | |
| Hi Beam | 2 C.P. | 1895 |
| Oil Pressure | 2 C.P. | 1895 |
| Generator | 2 C.P. | 1895 |
| Turn Signal | 2 C.P. | 1895 |
| Parking Brake Warning | 2 C.P. | 1895 |
| Illumination | | |
| Speedometer | 1.5 C.P. | 1445 |
| Cluster | 2 C.P. | 1895 |
| Heater Control | 2 C.P. | 158 |
| Clock | 2 C.P. | 158 |
| Radio Dial | 2 C.P. | 1891 |
| Courtesy and/or Map (Door Mounted) | 15 C.P. | 1003 |
| Automatic Transmission Control | 1 C.P. | 161 |

# VENTILATING, HEATING, AND ACCESSORIES

# GROUP 16


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# PART 16-1 GENERAL VENTILATING, HEATING, AND ACCESSORIES SERVICE


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1 Diagnosis and Testing ..... 16- 1
2 Cleaning and Inspection ..... 16- 5


## 1 DIAGNOSIS AND TESTING

### VENTILATING AND HEATING DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **INSUFFICIENT OR NO HEAT** | **1.** Burned out fuse or loose wires to the heater blower.<br>**2.** Defective motor ground.<br>**3.** Fan loose on motor shaft or motor stalled.<br>**4.** Defective heater blower switch.<br>**5.** Defective blower motor.<br>**6.** A kinked, clogged, or collapsed water hose. | **7.** Improperly connected heater hoses.<br>**8.** Plugged heater core.<br>**9.** Improperly installed or defective engine thermostat.<br>**10.** Incorrectly installed and adjusted control cables.<br>**11.** Air leaks in the body. |
| **INSUFFICIENT OR NO DEFROSTING** | **1.** Improperly adjusted defroster control cable.<br>**2.** Disconnected defroster hose.<br>**3.** Binding defroster valve. | **4.** Plugged or loose defroster nozzle.<br>**5.** Obstructed defroster openings at windshield. |
| **TOO MUCH HEAT** | **1.** Check for an incorrectly adjusted blend-air valve. | |

### AIR CONDITIONING DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **INSUFFICIENT OR NO COOLING** | **1.** Inoperative magnetic clutch.<br>**2.** Inoperative blower motor, or switch.<br>**3.** Obstructed air passages.<br>**4.** Complete loss of charge. (No bubbles in sight glass at system start up.) | **5.** Partial loss of charge. (Continuous bubbles in sight glass after start up.)<br>**6.** Service valves improperly set.<br>**7.** Inoperative vacuum Servo.<br>**8.** Suction pressure low, discharge pressure OK. |

CONTINUED ON NEXT PAGE

## AIR CONDITIONING DIAGNOSIS GUIDE (Continued)

| | | |
|---|---|---|
| **INSUFFICIENT OR NO COOLING (Continued)** | **9.** Suction pressure high, discharge pressure OK.<br>**10.** Discharge pressure low, suction pressure high.<br>**11.** Compressor defective, or loose or broken compressor belt.<br>**12.** A/C thermostat defective. | **13.** Clutch lead disconnected or broken.<br>**14.** Expansion valve inoperative—stays open or closed.<br>**15.** Plugs left in compressor under service valve. |
| **NOISY COMPRESSOR** | **1.** Loose, torn, or misaligned belt.<br>**2.** Loose, or slipping clutch. | **3.** Foreign material or damaged parts in compressor.<br>**4.** Compressor loose on bracket. |
| **COMPRESSOR VIBRATION** | **1.** Broken or loose mounting bracket. | **2.** Loose clutch.<br>**3.** Loose belt. |

## RADIO DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **NO RECEPTION** | **1.** Burned out fuse.<br>**2.** Reversed battery polarity.<br>**3.** Defective antenna.<br>**4.** Shorted speaker lead or defective speaker.<br>Be sure that proper voltage is available at the set then substitute the known good antenna and speaker. | |
| **NOISY OR ERRATIC RECEPTION** | **NOISY RECEPTION—ENGINE NOT RUNNING**<br>**1.** Loose connections.<br>**NOISY RECEPTION—ENGINE RUNNING**<br>**1.** Defective suppression equipment.<br>**2.** Suppression condensers not properly grounded.<br>**3.** Receiver not properly grounded to instrument panel.<br>**NOISY RECEPTION—CAR IN MOTION**<br>**1.** Loose or broken lead-in cable.<br>**2.** Loose or defective radio antenna.<br>**3.** Defective wheel static collectors. | |
| **DISTORTED OR GARBLED SOUND** | **1.** Voice coil rubbing on center pole piece of speaker magnet (either front or rear speaker).<br>**2.** Torn speaker cone.<br>**3.** Foreign material on cone.<br>**4.** Bent or twisted speaker mounting. | |
| **WEAK RECEPTION** | **1.** Beyond normal reception distance from station (FM only).<br>**2.** Defective antenna. If FM reception is poor be sure that antenna is at 30-32 inch height before trying a new antenna. | |

## SPEED CONTROL DIAGNOSIS GUIDE

| | | |
|---|---|---|
| **BLOWING FUSES** | **1.** Short or ground in the wiring circuit (Fig. 1). | |
| **NO SPEED CONTROL RESPONSE** | **1.** Accelerator linkage is broken or disconnected.<br>**2.** Drive cable broken or disconnected.<br>**3.** Blown fuse.<br>**4.** Loose connections or broken wires. (Internal or external.) | |
| **CONSTANT PRESSURE ON ACCELERATOR PEDAL REGARDLESS OF SELECTOR SETTING** | **1.** Blown fuse.<br>**2.** No current at No. 2 terminal.<br>**3.** Control cable is improperly adjusted.<br>**4.** Inoperative motor or locked drive screw. | |
| **AUTOMATIC CONTROL DOES NOT ENGAGE WHEN THE SLIDE SWITCH IS MOVED TO LOCK** | **1.** No current at No. 3 terminal.<br>**2.** Brake release switch improperly adjusted. | |

CONTINUED ON NEXT PAGE

**SPEED CONTROL DIAGNOSIS GUIDE (Continued)**

| | |
|---|---|
| **AUTOMATIC CONTROL REMAINS ENGAGED WHEN THE BRAKE PEDAL IS DEPRESSED** | 1. Brake switch improperly adjusted. 2. Inoperative brake switch. |
| **PULSATING ACCELERATOR PEDAL** | 1. Speedometer cable or drive cable kinked. 2. Lack of lubrication on cables. 3. Improper accelerator linkage adjustment. |
| **CARBURETOR DOES NOT RETURN TO NORMAL IDLE** | 1. Improper carburetor or accelerator linkage adjustment. |
| **SPEEDOMETER DOES NOT REGISTER OR THE UNIT DOES NOT OPERATE** | 1. Speedometer drive gear in the transmission damaged. 2. Broken drive cable from the transmission to the power unit. 3. Broken speedometer cable. 4. Defective speedometer. |
| **SPEEDOMETER NOISE** | 1. Cables bent or kinked. 2. Lack of cable lubrication. 3. Noisy speedometer head. |

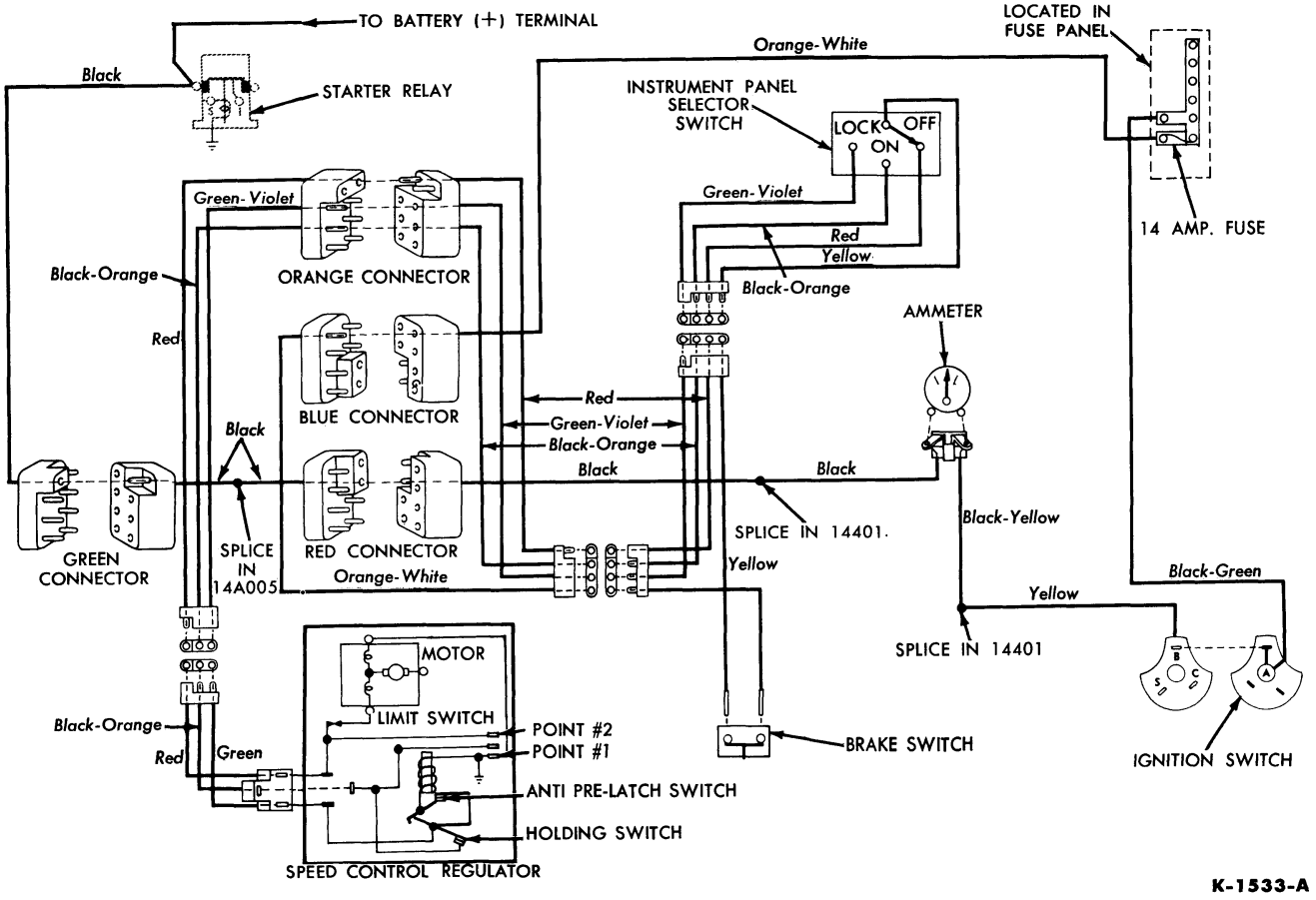



**FIG. 1 – Speed Control Wiring Diagram**

## TESTING VENTILATING AND HEATING

### HEATER CURRENT DRAW TEST

Connect a 0-50 ammeter as shown in Fig. 2. The blower motor will operate independently of the control switch, and the current draw of the motor will be indicated on the ammeter. Normal current draw should be to specifications.

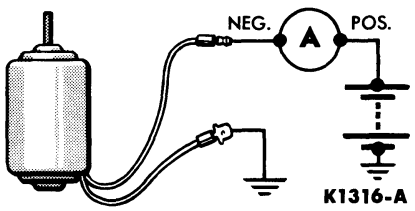



**FIG. 2—Heater Motor Current Draw Test**

## AIR CONDITIONING

### CHECKING FOR LEAKS

Attach the manifold gauge set (Fig. 3). Leave both manifold gauge valves at the maximum clockwise position. Set both service valves at the center position. Both gauges should now show approximately 60 to 80 pounds pressure at 75°F. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and set the low pressure manifold gauge valve to the counterclockwise position. This opens the system to tank pressure. Check all connections, and the compressor shaft seal for leaks, using a flame-type leak detector (Fig. 4). Follow the directions with the leak detector. The smaller the flame the more sensitive it is to leaks. Therefore, to insure accurate leak indication keep the frame as small as possible. The copper element must be red hot. If it is burned away, replace the element. Hold the open end of the hose at each suspected leak point for two or three seconds. The flame will normally be almost colorless. The slightest leak will be indicated by a bright color to the flame. Be sure to check the manifold gauge set and hoses for leaks as well as the rest of the system.

**If the surrounding air is permeated with refrigerant gas, the leak detector will indicate this gas all the time. Good ventilation is necessary to prevent this situation. A fan, even in a well ventilated area, is very helpful in removing small traces of refrigerant vapor.**

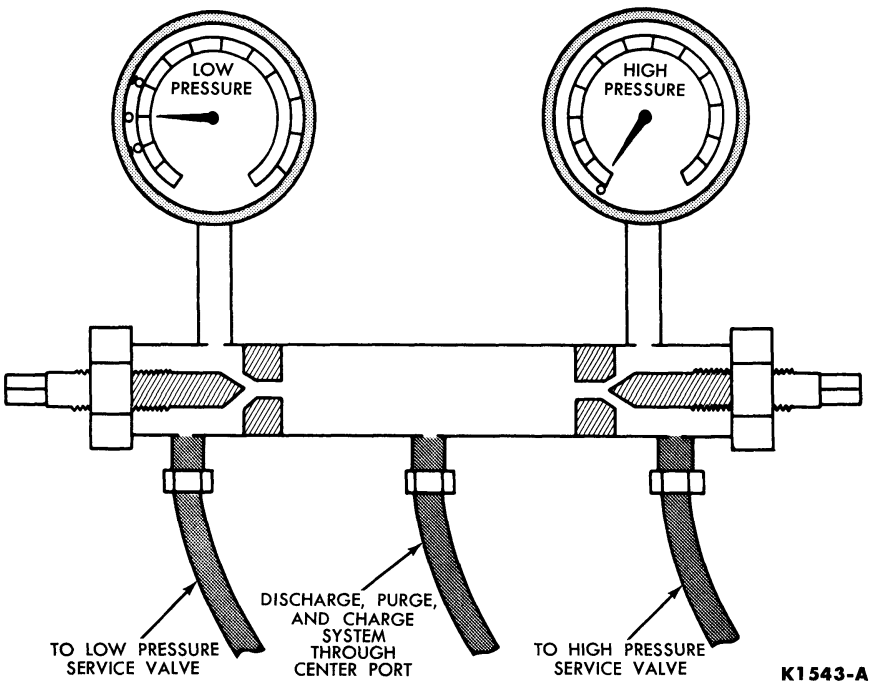



**FIG. 3—Manifold Gauge Set**

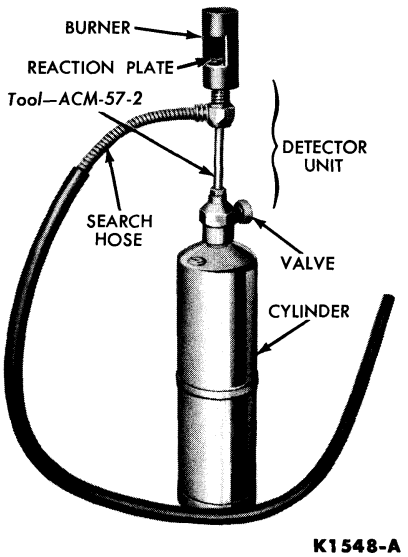



**FIG. 4—Torch Type Leak Detector**

## SPEED CONTROL

### PERFORMANCE CHECKS

After servicing the speed control unit, the car should be road tested for proper operation of the speed control in both the manual and automatic control positions. **The speed control unit cannot be tested with the car on a hoist or jack.**

**Manual Operation**

1. Set the selector dial for any desired speed.
2. With the car in motion, a resistance should be felt at the accelerator pedal when the pre-selected speed is reached.
3. While holding the accelerator pedal against the back pressure the vehicle should maintain a constant speed at the selected setting even when traveling up or down hills.
4. Push through the accelerator resistance to increase car speed above the speed control selector setting. The resistance should continue at all speeds above the pre-set speed.
5. Check to see if the selected car speed can be increased or decreased at any time by turning the selector dial. The accelerator pedal must be held against the back pressure during this test.

**Automatic Operation.** Before road testing the car for automatic operation, the speed control system should be tested for cancellation when the brake pedal is depressed.

1. Turn the ignition switch to the ACC position.
2. Press the accelerator pedal to the floor. Push the slide switch to lock.
3. Release the slide switch and the accelerator pedal. The speed control should hold the accelerator pedal in the full throttle position.

4. Depress the brake pedal ¼ inch. The accelerator pedal should return to the normal position.

5. Road test the car and set the selector knob to any desired speed.

6. When the pre-set speed is reached, hold the accelerator pedal against the resistance and push the slide switch to lock.

The car speed should now be automatically controlled and maintain the selected speed.

7. Test to see if the speed can be increased or decreased by turning the dial.

8. Again test to see if the automatic speed control cancels by lightly depressing the brake pedal or by turning the ignition switch to the OFF position. **It is not necessary to change the speed setting when re-engaging the automatic speed control. It can only be engaged when the selected speed is reached and the accelerator pedal is held against the resistance pressure when the slide switch is pushed to lock.**

9. Disengage unit by moving switch to OFF position.

## 2 CLEANING AND INSPECTION

### AIR CONDITIONING

On compressor clutch installations, carefully remove any burrs or dirt that may be on the compressor shaft. The shaft must be dry and brightly polished. Then install the key in the shaft.

When compressor is disassembled, completely clean up all surfaces of shreds and foreign objects.

If compressor shaft seal is being replaced, inspect the compressor internally and clean out dirt or chips as required.

When installing new control assembly or parts, inspect for dirt and foreign objects. Also check for cleanliness of hoses and that they are not pinched, or cracked.

(See also "Ventilating and Heating," this section.)

### COMPRESSOR OIL LEVEL CHECK

Under normal conditions, when the air cooling system is operating satisfactorily, the compressor oil level need not be checked. There is no place for the oil to go except inside the sealed system. When the car is first started, some of the oil will be pumped into the rest of the system. After 15 minutes of operation, most of the oil is returned to the compressor crankcase.

**Check the compressor oil level only if a portion of the refrigerant system is being replaced, or if there was a leak in the system and the refrigerant is being replaced.**

Check the oil after the system has been charged and has been operating at an engine speed of 1500 rpm for 15 minutes in 60°F. surrounding air temperature or above. Turn off the engine, and isolate the compressor. (See "In-Car Adjustments and Repairs," Part 16-2.) Remove the oil filler plug from the compressor; insert a flattened ⅛-inch diameter rod (Fig. 5) in the oil filler hole until it bottoms. The rod should show ⅞ inch of oil. This is equivalent to 11 ounces of oil on Tecumseh compressors. On York compressors, the measurement should be ¾ inches. This is equivalent to 10 ounces of oil. It may be necessary to rotate the compressor crankshaft slightly (by hand) so that the dip rod will clear the crankshaft. If additional oil is needed in the compressor, add Suniso 5 or Capella E refrigerator compressor oil or equivalent.

If more than ⅞ inch of oil is indicated, as might happen if a new compressor is installed and oil already in the system is pumped back to the compressor, draw out the excess oil until the proper quantity is indicated.

Replace the oil filler plug, then evacuate and connect the compressor back into the system. Be sure to check the compressor filler opening for leaks.

### CHECKING SYSTEM PRESSURES

The pressures developed on the high pressure and low pressure side of the compressor indicate whether or not the system is operating properly.

Attach the manifold gauge set (Fig. 3). It will not be necessary to attach the Refrigerant-12 tank unless refrigerant is to be added to the system. Set both manifold gauge valves at the maximum clockwise, or closed, position. Set both service valves at the center position.

**Check the system pressures with the engine running at 1500 rpm, all controls set for maximum cooling, and the front of the car at least 5 feet from any wall.**

The actual pressures indicated on the gauges will depend on the temperature of the surrounding air and the humidity. Higher air temperatures along with low humidity, will give higher system pressures. The lowest figures given are for an ambient (surrounding air) temperature of 75°F., 50% relative humidity.

The low pressure gauge should indicate a pressure of from 12-50 pounds. The high pressure gauge should indicate a pressure 6 or 7 times the low pressure or 80-300 pounds.

**At idle speed and a surrounding air temperature of 100°-110°F., the high pressure may go as high as 300 pounds or more.** If it becomes necessary to operate the air conditioner under these conditions, keep the high pressure down with a fan directed at the condenser and radiator.

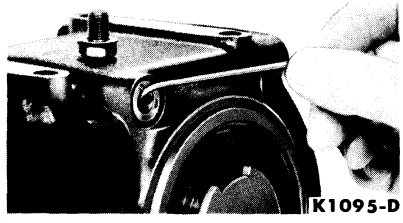



**FIG. 5—Compressor Oil Level Check**

# PART 16-2 VENTILATING AND HEATING


| Section | | Page |
|---|---|---|
| 1 | Description and Operation | 16- 6 |
| 2 | In-Car Adjustments and Repairs | 16- 8 |
| 3 | Removal and Installation | 16- 8 |


## 1 DESCRIPTION AND OPERATION

The Magic-Aire heater used on Ford and Mercury cars is of fresh air, blend air design. It operates in conjunction with the fresh air ventilating system.

Fig. 1 illustrates the typical car installation.

### OPERATING PRINCIPLES

Incoming fresh air enters the car through a grille running the full width of the cowl. The grille is open at all times. A trough directly under the grille collects any water that may enter and directs it to drain tubes on either side of the car.

The fresh air intake chamber connects to the passenger compartment through two air vent outlets on either side of the car under the instrument panel. Valves in the air vent outlets are controlled by the air control knobs on the right and left of the steering column. The heater blower couples to an opening in the right fresh air duct. An air valve in the heater plenum chamber is operated by the air control lever (bottom lever) in the heater control panel. These controls allow the selection of outside air for ventilation, heating, or defrosting.

### HEATER CONTROL OPERATION

The air temperature is controlled by the temperature control lever (top lever Fig. 3) in the heater control panel. The lever actuates the heat control valve in the heater blower housing (Fig. 2). The heat

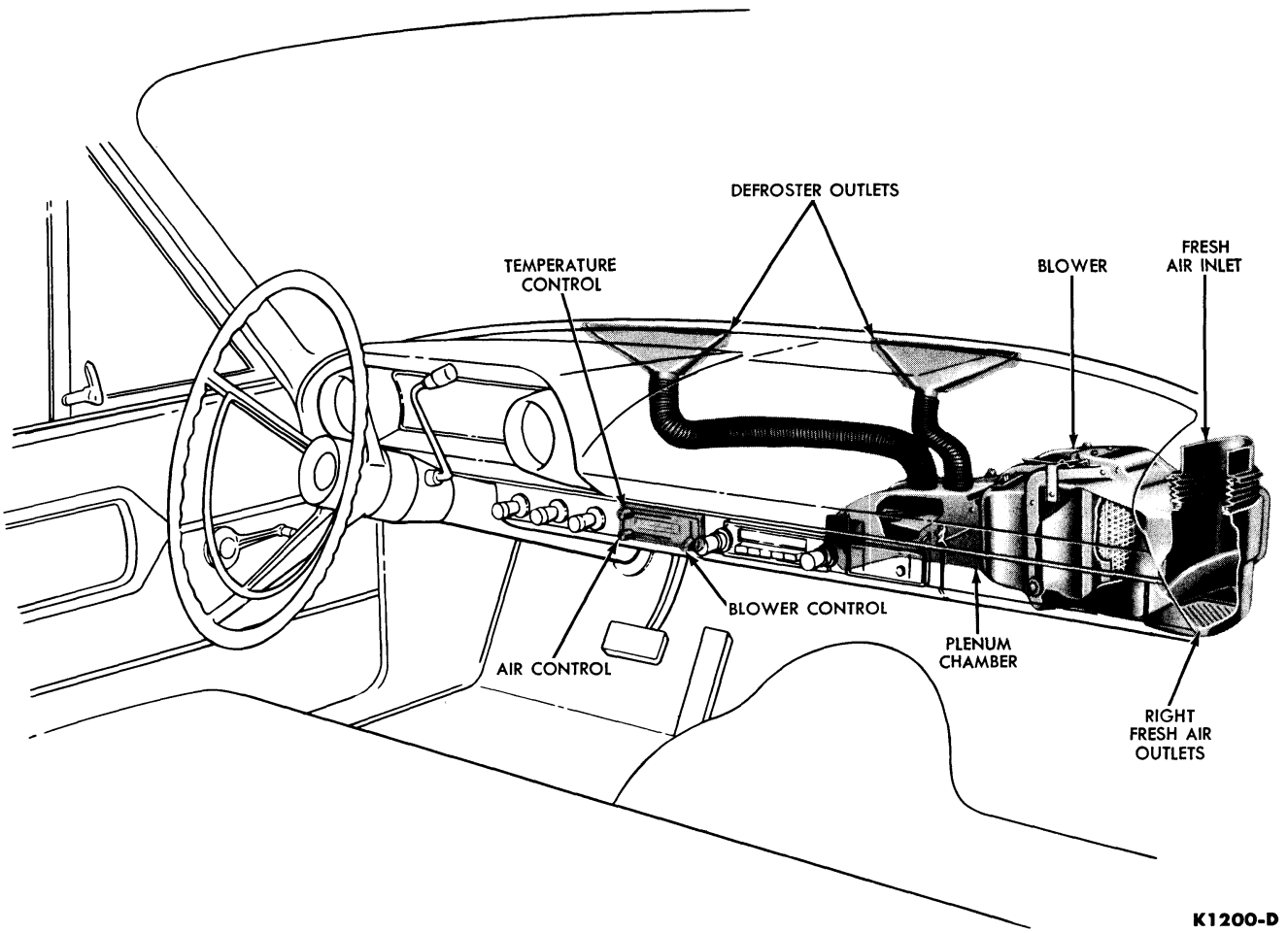



**FIG. 1—Heater Installation—Typical**

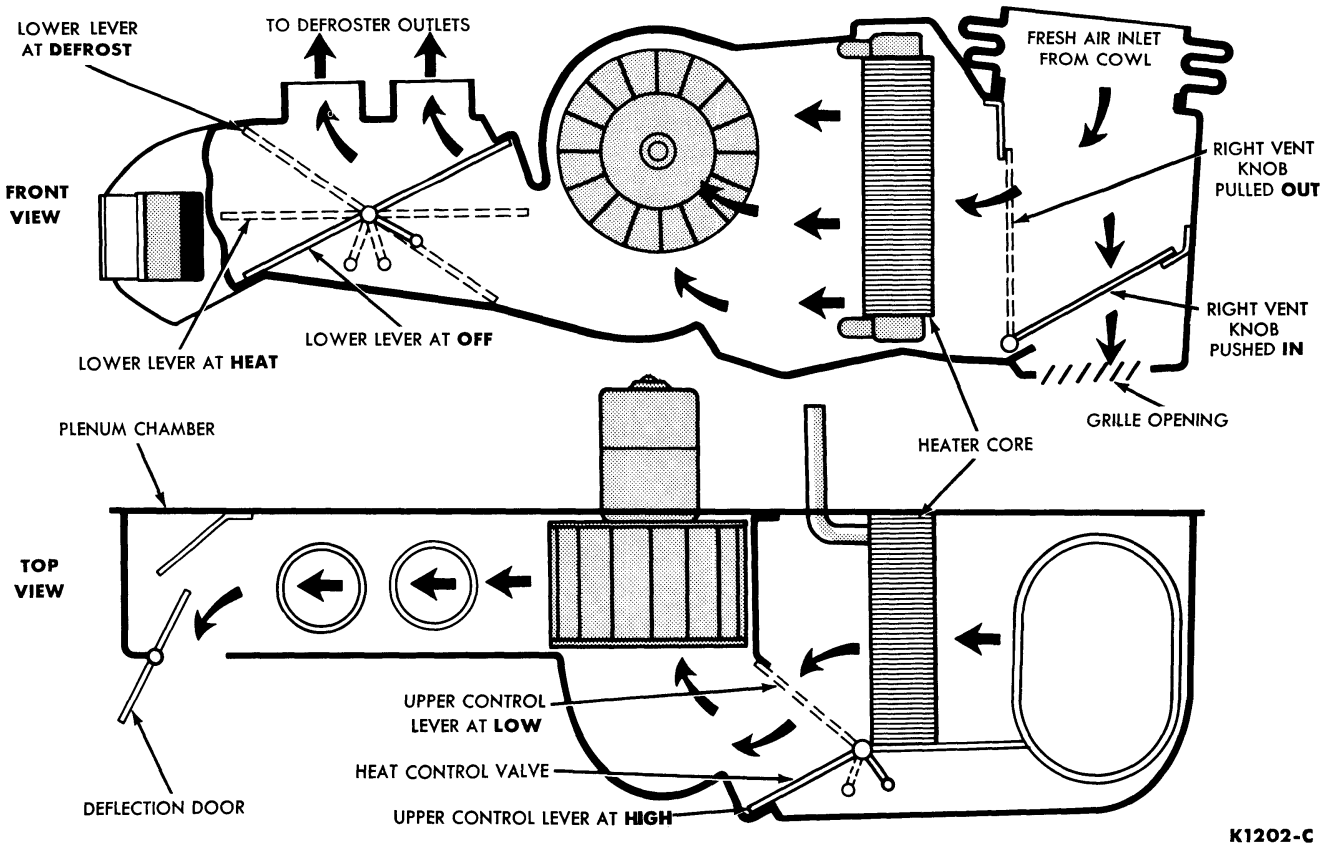



**FIG. 2—Heater—Air Flow—Typical**

control valve controls the amount of air flow through the heater core. Any intermediate position of the heat control valve allows both cool and heated air to be mixed in the plenum chamber for lower than maximum temperatures.

The defroster control (bottom lever Fig. 3), operates a valve in the plenum chamber (Fig. 2). When the defroster is fully on, the valve closes the plenum chamber outlet, causing maximum flow of air to the defroster. The distribution of air between the defroster and the plenum chamber is regulated by the position of the control lever between HEAT and DEFROST. The OFF position closes the plenum outlet when air flow is not desired.

Three speed ranges are provided for the blower fan by means of a four position switch and resistors (Fig. 4). The plenum chamber contains several outlets that serve as nozzles to direct the air downward to the floor. The air then flows under the front seat and circulates through the entire passenger compartment. A door in the front of the plenum chamber allows discharged air to be directed in various directions.

When the right vent air control knob is pushed in, fresh air is directed through the heater.

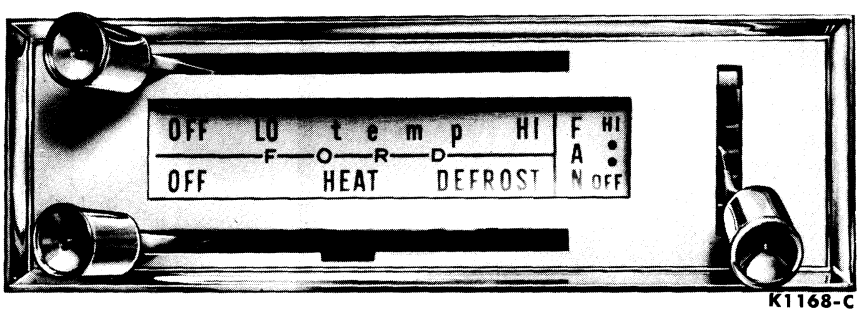



**FIG. 3—Heater Controls—Ford**

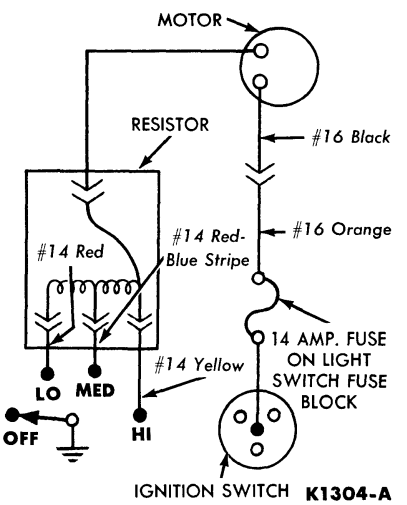



**FIG. 4—Heater Motor Circuit**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### HEATER CONTROL ADJUSTMENT

The upper lever of the control assembly is connected to the heat control valve. The control cable must be so adjusted that when the upper control lever is ⅛ inch from the left of the control head slot (Fig. 3), the valve closes the outlet from the heater core (valve crank maximum clockwise Fig. 5). Make this adjustment at the control head (Fig. 7).

With the lower lever at the center (heat) position, adjust the defroster valve so that the valve crank is centered between the dots (Fig. 6).

Adjust the right and left air vent valves so that they are closed when the air control knobs are approximately 1/16 inch from the all-the-way-in position.

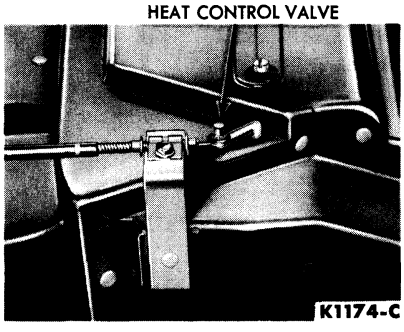



FIG. 5—Heat Control Valve

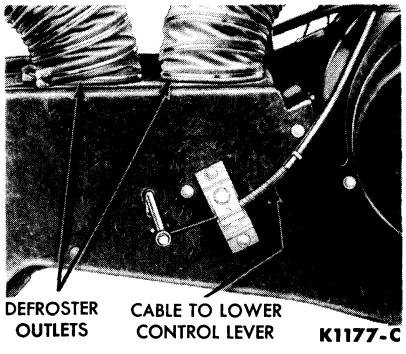



FIG. 6—Defroster Valve

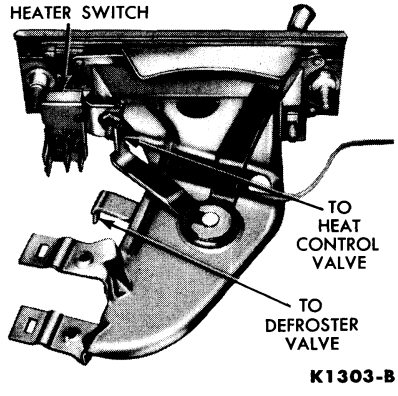



FIG. 7—Heater Control Cable Connections

## 3 REMOVAL AND INSTALLATION

### HEATER

#### REMOVAL

1. Partially drain the cooling system.
2. Disconnect the fresh air inlet control cable at the instrument panel. Disconnect the right air inlet boot at the blower housing.
3. Disconnect the defroster valve control cable at the plenum chamber. Disconnect the defroster hoses at the outlets. Disconnect the heater wires from the resistor, and disconnect the motor wire.
4. Disconnect the heater hoses at the firewall.
5. Remove the plenum chamber retaining nuts at the firewall and lay the assembly on the floor.
6. Disconnect the heat control valve cable at the valve. Remove the assembly from the car.

#### INSTALLATION

1. Position the assembly on the floor of the car.
2. Connect and adjust the heat valve control cable.
3. Position the heater assembly to the firewall and install the retaining nuts.
4. Connect the blower motor and resistor wires.
5. Connect the heater hose from the manifold outlet to the heater core lower tube.
6. Connect the air inlet boot at the blower housing. Connect the defroster hoses.
7. Connect and adjust the defroster control cable. Attach the right fresh air inlet valve control cable to the instrument panel.
8. Fill the cooling system and install the remaining heater hose.
9. Check the heater operation and inspect for leaks.

### HEATER CORE

1. Remove the heater assembly.
2. Remove the core cover retaining screws and remove the cover.
3. Remove the heater core from the plenum.
4. Position the heater core in the plenum, so that it will be held by the retaining clips.
5. Install the heater core cover.
6. Position the heater assembly on the car floor and install the heater.

### HEATER BLOWER MOTOR

1. Remove the heater assembly. Disconnect the heater wires.
2. Remove the heater blower motor retaining plate screws and remove the motor and fan assembly.
3. Loosen the fan set screw and remove the blower motor. Remove the retaining plate and gasket from the motor. Discard the production blower wheel.
4. Install the heater motor retaining plate and gasket to the motor. Install the fan on the motor and tighten the set screw. Install the blower assembly to the heater. Connect the motor wires.
5. Install the heater assembly. Check the blower operation.

### HEATER CONTROL

The heater control is mounted in the instrument panel, to the right of the steering column. To remove the control assembly, remove the knobs, remove the two nuts retaining the assembly to the instrument panel. Disconnect the cables, the switch wires, and the pilot light wire from its connector.

# PART 16-3 AIR CONDITIONING


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| 1 Description and Operation | 16- 9 |
| 2 In-Car Adjustments and Repairs | 16-13 |
| 3 Removal and Installation | 16-14 |


## 1 DESCRIPTION AND OPERATION

Both Ford and Mercury cars have two different air conditioners available. Ford cars have both the Select-Aire Conditioner, and the Ford Air Conditioner. Mercury cars offer the Deluxe Air Conditioner, and the Mercury Air Conditioner.

The SelectAire Conditioner (Fig. 1) discharges its cooling air from built-in registers in the front of the unit, and from below to cover the floor area. The controls located between these registers govern the operation of the thermostatic switch, and the blower, thus controlling the temperature and the volume of the cooling air.

The Deluxe Air Conditioner (Fig. 2) discharges its cooling air from registers mounted in the lower instrument panel, and from below to cover the floor area. The temperature, and volume of cooling air are controlled at the Heater-Air Conditioner control head. A seven position rotary switch controls the volume of cooling air by turning a knob clockwise. (Heater volume is controlled by counterclockwise rotation.)

Temperature of the cooling air is controlled by a Bowden cable between the temperature slide lever in the control head, and the thermostatic switch. This is operated the same as when the heater is used. The high temperature setting gives a minimum of cooling. The low temperature setting gives the maximum of cooling temperature, or the lowest temperature.

Aside from the above description, the two units have much in common. Fig. 3 shows the Deluxe Air Conditioner electrical control system.

The Ford Air Conditioner used on Ford, and the Mercury Air Conditioner used on Mercury, are basically similar units. Fig. 4 shows the electrical control system of these units.

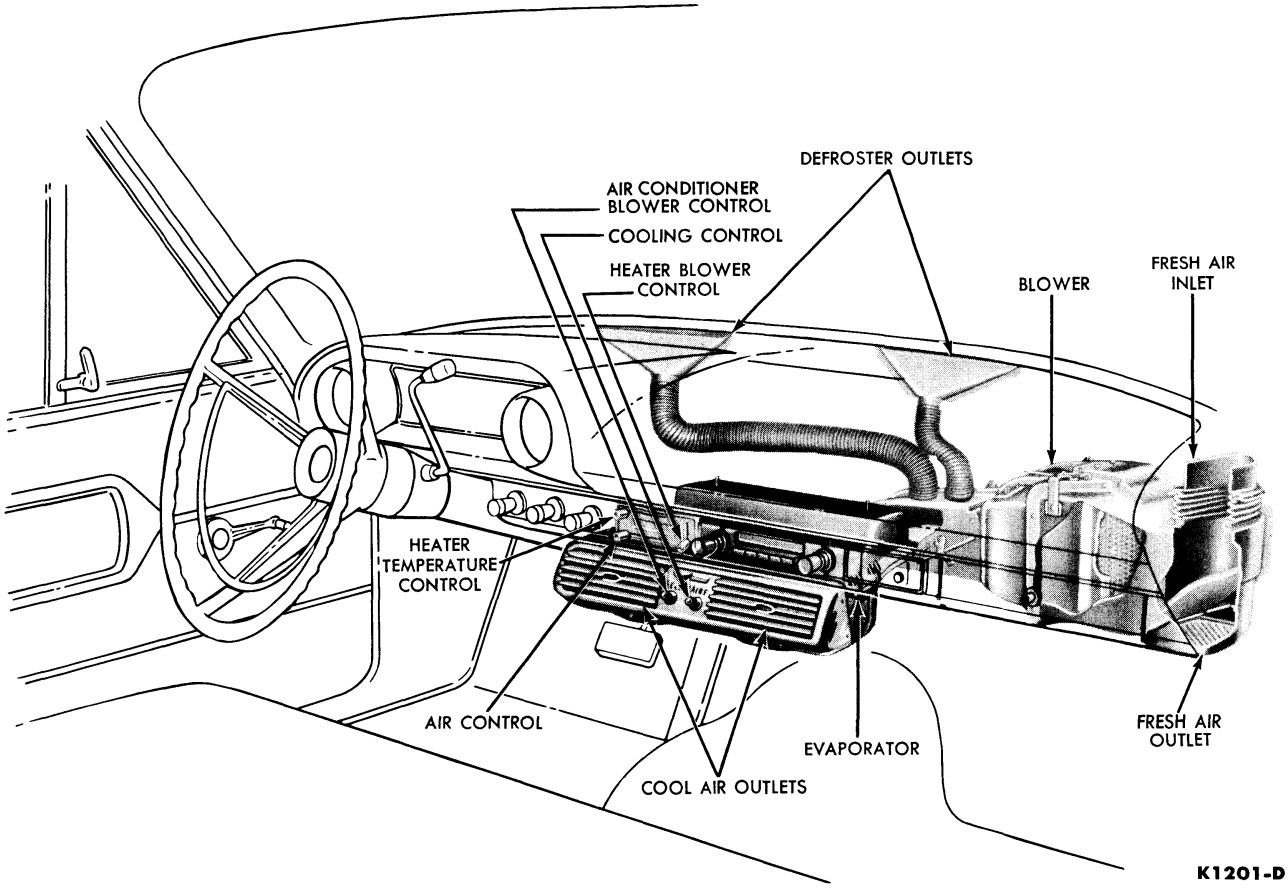



**FIG. 1—SelectAire Conditioner Installation**

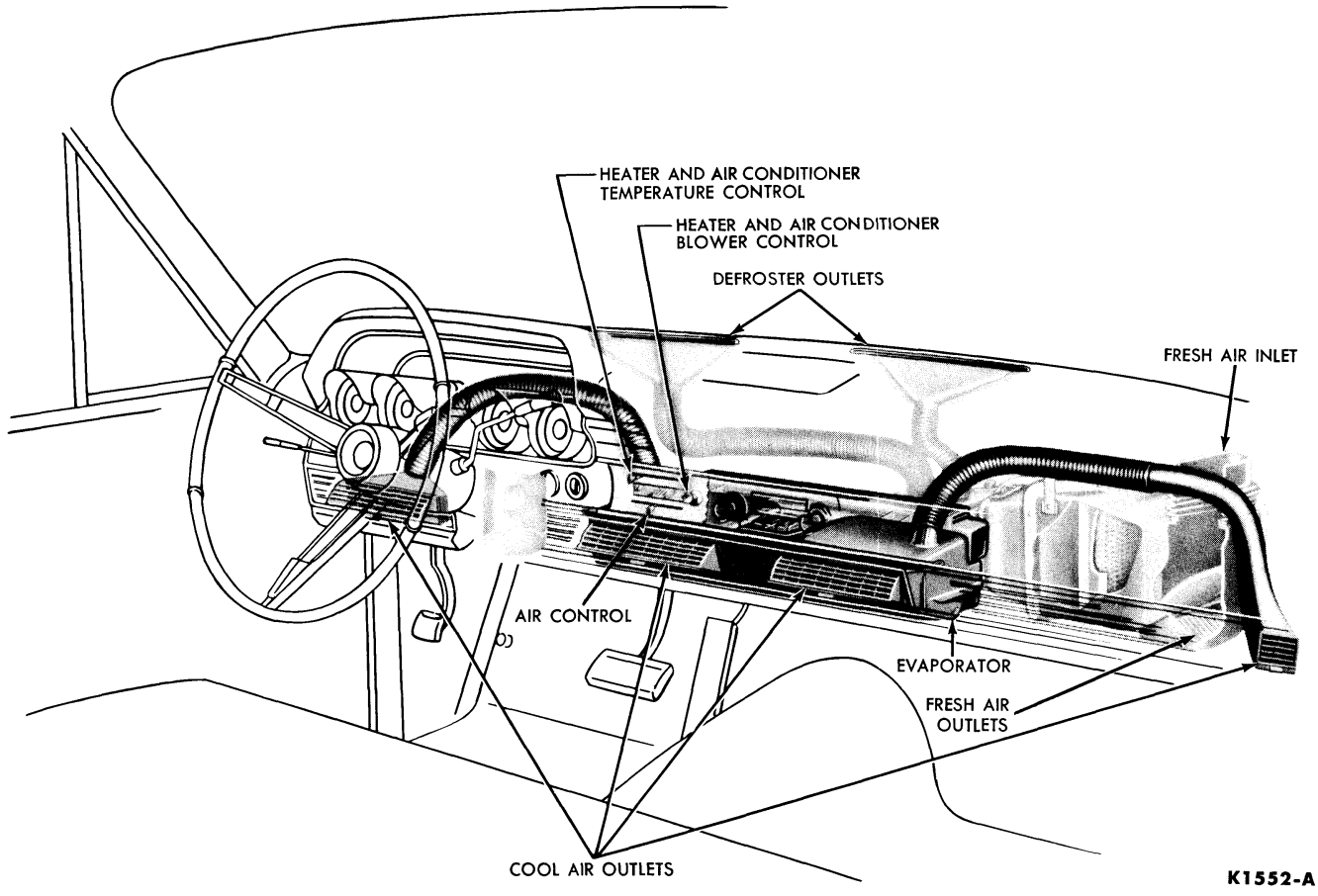



**FIG. 2—Deluxe Air Conditioner Installation**

The controls for the Ford and Mercury air conditioners, insofar as the blower and cooling are concerned, are operated the same as the SelectAire controls. The air outlets, of which there are four in the front and two on the sides, allow direction of cooled air in various directions.

## RECEIVER UNIT

The air cooling system stores the liquid Refrigerant-12 under pressure in a combination receiver and dehydrator. The pressure in the receiver normally varies from about 80 to 300 psi, depending on the surrounding air temperature and compressor speed. The receiver and condenser comes charged and marked with the total weight, so that any leak, indicated by a loss in weight, can be detected before assembly.

The dehydrator serves the purpose of removing any traces of moisture that may have accumulated in the system. Even small amounts of moisture will cause an air cooling unit to malfunction. A fusible plug is screwed into the receiver. This will release the refrigerant before the refrigerant temperature exceeds 212°F.

## EVAPORATOR UNIT

When the cooling system is in operation (Fig. 5), the liquid Refrigerant-12 flows from the combination receiver and dehydrator unit through a flexible hose to the evaporator (cooling unit Fig. 5), where it is allowed to evaporate at a reduced pressure. The SelectAire evaporator assembly is mounted on the passenger compartment side of the dash, at the same location as the fresh air heater.

## EXPANSION VALVE

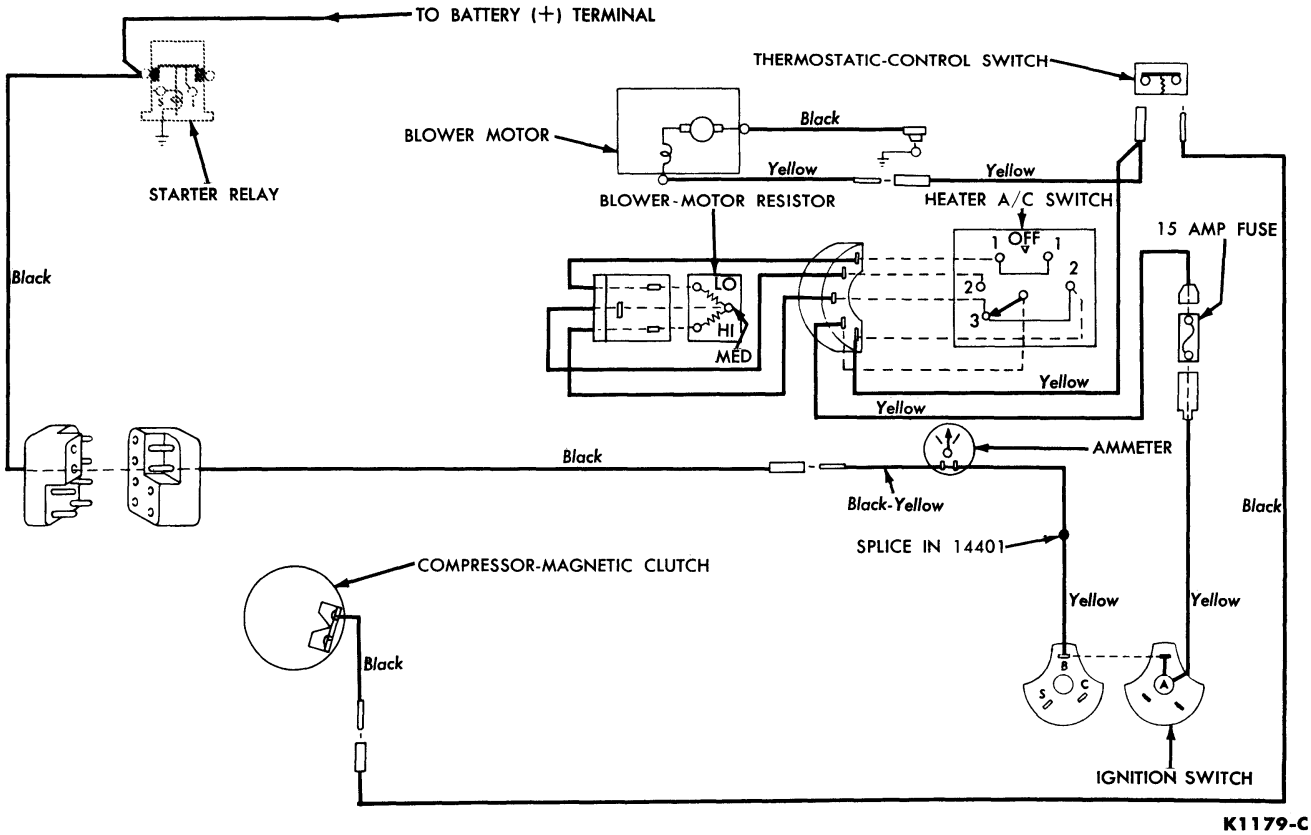
The rate of refrigerant evaporation is controlled by an expansion valve, which allows only enough refrigerant to flow into the evaporator to keep the evaporator operating efficiently, depending on its heat load.

The expansion valve consists of the valve and a temperature sensing capillary tube and bulb. The bulb is clamped to the outlet pipe of the evaporator. Thus, the operation of the valve is controlled by the temperature of the evaporated liquid at the point where it leaves the evaporator or cooling unit.

The restricting effect of the expansion valve at the evaporator causes a low pressure on the low pressure side of the system of 12-50 psi, depending on the surrounding air temperature and compressor speed.

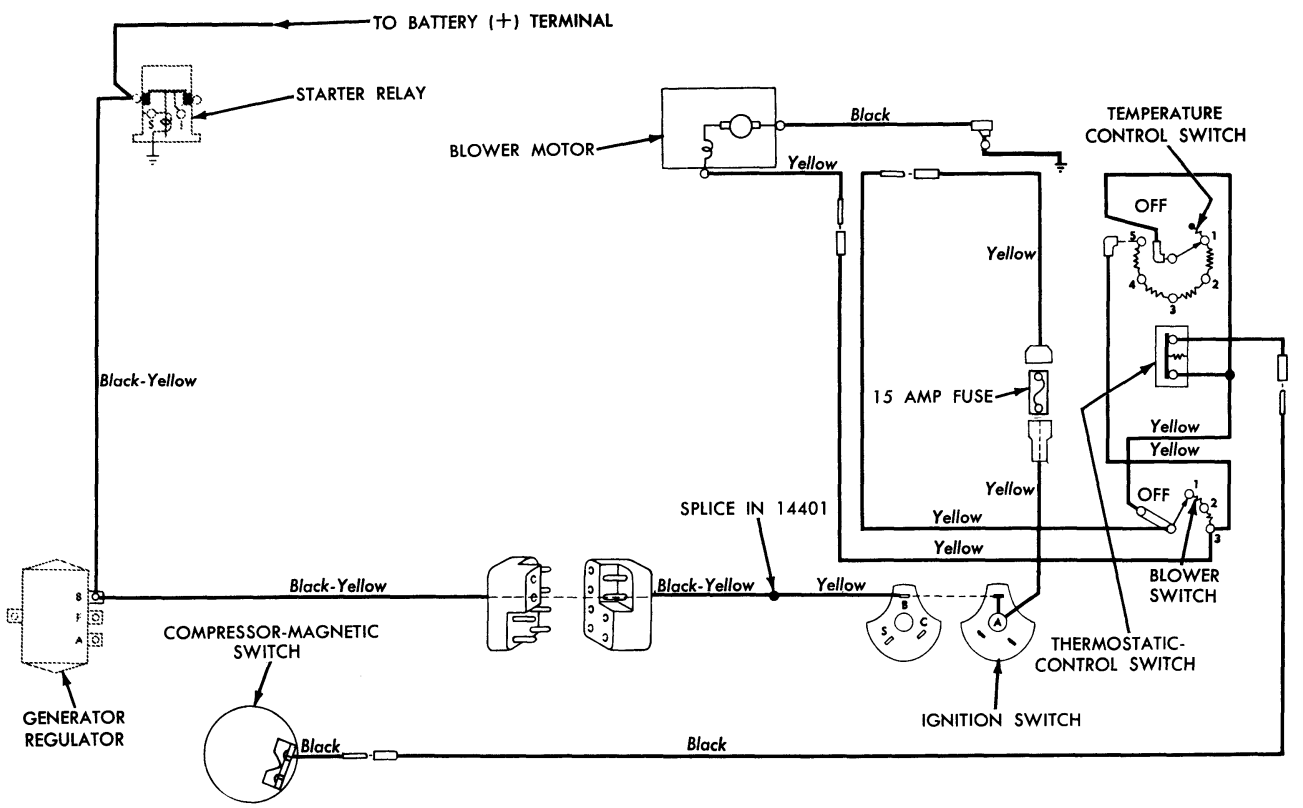
## LIQUID SIGHT GLASS

A liquid sight glass is mounted in the high pressure refrigerant line at the receiver outlet connection (Fig. 6). The sight glass is used to check whether or not there is enough liquid refrigerant in the system. Foam seen in the sight glass while the compressor is operating, is an indication of loss of refrigerant.




K1179-C

**FIG. 3—Deluxe Air Conditioner Electrical Control System**




K1230-B

**FIG. 4—Ford-Mercury Air Conditioner Electrical Control System**

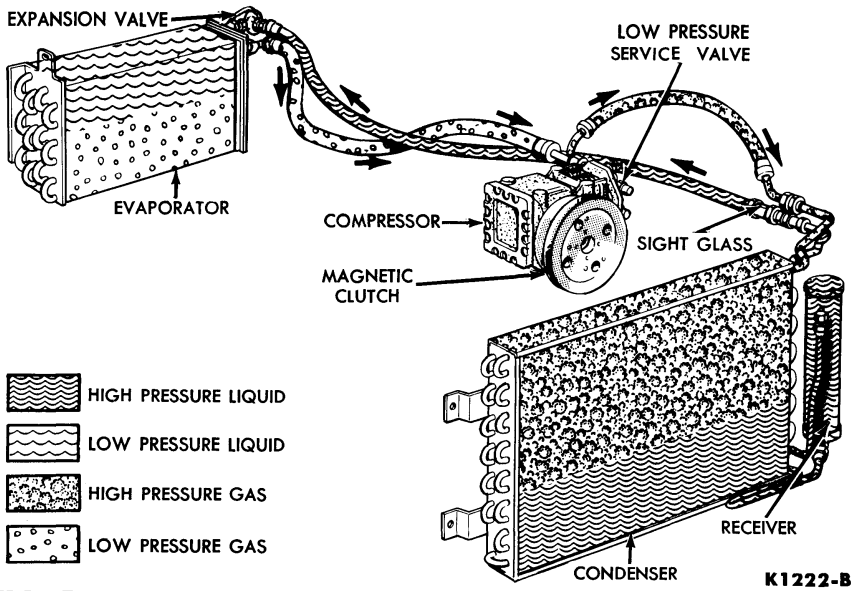



**FIG. 5—Air Conditioning System**

### COMPRESSOR UNIT

The evaporated refrigerant leaving the evaporator (now in the form of a gas), at a pressure of 12-50 psi is pumped by the compressor, located on the engine, into the top of the condenser (Fig. 5), located in front of the radiator.

The compressor maintains a pressure on its high pressure side of from 80-300 psi, depending on the surrounding air temperature and compressor speed.

As the heated and compressed refrigerant gas flows down through the condenser, it is cooled by air passing between the sections of the condenser. The cooled, compressed refrigerant gas condenses to liquid refrigerant which then flows into the receiver.

### MAGNETIC CLUTCH

It is necessary to control the amount of cooling that the system produces. To accomplish this, the compressor is electrically cut in and out of operation by the use of a magnetic clutch pulley mounted on the compressor crankshaft (Fig. 5). The magnetic clutch is controlled by a thermostatic switch which has its temperature sensing tube inserted in the fins of the evaporator core.

### THERMOSTATIC SWITCH

The thermostatic switch controls the operation of the compressor by controlling the compressor magnetic clutch. The temperature sensing tube of the switch is placed in contact with the evaporator fins. When the temperature of the evaporator becomes too cold, the thermostatic switch opens the magnetic clutch electrical circuit disconnecting the compressor from the engine. When the temperature of the evaporator rises to the upper limit at which the thermostatic switch is set, the thermostatic switch closes and energizes the magnetic clutch. This connects the compressor to the engine and cooling action begins again.

When the ignition switch is off, or the cooling control thermostatic switch is in the OFF position, the magnetic clutch is not energized, and the cooling system can not operate.

When the ignition switch is on (engine running), and the cooling control is in the cooling range, the magnetic clutch is energized, the compressor is connected to the engine and the cooling system is in operation.

The thermostatic switch may be adjusted to maintain an average evaporator temperature of from 30°-60°F. The thermostatic switch operating differential temperature at any one setting is 6°F. The switch is controlled by the cooling control (Figs. 1 and 2).

### SERVICE VALVES

The service valves on the compressor are used to test and service the cooling system (Fig. 7). The high pressure service valve, mounted at the outlet to the compressor, allows access to the high pressure side of the system for attaching a pressure gauge, or a servicing hose.

The low pressure valve, mounted at the inlet to the compressor, allows access to the low pressure side of the system for attaching a pressure gauge, or a servicing hose.

Both service valves may be used to shut off the rest of the system from the compressor during compressor service.

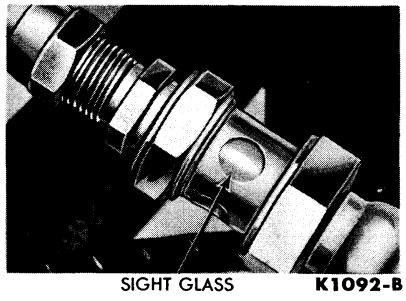
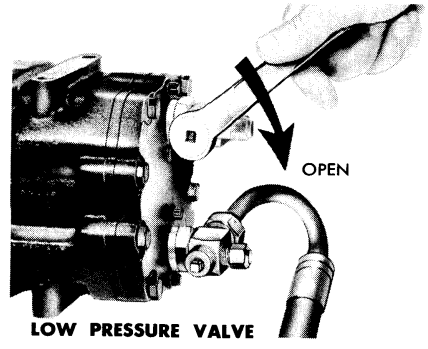



**FIG. 6—Sight Glass**



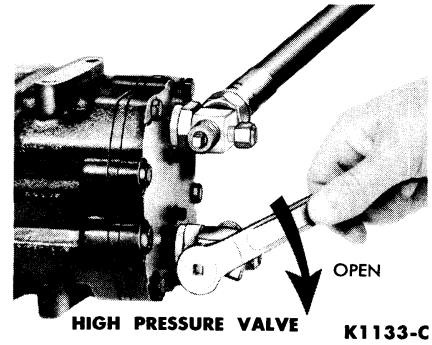




**FIG. 7—Opening Service Valve Gauge Ports**

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### MAKING A PARTIAL CHARGE

Attach the manifold gauge set and hoses (Fig. 8). Open both manifold valves. Close the vacuum pump valve. Open the Refrigerant-12 tank valve. Purge the air from the high pressure hose by loosening the high pressure hose at the service valve, for a few seconds. Tighten the connections and set the high pressure manifold gauge valve at the maximum clockwise position. Loosen the low pressure gauge hose slightly at the low pressure service valve, for a few seconds, to purge the air from the hose. Tighten the connection. Set both service valves at the center position.

Run the engine at 1500 rpm with all controls at the maximum cold position. Charge the system until all foam disappears from the sight glass, then add ½ pound of Refrigerant-12. Shut the Refrigerant-12 tank valve.

It may be necessary to place the Refrigerant-12 tank in a container of hot water at about 150°F. to force the gas from the tank during charging.

**Never heat the Refrigerant-12 tank with a torch. A dangerous explosion may result.**

Set both service valves at the maximum counterclockwise position.

Remove the gauge set, and cap the service valve gauge ports and valve stems.

### MAKING A COMPLETE CHARGE

Check for leaks first (See "Diagnosis and Testing," Part 16-1), release the pressure, then evacuate the system. Leave both service valves at the mid-position and the vacuum pump valve closed. Leave the low pressure manifold gauge valve at the maximum counterclockwise or open position. Set the high pressure manifold gauge valve at the maximum clockwise or closed position. Set all controls to the maximum cold position.

Open the Refrigerant-12 tank valve. Run the engine at 1500 rpm. Charge the system until the weight of refrigerant is to specifications. During the charging, the high pressure may build up to an excessive value. This can be caused by an overcharge of refrigerant, or an overheated engine, in combination with high surrounding temperatures. Never allow the high pressure to exceed 240 pounds while charging. Stop the engine, determine the cause, and correct it.

After the proper charge has been made, close the Refrigerant-12 tank valve, and check the system pressures for proper operation. Set both service valves at the maximum counterclockwise position. Remove the gauge set, and cap the service valve gauge ports and valve stems.

**Charging From Small Containers.** Refrigerant-12 is available in one-pound cans. A scale is not necessary if these small containers are used instead of a tank.

Attach the hose that would normally go to the large tank to the special valve that is provided for the small cans. Close the valve (maximum clockwise position) and follow the procedure for leak testing, evacuating and charging the system as previously given.

For charging, attach a one-pound can of Refrigerant-12 to the special valve, and open the valve. Keep the can in an upright position. When the can is empty (no frost showing), close the valve, remove the empty can, attach a new one, and open the valve again.

Allow only ½ of the third can of refrigerant to be pumped into the system by closing the valve at the can when the frost line has reached ½ way down the can. The system will then have been charged with 2½ pounds of refrigerant.

Check the system pressures, set both service valves at the maximum counterclockwise position. Remove the gauge set, and cap the service valve gauge ports and valve stems.

### EVACUATING THE SYSTEM

Attach the manifold gauge set, a tank of Refrigerant-12 and a vacuum pump to the system. Make certain that the Refrigerant-12 tank valve is tightly closed. Set both service valves to the mid-position. Open both manifold valves. Release any pressure in the system. Open the vacuum pump valve and run the pump until the low pressure gauge reads at least 25 inches, and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20 to 30 minutes to boil any moisture out of the system. Close the pump valve. Turn off the pump.

### ISOLATING THE COMPRESSOR

To isolate the compressor from the system, turn both the high and the low pressure service valves to the extreme clockwise position (Fig. 7). Loosen the cap on the high pressure service valve gauge port, and allow the gas to escape until the compressor is relieved of refrigerant pressure.

**Loosen the cap a small amount only, and do not remove it until the pressure is completely relieved.**

To connect the compressor back into the system, evacuate the compressor at the high pressure service valve gauge port, close the vacuum pump valve, turn both service valves to the maximum counterclockwise position, and cap the high pressure service valve gauge port and service valve stems.

### DISCHARGING THE SYSTEM

Discharge the refrigerant from the system before replacing any part of the system, except the compressor.

To discharge the system, connect the manifold gauge set to the system. Do not connect the manifold center connection hoses to the Refrigerant-12 tank, or vacuum pump. Place the open end of these hoses in a garage exhaust outlet. Set the high pressure manifold gauge valve at the maximum counterclockwise or open position. Open the high pressure service valve a slight amount (Fig. 7) and allow the refrigerant to discharge slowly from the system.

**Do not allow the refrigerant to rush out, as the oil in the compressor will be forced out along with it.**

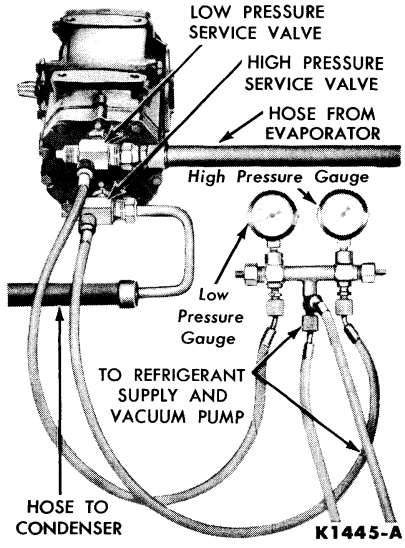



**FIG. 8—Charging the Air Conditioning System**

## 3 REMOVAL AND INSTALLATION

### SAFETY PRECAUTIONS

The refrigerant used in the air conditioner system is Refrigerant-12. Refrigerant-12 is nonexplosive, noninflammable, noncorrosive, has practically no odor, and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

**Use only Refrigerant-12.**

Liquid Refrigerant-12, at normal atmospheric pressures and temperatures, evaporates so quickly that it tends to freeze anything that it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

Refrigerant-12 is readily absorbed by most types of oil. It is therefore recommended that a bottle of sterile mineral oil and a quantity of weak boric acid solution be kept nearby when servicing the air conditioning system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out, then wash the eyes clean with the weak boric acid solution. Seek a doctor's aid immediately even though irritation may have ceased.

**Always wear safety goggles when servicing any part of the refrigerating system.**

The Refrigerant-12 in the system is always under pressure. Because the system is tightly sealed, heat applied to any part would cause this pressure to build up excessively.

**To avoid a dangerous explosion, never weld, use a blow torch, solder, steam clean, bake body finishes, or use any excessive amount of heat on, or in the immediate area of, any part of the air cooling system or refrigerant supply tank, while they are closed to the atmosphere whether filled with refrigerant or not.**

The liquid refrigerant evaporates so rapidly that the resulting refrigerant gas will displace the air surrounding the area where the refrigerant is released. To prevent possible suffocation in enclosed areas, always discharge the refrigerant from an air cooling system into the garage exhaust collector. Always maintain good ventilation surrounding the work area. **If the car is to be undercoated, make certain that the undercoating does not plug the evaporator drain tubes.**

Although Refrigerant-12 gas, under normal conditions, is non poisonous, the discharge of refrigerant gas near an open flame can produce a very poisonous gas. This gas will also attack all bright metal surfaces. This poisonous gas is generated in small quantities when the flame-type leak detector is used. Avoid inhaling the fumes from the leak detector. **Make certain that Refrigerant-12 is both stored and installed in accordance with all state and local ordinances.**

When admitting Refrigerant-12 gas into the cooling unit, always keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor. **In surrounding air temperatures above 90°F., prolonged engine idle will result in excessively high compressor pressures.**

### EVAPORATOR

#### REMOVAL

1. Disconnect the battery ground cable.
2. Disconnect the wiring.
3. Discharge the refrigerant into the garage exhaust system.
4. Cut, and open the insulation at the expansion valve and disconnect the refrigerant lines.
5. Disconnect the drain tube. (Disconnect register ducts on Mercury.)
6. Disconnect the evaporator by removing the mounting nuts.
7. Ease the evaporator to the floor of the car.
8. Remove the evaporator assembly from the car.

#### INSTALLATION

1. Place the evaporator assembly in position on the floor of the car.
2. Position the evaporator assembly and assemble the mounting nuts.
3. Connect and insulate the refrigerant lines.
4. Connect the drain tube. (Connect register ducts on Mercury.)
5. Connect the wiring.
6. Connect the battery ground cable.
7. Charge the system. (See "In-Car Adjustments and Repairs.") As there will be no pressure in the system to begin with, be sure to check for leaks after charging the system. (See "Cleaning and Inspection," Part 16-1.)

### EVAPORATOR CORE

#### REMOVAL

1. Remove the evaporator.
2. Remove the expansion valve.
3. Using Bonney pliers, carefully remove the assembly clips from the evaporator case, and remove the upper section.
4. Carefully remove the capillary tube from between the fins of the evaporator core.
5. Disconnect the core, from the lower section of the case, and remove the core.

#### INSTALLATION

1. Install the expansion valve.
2. Position the core in the lower section of the evaporator case.
3. Carefully insert the capillary tube between the center fins of the evaporator core.
4. Position the upper section of the evaporator case to the lower section. Carefully position the assembly clips.
5. Install the evaporator.

### COMPRESSOR

#### REMOVAL

1. Isolate the compressor (See "In-Car Adjustments and Repairs") and disconnect the two service valves and hoses from the compressor (Fig. 9). Energize the clutch and loosen and remove the clutch mounting bolt.
2. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen

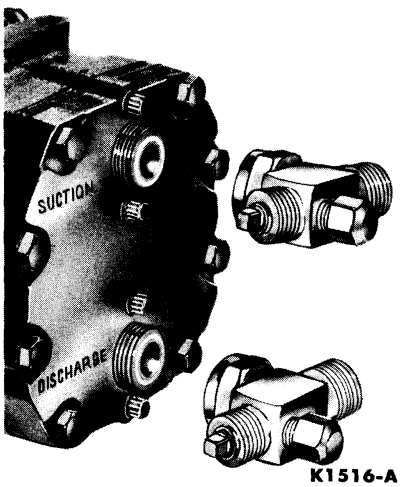



**FIG. 9—Compressor Service Valves Removed**

the clutch from the shaft. Disconnect the clutch wire at the bullet connector.

**3.** Loosen the compressor mounting bolts. Slide the compressor toward the center of the engine, remove the drive belt and the clutch, and then remove the mounting bolts and the compressor.

**4.** With the compressor on the work bench, remove the key from the shaft.

### INSTALLATION

Before installing compressor, see "Cleaning and Inspection—Air Conditioning" (Part 16-1).

**1.** Mount the clutch on the shaft and install the mounting screw and washer finger tight. Place the compressor on the mounting bracket and install the four mounting bolts finger tight.

**2.** Connect the clutch wire, energize the clutch and torque the clutch mounting bolt to specifications. **If the new compressor was shipped with a bolt and washer in the end of the crankshaft, remove and discard the bolt and use a bolt with a nylon insert in it.** Install and adjust the drive belt, and tighten the mounting bolts to specifications. Do not exceed torque specifications as misalignment can result.

**3.** Install the service valves on the compressor using new gaskets. Tighten the service valve flared nuts to specifications. Do not over tighten the flared nuts. The new ROTO-LOK service valves can be rotated slightly on their seat without breaking the high pressure seal. This is not an indication of a loose valve. Leak test the compressor, then evacuate it and connect it back into the system.

**4.** Check the oil level in the compressor and add or remove oil if necessary. (See "Cleaning and Inspection," Part 16-1.)

### COMPRESSOR COMPONENTS

All compressor removal and installation operations, except belt replacement, can be performed only after the unit has been isolated from the rest of the system. (See "In-Car Adjustments and Repairs.")

### VALVE PLATE

#### Removal

**1.** Isolate the compressor and disconnect the service valves. Remove the twelve head bolts.

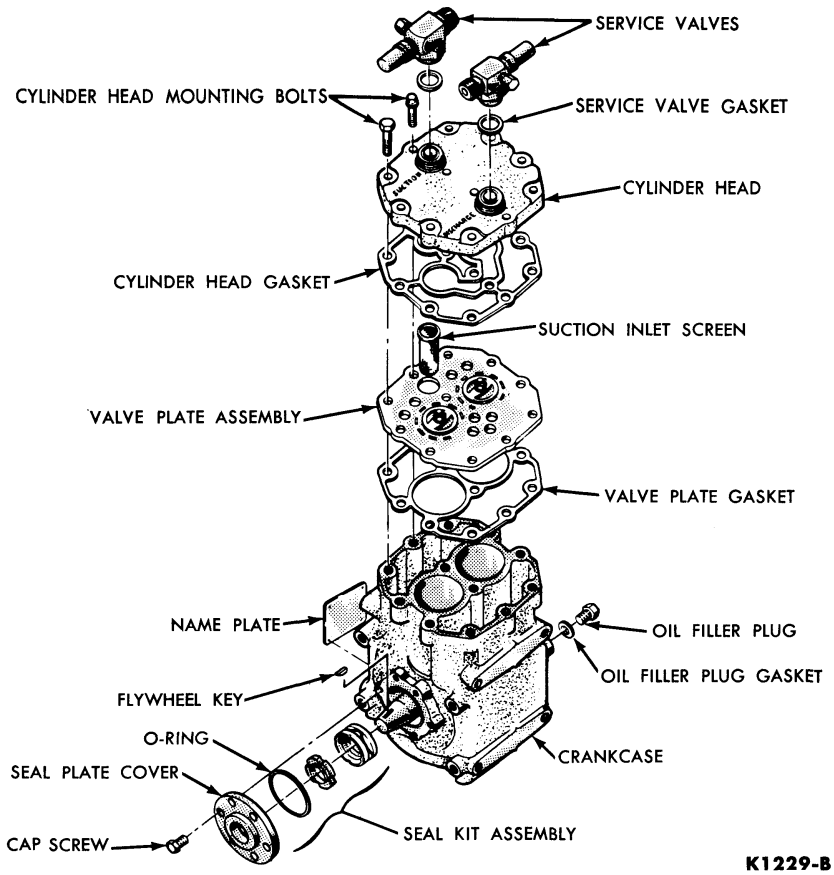



**FIG. 10—Cylinder Head and Valve Assembly**

**2.** Remove the cylinder head and valve plate from the top of the compressor body (Fig. 10). Do not tap or hit the head with any hard tool, as damage could result. (York compressors are aluminum.)

**3.** Remove and discard all gaskets, and be sure to clean gasket shreds from all gasket surfaces. Examine the cylinders and top of the pistons, particularly in case of valve breakage. If there are score marks, replace the compressor assembly.

**4.** If the cylinders and pistons are in good condition, check the valve plate and valve reeds for damage. If the valve assembly is in good condition, it can be used again. If the valve plate is damaged, install the entire replacement kit which includes the valve plate, valve reeds, and the two gaskets (Fig. 10).

**5.** When the valve plate assembly is reused, wash it in clean solvent and dry in dry air. Check the oil for dirt. If the system is not clean, replace the oil.

#### Installation

**1.** Starting with the valve plate gasket, assemble the parts in the order shown in Fig. 10. Insert the cylinder head bolts carefully to avoid damaging the gaskets. Before assembly apply a film of new refrigeration oil to both sides of both gaskets.

**2.** Tighten all bolts finger tight, then torque the bolts a quarter turn at a time to specifications. Do this by tightening the service valve bolts first. Then tighten the remaining bolts in a sequence so those diagonally opposite are evenly drawn to the required torque.

**3.** Connect the compressor into the system. Check the oil level in the compressor, and add or remove oil if necessary. (See "Cleaning and Inspection," Part 16-1.)

### BELT

#### Removal and Installation

**1.** Loosen the four compressor mounting bolts.

**2.** Slide the compressor toward the center of the car and remove the belt.

**3.** Place the new belt in position, and slide the compressor toward the outside of the car and tighten the four mounting bolts.

4. Adjust the belt tension to specifications.

5. Check the belt alignment, and adjust if necessary.

## CLUTCH

### Removal and Installation

1. Energize the clutch and loosen and remove the clutch mounting bolt.

2. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen the clutch from the shaft, then remove the magnetic clutch.

3. Install the clutch, the clutch mounting bolt, and the washer.

4. Energize the clutch, and torque the bolt to specifications.

## CRANKSHAFT SEAL

### Removal

1. Isolate the compressor, and remove from vehicle. (See "In-Car Adjustment and Repair.")

2. Remove the clutch and remove the Woodruff key.

3. Remove the seal plate bolts, and remove the plate and gasket. Do not mar the sealing surfaces, or the polished shaft surface.

4. Remove the carbon seal ring and seal housing assembly from the crankshaft. A disassembled view of the crankshaft seal assembly is included in Fig. 10.

5. Remove the baseplate and inspect internal compressor for foreign particles. Clean out as required.

6. Clean all old gasket material from the seal plate and the compressor. Make certain that the shaft, the seal plate and the compressor gasket surfaces are completely clean before installing the new seal.

### Installation

1. Remove new shaft seal washer from bellows seal assembly.

2. Coat the exposed surface of crankshaft with clean refrigeration oil.

3. Dip new bellows seal assembly and shaft seal washer in clean refrigeration oil.

4. Place bellows seal assembly over shaft with end for holding shaft seal washer going on last.

5. Push bellows seal assembly by hand on shaft to a position beyond taper of shaft.

6. Assemble shaft seal washer in bellows seal assembly, checking before doing so to see that bellows seal assembly and shaft are free from dirt and foreign material.

7. Assemble seal washer so that raised rim is away from bellows seal assembly and that the notches in washer line up with the nibs in bellows seal assembly.

8. Cover exposed surface of shaft seal washer with clean refrigeration oil.

9. Position the new gasket on the compressor and install the seal plate.

10. Torque the bolts to specifications.

11. Make certain that there are no burrs or dirt on the compressor shaft. Then install the key, the belt, and the clutch.

12. Install the new base plate gasket and install the base plate. Add new compressor oil to specifications. (See "Cleaning and Inspection," Part 16-1.)

13. Install the compressor.

14. Adjust the belt tension.

# PART 16-4 RADIO


| Section | Page |
|---|---|
| 1 Description and Operation | 16-17 |
| 2 In-Car Adjustments and Repairs | 16-17 |
| 3 Removal and Installation | 16-17 |


## 1 DESCRIPTION AND OPERATION

An AM and an AM/FM radio are available for 1964. Both radios have push button tuning as well as manual tuning. The antenna is mounted on the right fender. The antenna wand can be removed from the base without removing the base from the fender. A rear seat speaker and a front speaker are used.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### PUSH BUTTON ADJUSTMENT

Turn the radio on. Pull out the desired push button and reduce the volume to a low value. Tune in the desired station with the manual tuning knob. The station is correctly tuned in when the clearest tone is heard. Carefully push the button in all the way, then release it.

Adjust the remaining buttons and check all the positions for repeat accuracy. Repeat the procedure for any buttons that shift from the correct tuning point.

On the AM/FM radio, push one AM button all the way in before adjusting the AM buttons. Push one FM button all the way in before adjusting the FM buttons.

## 3 REMOVAL AND INSTALLATION

### RECEIVER

#### REMOVAL

To remove the radio receiver from a car with a SelectAire Conditioner, remove the glove box liner, radio speaker assembly, radio right mounting support, and remove the radio through the speaker opening.

To remove the radio receiver, proceed as follows:

1. Pull off the radio control knobs and remove the nuts and washers retaining the radio to the instrument panel.
2. Disconnect the antenna lead at the right side of the radio. Disconnect the speaker lead, and disconnect the pilot light wire at the wiring harness. Disconnect the radio lead wire at the fuse panel and remove the wire from the retaining clips.
3. Remove the radio back support bracket to radio retaining nut. Remove the radio assembly from the instrument panel.

#### INSTALLATION

1. Position the radio to the instrument panel, and then install the washers and retaining nuts at the knob shafts. Be sure that the radio mounting stud enters the support bracket. Install the radio support bracket retaining nut. Tighten all nuts to specifications.
2. Connect the antenna lead to the radio. Connect the radio speaker lead, and then connect the pilot light wire at the wiring harness.
3. Connect the radio power lead to the fuse panel mounted on the headlight switch.
4. Install the radio control knobs. Check the radio operation.

### ANTENNA

#### REMOVAL

1. Disconnect the antenna lead from the side of the radio receiver.
2. Remove the antenna mounting nut, and insulator, remove the spacer from the antenna, and remove the antenna assembly.

#### INSTALLATION

1. Tie a string to the new antenna lead, and fish the string through the opening into the passenger compartment with a piece of wire.
2. Position the antenna assembly in the opening, put the spacer in position on the antenna, pull the antenna up into position, and install the antenna insulator and retaining nut.
3. Carefully pull the antenna lead through the opening and route the lead on the instrument panel reinforcement under the glove box. Connect the lead to the radio.
4. The antenna trimmer is preadjusted and does not need adjusting for the front mounted antenna.

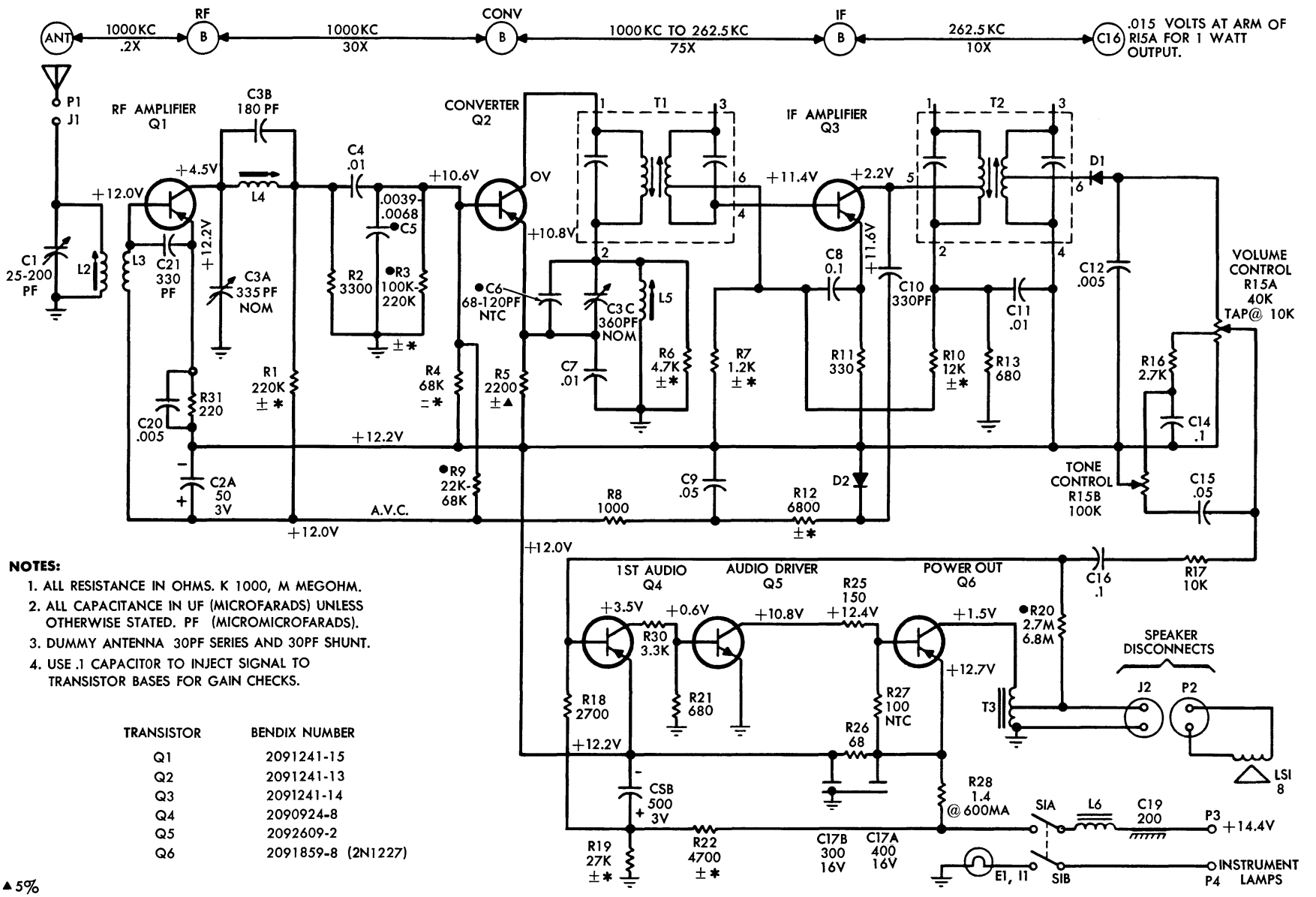
### SPEAKER

#### REMOVAL

1. Open the glove box door, reach through the opening in the upper left corner, and remove the two wingnuts retaining the speaker grille to the instrument panel.
2. Raise the right side of the speaker grille enough to clear the mounting studs from the instrument panel. Slide the grille assembly to the right to disconnect the clips retaining the grille left side.
3. Remove the speaker mounting retaining screws.
4. Lift the speaker from the opening, and then reach through the opening and disconnect the speaker lead at the back of the radio.

#### INSTALLATION

1. Install the new speaker leads in the radio.
2. Place the speaker assembly in the instrument panel opening. Install the speaker retaining screws.
3. Slide the left side of the speaker grille in the instrument panel opening and press the right side into the grille opening.
4. Install the speaker grille retaining wing-nuts.




**NOTES:**

1. ALL RESISTANCE IN OHMS. K 1000, M MEGOHM.
2. ALL CAPACITANCE IN UF (MICROFARADS) UNLESS OTHERWISE STATED. PF (MICROMICROFARADS).
3. DUMMY ANTENNA 30PF SERIES AND 30PF SHUNT.
4. USE .1 CAPACITOR TO INJECT SIGNAL TO TRANSISTOR BASES FOR GAIN CHECKS.

| TRANSISTOR | BENDIX NUMBER |
|---|---|
| Q1 | 2091241-15 |
| Q2 | 2091241-13 |
| Q3 | 2091241-14 |
| Q4 | 2090924-8 |
| Q5 | 2092609-2 |
| Q6 | 2091859-8 (2N1227) |

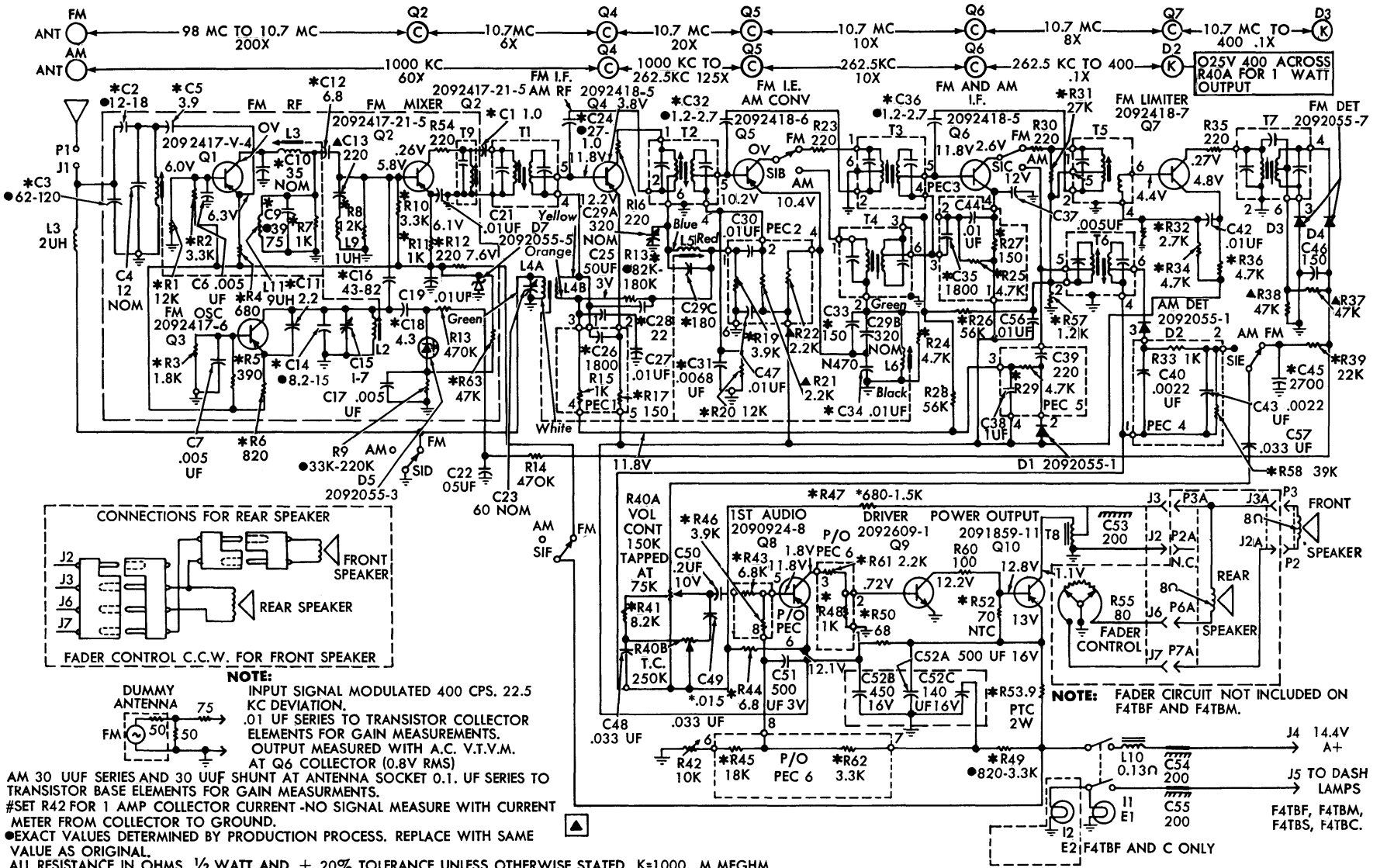
▲5%

*10%

●EXACT VALUE DETERMINED BY PRODUCTION PROCESS- REPLACE WITH SAME VALUE AS ORIGINAL.

K1160-D

**FIG. 1—AM Radio Wiring Diagram**




**NOTE:**

DUMMY ANTENNA 75 FM 50 50

INPUT SIGNAL MODULATED 400 CPS. 22.5 KC DEVIATION.
.01 UF SERIES TO TRANSISTOR COLLECTOR ELEMENTS FOR GAIN MEASUREMENTS.
OUTPUT MEASURED WITH A.C. V.T.V.M. AT Q6 COLLECTOR (0.8V RMS)

AM 30 UUF SERIES AND 30 UUF SHUNT AT ANTENNA SOCKET 0.1. UF SERIES TO TRANSISTOR BASE ELEMENTS FOR GAIN MEASURMENTS.

#SET R42 FOR 1 AMP COLLECTOR CURRENT -NO SIGNAL MEASURE WITH CURRENT METER FROM COLLECTOR TO GROUND.

●EXACT VALUES DETERMINED BY PRODUCTION PROCESS. REPLACE WITH SAME VALUE AS ORIGINAL.

ALL RESISTANCE IN OHMS. ½ WATT AND ± 20% TOLERANCE UNLESS OTHERWISE STATED. K=1000. M MEGHM.

ALL CAPACITANCE IN MICROMICROFARADS. 100 VOLTS MIN. AND ± 20% TOLERANCE UNLESS OTHERWISE STATED. GMV=GUARANTEED MIN. VALVE.

FM TUNING RANGE FROM 88MC TO 108MC. AM TUNING RANGE FROM 540KC TO 1600KC.

FM I.F. FREQUENCY 10.7MC. AM I.F. FREQUENCY 262.5KC.

VOLTAGE MEASUREMENTS:

1. ALL DC VOLTAGES MEASURED WITH A 20.000 OHM/VOLT METER. NO SIGNAL INPUT.
2. ALL AC VOLTAGES MEASURED WITH AN AC V.T.V.M. AT FULL VOLUME. 1 WATT OUTPUT.
3. ALL VOLTAGES MEASURED WITH RESPECT TO CHASSIS.
4. ALL VOLTAGES MEASURED WITH + 14.1 VOLTS INPUT WITH NEGATIVE TERMINAL GROUNDED,

NO UNGROUNDED AC POWERED TEST EQUIPMENT SHOULD EVER BE USED.

* 10% ▲ 5%

K1423-A

**FIG. 2—AM-FM Radio Wiring Diagram**

# PART 16-5 SPEED CONTROL


| Section | | Page |
|---|---|---|
| 1 | Description and Operation | 16-20 |
| 2 | In-Car Adjustments and Repairs | 16-20 |
| 3 | Removal and Installation | 16-21 |


## 1 DESCRIPTION AND OPERATION

The speed control unit available on Mercury cars is governed directly by car speed. A conventional speedometer drive cable, connected to the input shaft at the bottom of the control unit, drives a spring loaded governor in the control unit and at the same time drives a second cable which extends to the speedometer head by means of a 1:1 gear set. The spring loading of the governor is varied and controlled by turning the selector knob located on the instrument panel. For example, with the selector knob set at 50 mph the tension in the governor spring is such that when the car speed reaches 50 mph the force of rotation of the governor weights is balanced by the governor spring tension.

When the speed control unit is used as a mechanical speed reminder device, a resistance or back pressure is felt at the accelerator pedal at and above the speed selected on the selector dial.

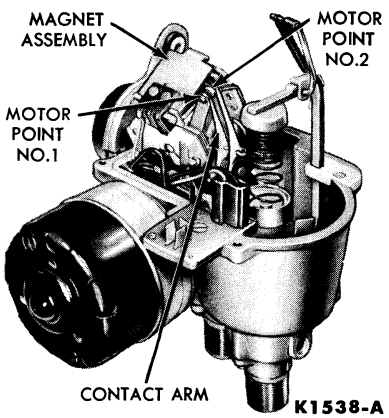



**FIG. 1—Speed Control Unit—Cover Removed**

The position of the back pressure point will vary with the road grade.

The car speed can be increased at any time by pushing the accelerator through the back pressure. Release pressure on the accelerator pedal and the car will slow down normally.

Turn the selector dial forward or backward to increase or decrease the speed setting. **Back pressure will always be felt when selected speed is reached.**

The automatic speed control feature can be put into operation by moving the slide switch to the lock position (it will return to the ON position when released) when a preselected speed is reached and the accelerator pedal is held against the reaction pressure.

The Speed Control will now operate automatically without the need of foot pressure on the accelerator pedal. The control unit motor will advance or retract the accelerator pedal to maintain the pre-selected speed. The speed of the vehicle may be increased or decreased by turning the selector dial while the Speed Control is operating automatically.

The automatic feature is released by depressing the brake pedal within the first ¼ inch of travel, moving the slide switch to the OFF position, or by turning the ignition switch to the OFF position. Any of these operations breaks the electrical circuit and the unit returns to manual control.

Inside the control unit, an activator assembly riding up and down on a shaft moves the contact arm between motor point #1 and #2 located on the magnet assembly (Fig. 1). Electrical contact between the point on the contact arm and either motor point activates a 12-volt reversible motor that rotates a drive screw. When the drive screw rotates, a nut on the screw moves the entire magnet assembly to the position where equilibrium is reached between the governor weights and the governor spring. When the pre-selected road speed is reached, a reaction pressure is felt on the accelerator pedal.

When the car tends to go slower than the pre-selected speed, as would be the case in going up a hill, the action of the governor weights causes the contact arm to move and establish contact with motor point #1. The motor now rotates in the opposite direction; thus the magnet assembly moves to allow the throttle to be opened, to maintain the pre-selected speed.

When the car travels downhill, it tends to travel faster than the preselected speed. The resulting action of the governor weights moves the contact arm to motor point #2, causing the motor to rotate the drive screw and move the magnet to close the throttle.

## 2 IN-CAR ADJUSTMENTS AND REPAIRS

### LINKAGE

**1.** Remove the cotter key from the accelerator linkage and pull the linkage from the exterior arm.

**2.** Start and run the engine until it operates at a slow idle.

**3.** Insert the gauge sleeve over the gauge bolt and hold the exterior arm securely against the gauge pin (Fig. 2).

The gauge tool is supplied in Speed Control Kits. However, if the gauge tool is not available, use a piece of 5/16 inch I. D. tubing of 1/16 inch wall thickness two inches long.

**4.** Adjust the swivel on the throttle linkage until the linkage will assemble to the exterior arm.

**5.** Replace the linkage and cotter pin.

**6.** Remove the gauge sleeve.

### CONTROL CABLE

**1.** Rotate the selector dial toward its low setting, as far as it will turn without forcing.

**2.** Loosen the screw on the dust shield. This screw retains the control cable in the bottom of the dust shield.

**3.** After loosening the screw pull the control cable out of the dust shield, making certain that the ferrule at end of the cable is free in the bottom of the dust shield.

**4.** Reinsert the ferrule in the dust shield. Push in lightly on the control cable until it stops. **Do not force the cable beyond this position.**

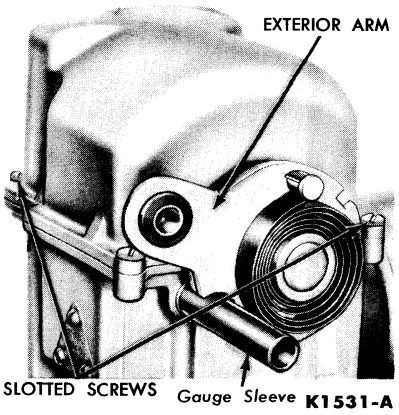



**FIG. 2—Gauge Tool Installed**

5. Again check the selector dial in order to make certain that it is at its low setting.

6. Again push on the control cable until it stops. While holding the cable in this position, tighten the screw on the dust shield securely.

### BRAKE PEDAL RELEASE SWITCH

1. Turn the ignition switch to the ACC position, and the speed control slide switch to the OFF position.

2. Place a 12-volt test lamp between terminal No. 1 and ground (Fig. 3). The test lamp should be on.

3. If the lamp is out, check for a blown fuse.

4. If the lamp fails to go on when the fuse is good, test the switch for proper operation.

5. If the switch is good, inspect the wiring for broken wires or loose connections (Fig. 3).

6. With the switch installed and the lamp on, depress the brake pedal to determine if the lamp goes out within the first ¼ inch of pedal travel.

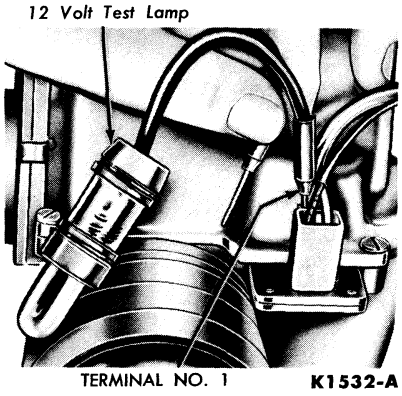



**FIG. 3—Checking Brake Release Switch Adjustment**

7. If the lamp fails to go out during the first ¼ inch of travel, loosen the switch adjusting nuts and reposition the switch so the lamp goes out during the first ¼ inch of brake pedal travel. Tighten the adjusting nuts to specifications.

## 3 REMOVAL AND INSTALLATION

### CONTROL UNIT

Whenever a faulty power unit is removed, the car can be driven with the speedometer operating by removing the power unit cables from the speedometer and transmission, and installing a standard speedometer cable and housing assembly between the transmission and speedometer.

#### REMOVAL

1. Disconnect the multiple electric connector at the power unit.

2. Disconnect the drive cable and the speedometer cable from the power unit.

3. Loosen the set screw at the lower end of the dust shield.

4. Remove the dust shield from the housing. Then slide the dust shield down the cable and slip the ball end of the Bowden cable out of its socket.

5. Disconnect the accelerator linkage from the exterior arm plate on the power unit.

6. Remove the two bolts securing the power unit to its mounting bracket and remove the power unit, leaving the mounting bracket attached to the fender dust shield.

#### INSTALLATION

1. Position the power unit on its mounting bracket and secure to the bracket with two bolts.

2. Connect the accelerator linkage to the locking arm on the power unit and adjust the linkage as described in this section of the manual.

3. Install the ball end of the Bowden cable in its socket on the power unit.

4. Install the dust shield in the housing. The dust shield has bayonet type retention. Push in and turn clockwise. **Do not tighten the set screw on the end of the dust shield until the control cable is properly adjusted.**

5. Adjust the control cable as described under "In-Car Adjustments and Repairs".

6. Connect the drive cable and speedometer cable to the power unit.

7. Connect the multiple electric connector at the power unit.

### SELECTOR ASSEMBLY AND CABLE

#### REMOVAL

1. Open the hood and loosen the cable retaining lock screw at the bottom of the dust shield.

2. Rotate the dust shield ¼ turn counterclockwise and remove it from the control unit.

3. Remove the dust shield from the cable.

4. From inside the car, remove the slide switch button, which will pull straight out.

5. Remove the two nuts which attach the assembly to the instrument panel.

6. Remove the selector assembly from the instrument panel.

7. Disconnect the selector wires and remove the complete assembly.

#### INSTALLATION

1. Position the cable through the dash, and connect the selector wires.

2. Assemble the selector assembly to the instrument panel, and assemble the two nuts which attach it.

3. Install the slide switch lever button.

4. Position the dust shield on the cable.

5. Insert the dust shield in the housing and turn the shield ¼ turn clockwise to properly retain the dust shield. **Do not tighten the set screw on the end of the dust shield until the control cable has been properly adjusted.**

6. Adjust control cable. (See "In-Car Adjustments and Repairs.")

# PART 16-6 SPECIFICATIONS

## BLOWER MOTOR CURRENT DRAW

| | | |
|---|---|---|
| At Low Speed | 2-4 | Amperes at 12 volts |
| At Medium Speed | 4-6 | Amperes at 12 volts |
| At High Speed | 6-8 | Amperes at 12 volts* |

*When in A/C position 8.4-8.9 Amperes at 12 volts on Select-Aire and Deluxe Air Conditioner. 6.5-7.5 Amperes at 12 volts on Ford, and Mercury Air Conditioners.

## AIR CONDITIONING COMPRESSOR

| Location | Torque (ft-lbs) Tecumseh | Torque (ft-lbs) York |
|---|---|---|
| Cylinder Head | 20-24 | 14-18 |
| Front Seal Plate | 6-10 | 13-17 |
| Service Valve (Rotolock) | 35 Max. | 35 Max. |
| Mounting Bolt | 14-17 | 14-17 |
| Oil Filler Plug | 18-22 | 18-22 |
| Clutch Mounting | 15-22 | 15-22 |
| Base Plate | | 7-11 |
| Back Plate | | 7-10 |

Oil Capacity Tecumseh ⅞ inch (11 ounces)
York ¾ inch (10 ounces)
Use Suniso #5, or Capella E, or equivalent.
Refrigerant Capacity 2½ pounds.

## CIRCUIT PROTECTION

| | |
|---|---|
| Heater | 3AG15 Fuse |
| Air Conditioner | 20 Amp. C.B. |

## DRIVEN BELT TENSION

**Between Fan Pulley and Air Conditioner Compressor**
All Engines.....New 120-150
Used* 90-120

*Belt operated for a minimum of 10 minutes is considered a used belt.

## SPEED CONTROL

**BRAKE PEDAL RELEASE SWITCH**
Adjustment Nut Torque.....48-60 in-lbs

## RADIO

Radio Current Draw.....1 ampere max. @ 12 volts

| Location | Torque (ft.-lbs.) |
|---|---|
| Radio to Instrument Panel | 25-35 |
| Mounting Plate Nuts | 25-35 |

# BODY, DOORS, AND WINDOWS

# GROUP 17

**PART 17-1** PAGE
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**PART 17-2**
FRONT SHEET METAL, BUMPERS, EXTERIOR MOULDINGS ..... 17-13

**PART 17-3**
DOORS, WINDOWS, TAILGATE, AND DECK LID ..... 17-31

# PART 17-1 GENERAL BODY SERVICE

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1 Diagnosis and Testing ..... 17-1
2 Common Adjustments and Repairs ..... 17- 3
3 Cleaning and Inspection ..... 17-11

## 1 DIAGNOSIS AND TESTING

### DUST AND WATER LEAKS

Sealer locations should be considered when checking for dust or water leaks. It should be remembered that the forward motion of the car creates a slight vacuum within the body, particularly if a window or ventilator is partially open. Any unsealed crevice or small opening in the lower section of the body will permit air to be drawn into the body. If dust is present in the air, it will follow any path taken by the air from the point of entry into the passenger and luggage compartments. Opening the ventilator air ducts, will equalize these pressures. Dust may work its way into the hollow, box-type, rocker panel which extends along the edge of the floor below the doors. Dust accumulates in the rocker panel, and may eventually work its way to the kick-up or the rear body pillar, and follow the contour of the wheelhouse into the luggage compartment.

To eliminate dust leakage, determine the exact point at which the dust enters. As explained above, the point of entry is often deceptive in that the dust may enter at one point then follow the passages, formed by interior trim, to another point.

Under certain conditions, water can enter an automobile body at any point where dirt or dust can enter. Any consideration of water leakage must take into account all points covered under dust leaks.

To determine the exact location of a dust leak, remove the following trim from the car:

1. Cowl side trim panel.
2. Quarter trim panel.
3. Rear seat back and seat cushion.
4. Luggage compartment floor mats, spare wheel, and side trim panel.
5. Center pillar trim on 4-door models.
6. Scuff plates.

After removing the trim, the location of most leaks will be readily evident. Seal these leaks, and road test the car on a dusty road to make sure all leaks are sealed. The entrance of dust is usually indicated by a pointed shaft of dust or silt at the point of entrance.

After the road test, check for indications of a dust pattern around the door openings, cowl panel, lower part of the quarter panel, and in the luggage compartment.

Sometimes leaks can be located by putting bright lights under the car, with the above components removed, and checking the interior of the body joints and weld lines. The light will show through where leaks exist.

### DOOR AND QUARTER POWER WINDOWS

Before making any of the following trouble checks, make sure the battery is fully charged, and turn the ignition switch to the accessory position.

#### ALL WINDOWS DO NOT OPERATE

1. Connect a voltmeter or test light from a ground to the power window relay black wire which is connected to the 20 ampere circuit breaker (Fig. 1). If no voltage is available, repair or replace the 20 ampere circuit breaker or the connecting black wire.
2. Connect a voltmeter from a ground to the red wire terminal of the power window relay. If no voltage is available, repair or replace the ignition switch or the red wire from the ignition switch to the relay.
3. Connect a voltmeter from a ground to the remaining terminal (black wire) of the power window relay (Fig. 1). If no voltage is available, replace the power window relay.
4. Check the black wire at the master control switch for voltage. If no voltage is available, repair or replace the black wire from the master control switch to the power window relay.

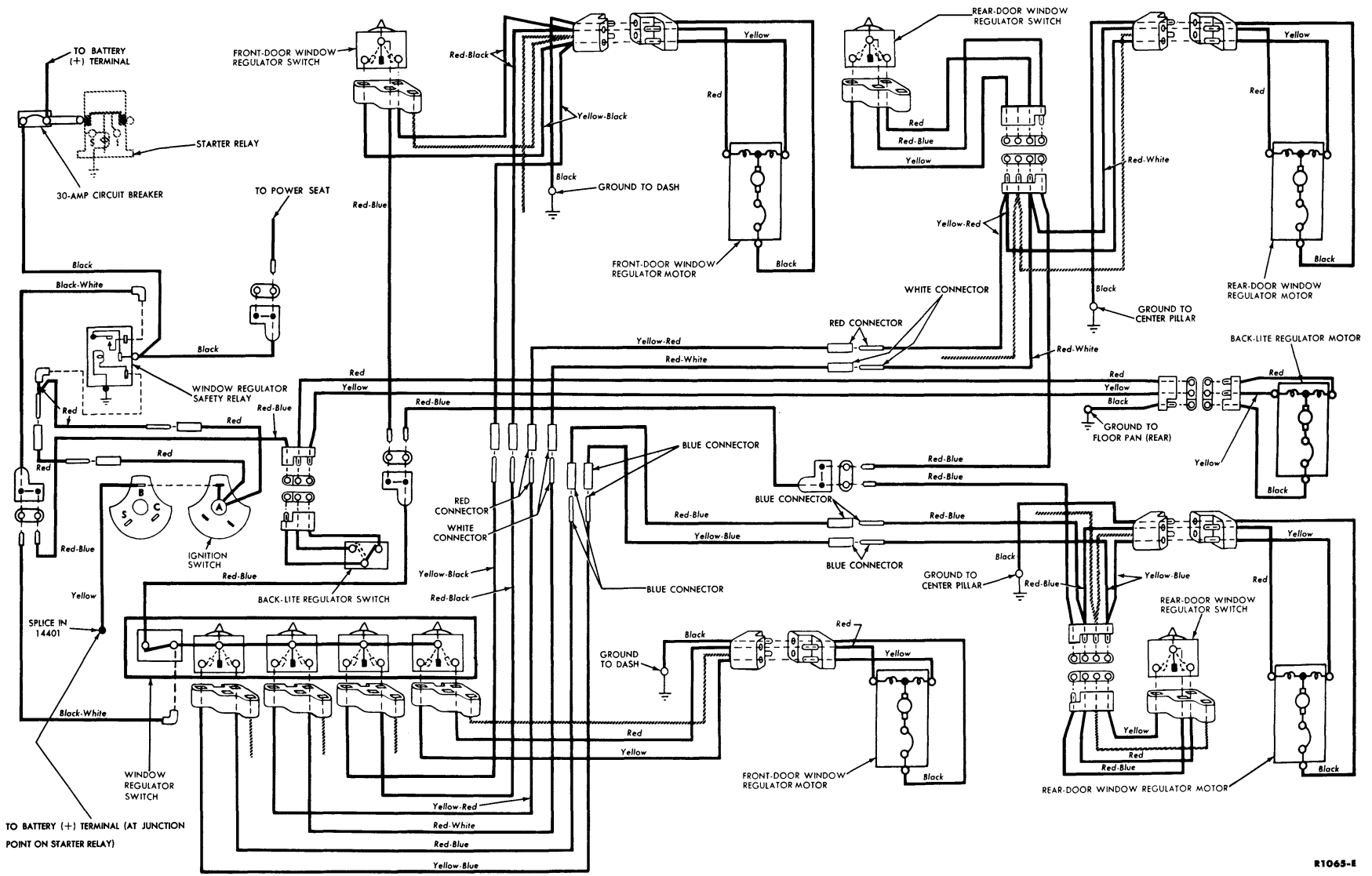



**FIG. 1—Power Window Wiring Diagram**

5. At this point the trouble causing all windows not to operate should have been found and corrected. The chances of having all of the control switches, ground circuit breakers, switch to motor wires, or motors defective at the same time are very remote.

**The power window, power seat, and convertible top electrical systems are connected through the same 20 ampere circuit breaker. If failure occurs in all the systems at the same time, the 20 ampere circuit breaker is probably defective.**

### ONE WINDOW DOES NOT OPERATE

1. Operate the switch and listen for the noise of the motor running free. If the motor is running, it is loose and has pulled away from its coupling.

2. Short out the ground circuit breaker of the inoperative window, and operate the switch. If the motor runs, replace the circuit breaker.

3. Disconnect the green wire at the motor and check it for voltage when the switch is operated. If no voltage is available, check for voltage at the green wire terminal of the switch. If there is voltage at the switch, repair or replace the green wire from the switch to the motor.

4. In case there is no voltage at the switch green wire terminal when the switch is operated, check for voltage at the switch red-blue stripe wire terminal. Replace the switch if there is voltage at the red-blue stripe wire terminal and none at the green wire terminal. Repair or replace the red-blue stripe wire if no voltage is available at the switch.

5. If voltage is available at the motor green wire terminal, check the red and yellow wires for voltage. If voltage is available at the red and yellow wires, replace the motor.

### WINDOW OPERATES IN ONE DIRECTION ONLY

1. Check the window operation with both switches. If the window operates properly with one switch and not the other, check the switch and the red and yellow wires for voltage. Replace the switch or the wires as necessary.

2. If both switches operate the window in only one direction, check the red and yellow wires at the motor for voltage. If voltage is available, a field coil is open and the motor must be replaced.

### WINDOW OPERATES SLUGGISHLY

1. Check the regulator and window runs for binding. Adjust the runs, repair and lubricate the regulator. Lubricate the runs with silicone lubricant.

2. Check for frayed insulation where the wires may partially ground. Check for loose connections which will cause high resistance, and make sure paint is not insulating the ground wires or ground circuit breakers where they attach to the body.

3. Connect an ammeter between the black motor wire and a ground. Current draw for normal operation should not exceed 20 amps. Current draw when the mechanism is against a stop should be within 30-50 amps, depending upon the motor temperature. If either check shows excessive amperage, the motor should be replaced.

4. Disconnect the motor from the regulator. Connect an ammeter in series with the ground wire, and operate the switch. The motor no-load current draw should not exceed 12 amps at 12 volts. If the current draw does not meet these specifications, the motor must be replaced.

## 2 COMMON ADJUSTMENTS AND REPAIRS

### TYPES OF SEALERS AND APPLICATION

Since many sealers are used in manufacturing assembly, the all purpose sealers described below have been selected for service use. The method and points of application (Figs. 2 through 6) are given under each sealer type.

### CAULKING CORD– AB-19560-A

This sealer has a plastic base with an asbestos filler, is heavy bodied, and is commonly known as "permagum." It is used on spotweld holes, around moulding clips, or between two surfaces not properly sealed by a gasket. Apply the sealer with a putty knife.

### TRIM CEMENT– C2AZ-19C525-A

This cement is specially recommended for instrument panel safety pad and body panel plastic water shield installation. It is also useful for repair or replacement of other vinyl and rubber trim.

### RUBBER CEMENT– 8A-19552-B

This quick-drying, strong, adhesive cement is designed to hold weatherstripping on doors, bodies, deck lids, cowl ventilators, and the surrounding metal. Windows and windshields that are set in rubber can be effectively sealed against leakage by flowing cement into affected areas.

Clean all grease, dirt, and old sealer from the surfaces to be cemented. Wash the surfaces thoroughly with a rag moistened with clean gasoline or cleaner's naphtha. For best results, apply a medium coat of cement to both surfaces, allow it to dry until tacky, and then press both surfaces firmly together.

### CLEANING SOLVENT– B7A-19520-A OR B7A-19521-A

**Prevent either of these cleaners from contacting either vinyl or leather.**

This general clean-up solvent cleans off cement smears, wax, tars, oils, grease, caulk and sealer. It can also be used to thin caulk and sealer. It is harmless to cured paint, and is useful in new car pre-delivery.

### SILICONE LUBRICANT– COAZ-19533-A (JELLY) OR COAZ-19533-B (SPRAY)

This lubricant can be used on the door upper weatherstrips of convertible and hardtop models. Its use makes the doors easier to close, avoids weatherstrip squeaks, retards excess weatherstrip wear chafing between the door glass upper frame and the weatherstrip, and helps to retain door window alignment by reducing friction between the glass frame and rubber weatherstrip.

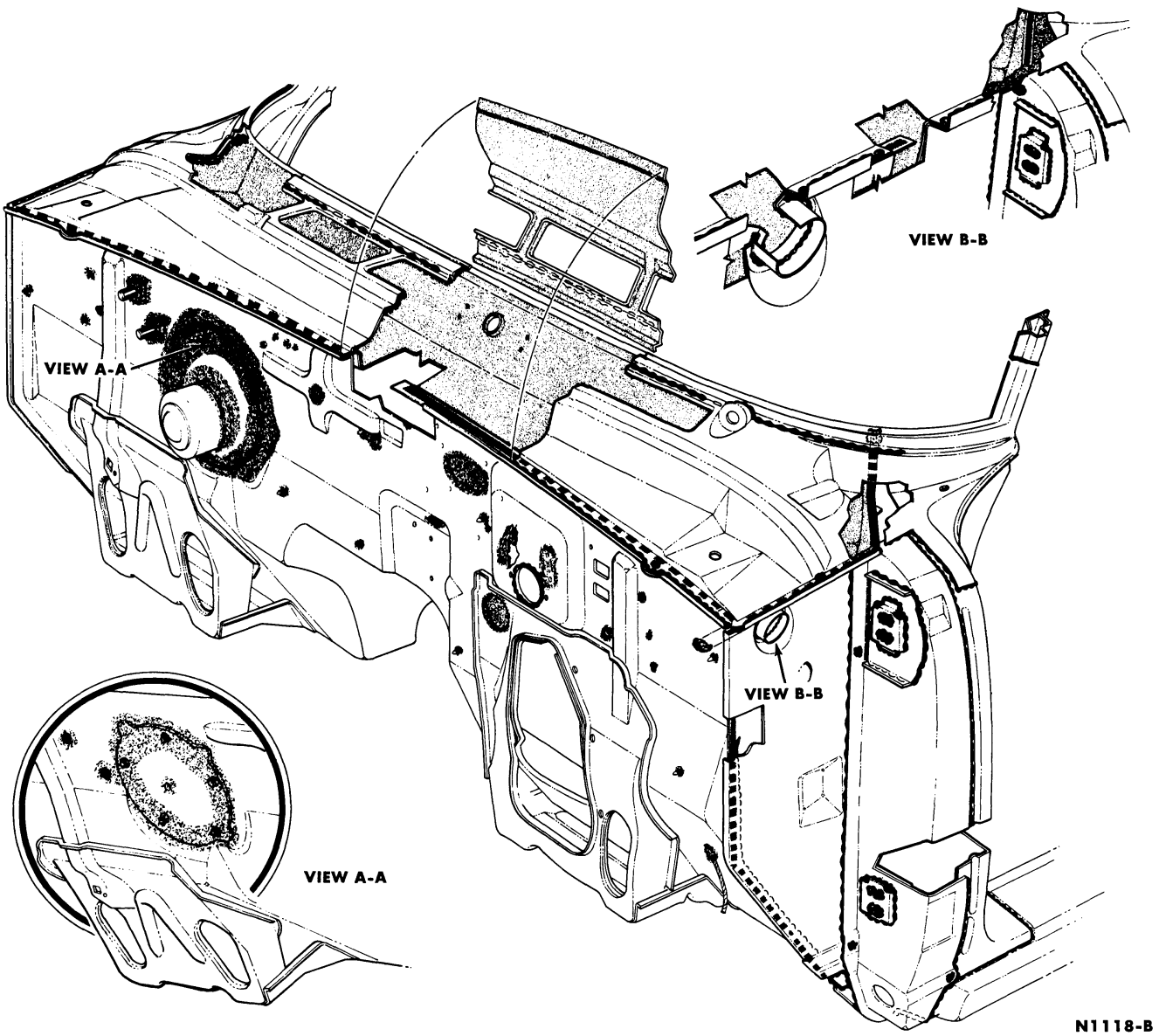



**FIG. 2–Body Cowl and Pillar Sealer Application**

## BODY ALIGNMENT

When checking alignment of a badly damaged body, be sure that all necessary frame corrections have been made before attempting to align the body.

Rough out badly damaged areas before taking measurements for squaring up a body. Remove glass to prevent breakage. In severe cases, reinforcement brackets and other inner construction may have to be removed or cut to permit restoration of the outer shell and pillars without excessive strain on the parts. Straighten, install, and secure all parts in place before attempting to align the body.

In cases of severe or sharp bends, it may be necessary to use heat. Any attempt to cold-straighten a severely bent bracket may cause ruptures of the welds (if any) and may also cause cracks in the bent part. Never heat the area more than enough to give a dull red.

## CHECKING BODY FOR MISALIGNMENT

To align or square up a body, take two opposite diagonal measurements between the front, center, or rear pillars. Take the measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured. Since all measurements should be made from the bare metal, remove all interior trim from the checking points.

Do not attempt to correct any serious misalignment with one jacking operation. This is particularly true if other sections of the body also require aligning. Align each section proportionately until the proper dimensions are obtained. If frame alignment is questionable, see Figs. 7 and 8.

## FRAME ALIGNMENT

Frame misalignment can affect front wheel alignment, body alignment, and the operation of the chassis parts. Window glass cracks, door and window opening troubles, and

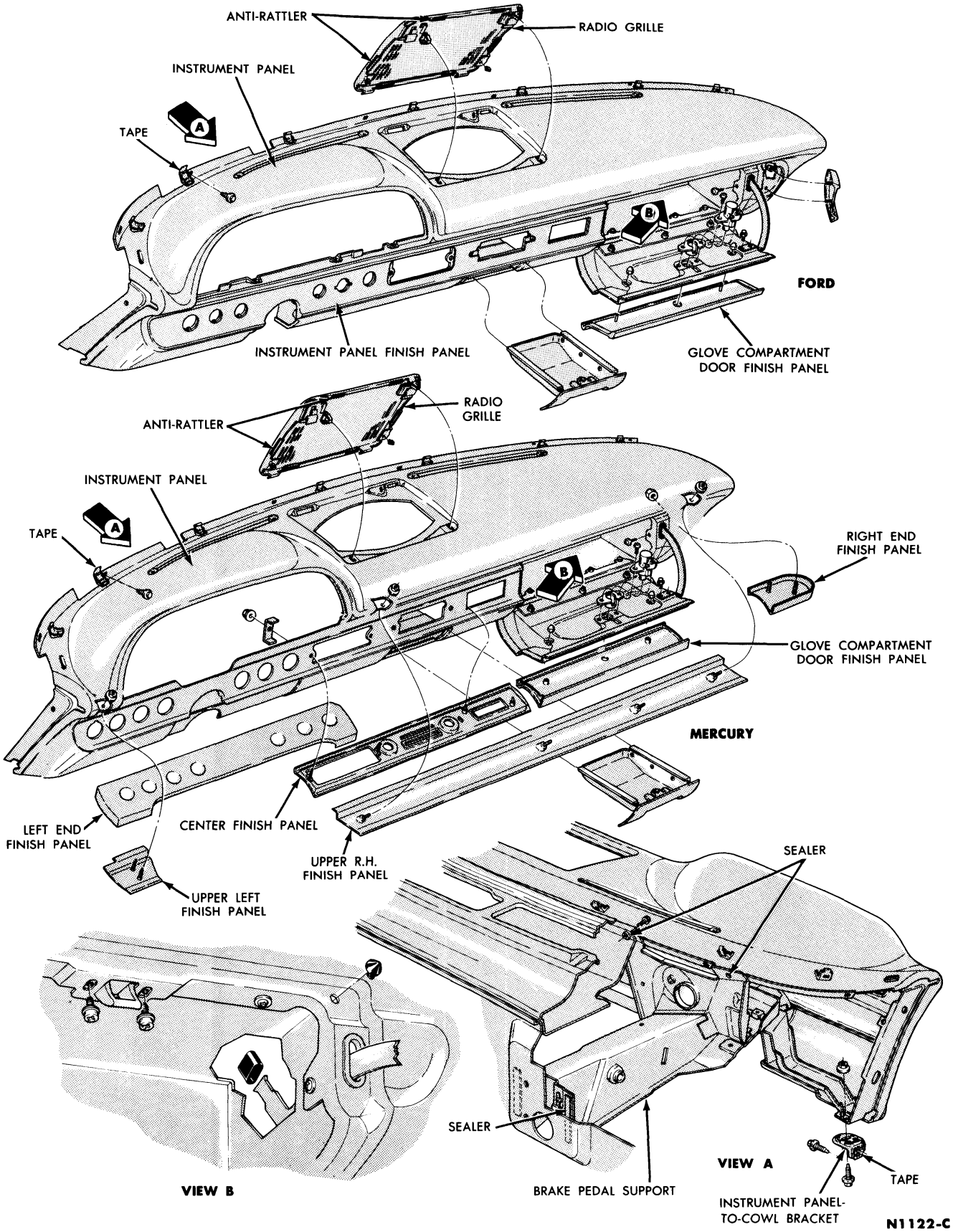



**FIG. 3—Instrument Panel and Glove Compartment**

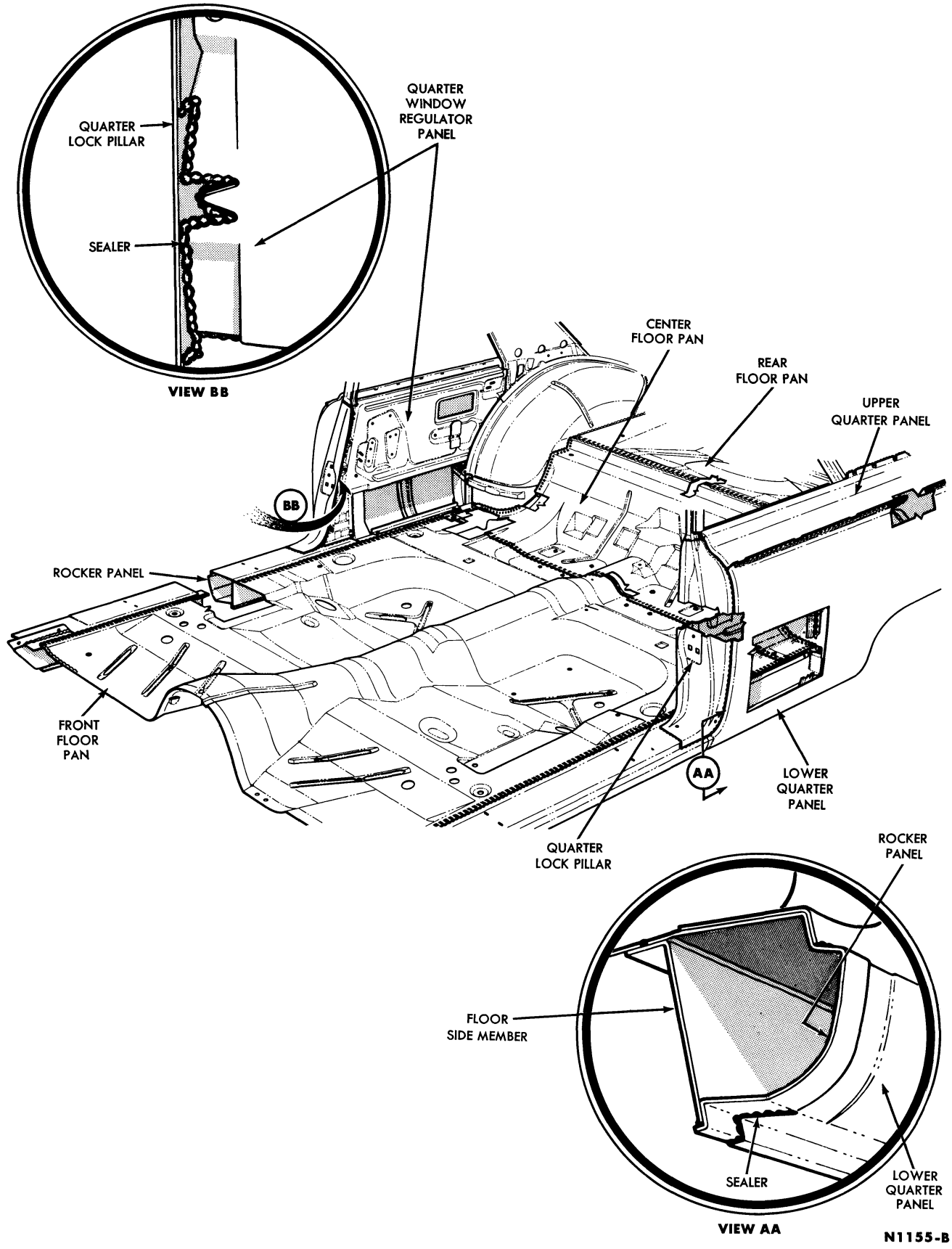



**FIG. 4—Front and Center Floor Pan Sealer Application—Body Types 62 and 75**

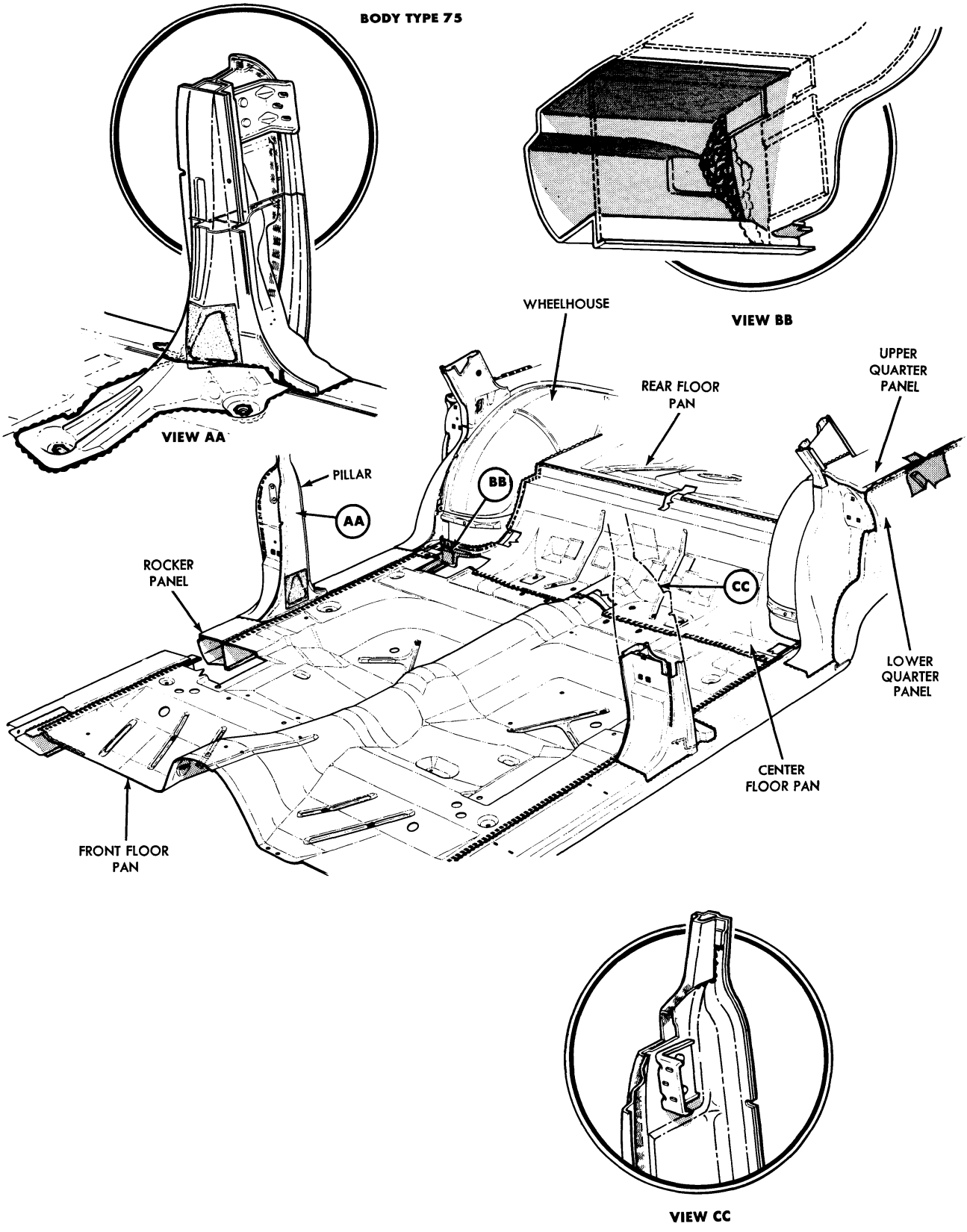



**FIG. 5—Front and Center Floor Pan Sealer Application—Body Types 54, 71, and 75**

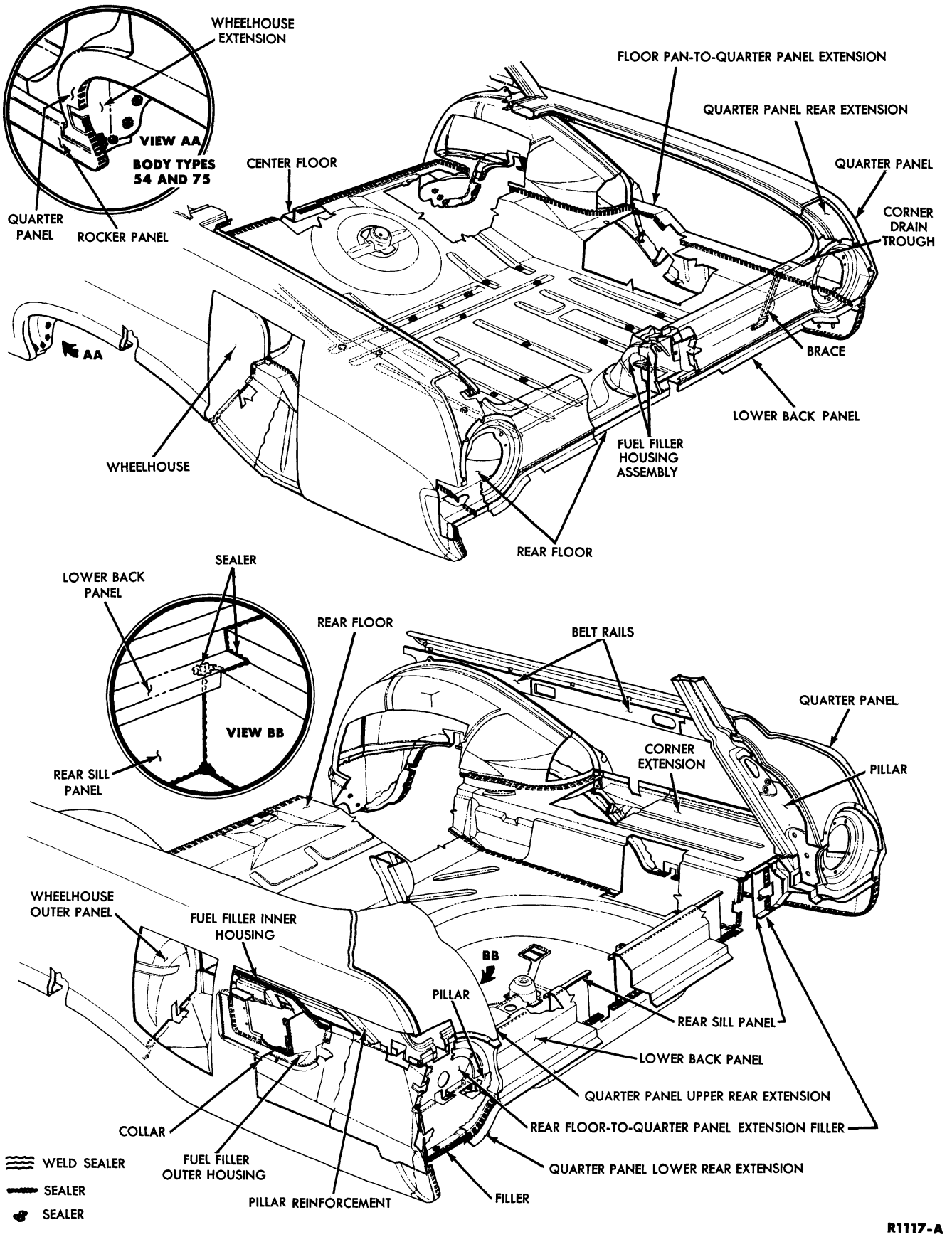
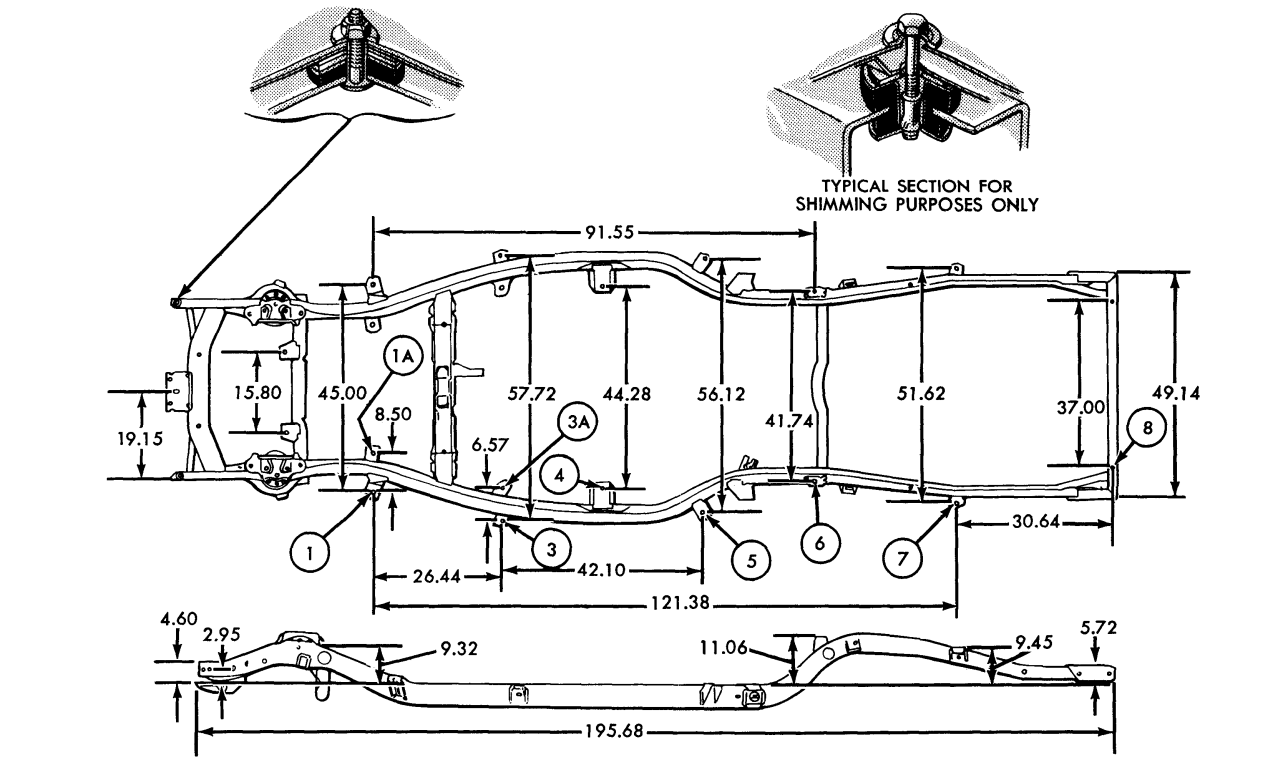
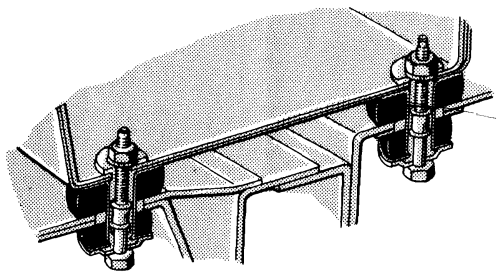
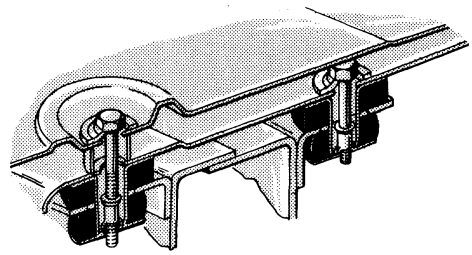



**FIG. 6—Rear Floor Pan Sealer Application**

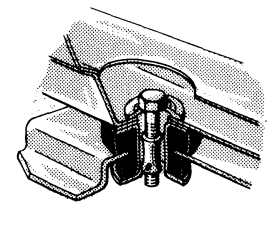


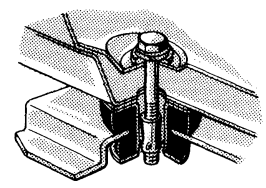


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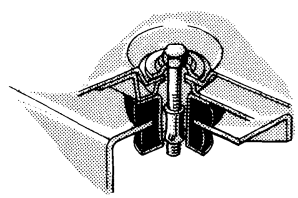

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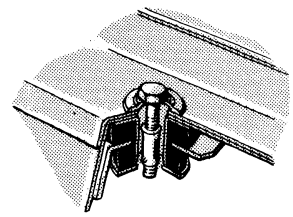

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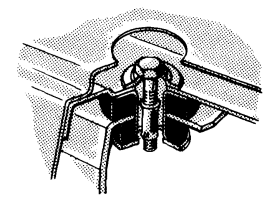

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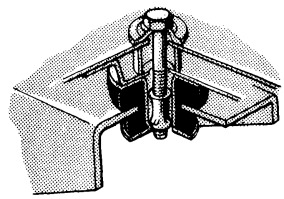

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PASS. CAR

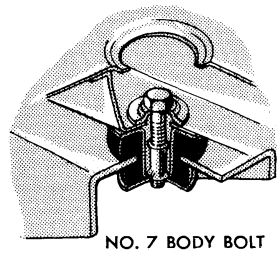

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STATION WAGON

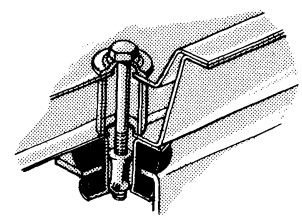

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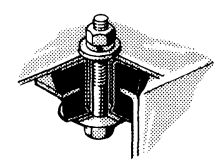

NO. 6 BODY BOLT
PASS. CAR


NO. 6 BODY BOLT
STATION WAGON


NO. 7 BODY BOLT
PASS. CAR

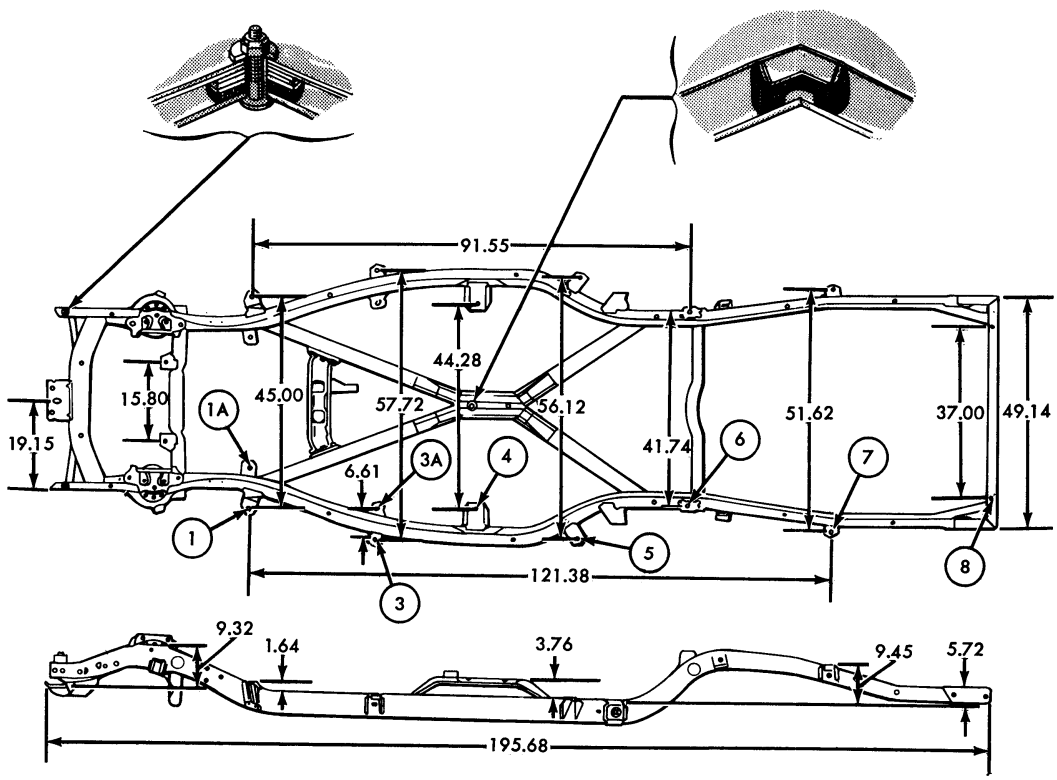

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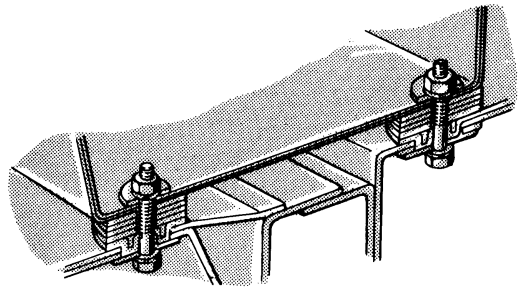

NO. 8 BODY BOLT
PASS. CAR


NO. 8 BODY BOLT
STATION WAGON

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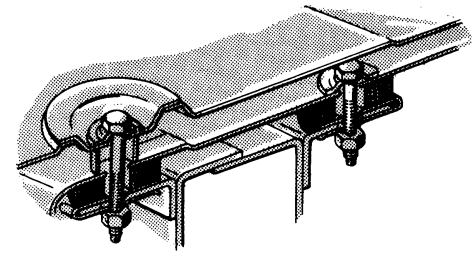
**FIG. 7—Conventional Frame and Body Bolts**



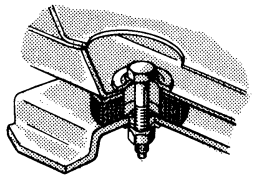
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NO. 1 BODY BOLT

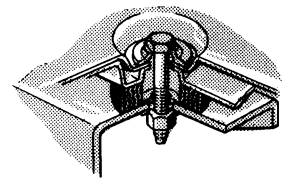


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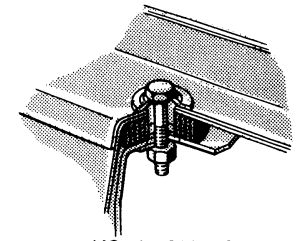
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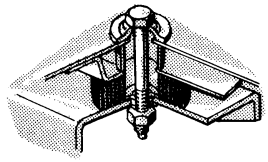
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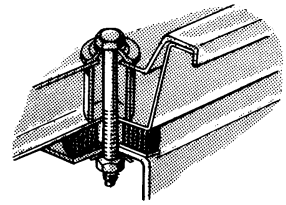
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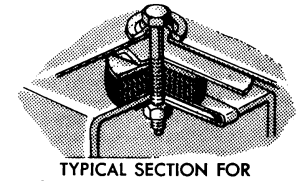
NO. 6 BODY BOLT



NO. 7 BODY BOLT



NO. 8 BODY BOLT



TYPICAL SECTION FOR SHIMMING PURPOSES ONLY

M1050-C

**FIG. 8—Convertible Frame and Body Bolts**

air or water leaks at the doors are often caused by improperly tightened body bolts (Figs. 7 and 8) or frame misalignment.

Before checking frame alignment, inspect all frame members for cracks, twists, or bends. Check all welded connections for cracks. Inspect the bolts and body support brackets for looseness. Make any necessary repairs or replacements.

The conventional frame and convertible frame dimensions are shown in Figs. 7 and 8.

### FRAME REPAIRS

To prevent internal stresses in the metal, frame straightening should be limited to parts which are not severely bent. If heat is needed to straighten a frame member, keep the temperature below 1200°F. Excessive heat may weaken the metal in the frame members and cause permanent damage.

Electric welding equipment should be used for all frame welding and **heat should be kept in a minimum area** so the hardness of the metal will not be affected.

When a reinforcement is to be welded to a frame side member, run the welds lengthwise along the side of the reinforcement.

If a damaged frame member is to be replaced, use the same method of attachment as on the original frame member. New bolts, required for replacement of parts, should be of the same specifications as the original bolts.

## 3 CLEANING AND INSPECTION

### FLOOR PAN PLUGS AND GROMMETS

Many plugs and grommets are used in the floor pan and dash panel. The floor pan plugs seal the various body bolt access holes. If any plugs are missing or improperly installed, a dust or water leak may result. This also applies to the grommets used on the dash panel. When dust or water leaks are evident, these plugs and grommets should be checked for proper installation.

### DRAIN AND DUST VALVES

Two drain and dust valves are provided in the bottom of each door, two in each rocker panel, and one in each quarter panel. These valves are located in the lowest points in the panels. The weight of the water will open the valve and allow the water to escape from the panel. After the water has drained, the valve will close and prevent the entry of dust. If for any reason the door trim panel, rocker panel scuff plate or luggage compartment trim panel has been removed, the drain holes in the metal should be inspected to make sure that they are not obstructed.

### BODY MAINTENANCE

Regular body maintenance preserves the car's appearance and reduces the cost of maintenance during the life of the car. The following steps are suggested as a guide for regular body maintenance.

**1.** Vacuum the interior thoroughly and wash the car.

**2.** Check all openings for water leaks, and seal where necessary.

**3.** Cement all loose weatherstrips which are still usable.

**4.** Replace all weatherstrips which are unfit for service. Apply silicone lubricant to the weatherstripping.

**5.** Replace all cracked, fogged, or chipped glass.

**6.** Align hood, doors, and deck lid if necessary.

**7.** Inspect windshield wiper blades and replace if necessary.

**8.** Tighten sill plate and garnish moulding screws.

**9.** Clean the seats, door trim panels, and headlining.

**10.** Touch-up or paint chipped or scratched areas.

**11.** Drain holes, located on the underside of each rocker panel, quarter panel, and door, should be cleared periodically.

### RATTLE ELIMINATION

Most rattles are caused by a loose bolt or screw. Foreign objects such as nuts, bolts, or small pieces of body deadener in the door wells, pillars, and quarter panels are often the source of rattles. Door wells can be checked by carefully striking the underside of the door with a rubber mallet. The impact made by the mallet will indicate if loose objects are in the door well.

All bolts and screws should be tightened periodically (Fig. 9). In the event that tightening the bolts and screws, located on such assemblies as the doors, hood, and deck lid, does not eliminate the rattles, the trouble is probably caused by misalignment. If this is the case, follow the adjustment and alignment procedures for these assemblies.

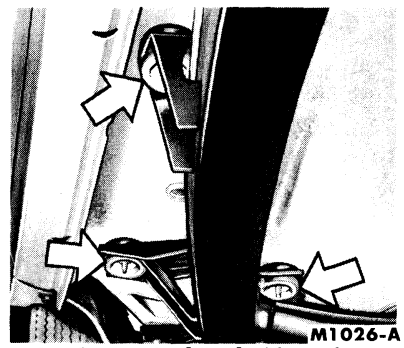


FIG. 9—Typical Body Mountings

Rattles and squeaks are sometimes caused by weatherstripping and anti-squeak material that has slipped out of position. Apply additional cement or other adhesive, and install the material in the proper location to eliminate this difficulty.

### EXTERIOR CLEANING

The outside finish should be frequently washed. Never wipe the painted surfaces with a dry cloth. Dusting the finish when it is dry tends to rub the dust and dirt into the baked enamel, and leaves a sandpaper effect on the surface. To keep the finish bright and attractive, and eliminate the necessity of using polish, wash the car whenever it has accumulated a moderate amount of dirt and road salt.

The bright metal parts of the car require no special care. Periodic cleaning will perserve the beauty and life of these finishes. Wash with clear water or if the parts are very dirty use COAA 19B521-A Cleaning Compound. Using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. FoMoCo

Chrome Cleaner may be used sparingly to remove rust or salt corrosion from chrome plated parts. Do not scour chrome finished parts with steel wool or polish them with products containing abrasives. A FoMoCo Polish will provide excellent protection for all bright metal parts.

## INTERIOR CLEANING

Use a vacuum cleaner to remove dust and dirt from the upholstery or floor covering. Vinyl and woven plastic trim that is dusty can usually be cleaned with a damp cloth. **Do not use cleaning materials containing kerosene, naphtha, toluol, xylol 10°, laquer thinners, cellulose acetate, butyl cellulose, carbon tetrachloride, body polish, battery acid, antifreeze, gasoline, motor oils or other type lubricants.**

Approved cleaners B8A-19523-A or B, B5A-19525-A, COAZ-19526-A or B (soft trim cleaners) and CIAZ-19C507-A (convertible back window cleaner) are available for service. Instructions for the use of these cleaners are included with their containers.

## CARE OF WOOD GRAIN PANELING

**Washing.** Never wipe the panels or trim rails with a dry cloth. This method of cleaning tends to rub dust particles into the finished surface and leave fine scratches. Flush off all loose dirt and other elements, and wipe the body panels and rails with a sponge and plenty of cold water. If desired, a mild soap may be used. Rinse thoroughly with clear water, and wipe dry.

**Glass Fiber Trim Rail Removal and Installation.** The glass fibre trim rails are serviced with the woodgrain already applied. To remove the body side trim rails, remove the cap over each trim rail screw to gain access to the screws. Remove the screws and the trim rail assembly.

When installing the body side trim rail, apply sealer (AB-19560-A) around each mounting hole. Install the cap retainer, screw, and cap.

**Application of Wood-Grain Transfers.** Wood-grain transfers are available for application to the panels. The materials necessary to apply the transfers are a bonding coat (M-4584), 20% transfer solution of M-5412-A, and clear spar varnish.

If the surface on which the transfer is to be applied is damaged, repair and metal finish first.

**1.** Mask off the area where the transfer is to be applied.

**2.** Prime-coat all bare metal areas, and wet sand.

**3.** Spray the surface with transfer bonding coat (M-4584). This coat is the binder for the transfer adhesive.

**4.** Allow the bonding coat to air-dry for one hour, or heat-dry (160°) for 20 minutes.

**5.** Lightly wet-sand the bonding coat, and wipe it dry.

**6.** Make a paper template of the damaged area, and cut the new transfer to size, using the template as a guide. Leave about ½ inch of extra material around the edge of the transfer to allow for matching and trimming.

**7.** Mix a solution of 20% transfer solution M-5412-A and 80% water. This solution permits shifting of the transfer after it has been applied, so that the graining can be matched. **Try a sample of the transfer and solution on an old piece of metal or fender. If the transfer cannot be pulled off after two minutes, the solution is too strong and must be diluted with more water.**

**8.** Soak the transfer in lukewarm water for one minute to loosen the paper backing. **Do not remove the backing until the transfer is applied.**

**9.** Using a cheese cloth pad, apply a 20% M-5412-A transfer solution to the panel. **Any excess solution that runs down on adjacent panels must be wiped off immediately.**

**10.** Place the wet transfer on the panel, paper side out. Adjust the transfer to match the graining on adjusting panels, and carefully remove the paper backing.

**11.** Sponge the transfer with clean water to remove all traces of the paper backing adhesive.

**12.** Remove all air bubbles and wrinkles with a squeegee.

**13.** Wash the transfer with clear water and dry with a chamois.

**14.** Pierce any blisters or small air bubbles as they appear, and press down the area with a finger to remove the air and excess solution.

**15.** Allow the panel to air-dry for one hour, or heat dry (160°) for 20 minutes.

**16.** When the panel is dry, spray two coats of clear spar varnish over the transfer. **Do not use clear lacquer or shellac.**

# PART 17-2 FRONT SHEET METAL, BUMPERS AND EXTERIOR MOULDINGS


| Section | Page | Section | Page |
|---|---|---|---|
| 1 In-Car Adjustments and Repairs | 17-13 | 2 Removal and Installation | 17-14 |


## 1 IN-CAR ADJUSTMENTS AND REPAIRS

### HOOD ADJUSTMENTS

The hood is provided with fore-and-aft, side-to-side, and vertical adjustments (Fig. 1). These directions refer to the position of the hood when it is fully lowered. The elongated horizontal bolt slots in the hood hinge provide fore-and-aft adjustment. The elongated bolt slots used to attach the hood hinge bracket to the hood provide the adjustment side-to-side. Vertical adjustment is made in the elongated bolt slots provided in the hood bracket.

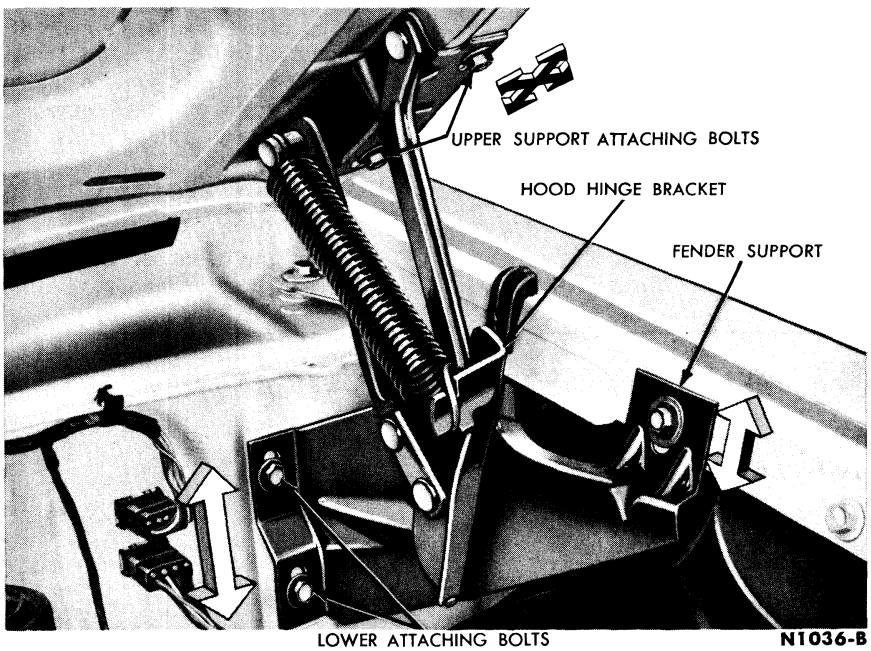



**FIG. 1—Hood Hinge Adjustment**

### HOOD LOCK ADJUSTMENT —FORD

Before adjusting the hood lock mechanism, make certain that the hood is properly aligned. The hood lock (Fig. 2) can be moved from side-to-side and fore or aft to align it with the lock dowel. The safety catch can be adjusted fore or aft to engage the striker that is located to the right of the hood lock.

**1.** Loosen the four hood lock attaching bolts (Fig. 2). Move the lock as required to align it with the lock dowel on the hood.

**2.** Tighten the four attaching bolts.

**3.** Loosen the lock nut on the hood lock dowel and turn the dowel inward to adjust the hood tighter or outward to loosen the adjustment.

**4.** The lock dowel is adjusted correctly when the top of the hood is flush with the fenders, when locked.

**5.** Tighten the dowel lock nut after adjusting the lock dowel.

**6.** To adjust the safety catch, loosen the two attaching screws and move the catch toward the rear of the hood. Tighten the screws and lower the hood to make certain that the safety catch engages the striker.

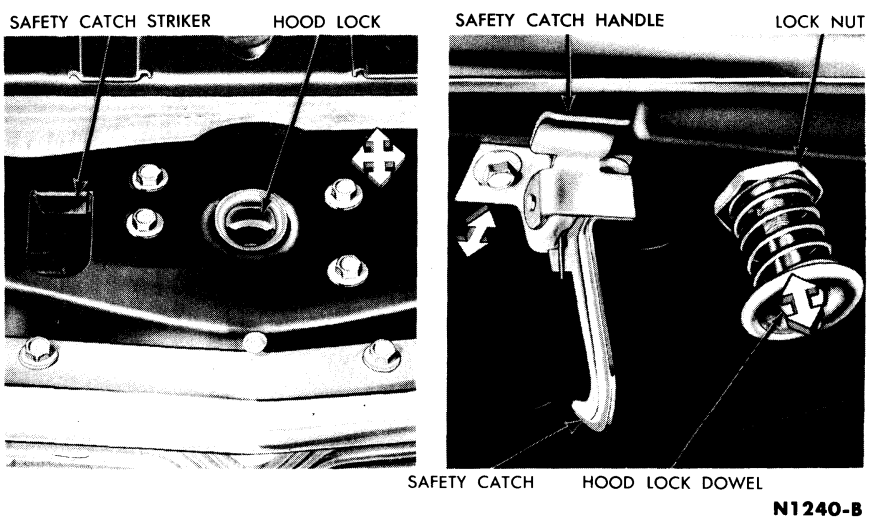



**FIG. 2—Hood Locking Mechanism—Ford**

### HOOD LOCK ADJUSTMENT —MERCURY

Before adjusting the hood lock

mechanism, make certain that the hood is properly aligned. The hood lock (Fig. 3) can be moved from side-to-side and the lock dowel fore or aft for proper alignment. The safety catch can be adjusted fore or aft to engage the striker located to the left of the lock dowel.

1. Loosen the four hood lock attaching bolts (Fig. 3). Move it as required to align it with the lock dowel on the grille center support. Tighten the four attaching bolts.

2. Loosen the lock nut on the hood lock dowel and turn the dowel clockwise to pull the hood tighter or counterclockwise to loosen it. The proper height is when the top of the hood is flush with the fenders.

3. Tighten the dowel lock nut after the proper adjustment has been obtained.

4. Release the hood latch. If the hood can be raised without releasing the safety catch, it will require adjustment.

5. To adjust the safety catch, loosen the two attaching screws and move the catch toward the rear of the hood. Tighten the attaching screws and lower the hood to make certain that the safety catch engages the striker on the grille support.

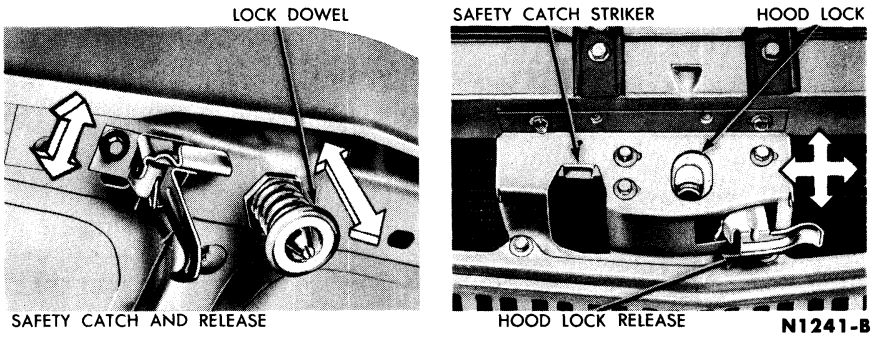



**FIG. 3—Hood Locking Mechanism—Mercury**

### HOOD HINGE REMOVAL AND INSTALLATION

1. Prop the front of the hood in the open position and cover the fender and cowl panel.

2. Remove the hinge-to-hood retaining bolts, the retaining bolts at the fender apron and cowl (Fig. 1), and remove the hinge.

3. Position the hood hinge on the body and install the hinge retaining bolts.

4. Adjust the hood for proper fit.

## 2 REMOVAL AND INSTALLATION

### GRILLE REMOVAL AND INSTALLATION—FORD

#### REMOVAL

1. Remove the four sheet metal screws from each headlamp door (Fig. 4). Remove the doors from the headlamp housings.

2. Remove the four screws that attach the lower end of the grille to the headlamp mounting brackets and hood lock support reinforcement.

3. Remove the six attaching screws from the upper end of the grille.

4. Lift the grille from the car.

#### INSTALLATION

1. Position the grille on the mounting brackets and install the six upper attaching screws.

2. Secure the grille to the headlamp mounting brackets and hood lock support with the four reinforcement nuts.

3. Secure each headlamp door to the housings with three sheet metal screws.

### GRILLE REMOVAL AND INSTALLATION—MERCURY

#### REMOVAL

1. Remove the battery.

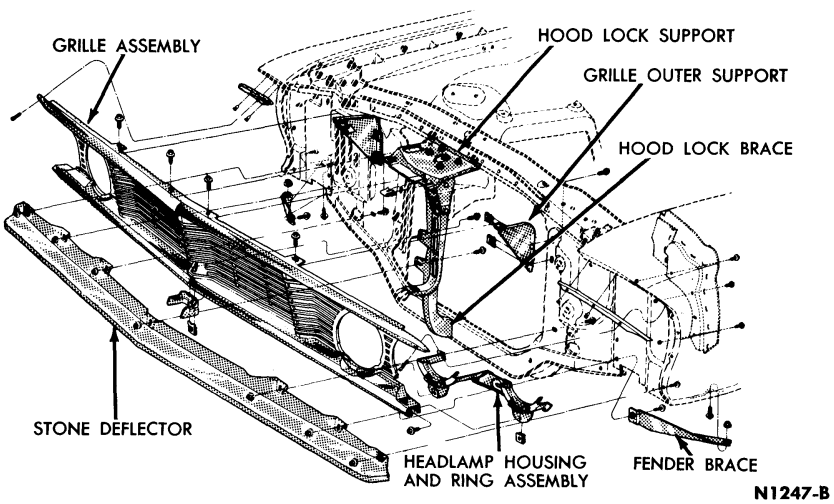



**FIG. 4—Grille Attaching Points—Ford**

2. Remove the two nuts that attach each handlamp to the radiator support.

3. Disconnect the headlamp wires at the connectors.

4. Working from the underside of the front fenders, remove the three metal screws that attach each splash shield to the fender and remove the shields.

5. Working from the underside of the fenders, remove the two nuts that secure each outer headlamp housing to the fender.

6. Working from the underside of the fenders, remove the attaching bolt from each end of the grille (Fig. 5).

7. Remove the two bolts that attach the lower end of the grille to the stone deflector.

8. Remove the four bolts that attach the upper end of the grille to the mounting brackets.

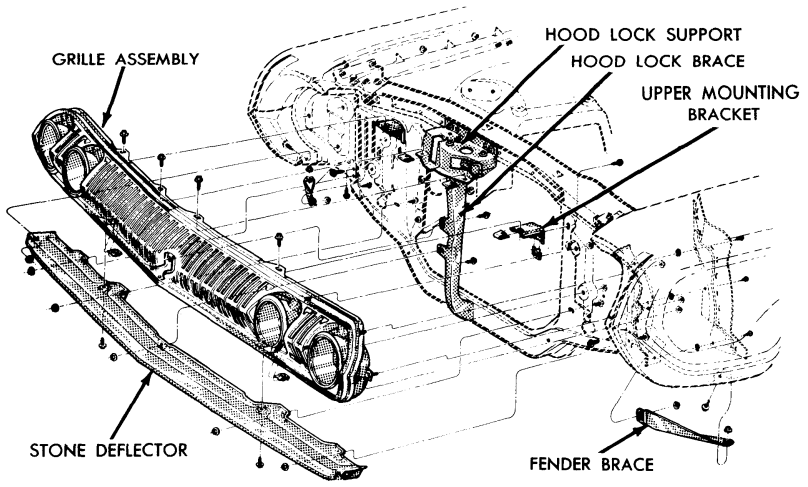



**FIG. 5—Grille Attaching Points—Mercury**

**9.** Lift the grille from the car.

**10.** Remove each headlamp housing from the grille.

**INSTALLATION**

**1.** Install the headlamp housings in the grille.

**2.** Position the grille on the mounting brackets.

**3.** Install the four bolts that attach the upper end of the grille to the mounting brackets. To simplify alignment, none of the grille attaching bolts should be tightened until all of them have been installed.

**4.** Install the two lower bolts that secure the grille to the stone deflector.

**5.** Install the bolt that secures each end of the grille to the fender.

**6.** Install the eight nuts that secure the headlamp housings to the fenders and radiator support.

**7.** Tighten all grille attaching bolts and nuts at this time.

**8.** Secure each splash shield to the fenders with three sheet metal screws.

**9.** Connect the headlamp wires to their respective terminals.

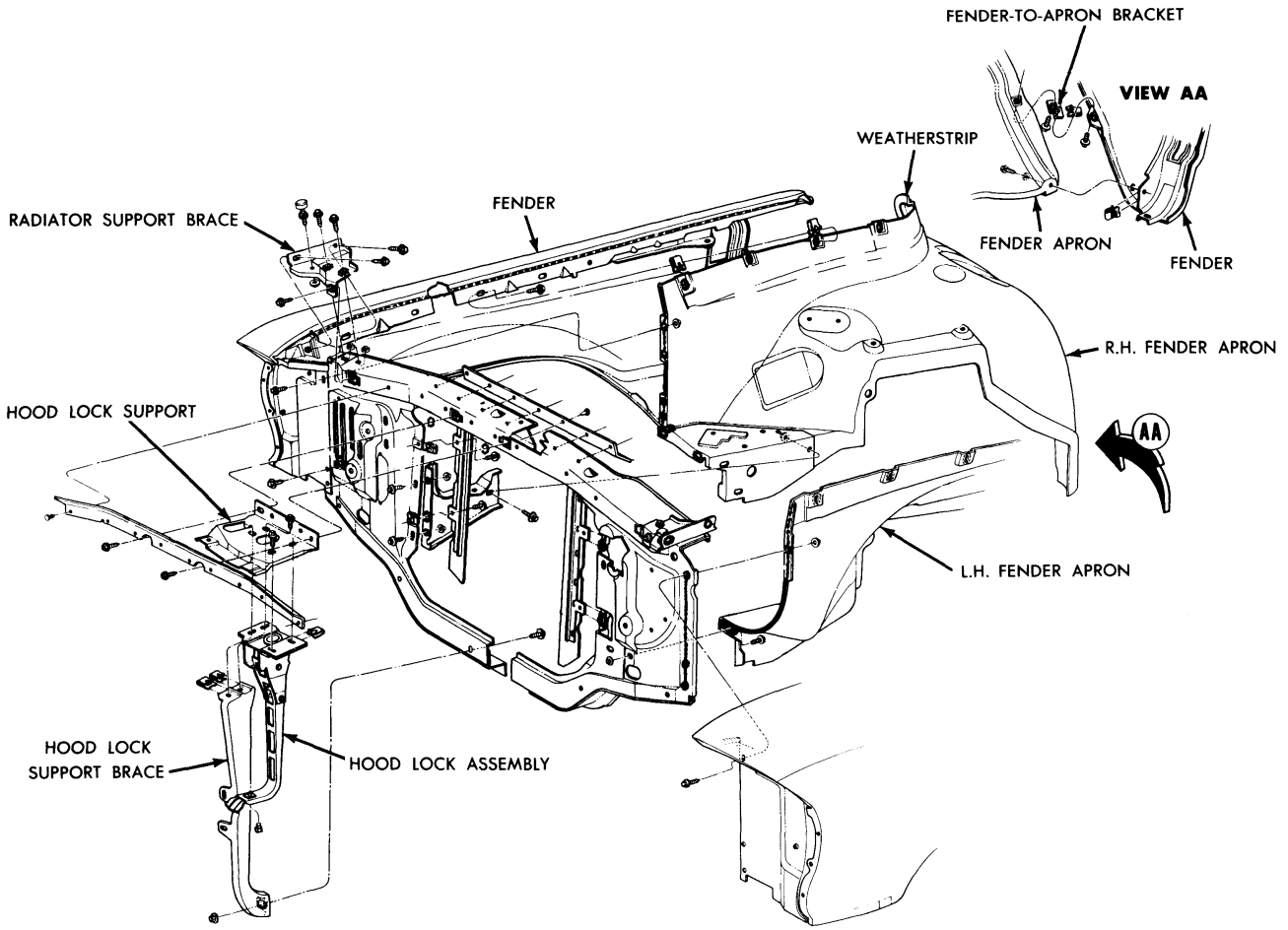
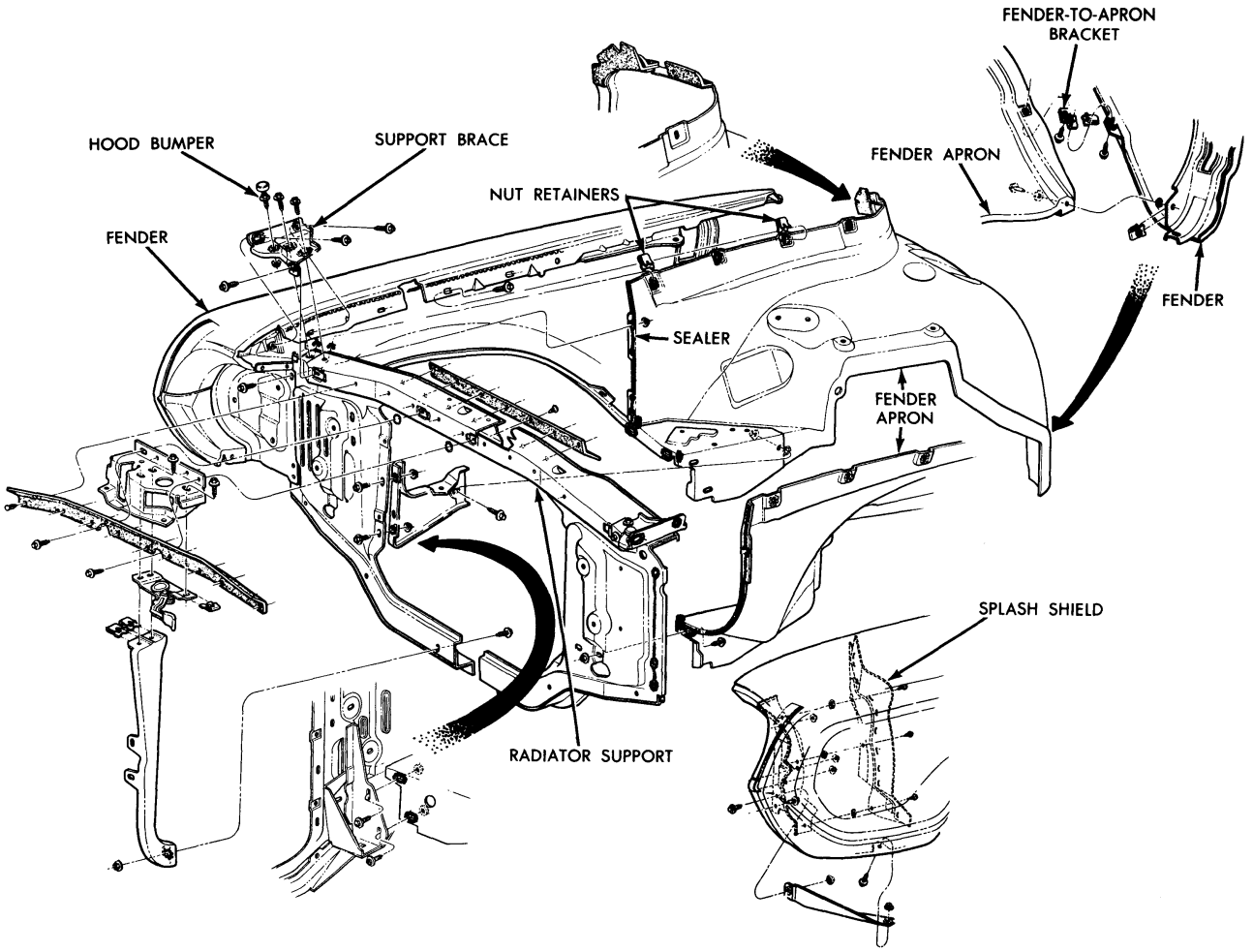



**FIG. 6—Front Fender Installation—Ford**




N1243-B

**FIG. 7—Front Fender Installation—Mercury**

**10.** Install the battery.

**11.** Check headlamp aiming – adjust if necessary.

## FENDER REMOVAL AND INSTALLATION—FORD

### REMOVAL

**1.** Remove the two bolts that attach the fender to the extension (Fig. 6).

**2.** Remove the bolt that attaches the brace to the underside of the fender.

**3.** Remove the cap screws that secure the fender to the apron and to the upper end of the cowl.

**4.** Remove the kick pad from the cowl on the inside of the car. Remove the nut that secures the fender to the cowl.

**5.** Remove the bolt that secures the fender to the rocker panel.

**6.** Remove the two bolts that secure the skirt of the fender to the fender apron.

**7.** Carefully lift the fender off the apron and the cowl.

### INSTALLATION

**1.** Apply a bead of sealer on the fender apron to cowl mounting surface. Carefully position the fender on the fender apron and the cowl.

**2.** Install the cap screws that secure the fender to the top of the apron and to the cowl (Fig. 6). Do not tighten any of the fender attaching bolts until all of them have been installed.

**3.** Install the two bolts that secure the fender skirt to the lower part of the fender apron.

**4.** Install the bolt that secures the lower end of the fender to the rocker panel.

**5.** Working from the inside of the car, install the nut that secures the fender to the cowl.

**6.** Install the bolt that secures the fender to the fender apron and radiator support.

**7.** Secure the fender to the fender extension with two bolts.

**8.** Shim the fender as necessary to make it flush with the top of the cowl.

**9.** Tighten all fender attaching bolts and nuts at this time.

**10.** Install the cowl kick pad.

## FENDER REMOVAL AND INSTALLATION—MERCURY

### REMOVAL

**1.** Working from the underside of the fender, remove the three sheet metal screws that attach the splash shield to the radiator and fender support (Fig. 7).

**2.** Remove the two nuts that attach the outer headlamp bracket to the fender.

**3.** Remove the nut that secures

the end of the grille to the underside of the fender.

**4.** Remove the bolt that secures the fender to the stone shield.

**5.** Remove the two bolts that secure the fender to the radiator support.

**6.** Remove the bolts that attach the fender to the radiator support brace and the fender apron.

**7.** Remove the bolts that attach the rear of the fender to the upper end of the cowl.

**8.** Remove the cowl kick pad from the inside of the cowl. Working from the inside of the car, remove the nut that attaches the fender to the cowl (Fig. 8).

**9.** Remove the two bolts that attach the skirt of the fender to the apron.

**10.** Remove the bolt that attaches the lower end of the skirt to the rocker panel.

**11.** Carefully lift the fender off the fender apron and cowl.

### INSTALLATION

**1.** Apply a bead of sealer to the apron, grille and the radiator support as shown in Fig. 7.

**2.** When installing the fender, make sure that all bolts are installed before tightening any of them. Carefully position the fender over the apron and on the cowl. Make sure that the lip on the fender skirt is on the outside of the apron. Install the two fender skirt-to-apron bolts.

**3.** Install the two bolts that attach the fender to the upper end of the cowl. Working from the inside of the car, install the nut that secures the fender to the cowl.

**4.** Install the bolts that attach the fender to the upper end of the apron and to the radiator support brace.

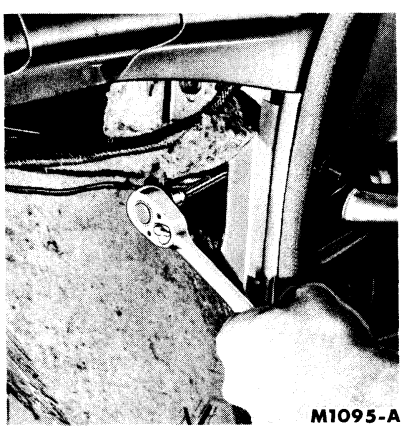



**FIG. 8—Removing Fender-to-Cowl Attaching Nut**

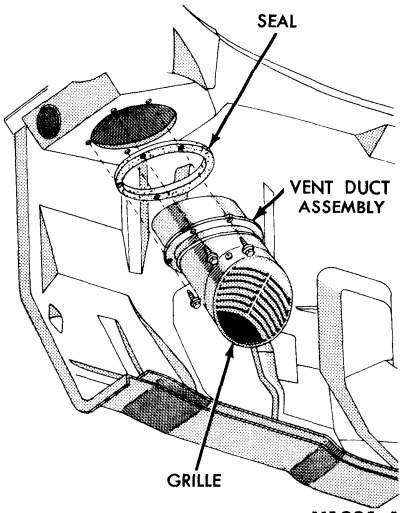



**FIG. 9—Ventilator Air Duct Installation**

**5.** Install the nut that secures the fender to the end of the grille.

**6.** Install the bolt that attaches the fender to the stone shield.

**7.** Install the two bolts that secure the fender to the radiator support.

**8.** Install the two nuts that secure the outer headlamp bracket to the fender.

**9.** Shim the fender as necessary to make it flush with the top of the cowl.

**10.** Tighten all attaching nuts and bolts at this time.

**11.** Secure the splash shield to the fender with three sheet metal screws.

## VENTILATOR AIR DUCT REMOVAL AND INSTALLATION

**1.** Disconnect the left fresh air vent control cable at the vent valve lever and remove the vent duct and valve assembly (Fig. 9).

**2.** Remove the air deflector grille and seal from the duct and valve assembly.

**3.** Position the air deflector grille and install three attaching screws.

**4.** Position the air vent valve assembly and seal on the cowl and install four attaching screws.

**5.** Connect and adjust the fresh air left hand control cable to the vent air duct and valve assembly.

## FRONT BUMPER REMOVAL AND INSTALLATION—FORD

### REMOVAL

**1.** Disconnect the parking lamp wires from their terminals.

**2.** Remove the license plate.

**3.** Remove the four bolts, flat washers and lock washers that secure the two bumper arms to each frame side rail (Fig. 10).

**4.** Carefully remove the bumper and arms from the car.

**5.** Remove the bumper bar center reinforcement from the bumper.

**6.** Remove the parking light attaching nuts and retainers. Remove the parking lights.

**7.** Remove all bumper arm bolts and spacer washers from the bumper. Keep all washers (shims) with their respective arms to permit proper alignment of the new bumper.

### INSTALLATION

**1.** Assemble the bumper bar center reinforcement to the bumper bar.

**2.** Assemble all arms to the bumper bar (Fig. 10) making sure that all washers (shims) are in their original location. Install the license plate.

**3.** Secure the parking lights to the bumper bar with the retainers.

**4.** Secure the bumper arms to the car frame with four bolts, flat washers and nuts.

**5.** Torque all bumper arm-to-frame attaching bolts to 60-80 ft-lbs. Torque the bar-to-arm bolts to 17-23 ft-lbs. Align the bumper with the eccentric bolts (Fig. 10).

**6.** Connect the parking lamp wires to their respective terminals.

## FRONT BUMPER REMOVAL AND INSTALLATION —MERCURY

### REMOVAL

**1.** Disconnect the parking lamp wiring connection.

**2.** Remove the four bolts retaining the bumper support arms to the frame side rails and remove the bumper assembly.

**3.** Remove the parking lamp retaining nuts and remove the parking lamps.

**4.** Remove the ten bumper center impact bar-to-bumper reinforcement bolts and remove the reinforcement (Fig. 11).

**5.** Remove the license plate and rubber bumper from the center impact bar.

**6.** Remove outer right and left bumper bar retaining bolts and remove the outer bars.

### INSTALLATION

**1.** Install the license plate bolt retainers, rubber bumper and the

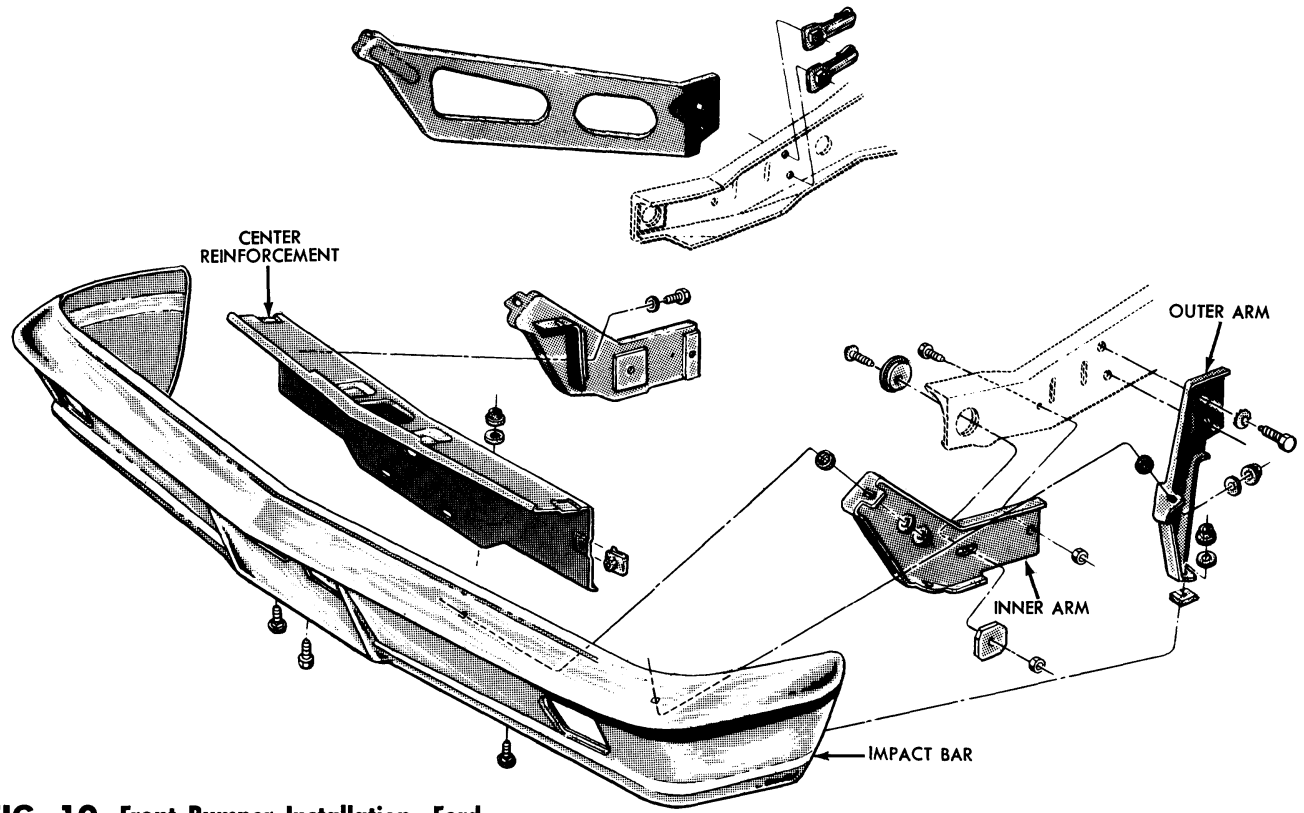



**FIG. 10—Front Bumper Installation—Ford**

N1277-B

license plate on the center impact bar.

**2.** Position and install left and right outer bars (Fig. 11) on the center impact bar.

**3.** Position the bumper reinforcement on the center bumper bar and install the retaining bolts.

**4.** Position the parking lamp assemblies in the bumper and install the retaining nuts.

**5.** Position and install the bumper arms on the bumper assembly.

**6.** Position the bumper assembly on the car and install the four bolts retaining the bumper support arms to the frame side rails. **Note that the forward bumper arm-to-frame bolts are eccentric bolts which permit vertical adjustment of the bumper assembly.**

**7.** Install the two bolts which retain each left and right outer bumper extension to the outer support arms. Tighten all retaining bolts.

**8.** Connect the parking lamp wiring connections.

## REAR BUMPER REMOVAL AND INSTALLATION —MERCURY

### REMOVAL

**1.** Remove the license plate retaining bolts and license plate.

**2.** Disconnect the license lamp wiring connector and remove the license lamp.

**3.** Remove the bumper retaining bolts (Fig. 12) and remove the bumper assembly.

### INSTALLATION

**1.** Position the bumper reinforcement on the bumper and loosely install two reinforcement-to-bumper retaining bolts.

**2.** Position the bumper-to-support arm washers on the support arms using sector to hold the washer in place.

**3.** Position the bumper assembly on the car and install the remaining eight retaining bolts. Tighten all retaining bolts.

**4.** Install the license plate lamp assembly and connect the license lamp wiring connector.

**5.** Install the license plate.

## REAR BUMPER REMOVAL AND INSTALLATION—FORD

### REMOVAL

**1.** Remove the license plate retaining bolts and license plate.

**2.** Disconnect the license lamp wiring connector.

**3.** Remove the right and left hand muffler rear hanger bracket (if so equipped) retaining bolts.

**4.** Remove the four bumper arm-to-frame retaining bolts (Fig. 13) and remove the bumper assembly.

### INSTALLATION

**1.** Transfer the bumper arms, license plate lamp and rubber bumpers to the new bumper.

**2.** Install the license plate.

**3.** Position the bumper assembly on the car and install the bumper arm-to-frame retaining bolts.

**4.** Install the muffler-to-rear hanger bracket retaining bolts (if so equipped).

**5.** Connect the license lamp wiring connector.

## EXTERIOR MOULDINGS REMOVAL AND INSTALLATION

Before removing exterior mouldings, it should be determined by the type of retainer used whether a respective door, quarter or luggage compartment trim panel must first be removed to provide access. Refer to Figures 14 through 23.

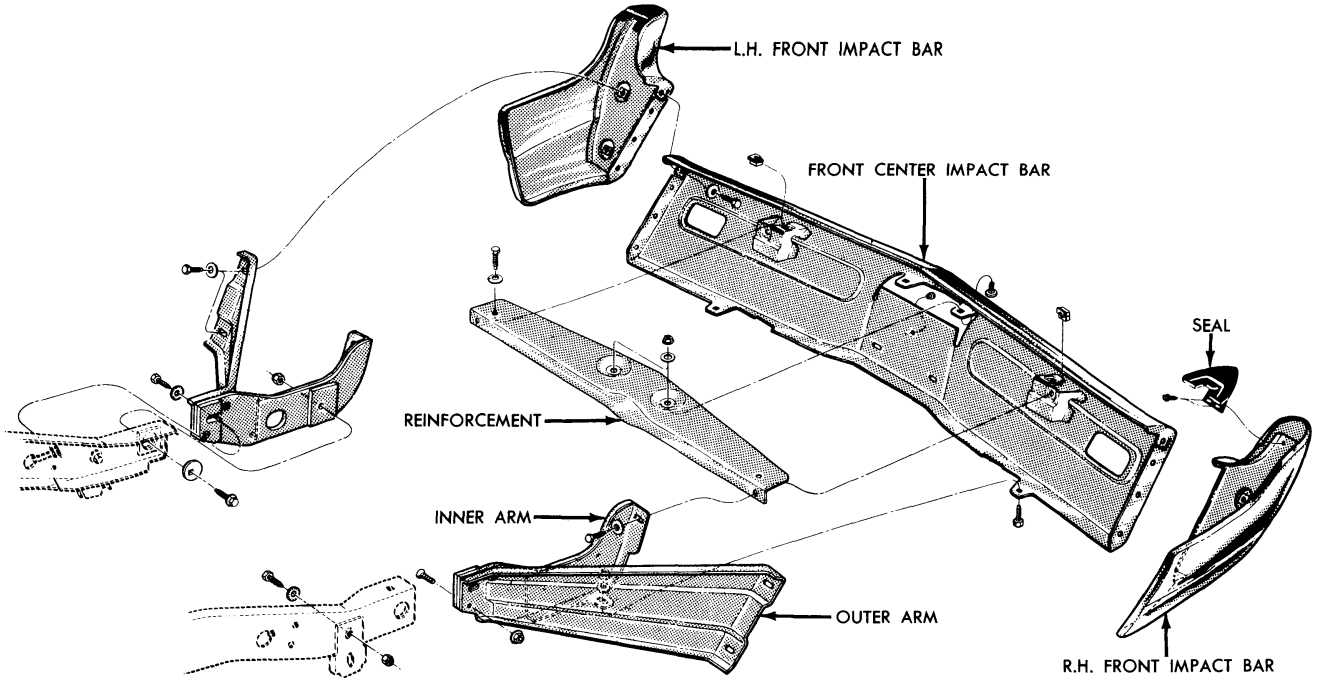



**FIG. 11—Front Bumper Installation—Mercury**

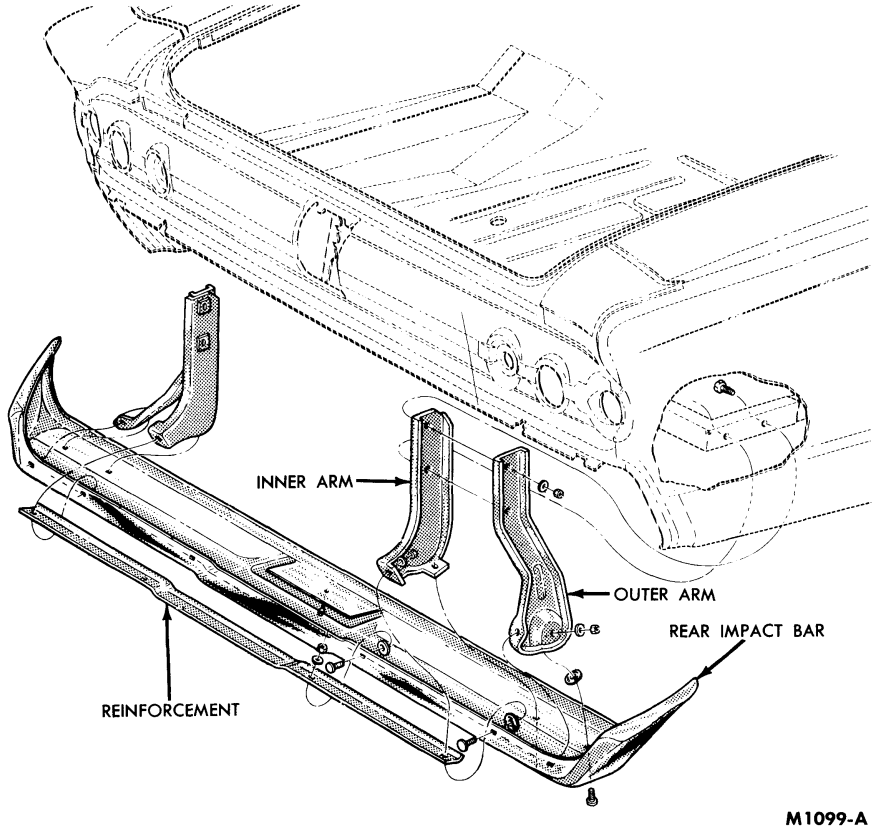



**FIG. 12—Rear Bumper Installation—Mercury**

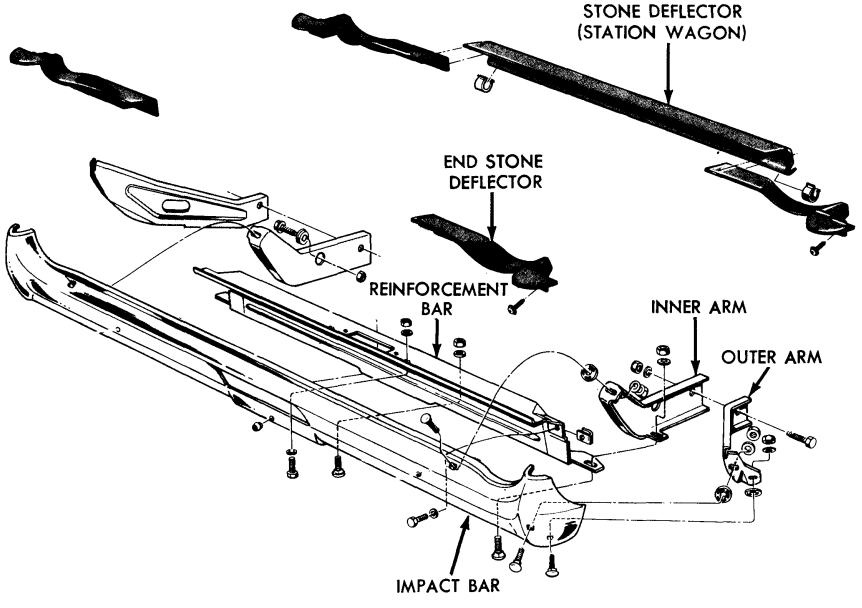
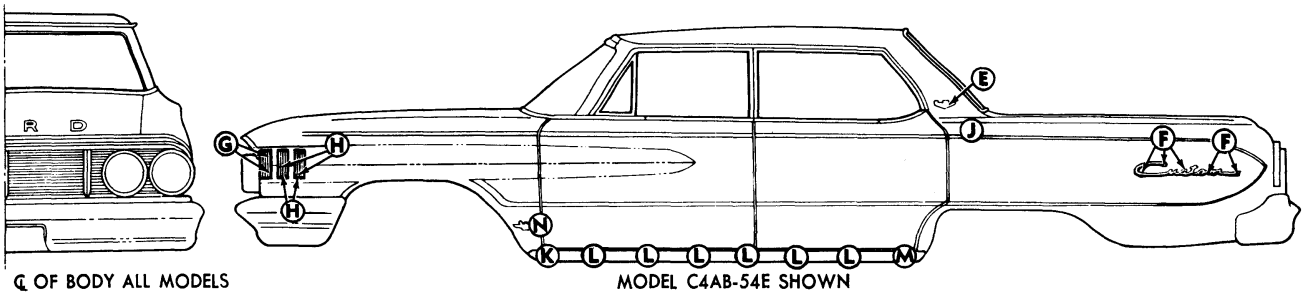
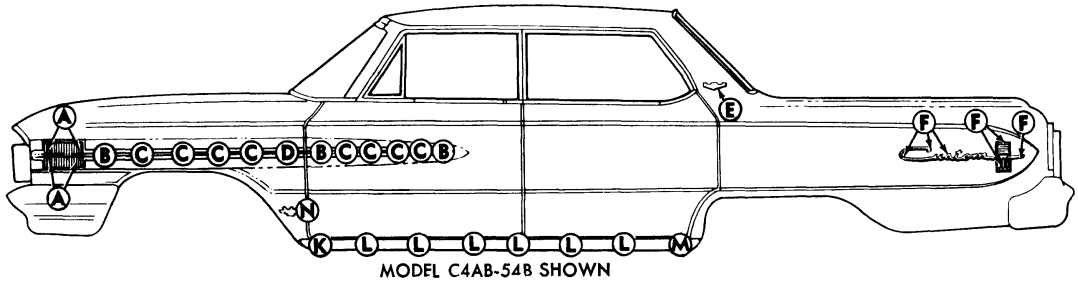
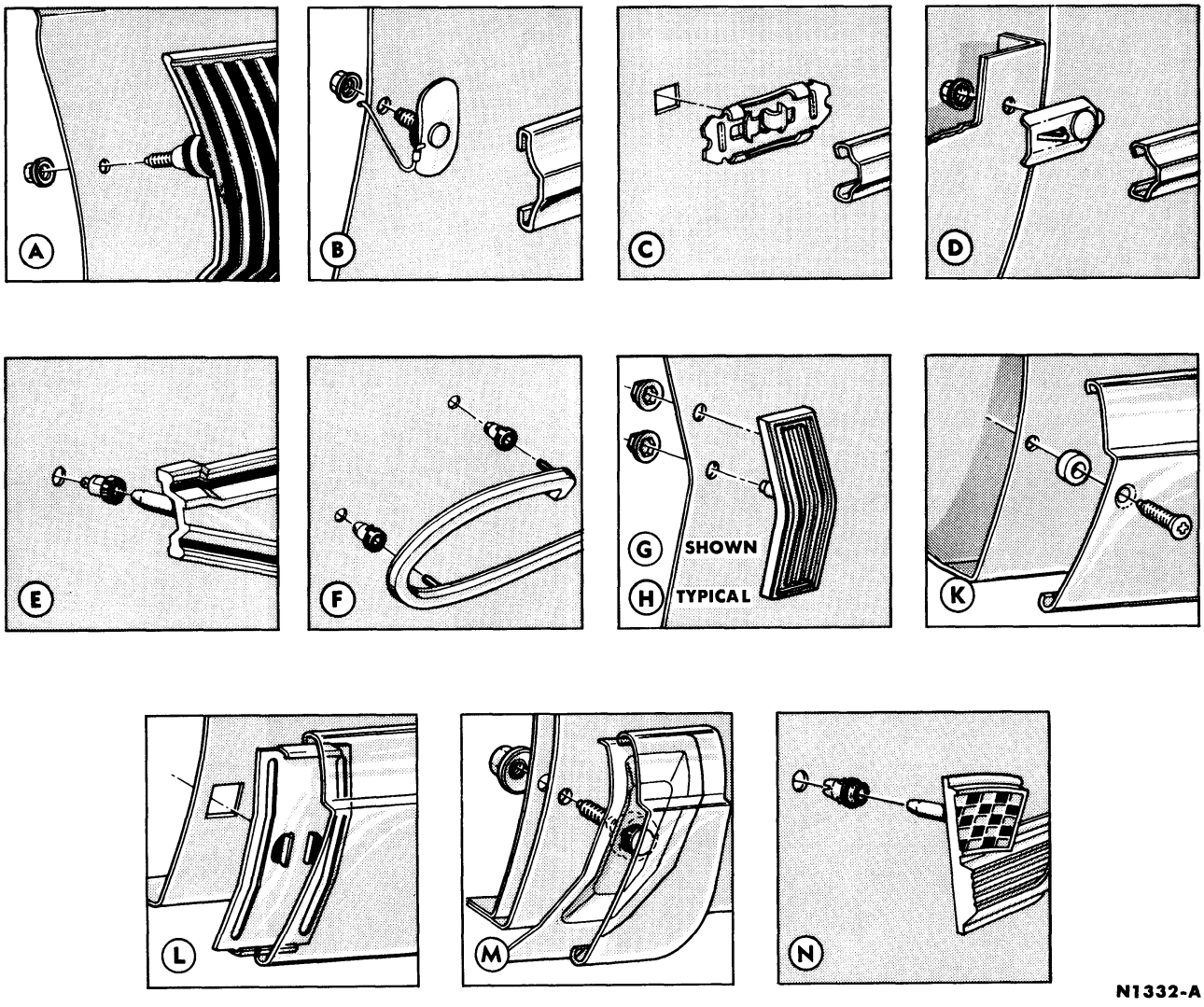



**FIG. 13—Rear Bumper Installation—Ford**

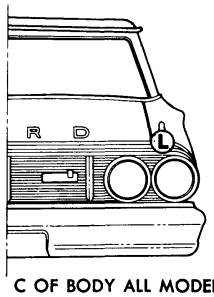


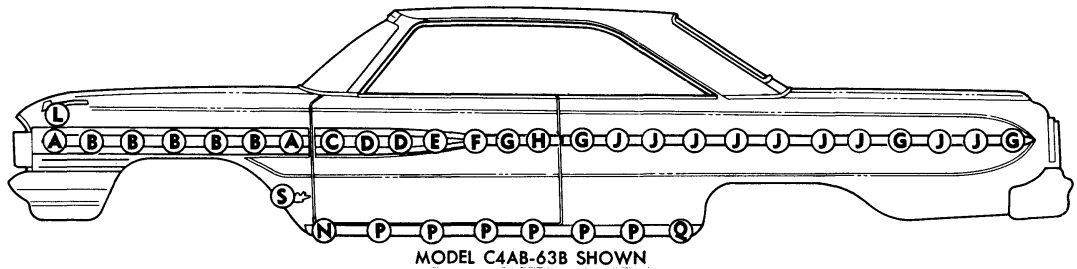




N1332-A

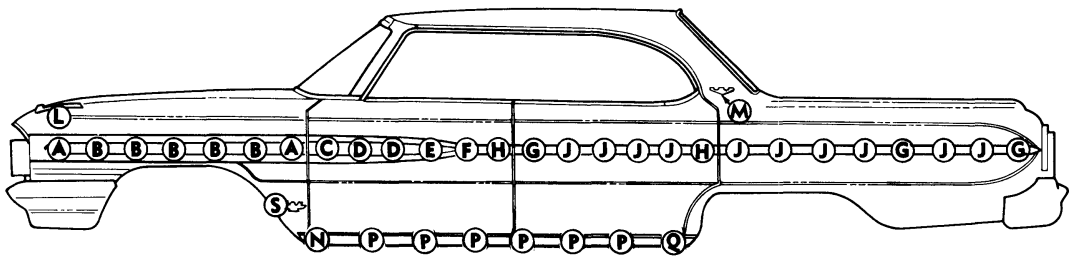
**FIG. 14—Exterior Mouldings—Ford Models 54B, 54E, 62B, 62E**




C OF BODY ALL MODELS

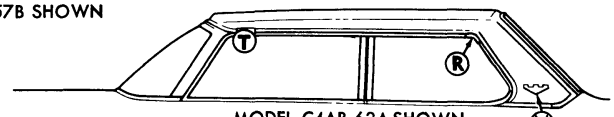



MODEL C4AB-63B SHOWN
MODELS C4AB-62A-76A TYPICAL

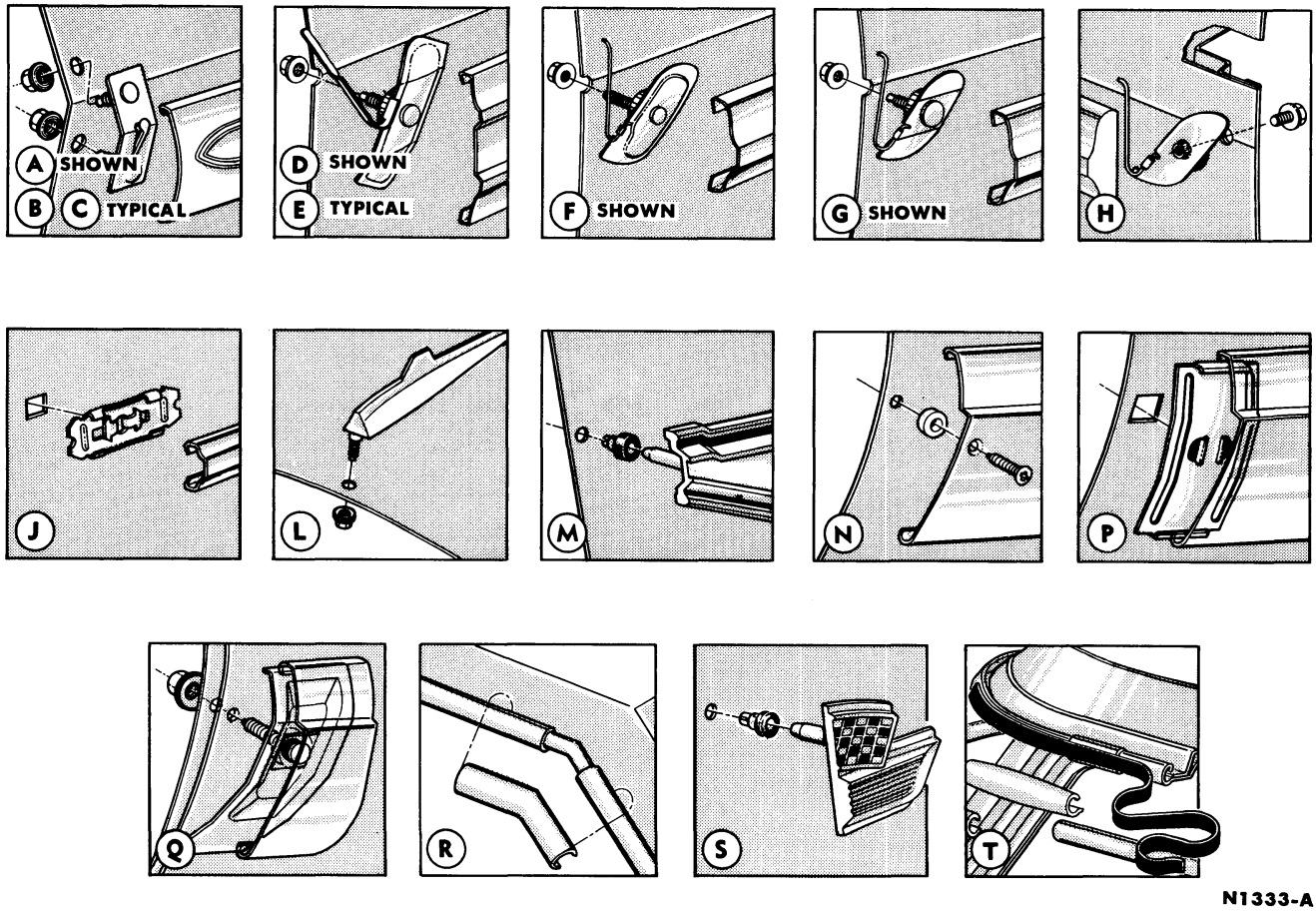



MODEL C4AB-54A TYPICAL

MODEL C4AB-57B SHOWN

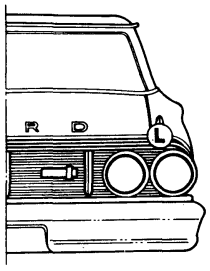



MODEL C4AB-62A SHOWN
MODEL C4AB-54A TYPICAL



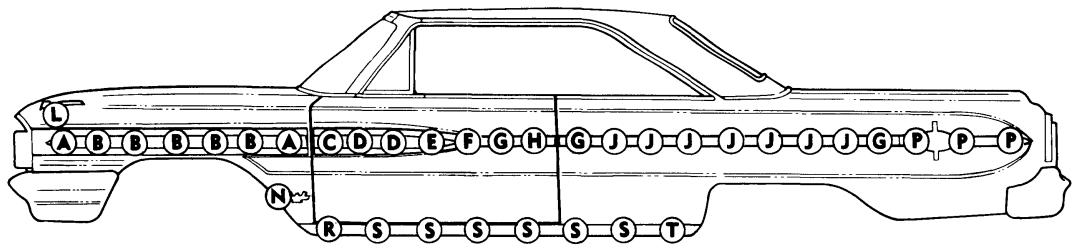

N1333-A

**FIG. 15—Exterior Mouldings—Ford Models 57B, 63B**

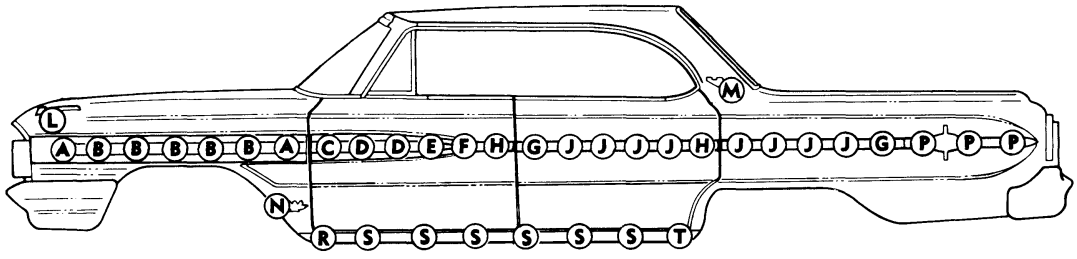



C OF BODY

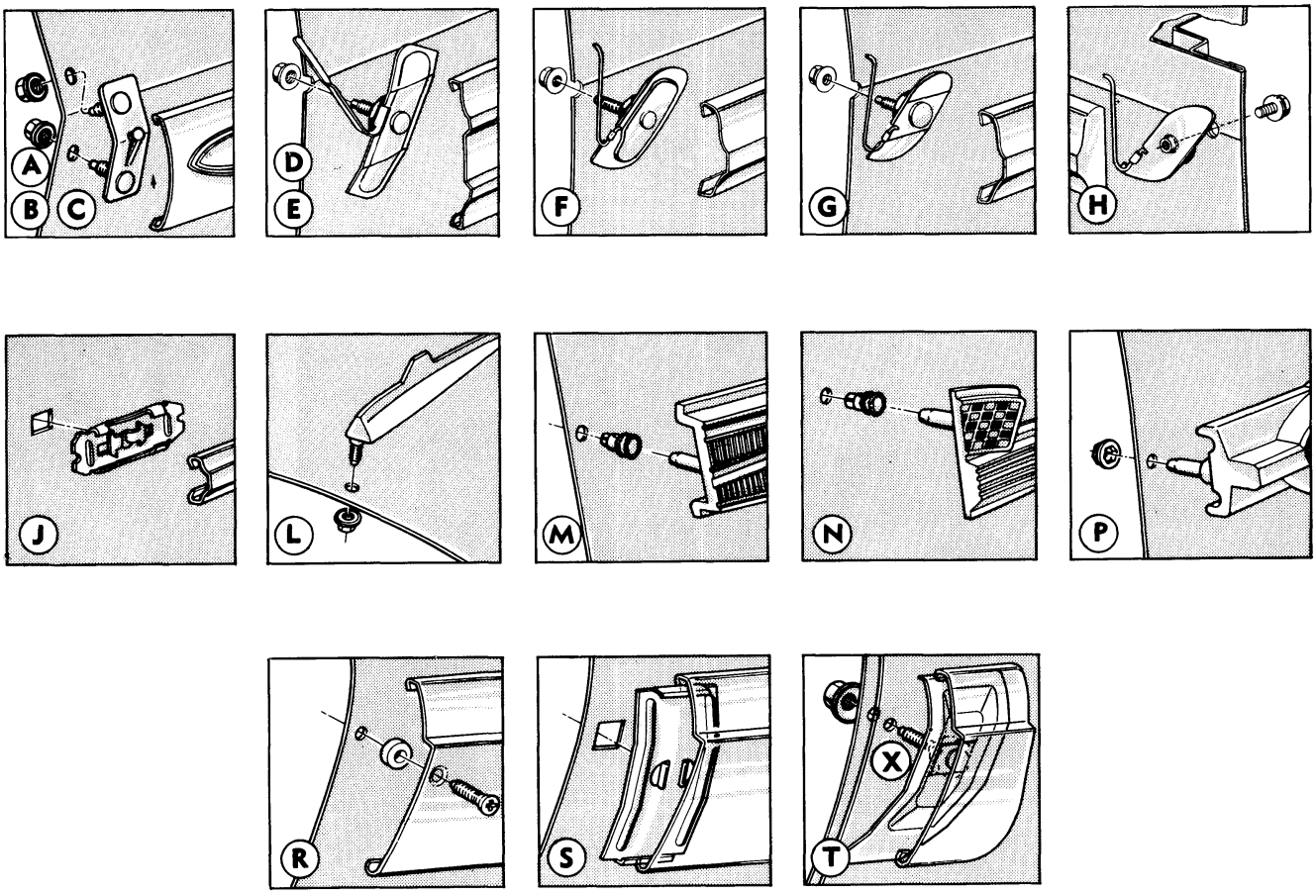
FRONT OF CAR




MODEL C4AB-63C SHOWN
MODEL C4AB-76B- TYPICAL

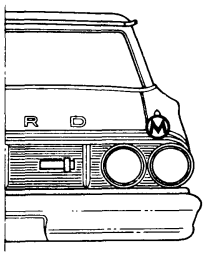



MODEL C4AB-57C SHOWN

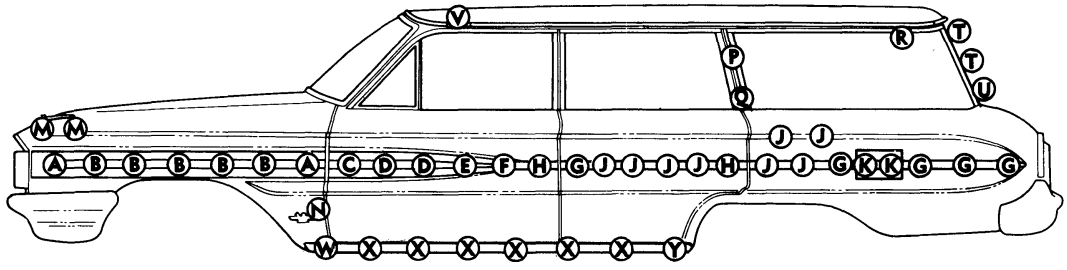



N1334-A

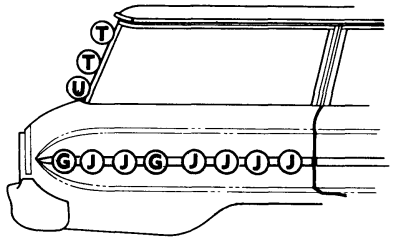
**FIG. 16—Exterior Mouldings—Ford Models 576, 636, 76B**




℄ OF BODY
FRONT OF CAR




MODELS C4AB-71B-71C SHOWN
MODELS C4AB-71A-71E TYPICAL

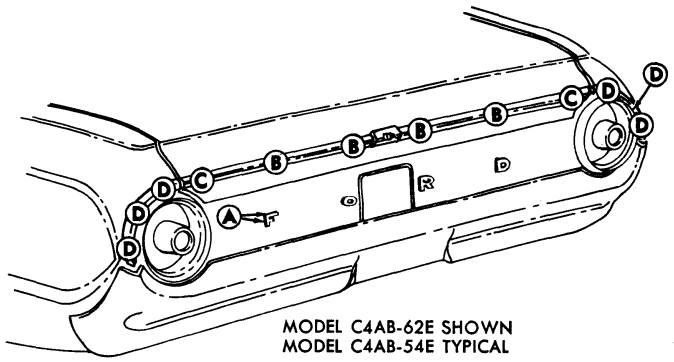



MODELS C4AB-71B-71C
RIGHT HAND SIDE SHOWN

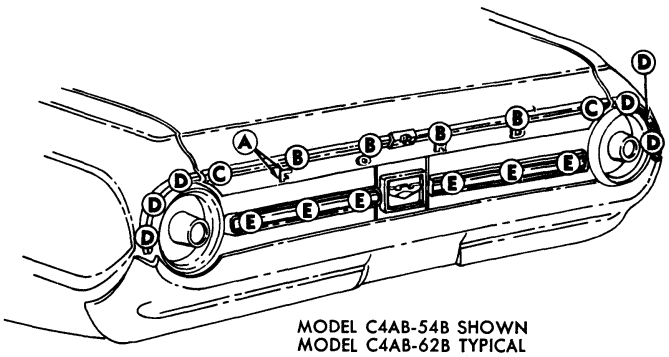



N1335-A

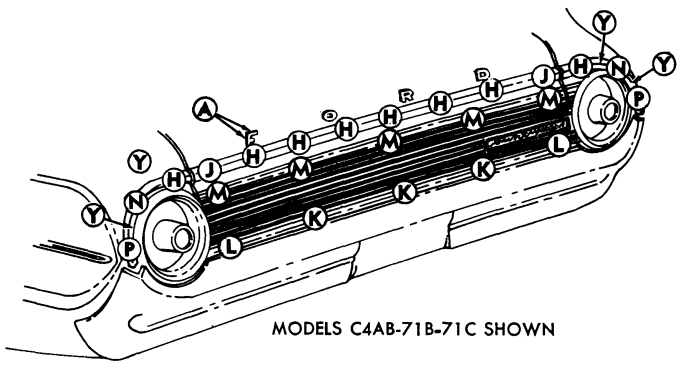
**FIG. 17—Exterior Mouldings—Ford Models 71A, 71B, 71C, 71E**



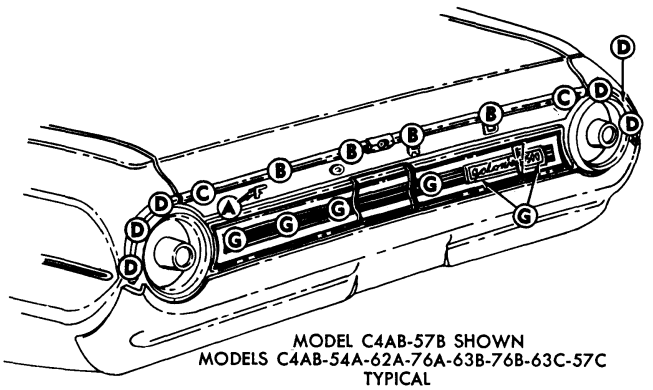
MODEL C4AB-62E SHOWN
MODEL C4AB-54E TYPICAL



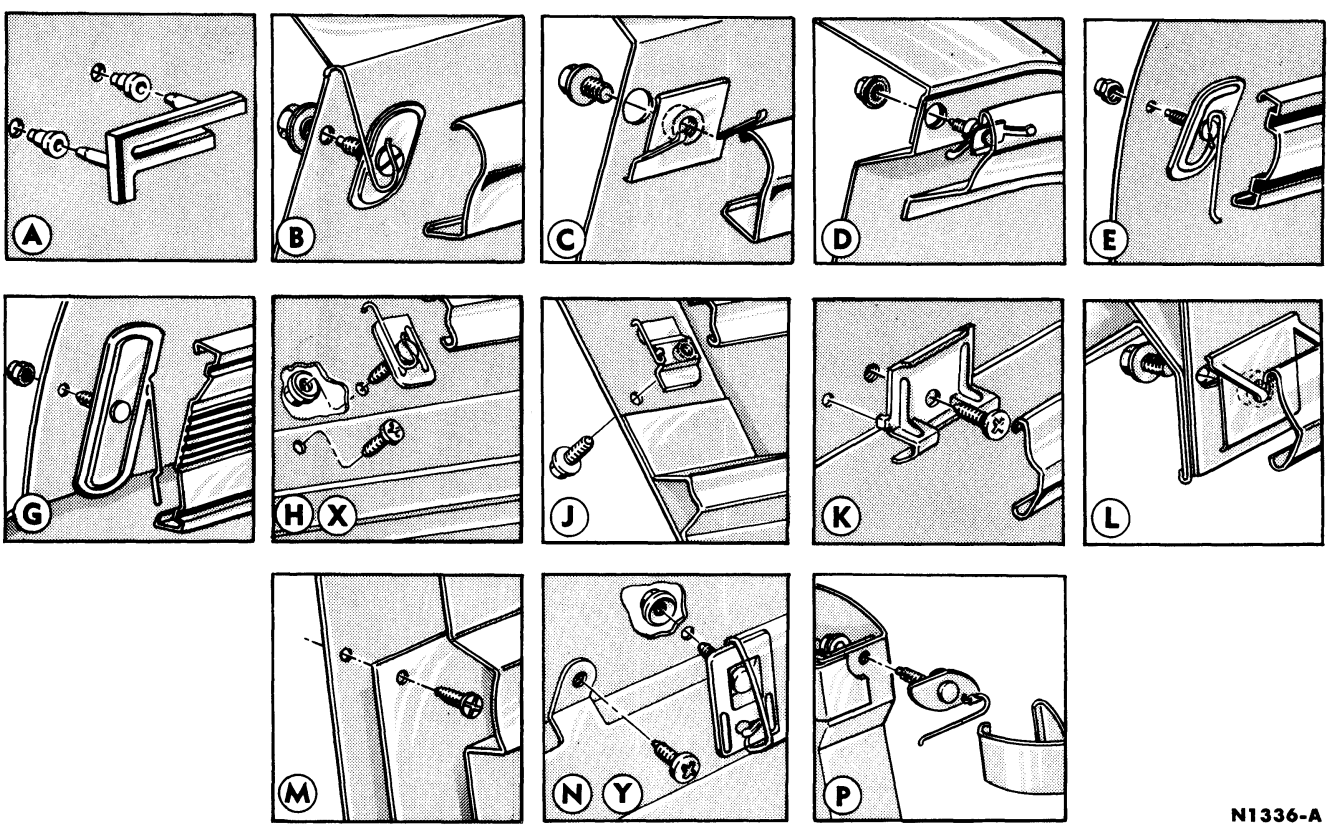
MODEL C4AB-54B SHOWN
MODEL C4AB-62B TYPICAL



MODELS C4AB-71B-71C SHOWN

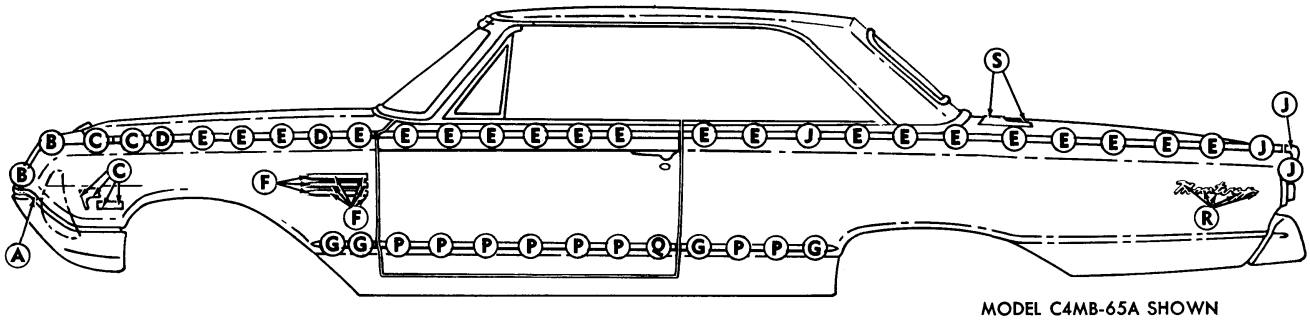


MODEL C4AB-57B SHOWN
MODELS C4AB-54A-62A-76A-63B-76B-63C-57C
TYPICAL

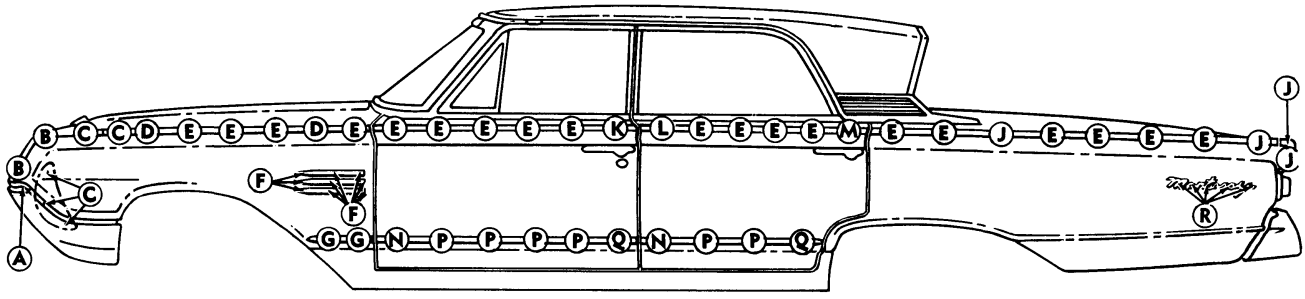



N1336-A

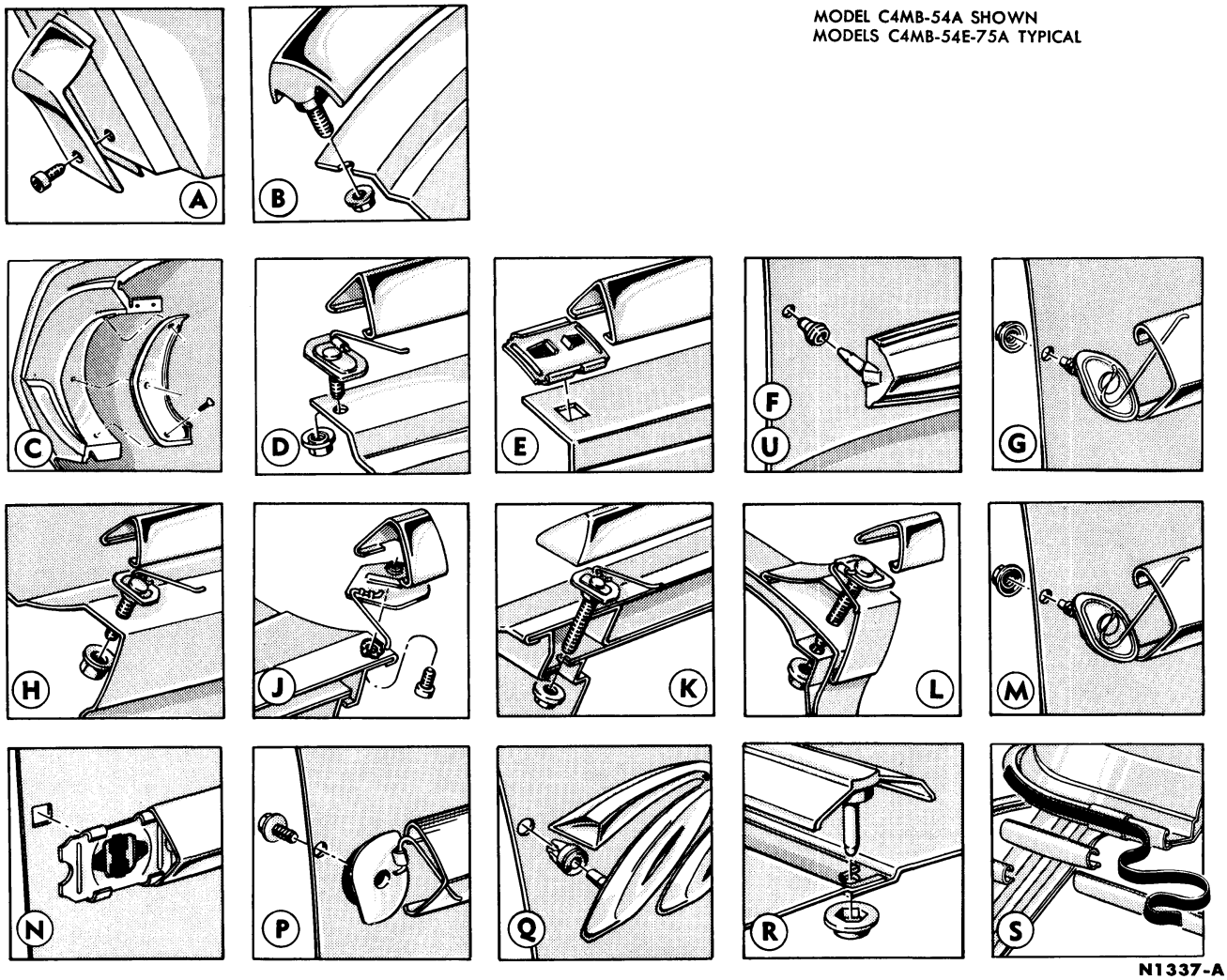
**FIG. 18—Exterior Rear Mouldings—Ford Models (All)**



MODEL C4MB-65A SHOWN
MODELS C4MB-62A-62E-76A TYPICAL



MODEL C4MB-54A SHOWN
MODELS C4MB-54E-75A TYPICAL



N1337-A

**FIG. 19—Exterior Mouldings—Mercury Models—54A, 54E, 62A, 65A, 75A, 76A**

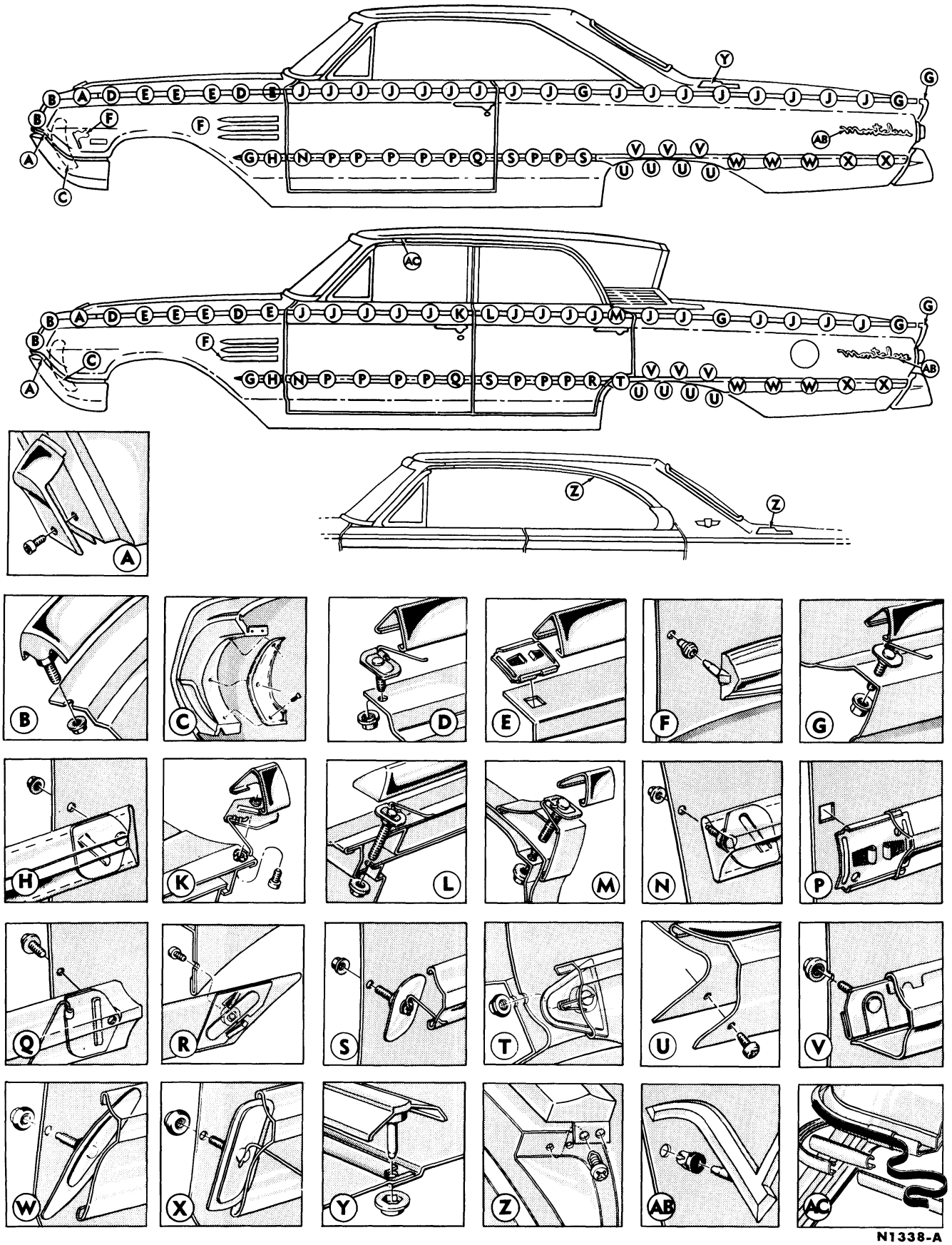



**FIG. 20—Exterior Mouldings—Mercury Models 57C, 57D, 63C, 63D**

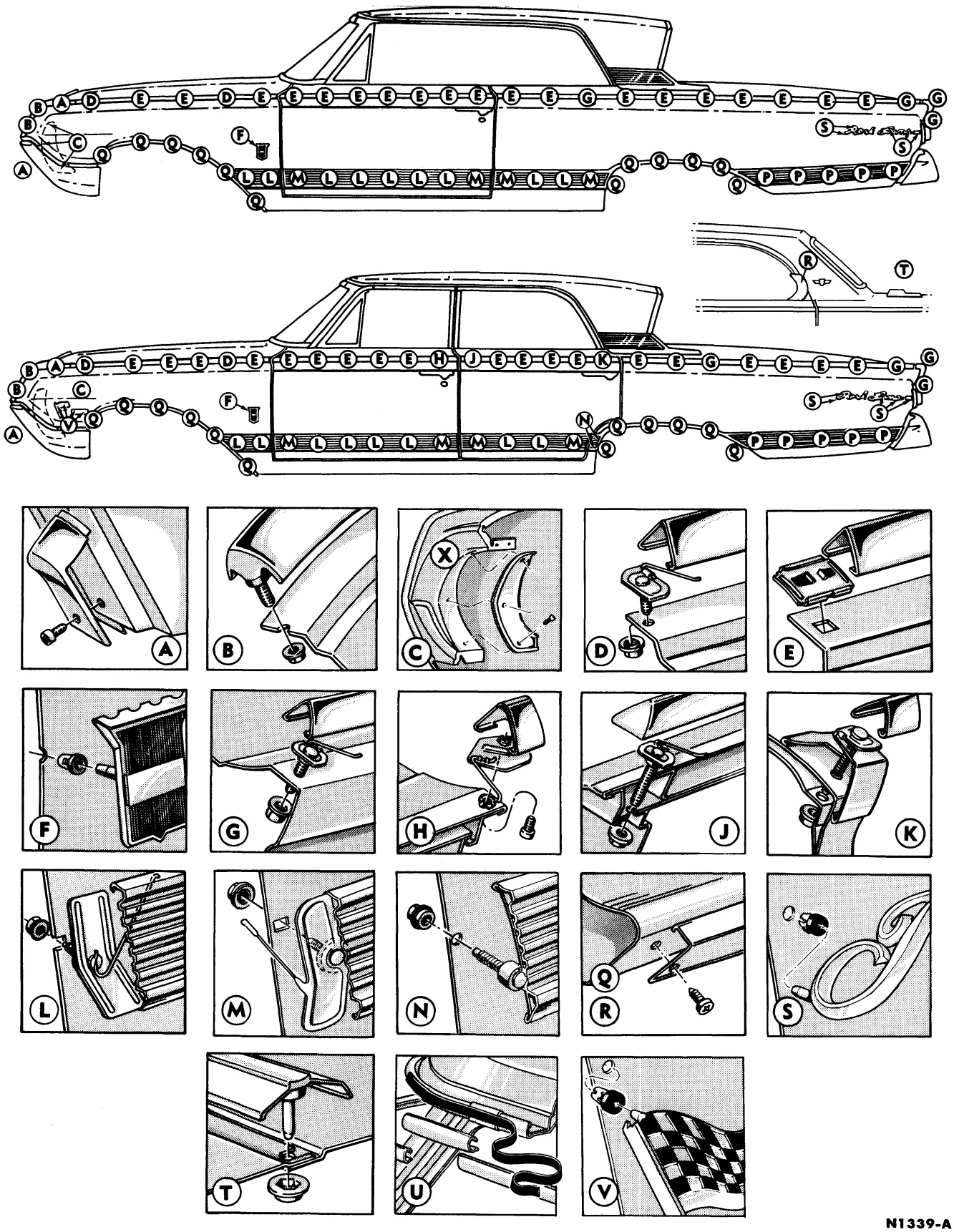
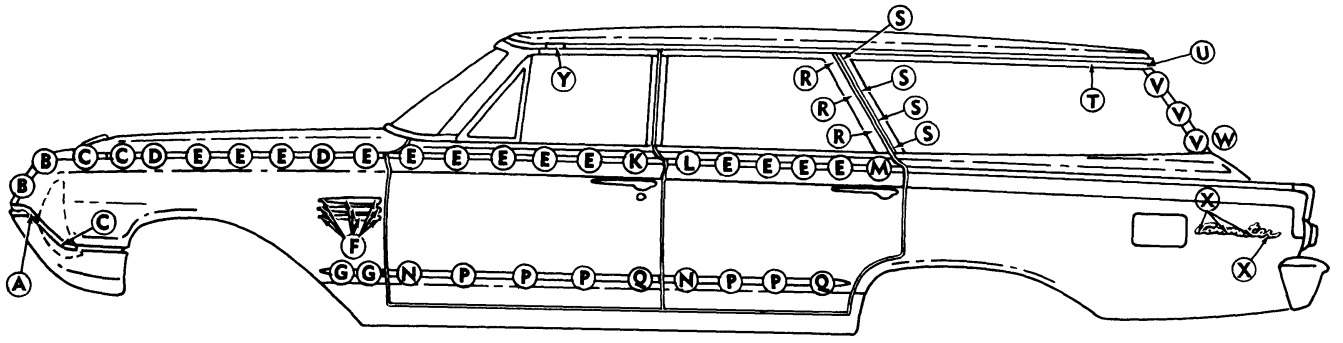
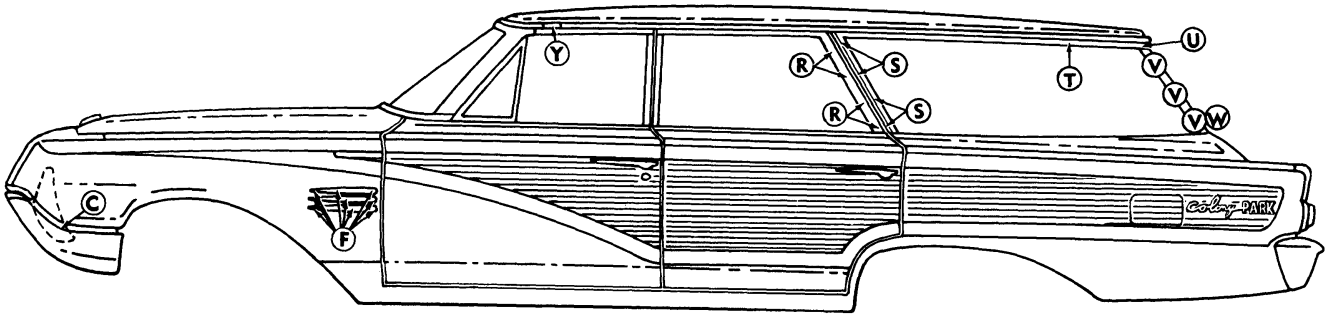


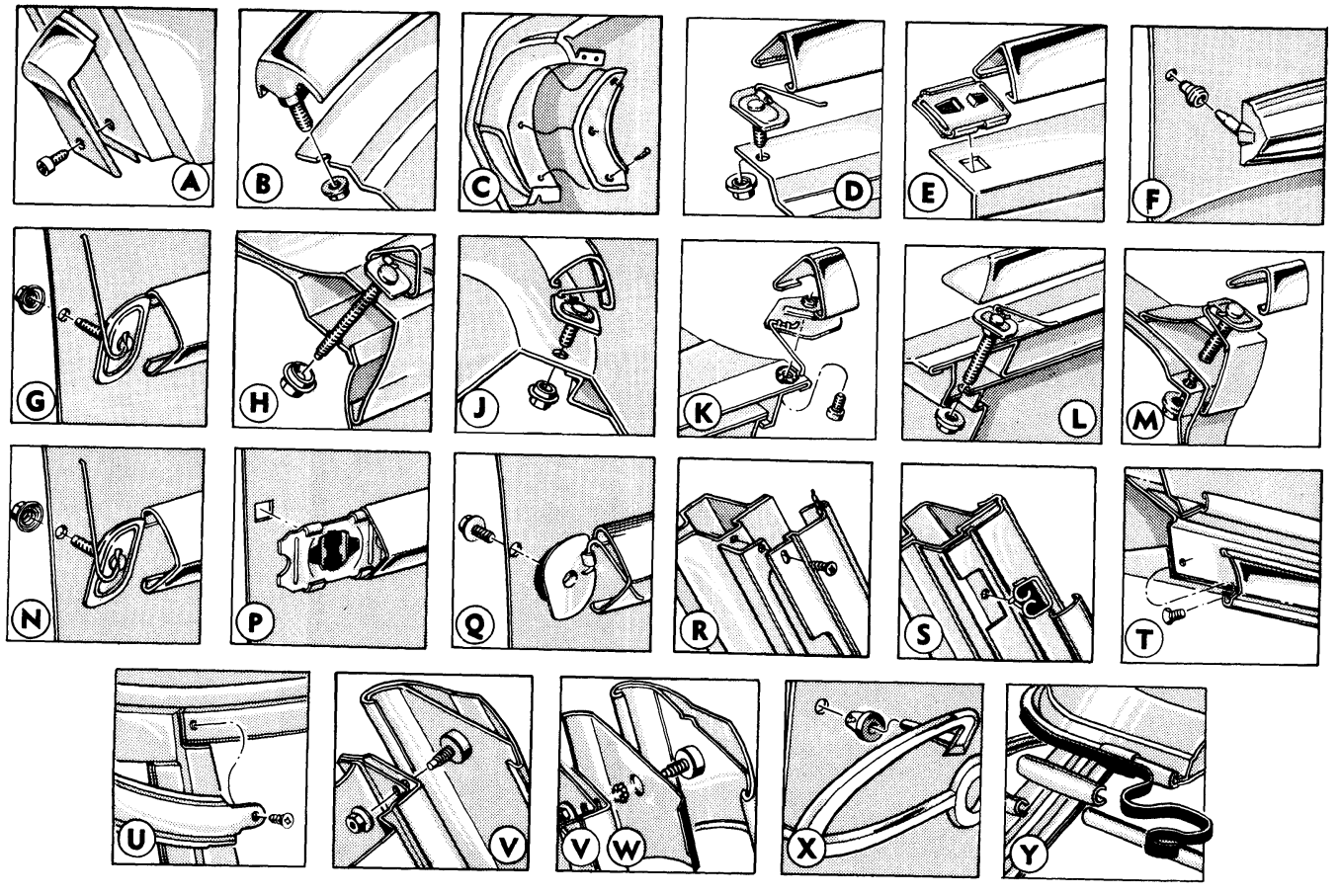

FIG. 21—Exterior Mouldings—Mercury Models 54C, 54F, 65C, 65F, 75F, 76C, 76F




MODELS C4MB-71A-71C

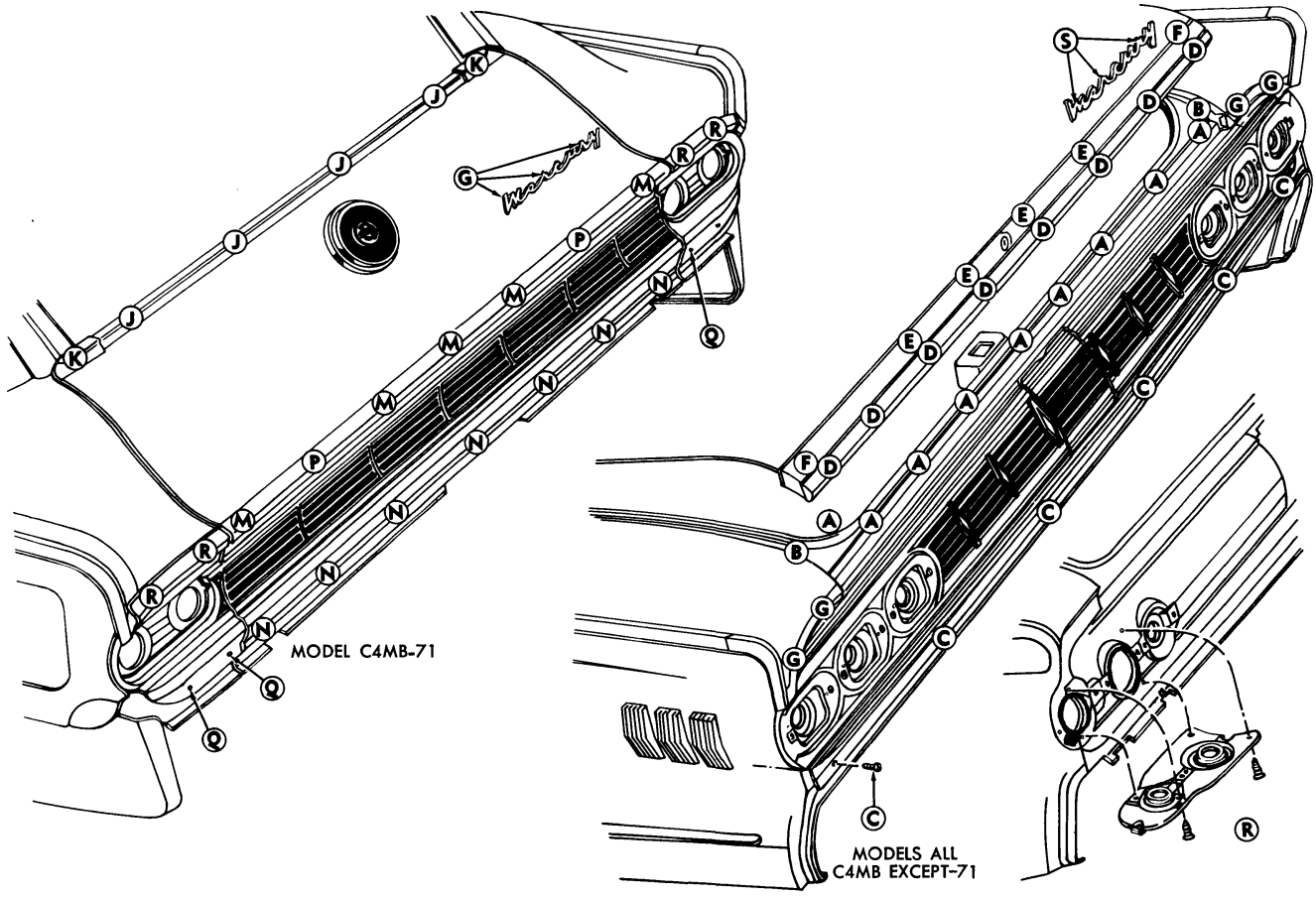


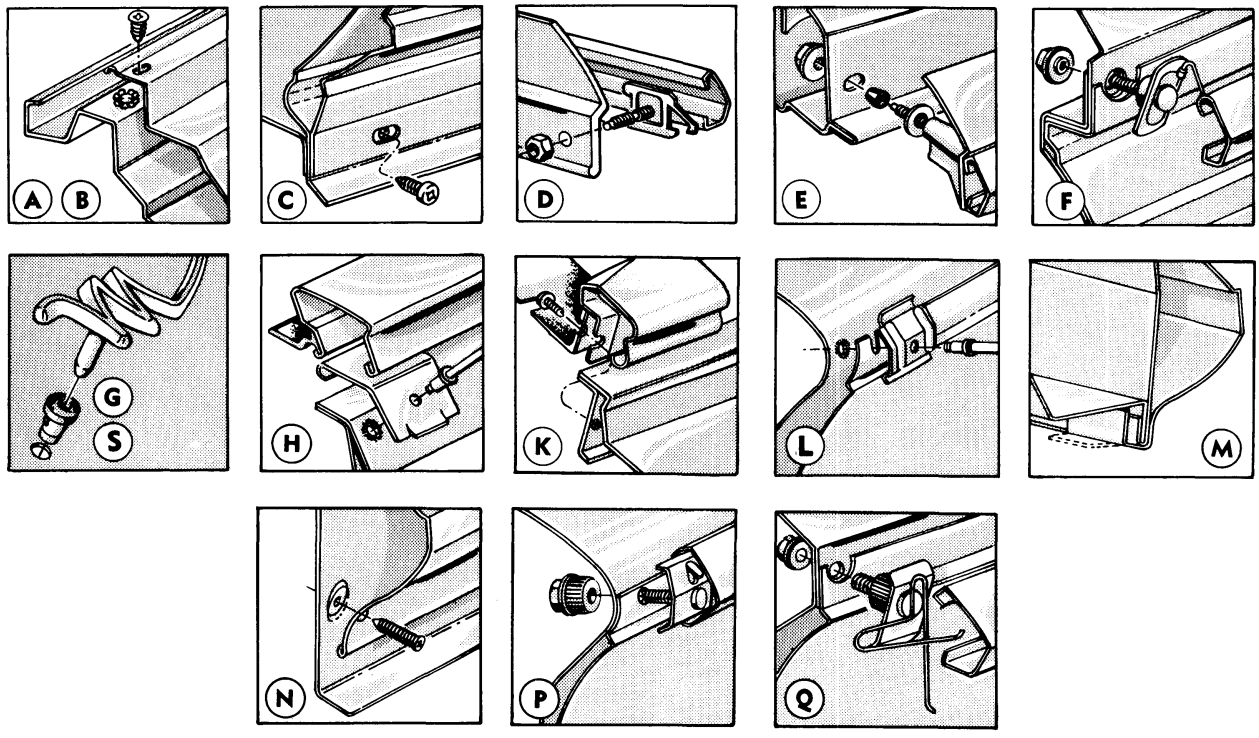

MODELS C4MB-71B-71D




N1340-A

**FIG. 22—Exterior Mouldings—Mercury Models 71A, 71B, 71C, 71D**




N1343-A

**FIG. 23—Exterior Rear Mouldings—Mercury Models (All)**

# PART 17-3 DOORS, WINDOWS, TAILGATE, AND DECK LID


| Section | Page | Section | Page |
|---|---|---|---|
| 1 In-Car Adjustments and Repairs | 17-31 | 2 Removal and Installation | 17-38 |


## 1 IN-CAR ADJUSTMENTS AND REPAIRS

### DOOR ALIGNMENT

The door hinges provide sufficient adjustment to correct most misalign-

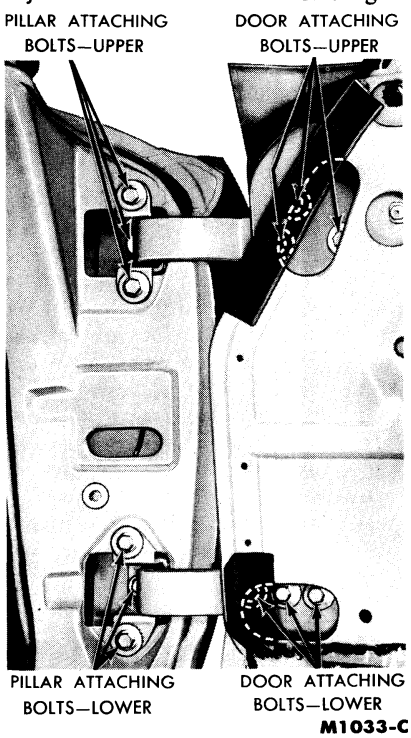



**FIG. 1—Front Door Hinges**

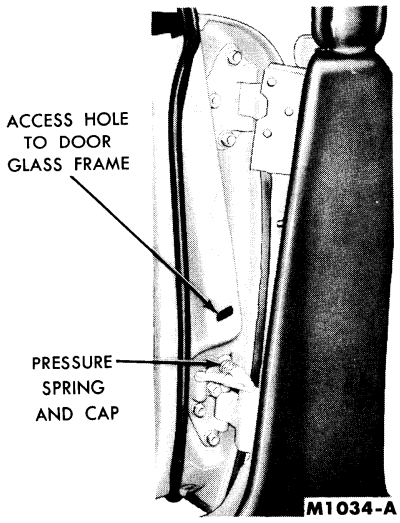
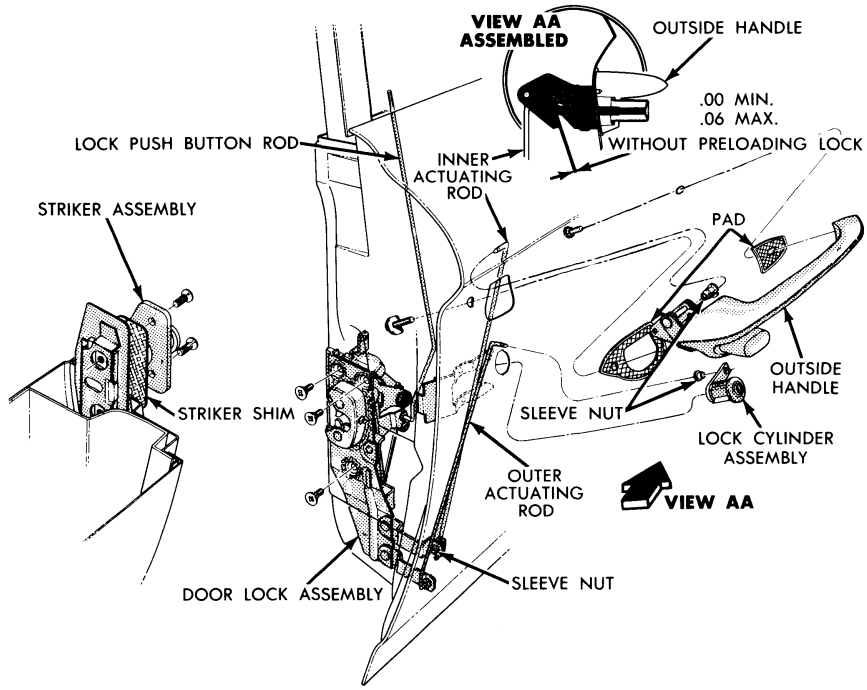



**FIG. 2—Rear Door Hinges**



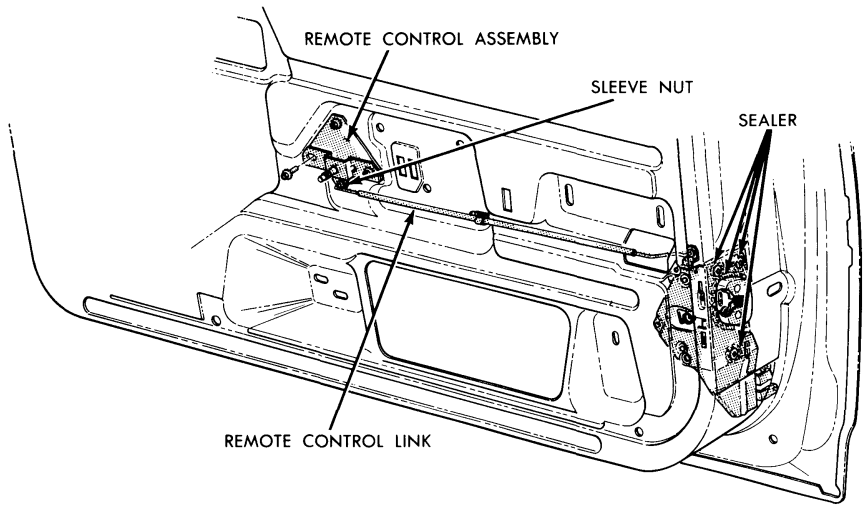




**FIG. 3—Front Door Lock Installation**

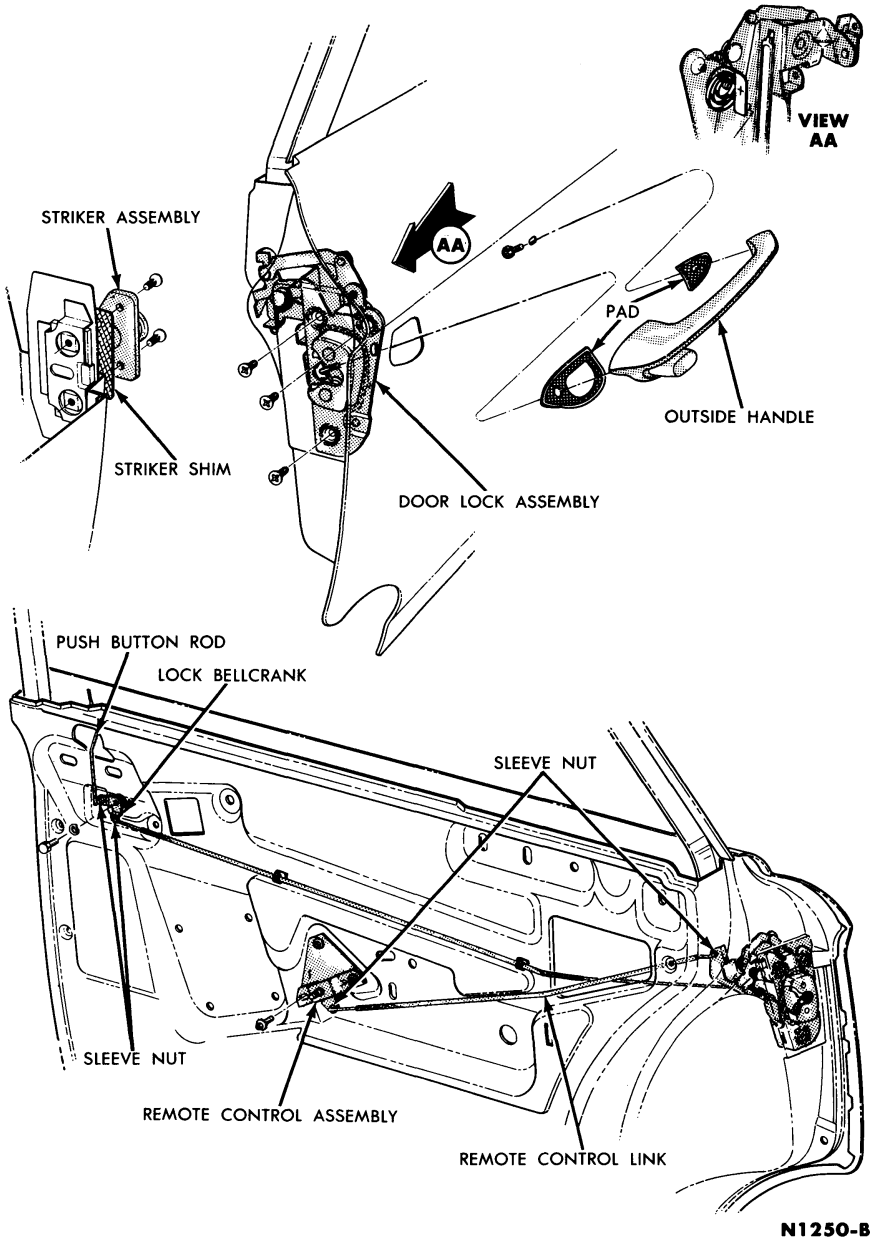



**FIG. 4—Rear Door Lock Installation**

ment conditions. The elongated holes where the hinges attach to the pillars provide in-and-out movement of the front door to obtain flush fits with the front fenders (Fig. 1), or fore and aft movement of the rear door to obtain correct spacing at the center pillar and quarter panel (Fig. 2).

To provide alignment of the fender with the door contour, the front fender is adjustable at the lower attaching bolt.

Where the doors attach to the hinges, enlarged bolt holes permit circular movement of the front door to obtain proper spacing all around the body opening. The enlarged holes in the rear door permit vertical or lateral (in-and-out) adjustment of the door.

Sometimes door misalignment results when the body is sprung because of improperly tightened body bolts or misalignment of the body or frame. Frame alignment information is included in Part 17-1. If the door contour appears to be correct, and shifting the door on the hinges will not correct the misalignment, check the body bolt torque specifications before bending the door or jacking the door opening (Part 17-1).

**Loosen all the body bolts and check the clearance between the mounting pad and the body. Add shims under any loose pads to bring them snugly against the body. Then start at the front and work from side to side toward the back, tightening each bolt to 20-25 ft-lbs.**

### ALIGNMENT PROCEDURE

**1.** Determine which hinge bolts must be loosened to move the door in the desired direction.

**2.** Loosen the hinge bolts enough to permit movement of the door with a **padded** pry bar.

**3.** Move the door the distance estimated to be necessary.

**4.** Tighten the hinge bolts and check the door fit.

**5.** Repeat the operation until the desired fit is obtained. Then check the alignment between the lock rotor and striker plate for proper door closing. The door locking mechanism (Figs. 3 and 4), consists of the door lock and rotor, lock cylinder, inside and outside handles, striker plate, and the linkage connecting these parts. Improperly aligned doors cause the major portion of lock failures by putting excessive strain on the striker plate and rotor. **Do not attempt to correct door misalignment with a striker plate adjustment.**

### LOCK STRIKER ADJUSTMENT

The striker pin can be adjusted laterally and vertically as well as fore and aft. **The lock striker should not be adjusted to correct door sag.** The lock striker should be shimmed to get the clearance shown in Fig. 5 between the lock striker and the lock. To check this clearance, clean the lock jaws and the striker area, and then apply a thin layer of dark grease to the lock striker. As the door is closed and opened, a measurable pattern will result. Move the striker

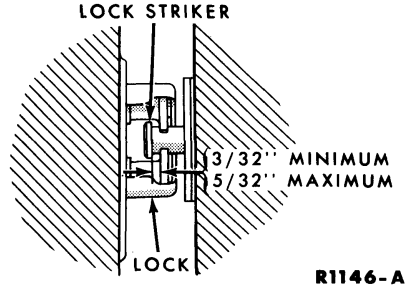



**FIG. 5—Door Lock Striker Adjustment**

assembly laterally to provide a flush fit at the door and the pillar or quarter panel.

## VENT WINDOW ADJUSTMENTS

### VERTICAL AND/OR FORE AND AFT

For proper clearance at the body front pillar and at the roof rail weatherstrip, loosen the vent window retaining screw (near the division bar), the front run bracket mounting bolt, the lateral adjustment lock nut, and the two vent window mounting bolts. Move the vent window as required, and tighten the mountings.

### LATERAL

To align the vent window with the front pillar, and/or the door glass, loosen the lateral adjustment lock nut (Fig. 6), the vent mounting bolts, and the vent window retaining screw (near the division bar). Adjust the lateral position of the vent window by turning the adjustment Allen screw, and then tighten the mountings.

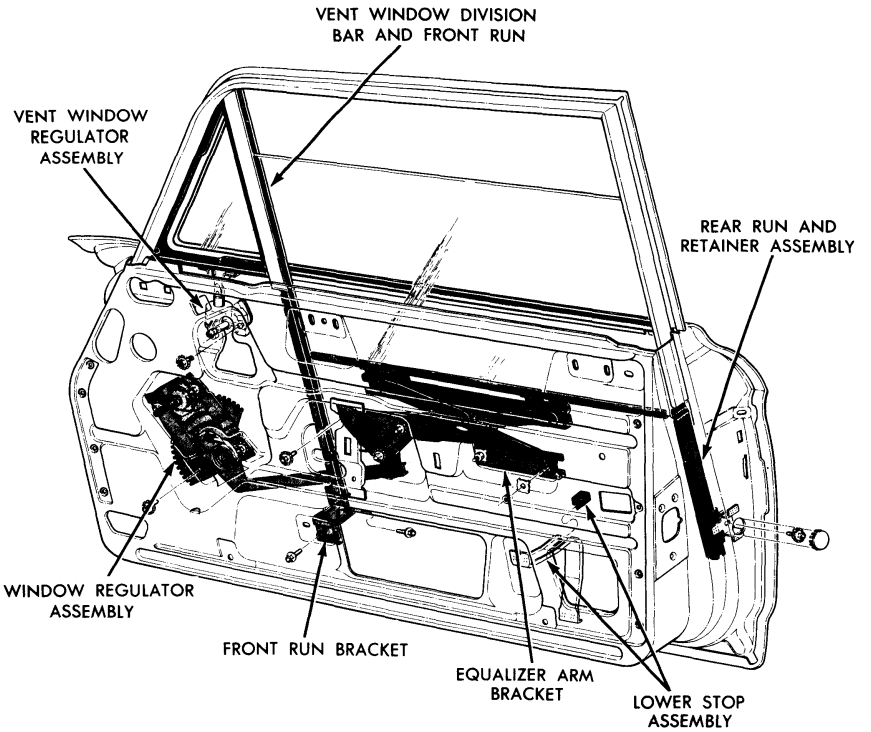



**FIG. 7—Front Door Window Mechanism—Body Type 62**

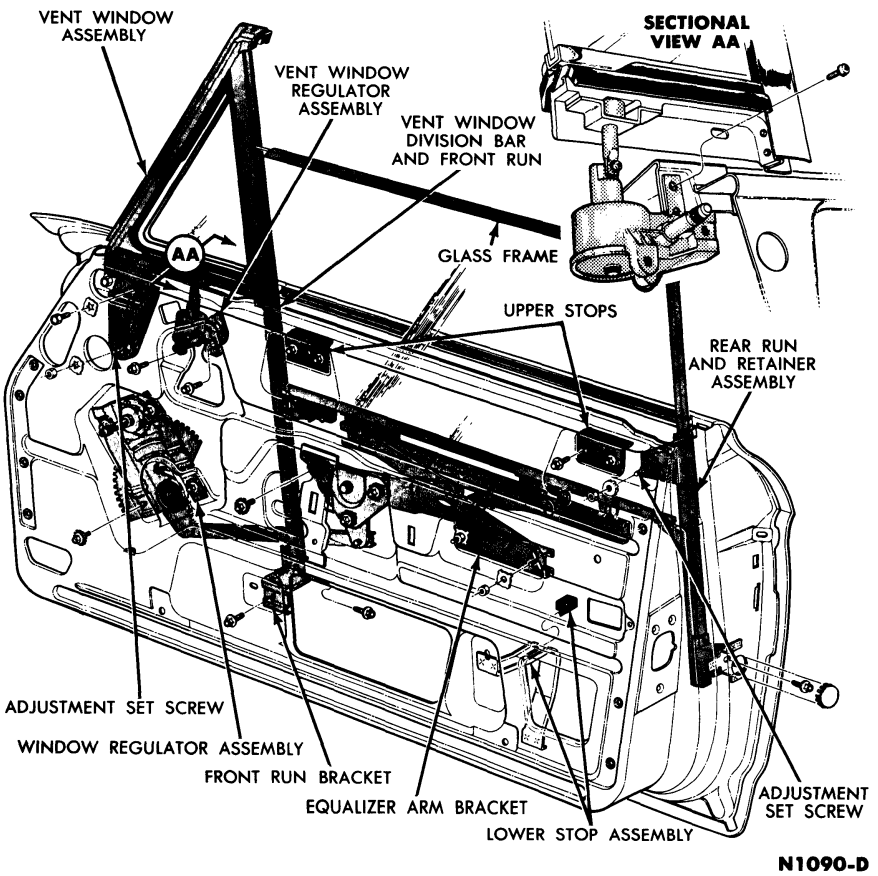



**FIG. 6—Front Door Window Mechanism—Body Types 57, 63, 65, 75, and 76**

## FRONT DOOR GLASS ADJUSTMENT

**The door must be properly adjusted to the door opening before any glass adjustments are made.**

### VERTICAL ADJUSTMENTS

To level the glass with the belt line on models without a door window frame, raise or lower the equalizer arm bracket.

To limit window travel on body types 65, 75, and 76, adjust the upper stops (Fig. 6). On body types 64, 62, and 71, the upper run provides an upper limit to glass travel.

### FORE-AND-AFT ADJUSTMENTS

To get a snug fit between the glass and the vertical runs, loosen the front run mounting bracket at the inner panel and vent window frame mounting screws (Figs. 6, 7 and 8). Compensate for any fore or aft movement by adjusting the opposite run mountings accordingly. Adjust the rear run bracket with the window lowered and adjust the rear run upper mounting with the window raised. After adjustment, tighten all mountings.

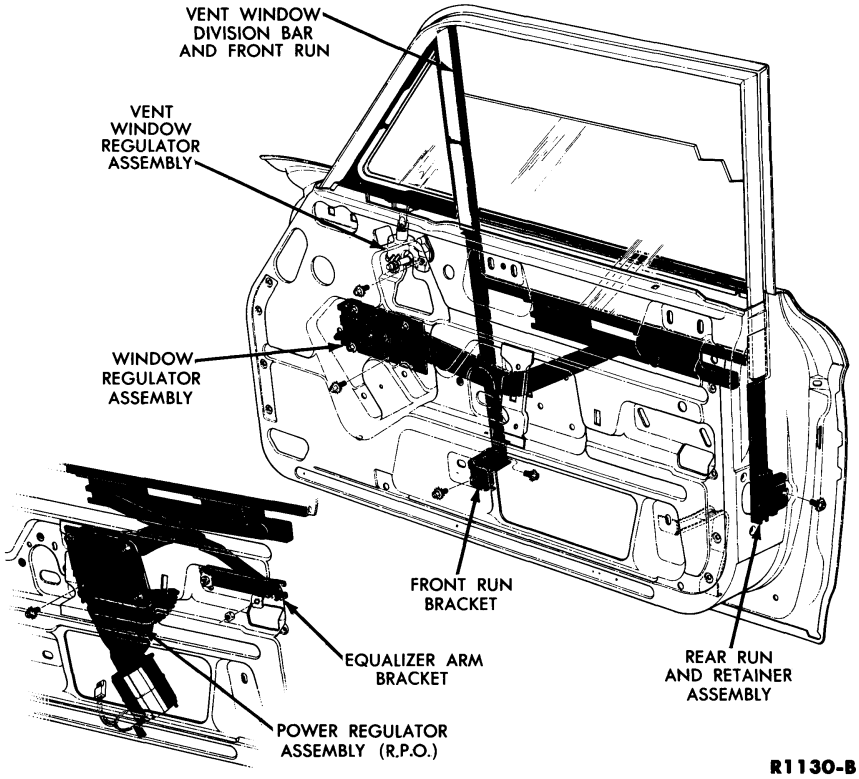



**FIG. 8—Front Door Window Mechanism—Body Types 54 and 71**

## REAR DOOR WINDOW GLASS ADJUSTMENT

**The door must be properly adjusted to the body opening before any glass and/or frame adjustments are made.**

### VERTICAL ADJUSTMENTS

To level the window with the belt line, raise or lower the equalizer arm bracket (or move the center guide fore or aft on a body type 75). If necessary, on a body type 75, adjust the upper stop accordingly.

To limit window travel, adjust the lower stop, and in addition, on a body type 75, the upper stop. On this model, also adjust the dovetail and striker at the glass channel forward edge. On body types 54, 62, and 71, the top run provides an upper limit to glass travel.

### FORE-AND-AFT ADJUSTMENTS

To move the glass fore or aft on a body type 75, loosen the 2 set screw nuts at the upper end of the front guide and the 3 center guide mounting screw and washer assemblies. Loosen the extension mountings (Fig. 22) and move the glass fore or aft to get a snug fit in the extension run and even spacing between the front and rear windows above the belt line. Tighten all mountings.

### LATERAL (IN-AND-OUT) ADJUSTMENTS

On a body type 75, loosen the 4 extension mountings, the 3 front guide mountings, and the 3 center guide mountings (Fig. 22). With the glass lowered, use an Allen wrench to adjust the set screw at the lower end of the extension as required, and tighten the lock nut. Adjust the lower end of the front guide, and tighten the bolt. With the glass lowered, use an Allen wrench to adjust the set screws at the upper end of the front guide, and then tighten the other mountings.

## QUARTER WINDOW ADJUSTMENT— BODY TYPE 62

**The door must be properly adjusted to the body opening before any glass adjustments are made.**

Fore-and-aft fit of the glass within the runs may be adjusted by fore-and-aft movement of the rear run upper and lower support brackets (Fig. 23). **Adjust the lower bracket with the window lowered, and adjust the upper bracket with the window raised.**

To limit lower travel of an electrically operated quarter window, adjust the position of the lower stop, which is located near the regulator.

## QUARTER WINDOW ADJUSTMENTS— BODY TYPE 63

### FORE AND AFT

**1.** Operate the window to its full up position.

**2.** Loosen the lock nuts at points "A" (Fig. 9) on the upper front stop assembly.

**3.** Loosen the lock nuts and screw at points "B" and "C" on the rear guide assembly (Fig. 9).

**4.** Adjust the window assembly fore or aft as required to obtain the $\frac{9}{32}$ inch parallel dimension between the front edge of the quarter window assembly and the rear edge of the front door glass frame. (Fig 9).

**5.** After adjustment, tighten the lock nuts and screws at points "A" "B" and "C" (Fig. 9).

### LATERAL (IN-OR-OUT)

**1.** Operate the window to its full up position.

**2.** Loosen the lock nuts at points "D" and "E" and the screws and washers at point "F" (Fig. 9).

**3.** Adjust the front guide, upper rear stop and the front guide lower bracket assembly to obtain the $\frac{1}{32}$" parallel dimension shown in Figure 9, View "CC".

**4.** Tighten points "E" and "F" securely. Tighten point "D" temporarily.

**5.** Loosen the lock nuts at points "B" and "D".

**6.** Adjust the window assembly towards the inside or outside of the body to obtain the $\frac{5}{16}$ inch parallel dimension shown in Figure 9, View "CC", by rotating the adjusting screws at point "G" and "H".

**7.** After adjustment, tighten the lock nuts "B" and "D" (Fig. 9).

**8.** To adjust the front guide assembly towards the inside or outside of the body, loosen the screws at points "K" (Fig. 9) which retain the front guide assembly to the front guide lower bracket assemblies.

**9.** After adjustment, tighten the screws at points "K".

UP AND DOWN

**The proper window "up" position is obtained while performing the lateral (in-or-out-) adjustment steps 2, 3 and 4.**

**1.** Operate the window to its full down position.

**2.** Loosen the lower stop assembly retaining screws (Fig. 9) and adjust the window assembly as necessary so that the high point of the window upper frame is level with the outside belt line window opening.

**3.** After adjustment, tighten the lower stop assembly retaining screws.

## QUARTER WINDOW ADJUSTMENT— BODY TYPE 65

To prevent a readjusted window stop or guide retaining nut or screw returning to the groove of the original setting, rotate the washer out of its original position or install a larger washer.

The clearance between the front edge of the quarter window and the rear edge of the front door glass can be adjusted by moving the regulator arm stop (Fig. 10). Torque the regulator arm stop retaining nut to 12-18 ft-lbs. The front and rear upper stops can be adjusted to control fore-and-aft movement.

To obtain the 0.16 inch dimension shown in Fig. 10, (view BB), adjust the front guide up or down after loosening items "A", "B", and "C". Torque items "A" to 8-13 ft-lbs, and items "B" and "C" to 12-18 ft-lbs.

The 0.26 inch dimension shown in Fig. 10 (view BB) is obtained by loosening the retaining nuts "A" and rotating the adjustment screw clockwise or counterclockwise as required. After the correct adjustment has been obtained, torque the retaining nuts to 8-13 ft-lbs.

For proper operation of the quarter window, adjust the guide actuator after loosening items "C" and "D" (Fig. 10).

**Torque the window stops and guide retaining screws and nuts on the high side of the preceding specifications.**

## QUARTER WINDOW ADJUSTMENT— BODY TYPE 76

To level the glass at the quarter panel belt line, screw the bumper into or out of the glass channel and/or move the hinge bracket up or down after loosening the set screw lock nuts (Fig. 11).

If the set screw adjustment is changed, check the fit of the quarter window at the front weatherstrip and at the top side rail weatherstrip.

To adjust the forward travel of the quarter glass, adjust the bumper that stops the regulator arm (Fig. 11) and/or the fore-and-aft position of the hinge bracket.

To adjust the lateral (in-and-out) position of the quarter glass, first loosen the guide upper and lower brackets for lateral adjustment. Then adjust the pivot bracket set screws

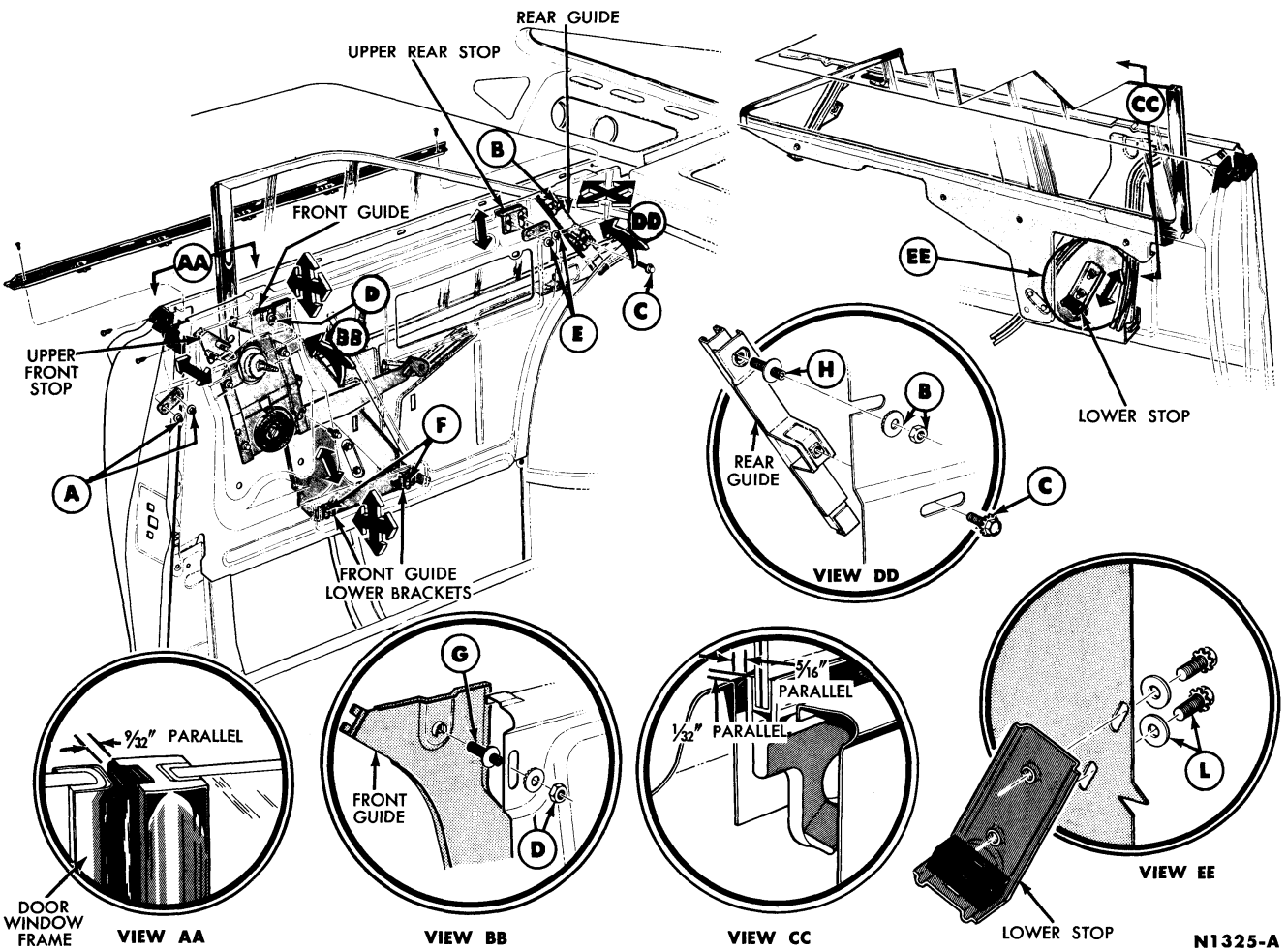



**FIG. 9—Quarter Window Adjustments—Body Type 63**

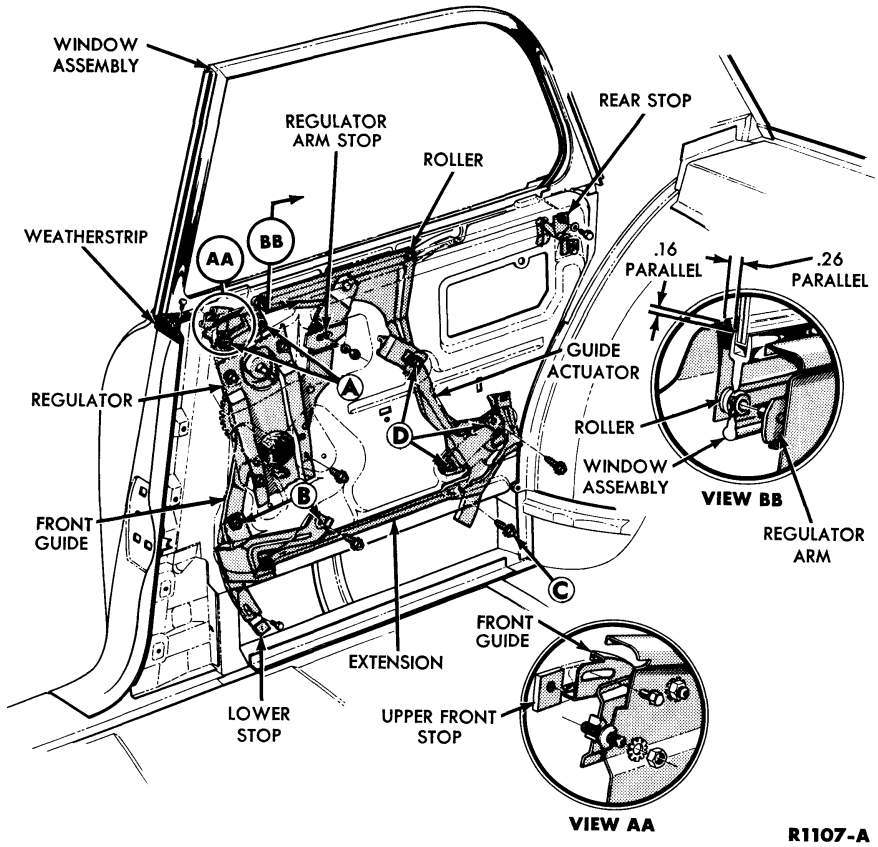



**FIG. 10—Quarter Window Adjustments—Body Type 65**

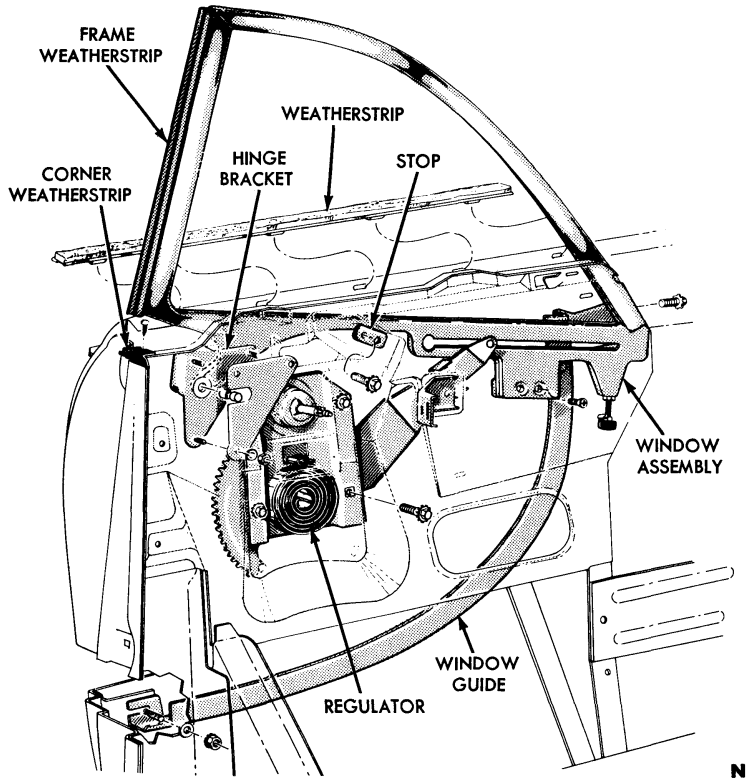



**FIG. 11—Quarter Window Adjustments—Body Type 76**

to move the glass for a centered fit in the quarter window weatherstrip and the top side rail weatherstrip. Tighten the upper bracket, lower the glass to position the guide, and tighten the lower bracket.

## STATION WAGON TAILGATE WINDOW ADJUSTMENTS

The tailgate window lower stops can be adjusted to level the top edge of the glass with the tailgate (Fig. 12).

The window regulator mounting holes are enlarged to correct window sag.

The tailgate window lower run mounting holes are enlarged for window alignment with the upper runs.

The tailgate window upper side run mounting holes are elongated. Remove the tailgate pillar garnish moulding to reveal the upper side run mounting screws.

The tailgate weatherstrips are shown in Fig. 13.

## TAILGATE EMERGENCY OPENING PROCEDURE

If the window regulator or the manual regulator handle is inoperative, the tailgate can be opened using the following procedure:

1. Remove the tailgate interior trim panel retaining screws (Fig. 13).
2. Actuate the tailgate lock handle to relieve the weatherstrip pressure on the tailgate interior trim panel.
3. To remove the tailgate trim panel, carefully pry up on the lower end of the skid strips with a large screwdriver. **Be sure to protect the trim panel from scratches.**
4. Remove the tailgate trim panel.
5. Remove the water shield and the access hole cover.
6. Remove the tailgate regulator arm roller retaining clips. It may be necessary to use a wire hook to remove the roller retaining clips.
7. Disconnect the regulator arms from the glass lower channel. Carefully lower the glass to the down position and open the tailgate.

## TAILGATE HINGE ADJUSTMENT

The tailgate can be adjusted fore or aft and up or down at the hinge to body mounting bolts.

To adjust the tailgate from side to side in the tailgate opening, remove the trim panel, loosen the hinge to tailgate bolts, and shift the tailgate as required.

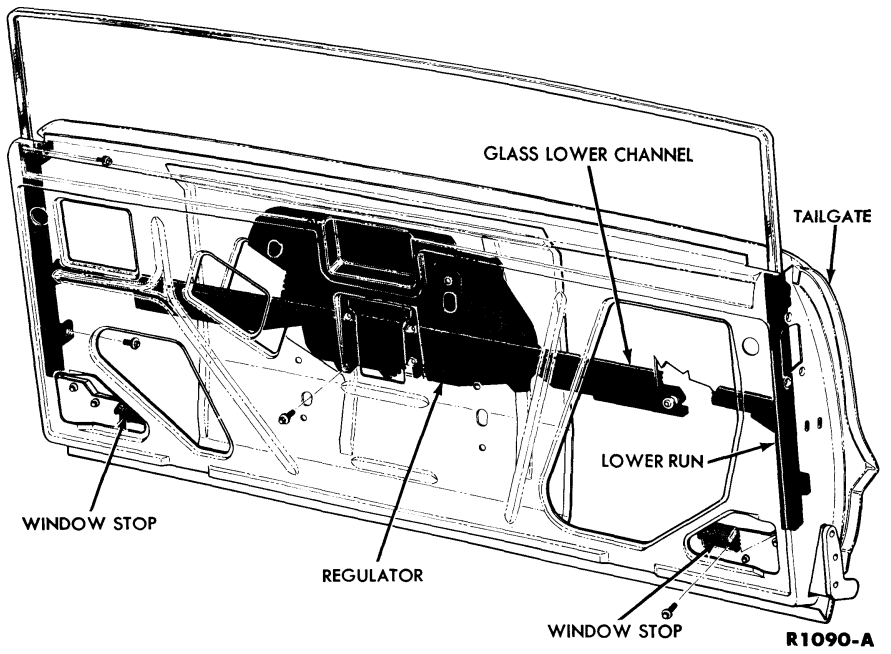



**FIG. 12—Tailgate Window Mechanism**

### DECK LOCK ADJUSTMENT —GALAXIE

The striker pin can be adjusted vertically and from side-to-side by tilting it. The lock can be adjusted as shown in Fig. 14.

### DECK LOCK ADJUSTMENT —MONTEREY

The striker plate can be adjusted vertically and the lock laterally to obtain the correct adjustment (Fig. 15).

### DECK LID ALIGNMENT

The deck lid can be shifted fore and aft, up and down, and from side to side (Fig. 16). Slotted hinge holes in the lid provide fore and aft movement, slotted hinge bolt holes in the mounting bracket provide vertical movement.

### CHECKING DECK LID FIT

After the lid has been fitted for a good exterior appearance, check the fit of the weatherstrip to the deck lid so as to prevent water leaks. To make this check, chalk the weather-

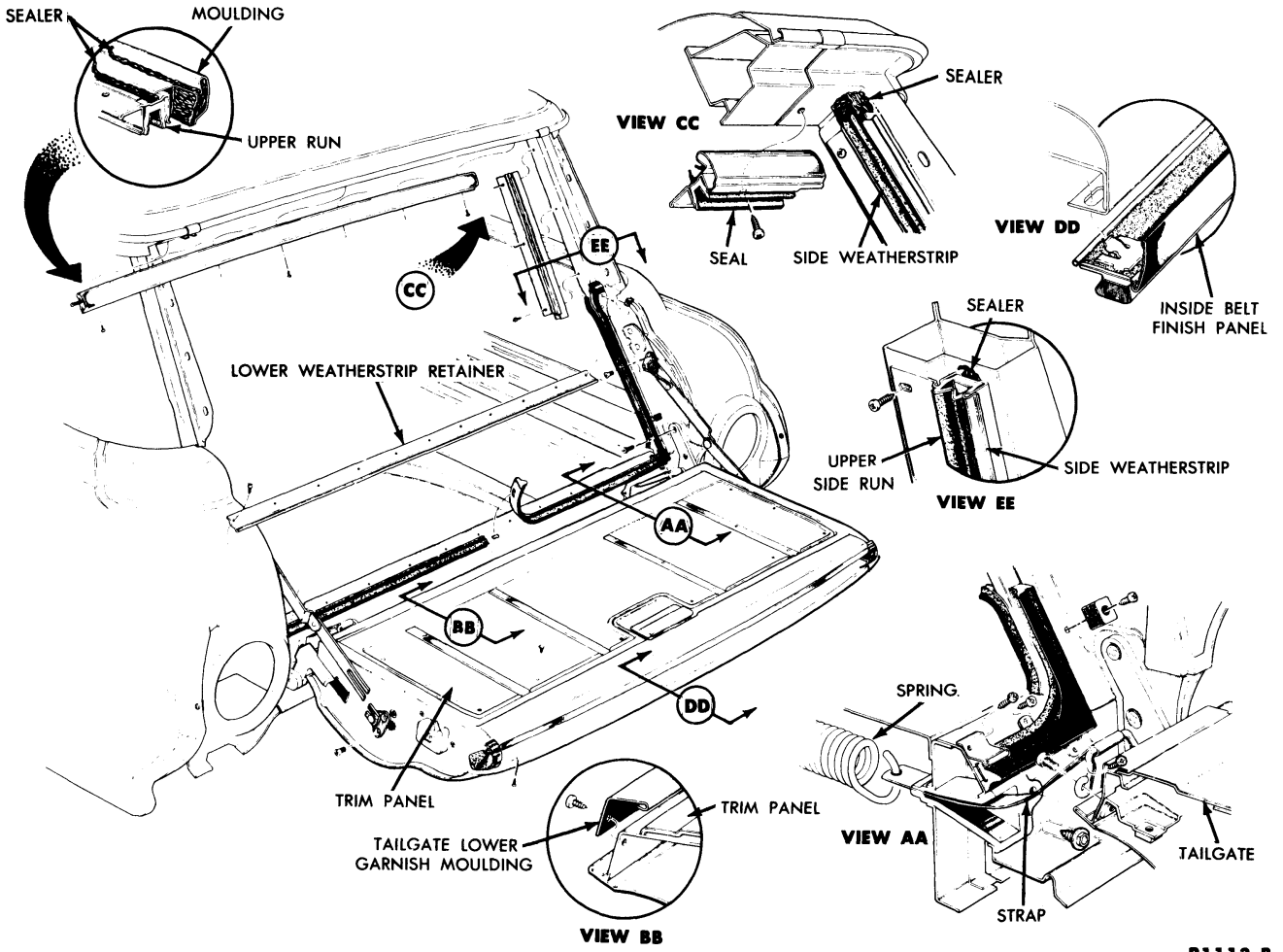
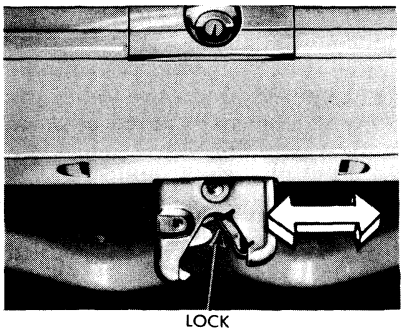



**FIG. 13—Tailgate Trim and Weatherstrips**



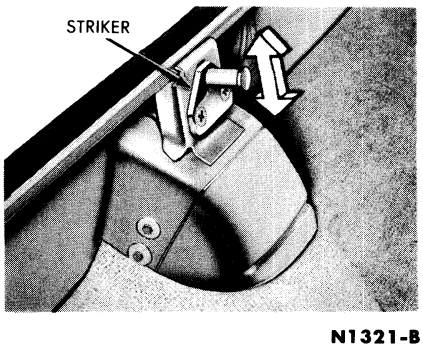
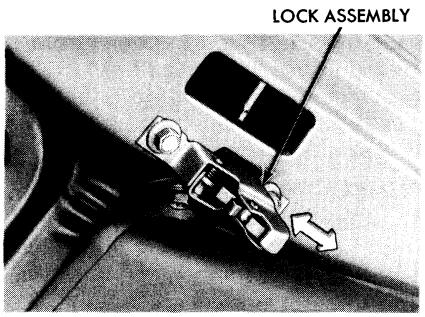




**FIG. 14—Deck Lock Adjustment—Ford**



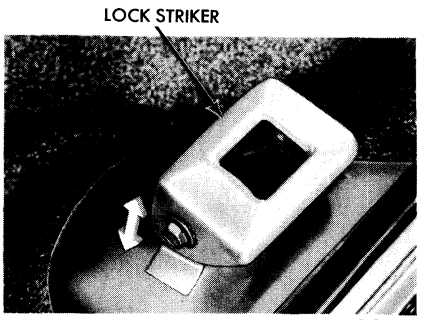




**FIG. 15—Deck Lock Adjustment—Mercury**

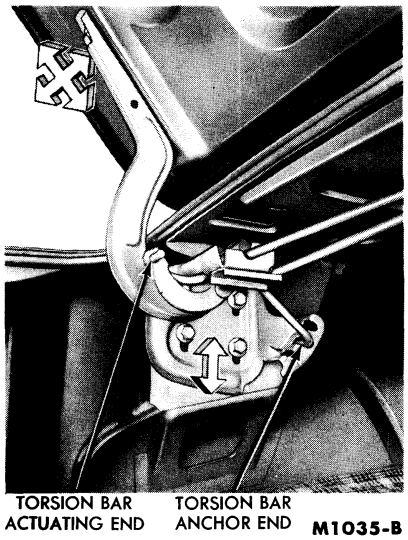



**FIG. 16—Deck Lid Hinge and Torsion Bars**

strip all the way around, and close the lid. Open the lid and check for a chalk mark all the way around the deck lid. If the chalk misses at any point, the weatherstrip should be shimmed to provide proper sealing or the deck lid should be readjusted.

## 2 REMOVAL AND INSTALLATION

### FRONT DOOR REMOVAL

1. Remove the trim panel, the water shield, and all usable outside mouldings and clips (if the door is to be replaced).
2. Remove the six attaching bolts from the door (Fig. 1).
3. Slide the door off the hinges.
4. If a hinge is damaged, remove the pillar attaching bolts, and replace the hinge.

### FRONT DOOR INSTALLATION

1. Drill holes as necessary for attaching outside mouldings. Cement door weatherstrips in proper position.
2. If the hinges were removed, install them in the front pillar.
3. Position the door on the hinges, partially tighten the bolts, align the door, and tighten the bolts securely.
4. Install the lock mechanism, the window mechanism, glass, vent window assembly, and the weatherstripping. It may be necessary, at this time, to perform a final door alignment to obtain a satisfactory weatherseal at the windshield pillar and/or the roof rail.
5. Install the exterior trim, garnish mouldings, water shield, and interior trim.

### REAR DOOR REMOVAL

1. Remove the trim panel, the water shield, and all usable outside mouldings and clips.
2. Brace the door so that it will not fall to the floor when the hinge attaching bolts are removed. Remove the bolts (Fig. 2) and remove the door.
3. If a hinge is damaged, remove the hinge attaching bolts from the pillar, and replace the hinge.

### REAR DOOR INSTALLATION

1. Drill holes as necessary for attaching outside mouldings. Cement door weatherstrips in position.
2. If the hinges were removed, install them in the center pillar.
3. Position the door on the hinges, partially tighten the bolts, align the door, and tighten the bolts securely.
4. Install the window and lock mechanisms, the door glass, and the weatherstripping. Make all necessary adjustments. Final door alignment may be necessary for a satisfactory door weatherseal.
5. Install the exterior trim, garnish mouldings, water shield, and interior trim.

### FRONT DOOR LOCK REMOVAL

1. Remove the door trim panel.
2. Remove the water shield from the door inner panel.
3. Disconnect the remote control link from the remote control and from the lock.
4. Disconnect the door lock actuating rods (Fig. 3) from the door lock.
5. Remove the three screws and lock washers that attach the door lock to the inner panel.
6. Remove the lock through the access hole in the inner panel.

### FRONT DOOR LOCK INSTALLATION

1. Apply a film of sealer to the door lock mounting surface.
2. Working through the access hole in the door inner panel, hold the lock in position and secure it in place

with three screws and lock washers.

3. Using two new sleeve nuts, connect the two door lock actuating rods to the lock.

4. Using two new sleeve nuts, connect the remote control rod to the door lock and to the remote control.

5. Check the door locking and window mechanism to make sure that they function properly.

6. Cement the water shield to the door inner panel.

7. Install the trim panel and hardware.

### REAR DOOR LOCK REMOVAL

1. Remove the door trim panel.

2. Remove the water shield from the door inner panel.

3. Remove the arm rest front support from the inner panel.

4. Disconnect the remote control link from the remote control and the lock.

5. Disconnect the lock control rod from the bellcrank and from the lock (Fig. 5).

6. Remove the three screws and washers that secure the lock to the inner panel.

7. Remove the lock through the access hole in the inner panel.

### REAR DOOR LOCK INSTALLATION

1. Apply a film of sealer to the door lock mounting surface.

2. Working through the access hole in the door inner panel, hold the lock in position and secure it in place with three screws and lock washers.

3. Using two new sleeve nuts, connect the lock control rod to the bellcrank and lock. Insert the rod in the retaining clip on the inner door panel.

4. Using two new sleeve nuts, connect the remote control link to the lock and to the remote control.

5. Secure the arm rest front support to the inner panel with two sheet metal screws.

6. Check the operation of the door lock and window mechanisms. Make the necessary adjustments.

7. Cement the water shield to the door inner panel.

8. Install the door trim panel and hardware.

### DOOR LOCK CYLINDER REMOVAL AND INSTALLATION

**The key code is stamped on the lock cylinder to assist in replacing lost keys.**

When a lock cylinder is replaced, both door lock cylinders and the ignition lock cylinder should be replaced in a set. This will avoid carrying an extra key which will fit only one lock.

1. Remove the door trim panel. Disconnect the lock actuating rod from the cylinder.

2. Pull the door lock cylinder retainer rearward to release the cylinder (Fig. 3). Pull the lock cylinder out from the door.

3. Transfer the lock cylinder arm and lock actuating rod retaining clip to the new lock cylinder.

4. Position the lock cylinder in the door, and install the lock cylinder retainer (Fig. 3). Connect the lock cylinder to the actuating rod.

5. Install the door trim panel.

### DOOR HANDLE PUSH BUTTON REMOVAL AND INSTALLATION

1. Remove the door trim panel, and loosen the water shield enough to reveal the access holes.

2. Remove the handle retaining screw and nut, and remove the handle (Fig. 3 or 4). To remove the front door handle, it will be necessary to disconnect the lock actuating link.

3. To replace the push button, remove the retaining plate screw, retaining plate, spring, push button, and rubber seal from the handle.

4. Install the push button assembly if it was removed, and install the handle assembly. Connect the lock actuating link if it was disconnected.

5. Cement the water shield in place, and install the door trim panel.

### VENT WINDOW OR WEATHERSTRIP REMOVAL AND INSTALLATION

The vent window glass can be replaced without removing the vent glass frame from the door (Figs. 17 and 18). Use a standard glass puller (Fig. 19). When installing new glass, use new tape and apply sealer to the lower outside edge of the glass frame.

The vent window frame may be replaced as follows:

1. Lower the door window. Remove the door trim panel and loosen the water shield to uncover the access holes.

2. Remove the screw retaining the vent window regulator to the vent glass lower pivot.

3. On body types 54, 62, and 71, remove the vent window frame retaining screws from under the door weatherstrip on the forward surface of the door window frame.

4. On body types 65, 75, and 76, remove the weatherstrip retaining screw (near the top of the vent window), and pull the weatherstrip away from the vent window frame. Remove the vent window frame mounting bolts and turn the vent window lateral adjustment screw inward (Fig. 6).

5. Remove the vent window frame lower mounting screw at the belt line.

6. Disconnect the lower end of the front run from its bracket.

7. On body types 54, 62, and 71, remove the lower stop, and lower the window as far as it will go. Pull the front run down, and tilt it to provide clearance for the vent window removal.

8. On body types 65, 75, and 76, lower the front run.

9. Remove the vent window assembly.

10. Remove the vent window upper pivot bracket retaining screws and remove the vent glass and lower pivot bushing.

11. If the vent window frame weatherstrip is to be replaced, carefully remove the rivets from the vent window frame. Position the new weatherstrip, and install the rivets.

12. Position the vent glass and bushing in the vent window. Install the upper pivot.

13. Position the assembly in the door and install the retaining screws finger-tight.

14. Install the screw retaining the vent window regulator to the vent glass lower pivot.

15. Install and adjust the front run and the window lower stop.

16. Align the vent window assembly, and tighten the mountings.

17. Check the operation of the vent glass and door glass.

18. On body types 65, 75, and 76, install the door weatherstrip.

19. Apply sealer AB-19560-A to existing holes, to the shafts of the regulator and inside handle, and also to the lower inside joint of the vent window weatherstrip and door inner panel. Install the water shield, using cement C2AZ19C525-A if needed. Install the trim panel.

### VENT WINDOW REGULATOR —REMOVAL AND INSTALLATION

1. Remove the door trim panel.

2. Remove the cap screw and lock washer that secures the vent glass

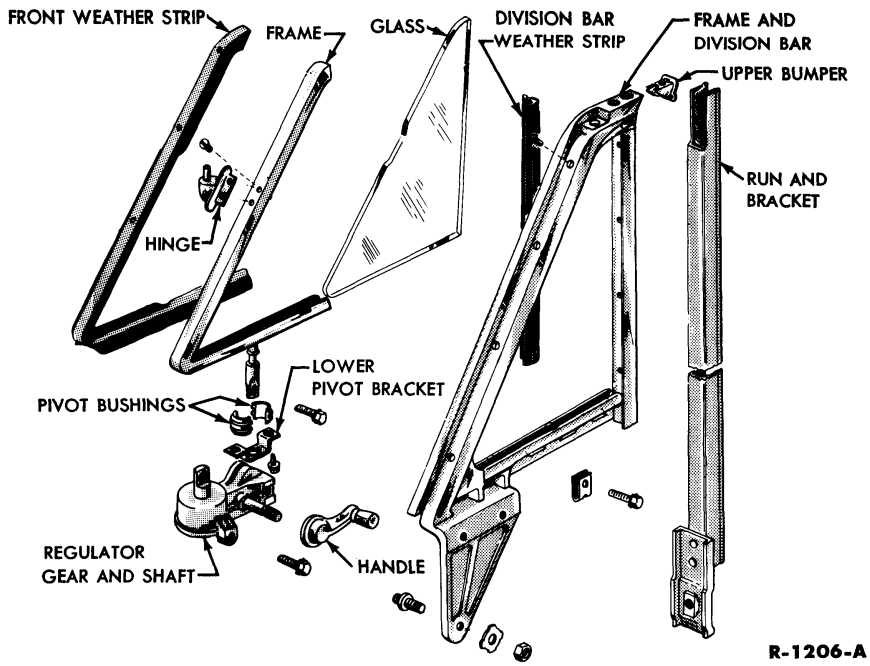



**FIG. 17—Vent Window—Body Types 63, 65, 75, and 76**

regulator to the vent glass lower pivot (Fig. 20).

**3.** Remove the two cap screws that secure the regulator to the door inner panel.

**4.** Remove the regulator through the opening in the inner panel.

**5.** Rotate the vent regulator handle shaft until the flat on the regulator shaft is at a 90° angle to the handle shaft.

**6.** Hold the regulator in place on the door inner panel and install but do not tighten the two attaching screws.

**7.** Secure the regulator shaft to the vent window pivot with a cap screw and lock washer.

**8.** Tighten the regulator-to-panel attaching screws.

**9.** Install the door trim panel and hardware.

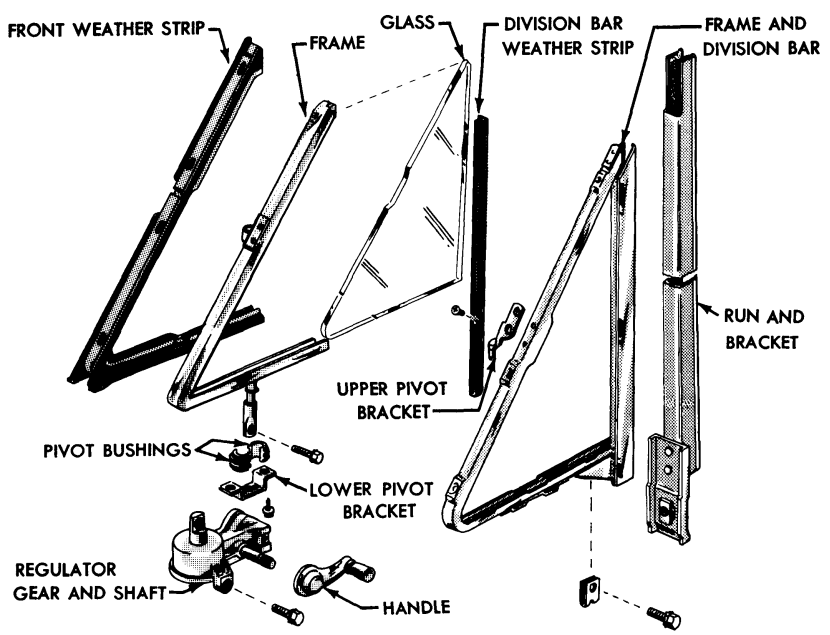



**FIG. 18—Vent Window—Body Types 54, 62, and 71**

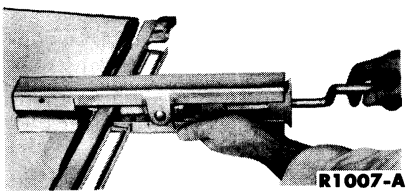



**FIG. 19—Glass Channel Replacement**

## FRONT DOOR GLASS REMOVAL AND INSTALLATION

**1.** Remove the trim panel and loosen the water shield to uncover the access holes.

**2.** Lower the glass as far as it will go.

**3.** On body types 54, 62, and 71, remove the window upper run, and disconnect the front run at the lower bracket. Lower and tilt the run for access when removing the glass (Fig. 7 or 8).

**4.** Disconnect the regulator arms from the glass channel by removing the roller-retaining clip.

**5.** On body types 57, 63, 65, 75 and 76, remove the window upper stops (Fig. 6), and lift the glass up and out of the door.

**6.** On body types 54, 62, and 71, tilt the glass forward nearly 90 degrees, and remove it by lifting up while the glass is tilted slightly inward.

**7.** If the glass channel or glass frame is to be replaced, use a tool similar to the one shown in Fig. 19. When installing the channel or glass frame, use new glass tape.

**8.** Position the glass in the door, reversing the procedure used for glass removal.

**9.** On body types 54, 62, and 71, snap the run into the vent window

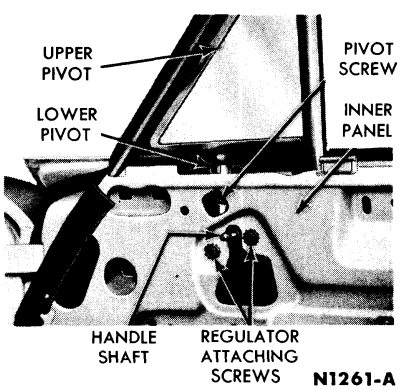



**FIG. 20—Vent Window Regulator Installed**

division bar, and connect the run to its bracket. Install the window upper run.

**10.** On body types 57, 63, 65, 75 and 76, install the window upper stops.

**11.** Connect the window regulator to the glass channel by installing the rollers. Apply Lubriplate or silicone lubricant to the rollers.

**12.** Install the window lower stop, and adjust the door glass.

**13.** Apply sealer AB19560-A to existing holes and around the inside door handle and window regulator shafts. Install the water shield, using cement C2AZ-19C525-A if needed. Install the trim panel.

## MANUAL WINDOW REGULATOR REMOVAL AND INSTALLATION—FRONT DOOR

**1.** Remove the trim panel and loosen the water shield to uncover the access holes.

**2.** Disconnect the regulator at the arm and plate on 2-door and 4-door hardtops (Fig. 7). On a 4-door model (except hardtop), disconnect the regulator from the glass channel roller (Fig. 8).

**3.** Raise the door glass by hand and secure it in the raised position.

**4.** On a 4-door model (except hardtop), disconnect the front run bracket from the inner panel to make room for removal of the regulator.

**5.** Remove the regulator retaining screw and washer assemblies, and remove the regulator through the door access hole.

**6.** Position the regulator inside the door, and install the retaining screw and washer assemblies.

**7.** On a 4-door model (except hardtop), connect the front run bracket.

**8.** Lower the glass, and connect the regulator.

**9.** Check the operation of the glass, and adjust it if necessary.

**10.** Apply sealer AB19560-A to existing holes and around the door handle and window regulator shafts. Install the water shield, using cement C2AZ-19C525-A if needed. Install the trim panel.

## FRONT DOOR GLASS REAR RUN REMOVAL AND INSTALLATION

### BODY TYPES 57, 63, 65, 75 and 76

**1.** Remove the trim panel and pull the water shield away from the access holes.

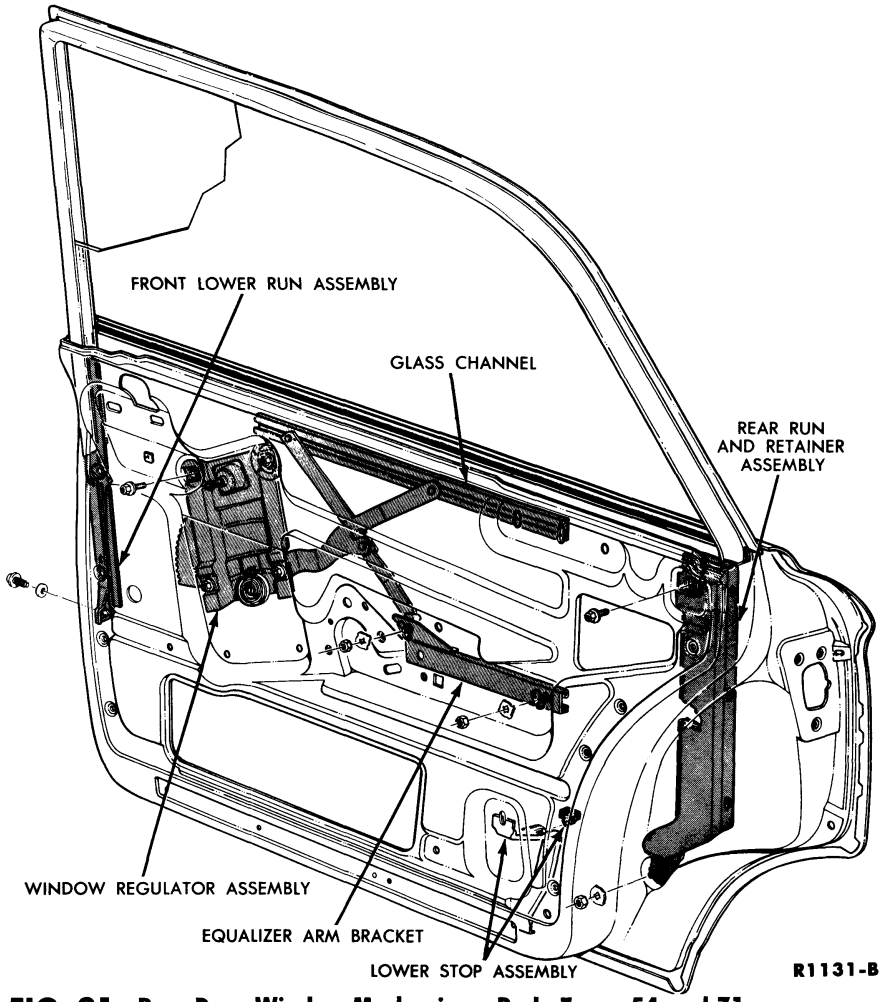



**FIG. 21—Rear Door Window Mechanism—Body Types 54 and 71**

**2.** Raise the door glass, remove the lock nut from the rear run set screw (Fig. 6), and turn the screw in several turns.

**3.** Disconnect the run from its lower mounting bracket.

**4.** Lower the run enough to allow removal of the set screw through the door access hole, and remove the run.

**5.** Position the run in the door, and loosely install the set screw and lock nut.

**6.** Loosely connect the run to its lower mounting bracket, and lower the door glass.

**7.** Check the operation of the door glass, and adjust it if necessary.

**8.** Install the water shield and the trim panel.

## REAR DOOR GLASS REMOVAL AND INSTALLATION

**The door must be properly adjusted to the body opening before any glass adjustments are made.**

**1.** Remove the trim panel, and loosen the water shield to uncover the access holes.

**2.** On all models, lower the glass about halfway, disconnect the regulator arms from the glass channel rollers, and lower the window to the stop (Fig. 21 or 22).

**3.** Remove the lower stop, and lower the window to the bottom of the door.

**4.** On a body type 75, remove the dovetail from the forward edge of the glass channel.

**5.** Remove the glass by raising the front part of the glass until it clears the run and then lift the assembly out of the door.

**6.** If the glass itself is to be replaced, use a tool such as the one shown in Fig. 19. When installing the channel, use new glass tape between the channel and the glass. On a body type 75, remove the three channel joint screws before removing the channel.

**7.** Transfer the rollers to the new door glass channel.

**8.** Position the glass in the door,

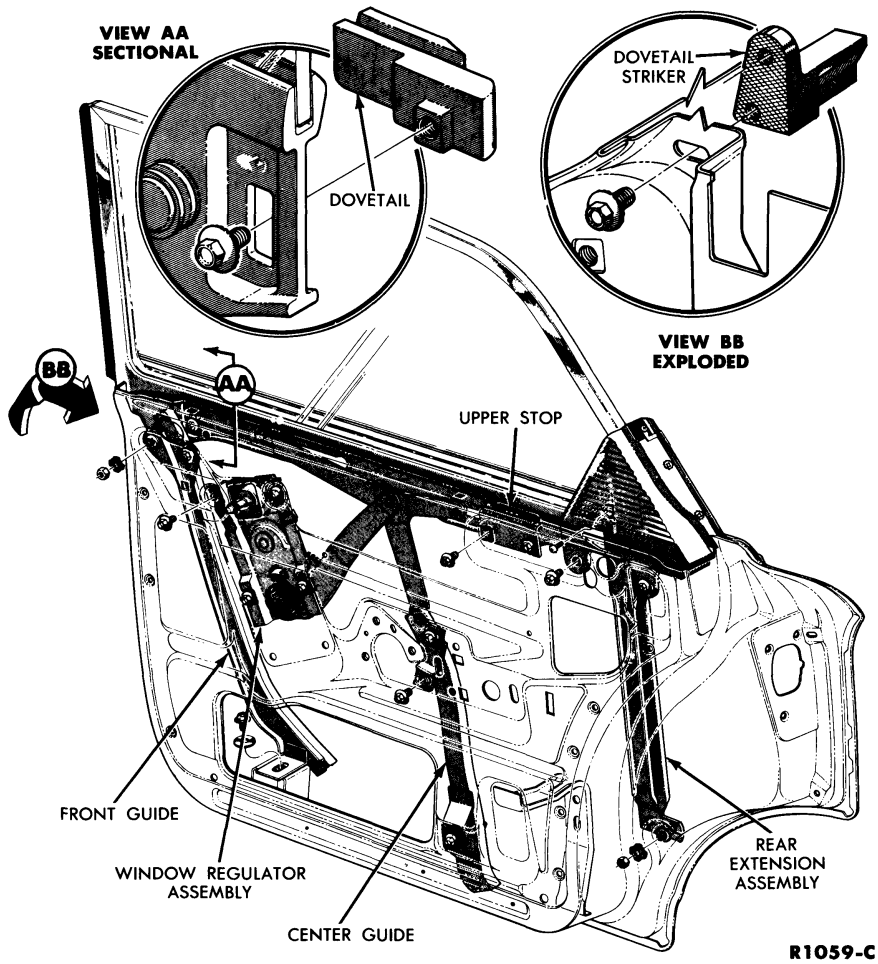



**FIG. 22—Rear Door Window Mechanism—Body Type 75**

and install the lower stop (and the dovetail on a hardtop).

**9.** Raise the window about halfway, and connect the regulator arms. Apply a coating of Lubriplate or silicone lubricant to the rollers.

**10.** Check the operation of the window, and adjust as necessary.

**11.** Apply sealer to existing holes and around the door handle and regulator shafts. Install the water shield, using cement C2AZ-19C525-A if needed. Install the trim panel.

## MANUAL WINDOW REGULATOR REMOVAL AND INSTALLATION—REAR DOOR

**1.** Remove the trim panel, and loosen the water shield to uncover the access holes.

**2.** Disconnect the regulator arms from the rollers, and support the window in raised position.

**3.** Remove the regulator retaining screws, slide the equalizer arm out of the bracket (Fig. 21) or the guide (Fig. 22), and remove the regulator through the door access hole.

**4.** Position the regulator in the door, engaging the equalizer, arm, and install the retaining screws. Apply a coating of Lubriplate to the rollers.

**5.** Lower the glass, and connect the regulator arms.

**6.** Check the operation of the glass, and adjust it as necessary.

**7.** Apply sealer AB-19560-A to existing holes and around the door handle and regulator shafts. Install the water shield, using cement C2AZ-19C525-A as necessary. Install the trim panel.

## EXTENSION REMOVAL AND INSTALLATION

**1.** Remove the trim panel, and loosen the water shield to uncover the access holes (Fig. 22).

**2.** Remove the weatherstrip retaining screw from the extension, and pull the weatherstrip away from the extension.

**3.** Remove the extension retaining screw from the outside of the door, the extension retaining screw and washer assemblies (near the belt line), and the set screw lock nut.

**4.** After turning the set screw in far enough for clearance at the inner panel, remove the extension assembly from the door.

**5.** Disassemble the extension, and transfer the usable parts to the new extension.

**6.** Position the new extension in the door, and install the mountings loosely.

**7.** Adjust the lateral (in-and-out) position of the extension by means of the adjustment screw, and tighten the rest of the mountings.

**8.** Using 8A-19552-B cement on the weatherstrip surface and on the metal surface, cement the weatherstrip to the extension. Install the weatherstrip retaining screw.

**9.** Install the water shield and the trim panel.

## QUARTER GLASS REMOVAL AND INSTALLATION—BODY TYPE 62

**1.** Remove the rear seat cushion, the seat back, and the quarter trim panel.

**2.** Loosen the water shield to uncover the access holes, and lower the window as necessary to disconnect the regulator arms from the glass channel (Fig. 23).

**3.** Remove the glass and channel as an assembly.

**4.** If the glass or channel is to be replaced, remove any glass frame retaining screws and use a tool similar to the one shown in Fig. 19. When installing the channel, use new glass tape between the channel and the glass.

**5.** With the rollers in the channel, position the glass in the quarter panel.

**6.** Connect the regulator arms.

**7.** Check and adjust the operation of the window.

**8.** Apply sealer AB19560-A to existing holes and around the regulator shaft. Install the water shield, using cement C2AZ-19C525-A if needed. Install the trim panel.

**9.** Install the seat back and the seat cushion.

## REGULATOR REMOVAL AND INSTALLATION—BODY TYPE 62

**1.** Remove the trim panel, and pull the water shield away from the access holes.

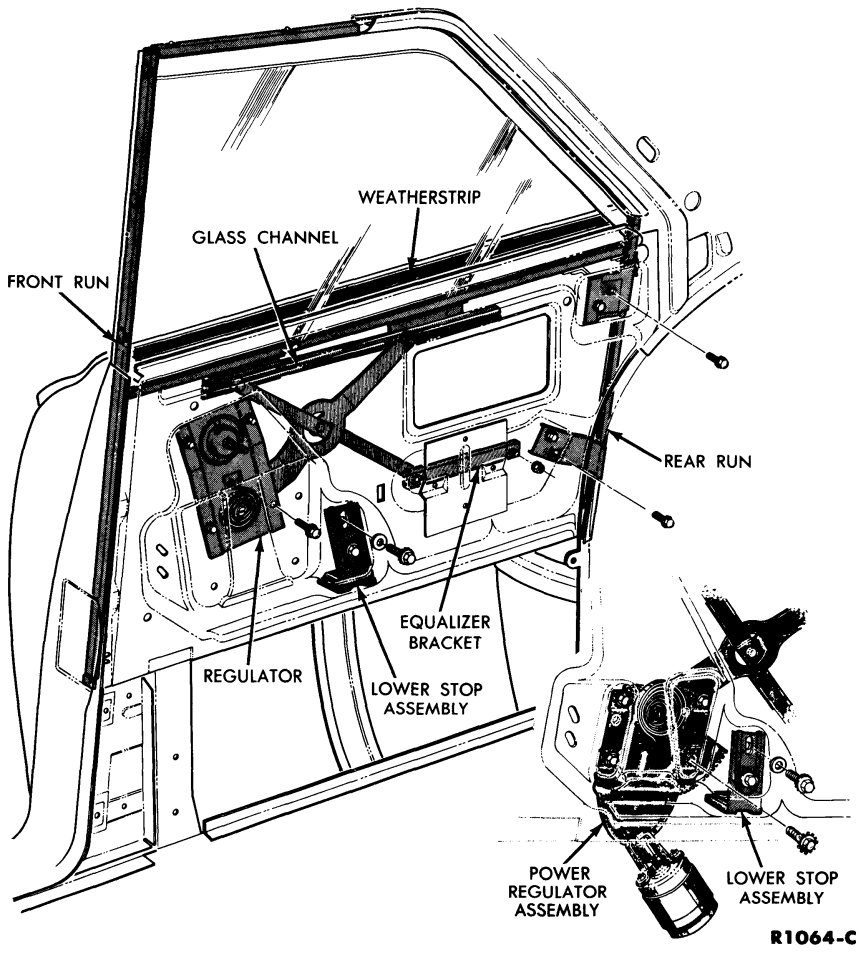



**FIG. 23—Quarter Window Mechanism—Body Type 62**

2. Disconnect the regulator from the glass channel rollers (Fig. 23).
3. Raise the window by hand, and support it in the raised position.
4. Remove the regulator retaining screws, slide the regulator arm out of the equalizer bracket, and remove the regulator.
5. Position the regulator inside the quarter panel, engage the arm in the equalizer bracket, and install the regulator retaining screws.
6. Position the rollers in the glass channel, lower the window, and connect the regulator to the rollers.
7. Adjust the rear run.
8. Apply sealer AB19560-A to existing holes and around the regulator shaft. Install the water shield, using cement C2AZ-19C525-A if necessary. Install the trim panel.

## QUARTER WINDOW FRONT RUN REMOVAL AND INSTALLATION—BODY TYPE 62

1. Remove the quarter trim panel, pull the water shield away from the access holes, and lower the window.
2. Remove the rear run lower support bracket screws, and slide the window to the rear (Fig. 23).
3. Remove the front run upper retaining screws and the lower retaining screw. Remove the run.
4. Position the run, install the retaining screws, and move the window forward.
5. After adjusting the lower end of the rear run, install the lower support bracket screws.
6. Raise the glass and adjust the rear run upper bracket.
7. Apply sealer AB19560-A to existing holes and around the regulator shaft. Install the water shield, using cement C2AZ-19C525-A if necessary. Install the trim panel.

## QUARTER WINDOW GLASS REMOVAL AND INSTALLATION —BODY TYPE 63

### REMOVAL

1. Remove the rear seat cushion and seat back.
2. Remove the quarter window garnish moulding, window operating handle, quarter arm rest and quarter trim panel. Peel back the plastic water shield.
3. Remove the upper rear stop retaining nuts and remove the upper rear stop.
4. Remove the upper front stop retaining nuts and remove the upper front stop.
5. Remove the lower stop retaining screws and remove the lower stop.
6. Disconnect the regulator arm retaining clip from the regulator arm roller.
7. Remove the quarter window assembly from the front guide.
8. Remove the quarter window rear guide.
9. Lift the quarter window assembly up and out of the quarter window opening.
10. Remove the window front weatherstrip.
11. Remove the upper channel to front channel retaining screws.
12. Remove the upper channel to lower rear channel retaining screw.
13. Remove the upper channel and glass from the lower and front channel assembly.
14. Remove the upper channel and seal from the glass.

### INSTALLATION

1. Position the glass tape around the front and lower edge of the glass and install the glass in the lower and front channel assembly. Trim off any excess glass tape.
2. Position glass tape and the upper channel on the glass.
3. Install the upper channel to front channel retaining screws.
4. Install the upper channel to lower channel retaining screw.
5. Trim the glass tape from the inner and outer sides of the glass flush with the channel.
6. Reposition the glass assembly in the quarter panel.
7. Position the front guide assembly.
8. Connect the regulator arm to the lower glass channel roller.
9. Raise the glass assembly to approximately the ¾ up position and loosely install the rear guide.
10. Loosely install the upper rear and upper front stops.
11. Loosely install the lower stop.
12. Adjust the glass assembly for proper alignment and recheck operation.
13. Install the watershield, quarter trim panel, garnish moulding and arm

rest. Install the seat back and seat cushion.

### QUARTER GLASS REMOVAL AND INSTALLATION—BODY TYPE 65

1. Remove the quarter trim panel.
2. Remove the quarter panel water shield support and water shield.
3. Remove the upper stop from the front guide (Fig. 10).
4. Disconnect the regulator arms from the rollers in the glass lower channel.
5. Tilt the rear of the glass down, and then slide the glass with the front guide roller out the top of the front guide and inside the car.
6. Disconnect the glass upper frame from the lower channel.
7. Remove the glass upper frame and lower channel from the glass.
8. Install glass tape on the new glass, and install the upper frame and lower channel on the glass.
9. Position the glass assembly in the guides and connect the regulator arms.
10. Install and adjust the front guide upper stop.
11. Apply sealer AB19560-A to the inner panel holes and regulator shaft. Install the water shield, using cement C2AZ-19C525-A.
12. Install the water shield support and quarter trim panel.

### QUARTER REGULATOR REMOVAL AND INSTALLATION—BODY TYPE 65

1. Remove the quarter trim panel, water shield support, and water shield.
2. Disconnect the regulator arm pivot from the roller, raise the window by hand, and support the window in the raised position.
3. Loosen the front guide upper retaining nuts and remove the extension (Fig. 10).
4. Remove the regulator retaining screws and remove the regulator.
5. Position the regulator inside the quarter panel and install the retaining screws.
6. Position the roller in the glass channel, lower the window, and connect the regulator to the rollers.
7. Install the extension and adjust the front guide.
8. Apply sealer AB19560-A to existing holes and around the regulator shaft. Install the water shield, using cement C2AZ-19C525-A.
9. Install the water shield support and trim panel.

### QUARTER GLASS REMOVAL AND INSTALLATION—BODY TYPE 76

1. Lower the convertible top and remove the quarter window garnish moulding.
2. Pull down the quarter window front edge weatherstrip enough to reveal the glass upper frame retaining screws, and remove the screws.
3. Remove the screws retaining the upper frame to the rear edge of the lower channel.
4. Remove the upper frame and glass from the lower channel.
5. Remove the upper frame and rubber seat from the glass.
6. Position glass tape on the front and lower edge of the glass and install the glass in the front and lower channels.
7. Trim the ends of the glass tape.
8. Position glass tape and the upper frame on the glass.
9. Install the upper frame retaining screws.
10. Pull up the quarter window front edge weatherstrip, and trim the glass tape.
11. Install the garnish moulding.

### QUARTER GLASS FRAME REMOVAL AND INSTALLATION—BODY TYPE 76

1. Stack the top, and remove the rear seat cushion, rear seat back, and the front and rear quarter trim panels.
2. Pull the water shield away from the access holes and lower the quarter window (Fig. 11). Disconnect the roller assembly from the lower channel and regulator arm.
3. Remove the quarter window guide button retainer (Fig. 11).
4. From above, with the window lowered, loosen the quarter window pivot pin set screw (Fig. 24). Insert a ¼-20 bolt through the access hole opposite the pivot pin, screw the bolt into the pivot pin, and pull out the pivot pin.
5. Move the glass toward the rear out of the pivot bracket, and lift it straight up and out of the quarter panel.
6. Remove the lower channel and frame assembly (and/or the top channel) from the glass with a glass channel replacer similar to the one shown in Fig. 19.

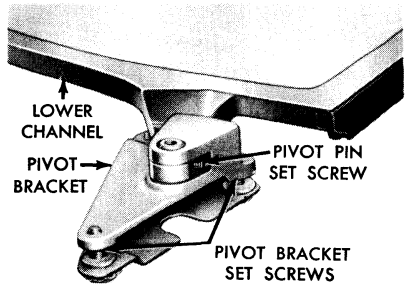



**FIG. 24—Quarter Window Pivot Bracket**

7. Install new glass tape all around the edge of the quarter glass, and install the lower channel (and/or the top channel) and frame.
8. Position the glass in the quarter panel.
9. Install the quarter window guide button retainer, and make sure the guide button is riding properly on the guide (Fig. 11).
10. Position the lower channel forward end in the pivot bracket, install the pivot pin with the ¼-20 bolt used for removal, and tighten the pivot pin set screw (Fig. 24). Remove the ¼-20 bolt from the pivot pin.
11. Connect the regulator arm, check the window operation, and adjust as necessary.
12. Install the water shield and the quarter trim panels.
13. Install the rear seat back and rear seat cushion.

### QUARTER REGULATOR REMOVAL AND INSTALLATION—BODY TYPE 76

1. Remove the rear seat cushion, rear seat back, quarter front and rear trim panels.
2. Pull the water shield away from the access holes, and lower the window. Disconnect the regulator arm, raise the glass, and block it in place (Fig. 11).
3. Remove the regulator retaining screws, and remove the regulator through the access opening.
4. Position the regulator in the quarter panel, and install the retaining screws.
5. Connect the regulator arm.
6. Check and adjust the window operation.
7. Install the water shield and the door trim panels.
8. Install the rear seat back, and rear seat cushion.

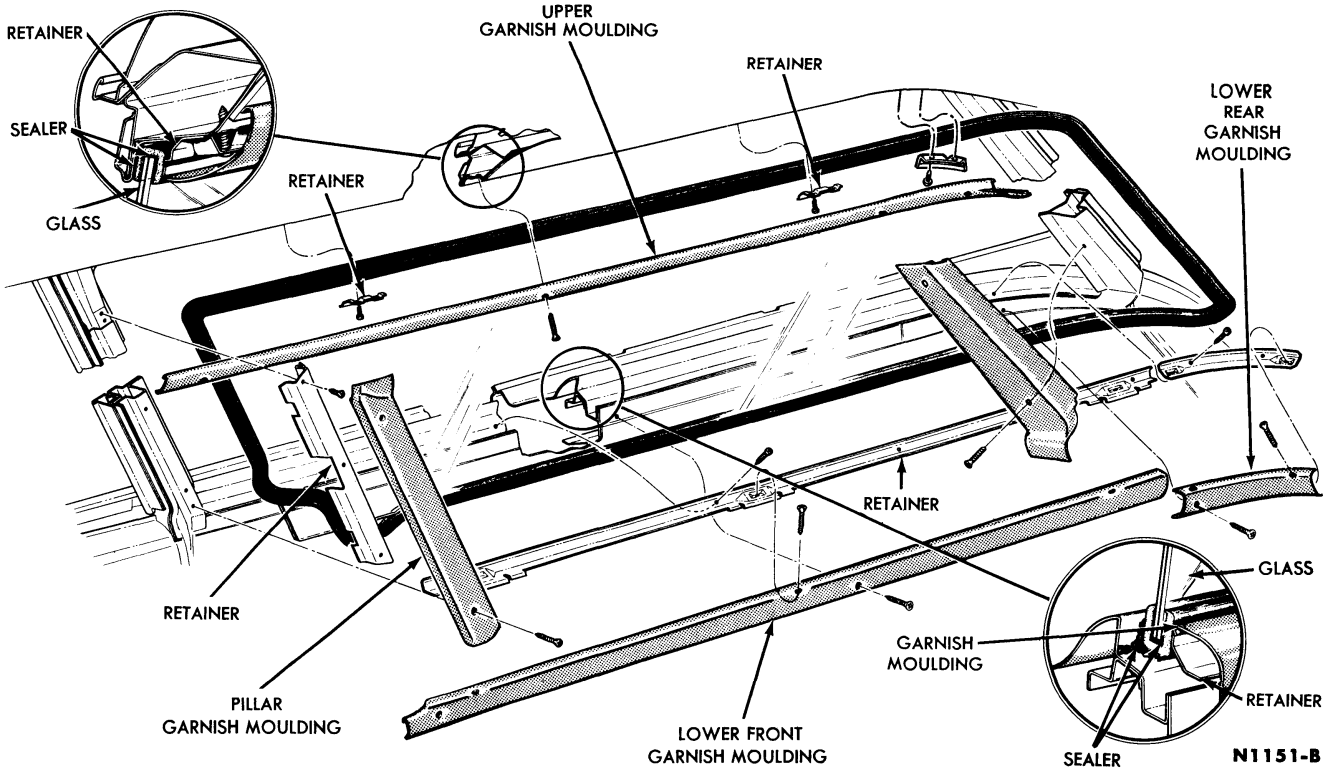



**FIG. 25—Quarter Window Installation—Body Type 71**

## POWER WINDOW REGULATOR REMOVAL AND INSTALLATION

To remove and install the power regulator assembly, including the motor, follow the appropriate removal and installation procedures given for the manual regulator. Connecting the wires presents no problem because of the type of wire connectors used.

If the regulator arm tension spring requires replacement, it can be replaced after the regulator is removed. This operation should be performed with the arm at its point of maximum upward travel so that there is a minimum of spring tension to overcome.

## REAR QUARTER WINDOW AND/OR WEATHERSTRIP REMOVAL AND INSTALLATION —STATION WAGON

**1.** Remove the tailgate pillar garnish moulding (Fig. 25), rear and front lower garnish mouldings, front pillar garnish moulding, and upper garnish moulding.

**2.** Remove the rear quarter window retainers (Fig. 25).

**3.** Push the glass and the weatherstrip inward and remove the assembly from inside the car.

**4.** Remove the weatherstrip and, using solvent, clean the glass (or the weatherstrip and the window opening.

**5.** Apply sealer all the way around the rear quarter window opening and all the way around the window glass groove in the weatherstrip.

**6.** Position the weatherstrip on the glass, place the glass and weatherstrip in the window opening, and install the retainers (Fig. 25).

**7.** Install the garnish mouldings.

## WINDSHIELD AND/OR WINDSHIELD WEATHERSTRIP REMOVAL AND INSTALLATION

**1.** On a convertible, lower the top and remove the visor arm assemblies.

**2.** Remove the windshield wiper arm and blade assemblies.

**3.** Remove the windshield outside side mouldings (Figs. 26, 27 and 28) and the lower outside belt moulding retaining screws and remove the mouldings.

**4.** Remove the outside top moulding retaining screws, and remove the moulding. On Model 63, remove the upper moulding retaining clips (Fig. 28).

**5.** Working from inside the car, remove all windshield garnish mouldings and the rear view mirror bracket.

**6.** Loosen the windshield weatherstrip from the body windshield opening flange, and push the windshield and weatherstrip out of the opening.

**7.** Remove the weatherstrip from the windshield.

**8.** Using solvent, clean the body windshield opening flange and the weatherstrip and/or the glass.

**9.** Position the weatherstrip on the glass, locating the vulcanized joints near each lower corner and spacing them evenly on both sides.

**10.** Using a sealer gun, apply sealer between the weatherstrip and the surface of the windshield.

**11.** Position a draw cord in the weatherstrip groove all around the windshield (Fig. 29) and overlap the cord about 18 inches at the lower center, taping the loose ends to the glass (Fig. 30).

**12.** Apply a heavy bead of sealer around the body windshield opening flange, and then apply a rubber lubricant to the weatherstrip. Position the windshield assembly in the body opening.

**13.** With a helper applying hand pressure from the outside, use the draw cord to pull the lip of the weatherstrip over the body opening flange. Draw the weatherstrip lip over

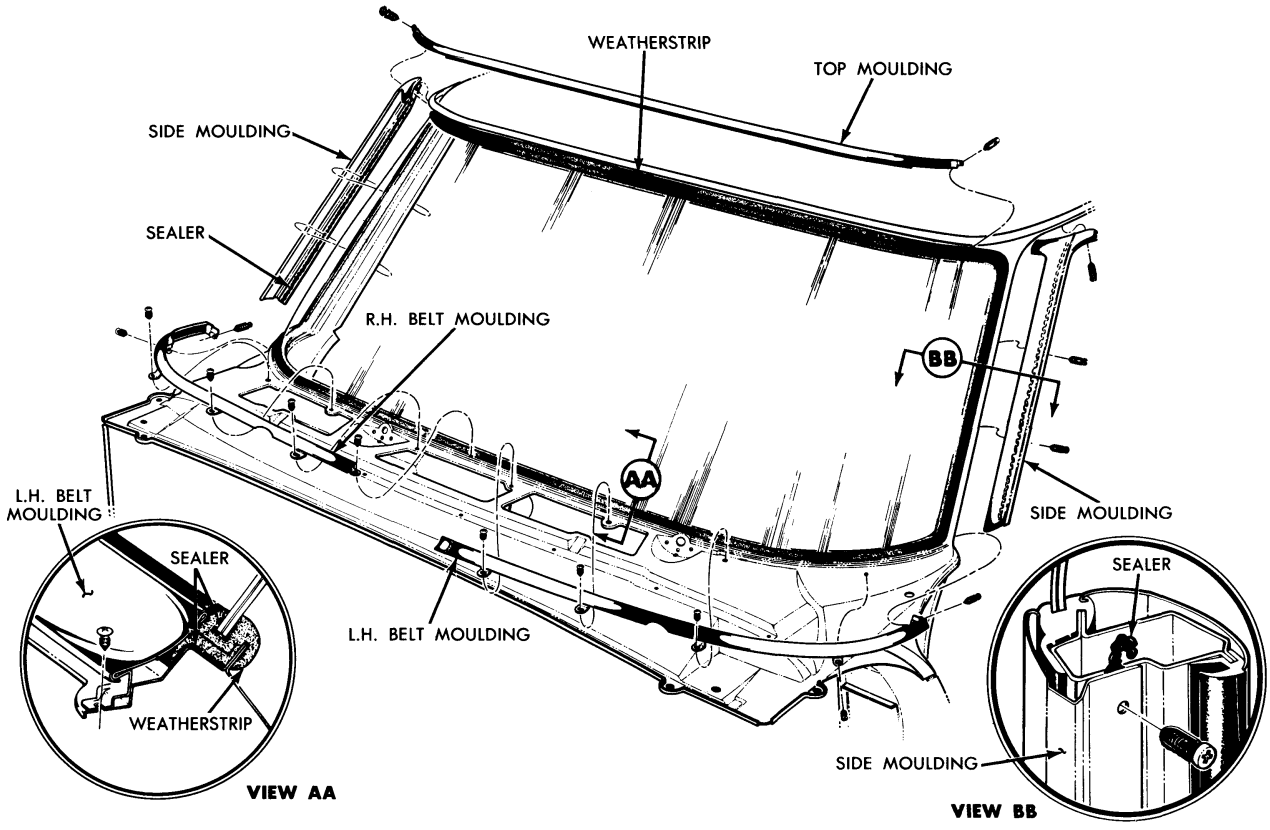



**FIG. 26—Windshield Installation—Except Convertible**

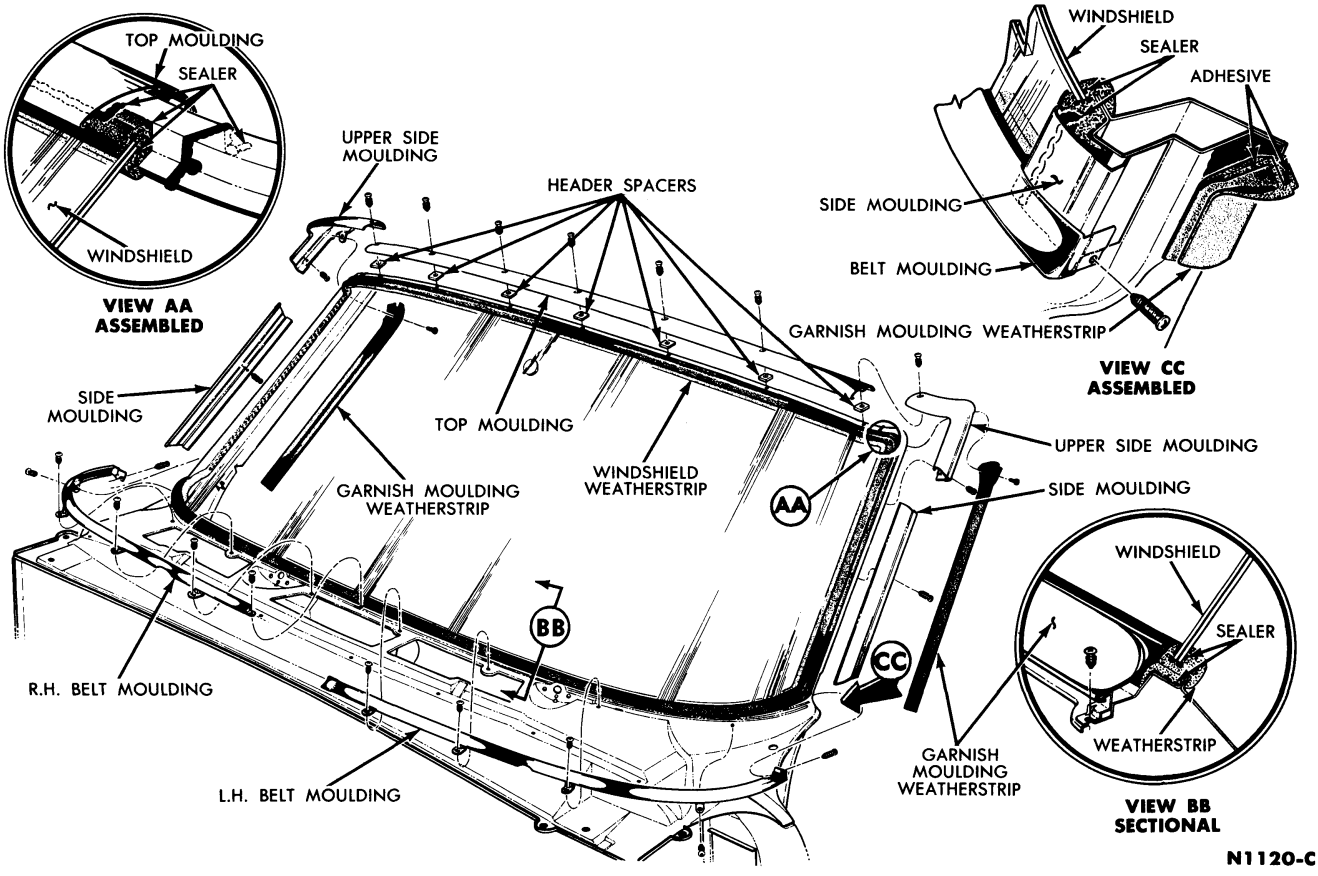



**FIG. 27—Windshield Installation—Convertible**

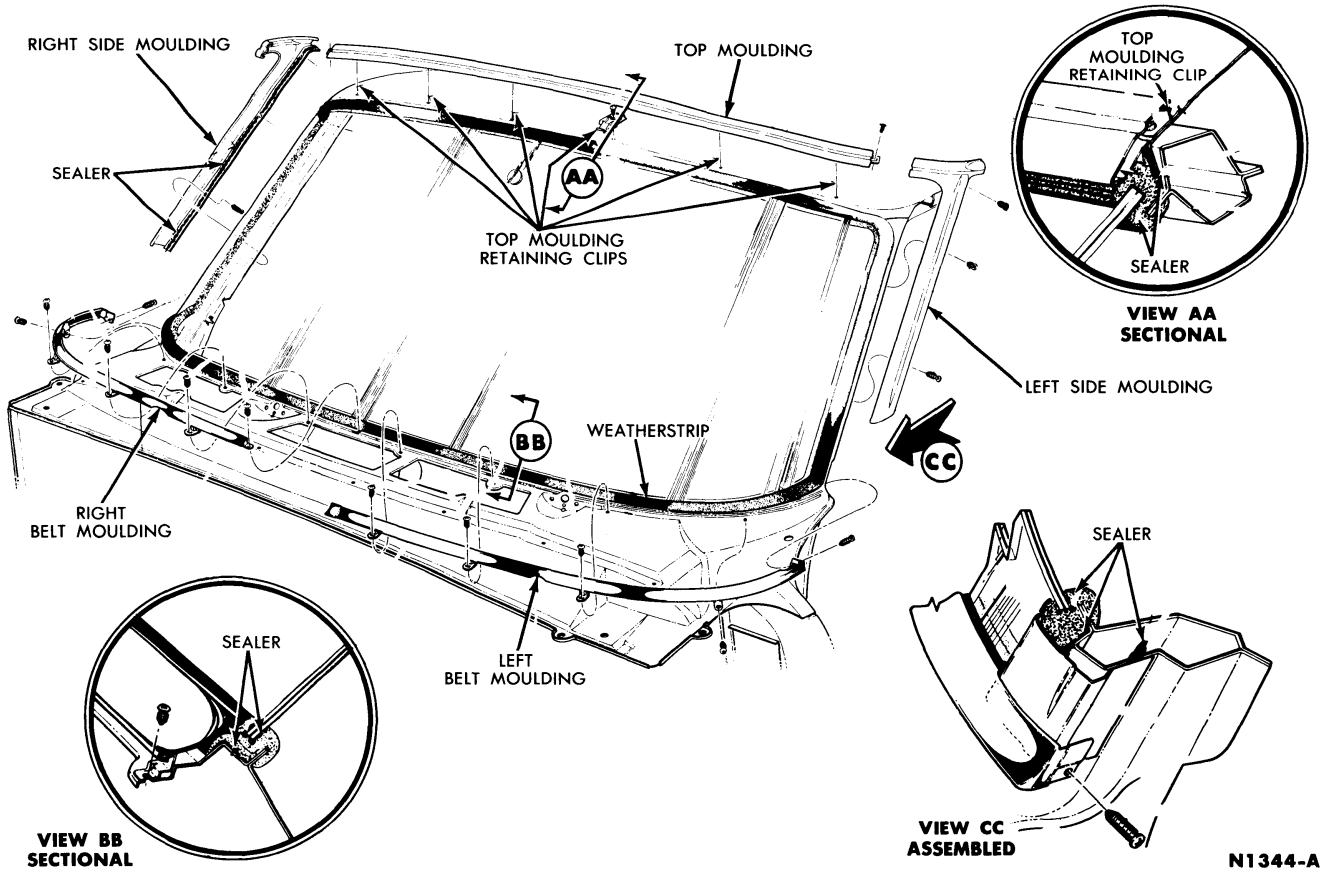



**FIG. 28—Windshield Installation—Model 63**

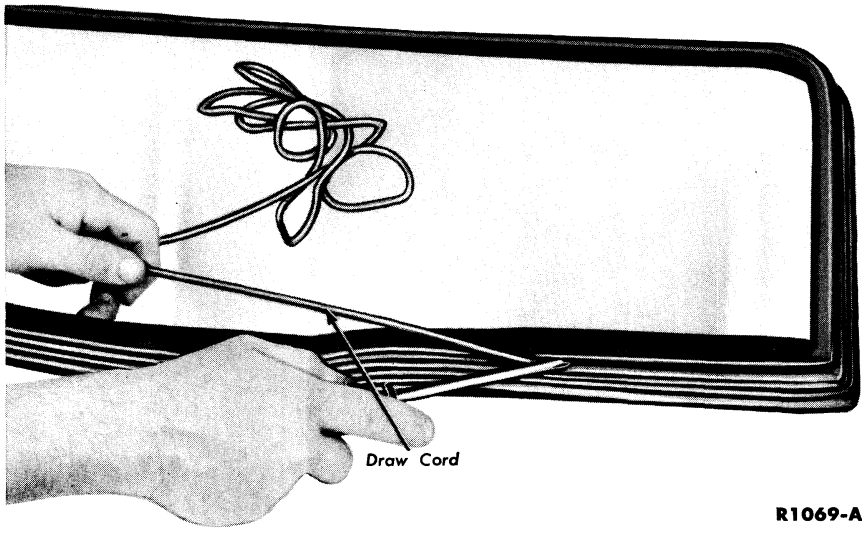



**FIG. 29—Draw Cord Installation—Typical**

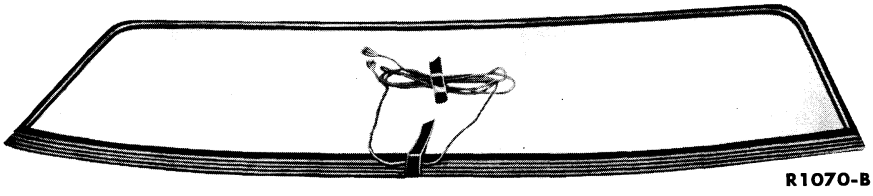



**FIG. 30—Draw Cord Installation—Typical**

the windshield opening lower flange, each side flange, and then over the upper flange.

**14.** Install the upper moulding retaining clips (model 63) and the upper moulding.

**15.** Install the lower moulding retaining screws (Figs. 26, 27 and 28).

**16.** Install the side and upper corner mouldings.

**17.** Install the windshield wiper arm and blade assemblies.

**18.** Install the garnish mouldings, sun visors, and the rear view mirror.

**19.** Check the windshield weatherstrip for leaks, and clean the windshield and mouldings.

## BACK WINDOW AND/OR WEATHERSTRIP REMOVAL AND INSTALLATION— EXCEPT MODELS 63, 57

**1.** From inside the car, loosen the weatherstrip edges, and then push out the back window, weatherstrip and mouldings as an assembly.

**2.** Unsnap the exterior mouldings from the weatherstrip (Fig. 31).

**3.** Remove the weatherstrip from the glass, and then clean the body

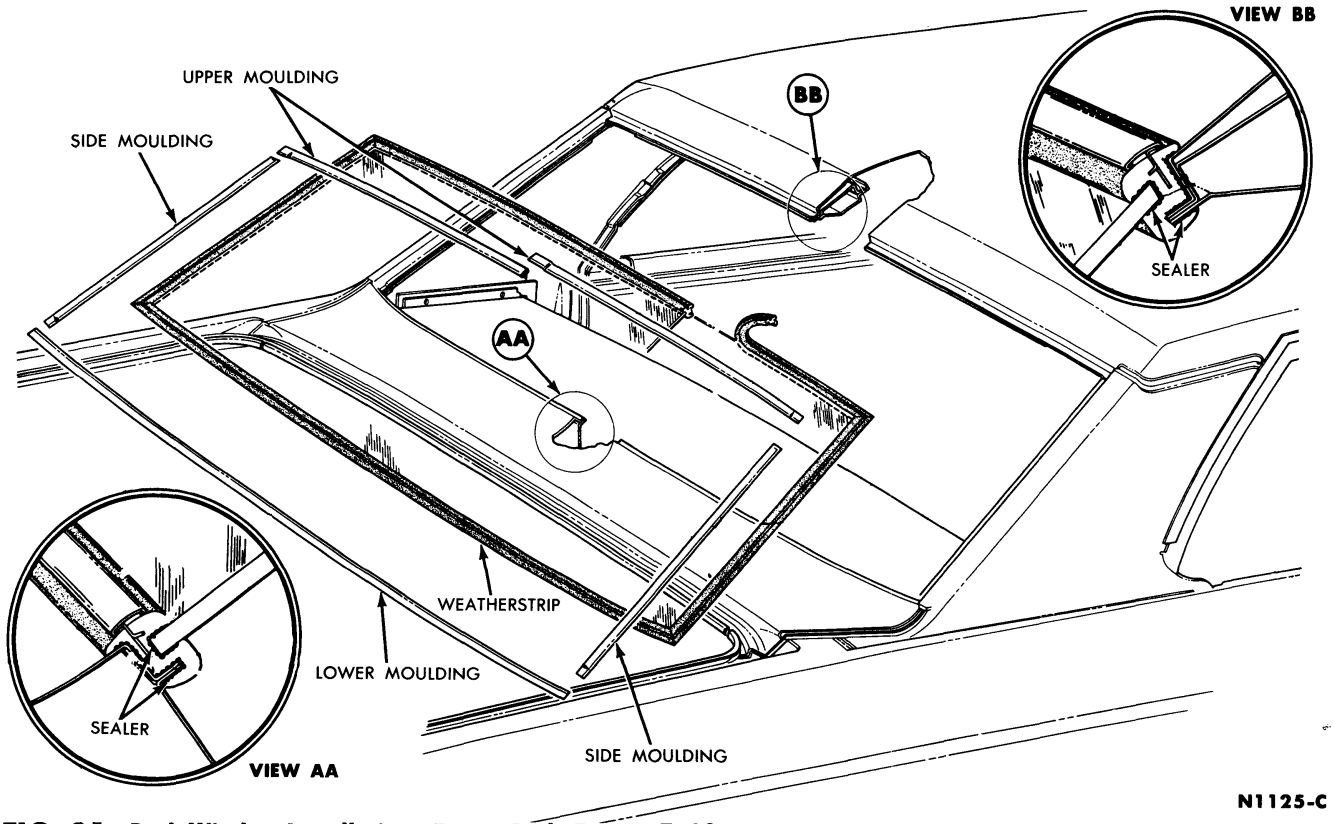



**FIG. 31—Back Window Installation—Except Body Types 57, 63**

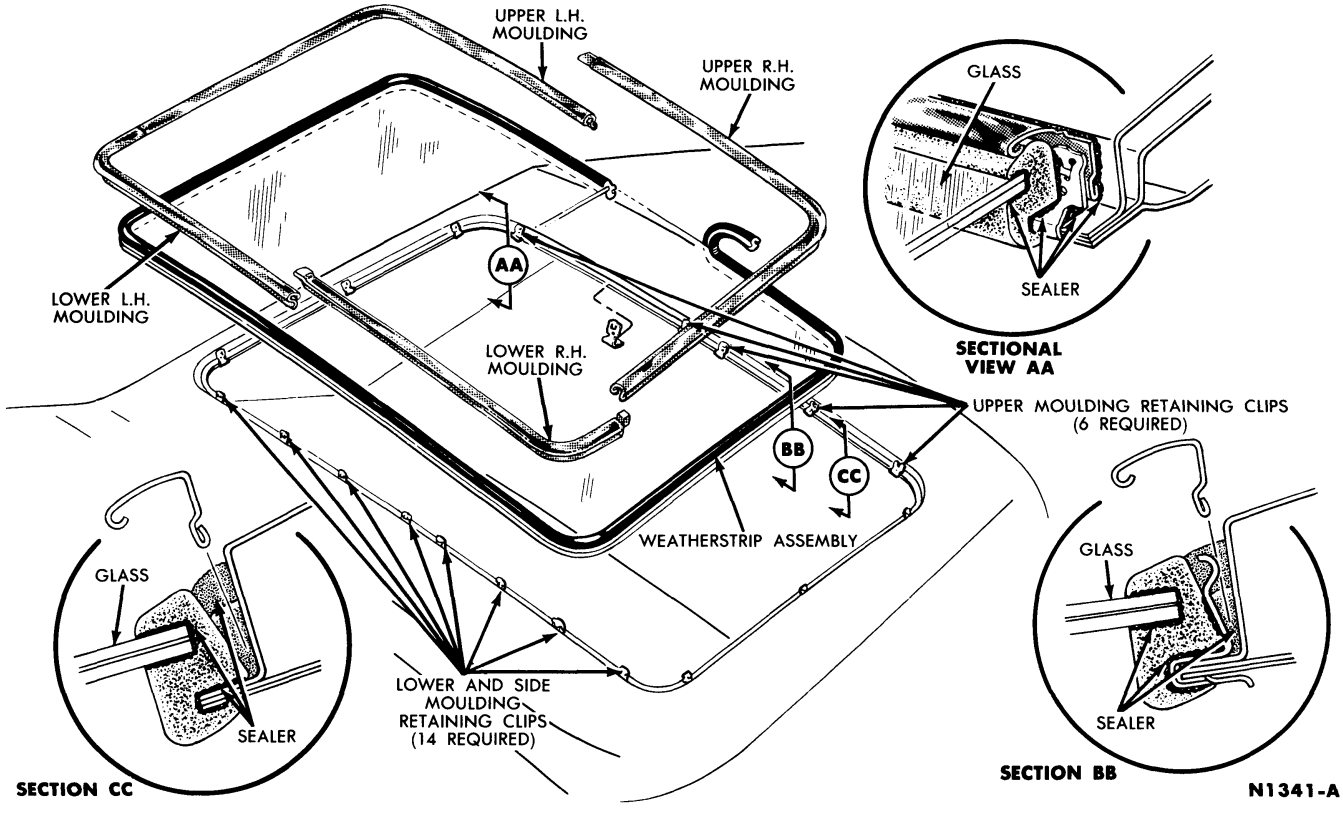



**FIG. 32—Back Window Installation—Body Types 57, 63**

window opening flange and the glass and/or weatherstrip.

4. Position the weatherstrip on the glass, and install a draw cord in the weatherstrip (Figs. 29 and 30).

5. Install the exterior mouldings in the weatherstrip (Fig. 30).

6. Use a sealer gun to apply sealer between the glass and the weatherstrip.

7. Apply a heavy bead of sealer around the body opening flange, and then apply a rubber lubricant to the weatherstrip.

8. Position the window assembly in the body opening. With a helper applying hand pressure from the outside, use the draw cord to pull the lip of the weatherstrip over the body opening flange. Draw the weatherstrip lip over the window opening lower flange, each side flange, and then over the upper flange.

## BACK WINDOW AND/OR WEATHERSTRIP REMOVAL AND INSTALLATION—MODELS 57, 63

1. With a screwdriver inserted between the exterior mouldings and the weatherstrip, pry the upper right exterior moulding loose from its retainers. In a similar manner, remove the upper left, lower right and the lower left exterior mouldings. Refer to Fig. 32 for the moulding retaining clip locations.

2. Remove the back window interior garnish mouldings.

3. From inside the car, loosen the weatherstrip edges and push out the window and weatherstrip assembly.

4. Place the glass and weatherstrip assembly on a bench and remove the weatherstrip from the glass.

5. Clean all old sealer from the body opening flange, the glass and the weatherstrip. If the old weatherstrip is torn or cracked, replace it. Replace any damaged moulding retaining clips.

6. Position the weatherstrip on the glass and install ⅛ inch sash cord in the weatherstrip groove all around the glass (Fig. 28 and Fig. 29).

7. Using a sealer gun, force sealer between the weatherstrip and the outside of the glass.

8. Apply a heavy bead of sealer around the body opening flange and apply a rubber lubricant to the weatherstrip.

9. Position the window and weatherstrip assembly in the body opening. With a helper applying hand pressure from the outside, use the draw cord to pull the lip of the weatherstrip over the window opening lower flange, each side flange and then over the upper flange.

10. Snap the exterior mouldings over their respective retaining clips in the reverse order of removal.

11. Test for water leaks. Apply additional sealer around the outer edge of the weatherstrip, if necessary.

12. Install the interior garnish mouldings.

## RETRACTABLE REAR WINDOW OR MOTOR REMOVAL AND INSTALLATION—MERCURY

### REMOVAL

1. Remove the seat cushion and the seat back.

2. Remove the two screws from each division bar moulding and remove the two mouldings.

3. Remove the six screws from the lower garnish moulding and remove the moulding.

4. Remove the six cap screws that secure the seat back support (Fig. 33) to the body and remove the support.

5. Remove the five screws that secure the inner weatherstrip to the cover and remove the weatherstrip.

6. Remove the eleven screws that secure the cover to the housing and remove the cover.

7. Remove the two nuts that attach the window side channel to one side of the housing (Fig. 34).

8. Remove the hairpin clip from each of the rollers in the glass channel.

9. Press the regulator arms to the rear to free them from the two rollers.

10. Lift the side channel off the two studs and allow the window to slide to the lower end of the channels.

11. Remove the window from the housing.

12. Working from inside of the luggage compartment, disconnect the motor wires from the main harness.

13. Remove the four cap screws that secure the regulator to the housing.

14. Slide the regulator arm and roller out of the equalizer bracket.

15. Turn the motor shaft coupling manually until the regulator gear is free of the pinion.

16. Remove the two nuts that secure the motor to the regulator and disconnect it from the shaft coupling.

### INSTALLATION

1. Engage the motor shaft to the coupling and secure the motor to the regulator with two nuts and lock washers.

2. Compress the regulator arm until the large gear contacts the pinion. Then, rotate the motor coupling manually until the gear is in the approximate position shown in Fig. 34.

3. Lubricate the equalizer bracket with Lubriplate or equivalent.

4. Connect the equalizer arm and roller on the regulator to the equalizer arm bracket.

5. Working from inside the luggage compartment, secure the regulator to the housing with four cap screws.

6. Connect the motor wires to the main harness.

7. Lubricate the window channel roller surface with Lubriplate or equivalent. Install the hairpin clip in each roller and install the two roller assemblies in the channel.

8. Insert the glass in the lower end of the side channels and carefully raise it into place. Insert the two regulator pins into the rollers. Make sure the hair pin clips snap into the retaining groove of the pins.

9. Secure the lower end of the side channel to the housing with two nuts.

10. Coat the housing flange (Fig. 34) with sealer. Secure the cover to the housing with eleven screws.

11. Secure the inner weatherstrip (Fig. 33) to the cover with five screws. Make sure that the weatherstrip contacts the window before tightening the screws.

12. Secure the seat back support to the body with six cap screws.

13. Secure the lower garnish moulding with six screws.

14. Secure each division bar moulding with two screws.

15. Install the seat back and the cushion.

## STATIONARY BACK WINDOW OR SIDE GLASS REMOVAL AND INSTALLATION —MERCURY

### REMOVAL

1. Remove the upper outside moulding from the six retaining clips (Fig. 35).

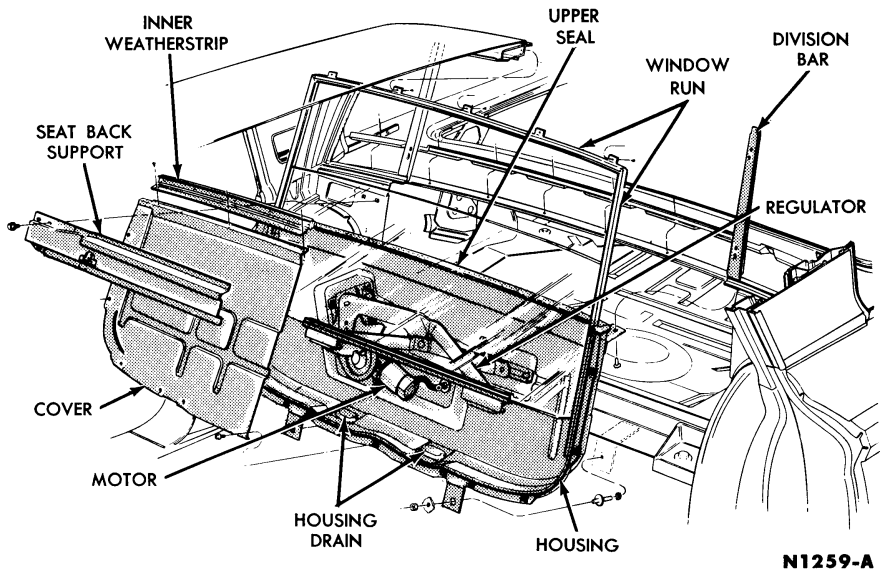



**FIG. 33—Retractable Rear Window Installation**

**2.** Remove the six moulding retaining clips.

**3.** Remove the two attaching screws from each side moulding and remove them.

**4.** Carefully pry the lower moulding and clips from the retainer. Remove the retainer attaching screws and lift the retainer from the body.

**5.** Remove the inside division mouldings if working on a car equipped with a retractable back window. Working from the inside of the car, remove the two cap screws that attach each division bar outside moulding. Remove the division bar mouldings.

**6.** Remove the lower garnish moulding attaching screws and remove the corners.

**7.** Remove the attaching screws from the two upper garnish mouldings and the joint. Remove the mouldings.

**8.** Working from the inside of the car, carefully press the glass outward to remove it from the flange.

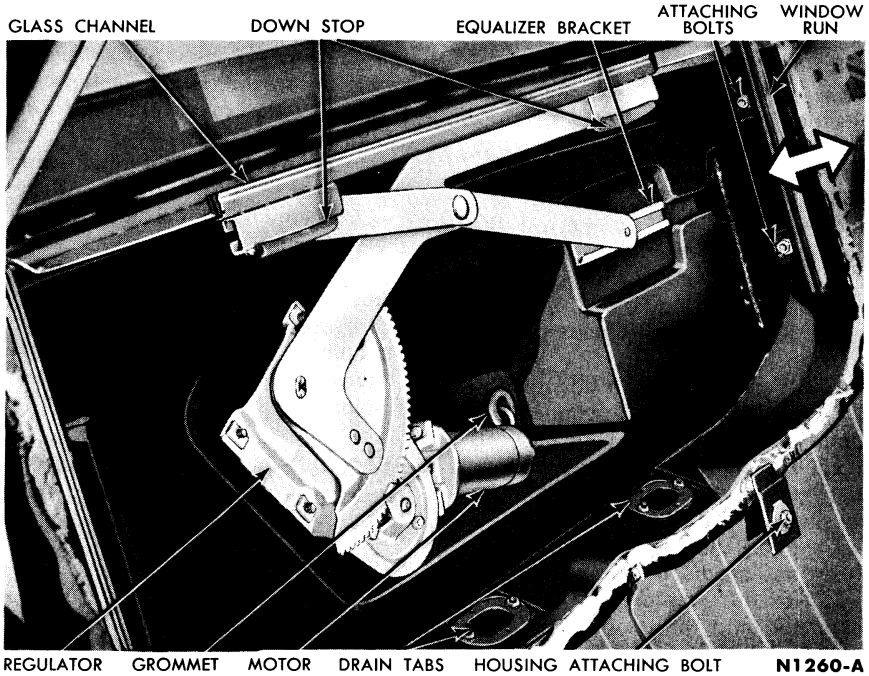



**FIG. 34—Retractable Rear Window Motor and Regulator**

**9.** Remove the weatherstrip from the glass.

**10.** Clean all of the sealer from the weatherstrip.

### INSTALLATION

**1.** Apply a film of sealer around the edge of glass and in the glass channel of the weatherstrip.

**2.** Install a piece of chalk line cord in the flange groove of the weatherstrip. Make sure that the ends of the cord overlap each other.

**3.** Apply a film of sealer around the window opening as shown in Fig. 36.

**4.** With an assistant pressing the glass and weatherstrip against the flange, draw the cord upward to lift the weatherstrip over the flange. This procedure applies to the side glass as well as a solid window.

**5.** If working on a retractable window, install the division bar outside mouldings and secure them with two cap screws.

**6.** Install the two upper garnish mouldings and joint (Fig. 37).

**7.** Install the moulding lower corners.

**8.** Install the two division bar mouldings.

**9.** Install the two division bar inside mouldings.

**10.** Apply a film of sealer on the weatherstrip retainer surface. Position the retainer against the weatherstrip and install the attaching screws.

**11.** Apply sealer to the lower moulding retainer clip holes and install the moulding.

**12.** Install the upper moulding retainer (Fig. 35). Install the upper moulding.

**13.** Install the two side mouldings.

**14.** Clean the glass.

## TAILGATE GLASS REMOVAL AND INSTALLATION

**1.** Open the tailgate and remove the trim panel with the skid strips attached.

**2.** Carefully remove the water shield enough to reveal the tailgate access holes and remove the cover from the large access hole.

**3.** Roll the window up approximately 6 inches and remove the glass lower channel retaining clips. Disconnect the regulator arms from the glass lower channel and remove the glass.

**4.** With a tool similar to the one shown in Fig. 19, remove the lower channel from the glass.

**5.** Install the new glass tape around

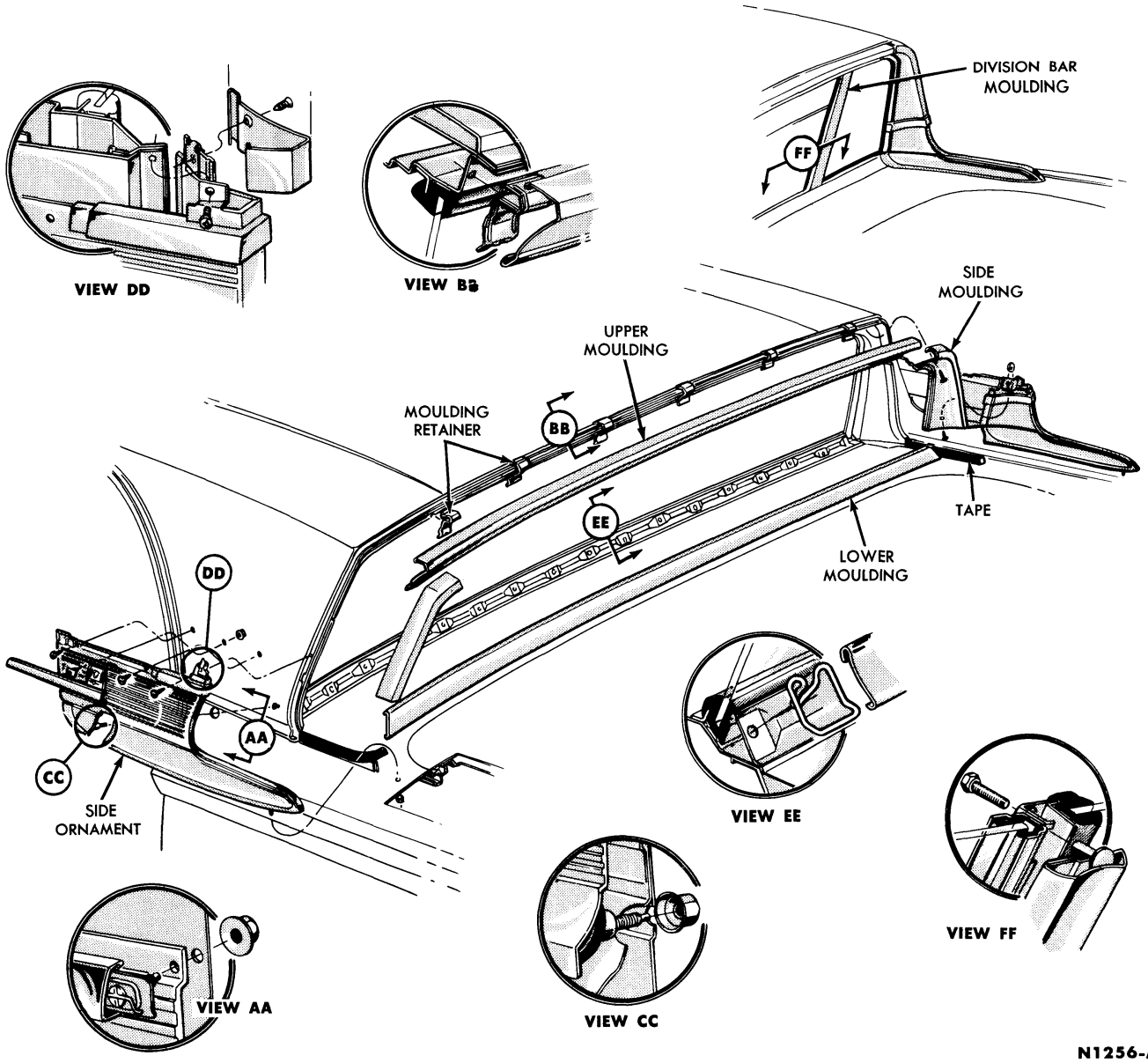



**FIG. 35—Back Window Exterior Moulding Installation—Mercury**

the glass, and install the lower channel.

**6.** Place the glass channel rollers, with the retaining clips installed, in the glass lower channel. Position the glass in the tailgate runs and install the regulator arms in the rollers.

**7.** Roll down the window, and check and align the glass.

**8.** Install the access hole cover, water shield, and the tailgate trim panel.

### TAILGATE WINDOW REGULATOR REMOVAL AND INSTALLATION

**1.** Remove the window.

**2.** Remove the regulator retaining bolts (Fig. 12).

**3.** On a manual window regulator, lift the regulator from the handle and remove the regulator.

**4.** On a power window regulator, disconnect the motor wires at the tailgate wiring harness and remove the regulator with the motor attached. **Do not remove the electric regulator drive assembly for transfer to the new regulator until the regulator counterbalance spring is unloaded.** To unload the regulator counterbalance spring, place the spring in a vise so that the spring can not unwind, disconnect the spring from the outer retaining tab, and then slowly loosen the vise jaws.

**5.** Remove the screws retaining the regulator drive assembly and the motor to the regulator and remove the drive assembly and motor.

**6.** Position the drive assembly and motor to the new regulator and install the retaining screws.

**7.** Drill out the rivets retaining the manual clutch gear and housing assembly to the regulator. Remove and discard the manual drive assembly. **The manual clutch and gear assembly should not be removed until the electric drive gear assembly is installed.**

**8.** Position the regulator to the tailgate and loosely install the regulator retaining bolts.

**9.** Install and adjust the tailgate window. Tighten the regulator retaining bolts.

**10.** Install the tailgate trim.

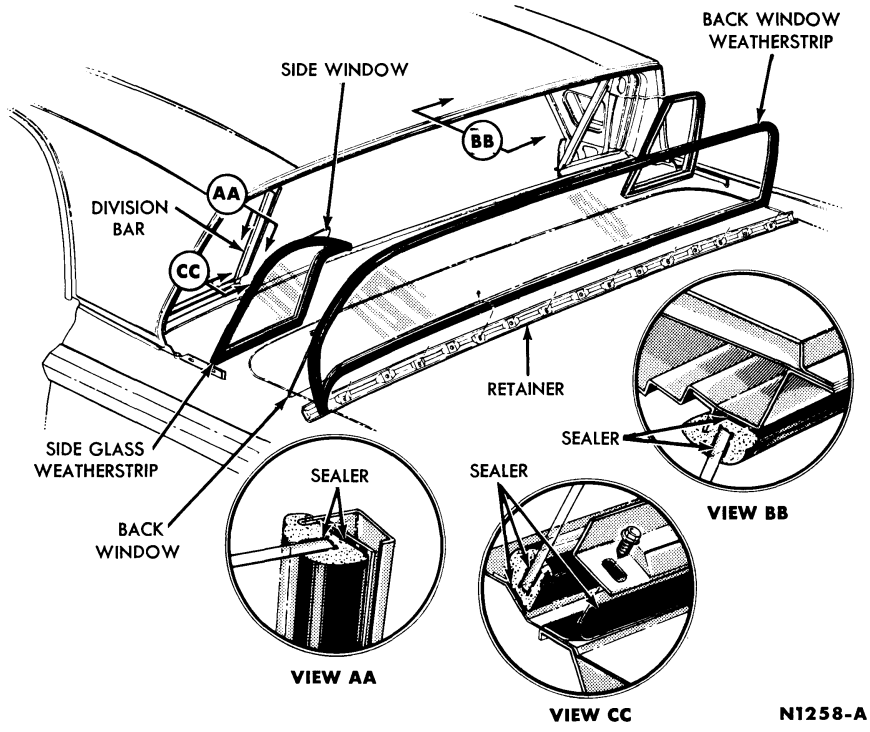



**FIG. 36—Back Window Weatherstrip Installation**

## TAILGATE REGULATOR MOTOR REMOVAL AND INSTALLATION

1. Remove the tailgate trim panel, and pull back the water shield enough to reveal the motor access hole.

2. If the motor failed with the glass in the down position, disconnect the regulator arms from the glass channel (Fig. 12) and remove the glass. Disconnect the motor wires from the tailgate wiring harness.

3. Remove the nuts retaining the motor to the drive assembly, and then remove the motor with the drive coupling.

4. Transfer the drive coupling to the replacement motor.

5. Route the motor wires between the tailgate inner and outer panels and install the motor and drive coupling to the drive assembly.

6. Connect the motor wires to the tailgate wiring harness.

7. Install the tailgate window, if required.

8. Install the water shield and the trim panel.

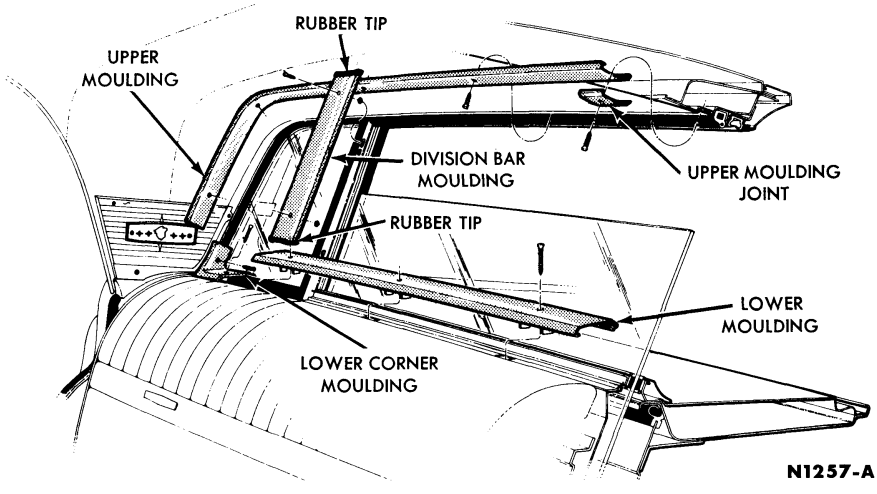



**FIG. 37—Interior Moulding Installation**

## TAILGATE SWITCH AND LOCK CYLINDER REMOVAL AND INSTALLATION

1. Remove the window from the tailgate.

2. Remove the regulator.

3. To remove the switch, remove the switch retaining nuts and disconnect the switch wire connectors.

4. To remove the lock cylinder, remove the switch retaining nuts and place the switch to one side. Insert the key in the lock cylinder, depress the lock cylinder retaining pin, rotate the key clockwise in the lock cylinder until the retaining pin drops, and then remove the lock cylinder.

5. To install the lock cylinder, insert the key in the lock cylinder and slide the cylinder into the retainer. It may be necessary to rotate the lock cylinder to align it with the switch. Install the switch retaining nuts.

6. To install the switch, route the switch wires between the tailgate outer and inner panels, connect the wires and install the switch retaining nuts. It may be necessary to rotate the lock cylinder to align it with the switch.

7. Install the window regulator.

8. Install the tailgate window and trim.

## TAILGATE WINDOW HANDLE REMOVAL AND INSTALLATION AND LOCK CYLINDER

1. Remove the tailgate window as previously described under "Glass Removal and Installation."

2. Remove the tailgate window regulator (Fig. 12).

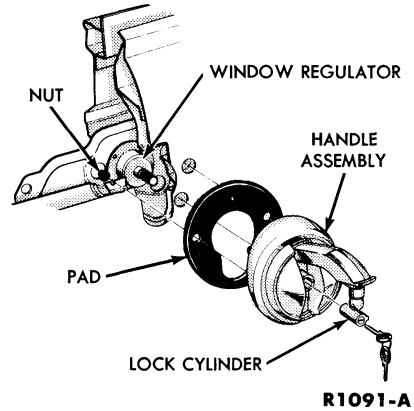



**FIG. 38—Tailgate Handle Assembly**

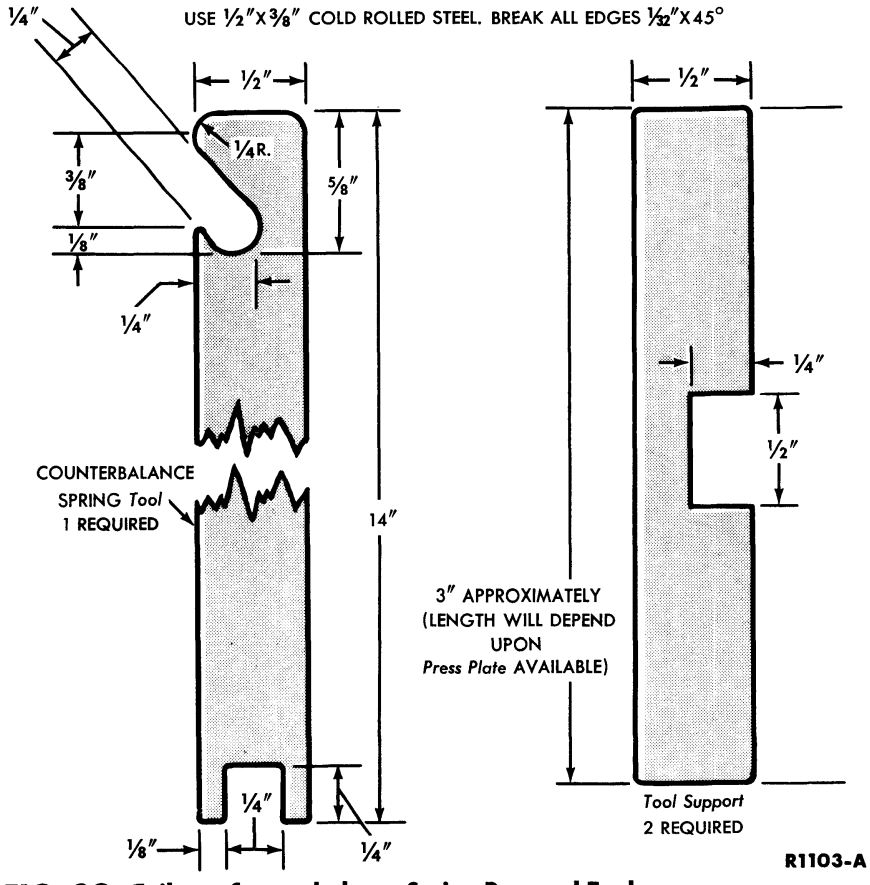



**FIG. 39—Tailgate Counterbalance Spring Removal Tool**

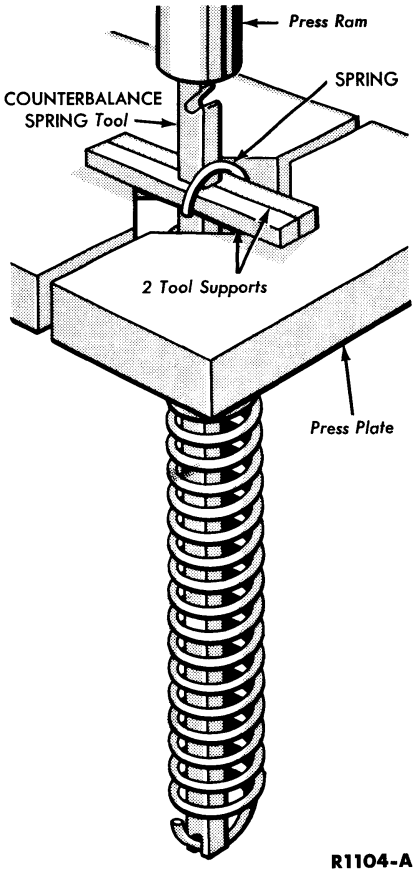



**FIG. 40—Spring Installation**

3. Remove the handle assembly retaining nuts, and remove the handle assembly and pad from the tailgate (Fig. 38).

4. To remove the lock cylinder, insert the key, depress the lock cylinder retaining pin, rotate the cylinder until the retaining pin drops, and then remove the lock cylinder.

5. To install the lock cylinder, insert the key in the lock cylinder and slide the cylinder into the retainer.

6. Install the handle assembly, regulator, and tailgate window.

## TAILGATE WINDOW INSTRUMENT PANEL SWITCH REMOVAL AND INSTALLATION

1. From under the instrument panel, disconnect the tailgate window switch wire connector from the switch.

2. Remove the switch retaining nut and bezel from the instrument panel, and then remove the switch.

3. Position the switch on the instrument panel and install the bezel and retaining nuts.

4. Connect the wire connector to the switch and check the switch operation.

## LIMIT SWITCH REMOVAL AND INSTALLATION

1. Open the tailgate and remove the limit switch retaining screws.

2. Pull the limit switch from the pillar and disconnect the wires at the connector.

3. Connect the switch wires and install the switch.

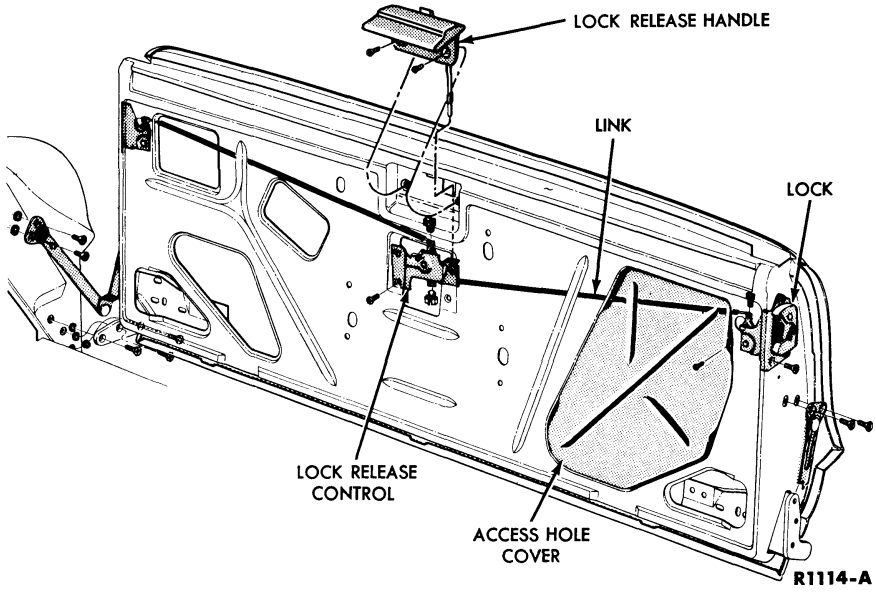



**FIG. 41—Tailgate Lock Mechanism**

## TAILGATE COUNTERBALANCE SPRING AND STRAP REMOVAL AND INSTALLATION—FORD

### REMOVAL

1. Open the tailgate and raise the car on a hoist.

2. Position a fabricated counterbalance spring tool similar to the one shown in Fig. 39 into the spring. Be sure the spring strap and bracket are between the tool and the open ends of the spring.

3. Close the tailgate and seat the spring ends on the tool. Disconnect the spring from the strap and hanger, and remove the spring and tool.

4. Remove the counterbalance spring strap from the tailgate bracket, if necessary.

### INSTALLATION

1. Install the counterbalance spring strap, if it was removed.

2. If a new spring is to be installed, place the counterbalance spring tool supports, tool (Fig. 39), and spring in a press and expand the spring until the upper end can be inserted into the tool notch (Fig. 40). With the spring ends securely seated on the tool, release the press.

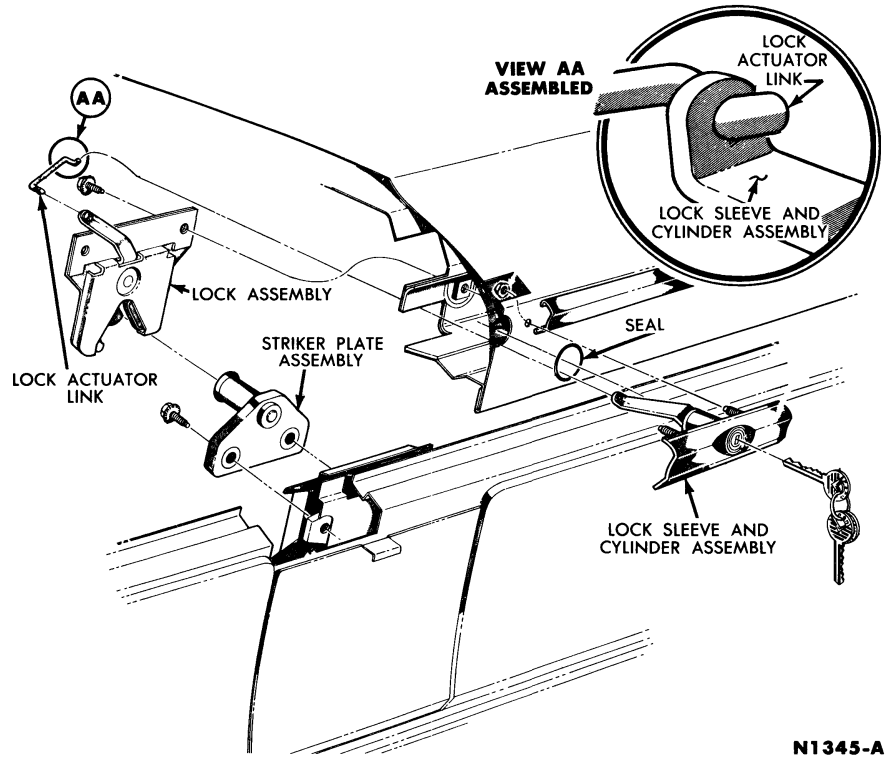



**FIG. 42—Deck Lid Lock Cylinder Installation—Ford**

3. Install the spring and tool to the strap and bracket, open the tailgate to expand the spring, and then remove the tool.

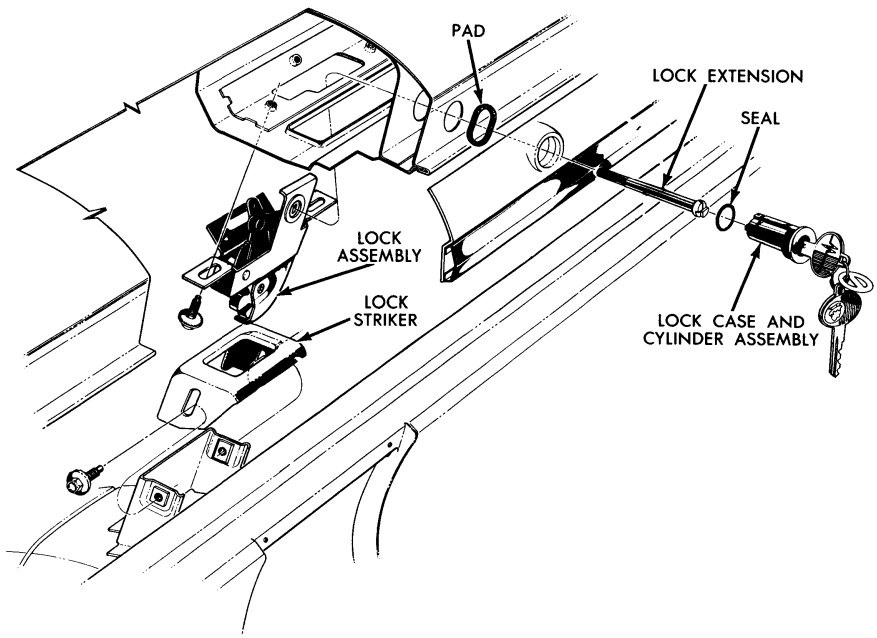



**FIG. 43—Deck Lid Lock Cylinder Installation—Mercury**

## TAILGATE HINGE REMOVAL AND INSTALLATION—FORD

1. Disconnect the tailgate counterbalance spring from the spring strap.
2. Remove the tailgate trim panel, and pull back the water shield to reveal the lower access holes.
3. With the tailgate open, extend the window enough to gain access to the hinge mounting bolts, and remove the hinge-to-tailgate mounting bolts.
4. Remove the hinge - to - body mounting bolts.
5. Remove the hinge rubber dust cover from the side of the tailgate.
6. Pull the end of the tailgate out slightly, and remove the hinge.
7. Position the hinge to the tailgate and snugly tighten the mounting bolts.
8. Check and adjust the tailgate alignments, and tighten the hinge mounting bolts.
9. Install the hinge dust cover, tailgate water shield, and trim panel.
10. Roll down the tailgate window, and then install the tailgate counterbalance spring.

## TAILGATE LOCK REMOVAL AND INSTALLATION

1. Open the tailgate. It may be necessary while the tailgate is closed

to remove the tailgate trim panel and water shield to actuate the tailgate lock mechanism.

2. With the tailgate open, remove the window and glass channel assembly.

3. Mark the tailgate window lower run mounting locations, remove the run upper mounting bolt, and loosen the lower bolt.

4. Disconnect the link at the lock.

5. Remove the lock retaining screw and the lock.

6. Install the lock and connect the link. The link can be adjusted at the lock release control end.

7. Install the window lower run.

8. Install the window and tailgate trim.

### TAILGATE LOCK RELEASE HANDLE REPLACEMENT

1. Open the tailgate, remove the trim panel, and pull back the water shield to reveal the lock release control.

2. Remove the lock release handle retaining screw (Fig. 41).

3. With the tailgate open, crank the window to its extended position and support the window.

4. Remove the lock release control retaining screws, move the control away from the handle, and remove the lock release handle.

5. Install the lock release handle, insert the handle actuating rod into the lock release control, and install the release control.

6. Retract the tailgate window.

7. Install the water shield and trim panel.

### LOCK RELEASE CONTROL REMOVAL AND INSTALLATION

1. Remove the tailgate trim panel, pull back the water shield, and remove the access hole cover.

2. Disconnect the lock links at the lock release control (Fig. 41), remove the control retaining screws, and remove the lock release control.

3. Install the lock release control and connect the lock links.

4. Install the access hole cover, water shield, and tailgate trim panel.

### DECK LID REMOVAL AND INSTALLATION

New deck lids are furnished in prime paint without hardware. All usable hardware parts should be removed from the old deck lid so they can be installed in the new one.

Before the old deck lid is removed and disassembled, time will be saved if the new one is prepared for installation. Inspect the new deck lid for dings and other minor damage, repair as necessary, and sand and paint it. While it is drying, remove and disassemble the old lid. When the new lid is dry, install the hardware.

1. Remove all serviceable hardware.

2. Remove the hinge attaching bolts from the deck lid, and lift it off the hinges.

3. Position the lid and install the attaching bolts loosely.

4. Close the lid gently to check the fit.

5. Adjust the deck lid and hinges for proper fit.

6. Adjust the striker plate.

### DECK LID HINGE OR TORSION BAR REMOVAL AND INSTALLATION

1. Prop the deck lid open.

2. Mark the hinge position on the lid and on the mounting bracket for reference when a new hinge is installed.

3. Using a torsion bar adjusting tool T64K-44890-A, pry the anchor end of the torsion bar out of its adjustment notch (Fig. 16). Lower the deck lid and from inside the luggage compartment remove the bar. Prop the deck lid open.

4. Position a cover under the hinge edge of the deck lid to prevent paint damage. Remove the hinge attaching bolts from the deck lid and from the mounting bracket, and remove the hinge.

5. Position the hinge, and partially tighten the mounting bolts.

6. Remove the protective cover and install the torsion bar, reversing the procedure in step 3. The farther rearward the anchor end is twisted, the greater the tension.

7. Remove the prop and check the lid position. After any necessary adjustment, tighten the hinge attaching bolts.

### DECK LID LOCK REMOVAL AND INSTALLATION

1. Unlock and open the deck lid.

2. Remove the bolts retaining the lock assembly and remove the lock. On Ford models, transfer the lock actuator link to new lock assembly.

3. Position the lock assembly to the deck lid and loosely install the retaining bolts.

4. Adjust the lock assembly and tighten the bolts.

### DECK LID LOCK CYLINDER REMOVAL AND INSTALLATION

1. Open the deck lid and remove the deck lid moulding assembly.

2. Remove the sleeve and cylinder assembly (Fig. 42 and Fig. 43).

3. To remove the lock cylinder from the sleeve assembly, turn the key clockwise in the cylinder ⅛ turn, depress the cylinder retaining pin, and remove the key and cylinder.

4. Reverse the procedure to install the lock cylinder.

# TRIM, SEATS, AND CONVERTIBLE TOP

# GROUP 18


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**PART 18-2**
SEATS ..... 18- 9

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**PART 18-3**
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# PART 18-1 INTERIOR TRIM AND LANDAU TOP COVER


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| 2 | Roof Trim Panel and Headlining | 18- 2 |
| 3 | Instrument Panel Pad | 18- 4 |
| 4 | Console | 18- 5 |
| 5 | Landau Top Cover | 18- 6 |


## 1 DOOR AND QUARTER TRIM PANELS

### REMOVAL AND INSTALLATION

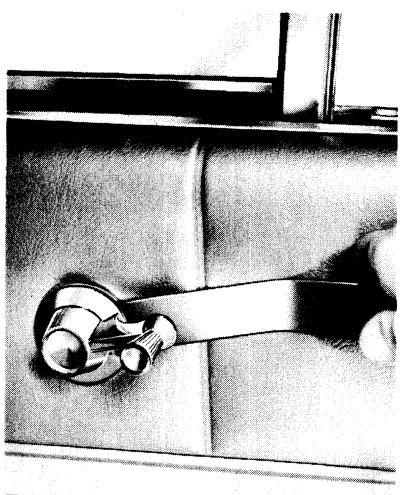
Basically, all door and quarter panels are retained in the same manner. In view of this, one removal and installation procedure will cover all models.

**1.** Unscrew the door lock push button.

**2.** Remove the door remote control and window regulator handles (Fig. 1).

**3.** Remove any screws retaining the trim panel to the inner panel, such as the arm rest retaining screws. On a car with arm rests, remove the arm rests.

**4.** With a putty knife, pry the trim panel retaining clips out of the inner panel at each side.



N1015-B

**FIG. 1—Handle Removal**

**5.** Lift the trim panel out of the lower retainer, remove the handle shaft springs, and carefully loosen the plastic water shield, if necessary. If the door has electric windows, disconnect the door switch wire connector from the switch.

**6.** Place a daub of AB-19560-A sealer over each trim retaining clip hole to seal the retaining clips when they are pushed into the door. Also, apply this sealer around the door handle, regulator shafts, and other existing holes.

**7.** If the door has electric windows, connect the switch wires. Fasten the plastic water shield to the inner panel with C2AZ 19C525-A cement (Figs. 2 and 3). Install handle shaft springs.

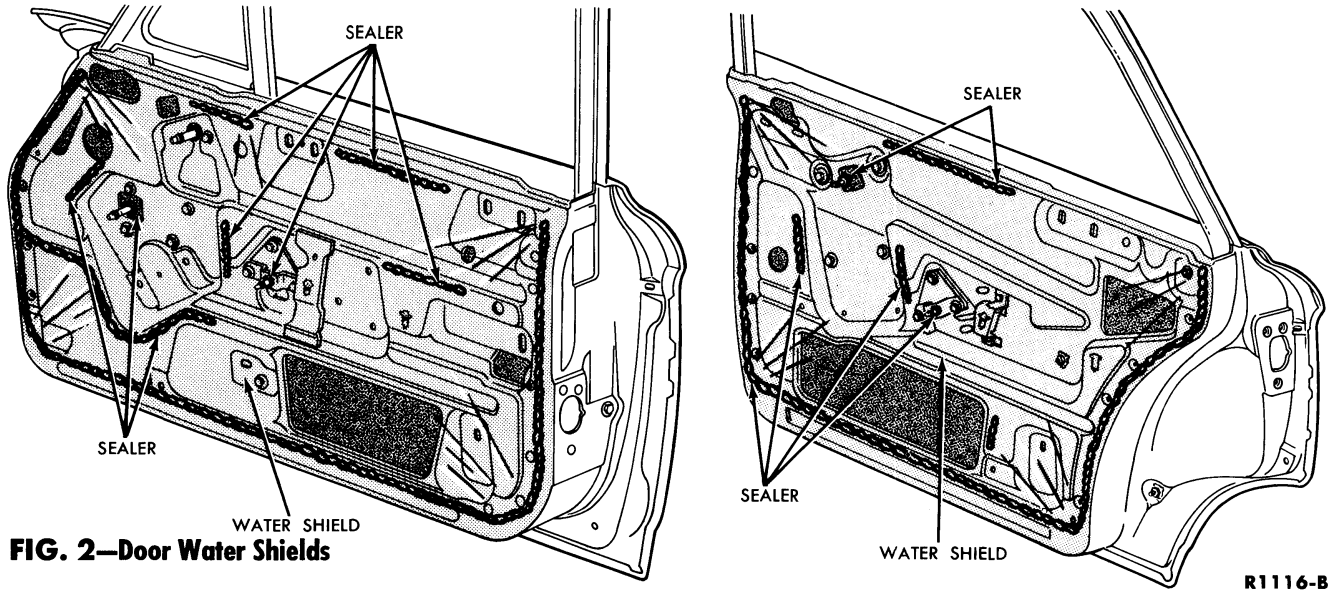



**FIG. 2—Door Water Shields**

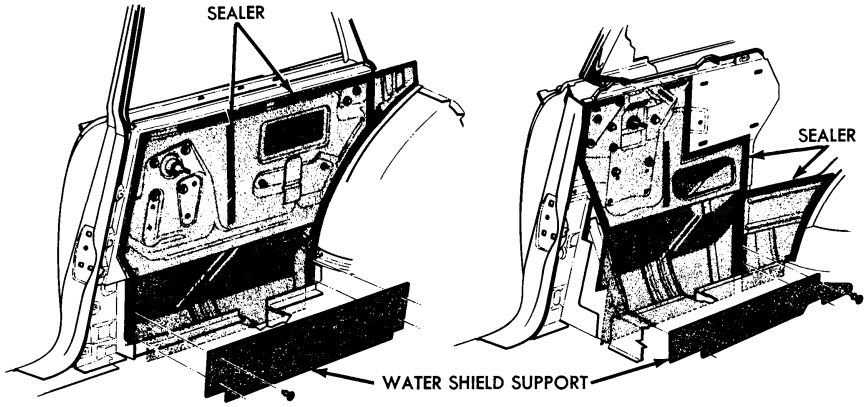



**FIG. 3—Quarter Panel Water Shields**

**8.** Make sure all the retaining clips are installed in the trim panel, place the upper portion of the door trim panel over the top edge of the door inner panel and position the lower edge of the trim panel in the retainer, and push the retaining clips into the holes in the door inner panel.

**9.** Install retaining screws (if previously removed).

**10.** Insert the spring clip in the handle(s), place the friction plate against the trim panel and push the handle onto the shaft until the spring clip snaps into the groove.

**11.** Screw the door lock push button on the rod.

## 2 ROOF TRIM PANEL AND HEADLINING

### ROOF TRIM PANEL

#### REMOVAL AND INSTALLATION

The station wagon roof trim panel can be replaced without removing the adjacent roof trim panels.

**1.** If the front roof trim panel is to be replaced, remove the sun visors, windshield side and upper garnish mouldings, and the rear view mirror if necessary.

**2.** If the rear roof trim panel is to be replaced, remove the dome lamp assembly, and the back window pillar and upper garnish mouldings.

**3.** To remove a trim panel, carefully pry the trim panel retainer(s) from the support(s) (Fig. 4) and remove the retainer(s) and end caps. **Identify the roof trim panel retainers since they vary in size and shape.** Remove the roof trim panel.

**4.** Install the roof trim panel, and all previously removed hardware (Fig. 4).

### HEADLINING

#### REMOVAL AND INSTALLATION

The following headlining removal and installation procedure generally applies to all models. If some of the steps do not apply to the particular model being serviced, skip to the next step.

**1.** Remove the coat hooks, the quarter window garnish mouldings, the windshield and back window, side and upper garnish mouldings, and window garnish mouldings. Remove the sun visors, the rear view mirror (if required), and the dome lamp lens.

**2.** Cut the headlining along the edge of the back window weatherstrip. On models using a tacking strip, remove headlining from the tacking strip. Disconnect the headlining along the side rails. Then, starting at the front of the car, push the ends of the roof bows out of the roof side rails (Fig. 5). At the rear bow, release the two rear bow retainers from the roof rear rail, and then remove the headlining.

**3.** Check the tabs on the headlining retaining strips. If any tabs are bent or flattened, repair them and tighten the retaining strips.

**4.** Transfer the headlining bows in sequence to the new headlining. **Roof bows are color coded at each end. When ordering new roof bows, be sure to note the color at each end of the bow.**

**5.** Install the rear bow in the side rails, and connect the rear bow retainers to the roof rear rail. Install

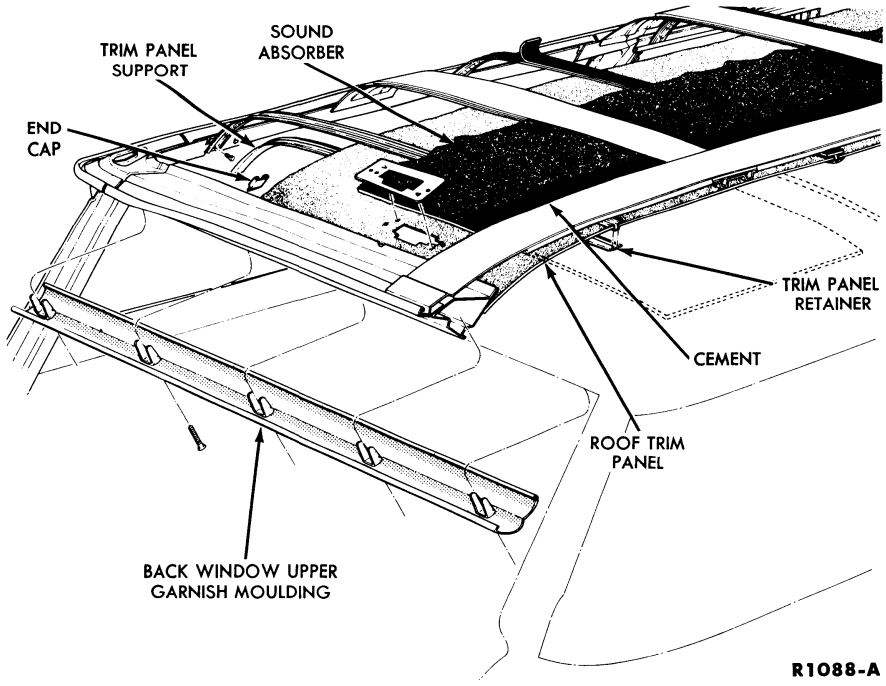



**FIG. 4—Station Wagon Roof Interior Trim**

the other headlining bows, working from the rear toward the front of the car. The headlining should be centered and the seams straight.

**6.** Apply trim cement to the back window upper rail, along the edge of the window weatherstrip. Starting at the center, smooth out the wrinkles and cement the headlining to the rear window opening.

**7.** Trim the headlining around the back window approximately ½ inch below the weatherstrip edge. Tuck the headlining under the back window weatherstrip.

**8.** If necessary, apply new cement to the tacking strip and center the headlining. Pull it as far forward as possible to remove wrinkles and tack to the tacking strip at windshield header, working from the center to the sides.

**9.** Cut off the excess material around the windshield header.

**10.** Pull the headlining down at the sides to remove the wrinkles. Cut the headlining bow retainers to eliminate gathering of the material. Trim the headlining on the sides to 1½ inch below the windlace. Starting at the front on each side of the car, use a putty knife (with rounded corners) to work the headlining up under the retaining strip. Be sure the headlining catches on the tabs.

**11.** Starting at the rear window and working forward, position all garnish mouldings and install any screws.

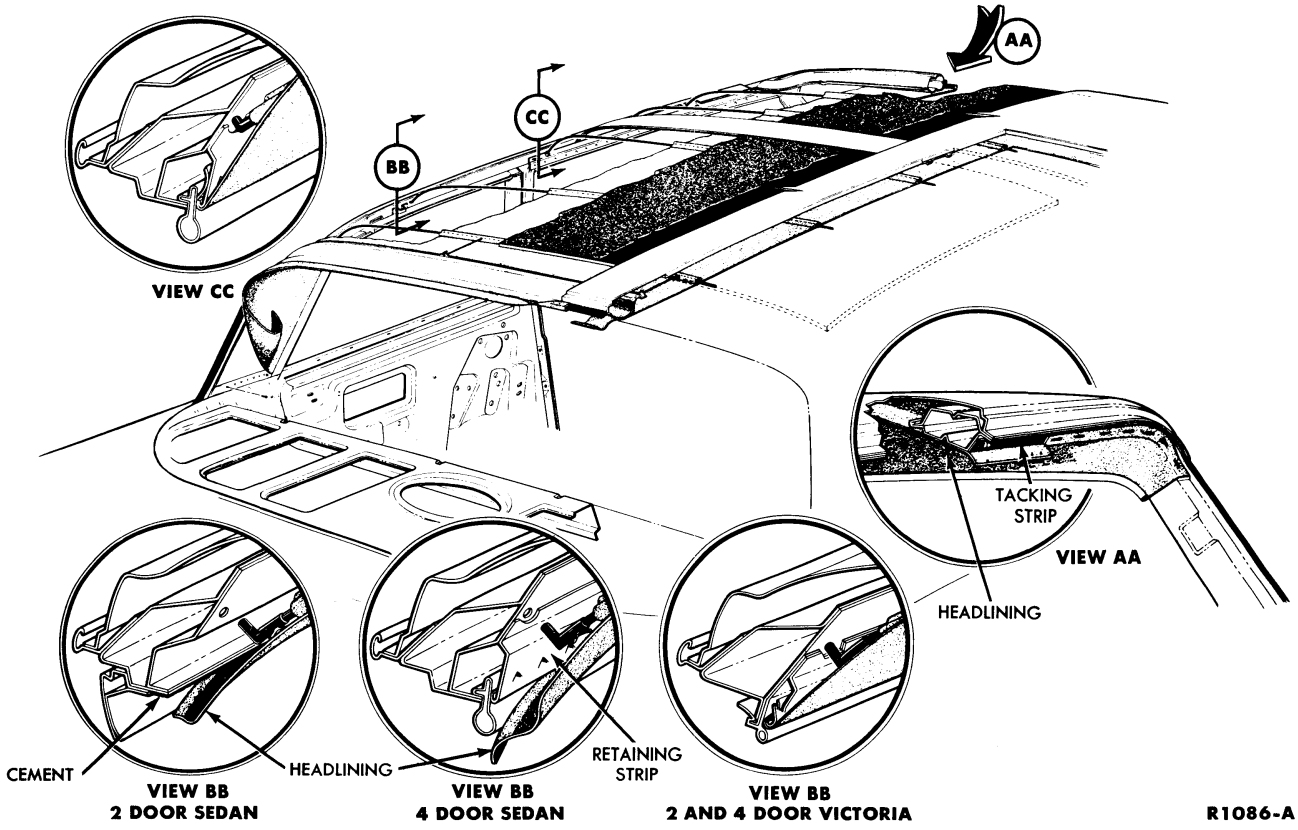



**FIG. 5—Typical Headlining**

12. Install the coat hooks and the rear view mirror (if removed).

13. Cut a hole in the headlining large enough for the dome lamp, but small enough that the dome lamp lens and bezel will cover the opening. Install the dome lamp lens.

14. Locate and punch the sun visor retaining screw holes in the headlining. Install the sun visors.

**Use warm water on a sponge to dampen a cloth headlining that sags or is slightly wrinkled, or spray it with live steam. On a vinyl headlining, live steam must be applied to the back side of the headlining through the dome lamp opening of the vinyl. As it dries, the headlining will shrink slightly, removing most wrinkles and sags.**

## 3 INSTRUMENT PANEL PAD

### REMOVAL AND INSTALLATION —FORD

1. Disconnect the battery negative (ground) cable.
2. Remove the sun visor retaining screws and remove the visors.
3. Remove the windshield interior garnish mouldings.
4. Remove the defroster outlet covers (Fig. 6).
5. Remove the radio speaker grille (Fig. 6).
6. Remove the four instrument cluster center filler retaining screws.
7. Remove the five instrument cluster retaining screws. Disconnect the speedometer cable from the speedometer, and position the instrument cluster on the steering column.
8. Remove the instrument panel pad and retainer assembly. Remove excessive pad material which may stick to the old adhesive.
9. Apply adhesive (C2AZ-19C525-A) to the instrument panel areas as shown in Fig. 6.
10. Allow the adhesive to become "tacky" (approximately three minutes). Transfer the eight retaining clips to the new cover (Fig. 6).
11. Place the pad and retainer assembly on the instrument panel and press firmly into position.
12. Position the instrument cluster in place and install the five cluster retaining screws. Connect the speedometer cable to the speedometer.
13. Install the instrument cluster center filler.
14. Install the radio speaker grille (Fig. 6).
15. Install the defroster outlet covers.
16. Install the windshield garnish mouldings.
17. Install the sun visors.
18. Clean the mouldings and instrument panel area.
19. Connect the battery negative (ground) cable.

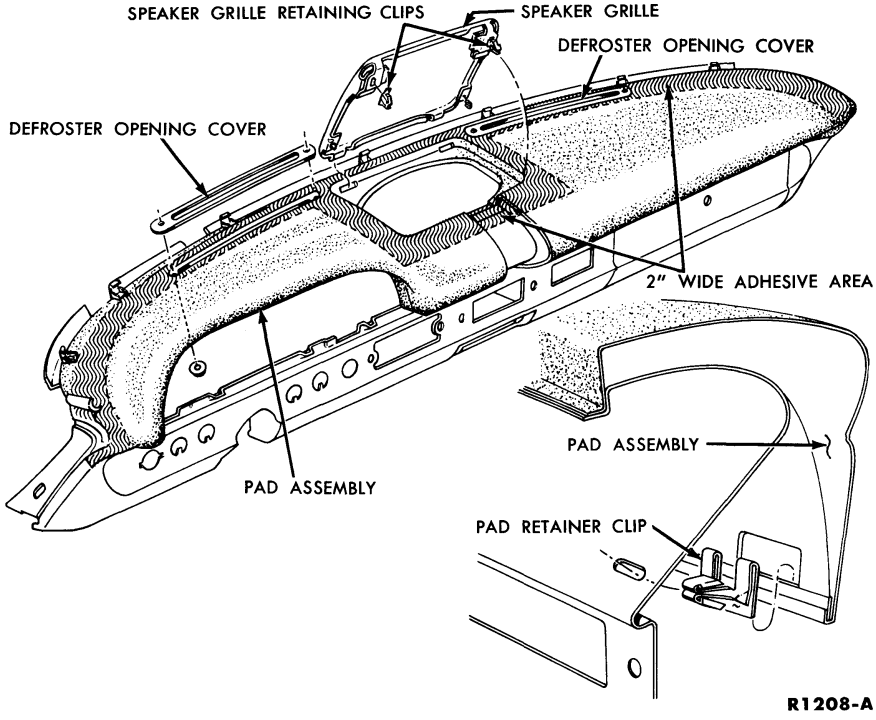



**FIG. 6—Instrument Panel Pad Installation—Ford**

### REMOVAL AND INSTALLATION —MERCURY

1. Remove the sun visor retaining screws and remove the visors.
2. Remove the windshield interior garnish mouldings.
3. Remove both defroster outlet covers and the radio speaker grille (Fig. 7).
4. Disconnect the battery negative (ground) cable.
5. Remove the seven glove compartment retaining screws and remove the glove compartment.
6. Remove the radio control knobs and bezels, and the heater and heater blower control knobs.
7. Remove the seven instrument cluster retaining screws. Disconnect the speedometer cable and position the instrument cluster on the steering column.
8. Remove the left upper instrument panel and finish moulding retaining nut.
9. Remove the two heater control assembly retaining nuts and position the heater control away from the instrument panel.
10. Remove the two clock retaining nuts. Position the clock and center instrument finish panel away from the instrument panel.
11. Remove the five right hand instrument panel and finish panel retaining nuts and remove the finish panel.
12. Remove the instrument panel pad assembly and remove any excessive old pad material which may stick to the old adhesive.
13. Apply adhesive (C2AZ-19C525-A) to the instrument panel areas shown in Fig. 7, and allow the adhesive to become "tacky". Then position the new pad assembly as shown in Fig. 7 and press firmly into place.
14. Place the right hand instrument finish panel in position and install the five retaining nuts.
15. Position the center instrument finish panel and clock in place and install the two retaining nuts.

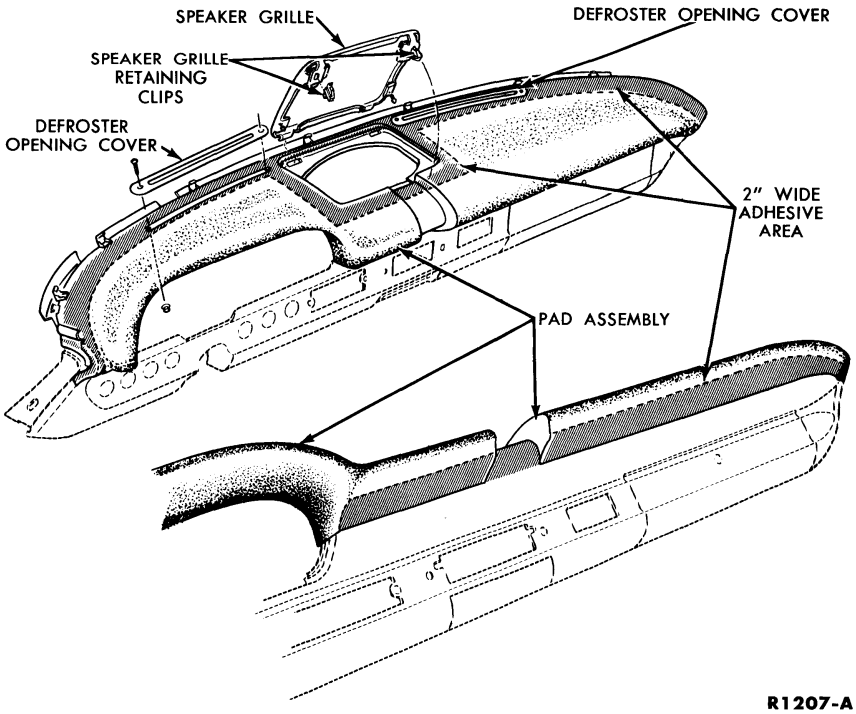



**FIG. 7—Instrument Panel Pad Installation—Mercury**

**16.** Position the heater control assembly in place and install the two retaining nuts.

**17.** Position the left upper instrument finish panel and install the retaining nut.

**18.** Position the instrument cluster in place and install the seven retaining screws.

**19.** Install the instrument cluster center filler and two retaining screws.

**20.** Connect the speedometer cable to the speedometer.

**21.** Install the heater control and heater blower control knobs, and the radio bezel and control knobs.

**22.** Position the glove box assembly in place and install the seven retaining screws.

**23.** Install the radio speaker grille and the defroster outlet covers.

**24.** Install the windshield garnish mouldings.

**25.** Install the sun visors.

**26.** Clean the mouldings and pad assembly.

**27.** Connect the battery negative (ground) cable.

## 4 CONSOLE

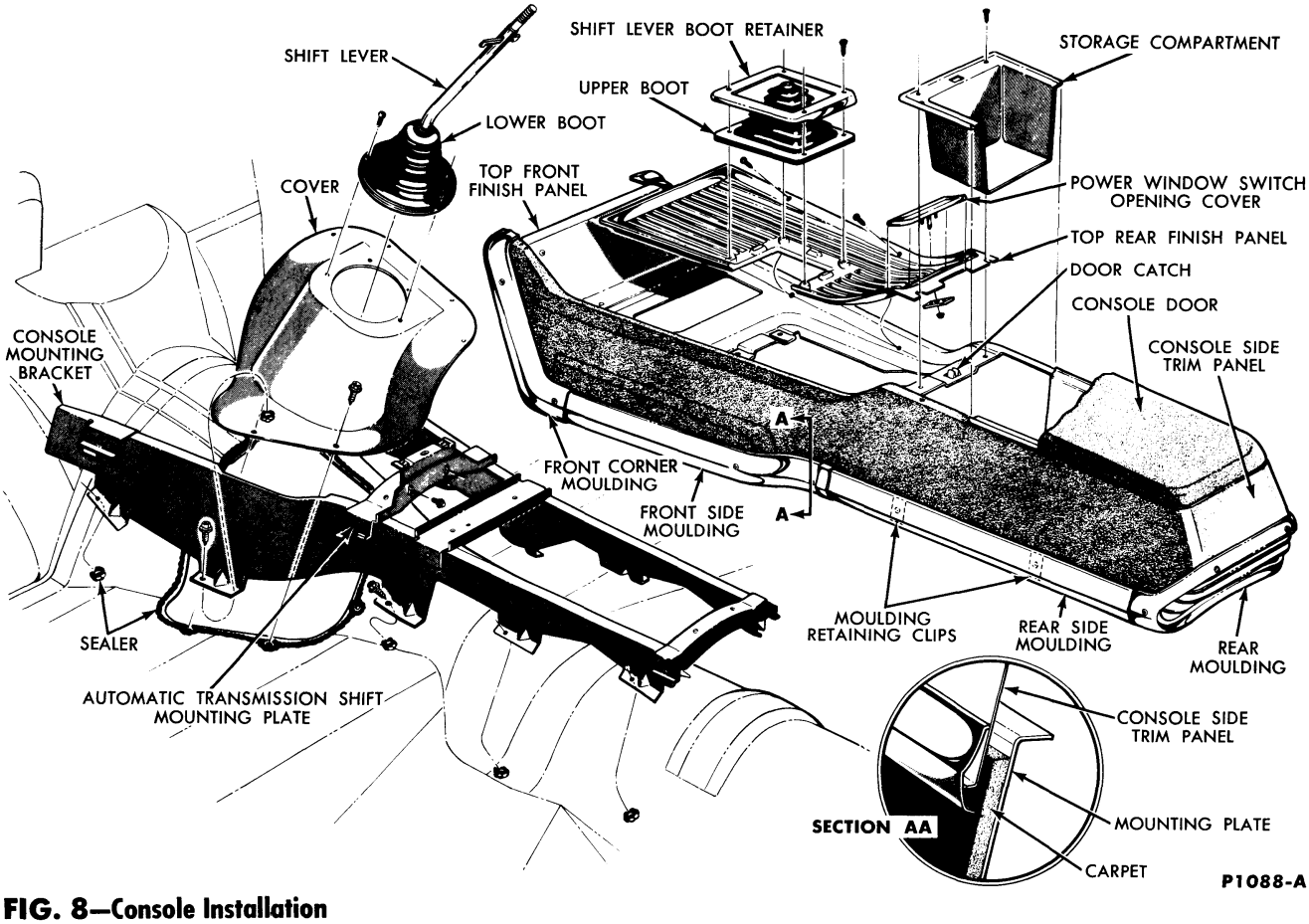



**FIG. 8—Console Installation**

### REMOVAL AND INSTALLATION

1. Remove the shift knob assembly.
2. Remove the nine glove box liner retaining screws and remove the glove box liner.
3. Remove the four rear moulding retaining screws and remove the rear moulding (Fig. 8).
4. Disconnect the power window switch wires and remove the switch finish panel.
5. Remove the four front finish panel retaining screws and remove the front finish panel (Fig. 8).
6. Remove the two console glove box door catch retaining screws and remove the door catch.
7. Remove the five console glove door and hinge retaining screws and remove the door, hinge and hinge plate.
8. Remove the left and right side console moulding retaining screws and remove the mouldings (Fig. 8).
9. Remove the shift assembly-to-console retaining screws.
10. Remove the eight screws retaining the console assembly to the console support assembly, and remove the console assembly (Fig. 8).
11. Transfer the moulding retaining clips to the new console assembly.
12. Position the console over the console support and install the eight retaining screws (Fig. 8).
13. Install the shift assembly.
14. Install the right and left side console mouldings (Fig. 8).
15. Install the glove box door, mounting plate and hinge.
16. Install the glove box door catch.
17. Install the console rear moulding.
18. Install the rear finish panel and connect the window switch wiring.
19. Install the upper front finish panel (Fig. 8).
20. Install the glove box liner.
21. Install the shift knob.

## 5 LANDAU TOP COVER

### COVER ASSEMBLY REMOVAL

1. Remove the sun visors and the windshield garnish mouldings.
2. Remove the windshield wiper arm and blade assemblies.
3. Remove the cowl top grille.
4. Remove the windshield outside mouldings and retainers, and the windshield assembly in the usual manner.
5. Remove the roof side rail weatherstrip assemblies.
6. Remove the roof side rail weatherstrip retainers.
7. Remove the belt side and belt back mouldings and retainers.
8. Remove the back window outside mouldings.
9. Remove the roof side rail inside mouldings.
10. Remove the package tray and back window garnish mouldings, and remove the back window and weatherstrip assembly.
11. Remove the back window outside moulding retainer clips.
12. Remove the quarter courtesy light bezels and lenses.
13. Remove the roof side rear trim covers.
14. Loosen the headlining sufficiently to permit access to the roof outside rear center moulding. Remove the outside roof center moulding and end mouldings.
15. Remove the drip rail mouldings, and remove the sealer from the drip rails.
16. Using a 0.128″-0.132″ diameter drill, remove the rivets from the drip rail retainers and discard the retainers.
17. Remove and discard all roof cover assembly retaining drive nails and screws, and remove and discard the cover assembly.
18. Remove all old sealer and/or cement from the roof panel and drip rail areas with naphtha solvent or equivalent. **It is extremely important that the entire roof and drip rails are thoroughly cleaned.**

### COVER ASSEMBLY INSTALLATION

It is recommended that a ⅛-inch oval head blind rivet (Part No. 378527-S, Pop Rivet) be substituted for the screw and the drive nail. The rivet and installing pliers (Mfg. Part No. PRP-26-A) can be procured from: "POP" Rivet Division, United Shoe Machinery Corp., Sheldon, Connecticut, or from their local distributor.

Wherever possible, use the existing drive nail or screw holes. Therefore, each location should be identified on the pinch weld flange with a wax crayon.

Seal all unused holes with either C1AZ-19627-A Pressure Sensitized Tape or AB-19560-A Sealer.

1. Carefully position the outside cover on the roof panel. ("Fore and aft" center punch marks have been provided in the cover for centering purposes.)
2. With the cover properly positioned and temporarily secured, apply an even coating of trim cement C2AZ-19C525-A to the roof panel and a like amount to the corresponding area of the roof outside cover assembly. For best results, secure limited sections at a time. **Make certain the adhesive is not lumpy as it will be objectionable from an appearance standpoint.**
3. Using a 0.128″-0.132″ diameter drill, pierce the vinyl material at the existing drive nail or screw hole locations. Install "POP" rivets in each of the holes.
4. Position both drip rail retainers and, using the same drill referred to above, pierce the vinyl at each of the holes. Install the "POP" rivets from the underside of the drip rail except at the extreme rear hole in which case the rivet should be inserted from the retainer side.
5. Trim excess cover material from around the entire perimeter.
6. Apply sealer C3AZ-19562-A (for white tops) or C3AZ-19562-B (for black tops) over the entire surface of drip rail retainers. With the drip rail properly sealed, a minimum depth of ⅛ inch should be retained for adequate water drainage. **Place masking tape on the cover assembly for the entire length of the drip rail before applying sealer. After sealer has been applied, remove tape.**
7. Install the drip rail mouldings.
8. From the underside of the roof panel, pierce the nine roof outside rear center moulding retainer holes

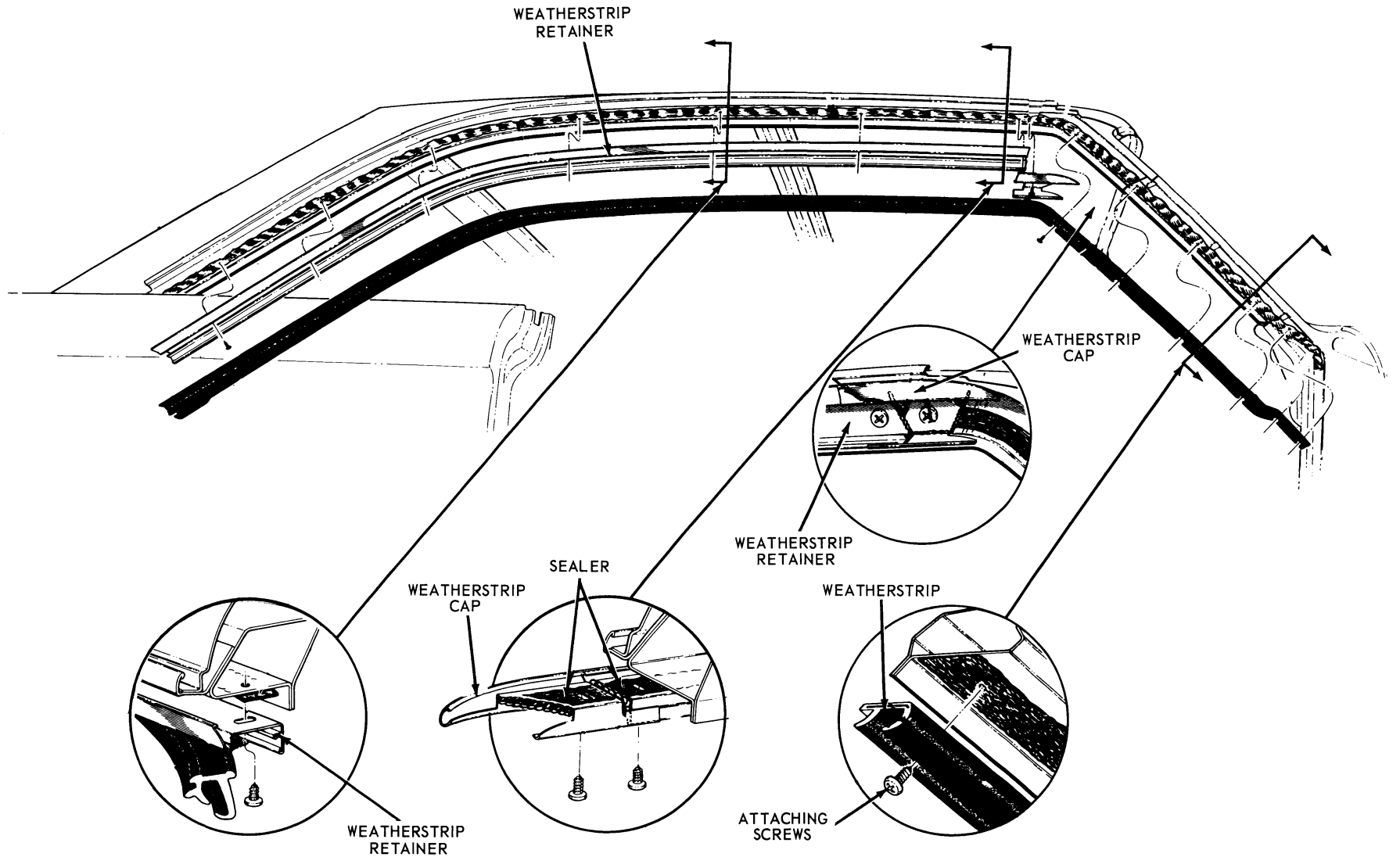



**FIG. 9—Roof Side Rail Weatherstrip**

and the two end moulding screw holes. Install the roof outside mouldings, making sure that all holes are adequately sealed.

**9.** Install the back window outside moulding retainer clips.

**10.** Install the back window and windshield in the usual manner.

**11.** Reposition and secure the headlining.

**12.** Install the roof side rear trim covers.

**13.** Install the courtesy light lenses and bezels.

**14.** Install the back window and package tray garnish mouldings.

**15.** Install the roof side rail inside mouldings.

**16.** Apply an ample amount of caulking cord AB-19560-A around the entire outer perimeter of the back window, between the weatherstrip and the recess of the body opening.

**17.** Install the back window outside mouldings.

**18.** Install the back belt side and back moulding retainers and mouldings.

**19.** Apply caulking cord AB-19560-A to each roof side rail weatherstrip retainer before installing the retainer (Fig. 9).

**20.** Install the roof side rail weatherstrip.

**21.** Install the windshield outside moulding retainers and mouldings.

**22.** Install the cowl top grille.

**23.** Install the wiper arms and blades.

**24.** Install the sun visors.

# PART 18-2 SEATS


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## 1 MANUAL SEATS

### FRONT SEAT AND/OR TRACK REMOVAL AND INSTALLATION

Work other than that of minor nature is more easily performed when the front seat assembly is removed from the car.

**1.** Remove the right and left cushion side shields. Remove the bolts retaining the seat tracks to the floor pan, and lift the seat assembly from the car.

**2.** Remove the bolts and lockwashers retaining each seat track to the seat (Fig. 1), and disconnect the seat track tie rod as the track assembly is removed.

**3.** On a car with a one-piece seat back, remove the bolts and washers attaching the seat back. Remove the hairpin clip from the seat back pivot pins.

On a car with a split seat back, remove the screw from the center bracket cover, and remove the hairpin clips from the seat back studs.

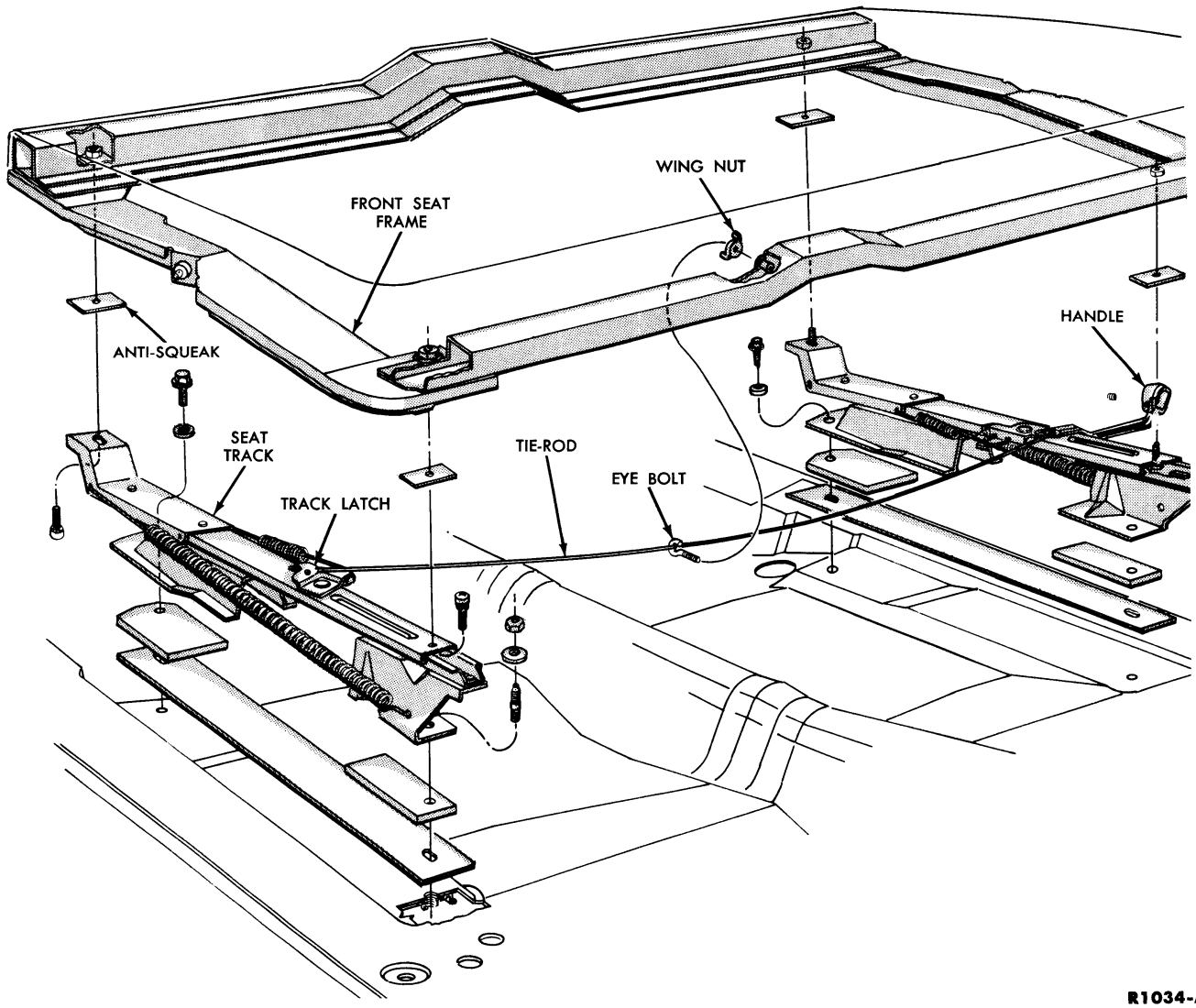



**FIG. 1—Manual Front Seat Mechanism**

**4.** Remove the seat back from the seat.

**5.** Position the seat back assembly on the seat. On a car with the split seat back, install the hairpin clips and attach the center bracket cover screw and washer.

**6.** Install hairpin clips on the seat back pivot pin. On a car with a one-piece seat back, install the bolts and washers attaching the seat back to the seat.

**7.** Connect the seat track tie rod as the seat track is positioned; then install the bolts and lockwashers retaining the seat track to the seat assembly.

**8.** Position the seat assembly in the car and install the retaining bolts and nuts. Position the cushion side shields, and install the retaining screws.

### TIE ROD ADJUSTMENT

Tie rod maladjustment will affect only the passenger side of the seat. In case the latch retaining the track fails to release, remove the tie rod from the adjusting eye bolt and loosen the wing nut. Turn the eye bolt enough to shorten the tie rod travel sufficiently to release the track latch. If the latch fails to secure the seat travel, turn the tie rod adjusting eye bolt counterclockwise enough to allow the latch to snap into locking position. Tighten the wing nut and position the tie rod on the adjusting eye bolt.

## REAR SEAT— SIX PASSENGER WAGON

### SEAT BACK AND/OR CUSHION REMOVAL

The seat back is retained by four screws located at the back top edge of the seat back floor panel (Fig. 2). After removing the retaining screws, lift the seat back out of the two bottom hooks.

To remove the seat cushion, pull back the carpet and remove the torsion bar retaining brackets (Fig. 2). Lift the seat cushion enough to gain access to the cushion retaining screws (Fig. 2). Remove the retaining screws from both hinge brackets, and remove the cushion with the torsion bars attached.

### SEAT BACK RELEASE HANDLE AND/OR HANDLE RETURN SPRING REMOVAL AND INSTALLATION

**1.** Release the seat back locks from the strikers, and then remove the seat back.

**2.** Disconnect the handle return spring, and then remove the handle and spring retaining pin.

**3.** Remove the handle and handle return spring.

**4.** Position the handle and spring on the handle connecting rod and install the retaining pin.

**5.** Connect the handle return spring, and then install the seat back.

### SEAT CUSHION, BACK, AND/OR COVER REMOVAL AND INSTALLATION

Standard or custom seat cushion and seat back assemblies are available in kits. A typical covered seat is shown in Fig. 3. The covers are serv-

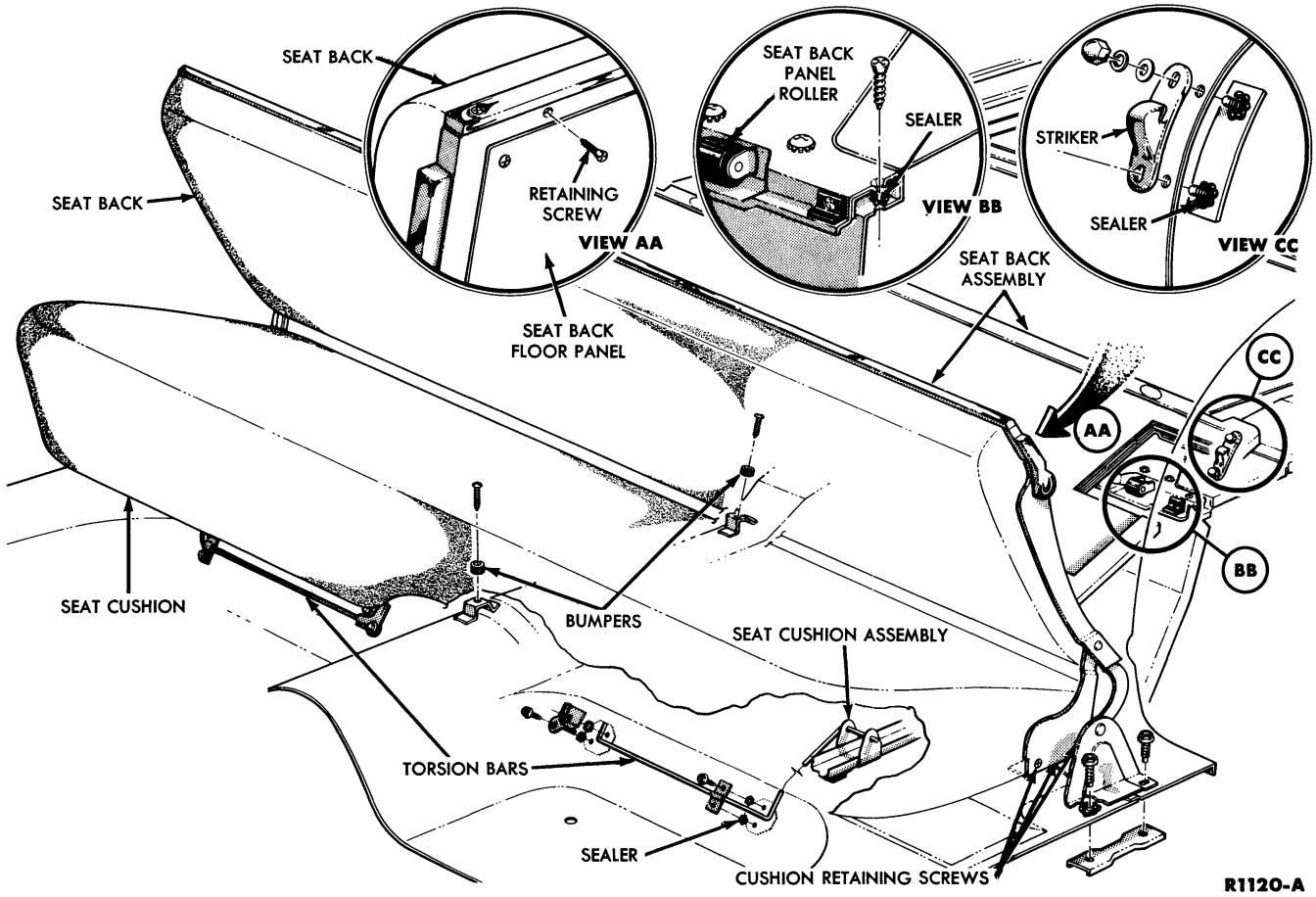



**FIG. 2—Six Passenger Wagon Second Seat**

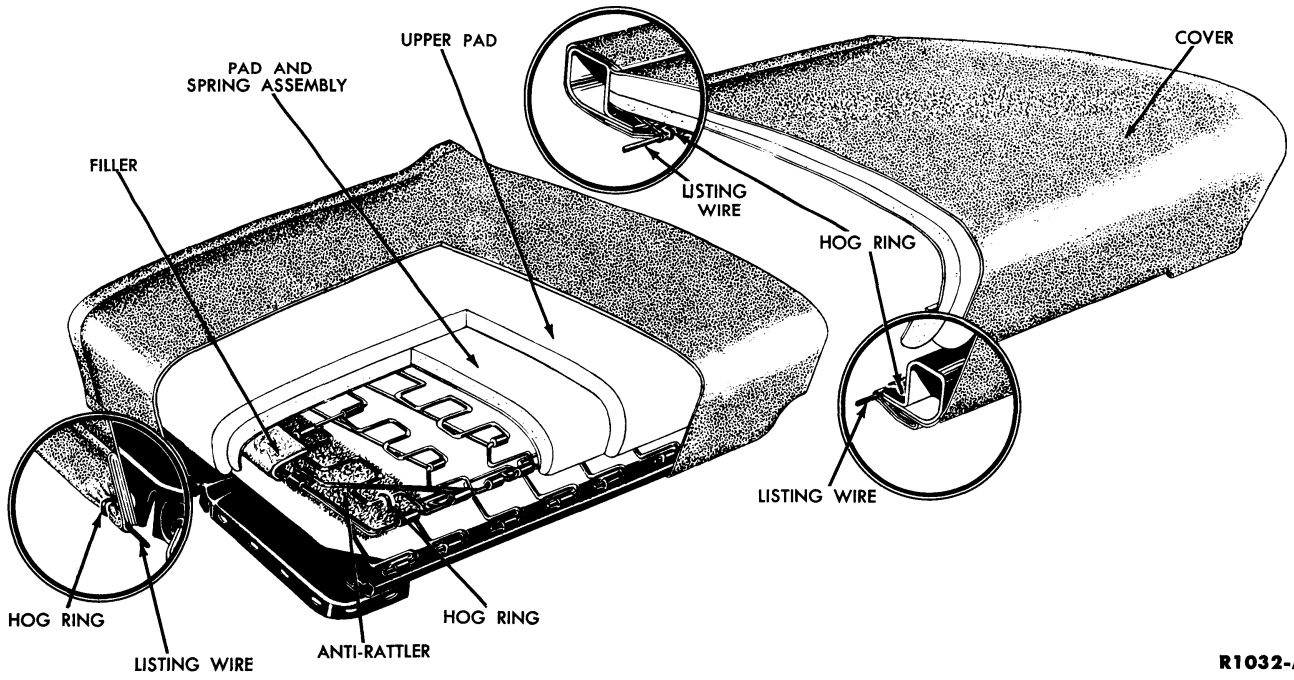



**FIG. 3—Typical Seat Cushion Build-Up**

iced separately to match the trim in a given car. A damaged frame, spring, or pad requires a complete frame and spring kit for repair. A damaged or worn cover can be replaced separately. The following procedure for seat back or cushion replacement includes steps necessary for cover replacement, and is applicable to most kits.

**1.** Remove the seat or back assembly from the car and remove the cover and/or the pad. If working on a seat cushion, remove the tracks and any operating mechanism from the frame.

**2.** Position the frame and spring right side up on a clean working surface.

**3.** Carefully center the pad support and the pad(s) in the order shown in Fig. 3.

**4.** Insert the listing wire(s) in the cover.

**5.** Center the cover on the pad, and draw the cover over the corners, working out any wrinkles.

**6.** Carefully turn the frame bottom side up, being careful not to disturb the pads and cover.

**7.** Working on the edge of the cover with the listing wire(s), start at the center and use hog rings to fasten the cover to the frame. Work alternately toward the corners and along each side, installing the rings about four inches apart.

**8.** Fasten the other long edge of the cover to the frame, using hog rings about four inches apart. Work alternately to each corner from the center.

**9.** Install the seat tracks and any operating mechanism that was previously removed.

**10.** After applying Lubriplate to the track slides and to the seat back pivots, install the complete assembly in the car.

## 2 FOUR-WAY POWER SEATS

### DESCRIPTION AND OPERATION

The power seat is controlled by a single toggle switch which can be operated in four directions. The switch, mounted on the front seat cushion left side shield, and independent of the ignition switch, controls a single electric motor.

When the switch is operated for vertical seat motion, the left solenoid actuates the clutch and transmits power to the vertical screw. The seat is raised or lowered by two pivot arms at each side of the seat (Fig. 4). The vertical motion is transmitted to

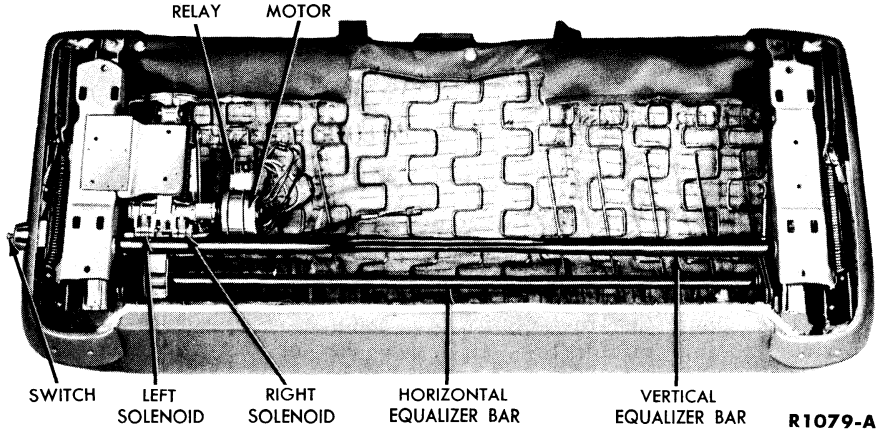



**FIG. 4—Underside View of 4-Way Power Seat**

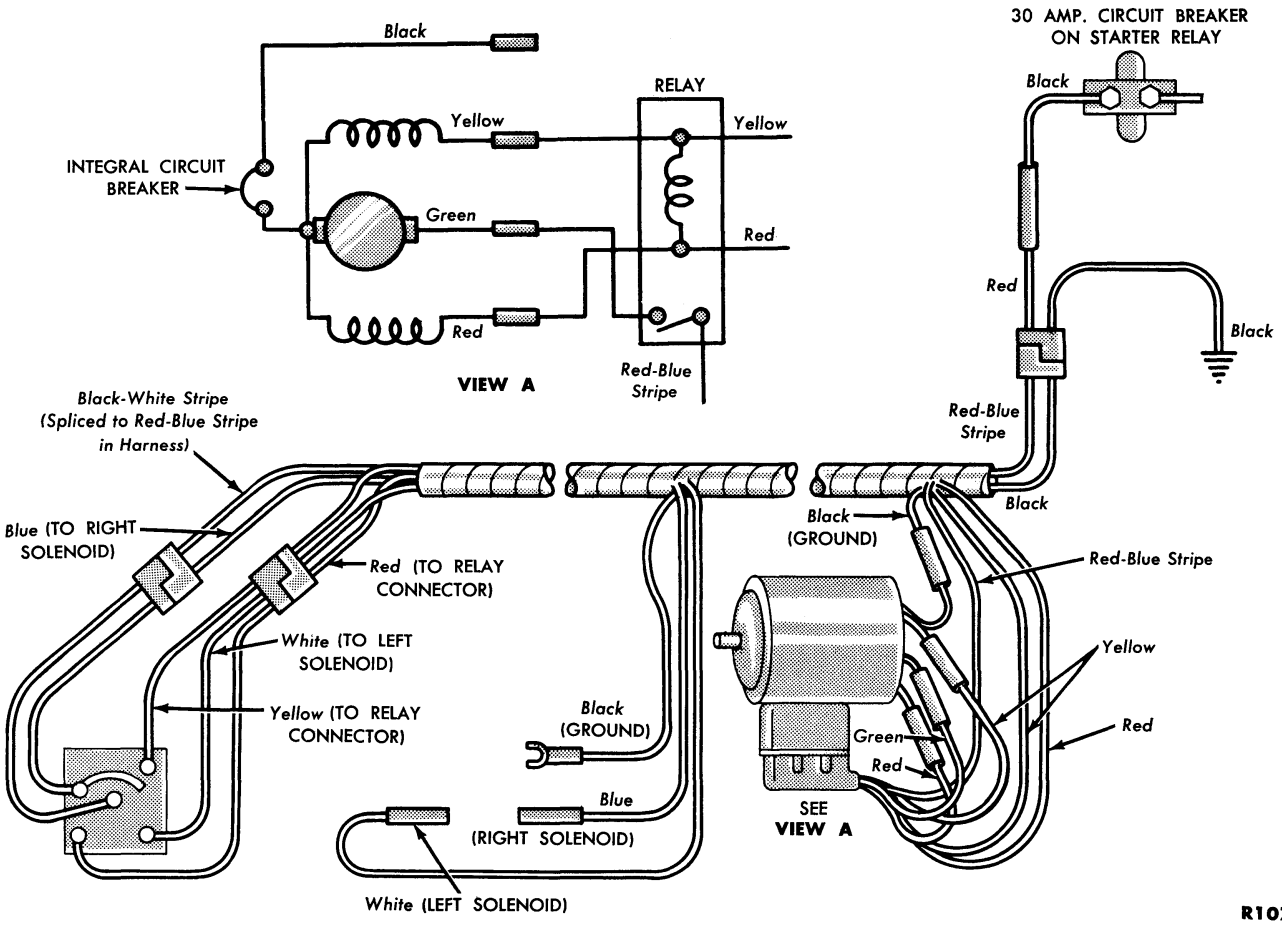



**FIG. 5—Four-Way Power Seat Wiring**

the right seat track by a vertical equalizer bar.

When the switch is operated for fore-or-aft movement of the seat, the right solenoid actuates the clutch and couples the motor to the horizontal screw. The fore-and-aft motion is transmitted to the right seat track by the horizontal equalizer bar (Fig. 4).

## DIAGNOSIS AND TESTING

### 4-WAY POWER SEAT

Figure 5 shows a wiring diagram of the power seat electrical circuit. The following symptoms are sometimes found in power seat failures. **The battery must be fully charged before any checks are made.**

**Seat will not operate.** If the seat does not operate in any direction, the cause is likely to be an open circuit or power failure due to defective wiring, 20-amp circuit breaker, switch, relay, or motor.

**1.** Connect a voltmeter or a test light between the outlet terminal of the 20-amp circuit breaker and ground. The circuit breaker is located on the starter relay. If there is no voltage available, replace the 20-amp circuit breaker.

**2.** Disconnect the double wire connector under the center of the seat near the grounding screw (Fig. 5). Connect a voltmeter or test light between the red wire and ground. If no voltage is available, repair or replace the wire and/or connections to the 20-amp circuit breaker.

**3.** Disconnect the double connector at the seat control switch (Fig. 5). Connect a voltmeter or test light between the black-white stripe wire of the harness and ground. If no voltage is available, repair or replace the wire. If voltage is available, connect the double connector and disconnect the triple connector. With a voltmeter or test light, test each lead from the switch while the switch is operated. If no voltage is available at any of the wires, replace the switch.

**4.** Connect a voltmeter from the red-blue stripe wire terminal of the relay connector to ground. If no voltage is available, repair or replace the wire.

**5.** If the switch operates properly, disconnect the green wire at the motor. Connect a voltmeter between the green lead of the relay and ground. If no voltage is available when the switch is operated, replace the relay.

**6.** Disconnect the black wire at the motor. Ground the motor black wire and actuate the seat switch. If the motor runs, the black ground wire should be repaired or replaced. If the motor does not run, the motor is defective.

**Seat moves in one plane only.** If the seat moves in one plane only, the cause is likely to be a defective solenoid, switch, or wires from the switch to the solenoid.

Actuate the seat switch and observe the solenoids. If a solenoid is inoperative, connect a voltmeter from the solenoid lead to ground. If voltage is indicated when the switch is activated, replace the solenoid. If no voltage is indicated, check for a defective wire or seat switch.

### MOTOR REMOVAL AND INSTALLATION

1. Disconnect the wire connector from the seat regulator (Fig. 5) and the four wire connectors to the seat motor.

2. Remove the power seat motor to housing retaining nuts. Remove the motor and rubber coupling from the housing.

3. Transfer the seat regulator control relay and the rubber coupling to the new motor.

4. Secure the motor to the seat mechanism housing with the retaining nuts.

5. Connect the wires (Fig. 5) and check the seat operation.

### SOLENOID REMOVAL AND INSTALLATION

A power seat with a defective solenoid can be moved to a convenient working position by operating the seat switch while manually actuating the yoke and clutch (Fig. 6).

1. Remove the seat regulator control solenoid to housing retaining screw.

2. Disconnect the wire connector at the solenoid and slide the solenoid from the solenoid shaft.

3. Connect the wire to the solenoid, slide the solenoid onto the solenoid shaft, and install the solenoid retaining screw. **Be sure to connect the ground wire (black) to the solenoid, if it was removed.**

### POWER SEAT MECHANISM REMOVAL

1. Remove the seat track to floor pan retaining bolts. Disconnect the double wire connector at the floor pan beneath the center of the seat assembly. Remove the seat assembly from the car.

2. Disconnect the seat switch wires at the left seat track. Remove the bolts retaining the seat tracks to the seat assembly and remove the seat track assembly.

3. Disconnect the wires at the relay, motor, and solenoids.

4. Remove the clevis pins retaining the regulator to the seat track. Remove the shoulder bolts retaining the ball nut assemblies to the equalizer bar links and remove the regulator.

### POWER SEAT MECHANISM INSTALLATION

1. Place the regulator assembly on the seat track assembly, and connect the equalizer bar links to the ball nuts.

2. Retain the regulator to the seat track with the clevis pins.

3. Connect the wires at the relay, motor, and solenoids (Fig. 5).

4. Install the seat track assembly to the seat assembly. Connect the seat switch wires at the left seat track.

5. Place the assembly in the car and install the retaining bolts.

6. Connect the wires beneath the center of the seat assembly.

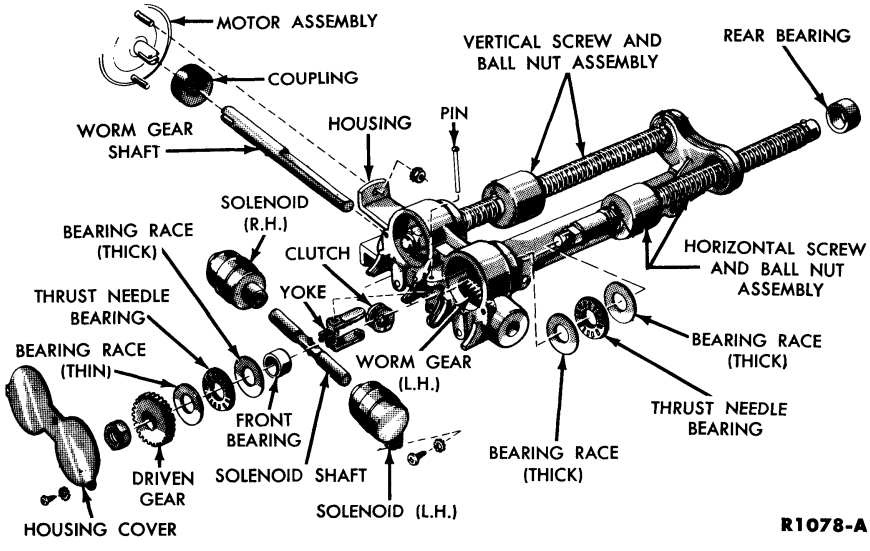



**FIG. 6—Four-Way Power Seat—Disassembled**

### POWER SEAT MECHANISM DISASSEMBLY

1. Remove the regulator motor and coupling (Fig. 6).

2. Remove both solenoids and shaft, the yoke pin and yoke, worm gear shaft, and the clutch.

3. Remove the regulator housing cover and remove the nuts retaining the driven gears to the screws.

4. To remove the screw assemblies, support the regulator housing on the rear face, place a wood block on the threaded end of the screw, and press the rear bearing out of the housing. With the rear bearing removed, the vertical and horizontal screw assemblies, regulator driven gear, and thrust needle bearings and races are loose items (Fig. 6).

### POWER SEAT MECHANISM ASSEMBLY

1. If the screw front bearing is to be installed, support the housing and press in the bearing.

2. Install a thrust needle bearing, with a bearing race (thick) on each side, onto the threaded end of each screw assembly (Fig. 6). Position each screw assembly in the regulator housing and install the rear bearing.

3. Install the bearing race (thick), thrust needle bearing, bearing race (thin), regulator driven gear, and retaining nut on each screw assembly. Torque the retaining nuts to 30-35 ft-lbs, and stake each nut in three places.

4. Pack the gear housing with lubricant (B8A-19578-A), and install the cover.

5. Install the clutch and the worm gear shaft.

6. Install the coupling and motor.

7. Install the yoke, retaining pin, solenoid shaft, and both solenoids.

8. Apply Lubriplate to the vertical and horizontal screw assemblies.

### POWER SEAT MECHANISM INSPECTION

1. Clean all parts and check the screw assemblies for free movement of the ball nut assemblies. Make certain the nut moves from one stop to the other without binding or roughness.

2. Check the regulator housing for cracks.

3. Check the regulator driven gear and worm gear for worn or chipped teeth.

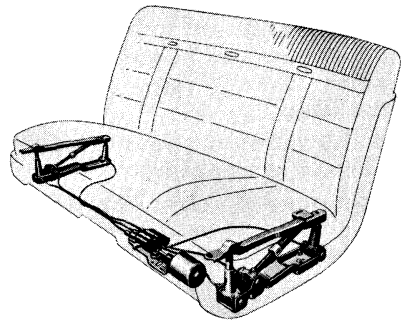
4. Check the thrust needle bearings for pitting or looseness.
5. Check each screw, front and rear bearing for roughness or loose fit. If a front bearing requires replacement, support the housing in the bearing area and with a press remove the bearing. The front bearing will not require removal if the regulator housing is to be replaced since the replacement housing contains front bearings.

## 3 SIX-WAY POWER SEAT—MERCURY

### DESCRIPTION AND OPERATION

The six-way power seat provides horizontal, vertical, and tilting adjustments. The seat is driven by a single motor through a transmission and six flexible drive cables encased in housings (Fig. 7).

The control switches are mounted on the left seat side shield. The forward switch controls the vertical movement, or tilt, of the front portion of the seat. The rear switch controls the vertical movement, or tilt, of the rear portion of the seat. The center switch controls both horizontal and vertical movement of the seat. These switches control the operation of three solenoids through relays with the exception of horizontal movement, which is controlled directly by the switch.



N1246-A

**FIG. 7—Six-Way Power Seat**

The solenoids engage the transmission gears, transmitting driving power to the respective driven mechanisms of the seat through drive cables. The forward solenoid operates the rear vertical seat drive assemblies. The center solenoid operates the front vertical drive assemblies. The horizontal seat screw jacks are operated by the rear solenoid.

Both the control and power circuits are protected by a common 20-ampere circuit breaker mounted on the starting motor relay (Fig. 8).

### DIAGNOSIS AND TESTING

#### SIX-WAY POWER SEAT

**Motor Operates, But Seat Does Not Move**

1. Defective shaft or coupling between motor and transmission.
2. Solenoid not engaging transmission.
3. Solenoid relay not energizing the solenoid.

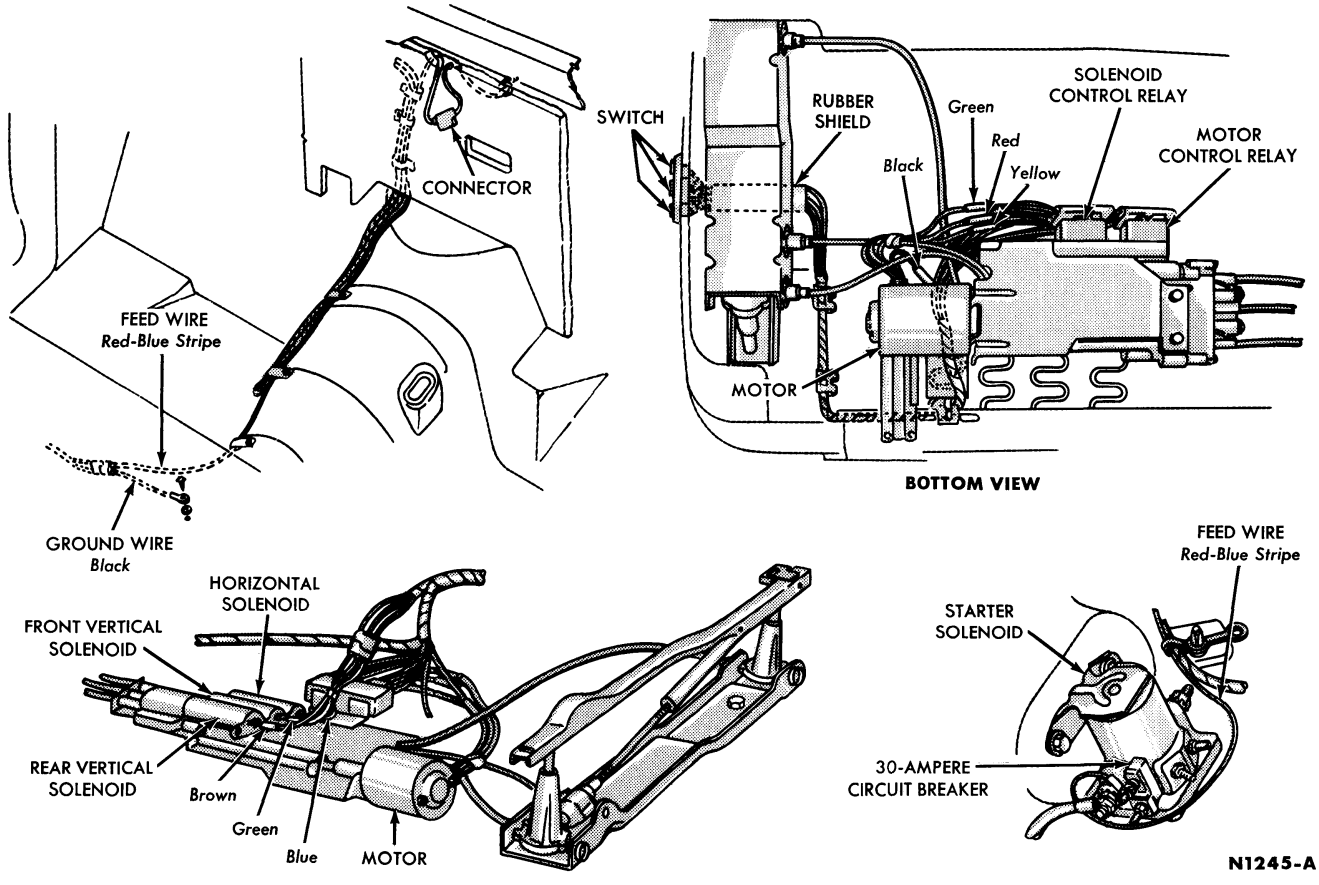



**FIG. 8—Six-Way Power Seat Wiring**

**Motor Does Not Operate**

1. Defective (20-amp) circuit breaker.
2. Defective motor relay.
3. Defective seat control switch.
4. Broken wire or loose connection.
5. Defective motor.

**Seat Will Not Move In One Particular Direction**

1. Appropriate solenoid not operating.
2. Transmission binding.
3. Seat control switch inoperative.
4. Broken flexible drive shaft.
5. Broken or binding mechanical drive system.
6. Broken, worn or loose connection.

## SEAT REMOVAL

1. Disconnect the ground cable from the battery.
2. Remove the nut and washer from the front end of each seat actuator.
3. Remove cap screw and lockwasher from the rear of each seat actuator.
4. Remove the nut and washer that secures the motor mounting bracket to the floor pan.
5. Disconnect the main harness from the wire leading to the 20-ampere circuit breaker (Fig. 8).
6. With an assistant, lift the seat and regulator from the car.
7. Remove the four cap screws and washers that secure the seat to the actuators.

## MOTOR REMOVAL AND INSTALLATION

1. Disconnect the motor leads from the four connectors (Fig. 9).
2. Remove the two nuts and lockwashers that secure the motor to the mounting bracket.
3. Slide the motor out of the shaft coupling and off the mounting bracket.
4. Slide the motor shaft into the coupling and the studs into the mounting bracket.
5. Secure the motor to the mounting bracket with two lockwashers and nuts.
6. Connect the green, red, yellow and the black motor leads to their respective connectors.

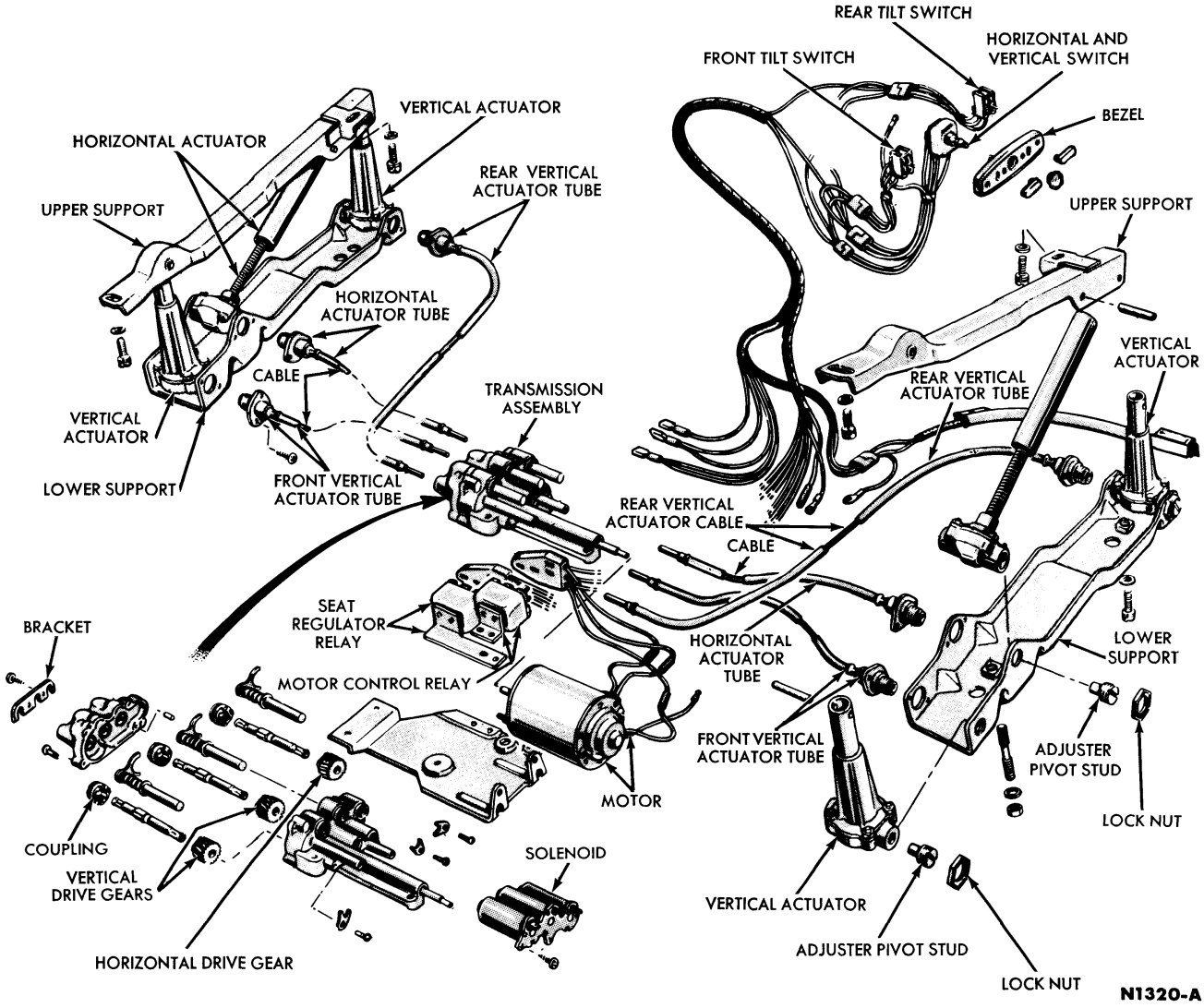



**FIG. 9—Six-Way Power Seat—Disassembled**

### RELAY REMOVAL AND INSTALLATION

1. Disconnect the connector from the seat regulator relay and from the motor control relay (Fig. 9).
2. Remove the two sheet metal screws that secure both relays to the mounting bracket and remove the relays.
3. Secure both relays to the mounting bracket with two sheet metal screws. Make sure that the motor control relay (four-prong connector) is toward the driver's side of the seat.
4. Connect each connector to its respective relay.

### TRANSMISSION REMOVAL AND INSTALLATION

1. Disconnect the three leads from the three solenoids on the transmission (Fig. 9).
2. Remove the cable housing retainer from each end of the transmission. Separate the six cables and housings from the transmission.
3. Remove the two cap screws and lock washers that secure the transmission to the mounting bracket. Separate the transmission from the mounting bracket.
4. Secure the transmission to the mounting bracket with two lock washers and cap screws.
5. Slip the six cables and housings into their respective ports. Install the two cable housing retainers.
6. Connect the brown lead to the front solenoid, the green lead to the center solenoid and the blue lead to the rear solenoid.

### SWITCH REMOVAL AND INSTALLATION

1. Remove the left seat side shield attaching screws. If working on an "A" model, remove the two switch attaching screws (Fig. 10). Separate the side shield from the seat.
2. Remove the wiring shield that encloses the seat switch wires.
3. Disconnect the switch from the four connectors.

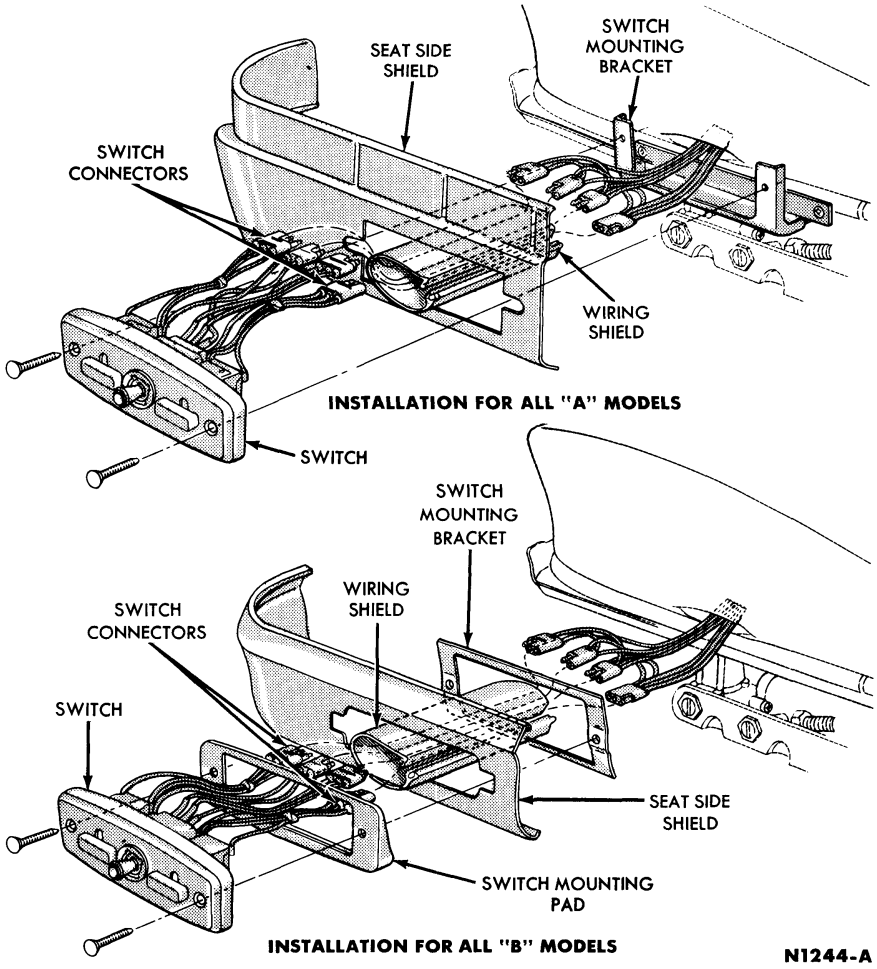



**FIG. 10—Six-Way Switch Installation**

4. Remove the two switch attaching screws and remove the switch, mounting pad and the mounting bracket ("B" models only).
5. Secure the switch, mounting pad and the mounting bracket to the left seat side shield with the two attaching screws ("B" models only) as shown in Fig. 10.
6. Connect the four connectors at the switch leads.
7. Install the wiring shield to enclose the wiring and seat switch connectors.
8. Install the left seat side shield.
9. Secure the switch to the side shield with the two attaching screws ("A" models only).

### SEAT INSTALLATION

1. Secure the seat to the regulator with four attaching screws.
2. With an assistant, carefully position the seat and regulator in the car.
3. Secure the motor mounting bracket to the floor pan with a nut and washer.
4. Secure each seat actuator (regulator) to the floor pan with a cap screw, two washers and a nut.
5. Connect the main harness to the harness leading to the 20-ampere circuit breaker (Fig. 10).
6. Connect the ground lead to the battery.
7. Check the operation of the seat to make certain that it moves in all directions.

# PART 18-3 CONVERTIBLE TOP


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Care of Top Fabric | 18-17 | 3 Adjustment and Light Repair | 18-19 |
| 2 Diagnosis and Testing | 18-17 | 4 Removal and Installation | 18-20 |


## 1 CARE OF TOP FABRIC

Proper care of the top material will reduce the possibility of water stains, mildew, or shrinkage. Do not stack the top if it is damp. Always use the convertible top vinyl boot to keep the top material clean, dry, and positioned when the top is stacked.

The rear window slide fastener should be lubricated at least once a year with stainless stick lubricant such as "Door Ease".

Use the top compartment behind the rear seat back only for storage of the top. The storage of other items not only interferes with the proper operation of the top, but may also damage or stain the top material.

The vinyl top may be washed each time the car is washed. Clean the material with FoMoCo Interior Trim Cleaner and scrub brush. For an extremely soiled top, use an abrasive cleaner sparingly. Be sure to rinse the top thoroughly with clean water during and after washing.

**Do not use a cleaning fluid that is not recommended for vinyl material because damage to the top may result.**

The vinyl coating becomes tacky at approximately 180° F. Therefore, when making paint repairs, be sure to protect the top material from heat.

## 2 DIAGNOSIS AND TESTING

If the top cannot be lowered or raised satisfactorily, or if it fails to operate at all, and the trouble is not readily apparent, make the following mechanical, electrical, and hydraulic tests to find the cause of the trouble. **Always check the battery before making any of the following checks.**

Table 1 shows symptoms and possible causes of trouble.

### MECHANICAL CHECKS

**1.** If the action of the top is slow, raise and lower it slowly and look for bent or misaligned linkage.

**2.** If binding is noted when clamping the top at the header, check the alignment of the door and the quarter windows with the side rail weatherstrips. Also check the top sag adjustment and toggle clamp adjustment.

### ELECTRICAL TESTS

**Battery Charge.** The battery charge should be determined before making any electrical checks because a partially discharged battery will cause slow motor and pump operation.

**Current Draw.** To check the current draw in the top operating circuit, disconnect the black wire at the circuit breaker (located on the starter relay), and connect an ammeter in series in the circuit. Operate the top control switch and note the ammeter readings. The current draw should be 35 amps maximum operating, and 40-50 amps stalled, with a voltage reading of 9-10. Current in excess of 75 amps indicates a frozen pump or cylinder or a mechanical obstruction. Low amperage with the motor running and no top movement indicates a defective pump or low fluid level in the reservoir.

**Top Control Switch**

**1.** Connect one terminal of a test lamp to the black (feed) wire of the top control switch, and ground the other lead (Fig. 1). If the test lamp does not light, there is an open or short circuit between the battery and the switch.

**2.** If there is voltage to the switch, connect a jumper wire between the black (feed) wire and the red wire, and then between the black wire and the yellow wire (Fig. 1). If the top motor operates, the switch is faulty and must be replaced.

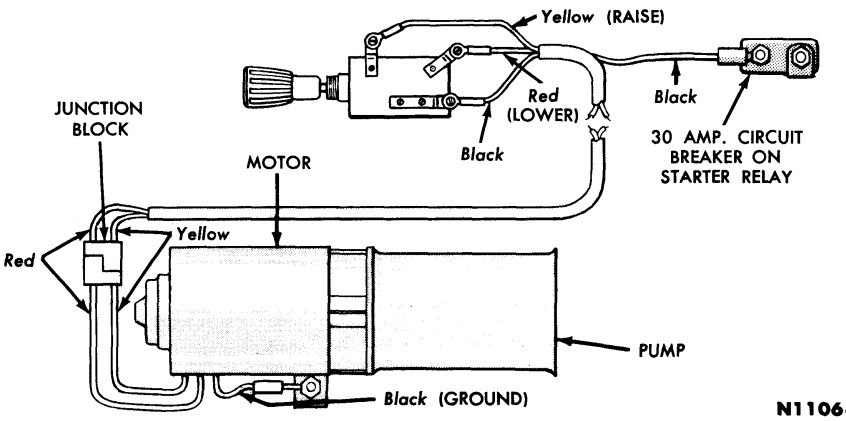



**FIG. 1—Convertible Top Electrical Circuit**

| Symptoms | Possible Causes | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Top Control Switch | Inadequate Battery Charge | Motor | Circuit Breaker | Faulty Wiring | Hydraulic Cylinder(s) | Air in Hydraulic System | Insufficient Hydraulic Fluid | Bent Linkage | Top Lowered When Wet Causing Fabric to Shrink | Pivot Bracket Adjustment | Toggle Clamp Adjustment* | Door Window Adjustment* | Quarter Window Adjustment* | Weatherstripping | Balance Link Bracket Adjustment |
| Top Does Not Retract | x | x | x | x | x | x | x | x | x | | | | | | | |
| Top Action Sluggish | | x | | | x | x | x | x | x | | | | | | | |
| Top Sides Operate Unevenly | | | | | | x | | | x | | | | | | | |
| Top Does Not Stack | | | | | | | | | | | x | | | | | x |
| Side Rail(s) Do Not Fit | | | | | | | | | | | | | x | x | | x |
| Top Does Not Rise From Stack | x | x | x | x | x | x | x | x | x | | | | | | | |
| Top Does Not Latch | | | | | | | | | x | x | x | x | | | | |
| Top Leaks | | | | | | | | | x | | | x | x | x | x | |

*Top should not be raised with windows up

**Circuit Breaker.** If there is no voltage at the top control switch, connect a jumper wire across the terminals of the circuit breaker (located on the starter relay) and operate the switch. If the top motor operates, the circuit breaker is faulty and must be replaced. If there is no voltage at the circuit breaker, check the black wire from the circuit breaker to the starter relay.

**Switch-to-motor Wires.** Disconnect the yellow and the red switch-to-motor leads at the junction block near the motor. Connect a test lamp between the yellow wire and a ground, and check by operating the top control switch to raise the top. Connect the test lamp between the red wire and a ground, and check by operating the switch to lower the top. If the test lamp does not light in either case, the wire from the junction block to the switch is open or shorted.

**Motor.** Check the operation of the motor by connecting first one motor lead, and then the other, directly to the battery positive terminal. If the motor operates in either case, but will not operate when hooked into the wiring harness, check the wiring harness again for short or open circuits. If the motor will not work when hooked directly to the battery, check the black (ground) wire from the motor. If the motor still does not work, it must be replaced.

## HYDRAULIC TESTS

Faulty hydraulic system operation can be caused by lack of fluid, leaks, air in the system, obstructions or kinks in the hoses, or faulty operation of a cylinder or the pump.

### Fluid Level

1. Remove the rear seat and raise the top.
2. Place absorbent cloths below the filler plug.
3. Remove the filler plug, and check the fluid level. It should be level with the bottom edge of the hole.
4. If the level is low, check the system for leaks, adding automatic transmission fluid–Type A, Suffix A –as necessary.

**Lift Cylinder.** Remove the rear seat and the quarter trim panels, operate the top control switch, and observe the operation of the lift cylinders for the following:

If the movement of the piston rods is sluggish or uneven, check the hoses from the pump to the cylinders for kinks.

If one piston rod moves more slowly than the other, the cylinder with the slower rod is defective and should be replaced.

If both rods move slowly, or do not move at all, disassemble and repair the pump.

## 3 ADJUSTMENTS AND LIGHT REPAIR

If the top is misaligned, corrections should not be made until after a check has been made for bent linkage.

Before aligning the top, visually determine if the trouble results from top misalignment and/or window misalignment. It may be necessary to align both the top and the windows because of the relationship between the two. Adjustments of the door and quarter windows must be checked and any necessary changes made before making top adjustments. These windows must be fully closed to insure proper adjustment. Door window and quarter window adjustments are outlined in Part 17-3.

### SIDE RAIL WEATHERSTRIP ADJUSTMENTS

The side rail weatherstrips can be adjusted laterally and also fore and aft (Fig. 2).

Adjust the weatherstrips laterally so that the sealing lips make full contact with the door and quarter window frames.

Adjust the weatherstrips fore or aft to butt the ends of the weatherstrips together for a watertight seal.

### STRIKER PLATE ADJUSTMENT

The striker plates must be aligned with the dowel pins prior to making other top adjustments. The dowel pins are not adjustable. A slight lateral adjustment of the striker plate is provided by loosening the striker plate retaining screws.

### TOGGLE CLAMP ADJUSTMENT

The toggle clamps that hold the header bow against the header can be adjusted to provide a good seal.

**1.** To determine which side is not sealing, check the weatherstrip between the header bow and the header. Refer to Fig. 2 for side rail weatherstrip installation. Both toggle clamps need not be adjusted unless necessary.

**2.** Release the toggle clamps, and thread the toggle hook in or out until adequate sealing pressure is applied at the header weatherstrip. Excessive tightening of the toggle hooks will distort the No. 1 bow and cause poor weatherstrip sealing.

### BALANCE LINK ADJUSTMENT

The balance link adjusting bracket is mounted on the main pivot bracket support (Fig. 3). Two adjustments

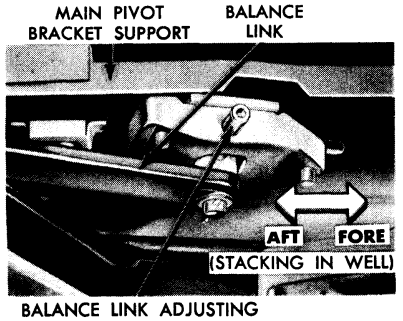



**FIG. 3—Balance Link Adjustment**

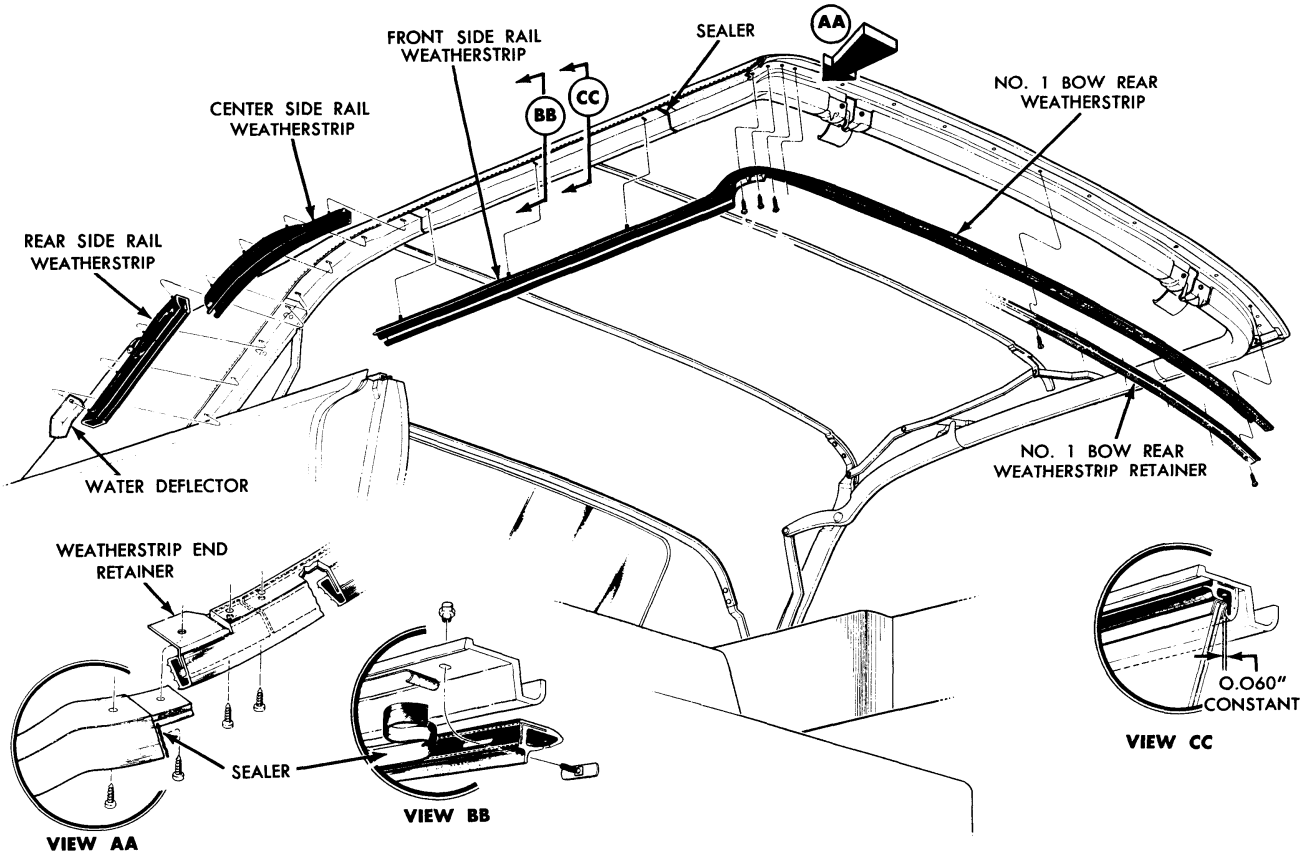



**FIG. 2—Convertible Top Weatherstrip and Adjustment**

are provided at the bracket. Sliding the bracket in the elongated mounting holes permits proper stacking of the top in the well. Turning the Allen head adjusting screw adjusts the side rail to glass clearance.

**Side Rail Sag.** If the side rail sags above the door glass, adjust as follows:

**1.** Use the top of the door glass and quarter glass as reference points to determine the proper level of the side rail.

**2.** Have the top locked in the fully raised position.

**3.** With an Allen wrench, turn the adjusting screw in the balance link adjusting bracket down to raise the side rail. The adjusting bracket retaining screws should be loosened during this adjustment.

**4.** If the side rail is too high, or crowned, above the windows, turn the adjusting screw up to lower the side rail.

**Top Stack.** If the top stacks too high in the well, it will be difficult to fasten down the boot. To obtain proper stacking, loosen the main pivot bracket mounting screws, and let the bracket seek its own position. Then tighten the main pivot bracket retaining screws.

### MAIN PIVOT BRACKET ADJUSTMENTS

The main pivot bracket is mounted on the main pivot bracket support. The support is mounted to the inner quarter panel and the wheelhouse extension. The main pivot bracket mounting provides for shifting of the entire top assembly, fore and aft, vertically and laterally.

**Fore and Aft Adjustment.** This adjustment moves the top assembly straight forward or rearward to obtain a good fit between the rear side rail weatherstrip and the rear edge of the quarter glass. The top assembly can also be moved across the windshield header by this adjustment.

**1.** Loosen the balance link retaining screws and disconnect the top assembly lift cylinders.

**2.** Loosen the screws which retain the main pivot bracket support to the inner quarter panel and to the wheelhouse extension (Fig. 4).

**3.** Shift the entire pivot bracket support fore or aft as required to bring the rear side rail in proper relationship to the quarter glass and tighten the main pivot bracket retaining bolts.

**4.** Tighten the balance link retaining screws and connect the top assembly lift cylinders.

**Vertical Adjustment.** This adjustment moves the top assembly to obtain a good fit between the windshield header and the top assembly, and between the top assembly and the window glass line.

**1.** Loosen the screws which retain the main pivot bracket to its support (Fig. 4).

**2.** Shift the main pivot bracket up or down as necessary to obtain the proper clearance along the side rails and quarter and door glass.

**Lateral Adjustment.** This adjustment shifts the top assembly sidewise to obtain a good seal between the side of the rear side rail and the quarter outside rear side belt moulding.

**1.** Loosen the screws which retain the main pivot bracket to its support.

**2.** Shift the main pivot bracket toward either side as necessary to obtain the proper clearance (0.38 inch) between the rear side rail and the quarter outside rear side belt mouldings and tighten the retaining screws.

**3.** Adjust the side rail weatherstrips as necessary to obtain a satisfactory seal along the glass line.

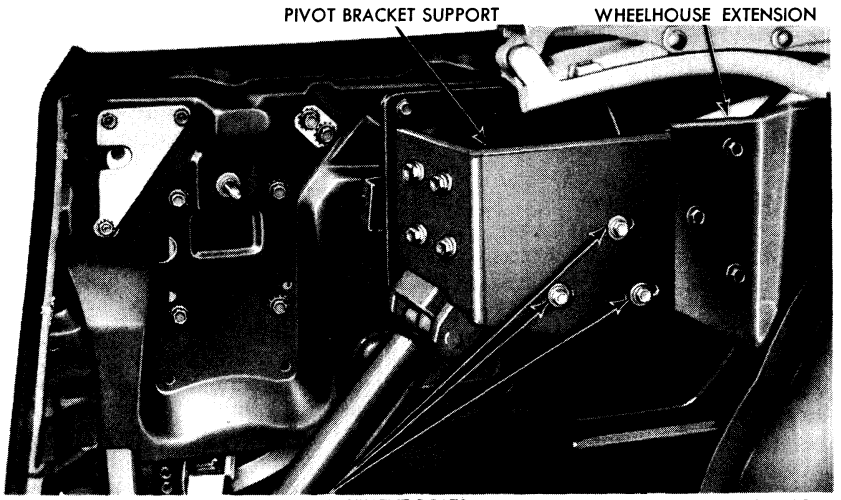



**FIG. 4—Main Pivot Bracket Adjustment**

## 4 REMOVAL AND INSTALLATION

### MOTOR AND PUMP

A pump repair kit and a reservoir repair kit are available for service.

REMOVAL

**1.** Operate the top to the fully raised position.

**2.** Remove the rear seat cushion.

**3.** Disconnect the motor leads and the ground wire.

**4.** Remove the attaching screws, and remove the motor and pump assembly from the floor pan. Do not lose the rubber grommets.

**5.** Vent the reservoir by removing the filler plug, and then reinstall the filler plug. **The reservoir must be vented in order to equalize the pressure. This lessens the possibility of fluid spraying on the trim and paint when the hoses are disconnected.**

**6.** Place absorbent cloths beneath the hose connections, disconnect the hoses, and then plug the open fittings and lines.

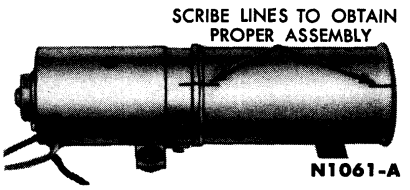



**FIG. 5—Reservoir Marked Before Disassembly**

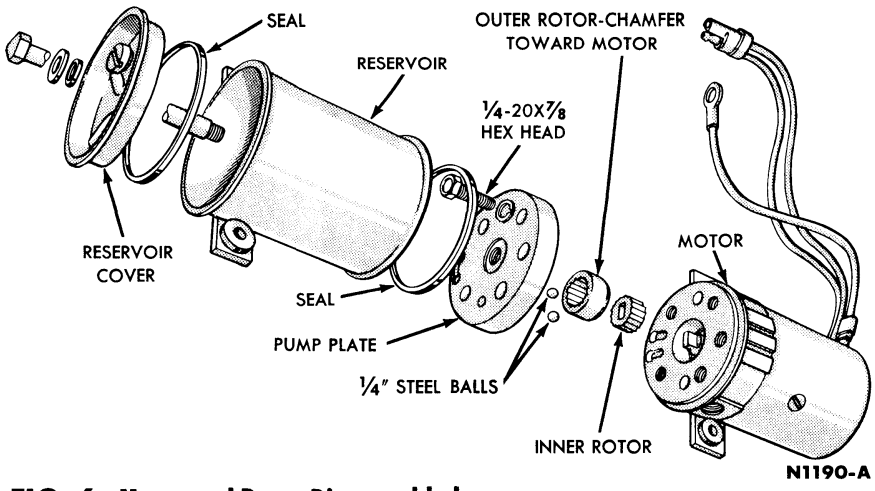



**FIG. 6—Motor and Pump Disassembled**

DISASSEMBLY

**1.** Remove the filler plug, and drain the fluid from the reservoir into a clean container.

**2.** Scribe lines on the reservoir, pump body, and reservoir cover so these parts can be positioned properly upon assembly (Fig. 5).

**3.** Remove the center bolt from the reservoir cover (Fig. 6).

**4.** Remove the cover and reservoir, and the seal at each end of the reservoir.

**5.** Remove the mounting bolts that hold the valve body on the pump body.

**6.** Place a cloth under the assembly, and carefully remove the valve body so that the check balls are not lost.

**7.** Remove both rotors and the drive ball.

ASSEMBLY

Use all the parts contained in the pump repair kit when assembling the pump or reservoir.

**1.** Install the drive ball and inner rotor on the armature shaft.

**2.** Install the outer rotor over the inner rotor.

**3.** Place the check balls in the pump body channels.

**4.** Install the valve body on the pump body.

**5.** Install the valve body mounting bolts.

**6.** Install a seal in each end of the reservoir.

**7.** Install a new seal on the center bolt, and install the reservoir and cover on the valve body, using the lines previously scribed as guides (Fig. 5).

**8.** Place the assembly in a horizontal position, fill the reservoir with automatic transmission fluid Type A, Suffix A to the level of the bottom of the filler plug hole. Install the filler plug and new seal.

INSTALLATION

**1.** Remove the plugs from the lines and fittings, and connect the lines to the pump. Use cloths to absorb any fluid that leaks out of the lines or the pump.

**2.** Install the assembly on the floor pan, making sure the rubber grommets are in proper position under the mounting brackets.

**3.** Connect the motor lead wires and ground wire.

**4.** Loosen the reservoir filler plug and operate the top assembly two or three times to bleed any air from the system. Check the fluid level in the reservoir and tighten the filler plug. **The top must be up when the level is checked.**

**5.** Install the rear seat cushion.

## LIFT CYLINDER REMOVAL AND INSTALLATION

**1.** Operate the top to the fully raised position.

**2.** Remove the rear seat cushion and back and the quarter trim panels.

**3.** Remove the cylinder assembly support pivot bracket retaining bolts and bracket.

**4.** Remove the hair pin clip and clevis pin at the top end of the cylinder and remove the cylinder.

**5.** Disconnect and plug the hydraulic lines at the upper and lower ends of the cylinder. Use absorbent cloths to catch any fluid that leaks out.

**6.** Position the cylinder in the floor bracket with the hose connections facing down.

**7.** Connect the hydraulic lines to the cylinder.

**8.** Install the clevis pin and hair pin clip at the top end of the cylinder.

**9.** Position the cylinder assembly to the support pivot bracket and install retaining bolts.

**10.** Loosen the reservoir filler plug and operate the top assembly two or three times to bleed any air from the system.

**11.** With the top in the raised position, check the reservoir fluid level.

**12.** Install the quarter trim panels and the rear seat back and cushion.

## TOP REAR SIDE RAIL REMOVAL AND INSTALLATION

**1.** Unfasten the clamps that hold the top to the windshield header.

**2.** Remove the rear seat cushion, seat back and quarter trim panel.

**3.** Remove the bolts and nuts retaining the rear side rail weatherstrip (Fig. 2) and remove the weatherstrip.

**4.** Pull the top fabric from the rear side rail.

**5.** Lift the top and temporarily support it in a vertical position. Remove the cotter pin and washers retaining the pivot pin at the control link, rear side rail, and number 3 bow bracket (Fig. 7). Lift the top to the closed position, but do not fasten the windshield header clamps.

**6.** With a block of wood, support the center side rail.

**7.** Remove the roll pin and pivot pin retaining the center side rail to the rear side rail.

**8.** Remove the cotter pin, washers, and pivot pin retaining the rear bow and rear side rail.

**9.** Remove the pivot pin retaining the top control link, rear side rail and number 3 bow.

**10.** Remove the roll pin and pivot pin retaining the power link to the rear side rail.

**11.** Pry the rear side rail from the center side rail.

**12.** Remove the cotter pin, washer, and pivot pin retaining the rear side rail to the main pivot bracket support.

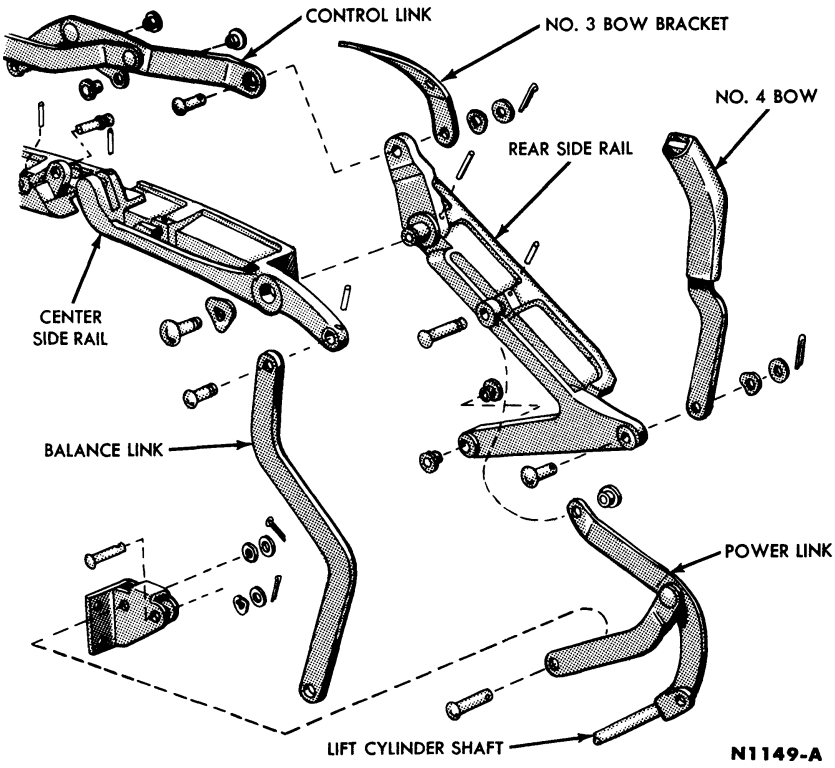



**FIG. 7—Rear Side Rail Connections**

**13.** Remove the rear side rail.

**14.** Transfer the rear side rail bushings and deflector to the new rear side rail.

**15.** Connect the rear side rail to the main pivot bracket with the pivot pin, washer and cotter pin (Fig. 7).

**16.** Connect the power link to the rear side rail with the pivot pin and roll pin.

**17.** Connect the center side rail to the rear side rail with the pivot pin and roll pin.

**18.** Connect the rear bow to the rear side rail with the pivot pin, washer, and cotter pin.

**19.** Lift the top, temporarily support it in a vertical position, and remove the center side rail temporary support. Connect the top control link and the number 3 bow to the rear side rail with the pivot pin, washer, and cotter pin.

**20.** Cement the top fabric to the rear side rail and install the weatherstrip.

**21.** Close the top and fasten the windshield header clamps.

**22.** Install the quarter trim panel, rear seat back and seat cushion.

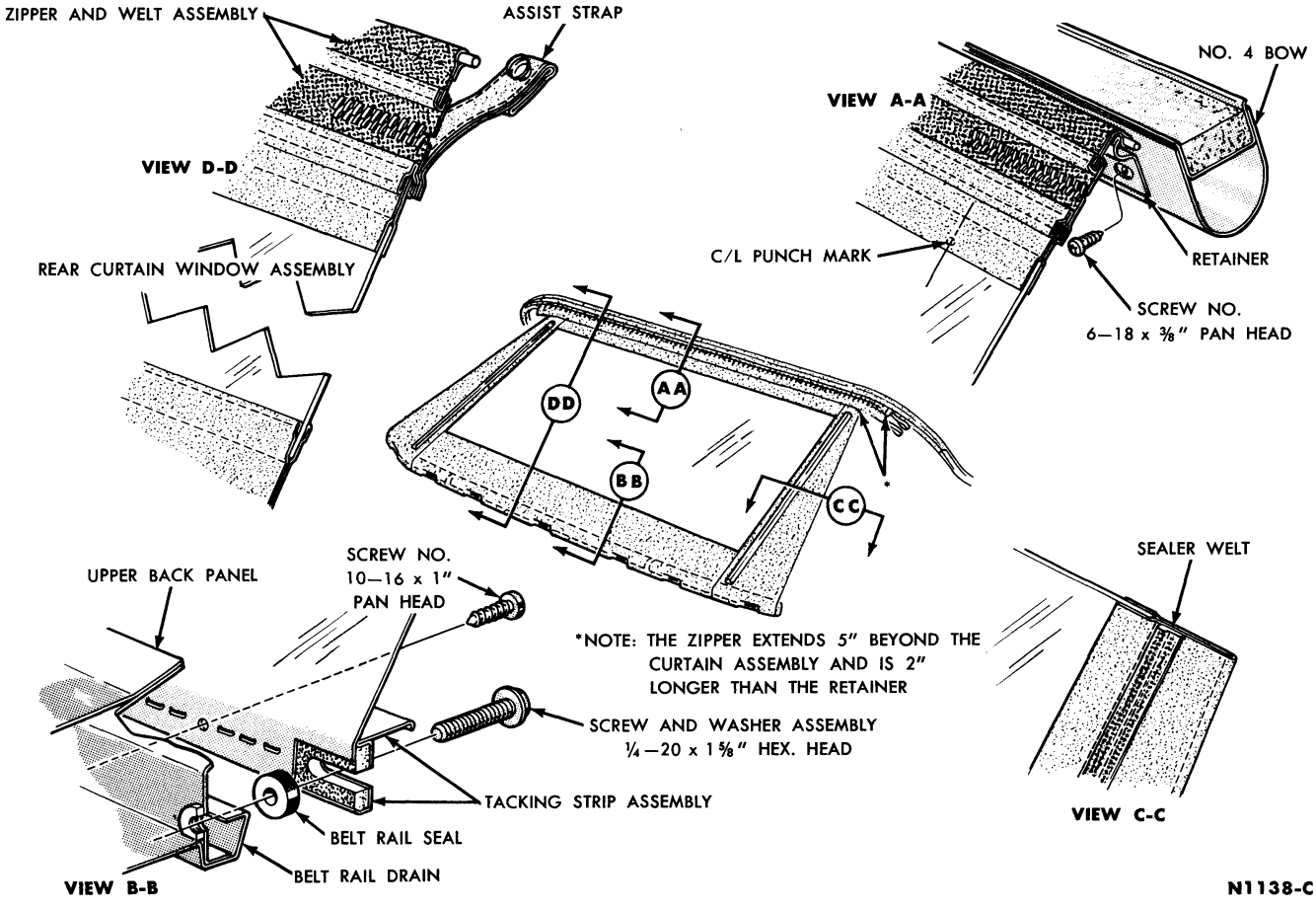



**FIG. 8—Back Curtain Window**

### BACK CURTAIN WINDOW REMOVAL AND INSTALLATION

1. Unfasten the clamps that hold the top to the windshield header.
2. Unsnap the well cover from the back curtain window rear and side belt tacking strips.
3. Remove the bolts and lockwashers that retain the curtain rear and side belt tacking strips to the body panel.
4. Open the back curtain window slide fastener and remove the curtain assembly.
5. Pull the tacking strips from the curtain and remove the staples from the tacking strip.
6. Remove the tacking strip adjustment retaining screws from the tacking strips (Fig. 8).
7. Align the belt center tacking strip on the curtain and staple the curtain securely to the tacking strip.
8. Staple the side tacking strips to the curtain.
9. Position the curtain assembly to the body panel, and loosely install the belt tacking strip retaining bolts and lock washers.
10. Close the curtain window slide fastener and fasten the top clamps at the windshield header.
11. To adjust the curtain window, tighten or loosen the tacking strip retaining bolts as required. After adjusting the curtain, install and tighten the tacking strip adjustment retaining screws until they bottom against the body panel.
12. Snap the top well cover retainers into the tacking strip.

### UPPER HALF CURTAIN SLIDE FASTENER REMOVAL AND INSTALLATION

1. Unfasten the top clamps at the windshield header, and then open the curtain window slide fastener.
2. Using a marking pencil, mark mating lines at the center of the No. 4 bow, the retainer, and the slide fastener and welt assembly.
3. Loosen the retainer attaching screws along the back face of the No. 4 bow sufficiently and remove the upper half of the slide fastener and welt assembly (Fig. 8).
4. Remove the upper half of the slide fastener from the welt assembly.
5. Position the upper half of the slide fastener on the welt assembly and sew. Make sure the slide fastener overhangs the welt by the same amount as the original installation.
6. Position the welt portion of the slide fastener in the retainer on the No. 4 bow center, using locating marks, and tighten the retaining screws.
7. Close the slide fastener, and then fasten the top clamps at the windshield header.
8. To adjust the curtain window unsnap the convertible top well cover from the curtain rear and side belt tacking strips. Loosen the tacking strip adjustment retaining screws. Then, tighten or loosen the tacking strip retaining bolts as required.
9. After adjusting the curtain, tighten the tacking strip adjustment retaining screws until they bottom against the body panel. Snap the top well cover retainers into the tacking strip.

### LOWER HALF CURTAIN SLIDE FASTENER REMOVAL AND INSTALLATION

1. Unfasten the convertible top clamps at the windshield header.
2. Unsnap the convertible top well cover from the curtain rear and side belt tacking strips.
3. Remove the bolts and lock washers that retain the curtain rear and side belt tacking strips to the body panel (Fig. 8).
4 Open the curtain window slide fastener, and remove the curtain assembly.
5. Cut the old slide fastener from the curtain and sew the new slide fastener in place.
6. Loosen the tacking strip adjustment retaining screws.
7. Position the curtain assembly to the body panel, and loosely install the belt tacking strip retaining bolts and lock washers.
8. Close the curtain window slide fastener and fasten the top clamps at the windshield header.
9. To adjust the curtain window, tighten or loosen the tacking strip retaining bolts as required. After adjusting the curtain, tighten the tacking strip adjustment retaining screws until they bottom against the body panel.
10. Snap the top well cover retainers into the tacking strip.

### CONVERTIBLE TOP FABRIC REMOVAL AND INSTALLATION

The convertible top consists of the deck and two side quarters, bonded into one piece of material. The bonded seams eliminate the possibility of leaks and also separation, due to thread deterioration. In most cases it will be advantageous to replace the back curtain when replacing the top fabric.

#### REMOVAL

1. Place a protective cover across the deck, cowl and hood to prevent scratching the finish when replacing the top.

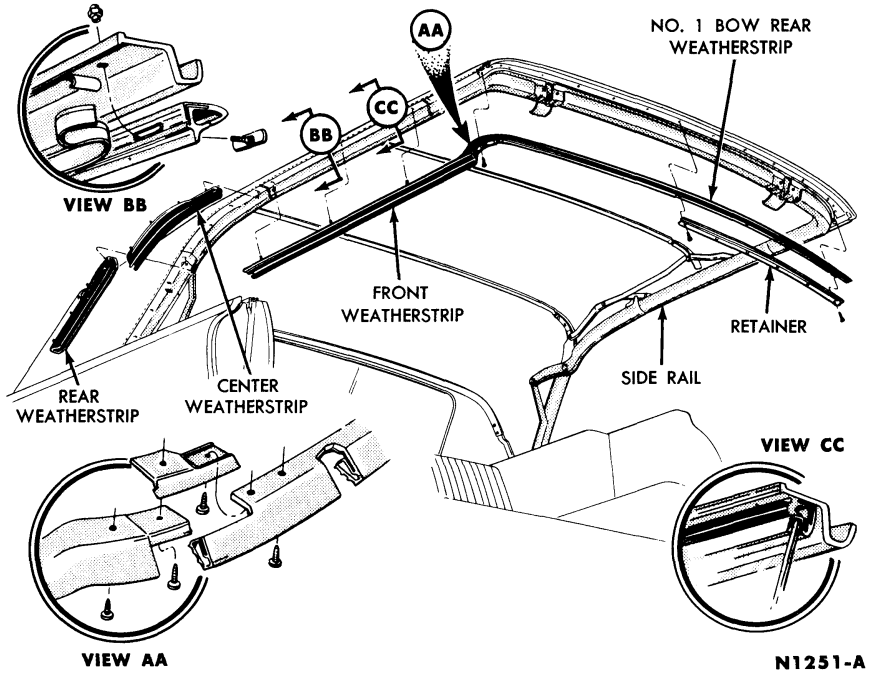



**FIG. 9—Weatherstrip Installation**

2. Remove the rear seat cushion and seat back.

3. Raise the top to gain access to the underside of the front bow.

4. Remove the front weatherstrip retainer (Fig. 9) and the weatherstrip.

5. Remove the two front side rail weatherstrip retainers and the weatherstrips.

6. Remove the two center side rail and the two rear side rail weatherstrips.

7. Remove the metal screw and washer that secures each end of the folding top compartment well to the pivot bracket supports.

8. Starting at one end of the compartment, carefully pull the trim retainer out of the channel. Fold the trim over the seat area and quarter panel trim.

9. Remove the tip from each end of the moulding on the rear bow. Carefully pull the moulding out of the retainer. Pry the moulding retainer off the bow.

10. Remove the bolts that attach the top and back curtain tacking strips to the body.

11. Remove the staples that secure the top material to the rear bow.

12. Carefully pull the top material free from the underside of each side rail.

13. Remove the staples that secure the top material to the underside of the front bow.

14. Carefully separate the top from the listings on No. 2 and 3 bows.

## INSTALLATION

1. Remove the tacking strips from the old top.

2. Staple them to the new top in the same location as they were on the old top.

3. Fit the new top on the roof bows.

4. Working from the center outward, staple the top deck to the rear bow. Make sure that the rear section of the slits is stapled to the bow before drawing and stapling the front portion of the slits.

5. Secure, and tighten the quarter deck tacking strips to the body as required to align the listings with the No. 2 and 3 bows.

6. Center the top material and pull it forward over the front bow to remove the wrinkles from the top deck and quarters. While the material is pulled over the front bow, make a reference mark on the material at the leading edge of the bow with a piece of chalk. The mark should extend the entire length of the bow.

7. Raise the top high enough to gain access to the underside of the front bow.

8. Align the reference mark to the leading edge of the bow and staple the material in place.

9. Install the weatherstrip and the three retainers on the No. 1 bow.

10. Secure the flaps to the underside of the side rail with trim cement. Trim the excess material from the flaps.

11. Install the rear, center and the front weatherstrips on the side rails so that the end of the weatherstrips are in alignment of the side rail joints.

12. Tighten the quarter deck tacking strips as required to remove wrinkles from the material and obtain a tight seal at the mouldings.

13. Install a piece of tape across the rear bow to cover the staples.

14. Install the moulding retainer, moulding and the two tips on the rear bow.

15. Secure the back curtain to the upper part of the zipper.

16. Secure the back curtain tacking strip in place with the attaching bolts. Tighten the bolts as required working from the center outward.

17. Starting at one end of the folding top compartment, insert the trim retainer into the channel.

18. Secure each end of the trim to the pivot bracket supports with a metal screw and washer.

19. Install the rear seat back and cushion.

20. Cement the top material to the listings on the No. 2 and 3 bows.

21. Remove the protective covers from the deck and the hood.

22. Clean all chalk reference marks from the top material.

# MAINTENANCE SCHEDULE

# GROUP 19

| THOUSANDS OF MILES OR NUMBER OF MONTHS, WHICHEVER OCCURS FIRST (Except Where Noted) | As Required | 6 | 12 | 18 | 24 | 30 | 36 |
|---|---|---|---|---|---|---|---|
| **ENGINE** | | | | | | | |
| Change oil and filter | | X | X | X | X | X | X |
| Check oil level | | | At Fuel Stops | | | | |
| Adjust carburetor—idle speed, idle mixture, and fast (cold) idle speed (automatic choke only) | X | | | | | | |
| Adjust power steering idle speed (289 C.I.D.) compensator | X | | | | | | |
| Clean carburetor air cleaner and filter | | X | X | X | X | X | |
| Replace carburetor air cleaner and filter | | | | | | | X |
| Clean crankcase oil filler breather cap | | X | X | X | X | X | |
| Check engine accessory drive belts and adjust or replace as required | | X | | X | | X | |
| Valve tappet adjustment—(conventional)—289-4V C.I.D. and 427 C.I.D. high performance engine only) | | | X | | X | | X |
| Valve tappet adjustment—(mechanical silent lash)—223 C.I.D. | X | | | | | | |
| Clean positive crankcase ventilation system | | | X | | X | | X |
| Clean positive crankcase ventilation system valve | | X | X | X | X | X | X |
| Check ignition timing and adjust as required | | | X | | X | | X |
| Check and adjust or replace distributor points | X | | | | | | |
| Check and adjust or replace spark plugs | X | | | | | | |
| Replace fuel filter (427 C.I.D. only) | | X | X | X | X | X | X |
| Lubricate exhaust control valve (223-427 C.I.D. only) | | X | X | X | X | X | X |
| Adjust accelerator pump lever | X | | | | | | |
| Replace engine coolant | | | | | | | X* |
| Check engine coolant level | X | | | | | | |
| **TRANSMISSION** | | | | | | | |
| Adjust automatic transmission bands — Rear | X | | | | | | |
| Adjust automatic transmission bands — Front | | | | | | | X |
| Check transmission oil level | | X | X | X | X | X | X |
| **CHASSIS** | | | | | | | |
| Lubricate automatic transmission kickdown linkage | X | | | | | | |
| Check clutch linkage adjustment (standard and overdrive) | X | | | | | | |
| Inspect and cross-switch wheels and tires | X | | | | | | |
| Check power steering reservoir fluid level | | X | X | X | X | X | X |
| Check master cylinder fluid level | | X | X | X | X | X | X |
| Check axle fluid level | | X | X | X | X | X | X |
| Lubricate front suspension ball joints | | | | | | | X |
| Lubricate steering linkage | | | | | | | X |
| Change power steering filter | | | | | | | X |
| Check and adjust steering gear pre-load as required | | | X | X | X | X | X |
| Clean and pack front wheel bearings as required | | | | | X† | | |
| Lubricate universal joints | | | | | | | X |
| Check brake lines and lining | | | | | X | | |
| Check air conditioning system | | | Annually at Beginning of A/C Season | | | | |
| Check front wheel alignment and linkage and adjust as required | | | X | | X | | X |
| Check tire pressure | X | | | | | | |
| Check battery fluid level | X | | | | | | |
| **BODY** | | | | | | | |
| Lubricate hood latch | X | | | | | | |
| Lubricate hood auxiliary catch | X | | | | | | |
| Lubricate door lock cylinders | X | | | | | | |
| Lubricate luggage compartment lock cylinder | X | | | | | | |
| Lubricate tailgate lock cylinders | X | | | | | | |
| Lubricate tailgate support and hinges | X | | | | | | |
| Lubricate fuel filler door hinges | X | | | | | | |
| Check convertible top operation | X | | | | | | |
| Check convertible top fluid level | X | | | | | | |
| Replace windshield wiper blades | X | | | | | | |
| Lubricate door hinge and hinge check | X | | | | | | |
| Lubricate hood hinge pivots | X | | | | | | |
| Lubricate luggage compartment hinge pivots | X | | | | | | |

*Or every two years †At mileage interval only

# MAINTENANCE OPERATIONS

# GROUP 20

# PART 20-1 MAINTENANCE OPERATIONS


| Section | Page | Section | Page |
|---|---|---|---|
| 1 Engine | 20-1 | 3 Chassis | 20- 9 |
| 2 Transmission | 20-7 | 4 Body | 20-15 |


## 1 ENGINE

### CHANGE OIL AND FILTER

1. Raise the car.

2. Remove the oil pan drain plug and allow the engine oil to drain into a container.

3. Place a drip pan under the filter. Unscrew the filter from the adapter fitting.

4. Coat the gasket on the filter with oil. Place the filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

5. Replace the oil pan drain plug and tighten it securely.

6. Refill the crankcase with the proper amount and grade of oil.

7. Lower the car.

8. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage.

### ADJUST CARBURETOR—IDLE SPEED, IDLE MIXTURE AND FAST (COLD) IDLE SPEED (AUTOMATIC CHOKE)

#### FORD SINGLE-BARREL CARBURETOR

**Idle Adjustments.** A stop screw at the throttle lever flange of the carburetor (Fig. 1) controls the engine idle speed. Turn the screw outward (counterclockwise) to increase the engine idle speed and inward (clockwise) to decrease the engine idle speed. Make the idle adjustments in the sequence listed.

INITIAL CURB IDLE. The initial curb idle adjustment will automatically set the initial fast idle rpm required.

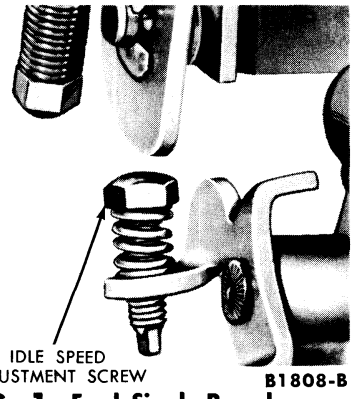



**FIG. 1—Ford Single-Barrel Idle Speed Adjustment**

Position the choke control lever so that the choke plate is fully open. Seat the throttle plate in the throttle bore. **It may be necessary to back off on the dashpot adjustment screw to seat the throttle plate in the throttle bore.** Set the idle adjusting screw to just make contact with the cam contour; then, turn the screw outward (counterclockwise) an additional turn.

The "Final (Hot) Engine Idle and Fuel Mixture" adjustments provide the specified rpm required for the car model.

FINAL (HOT) ENGINE IDLE AND FUEL MIXTURE

1. Place the transmission selector lever in neutral position and set the parking brake.

2. Operate the engine at fast idle until the temperature has stabilized (approximately 1200 rpm for 30 minutes).

3. Attach a tachometer to the engine.

On a car with a manual-shift transmission, turn the idle speed "stop" screw in a direction to obtain the specified rpm. Open the throttle by hand and allow it to close normally. Recheck the engine idle speed.

On a car with an automatic transmission, **be sure the parking brake is on.** Place the transmission selector lever in neutral position. Check the engine idle speed and adjust it to the specified rpm in drive range.

Final engine idle speed may be varied to suit the conditions under which the car is to be operated.

4. Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can

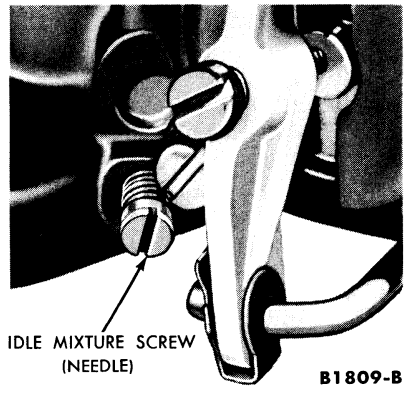



**FIG. 2—Ford Single-Barrel Idle Fuel Mixture Adjustment**

be checked after the mixture has been adjusted.

IDLE MIXTURE. The idle fuel mixture is controlled by the idle mixture adjusting needle (Fig. 2). Turn the needle inward to lean the mixture, and outward to enrich the mixture.

1. Adjust the engine idle speed.

2. Make the initial mixture adjustment by turning the screw inward until it lightly touches its shoulder; then, back it off the specified number of turns.

3. Be sure the engine is at normal operating temperature.

4. Turn the idle mixture screw (needle) inward until the engine rpm begins to drop, due to the lean mixture. Turn the needle screw outward until the engine rpm increases and begins to drop again, due to the rich mixture; then, turn the screw inward for maximum engine rpm and smoothness. **Always favor a rich mixture rather than a lean mixture.**

5. Check the engine idle speed and adjust it, if necessary.

## FORD 2- AND 4-BARREL CARBURETOR

### Engine Idle Speed and Mixture (Hot)

1. Operate the engine for 30 minutes at 1200 rpm to stabilize engine temperatures. Be sure the dashpot is not interfering with the throttle lever, and make sure the choke fast idle cam is in the slow position (fast idle screw not contacting the fast idle cam).

**On a car with an air conditioner, operate the air conditioner for 20 minutes before setting the engine idle speed.**

2. Attach a tachometer to the engine. On a car with an automatic transmission, set the parking brake. Place the transmission selector lever in neutral range. Check the engine idle speed. Adjust the engine idle speed to specifications by turning the screw inward to increase the speed or by turning the screw outward to decrease the speed. **When performing this adjustment, be sure the dashpot is not interfering with the throttle lever or the fast idle adjusting screw is not contacting the fast idle cam.**

On a car with a manual-shift transmission, the engine idle speed is checked and adjusted with the transmission selector lever in neutral position. Adjust the engine idle speed to specifications by turning the screw inward to increase the speed or outward to decrease the speed. Be sure the fast idle screw is not touching the fast idle cam when performing this adjustment.

3. Turn each mixture screw (needle) in until the engine rpm begins to drop, due to the lean mixture. Turn the needles out until the engine rpm increases and then begins to drop, due to the rich mixture; then, turn the needles inward for maximum engine rpm and smoothness. The needles should be turned approximately the same amount. The final setting may vary about ½-turn difference between the needles. Always favor a slightly rich mixture rather than a lean mixture.

4. Check the final engine idle speed by manually opening and closing the throttle. Adjust the idle speed, if necessary.

Final engine idle speed may be varied to suit the conditions under which the car is to be operated.

**Engine Fast (Cold) Idle Speed.** The adjusting screw on the right side of the carburetor contacts one edge of the fast idle cam. The cam permits a faster engine idle speed for smoother running when the engine is cold during choke operation. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Each position on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

Manually rotate the fast idle cam until the fast idle adjusting screw rests on the next to highest (starting) step of the fast idle cam, adjacent to the shoulder (kickdown step).

Start the engine and turn the fast idle adjusting screw as required to obtain the specified fast idle rpm.

Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can be checked after the idle fuel mixture has been adjusted.

## HOLLEY 4-BARREL CARBURETOR

**Engine Idle Speed.** The engine idle speed is adjusted to settings for a hot engine and a cold engine (fast idle speed) during choke operation.

1. Operate the engine for 30 minutes at 1200 rpm. **On a car with an air conditioner, operate the air conditioner for 20 minutes before setting the engine idle speed.**

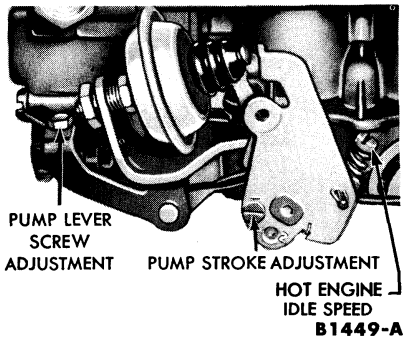



**FIG. 3—Holley 4-V Idle Adjustments—Typical**

2. When the engine temperature has stabilized and the choke fast idle cam is in the slow position (bottom step on cam contacting the fast idle adjusting screw), back off the fast idle screw from the fast idle cam.

3. Attach a tachometer to the engine.

4. With the transmission shift lever in neutral position, adjust the engine idle speed to specified rpm by turning the screw in to increase the speed or by turning the screw out to decrease the speed (Fig. 3).

5. After the correct engine idle speed has been obtained, open the throttle by hand and allow it to close normally. Check the engine idle speed.

6. The adjusting screw, on the right side of the carburetor, contacts steps on the fast idle cam during the engine warm-up period and controls the fast idle speed (Fig. 4). Steps on one edge of the fast idle cam permit a faster engine idle speed for smooth-

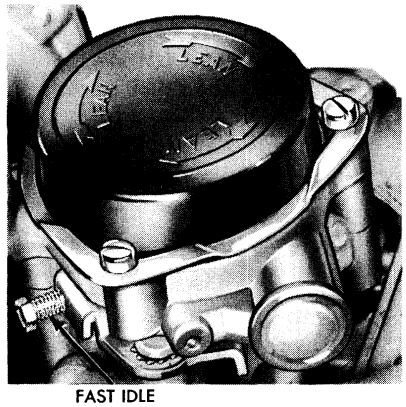



**FIG. 4—Holley 4-V Fast Idle Adjustments**

er running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Each step on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

Set the fast idle speed with the engine at normal operating temperature. Align the kickdown step of the fast idle cam with the adjusting screw, and turn the adjusting screw to obtain the specified fast idle speed (rpm).

Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can be checked after the idle fuel mixture has been adjusted.

### DUAL HOLLEY 4–BARREL

**Idle Adjustments**

In order to achieve a satisfactory, stable idle and fuel mixture adjustment, it is of utmost importance that the idle fuel system be balanced as close as possible. This can be achieved only by establishing initial idle speed and mixture adjustments before proceeding with the final idle speed and mixture adjustment and the fast (cold) idle speed adjustment.

The engine idle speed is adjusted to settings for a hot engine and a cold engine (fast idle speed) during choke operation. All final idle speed and mixture adjustments must be made on a hot, normalized engine.

#### INITIAL IDLE SPEED AND MIXTURE ADJUSTMENTS

**1.** Turn the idle (hot engine) speed screw on each carburetor outward until the throttle plates close tight in the throttle bores. It may be necessary to back the fast (cold) idle adjusting screws outward in order to close the plates tight in the bores.

**2.** Turn each idle (hot engine) speed adjusting screw inward 3 full turns. Readjust the fast (cold) idle on the front carburetor if the setting was altered.

**3.** Initially set the idle mixture by turning the idle mixture screws inward until they are lightly seated, then turn the screws outward one and one-half turns. **Do not turn the needles tightly against the seat as this may groove the ends. If a needle is damaged, it must be replaced before a satisfactory fuel mixture can be obtained.**

#### FINAL IDLE (HOT) SPEED AND MIXTURE ADJUSTMENT

**1.** Attach a tachometer to the engine. Place the transmission selector lever in neutral and set the parking brake. Start the engine.

**2.** Operate the engine until it reaches normal operating temperature. **If the car is equipped with an air conditioner, the engine must be operated at least 20 minutes.**

**3.** Adjust the engine idle speed to 750 rpm by turning each idle (hot engine) speed adjusting screw equally and alternately. **Turn the screws inward to increase the speed and outward to decrease the speed. Be sure the fast (cold idle) screw is not touching the fast idle cam when performing this adjustment.**

**4.** Adjust the idle fuel mixture by turning each idle mixture screw, starting with the front carburetor and finishing with the rear carburetor, inward until the engine begins to run rough from the lean mixture and; then turn the screw outward until it runs rough from the rich mixture and then inward just enough to smooth out the roughness. **Always favor a slightly rich idle fuel mixture.** Final adjustment of the screws should be within ⅛ turn of each other. It may be necessary to repeat step 3 to readjust the idle speed.

**5.** If the engine still does not idle properly, it may be caused by improper idle fuel mixture settings or the interconnecting linkage is not set properly.

**6.** Adjust the engine fast (cold) idle speed.

#### FAST (COLD) IDLE SPEED ADJUSTMENT

The fast (cold) idle speed adjustment is performed on the front carburetor only. The choke on the rear carburetor is inoperative.

**1.** With the transmission in neutral, engine at normal operating temperature, and the tachometer attached; adjust the fast idle screw so as to achieve the specified speed when the screw is set on the top of the fast idle cam.

## ADJUST POWER STEERING IDLE SPEED COMPENSATOR

### CHECK AND ADJUSTMENT

**1.** With the wheel in a straight-ahead position, set the engine to the proper idle speed.

**2.** If the engine idle speed is too high or low when the wheels are turned against the steering linkage stops, loosen the lock nuts on the power steering engine idle control valve mounting bracket. **Do not hold the wheels against the stops for periods over 15 seconds.**

**3.** Adjust the control valve until the proper engine idle speed can be maintained with the linkage against the stops.

**4.** Tighten the control valve lock nuts.

## CLEAN CARBURETOR AIR CLEANER AND FILTER

### REMOVAL

**1.** Remove the wing nut(s) retaining the air cleaner assembly to the carburetor and the air duct (if equipped with air duct).

**2.** Remove the air cleaner assembly from the carburetor. **To prevent dirt from entering the carburetor, the filter element must never be removed when the air cleaner body is mounted on the carburetor.**

**3.** Remove the cover and filter element. Discard the air cleaner mounting gasket on the carburetor if it is excessively worn or damaged.

### FILTER ELEMENT

**The filter element must never be cleaned with a solvent or cleaning solution. Also, oil must not be added to the surfaces of the filter element or air cleaner body.**

There are two alternate procedures that can be used to clean the air filter element. One method is performed with the use of compressed air. The other is performed by tapping the element on a smooth horizontal surface.

**Compressed Air Method.** Direct a stream of compressed air through the element in the direction opposite that of the intake air flow, that is from the inside outward. **Extreme care must be exercised to prevent rupture of the element material.**

**Tapping Method.** Hold the element in a vertical position and tap it lightly against a smooth, horizontal surface to shake the dust and dirt out. **Do not deform the element or damage the gasket surfaces by tapping too hard.** Rotate the filter after each tap until the entire outer surface has been cleaned.

**Inspection.** Hold the filter in front of a back-up light and carefully inspect it for any splits or cracks. If

the filter is split or cracked, replace it.

### BODY AND COVER

Clean the air cleaner body and cover with a solvent or compressed air. Wipe the air cleaner dry if a solvent is used. Inspect the air cleaner body and cover for distortion or damage at the gasket mating surfaces. Replace the cover or body if they are damaged beyond repair.

### INSTALLATION

**1.** Install a new air cleaner mounting gasket on the carburetor, if necessary. Install the air cleaner body on the carburetor so that the word "FRONT" faces the front of the car.

**2.** Place the element in the air cleaner body. **Make sure the element gasket is properly seated.** Install the cover and connect the air duct to the air cleaner (if equipped with air duct). Tighten the retaining wing nut(s).

## REPLACE CARBURETOR AIR CLEANER FILTER

### REMOVAL

**1.** Remove the wing nuts retaining the air cleaner assembly to the carburetor and the air duct (if equipped with air duct).

**2.** Remove the air cleaner assembly from the carburetor. **To prevent dirt from entering the carburetor, the filter element must never be removed when the air cleaner body is mounted on the carburetor.**

**3.** Remove the cover and filter element. Discard the filter element. Discard the air cleaner mounting gasket on the carburetor if it is excessively worn or damaged.

### INSTALLATION

**1.** Install a new air cleaner mounting gasket on the carburetor, if necessary. Install the air cleaner body on the carburetor so that the word "FRONT" faces the front of the car.

**2.** Place the new element in the air cleaner body. **Make sure the element gasket is properly seated.** Install the cover and connect the air duct to the air cleaner (if equipped with air duct). Tighten the retaining wing nuts.

## CLEAN CRANKCASE OIL FILLER BREATHER CAP

Wash the crankcase filler cap in solvent. **Do not oil the filter mesh.**

## CHECK ENGINE ACCESSORY DRIVE BELTS AND ADJUST OR REPLACE AS REQUIRED

### BELT TENSION

**1.** Install the belt tension tool on the drive belt (Fig. B1526-B) and check the tension following the instructions of the tool manufacturer.

**2.** If adjustment is necessary, loosen the generator or alternator mounting bolts and the generator or alternator adjusting arm bolt. Move the generator or alternator toward or away from the engine until the correct tension is obtained. Remove the gauge. Tighten the generator or alternator adjusting arm bolt and the mounting bolts. Install the tension gauge and check the belt tension.

If the car is equipped with air conditioning:

**1.** Loosen the four compressor mounting bolts.

**2.** Adjust the belt tension by sliding the compressor towards the center of the car to decrease the tension, and towards the outside of the car to increase the tension.

**3.** Tighten the four mounting bolts to specification and check the belt tension.

If the car is equipped with power steering:

**1.** Loosen the power steering pump bracket adjusting bolt and the pivot bolt.

**2.** Increase or decrease tension as required by adjusting the pump position.

**3.** Torque the adjusting bolt and the pivot bolt to specification, and check the power steering belt tension.

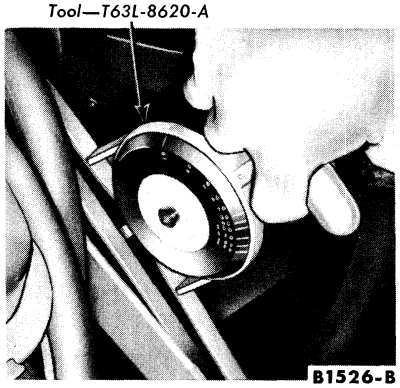



**FIG. 5—Checking Drive Belt Tension**

### DRIVE BELT REPLACEMENT

**1.** On a car with power steering, loosen the power steering pump bracket at the water pump and remove the drive belt.

On a car with an air conditioner, remove the compressor drive belt.

**2.** Loosen the alternator or generator mounting bolts and the alternator or generator adjusting arm bolt. Move the alternator or generator toward the engine. Remove the belt(s) from the alternator or generator and crankshaft pulleys, and lift them over the fan.

**3.** Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley and alternator or generator pulley grooves. Adjust the belt tension to specifications.

**4.** On a car with an air conditioner, install and adjust the compressor drive belt to specifications.

**5.** On a car with power steering, install the power steering pump drive belt and tighten the pump bracket to the water pump. Adjust the drive belt tension to specifications.

## VALVE TAPPET ADJUSTMENT (CONVENTIONAL) HIGH PERFORMANCE ENGINE ONLY

**1.** Be sure the engine is at normal operating temperature before attempting to set the valve lash.

**2.** Remove the air cleaner.

**3.** Remove the valve rocker arm covers and gaskets.

**4.** With the engine idling, set the valve lash (Fig. 6) using a step-type feeler gauge only ("go" and "no go"). The final (hot) intake and exhaust valve lash settings are listed in the Specifications Section.

For example, to obtain the correct setting if the valve lash is 0.019 inch,

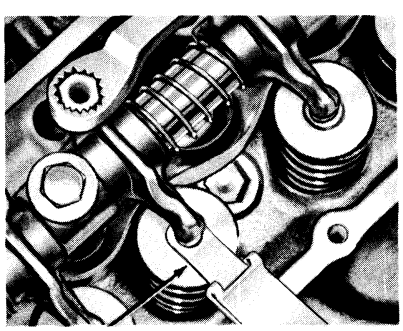



**FIG. 6—Valve Lash Adjustment —Mechanical Valve Lifters**

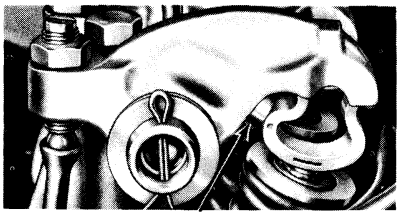



**FIG. 7—Correct Position of Eccentric**

use a step-type feeler gauge of 0.018 inch ("go") and 0.020 inch ("no go"). The "go" step should enter, and the "no go" step should not enter. The resultant setting will be to the required setting (0.019 inch).

5. Install the valve rocker arm cover gaskets and covers.

6. Install the air cleaner.

## VALVE TAPPET ADJUSTMENT (MECHANICAL SILENT LASH) 223 CID

1. Remove the air cleaner.

2. Remove the valve rocker arm cover gasket and cover.

3. Start the engine and operate it at normal idle speed. Observe the position of the adjustment mark on each eccentric (Fig. 7). Make minor adjustments, as necessary, with the engine idling by turning the adjusting screws in or out (Fig. 8).

4. After making the minor adjustments, stop the engine and install the valve rocker arm cover gasket and cover.

## CLEAN POSITIVE CRANKCASE VENTILATION SYSTEM

1. Remove the wing nut(s) retaining the air cleaner assembly to the carburetor. Remove the wing nuts that retain the air cleaner assembly to the air duct (if equipped).

2. Remove the air cleaner assembly from the carburetor.

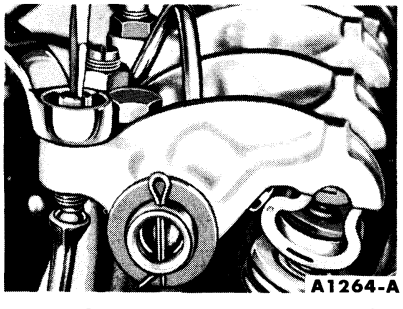



**FIG. 8—Aligning Eccentric Mark**

3. Remove the regulator valve, intake manifold fitting, exhaust tube, connections, and outlet adapter.

4. Clean the valve, exhaust tube, intake manifold fitting, and outlet adapter in clean carburetor solvent and dry them with compressed air.

5. Clean the rubber hose connections with a low volatility petroleum base solvent and dry them with compressed air.

6. Install the regulator valve, intake manifold fitting, exhaust tube, connections and outlet adapter.

7. Install the air cleaner assembly on the carburetor.

8. Install the wing nut(s) retaining the air cleaner assembly to the carburetor. Install the wing nuts retaining the air cleaner assembly to the air duct (if equipped).

## CLEAN POSITIVE CRANKCASE VENTILATION SYSTEM VALVE

### REGULATOR VALVE DISASSEMBLY

Remove the retaining ring from the end of the regulator valve assembly using a snap ring retainer tool, then remove the valve retaining washer, valve and spring (Fig. 9).

### CLEANING AND INSPECTION

1. Soak all regulator valve parts and metal fittings in carburetor solvent.

2. Probe all valve orifices and metal fitting passages with appropriate diameter drill or wire to insure removal of all emission deposits.

3. Thoroughly wash all parts in clean carburetor solvent and dry with compressed air.

### REGULATOR VALVE ASSEMBLY

Assemble the regulator valve components in the following order:

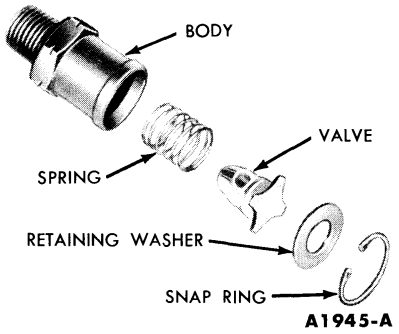



**FIG. 9—Regulator Valve Assembly**

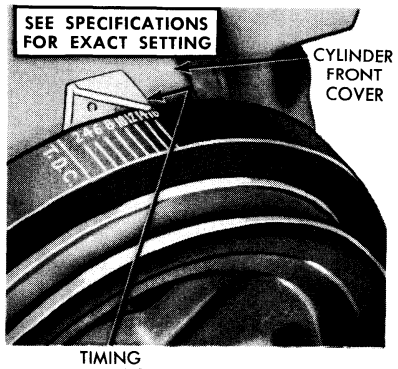



**FIG. 10—Mileage Maker Six Timing Marks**

1. Spring.

2. Valve with the pointed end toward the hose connection.

3. Valve retaining washer.

4. Valve retaining washer snap ring retainer.

## CHECK AND ADJUST IGNITION TIMING AS REQUIRED

### TIMING MARK LOCATIONS

**Mileage Maker Six.** The crankshaft damper (Fig. 10) has 9 timing marks ranging from top dead center (TDC) to 16° before top center (BTC). Refer to specifications for the correct ignition timing.

**V-8 Engines.** The timing pointer for the 352, 390 and 427 V-8 engines, has 4 timing marks ranging from top dead center (TDC) to 10° before top center (BTC). The timing pointer for the 289 V8 has 4 timing marks ranging from 0° (TDC) to 10° (BTC). To adjust ignition tim-

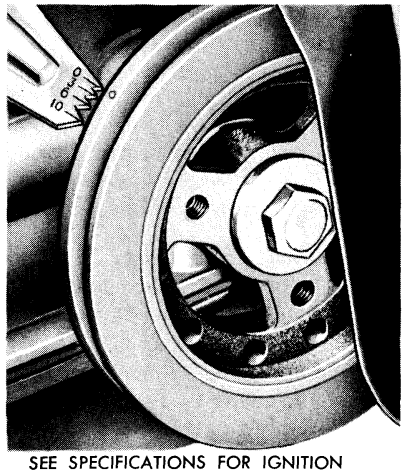



**FIG. 11—Timing Marks**

ing, align the pin on the damper or the pointer with the proper timing mark (Fig. 11).

### TIMING–ADJUSTMENT

**1.** Disconnect the vacuum line. If necessary, clean and mark the desired timing mark (Fig. 5).

**2.** Attach a timing light to the number one spark plug.

**3.** Connect a tachometer to the engine.

**When connecting a tachometer to a car equipped with a transistorized ignition, connect the leads to the tachometer block (positive lead to red terminal, negative to black).**

**4.** Start the engine and adjust the speed to the specified RPM for initial timing adjustment. Allow the engine to warm up.

**5.** Observe the timing with the light.

**6.** If the timing is not correct, loosen the hold down bolt and rotate the distributor clockwise to advance the timing or counterclockwise to retard it.

**7.** Tighten the hold down bolt and check the timing.

## CHECK AND ADJUST OR REPLACE DISTRIBUTOR POINTS

Unsnap the distributor cap retaining clips, lift the distributor cap off the distributor housing, and position the cap out of the way (if necessary, remove the air cleaner and/or the high tension wire to gain access to the distributor).

Lift the rotor off the cam. Remove the dust cover (transistorized ignition).

### INSPECTION

Replace the distributor point assembly if the contacts are badly burned or excessive metal transfer between the points is evident. Metal transfer is considered excessive when it equals or exceeds the gap setting.

### REMOVAL

**1.** Remove the primary distributor-transistor lead and condenser wire (if equipped) from the breaker plate.

**2.** Remove the screw attaching the ground wire to the distributor point assembly.

**3.** Remove the screw nearest the distributor points, then remove the distributor point asembly.

### INSTALLATION

**1.** When installing new distributor points, reverse the procedure for removal and make sure that the ground wire is attached to the distributor point assembly attaching screw which is furthest from the distributor points.

**2.** If the used points are serviceable, set the gap using a dwell meter.

To set the gap with a duel meter:

Connect the dwell meter following the manufacturer's instructions.

NOTE: **In a car equipped with transistor ignition, make sure that the dwell meter is connected to the tachometer block rather than the coil.**

Operate the engine at idle speed and note the reading on the dwell meter.

Stop the engine and adjust the gap (decreasing the gap increases the dwell). Now check the dwell again.

Repeat this procedure until specified dwell is obtained.

If new points are installed, set the gap to specifications using a feeler gauge.

**3.** Install the dust cover (transistorized ignition).

**4.** Install the rotor. Install the distributor cap on the distributor housing and snap the retaining clips in place.

**5.** Install the air cleaner and/or the high tension lead if either was removed.

## CHECK AND ADJUST OR REPLACE SPARK PLUGS

### REMOVAL

**1.** Remove the wire from each spark plug by grasping the moulded cap of the wire only. **Do not pull on the wire because the wire connection inside the cap may become separated or the weather seal may be damaged.**

**2.** Clean the area around each spark plug port with compressed air, then remove the spark plugs.

**3.** Clean the plugs on a sand blast cleaner, following the manufacturer's instructions. **Do not prolong the use of the abrasive blast as it will erode the insulator.** Remove carbon and other deposits from the threads with a stiff wire brush. Any deposits will retard the heat flow from the plug to the cylinder head causing spark plug overheating and pre-ignition.

**4.** Clean the electrode surfaces with a small file (Fig. 12). Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.

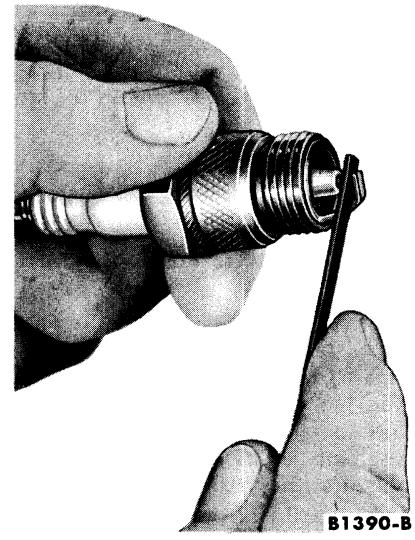



**FIG. 12–Cleaning Plug Electrode**

**5.** After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of failure. Replace as required.

### ADJUSTMENT

Set the spark plug gap to specifications by bending the ground electrode (Fig. B1391-B).

### INSTALLATION

**1.** Install the spark plugs and torque each plug to 15-20 ft-lbs.

When a new spark plug is installed in a new replacement cylinder head, torque the plug to 20-30 ft-lbs.

**2.** Connect the spark plug wires. Push all weather seals into position.

## REPLACE FUEL FILTER (427 ONLY)

**1.** Raise the car.

**2.** Remove the filter housing gas-




**FIG. 13–Gapping Spark Plug**

ket and filter element. Discard the filter element.

3. Place a new filter element in the filter recess. Lightly lubricate and position the gasket, then screw the filter housing on. Hand tighten the filter housing until the gasket contacts the filter recess body, then advance it ⅛ turn.

4. Lower the car.

5. Start the engine and check for leaks.

### LUBRICATE EXHAUST CONTROL VALVE

Lubricate the shaft bushings with FoMoCo Exhaust Gas Control Valve Solvent (COAA-19A501-A) or a penetrating oil and graphite mixture, while operating the valve manually.

### ADJUST ACCELERATING PUMP LEVER

#### SIX-CYLINDER ENGINES

The pump stroke is controlled by changing the location of the roll pin in the lever stop hole (Fig. 14).

For operation in ambient temperature 50°F. and below, place the roll pin in the hole of the pump operating lever marked "H" (lower-hole). For best performance and economy at normal ambient temperatures and high altitude (above 50°F. and/or above 5,000 feet altitude), place the roll pin in the "LO" (upper hole) of the lever.

#### V-8 ENGINES

Insert the link in the inboard hole of the pump lever for all settings. Insert the link into the overtravel lever to suit climatic conditions.

#4 hole for 40°F and below.

#3 hole for 40°F to 80°F.

#2 hole for 80°F and above.

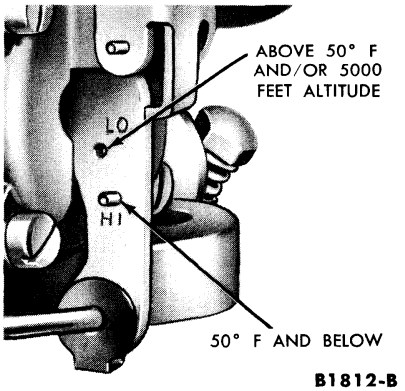



**FIG. 14—Ford Single-Barrel Carburetor Accelerating Pump Lever Adjustment**

### REPLACE ENGINE COOLANT

To drain the radiator, open the drain cock located at the bottom of the radiator. The cylinder block of the V-8 engines has a drain plug located on both sides of the block (Fig. 15). The Six Cylinder engines have one drain plug located at the left rear of the cylinder block.

To fill the cooling system, close the drain cocks or install the plugs in the block and close the radiator drain cock. Fill the system to just below the filler neck of the radiator supply tank. Disconnect the heater outlet hose at the water pump to bleed or release trapped air in the system. When the coolant begins to escape, connect the heater outlet hose. Operate the engine until normal operating temperature has been reached. **After the initial fill, the coolant level will drop approximately one quart after the engine has been operated about 20 minutes at 2000 rpm. This is due to the displacement of entrapped air.** Add more coolant to fill the radiator supply tank.

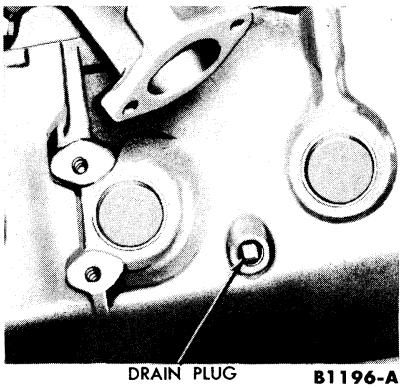



**FIG. 15—Typical Cylinder Block Drain Plug**

### CHECK ENGINE COOLANT LEVEL

The coolant level should be kept below the filler neck.

## 2 TRANSMISSION

### ADJUST CRUISE-O-MATIC AND MERC-O-MATIC DUAL RANGE TRANSMISSION BANDS

#### FRONT BAND ADJUSTMENT

1. Drain the fluid from the transmission by removing the oil filter tube. Use a clean drain can equipped with a fine meshscreen if the fluid is to be reused.

2. Remove the oil pan, then remove the oil screen and clip from the transmission. Clean the inside of the oil pan. Remove all gasket material from oil pan and pan mounting face of case.

3. Loosen the front servo adjusting screw locknut two full turns.

4. Pull back on the actuating rod, then insert the Gauge Block, Tool 7225-C13-B, of front band adjusting Tool 7225-C, (Fig. 16) between the servo piston stem and adjusting screw. Tighten the adjusting screw until the wrench overruns. Back off the adjusting screw **exactly one complete turn,** then hold the adjusting screw stationary and tighten the locknut to specifications. Remove the gauge block. **Severe damage may result if the adjusting screw is not backed off exactly one complete turn.**

5. Install the transmission fluid screen. Install the pan, using a new gasket.

6. Connect the transmission fluid filler tube to the oil pan.

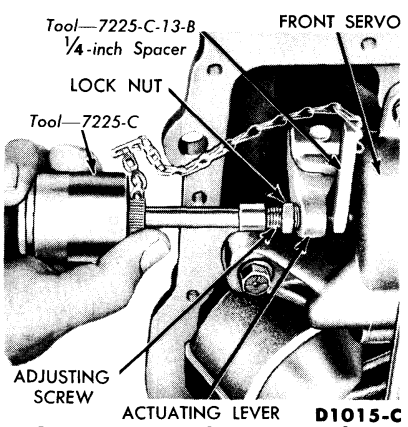



**FIG. 16—Typical Front Band Adjustment**

7. Refill the transmission to the **FULL** mark on the dipstick.

8. Start the engine and engage the transmission in each drive range to fill all fluid passages, then place the selector in the "P" position. Check the fluid level and add enough fluid to bring the level up to the **FULL** mark on the dipstick.

### ALTERNATE FRONT BAND ADJUSTMENT PROCEDURE– (FORD TOOLS)

1. Disconnect the fluid filler tube from the oil pan, and drain the fluid from the transmission. **If the same fluid is to be used again in the transmission after the band adjustment, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.**

2. Remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.

3. Loosen the front servo adjusting screw locknut two full turns with a 9/16-inch wrench. Check the adjusting screw for free rotation in the actuating lever after the locknut is loosened, and free the screw if necessary.

4. Pull the adjusting screw end of the actuating lever away from the servo body, and insert the adjusting tool gauge block (Fig. 17) between the servo piston stem and the adjusting screw.

5. Install the socket handle on the 9/16-inch socket.

6. Insert the T-handle extension through the socket handle and socket, and install the screwdriver socket on the T-handle extension.

7. Place the tool on the adjusting screw so that the screwdriver socket engages the screw and the 9/16-inch socket engages the locknut.

8. With a torque wrench on the T-handle extension, tighten the adjusting screw to 10 inch-pounds torque, and then back off the screw exactly one full turn. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly one full turn.**

9. Hold the adjusting screw stationary, and torque the locknut to specification.

10. Remove the gauge block from the transmission.

11. Place a new gasket on the oil pan, and install the screen and pan on the transmission.

12. Connect the filler tube to the oil pan and tighten the fitting securely.

13. Fill the transmission with fluid.

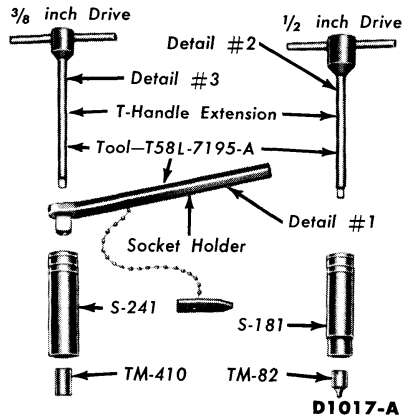



**FIG. 17—Front and Rear Band Adjusting Tools**

### REAR BAND ADJUSTMENT

1. Fold back the floor mat to expose the right side of the floor pan.

2. Remove the access hole cover from the floor pan. Remove all dirt from the adjusting screw threads, then oil the threads.

3. Loosen the rear band adjusting screw locknut with Tool 7195-C (Fig. 18). Using the "T" handle portion of the tool, tighten the adjusting screw until the wrench overruns.

**If the screw is found to be tighter than wrench capacity (10 lbs. ft. torque), loosen the screw and retighten until the wrench overruns.**

4. Back off the adjusting screw 1½ turns. Hold the adjusting screw stationary, and tighten the adjusting screw locknut to specifications.

**Severe damage may result if the adjusting screw is not backed off exactly 1½ turns.**

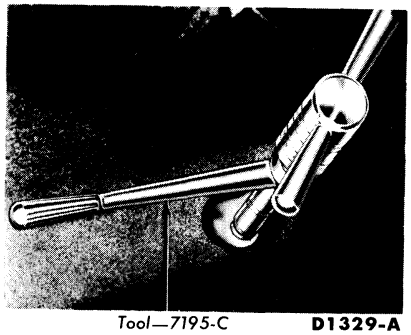



**FIG. 18—Rear Band Adjustment**

### ALTERNATE REAR BAND ADJUSTMENT PROCEDURE– (FORD TOOLS)

The tool shown in Fig. 17 may be used to adjust the rear band.

1. Place the socket holder on the ¾-inch socket (Fig. 17). Insert the T-handle extension through the handle and socket.

2. Place the 5/16-inch 8-point socket on the extension. Place a torque wrench on the T-handle extension.

3. Insert the assembled tool in the access hole so that it engages the adjusting screw and the locknut.

4. Loosen the adjusting screw locknut.

5. Torque the adjusting screw to 10 foot-pounds.

6. Remove the torque wrench from the T-handle extension and back off the adjusting screw exactly 1½ turns. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly 1½ turns.**

7. Hold the adjusting screw stationary, and tighten the locknut securely.

### REAR BAND ADJUSTMENT WITH CONSOLE

Part of the console assembly will have to be removed to adjust the rear band.

1. Loosen the two forward screws that attach the glove compartment to the console panel.

2. Remove the gear shift lever knob.

3. Remove the four screws that attach the console finish panel casting to the console panel, and remove the casting (Fig. 19).

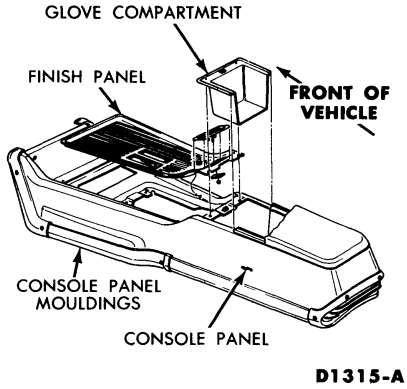



**FIG. 19—Console Component Parts**

4. Remove the four bolts that secure the gear shift indicator to the support assembly.

5. Remove the twelve screws that attach the console panel mouldings to the console panel and remove the mouldings (Fig. 19).

6. Remove the eight screws that attach the console panel to the console support assembly.

7. Position the console panel out of the way and adjust the transmission rear band (Figs. 17 and 18).

8. Install the console panel and secure to the support assembly with eight screws.

9. Install the mouldings and the twelve attaching screws.

10. Secure the gear shift indicator with the four attaching bolts.

11. Install the console finish panel and secure with the four screws. Also tighten the two forward screws of the glove compartment.

12. Install the gear shift lever knob.

### ADJUST C4 AUTOMATIC DUAL RANGE TRANSMISSION BANDS

#### INTERMEDIATE BAND

1. Clean all the dirt from the band adjusting screw area. Loosen the lock nut several turns.

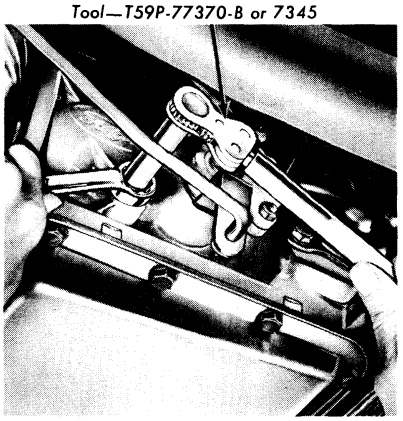
2. With the tool shown in Fig. 20 tighten the adjusting screw until the tool handle clicks. The tool is a preset torque wrench which clicks and overruns when the torque on the adjusting screw reaches 10 ft. lbs.

**3. Back off the adjusting screw exactly 1½ turns.**

4. Hold the adjusting screw from turning and torque the locknut to specification.

#### LOW-REVERSE BAND

1. Clean all the dirt from the adjusting screw area. Loosen the lock nut several turns.




D1460-A

**FIG. 20—Intermediate Band Adjustment**

2. With the tools shown in Fig. 21, tighten the adjusting screw until the tool handle clicks. The tool is a present torque wrench which clicks and overruns when the torque on the adjusting screw reaches 10 ft-lbs.

**3. Back off the adjusting screw exactly 3 full turns.**

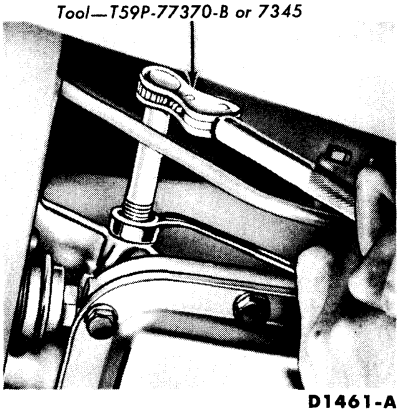
4. Hold the adjusting screw from turning and torque the lock nut to specification.

### CHECK AUTOMATIC TRANSMISSION FLUID LEVEL

1. Make sure that the car is standing level. Then firmly apply the parking brake.

2. Run the engine at normal idle speed. If the transmission fluid is cold, run the engine at fast idle speed (about 1200 rpm) until the fluid reaches its normal operating temperature. When the fluid is warm, slow the engine down to normal idle speed.

3. Shift the selector lever through all positions, and place the lever at P. Do not turn off the engine during the fluid level checks.




D1461-A

**FIG. 21—Low-Reverse Band Adjustment**

4. Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.

5. Pull the dipstick out of the tube, wipe it clean, and push it all the way back into the tube.

6. Pull the dipstick out of the tube again, and check the fluid level. If necessary, add enough fluid to the transmission through the filler tube to raise the fluid to the transmission through the filler tube to raise the fluid level to the F (full) mark on the dipstick. **Do not overfill the transmission.**

### CHECK TRANSMISSION OIL LEVEL—MANUAL SHIFT

1. Remove the filler plug from the side of the case.

2. If lubricant does not flow from the filler hole, fill the case with the specified lubricant until it is level with the lower end of the filler hole.

3. Install the filler plug.

## 3 CHASSIS

### LUBRICATE AUTOMATIC TRANSMISSION KICKDOWN LINKAGE

Lubricate all pivot points in the kickdown linkage with SAE 10W engine oil.

### CHECK CLUTCH LINKAGE ADJUSTMENT (STD. & O/D)

1. Loosen the interlock shift rod at the equalizer (Fig. 22). This step applies only to cars equipped with an overdrive transmission.

2. Measure the total travel of the pedal (Fig. 23). If the travel is not within specification, move the clutch pedal bumper and the bracket up or down until the travel is within specified limits. **Always check and adjust total travel before checking free travel.**

3. With the clutch pedal against its bumper (pedal released), measure the overall length of the spring. The overall length should be 10¼ inches.

4. With the engine idling, depress the pedal just enough to take up the free travel and note the reading on the tape (Fig. 23). The difference between this reading and the reading where the pedal is released is the clutch pedal free travel. If the free travel is not within specification,

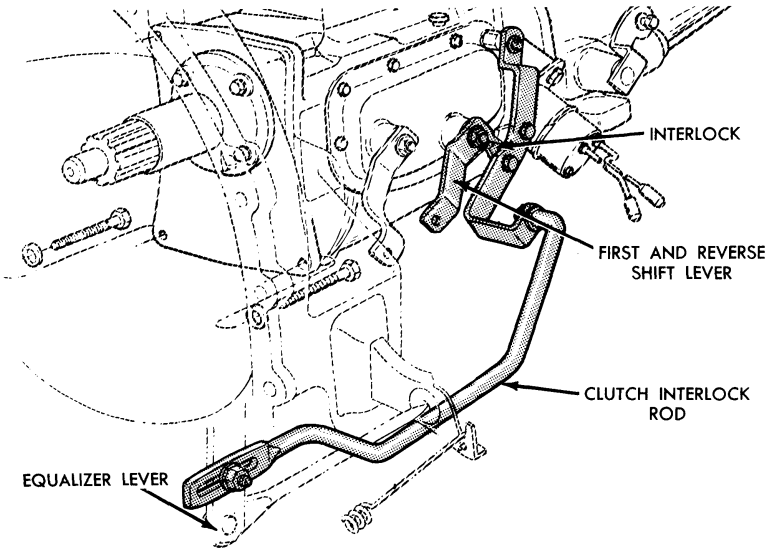



**FIG. 22—Interlock Mechanism (Used with 352 and 390 Cu. In. Engines)**

adjust the clutch pedal to equalizer rod (Fig. 24). To increase the free travel loosen the rearward adjusting nut and tighten the forward nut. To reduce the free travel, loosen the forward nut and tighten the rearward nut. **Both nuts must be tightened against the trunnion after making the adjustment.**

**5.** With the transmission in neutral and the interlock pawl snugly engaged (overdrive only) connect the interlock shift rod.

### INTERLOCK (OVERDRIVE MODELS ONLY)

**Be sure that the clutch linkage and pedal height are correctly adjusted before adjusting the interlock (Fig. 22).**

Adjust the interlock as follows:

**1.** With the interlock shift rod disconnected at the interlock shift lever and the transmission in neutral, adjust the position of the pawl or the plate so that the two interlock parts fit snugly.

Tighten the pawl or the plate attaching bolts.

**2.** Shift the transmission into low and into neutral to check operation of the interlock. Adjust the length of the interlock shift rod so that the low and reverse shift lever is engaged by the pawl or the plate until the clutch pedal enters the overtravel or reserve area. Readjust the pawl for snug fit, if necessary.

**3.** With the transmission in neutral, connect the interlock rod to the shift lever and check the shift linkage operation.

**4.** Use COAZ-19584-A lubricant as required for the interlock linkage.

### INSPECT AND CROSS-SWITCH WHEELS AND TIRES

Switch the tires according to Fig. 25.

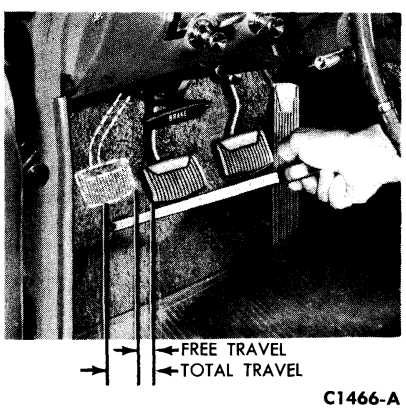



**FIG. 23—Clutch Pedal Free Travel**

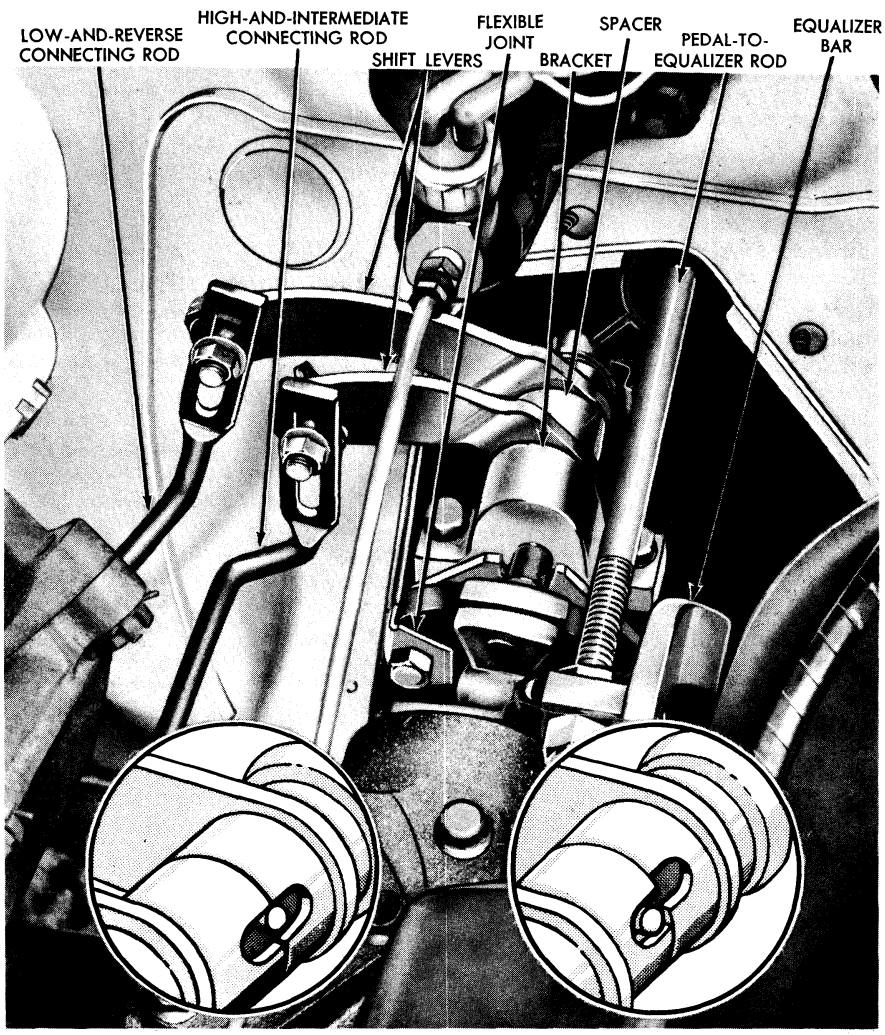



**FIG. 24—Clutch Pedal Travel Linkage Adjustments–Typical**

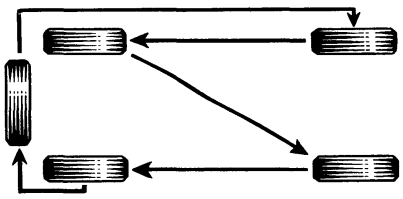

F1019-A

**FIG. 25—Tire Cross Switching Diagram**

Tighten the wheel nuts to specified torque.

### CHECK POWER STEERING RESERVOIR FLUID LEVEL

Start the engine, turn the steering wheel all the way to the left and right several times, and shut off the engine.

Check the fluid level in the reservoir. If the level is low, add enough fluid to raise the level to the F mark on the dipstick. On a car equipped with air conditioning, fill the reservoir to within ¼-inch of the top. **Do not overfill the reservoir.**

### CHECK MASTER CYLINDER FLUID LEVEL

**1.** Remove the filler cap from the master cylinder.

**2.** Fill the reservoir to ⅜-inch from the top.

**3.** Install the filler cap.

### CHECK AXLE FLUID LEVEL

The lubricant level should be maintained at the bottom of the filler plug hole with the specified lubricant.

### LUBRICATE FRONT SUSPENSION BALL JOINTS

Wipe any accumulated dirt from around the lubrication plugs.

Remove the plugs and install lubrication fittings. Lubricate the ball joints and remove the lubrication fittings. Install the plugs.

### LUBRICATE STEERING LINKAGE

Wipe any accumulated dirt from around the lubrication plugs.

Remove plugs and install fittings.

Apply the recommended lubricant to each steering linkage fitting with a pressure gun. Remove the fittings and replace the plugs.

### CHANGE POWER STEERING FILTER

Remove the power steering pump cover spring and washer. Remove all fluid from the reservoir with a suction gun. Lift the filter from the reservoir. Wipe the reservoir clean with a lint-free cloth. Place a new filter on the seat. Position the washer and spring on the cover stud. Install a new gasket in the cover. Install the cover on the reservoir.

### CHECK AND ADJUST STEERING GEAR PRELOAD AS REQUIRED

**1.** Disconnect the Pitman arm from the steering arm-to-idler arm rod. On a car with power steering, disconnect the arm from the control valve ball stud.

**2.** Loosen the nut which locks the sector adjusting screw (Fig. 26), and turn the adjusting screw counterclockwise.

**3.** Measure the worm bearing preload by attaching an inch-pound torque wrench to the steering wheel nut (Fig. 27). With the steering wheel off center, read the pull required to rotate the input shaft approximately 1½ turns either side of center. If the torque or preload is not within specification, adjust as explained in the next step.

**4.** Loosen the steering shaft bearing adjuster lock nut, and tighten or back off the bearing adjuster (Fig. 26) to bring the preload within the specified limits.

**5.** Tighten the steering shaft bearing adjuster lock nut, and recheck the preload.

**6.** Turn the steering wheel slowly to either stop. **Turn gently against the stop to avoid possible damage to the ball return guides.** Then rotate the wheel 2¾ turns to center the ball nut.

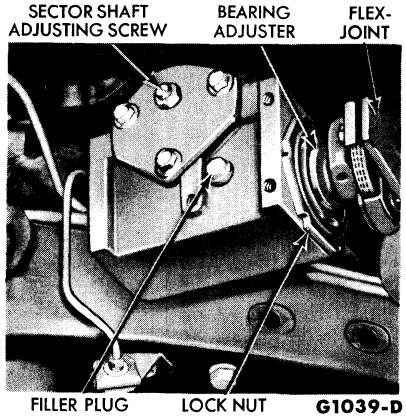



**FIG. 26—Steering Gear Adjustments**

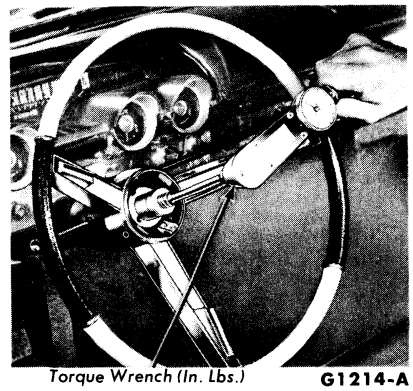



**FIG. 27—Checking Preload**

**7.** Turn the sector adjusting screw clockwise until the specified pull is necessary to rotate the worm past its center (high spot). **No perceptible backlash is permissible at 30° on either side of center.**

**8.** While holding the sector adjusting screw, tighten the locknut to specifications and recheck the backlash adjustment.

**9.** Connect the Pitman arm to the steering arm-to-idler arm rod. On a car with power steering, connect the arm to the control valve ball stud.

### CLEAN AND PACK FRONT WHEEL BEARINGS

**1.** Raise the car until the wheel and tire clear the floor.

**2.** Insert a narrow screwdriver through the brake adjusting hole at the inner side of the brake carrier plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the screw, back off the adjusting screw with the brake adjusting tool. **Be very careful not to burr, chip, or damage the notches in the adjusting screw; otherwise the self adjusting mechanism will not function properly.**

**3.** Remove the wheel cover or hub cap. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly.

**4.** Pull the wheel, hub, and drum assembly off the wheel spindle.

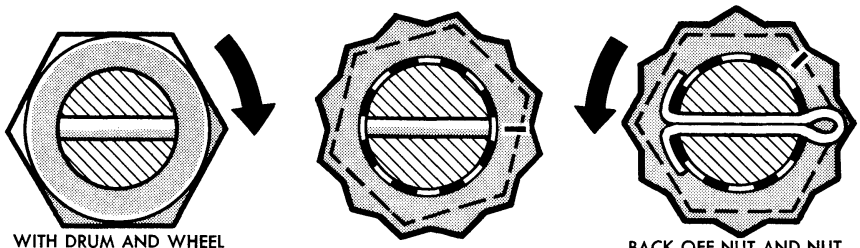



**FIG. 28—Front Wheel Bearing Adjustment**

**5.** Remove the grease retainer and the inner bearing cone and roller assembly from the hub.

**6.** Clean the lubricant off the inner and outer bearing cups with solvent.

**7.** Soak a new grease retainer in light engine oil at least 30 minutes before installation. Thoroughly clean the inner and outer bearing cones and rollers with solvent, and dry them thoroughly. Do not spin the bearings dry with compressed air.

Inspect the bearing cups, cones and rollers for wear or damage, and replace them if necessary. The cone and roller assemblies and the bearing cups should be replaced as a unit if damage to either is encountered.

**8.** Thoroughly clean the spindle and the inside of the hub with solvent to remove all old lubricant.

Cover the spindle with a clean cloth, and brush all loose dust and dirt from the brake assembly. **To prevent getting dirt on the spindle, carefully remove the cloth from the spindle.**

**9.** Pack the inside of the hub with specified wheel bearing grease. Add lubricant to the hub only until the grease is flush with the inside diameter of both bearing cups.

**10.** Pack the bearing cone and roller assemblies with wheel bearing grease. A bearing packer is desirable for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.

**11.** Place the inner bearing cone and roller assembly in the inner cup, and install the new grease retainer. **Be sure that the retainer is properly seated.**

**12.** Install the wheel, hub, and drum assembly on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.**

**13.** Install the outer bearing cone and roller assembly and the flat washer on the spindle, then install the adjusting nut.

**14.** While rotating the wheel, hub, and drum assembly, torque the adjusting nut to 15-20 ft-lbs to seat the bearings (Fig. 28).

**15.** Locate the nut lock on the adjusting nut so that the castellations on the lock are aligned with the cotter pin hole in the spindle.

**16.** Back off both the adjusting nut and the nut lock together until the next castellation on the nut lock aligns with the cotter pin hole in the spindle.

**17.** Install a new cotter pin. Bend the ends of the cotter pin around the castellations of the nut lock to prevent interference with the radio static collector in the grease cap. Install the grease cap.

**18.** Adjust the brake shoes. Install the wheel cover.

## LUBRICATE UNIVERSAL JOINTS

Wipe any accumulated dirt from around the lubrication plugs.

Remove the plugs and install lubrication fittings.

Apply the specified lubricant. Remove the fittings and install the plugs.

## CHECK BRAKE LINES AND LINING

**1.** Raise all four wheels. Remove one of the front brake drums, and inspect the drum and the linings (the wheel bearings should be inspected at this time and repacked if necessary). **Do not let oil or grease touch the drum or the linings.** If the linings are worn to within 1/32 inch of the rivet heads, replace or reline both sets (primary and secondary) on the front or rear wheels. **Under no circumstances replace one lining only, or one wheel set. Both front wheel sets or both rear wheel sets should be replaced whenever a respective lining or shoe is worn or damaged.** If the drum braking surface is excessively scored, refinish it. The condition of the remaining front linings is usually about the same as that of the one inspected. The rear brake linings may also need replacing at the same time.

**2.** With the parking brakes in the fully released position, check the brake cables. The cable adjustment should be just tight enough to remove the slack. **Excessive tightening may pull the brake shoes off their anchors.**

**3.** Check all brake lines for leakage or physical damage and replace or repair as required.

**4.** Lower the car.

## CHECK AIR CONDITIONING SYSTEM

A quick test of the refrigerant supply can be made by observing the flow of refrigerant through the sight glass (Fig. 29).

To check the refrigerant supply, place a large fan in front of the radiator to aid in cooling the engine. Set the servo control for maximum cooling and the blower on high. Operate the engine at 1300 rpm. and observe the sight glass while the compressor is operating. There should be no bubbles in the sight glass after the start of the compressor. Bubbles will appear when the compressor starts but should clear after a few moments.

## CHECK FRONT WHEEL ALIGNMENT AND LINKAGE

If abnormal tire wear or ride and handling characteristics such as

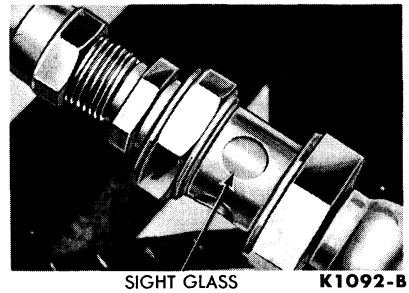



**FIG. 29—Sight Glass**

vehicle lead or wander are experienced with properly inflated tires, the front end alignment should be checked.

### FRONT WHEEL ALIGNMENT CHECKS

**Do not check and adjust front wheel alignment without first making the following inspection for front end maladjustment, damage, or wear.**

**1.** Check for specified air pressures in all four tires.

**2.** Raise the front of the car off the floor. Shake each front wheel grasping the upper and lower surfaces of the tire. Check the front suspension ball joints and mountings for looseness, wear, and damage. Check the brake backing plate mountings. Torque all loose nuts and bolts to specifications.

**3.** Check the steering gear mountings and all steering linkage connections for looseness. Torque all mountings to specifications. If any of the linkage is worn or bent, replace the parts.

**4.** Check the front wheel bearings. If any in-and-out free play is noticed, adjust the bearings to specification. Replace worn or damaged bearings.

**5.** Spin each front wheel with a wheel spinner, and check and balance each wheel as required.

**6.** Check the action of the shock absorbers. If the shock absorbers are not in good condition, the car may not settle in a normal, level position, and front wheel alignment may be affected.

**Wheel Inspection.** Wheel hub nuts should be inspected and tightened to specification at pre-delivery. Loose wheel hub nuts may cause shimmy and vibration. Elongated stud holes in the wheels may also result from loose hub nuts.

Keep the wheels and hubs clean. Stones wedged between the wheel and drum and lumps of mud or grease can unbalance a wheel and tire.

Check for damage that would affect the runout of the wheels. Wobble or shimmy caused by a damaged wheel will eventually damage the wheel bearings. Inspect the wheel rims for dents that could permit air to leak from the tires.

Check all the factors of front wheel alignment except toe-out on turns before making any adjustments. Toe-out on turns should be checked only after caster, camber, and toe-in have been adjusted to specifications.




**FIG. 30—Typical Straight Ahead Position Marks**

**Equipment Installation.** Equipment used for front wheel alignment inspection must be accurate. If portable equipment is being used, perform all inspection operations on a level floor.

**1.** Drive the car in a straight line far enough to establish the straight-ahead position of the front wheels, and then mark the steering wheel hub and the steering column collar (Fig. 30). **Do not adjust the steering wheel spoke position at this time.** If the front wheels are turned at any time during the inspection, align the marks to bring the wheels back to the straight-ahead position.

**2.** Install the wheel alignment equipment on the car. Whichever type of equipment is used, follow the installation and inspection instructions provided by the equipment manufacturer.

**Caster.** Check the caster angle at each front wheel.

The caster is the forward or rearward tilt of the top of the wheel spindle. If the spindle tilts to the rear, caster is positive. The spindle tilts to the front, caster is negative. The correct caster angle, or tilt, is — ½° to + ½°. The maximum difference between both front wheel caster angles should not exceed ½°. However, a difference of not more than ¼° is preferred.

**Camber.** Check the camber angle at each front wheel.

Camber is the amount the front wheels are tilted at the top. If a wheel tilts outward, camber is positive. If a wheel tilts inward, camber is negative. The correct camber angle, or outward (positive) tilt, is + 0° 15′ to + 1°. The maximum difference between both front wheel camber angles should not exceed ½°. However, a difference of not more than ¼° is preferred.

**Toe-In.** Check the toe-in with the front wheels in the straight-ahead position. **Run the engine so that the power steering control valve will be in the center (neutral) position.** Measure the distance between the extreme front and also between the extreme rear of both front wheels. The difference between these two distances is the toe-in.

Correct toe-in, or inward pointing of both front wheels at the front, is ⅛ to ¼ inch.

**Front Wheel Turning Angle.** After caster, camber, and toe-in have been adjusted to specifications, check the turning angle. The turning angle of an outside wheel should be 17° 30′ with P/S and 17° 21′ with manual steering when the inside wheel is turned 20°. If this angle is not correct, spindle arm is probably bent and should be replaced.

After front wheel alignment factors have been checked, make the necessary adjustments. **Do not attempt to adjust front wheel alignment by bending the suspension or steering parts.**

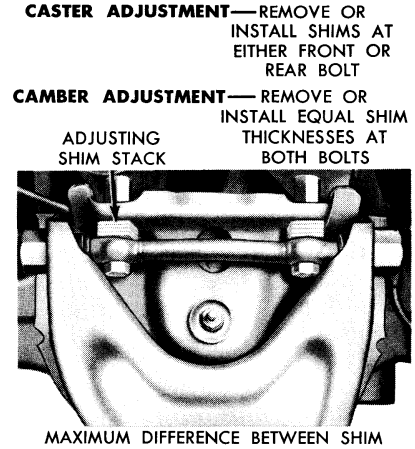



**FIG. 31—Caster and Camber Adjustments**

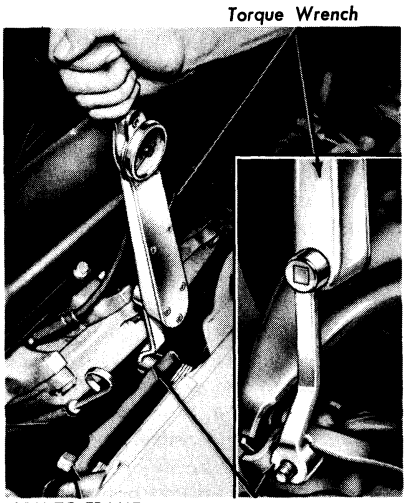



**FIG. 32—Inner Shaft Retaining Nut**

### CASTER AND CAMBER ADJUSTMENTS

Caster and camber can be adjusted by removing or installing shims between the inner shaft of the front suspension upper arm and the mounting bracket on the frame in the engine compartment. The adjusting shims (Fig. 31) are located on the fender side of the bracket.

Both caster and camber adjustments can be made at the same time by loosening the nuts on the two bolts that fasten the inner shaft to the mounting bracket. Use the tool shown in Fig. 32. After the required shims have been removed or installed, torque the nuts to specifications, using the tool shown in Fig. 32. To obtain this torque, turn the nut until 50 ft-lbs is shown. **The wrench and the tool must stay in line (as shown) during the tightening operation.** Caster and camber adjusting shims are available in 1/32-inch and 1/8-inch thicknesses.

**Caster.** To adjust caster, remove or install shims at either the front bolt or the rear bolt (Fig. 31).

The removal of shims at the front bolt or the installation of shims at the rear bolt will cause the upper ball joint to move forward. The removal of shims at the rear bolt or the installation of shims at the front bolt will cause the ball joint to move rearward. A 1/16-inch change of shim thickness at either bolt will change the caster angle 1/2°. The difference between the shim stack thicknesses at the two bolts should not exceed 1/8 inch.

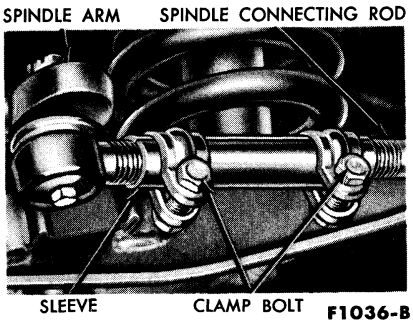



**FIG. 33—Spindle Connecting Rod Sleeve**

### TOE-IN AND STEERING WHEEL SPOKE POSITION ADJUSTMENTS

Check the steering wheel spoke position when the front wheels are in the straight-ahead position. If the spokes are not in their normal position, they can be properly adjusted while toe-in is being adjusted.

**1.** Loosen the two clamp bolts on each spindle connecting rod sleeve (Fig. 33).

**2.** Adjust toe-in. If the steering wheel spokes are in their normal position, lengthen or shorten both rods equally to obtain correct toe-in (Fig. 34). If the steering wheel spokes are not in their normal position, make the necessary rod adjustments to obtain correct toe-in and steering wheel spoke alignment (Fig. 35).

**3.** Recheck toe-in and the steering wheel spoke position. If toe-in is correct and the steering wheel spokes are still not in their normal position, turn both connecting rod sleeves upward or downward the same number of turns to move the steering wheel spokes (Fig. 34).

**4.** When toe-in and the steering wheel spoke position are both correct, torque the clamp bolts on both connecting rod sleeves to 11-14 ft-lbs. If the car is equipped with power steering, both bolts on the left sleeve should be in a vertical position on the forward side of the sleeve to prevent interference with the control valve. **The sleeve position should not be changed when the clamp bolts are tightened.**

### CHECK TIRE PRESSURE

Check all tires for specified pressures (cold).

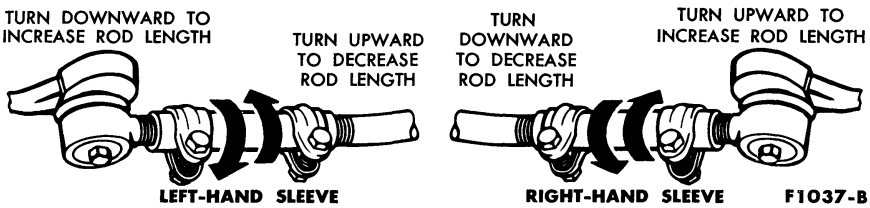



**FIG. 34—Spindle Connecting Rod Adjustments**

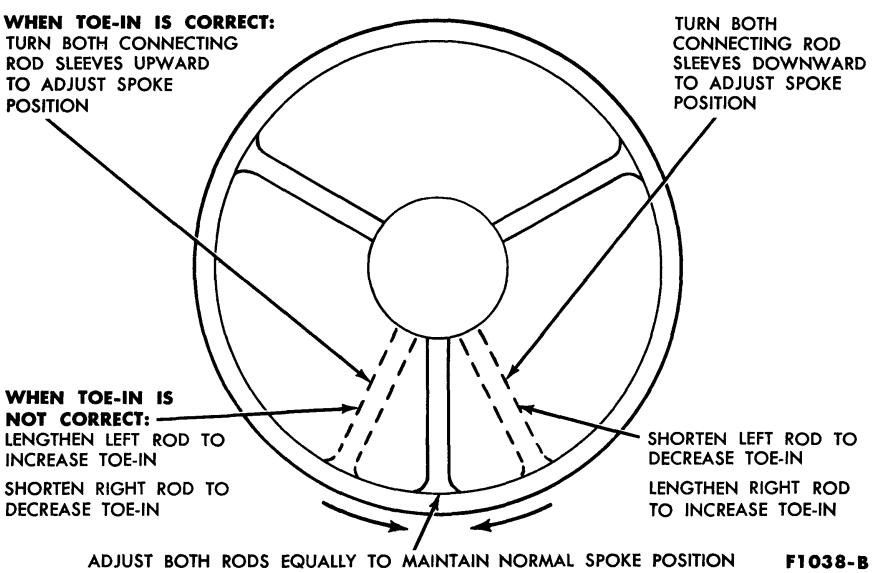



**FIG. 35—Toe-In and Steering Wheel Spoke Adjustments**

### CHECK BATTERY FLUID LEVEL

The battery is mounted under the hood at the right front side of the engine compartment.

Keep the fluid in each battery cell up to the level of the ring in the bottom of the filler well. Generally, tap water may be added unless it has a high mineral content or has been stored in a metal container.

## 4 BODY

### LUBRICATE HOOD LATCH

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to all pivot points and to the striker plate as required to eliminate any binding condition. Operate the latch mechanism several times to be sure that the lubricant has effectively worked in.

### LUBRICATE HOOD AUXILIARY CATCH

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A) to all pivot points as required to eliminate any binding conditions. Operate the catch several times to be sure that the lubricant has effectively worked in.

### LUBRICATE DOOR LOCK CYLINDERS

Apply Rotunda lock lubricant R-117-A (Ford Specification M2C20) sparingly through the key slot. Insert the key and operate the lock several times to be sure that the lubricant has effectively worked in.

### LUBRICATE LUGGAGE COMPARTMENT LOCK CYLINDER

Apply Rotunda lock lubricant R-117-A (Ford Specification M2C20) sparingly through the key slot. Insert the key and operate the lock several times to be sure that the lubricant has effectively worked in.

### LUBRICATE TAILGATE LOCK CYLINDERS

Apply Rotunda Lock Lubricant R-117A (Ford Specification M2C20) sparingly through the key slot. Insert the key and operate the lock several times to be sure that the lubricant has effectively worked in.

### LUBRICATE TAILGATE SUPPORT AND HINGES

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to all pivot and friction points to eliminate any binding conditions. Operate the tailgate several times to be sure that the lubricant has effectively worked in.

### LUBRICATE FUEL FILLER DOOR HINGES

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to the hinge pivot points as required to eliminate any binding condition. Open and close the door several times to be sure that the lubricant has effectively worked in.

### CHECK CONVERTIBLE TOP OPERATION

If convertible top operation becomes sluggish or slow, check the hydraulic reservoir fluid level. Fluid level should be approximately ¼ inch from the filler opening. The proper fluid for all cars is automatic transmission fluid "Type A, Suffix A."

### CHECK CONVERTIBLE TOP FLUID LEVEL

1. Remove the rear seat and raise the top.
2. Place absorbent cloths below the filler plug.
3. Remove the filler plug, and check the fluid level. It should be level with the bottom edge of the hole.
4. If the level is low, check the system for leaks, adding hydraulic fluid as necessary (Automatic Transmission Fluid "Type A, Suffix A").

### REPLACE WINDSHIELD WIPER BLADES

Wiper blade replacement intervals will vary with the amount of use, type of weather, chemical reaction from road tars or salts and the age of the blades. Be sure that the windshield glass surface is not contaminated with oil, tree sap or other foreign substance which cannot be easily rubbed off.

Generally, if the wiper pattern across the glass is still uneven and streaked after these tests, replace the blades.

### LUBRICATE DOOR HINGE AND HINGE CHECK

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to the hinge pivot points as required to eliminate any binding condition. Open and close the door several times to be sure that the lubricant has effectively worked in.

### LUBRICATE DOOR CHECKS

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to the door check as required to eliminate any binding condition. Open and close the door several times to be sure that the lubricant has effectively worked in.

### LUBRICATE HOOD HINGE PIVOTS

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to the hinge pivot points as required. Open and close the hood several times to be sure that the hinge pivots do not bind.

### LUBRICATE LUGGAGE COMPARTMENT HINGE PIVOTS

Apply Rotunda Silicone Lubricant R-113 (Ford Specification M99C40-A or B) to the hinge pivot points as required. Open and close the luggage compartment several times to be sure that the hinge pivots do not bind.

# LUBRICANT CHARTS AND SPECIFICATIONS

# GROUP 21

## LUBRICANT SPECIFICATIONS

| ITEM | PART NUMBER | PART NAME | FORD SPECIFICATION | ALTERNATE LUBRICANT |
|---|---|---|---|---|
| Body Hinges | R113 | Rotunda Silicone Lubricant | M-99C40-A or -B | |
| Brake Master Cylinder | R-103-A | Rotunda Heavy Duty Brake Fluid | M-3833-D | Alternate fluid must meet SAE J70B specification for 70R3 type extra heavy duty brake fluid. |
| Distributor Cam | | Distributor Cam Grease | M-1C-66-A | Use a good high temperature No. 2 grade sodium soap grease. |
| Distributor Wick and Bushing | | Engine Oil—SAE 10W | | |
| Front Suspension Ball Joints and Steering Linkage | C1AZ-19590-B | FoMoCo Ball Joint Grease | ESA-M-1C47-A | Substitute must meet Ford Specification. |
| Front Wheel Bearings | C2AZ-19585-A | FoMoCo Wheel Bearing Grease | ESA-M-1C60-A | Substitute must meet Ford Specification. |
| Hood Latch and Safety Catch | R113 | Rotunda Silicone Lubricant | M-99C40-A or -B | Substitute must meet Ford Specification. |
| Lock Cylinders | R117-A | Rotunda Lock Lubricant | ESB-M-2C20-A | Substitute must meet Ford Specification. |
| Rear Axle (Except High Performance) | C1AZ-19580-E | FoMoCo Hypoid Gear Lubricant | M-2C50-B* | Substitute must meet Ford Specification. |
| Rear Axle (High Performance) | C2AZ-19580-A | FoMoCo Hypoid Gear Lubricant | M-2C57-A* | Substitute must meet Ford Specification.** |
| Steering Gear Housing (Manual or Power) | C3AZ-19578-A | FoMoCo Special Steering Gear Lubricant | ESW-M-1C87-A | A good lithium base grease #1 grade may be used to "add to" factory fill. |
| Exhaust Control Valve | COAA-19A501-A | FoMoCo Solvent and Penetrating Fluid | | |
| Steering Power (Pump Reservoir) Convertible Top Reservoir | R106-A | Rotunda Automatic Transmission Fluid | M-2C33-C or -D | Automatic transmission fluid marked "TYPE A, SUFFIX A" may be used to "add to" factory fill. |
| Transmission (Automatic) | R106-A | Rotunda Automatic Transmission Fluid | M-2C33-C or -D<br>M-2C33-B | Only one quart of automatic transmission fluid marked "TYPE A, SUFFIX A" may be used to "add to" factory fill. |
| Transmission (Manual Shift) | R-139-A | Rotunda Manual Transmission Lubricant | M-568-D | Reputable SAE 80 grade mild extreme pressure type lubricant can be used to "add to" factory fill. |
| Universal Joints | C1AZ-19586-B | FoMoCo Universal Joint Lubricant | M-1C57 | Substitute lubricant must conform to Ford Specification. |

*SAE 90 grade lubricants are recommended for all temperatures above —25° F. For temperatures below —25° F., the same type of lubricant, but of SAE 80 grade, should be used.
**Add 1 oz. of Hypoid Additive—Ford C1AA-19B546-A (Ford Spec. M2C-58-A) to each pint if axle is equipped with Equa-Lock differential.

## ENGINE CRANKCASE OILS

Use of SAE 10W-30 oil will provide the proper viscosity for all normal ranges of outside temperatures. For operation at sustained outside temperatures below —10°F. a 5W-20 oil should be used.

### Oil Quality

Use only oils which have been tested and certified by the maker as satisfying automobile manufacturers specifications for Engine Operating Sequence Tests for Service M.S. the Ford Motor Company specification covering these tests is M2C27. These tests are defined by ASTM committee D2 for Section G-IV of technical committee B and are published in the SAE Handbook.

These tests cover oil characteristics as follows:

Sequence I – Low Temperature Wear Prevention – (Cold Starts)

Sequence II – High Speed – High Temperature Wear Prevention

Sequence III – High Temperature Deposit Formation–(Varnish)

Sequence IV – Corrosion and Rust Prevention

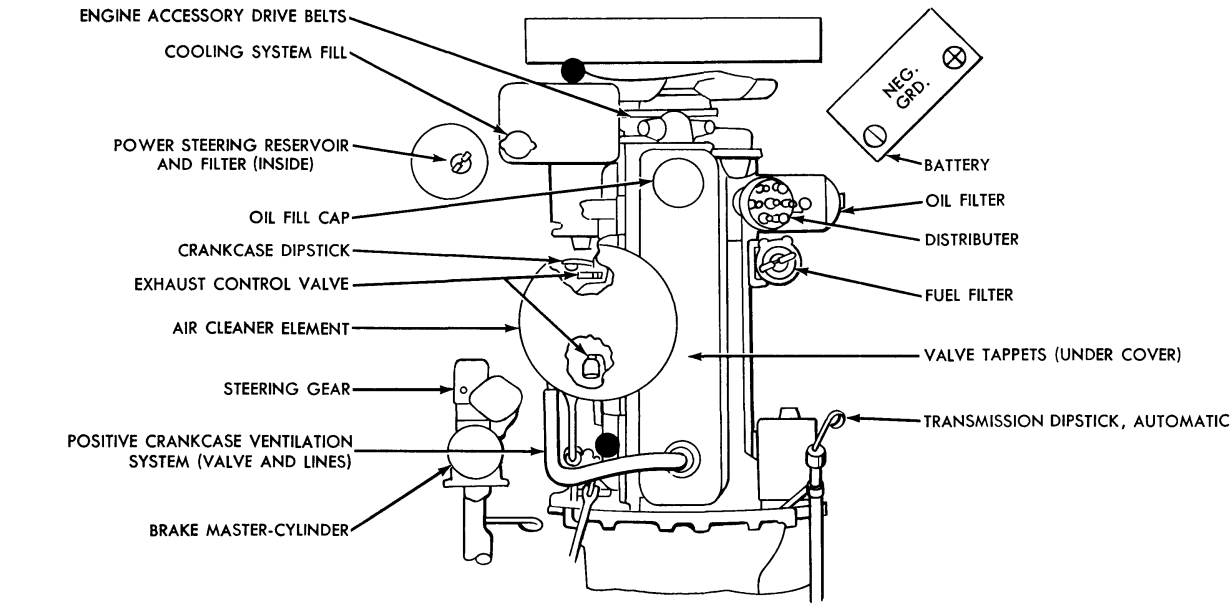
Sequence V – Sludge Formation

If engine oils are used which do not meet these requirements, it will be necessary to change oil more frequently than every 6,000 miles.

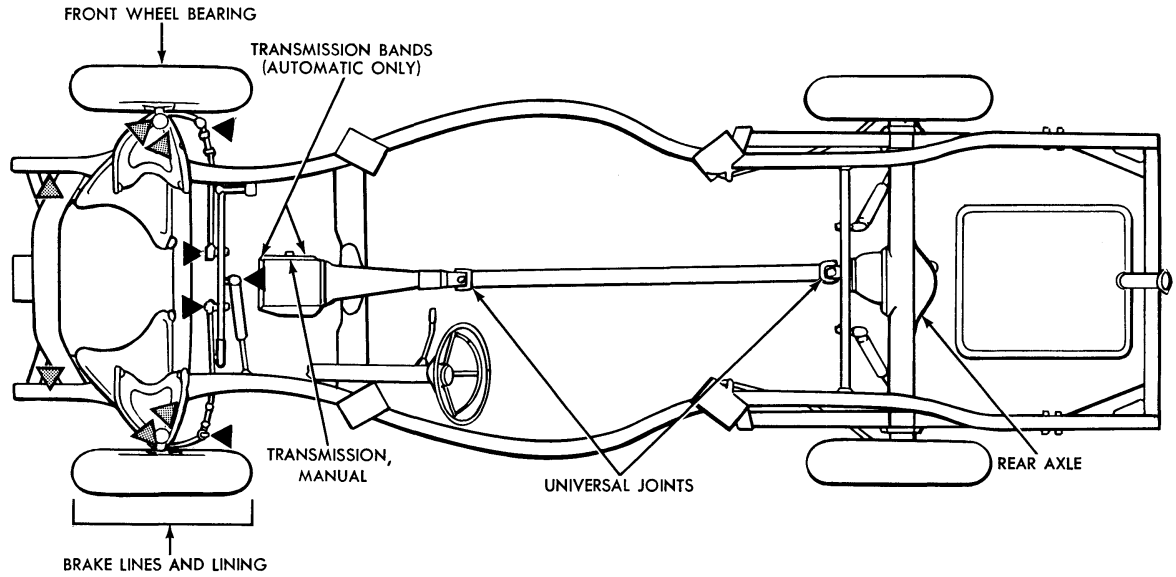
If it is necessary to use an "MS" oil which is not certified by the marketer as having passed the Engine Operating Sequence Tests, the addition of Rotunda Oil Conditioner to the oil will satisfy the requirements.

### Oil Filter

Use of the right oil filter is also essential to good engine life and operation. For 6,000 mile filter change intervals, filters must meet Ford Specification ES-COAE-6714-A. The genuine Rotunda Oil Filter meets this requirement.



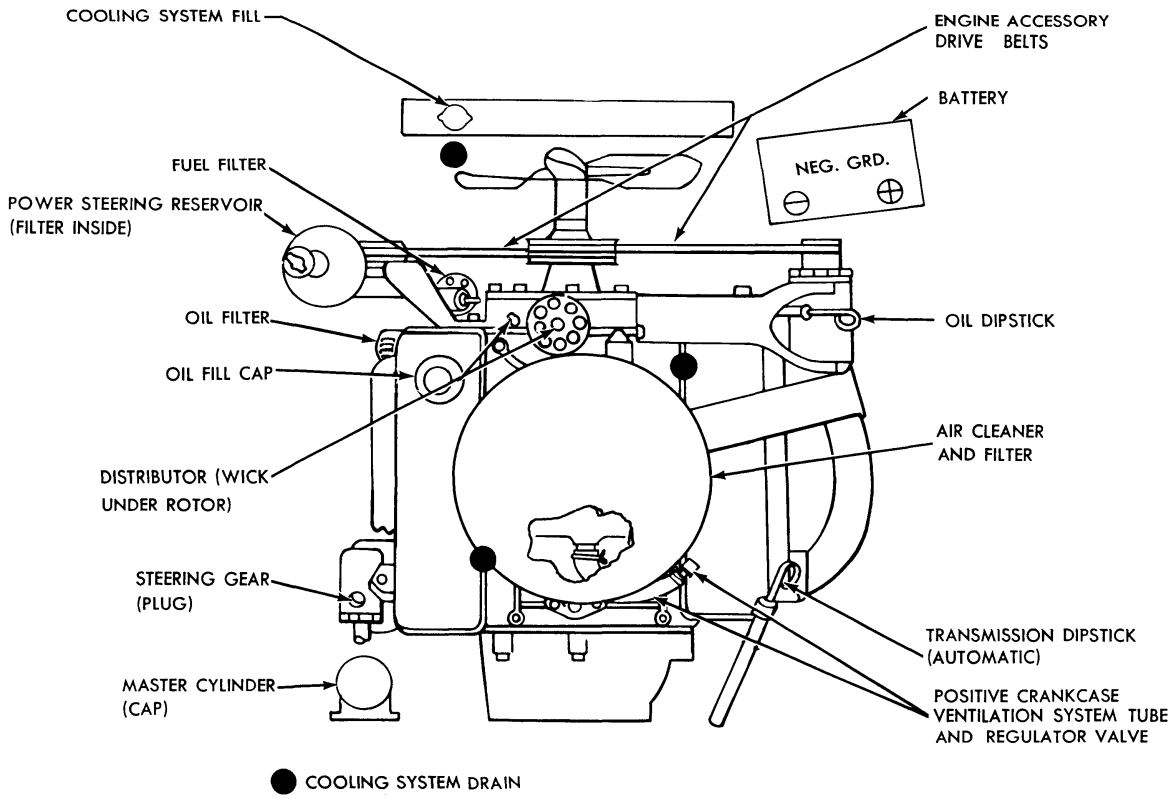

● COOLING SYSTEM DRAIN

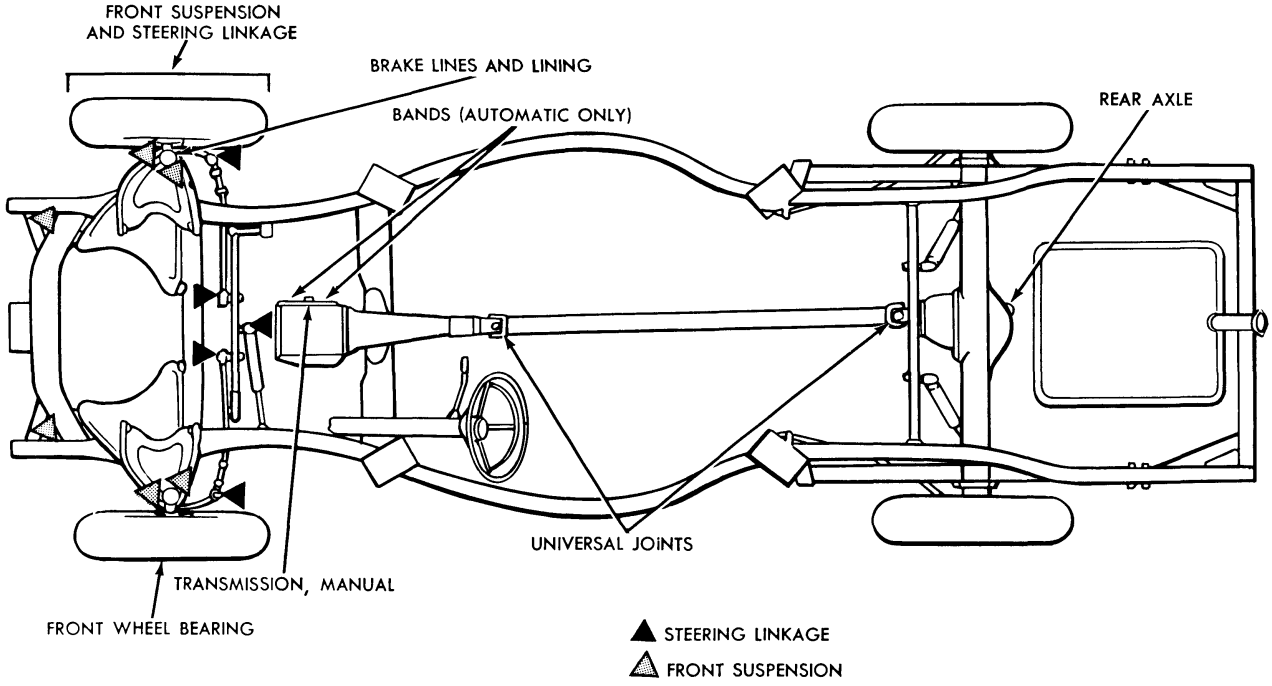



▲ STEERING LINKAGE
▲ FRONT SUSPENSION

Y1001-A

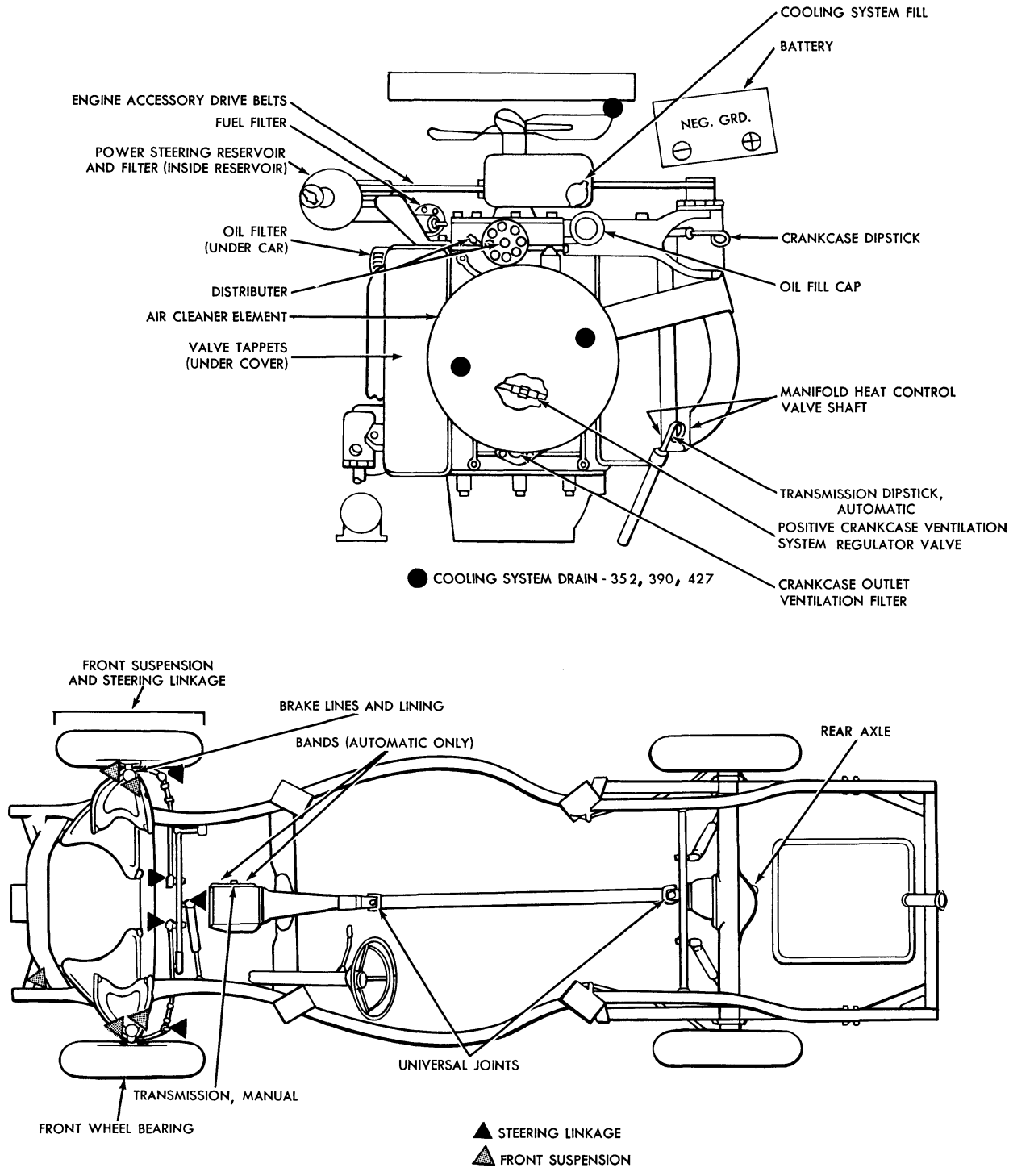
**FIG. 1—Lubrication Chart—6-Cylinder Engine**




Y1003-A

**FIG. 2—Lubrication Chart—289 V-8 Engine**




Y 1002-A

**FIG. 3—352, 390 and 427 V-8 Engines**

# SPECIAL SERVICE TOOLS

# GROUP 22

The usage of special service tools is illustrated and described in the text of this manual. Refer to the specific service procedure for the proper tool application.

The numbers shown in the first columns are Ford tool numbers. The second column indicates former vendor tool numbers. These tools may be obtained from Ford by ordering by the COMPLETE TOOL NUMBER as shown in the first column.

## BRAKES

| Ford Tool No. | Former No. | Description |
|---|---|---|
| — | LM-119 | Brake Cylinder Retaining Clamp |
| — | 2035N 2086L | Brake Shoe Retracting Spring Remover and Installer |
| TOOL-4235-C | 4235-C | Axle Shaft and Bearing Remover |
| TOOL-33621 | 33621 | Pump Shaft Bearing Retainer and Power Brake Pliers |
| — | 1112-144 | Inch-Pound Torque Wrench |

## SUSPENSION, STEERING, WHEELS AND TIRES

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T59L-100-B | — | Impact Slide Hammer |
| T58L-101-A | — | Puller Attachment |
| T53L-200-A | — | Handle Adapter |
| T56P-1217-A | — | Front Hub Bearing Cup and Grease Seal Replacer |
| T57P-3006-A | 3006-B | Spindle Ball Joint Assembly Remover Press |
| T54P-3044-A7 | — | Adapter |
| T54P-3044-A13 | — | Remover |
| T57P-3044-A | — | Front Suspension Lower Arm Support |
| T58P-3044-A | — | Upper Arm Shaft Locating Gauge |
| T58P-3047-A | — | Torque Wrench Adapter |
| TOOL-3290-B | 3290-B | Dist. Gear & Tie Rod Ends Remover |
| T61P-3355-A | 3355-E | Idler Arm Bushing Remover & Replacer |
| T58L-3548-A | 3552-G | Sector Shaft Bushing and Worm Gear Bearing Cup Replacer |
| T58L-3576-A | 3574-M | Steering Gear Housing Bearing & Oil Seal Remover |
| T62F-3576-A | — | Sector Shaft Bushing Remover & Replacer |
| T64K-3576-B | — | Sector Shaft or Needle Bearings and Seal Remover & Replacer |
| TOOL-3600-AA | 3600-AA | Bolt-on Type Steering Wheel Remover |
| T63L-8620-A | 8620<br>BT-33-73-F | Belt Tension Gauge |
| T57P-18201-A | 18201-A | Shock Absorber Bushing Assembly Remover and Replacer Kit |
| T56L-33610-D | — | Power Steering Pump Pressure Gauge |
| T53P-33623-A | 33623 | Power Steering Pump Rotor Shaft Oil Seal Replacer Adapter |

## REAR AXLE

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T50T-100-A | T50T-100-C | Impact Hammer |
| T53L-200-A | — | Handle Adapter |
| T57L-500-A | — | Bench Mounted Holding Fixture |
| — | CJ-950<br>OTC-951 | Bearing Remover |
| TOOL-1175-AB | 1175-AB | Grease Seal Remover (Head Only) |
| TOOL-1177 | 1177<br>1177-N | Axle Shaft Oil Seal Replacer |
| — | 1202-D | Pinion Bearing Cup Remover |

## REAR AXLE (Cont'd)

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T60K-1225-A | 4234-4<br>4234-4 | Axle Shaft Bearing Replacer and Remover |
| T59L-4204-A | 44211<br>44211-A | Locking Differential Torque Check |
| TOOL-4209-C | 4209-C | Pinion Tension Scale with TOOL-4209-C12 Socket |
| T57L-4220-A | — | Differential Bearing Assembly Remover |
| TOOL-4221-AF | 4221-AF | Differential Bearing Cone Pilot-Remover |
| TOOL-4221-AH | 4221-AH<br>4221-AE | Conventional Differential Bearing Cone Remover |
| T57L-4221-A | 4222-K | Differential Bearing Cone Replacer |
| TOOL-4235-C | 4235-C | Axle Shaft and Bearing Remover |
| T53T-4242-F11 | — | Pinion Bearing Cone Remover |
| TOOL-4245-B | 4245-B | Wheel Bearing Seal Replacer |
| T57L-4614-A | 4614 | Drive Pinion & Drive Pinion Retainer Assembly Support |
| — | JAW-4615-D-1 | Pinion Bearing Cup Remover |
| T57L-4616-A | 4615-E & F | Drive Pinion Bearing Cup Remover & Replacer |
| TOOL-4621-K | 4621-K | Drive Pinion Bearing Cone Remover |
| T57L-4621-B | 4621-L | Pinion Bearing Cone Replacer |
| T57L-4625-A | 4625-K & KA | Drive Pinion Pilot Bearing and Retaining Ring Remover & Replacer |
| T58L-4676-A | 4676-F | Drive Pinion Oil Seal Replacer |
| T53T-4851-A | 4851-A<br>4858-D | Flange (Universal Joint) Axle End Remover |
| T57L-4851-A | 4851-K | Universal Joint Flange Holder |
| TOOL-4858-E | 4858-E | Companion Flange & Pinion Bearing Replacer |

## DRIVE LINE AND CLUTCH

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T61K-6392-A | — | Clutch Pilot & Flywheel Housing Runout Gauge Adapter |
| T64L-6392-A | — | Conversion Dial—Dial Indicator to D-1 |
| T49P-7580-A | 7580-A | Transmission Clutch Release Bearing Replacer |

## MANUAL TRANSMISSION

| Ford Tool No. | Former No. | Description |
|---|---|---|
| — | CJ95 | Drive Pinion Bearing Cone Remover |
| T50T-100-A | — | Impact Hammer |
| T58L-101-A | — | Puller Attachment |
| TOOL-1175-AB | 1175-AB | Grease Seal Remover (head only) |
| T50T-100-A & TOOL-1175-AB | 1175-AE | Seal Remover |
| TOOL-3552-H | 3552-H | Worm Thrust Bearing Cup—Remover (Use with TOOL-7600-E) |
| T57L-4220-A4 | — | Horseshoe |
| T53T-4242-F11 | — | Pinion Bearing Cone Remover |

## MANUAL TRANSMISSION (Cont'd)

| Ford Tool No. | Former No. | Description |
|---|---|---|
| TOOL-4621-K | 4621-K | Drive Pinion Bearing Cone Remover |
| T53T-4621-B | 4621-F | Pinion Bearing Cone Replacer (front & rear) |
| T53T-4621-C | — | Pinion Bearing Cone Replacer |
| T57L-4621-A | 4625-F | Drive Pinion Rear Bearing Cone Remover |
| T52T-6500-DJD | 6500-D | Solid Tappet Remover |
| T52L-7000-CAE | 7000-G | Transmission Extension Housing Rear Bearing Remover |
| T63P-7025-A | — | Output Shaft Bearing Remover and Replacer |
| T56P-7111-B | 7111-E | Cluster Gear Roller Retainer Shaft |
| T57L-7111-A | 7111 | Cluster Gear Roller Retainer Shaft |
| T63P-7111-A | — | Cluster Gear Roller Retainer Shaft (5.69) |
| T63P-7111-B | — | Cluster Gear Roller Retainer Shaft (5.17) |
| T63P-7111-C | — | Cluster Gear Roller Retainer Shaft (4.67) |
| T58L-101-A<br>T59L-100-B | 7600-E | Clutch Pilot Bearing Replacer |
| T55P-7657-A | 7657-D | Transmission Extension Housing Oil Seal Replacer |
| T57-7657-A | 7657-F | Oil Seal Assembly Replacer |
| T60K-7657-B | 7657-G | Transmission Extension Housing Oil Seal Assembly Replacer |
| T61L-7657-A | 7657-AA | Transmission Extension Housing Oil Seal Replacer |
| T57P-7697-B | 7000-J | Transmission Extension Housing Bushing Replacer |
| T57P-77047-A | 70256-6B | Transmission Input Shaft Oil Seal Replacer |

## AUTOMATIC TRANSMISSION

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T50T-100-A | — | Impact Hammer |
| T59L-100-B | — | Impact Slide Hammer |
| T58L-101-A | — | Puller Attachment |
| T57L-500-A | — | Bench Mounted Holding Fixture |
| TOOL-1175-AB | 1175-AB | Grease Seal Remover (head only) |
| T50T-100-A<br>TOOL-1175-AB | 1175-AE | Seal Remover |
| T53T-1175-E | — | Rear Wheel Grease Retainer Replacer |
| — | 1202-D | Pinion Bearing Cup Remover |
| TOOL-4201-C | 4201-C | Differential Backlash & Runout Gauge with Univ. Bracket, Dial Indicator & Bracket |
| TOOL-7000-CJ | 7000-CC<br>7000-CJ | Transmission Overhaul Holding Fixture |
| TOOL-7000-DD | 7000-DD | Air Nozzle Rubber-Tip Assembly |
| T52L-7000-HAE | 7000-HF | Transmission Extension Housing Rear Bearing Remover |
| TOOL-7003 | 7003 | Bench Test Turning Tool |
| T64P-7A128-A | — | Manual Valve Detent Spring |
| TOOL-7195-C | 7195-C | Rear Band Adjustment Wrench |
| T58L-7195-A | — | Fordomatic Band Adjustment Wrench |
| TOOL-7225-B | 7225-B | Front Band Adjustment Wrench |
| TOOL-7225-C13-B | 7225-C13-B | Gauge Block and Chain Assembly |
| T64P-7B456-A | — | Clutch Race to Case Bolts Socket |
| T61L-7657-A | 7657-AA | Transmission Extension Housing Oil Seal Replacer |
| T61L-7657-B | 7657-AB | Transmission Extension Housing Oil Seal Replacer |
| T57P-7697-A | 7000-AD | Transmission Extension Housing Bushing Remover |
| T57P-7697-B | 7000-J | Transmission Extension Housing Bushing Replacer |
| T58L-7902-A or B | 7937-A<br>7946-A | Welded Converter Sprag Driver and Gauge Post |
| T59P-7902-B | 7937-B | Welded Converter Sprag Driver and Gauge Post |
| T63P-7902-A | — | Converter Stator Check Adapter |
| T64L-7902-A | — | Welded Convertor Sprag Driver and Gauge Post Adapter Kit for T59P-7902-B |

## AUTOMATIC TRANSMISSION (Cont'd)

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T59P-77067 | 77067 | Dial Indicator Support Fixture |
| TOOL-77288 | 77288 | Control Shaft Seal Replacer |
| T59P-77370-B | 7345 | Front Bank Torque Wrench |
| T59L-77515-B | 77515-A<br>77515 | Rear Clutch Spring Compressor |
| TOOL-77530-A | 77530-A<br>77530 | Clutch Assembly Fixture |
| TOOL-77565 | 77565 | Front Clutch Spring Compressor |
| T57L-77820-A | 77820-B | Automatic Transmission 400 Pound Pressure Gauge |
| T59L-77837-A | — | Front Pump Seal Replacer |
| T63L-77837-A | 77837 | Front Pump Seal Replacer |
| TOOL-77869-A | 77869-A<br>77869-W | Transmission Sleeve Remover & Replacer |

## ENGINE

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T59L-100-B | — | Impact Slide Hammer |
| T58L-101-A | — | Puller Attachment |
| T53L-200-A | — | Handle Adapter |
| T53L-300-A | 6000-BA | Engine Lifting Sling |
| — | OTC927 | Clutch Pilot Bushing Remover—Use with T58L-101-A |
| T52L-6000-C | 6000-AB | Engine Lifting Hook |
| T58P-6000-A | 6000-BD | Engine Lifting Bracket |
| T52T-6005-CJD | 6005-BKS | Engine to Repair Stand Engine Mount (Splined Shaft) |
| T54T-6005-C | 6005-CE | Engine Assembly to Repair Stand Adapter |
| T52T-6005-KJD | — | Engine Mount (Keyed Shaft) |
| TOOL-6001-E | 6011-E | Cylinder Ridge Reamer |
| T52L-6059-AAE | 6059-A | Cylinder Front Cover Pilot |
| T61P-6119-B | 6059-F | Cylinder Front Cover Pilot |
| T52P-6085-DAD | 6085-D | Cylinder Head Holding Fixture |
| T58P-6085-A | 6085-M | Cylinder Head Holding Fixture |
| T62F-6085-A | — | Engine Lifting & Head Holding Brackets |
| T52P-6135-DAD | — | Piston Pin Remover |
| T60K-6135-A | 6135-J | Piston Pin Remover & Replacer Press |
| — | FLM-6149<br>6149<br>6149-A or E | Piston Pin Ring Compressor |
| T54T-6250-B | 6261-E<br>6261-J | Camshaft Bearing Remover & Replacer Adapters |
| T62F-6250-A | 6261-AD | Camshaft Bearing Adapters |
| T52L-6261-CEE | 6261-C | Camshaft Bearing Remover & Replacer |
| T52L-6266-BGD | 6266-B | Cylinder Head Core Plug, Cylinder Block Core Plug & Camshaft Bearing Bore Plug Replacer |
| T58P-6266-A | — | Camshaft Bearing Bore Plug Replacer Adapter |
| T62F-6266-A | 6266-B | Camshaft Rear Bearing Bore Plug Adapter |
| TOOL-6306-AG | 6306-AG | Crankshaft Damper Remover & Power St. Pump Socket Replacer |
| TOOL-6306-AJ | 6306-AJ | Crankshaft Damper Remover & Replacer |
| T52L-6306-AEE | 6306-AC | Crankshaft Damper Replacer |
| T52L-6316-FEE | 6316-FF | Crankshaft Damper Remover |
| T58P-6316-A | — | Crankshaft Damper Remover |
| TOOL-6331 | 6331 | Upper Main Bearing Insert Remover & Replacer |
| TOOL-6331-E | 6331-E | Upper Main Bearing Insert Remover & Replacer |
| T62F-6316-B | — | Crankshaft Damper Remover Adapter Screw |
| T56P-6362-A | — | Crankshaft Pulley Spacer Remover |
| TOOL-6500-C | 6500-C | Hydraulic Tappet Clip Replacer |
| TOOL-6500-F | 6500-F | Hydraulic Tappet Plunger Remover & Replacer |
| T52T-6500-DJD | 6500-D | Solid Tappet Remover |
| — | 6513-EE | Valve Spring Compressor |
| T62F-6565-A | 6513-HH | Valve Spring Compressor |

## ENGINE (Cont'd)

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T58P-6700-B | 6700-B | Cylinder Block Front Cover Oil Seal Replacer Adapter |
| T52L-6700-BEE | — | Front Cover Oil Seal Replacer |
| T52L-6701-AGD | 6701-A | Crankshaft Rear Oil Seal Forming Tool |
| T58P-6701-A | 6701-C | Crankshaft Rear Bearing Seal Replacer |
| T62F-6701-A | 6701-E | Crankshaft Rear Seal Replacer |
| TOOL-7563 | 7563 | Clutch Compressor with Three Pilots |
| T58P-7563-A | — | Disc Clutch Pilot |
| T58L-101-A<br>T59L-100-B | 7600-E | Clutch Pilot Bearing Replacer |
| TOOL-7600-H | 7600-H | Clutch Pilot Bearing Replacer |
| TOOL-7675-N | — | Three-Jawed Puller—typical |
| T52T-12175-AJD | 7600-H | Clutch Pilot Bearing Installer |

## IGNITION SYSTEM

| Ford Tool No. | Former No. | Description |
|---|---|---|
| — | S-8683 | Double Hex Distributor Wrench (typical) |
| T57L-12120-A | — | Distributor Base Upper Bushing Replacer |
| T52L-12131-CAD | 12131-C | Distributor Shaft Gear and Collar Retaining Pin Remover and Replacer Fixture |
| TOOL-12132 | 12132 | Distributor Shaft Bushing Burnisher |
| TOOL-12132-A | 12132-A | Distributor Shaft Bushing Replacer |
| — | 12132-B1 or N | Distributor Shaft Bushing Remover |
| T58L-12132-B | — | Distributor Body Holding Clamp |
| T58P-12132-B | — | Distributor Body Holding Clamp |
| — | 12150-D | Distributor Adjusting Wrench |
| TOOL-12151 | 12151 | Distributor Point Tension Scale |
| T52L-12390-CAD | 12390-C | Distributor Shaft Drive Gear Remover Kit |
| T52L-12390-DED | 12390-D | Distributor Gear Locating & Installing Fixture |
| T57L-12390-A | 12175-B | Tach Gear & Drive Gear Locating & Installing Fixture |
| T57L-12390-A5 | 12390-E | Locating Gauge |

## FUEL SYSTEM

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T62P-9A274-A | — | Full Line Tube Die |
| T56L-9350-A Kit | 9350<br>9350-A, C<br>9350-D, E | Fuel Pump Repair Overhaul Tool Kit |
| T57L-9904-A | — | Carburetor Power Valve and Gasket Test Fixture |
| T57L-9904-A17 | — | Curved Wand Assembly |

## COOLING SYSTEM

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T57L-4614-A | 4614 | Drive Pinion & Drive Pinion Retainer Assembly Support |
| T57L-4621-A | 4625-F | Drive Pinion Rear Bearing Cone Remover |
| — | 7576-N | Three-Jawed Puller-typical |
| TOOL-8501-F | 8501-F | Water Pump Overhaul Kit |
| T52L-8501-DAD | 8501-DD | Water Pump Overhaul Kit |
| T58P-8501-A | — | Water Pump Overhaul Kit |
| T57L-8512-A | 8530 | Water Pump Impellor Replacer Adapter |
| T62F-8512-A | — | Water Pump Impellor Replacer Gauge |
| T62F-8530-A | — | Water Pump Bearing and Shaft Remover & Replacer |
| T63L-8620-A | 8620<br>BT-33-73-F | Belt Tension Gauge |

## CHARGING SYSTEM

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T58P-7563-A | — | Disc Clutch Pilot |
| T63L-8620-A | 8620<br>BT-33-73-F | Belt Tension Gauge |
| TOOL-10044-A | 10044-A | Generator Pole Screw Wrench |
| T63L-10300 | — | Alternator Pulley Remover |
| TOOL-10505-F | 10505-F | Voltage Regulator Adjustment Bending Tool |
| T56L-10505-A | M-183-RT6-5 | Voltage Regulator Setting Thermometer |

## STARTING SYSTEM

| Ford Tool No. | Former No. | Description |
|---|---|---|
| TOOL-10044-A | 10044-A | Generator Pole Screw Wrench |

## AIR CONDITIONING

| Ford Tool No. | Former No. | Description |
|---|---|---|
| ACM-57-2-TOOL | ACM-57-2 | Leak Detector—Complete |

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