# PART 15-01 General Driving Axle and Drive Shaft Service

**Applies To All Series Except for Vacuum Operated Lock-Out Control and Straight Air Shift Components (Tandem Series)**



## 3 ADJUSTMENTS

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, wheel bearing, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing or replacing any of the parts. Reference to the Truck Diagnosis Manual can be very helpful.

On F-100 through F-350 vehicles, certain trouble symptoms may be caused by limited-slip differentials. To determine whether these vehicles are equipped with conventional or limited-slip differentials, check the vehicle rating plate and the axle ratio tag.

Location of the axle Identification Code on the Rating Plate is shown in Fig. 1. These codes are also listed in Fig. 2.

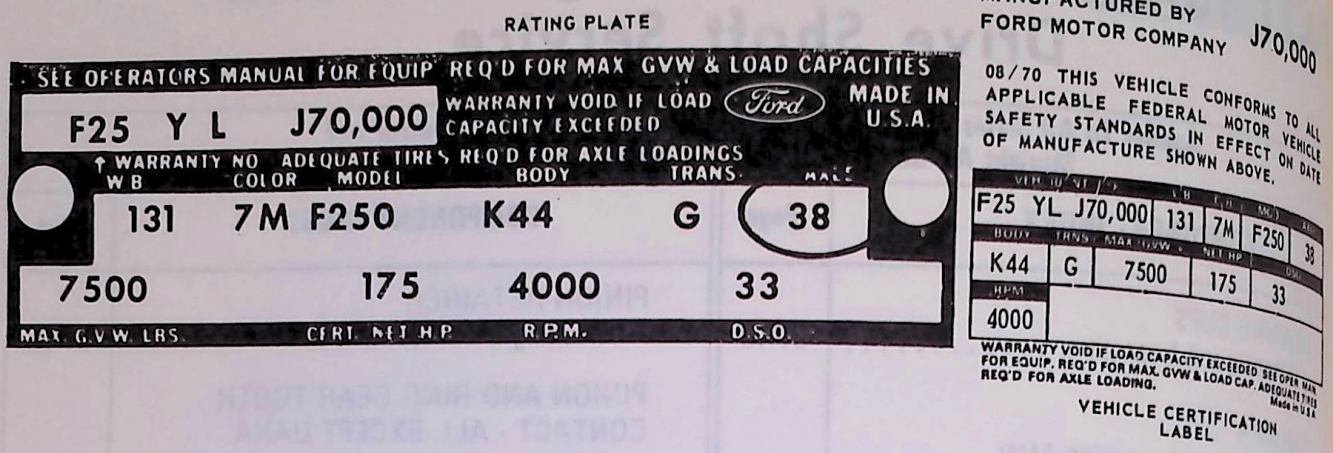


FIG. 1 Truck Rating Plate— Rear Axle Code Location

## TOOTH CONTACT PATTERN CHECK (ALL EXCEPT FORD)

Paint the gear teeth and roll a pattern as described in Section 3. After diagnosing the tooth pattern as described here, make the appropriate adjustments as detailed in Section 2.

The correct tooth contact pattern is considered to be the final check on pinion depth and backlash adjustments. Backlash adjustments, however, must be within the limits given in Fig. 11.

Fig. 3 shows typical Dana patterns, and Fig. 4 shows typical Eaton and Rockwell patterns.

Due to minor differences existing between individual gear sets, these patterns 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.

In general, desirable tooth patterns should have the following characteristics:

1. The drive pattern should be fairly well centered on the tooth.
2. The coast pattern should be centered on the tooth but may be slightly toward the toe.
3. Some clearance between the pattern and the top of the tooth is desirable.
4. There should be no hard lines where the pressure is high.

The pattern movements with changes in backlash and pinion depth are typical of all axle gears, hypoid or spiral bevel.

The movement of tooth contact patterns can be summarized as follows:

a. Decreasing backlash moved the ring gear closer to the pinion:

(1) Drive pattern (convex side of gear) moves slightly lower and toward the toe.

(2) Coast pattern (concave side of gear) moves lower and toward the toe.

b. Increasing backlash moves the ring gear away from the pinion.

(1) Drive pattern moves slightly higher and toward the heel.

(2) Coast pattern moves higher and toward the heel.

c. Thinner shim with the backlash constant moves the pinion closer to the ring gear:

(1) Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

(2) Coast pattern moves deeper on the tooth and toward the heel.

d. Thicker shim with the backlash constant moves the pinion further from the ring gear:

(1) Drive pattern moves toward the top of the tooth (face contact) and toward the heel.

(2) Coast pattern moves toward the top of the tooth and slightly toward the toe.

If the patterns are not correct, make the changes as indicated. The pinion need not be disassembled to change a shim.

## GEAR TOOTH CONTACT PATTERN CHECK (FORD AXLES)

**When rolling a tooth pattern, use the special compound (tube) packed with each service ring gear and pinion set.**

**Paint all 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, nonhunting and partial non-hunting. Each type is determined by 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 ring gear teeth.**

### Acceptable Tooth Patterns (Ford Axles)

Figure 5 shows acceptable tooth patterns for all axles. Any combination of drive and coast patterns will be acceptable.

In general, acceptable tooth patterns should have the following characteristics:

1. The drive pattern should be fairly well centered on the tooth.
2. The coast pattern should be fairly well centered on the tooth.
3. Some clearance between the pattern and the top of the tooth is desirable.
4. 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. **Any combination of drive and coast patterns shown in Fig. 5 are acceptable**

### Hunting Gear Set

In a hunting-type gear set, any one pinion gear tooth comes into contact with all ring gear teeth. In this type, several revolutions of the ring gear are required to make all possible gear

REAR AXLE IDENTIFICATION

| Type | Code | Model |
|---|---|---|
| Ford Single Speed | 02, 03, 04, 05, 06, 07, 08<br>09, 10, 11, 12, 13, 17, 18 | |
| Ford Single Speed Locking Axle | A1, A2, A3, A4, A5<br>B8, B9, H1, H2, H3 | |
| Dana Single Speed | 31, 33, 35, 36<br>24, 25, 37, 38<br>22, 23, 27, 28, 36 | —<br>60<br>70 |
| Dana Single Speed Locking Axle | C1, C3, C5, C6<br>B4, B5, C7, C8<br>D6, D7, D8 | —<br>60<br>70 |
| Rockwell Single Speed Single Reduction | 30, 32, 34<br>41, 42, 44<br>62, 64, 66<br>H1, H2, H3, H4, H5, H6, H7, H8, H9<br>52, 53, 54, 55 | C-100<br>D-100<br>F-106<br>R-171<br>H-170 |
| Rockwell Single Speed Double Reduction | L1, L2, L3, L4, L5<br>P5 | Q-246<br>RT-241 |
| Rockwell Two Speed Double Reduction | X1, X2, X4, X5<br>T3, T4, T5<br>Y4, Y5 | RT-341<br>Q-346<br>R-302 |
| Rockwell Tandem Single Speed Single Reduction | B1, B2, B3, B4, B5, B6, B7, B8, B9, B0, BA<br>D1, D2, D3, D4, D5, D6, D7, D8, D0, DA<br>W3, W4, W5 | SLHD<br>SQHD<br>SHHD |
| Eaton Single Speed Single Reduction | GG, AG, BG, HG, CG, DG, EG, FG<br>AK, FK<br>DK, GK, EK, BK, CK<br>DQ, CQ<br>EQ, FQ, GQ, HQ, IQ | 19121<br>18101<br>18121<br>17101<br>17121 |
| Eaton Single Speed Double Reduction | CJ | 18301 |
| Eaton Two Speed Single Reduction | E1, E2, E3<br>F1, F2, F3<br>BB, CB, HB<br>DB, FB, GB, EB<br>BH, CH, DH<br>EH, FH, GH, HH<br>FP, GP, AP, HP, BP, CP, DP, EP | 16244<br>15201<br>18201<br>18221<br>17201<br>17221<br>19221 |
| Eaton Tandem Single Speed Single Reduction | AC, BC, CC, DC, EC, FC, GC, HC<br>GF, HF, IF, KF<br>LF, JF, BF, CF, DF, EF, FF<br>F1, G1, A1, B1, H1, C1<br>D1, E1, J1, K1 | 30D SC<br>34D SE<br>34D SC<br>38D SC<br>38D SE |
| Eaton Tandem Single Speed Double Reduction | BN, CN, DN, EN, FN<br>GN<br>AR, BR, CR, DR, ER, FR<br>GR<br>AV, CV, DV<br>BV<br>AD, BD, CD, DD | 34D PC<br>34D PE<br>38D PC<br>38D PE<br>42D PB<br>42D PD<br>30D PC |
| Eaton Tandem Two Speed Single Reduction | AW, BW, DW, KW, IW<br>FW, GW, HW | 34D TC<br>34D TE |
| Eaton Tandem Two Speed Double Reduction | CL, DL, EL, FL | 30D TC |
| Eaton Tandem Three Speed Single Reduction | AZ, BZ<br>JT | 38D TC<br>34D TE |
| Eaton Tandem Three Speed Double Reduction | HT, AT, BT, IT | 34D TC-3 |

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FIG. 2 Driving Axle Identification Codes

### Non-Hunting Gear Set

In a non-hunting type gear set, any one pinion gear tooth comes into contact with only a few ring gear teeth. In this type, only one revolution of the ring gear is required to make all possible tooth contact combinations. **Any combination of drive and coast patterns shown in Fig. 5 are acceptable.**

### 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 ring gear teeth, but more than one revolution of the ring gear is required to make all possible gear tooth combinations. **Any combination of drive and coast patterns shown in Fig. 5 are acceptable.**

### Shim Changes

Since each gear set rolls a characteristic pattern, the patterns shown in Fig. 5 are considered acceptable and should be used as a guide. 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 shimming can be summarized as follows:

**1.** Thicker shim with the backlash set to specifications moves the pinion further from the ring gear:

**2.** Thinner shim with the backlash set to specifications moves the pinion closer to the ring gear:

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 nonhunting or partial non-hunting gear set, be sure that the marked tooth on the pinion indexes between the marked teeth on the ring gear. Refer to Pinion and Ring Gear Tooth Contact Adjustment, Section 2.

## REAR AXLE COMPANION FLANGE RUNOUT CHECK (FORD AND DANA AXLES)

**1.** Raise the vehicle on a hoist that supports the rear axle (twin-post hoist).

**2.** Remove the driveshaft assembly (Part 15-60).

**3.** Check the companion flange for damage to the universal joint bearing locating lugs. If the universal joint bearing locating lugs on the companion flange are shaved (worn) or damaged, replace the companion flange Fig. 6.

**4.** The rear axle companion flange runout is checked with a modified universal joint (checking tool) a dial indicator with 1.000 inch minimum travel, and a cup-shaped dial indicator adapter tool (Fig. 7). To fabricate the checking tool, modify a universal joint assembly by removing two bearing cups that are opposite each other, and cutting or grinding off one of the universal joint bearing flanges (Fig. 7).

**5.** Install the cup-shaped adapter on the dial indicator stem. Install the dial indicator on the pinion retainer or pinion nose bumper bracket. Position the indicator to allow an indication at the ends of the universal joint bearing cups and the remaining exposed journal of the cross-shaft.

**6.** Turn the companion flange so that the dial indicator cup-type adapter rests on the machined surface of the bearing cup (Fig. 7). Rotate the companion flange side-to-side slightly to obtain a reading indicating that the bearing cup surface is perpendicular to the indicator cup-type adapter. **This will be the point at which the dial indicator cup is closest to the center of companion flange rotation. It is also the point at which the dial indicator hand will reverse direction as the companion flange is turning.** Set the dial indicator to zero.

**7.** Carefully retract the dial indicator stem and rotate the companion flange 180 degrees to position the machined surface of the opposite universal bearing under the dial indicator adapter tool. Again, slightly rotate the flange side-to-side to position the bearing perpendicular to the dial indicator adapter. Again, this is the point at which the indicator hand will reverse direction as the flange is rotated. Record the flange bearing cup runout reading obtained from the indicator (Fig. 8).

Rotate the companion flange 90 degrees and position the dial indicator adapter on the machined end of the exposed journal (Fig. 9). **Be sure the end surface of the exposed journal is perpendicular to the indicator cuptype adapter.** This requires that the cross-shaft be moved fore and aft on the flange bearing cups. **Note the point at which the indicator hand reverses direction.** Rotate the flange assembly side-to-side until the crossshaft is perpendicular to the pinion shaft axis, and the indicator hand reverses direction. Zero the dial indicator and check the zero point again by slightly moving the cross-shaft fore and aft, then rotate the companion flange from side-to-side.

**8.** With the indicator at zero, carefully retract the dial stem and rotate the flange 180 degrees. Rotate the cross-shaft 180 degrees on the flange bearing cups to position the exposed journal under the dial indicator adapter. Rock the cross-shaft fore and aft and the companion flange side-to- side to establish the point at which the indicator hand reverses direction. This will determine the driveshaft universal cross-shaft runout. Record this reading (Fig. 9).

**9.** Repeat steps 5 through 8 at least three times and average the indicator readings obtained (Fig. 8).

**10.** To determine the total (combined) companion flange runout, it will be necessary to use the combined runout chart (Fig. 10). Position a straight edge at the amount of flange bearing cup runout indicated on the left hand column of the chart. Position another straight edge vertically at the amount of driveshaft universal cross-shaft runout indicated on the top of the chart. The point at which the straight edges cross the chart indicates the combined rear axle flange runout. For example:

With an indicated 0.003 inch flange bearing cup runout and an indicated 0.004 inch universal cross-shaft runout (Fig. 9), the combined companion flange runout will be 0.005 inch as indicated in the square on the chart (Fig. 10).

**11.** If the reading obtained in Step 10 exceeds specifications, reposition the companion flange 180 degrees on

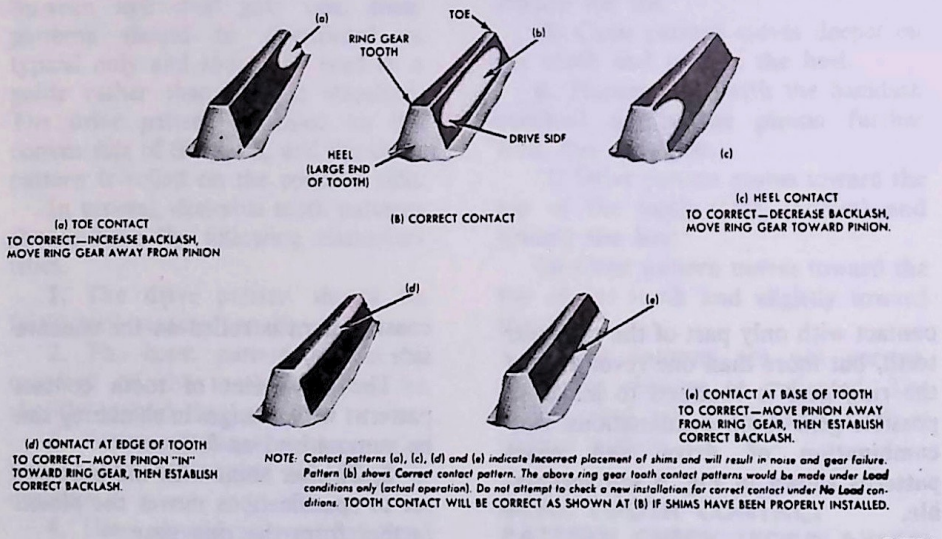


FIG. 3 Typical Gear Tooth Contact Patterns—Dana

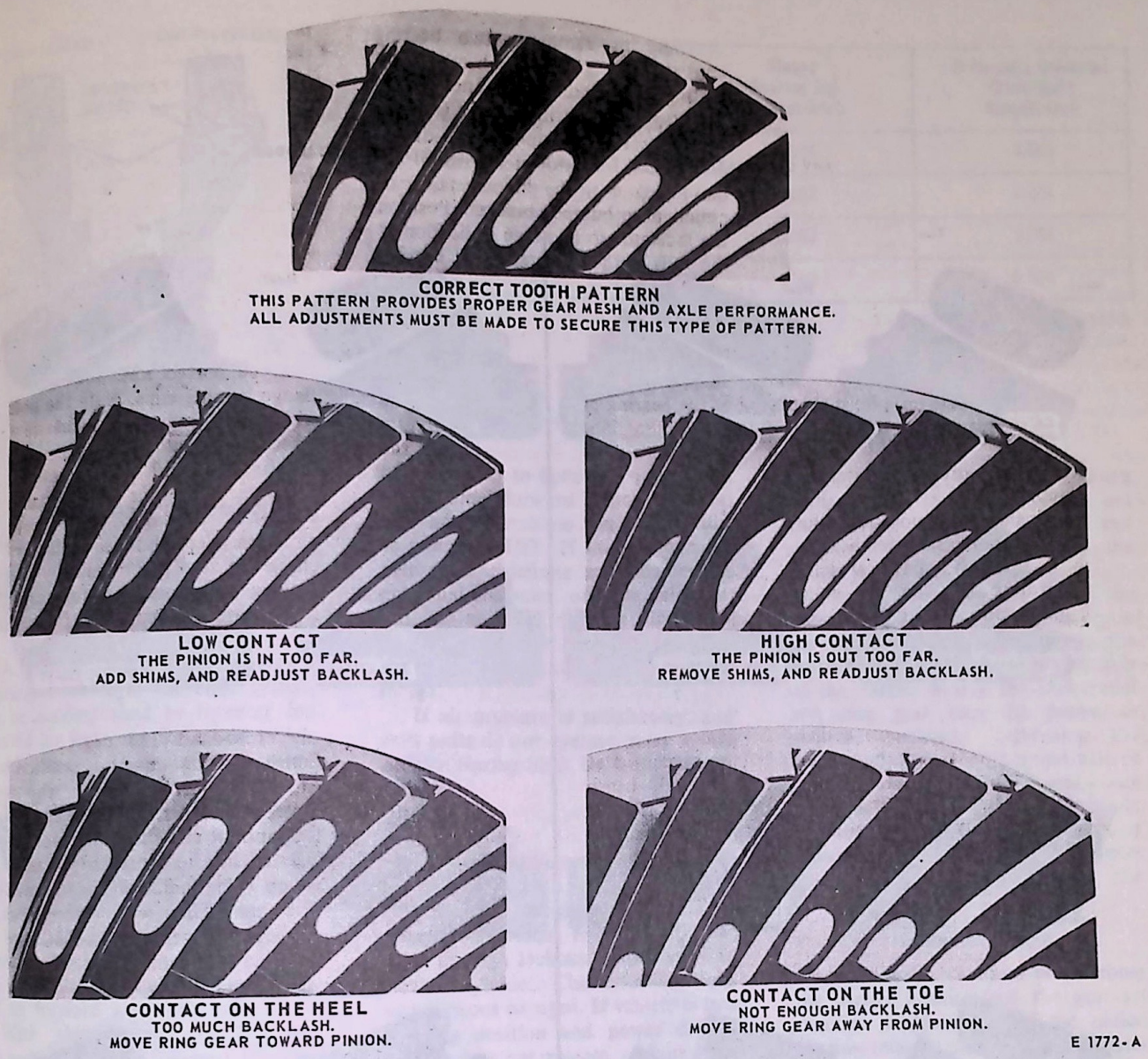


FIG. 4 Eaton and Rockwell Gear Tooth Contact Patterns

the pinion shaft and repeat steps 1 through 11.

**12.** If the repeat readings still exceed specifications, re-position the flange an additional 90 degrees on the pinion shaft and check the runout (Steps 4 through 10).

**13.** If the runout is still excessive, replace the companion flange and check the runout. If necessary, rotate the new flange on the pinion shaft until an acceptable runout is obtained.

If excessive runout is still evident after replacement of the companion flange, it will be necessary to replace the ring and pinion gear, and repeat the above checks until runout is within specifications.

**14.** Install the driveshaft assembly (Part 15-60). **Make sure the universal joint bearing cups are properly positioned between the companion flange lugs.**

**15.** Lower the vehicle. Road test the vehicle. If drive shaft vibrations are evident during the road test, remove the driveshaft from the companion flange and rotate it 180 degrees. Road test the vehicle again.

## TANDEM INTER-AXLE DIFFERENTIAL VACUUM OPERATED LOCKOUT CONTROL—LEAKAGE TEST

Place the vehicle on level ground with the parking brake released and the transmission in neutral. Start the engine with the valve control knob pulled out (the power divider differential locked out).

Accelerate the engine for a few seconds, release the accelerator, and turn off the ignition switch. Immediately measure the distance between the face of the lockout cylinder mounting bracket and the center of the push rod yoke to the lever pin. Then after ten minutes, measure the distance again. If the distance has not increased, the system may be considered vacuum tight. However, if the distance has increased, a vacuum leak exists in the system.

First check all the connections. After all the hoses and the pipe connections have been checked and tightened, test the system again. If the vacuum leaks still exist, check the control valve and check valve assembly, and the power divider lockout cylinder in the order given.

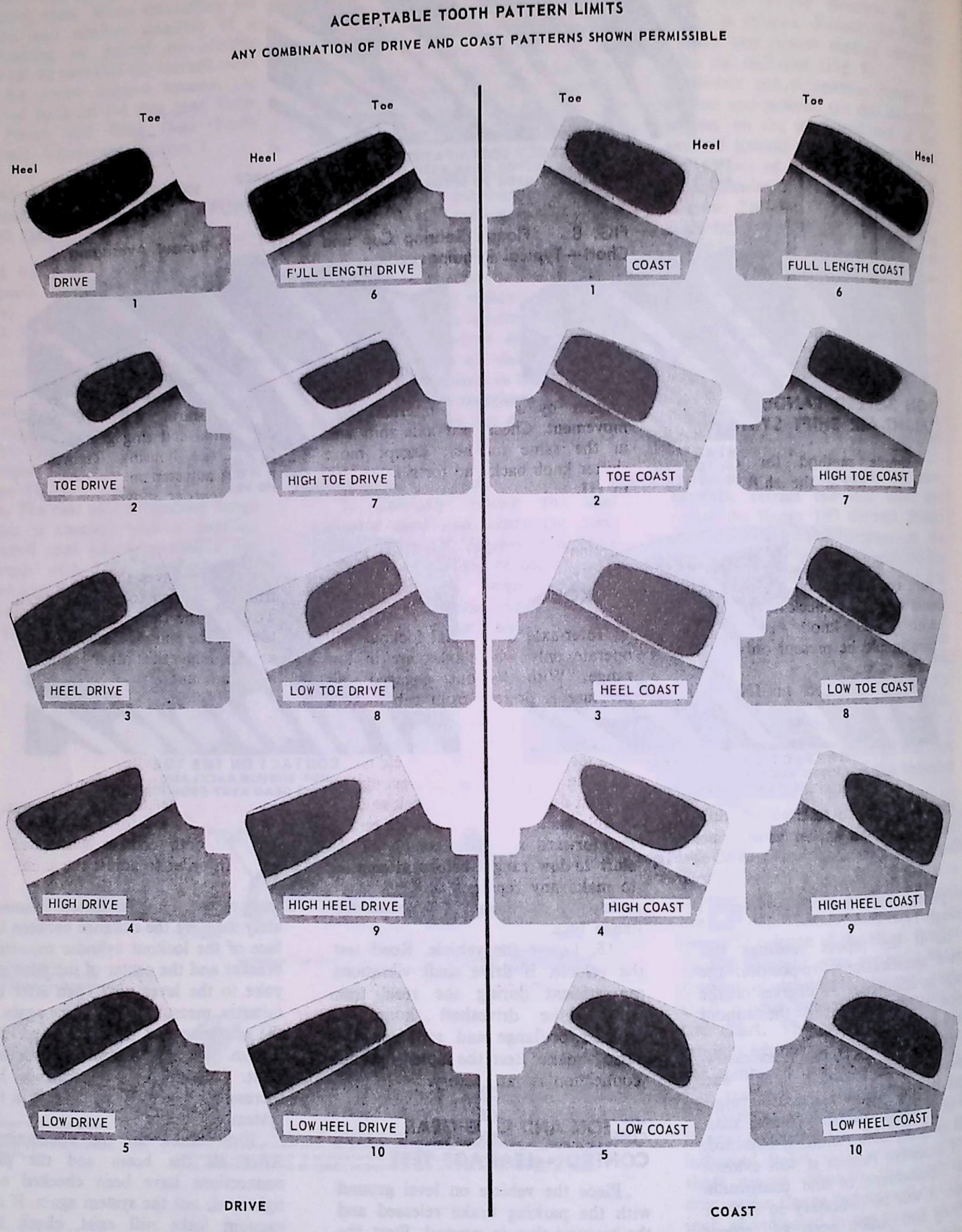


FIG. 5 Typical Gear Tooth Contact Patterns—Ford

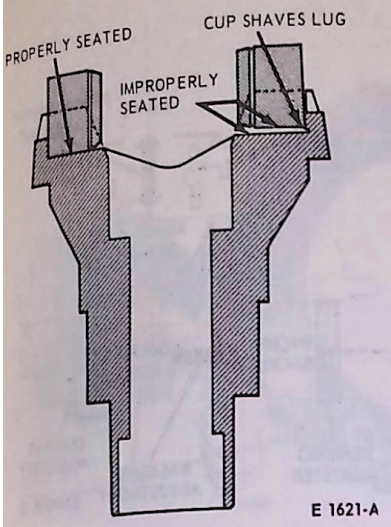


FIG. 6 Checking Companion Flange

| Indicator Reading | Flange Bearing Cup Runout—Inch | Driveshaft Universal Cross-Shaft Runout—Inch |
|---|---|---|
| 1 | 0.004 | 0.005 |
| 2 | 0.002 | 0.004 |
| 3 | 0.003 | 0.003 |
| Average | 0.003 | 0.004 |

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FIG. 8 Flange Bearing Cup and Cross Shaft Runout Averaging Chart—Typical Readings

## EATON 3-SPEED TANDEM STRAIGHT-AIR SHIFT SYSTEM

A simple method for quickly locating troubles in the shift system can be accomplished by listening for possible air leaks and for sound which would indicate shift unit operation. Proceed as follows:

Turn ignition switch **ON** to open solenoid valve, and check for air leaks.

With shifter knob in **LO**, air pressure should be present only up to air shifter valve.

With shifter knob in **INT**, air pressure should be in forward axle air line only (through quick release valve and to forward axle shift unit).

With shifter knob in **HI**, air pressure should be present in the entire system, from reservoir, through solenoid valve, air shifter valve, quick release valves to both axle shift units.

To check forward axle for shifting, operate shifter knob back and forth from **LO** to **INT**. If the shift unit is operating, a definite reaction will be evident by sound of internal parts movement. Check rear axle shift unit in the same manner, except move shifter knob back and forth from **INT** to **HI**.

**If air pressure is satisfactory, and shift units do not operate, refer to Air Torsion Spring Shift Unit, Part 15-13.**

## LOCKOUT

Inter-axle differential lockout will operate only when axles are in low range. With lockout engaged, air pressure is present from cab lockout valve through lockout control valve to lockout cylinder. Check for air leaks with lockout engaged. **If vehicle is in a standing position and power divider lockout does not operate, rock or drive vehicle back and forth to make certain the forward axle has completed the shift to low range; before attempting to make any repairs.**

## SPEEDOMETER ADAPTERS

To locate troubles in adapter operation, trace electrical circuit from ignition switch through circuit breaker, pressure switches to adapters. Also make sure adapter ground connection is satisfactory.

## PINION AND RING GEAR TOOTH CONTACT ADJUSTMENTS (ALL EXCEPT DANA)

Two adjustments affect pinion and ring gear tooth contact. They are pinion depth and backlash (Fig. 11).

The pinion depth adjusting shims are installed between the pinion bearing retainer or cage and the carrier housing; therefore, adding shims would move the pinion out away from the ring gear, and removing shims would move the pinion in toward the ring gear.

The bearing adjusters locate the differential and ring gear assembly in the carrier housing. Tightening the bearing adjuster on the ring gear side of the carrier moves the differential and ring gear into the pinion to decrease backlash. Tightening the bearing adjuster on the pinion side of the carrier moves the ring gear away from the pinion to increase backlash. To move the ring gear away from, or toward, the pinion, loosen one adjuster and tighten the other adjuster the same amount.

### Shim Selection

Individual differences in matching the carrier housing and the gear set requires a shim between the pinion bearing retainer sleeve and the carrier housing to locate the pinion for correct tooth contact with the ring gear. In order to adjust the shim pack

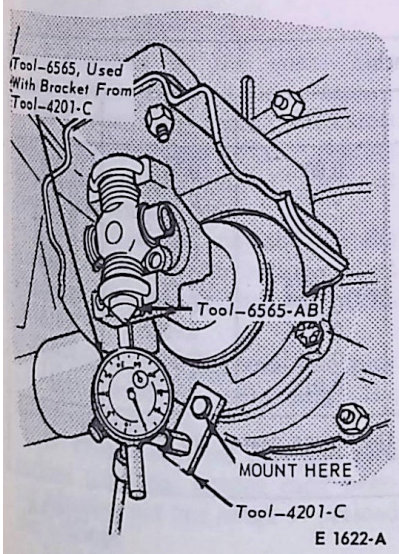


FIG. 7 Flange Bearing Cup Runout Check

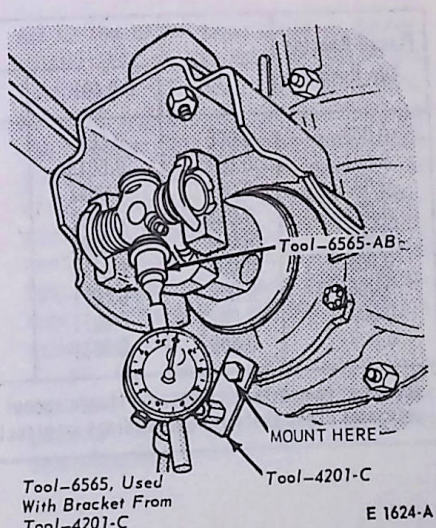


FIG. 9 Cross Shaft Runout Check

to the correct thickness for a given gear seat, each pinion gear is marked with an adjustment number (individual variation from nominal dimension) such as the 10 marking (Rockwell) and the 3 marking (Eaton) shown in Fig. 12.

**Shim thickness for Ford gears is determined by the gear pattern check. Add or remove shims from the original or nominal shim pack, as required, until a proper gear pattern is established. Adding shims will move the pinion away from the ring gear and removing shims will move the pinion toward the ring gear.**

**If the original ring gear and pinion are used in reassembly, use the original shim pack removed during disassembly.**

**When replacing a ring gear and pinion, it should be noted that the original factory installed shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimensions; therefore, to select the 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.

**3.** Refer to Fig. 13 to determine the correct amount of shim thickness change. The amount shown in Fig. 10, 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 14, for example, and the new pinion is marked -5, the table indicates that 0.019 inch of shim stock should be removed for the original shim pack.**

If the **original** shim pack was lost or if a new carrier housing is being installed (Eaton axles only), substitute a **nominal** shim for the **original,** and follow the foregoing procedure for a trial build-up, see Specifications Part II in this manual. If any further shim change is necessary, it will be indicated in the tooth pattern check.

In the case of a Rockwell axle with a lost **original** shim pack or new carrier installation, install a 0.025-0.030 inch shim pack for a trial build-up, and run a tooth pattern. The tooth pattern will indicate how much this shim pack should be increased or decreased.

In any Rockwell axle, the shim pack should consist of at least three shims one of which should be thin. Position the thin shim next to the carrier.

## DIFFERENTIAL BEARING PRELOAD AND BACKLASH- ALL EATON AXLES, ROCKWELL STANDARD SINGLE REDUCTION AXLE

**1.** Mesh the ring gear and pinion with a slight amount of backlash.

**2.** Set the differential bearing adjusters in the carrier bearing pocket threads, so that they just contact the bearing cups.

**3.** Carefully position the bearing caps on the carrier. Match the marks made when the caps are removed.

**4.** Install the hardened flat washers (if so equipped), bearing cap bolts or stud nuts, and alternately tighten them to specified torque. The bolts must be

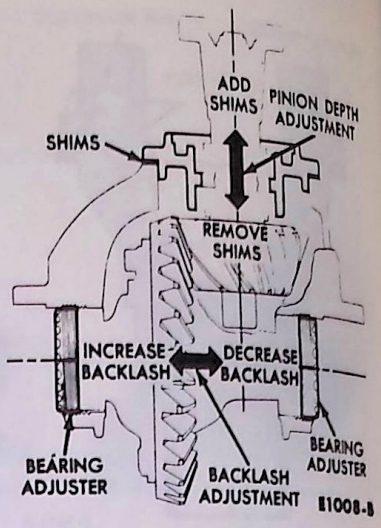


FIG. 11 Pinion and Ring Gear Tooth Contact Adjustment—Except Dana

torqued to specifications to be sure that the bearing cups and adjusters are seated. Check the adjusters for freedom of movement as the bolts are tightened. If the adjusters do not turn freely, remove the bearing caps and again inspect for damaged threads or incorrectly positioned caps.

**5.** On a Rockwell single reduction axle, the adjusters and bearing cups should move easily with the caps tightened to specified torque. On an Eaton axle, loosen the bearing cap bolts or stud nuts until the adjusters and bearing cups can be moved easily.

**6.** Alternately tighten the bearing adjusters until there is some backlash between the ring gear and pinion and there is some preload on the bearings (Fig. 14). While the bearings are preloaded, rotate the ring gear several turns in each direction to seat the

| Flange Bearing Cup Runout | Drive Shaft Universal Cross-Shaft Runout—Inch | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.000 | 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 | 0.007 | 0.008 |
| 0.000 | 0.000 | 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 | 0.007 | 0.008 |
| 0.001 | 0.001 | 0.0013 | 0.0022 | 0.0032 | 0.0042 | 0.0051 | 0.0061 | 0.0071 | 0.0081 |
| 0.002 | 0.002 | 0.0022 | 0.0027 | 0.0037 | 0.0045 | 0.0053 | 0.0062 | 0.0072 | 0.0082 |
| 0.003 | 0.003 | 0.0032 | 0.0036 | 0.0042 | 0.005 | 0.0058 | 0.0067 | 0.0077 | 0.0085 |
| 0.004 | 0.004 | 0.0042 | 0.0045 | 0.005 | 0.0057 | 0.0064 | 0.0072 | 0.0081 | 0.009 |
| 0.005 | 0.005 | 0.0051 | 0.0053 | 0.0058 | 0.0063 | 0.0071 | 0.0078 | 0.0087 | 0.0094 |
| 0.006 | 0.006 | 0.0061 | 0.0062 | 0.0068 | 0.0072 | 0.0078 | 0.0085 | 0.0092 | 0.010 |
| 0.007 | 0.007 | 0.0071 | 0.0073 | 0.0075 | 0.0081 | 0.0087 | 0.0093 | 0.0099 | 0.0103 |
| 0.008 | 0.008 | 0.0081 | 0.0082 | 0.0087 | 0.009 | 0.0094 | 0.010 | 0.0104 | 0.011 |

The total (combined) companion flange runout is located in the square where the columns containing the flange bearng cup runout and universal cross shaft runout readings intersect.

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FIG. 10 Companion Flange Combined Runout Chart

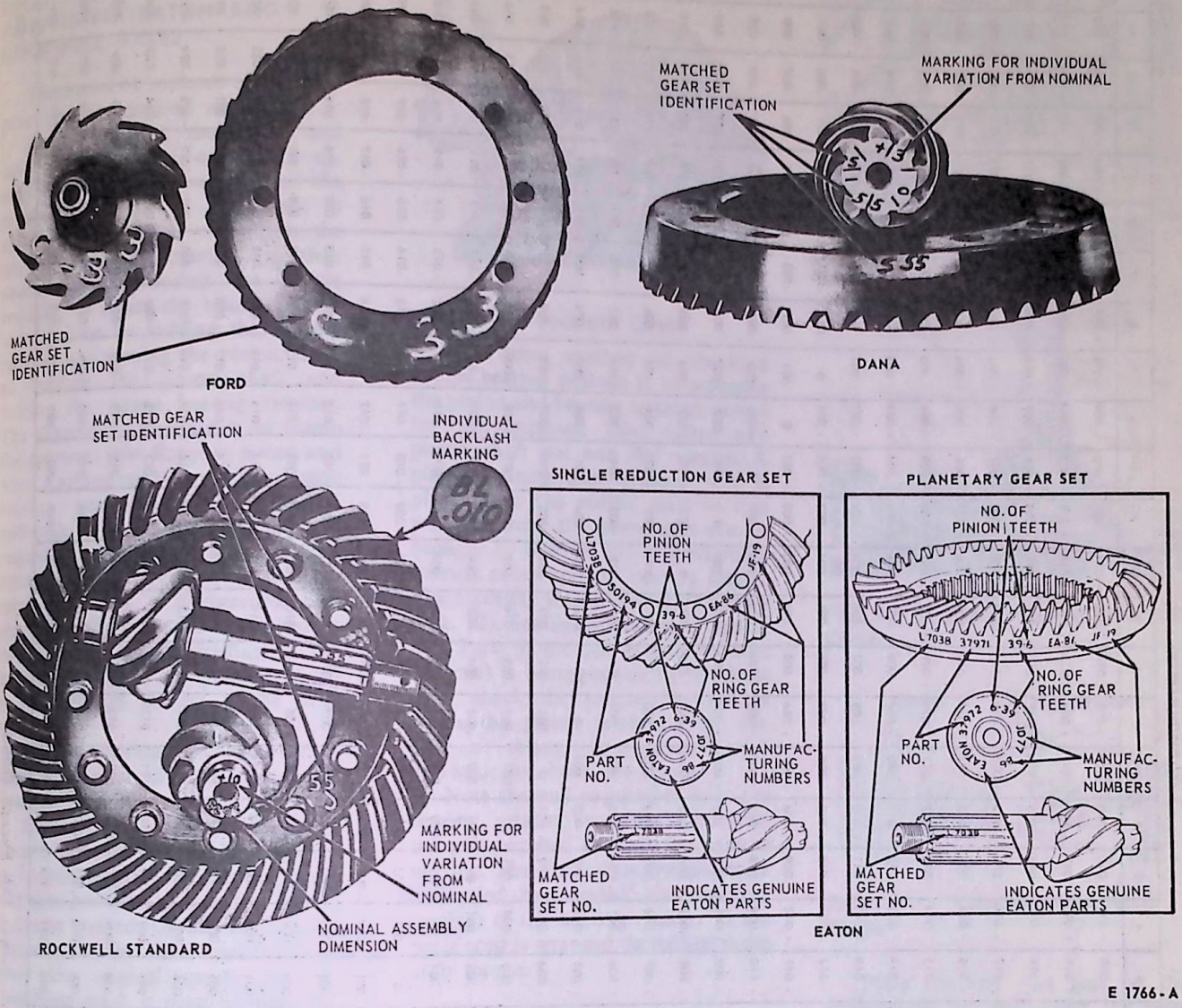


FIG. 12 - Typical Pinion and Ring Gear Set Marking

bearing rollers in the cups. This **bearing roller seating is important.**

7. Loosen the bearing adjusters until they are clear of the bearing cups, then tighten them until they just touch the bearing cups.

8. Install a dial indicator on the carrier housing with the button against the back face of the ring gear (Fig. 14).

9. Adjust the differential end play to zero without preloading the differential bearings.

10. From a zero end play and zero preload condition, tighten each bearing adjusting nut one notch to preload the bearings.

11. Mount the indicator to check the pinion and ring gear backlash (Fig. 15). Check the backlash at four equally-spaced points on the ring gear.

12. To reduce backlash loosen the pinion side adjuster and tighten the ring gear side adjuster the same number of notches, in order to maintain the preload. To increase backlash, perform the same operation in reverse.

**When moving the adjusters, the final movement should always be made in a tightening direction. For example, if one adjuster is to be loosened one notch, loosen it two notches, then tighten it one. This procedure makes certain that the adjuster is contacting the bearing cup, and that the cup will not shift after being put in service.**

13. On the Rockwell single reduction axle, the backlash should be set to the same adjustment as before disassembly, if the original gears are being used. If new gears are being installed, adjust to the **BL** marking on the ring gear (Fig. 12), and run a tooth pattern check. If the pattern is unsatisfactory at the marked setting, adjust the backlash to the best tooth contact pattern with the limits given in Specifications. For back lash adjustment on Rockwell double reduction axles, see Part 15-12.

14. On Eaton axles, adjust the backlash to the best tooth contact pattern within the limits given in Specifications.

| New Pinion Marking | OLD PINION MARKING | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -15 | -14 | -13 | -12 | -11 | -10 | -9 | -8 | -7 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
| +15 | +.030 | +.029 | +.028 | +.027 | +.026 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 |
| +14 | +.029 | +.028 | +.027 | +.026 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 |
| +13 | +.028 | +.027 | +.026 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 |
| +12 | +.027 | +.026 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 |
| +11 | +.026 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 |
| +10 | +.025 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 |
| +9 | +.024 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 |
| +8 | +.023 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 |
| +7 | +.022 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 |
| +6 | +.021 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 |
| +5 | +.020 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 |
| +4 | +.019 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 |
| +3 | +.018 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 |
| +2 | +.017 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 |
| +1 | +.016 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 |
| 0 | +.015 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 |
| -1 | +.014 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 |
| -2 | +.013 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 |
| -3 | +.012 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 |
| -4 | +.011 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 |
| -5 | +.010 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 |
| -6 | +.009 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 |
| -7 | +.008 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 |
| -8 | +.007 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 |
| -9 | +.006 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 |
| -10 | +.005 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 |
| -11 | +.004 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 | -.026 |
| -12 | +.003 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 | -.026 | -.027 |
| -13 | +.002 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 | -.026 | -.027 | -.028 |
| -14 | +.001 | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 | -.026 | -.027 | -.028 | -.029 |
| | 0 | -.001 | -.002 | -.003 | -.004 | -.005 | -.006 | -.007 | -.008 | -.009 | -.010 | -.011 | -.012 | -.013 | -.014 | -.015 | -.016 | -.017 | -.018 | -.019 | -.020 | -.021 | -.022 | -.023 | -.024 | -.025 | -.026 | -.027 | -.028 | -.029 | -.030 |

CE1986-B

FIG. 13 Drive Pinion Adjusting Shim Thickness Change—Inches (All Except Dana)

## PINION BEARING PRELOAD ADJUSTMENT-EATON AND ROCKWELL AXLES

There are two methods of checking pinion bearing preload adjustment.

In one method, the pinion and bearing retainer are completely assembled without the oil seal, and the pinion shaft nut is tightened to specified torque. The preload on the opposed, tapered bearings is then checked by measuring the torque required to rotate the bearings. This can be done by holding the bearing retainer and turning the pinion shaft, or holding the pinion shaft and turning the pinion bearing retainer. The suggested procedure is to clamp the universal joint flange in a vise, and wrap a strong cord around the pinion bearing retainer. Attach a pound pull-scale to the cord. Note the pull required to keep the bearing retainer rotating. The pull required to start the retainer moving is disregarded. The reading on the pull-scale multiplied by one-half the diameter (radius) of the bearing retainer at the point the cord is wrapped (in inches) is the in-lb torque.

Pinion bearing preload torque specifications for all axles are given in Specifications.

Pinion bearing preload on these axles is adjusted by installing spacers of various lengths. A shorter spacer increases preload and a longer spacer decreases preload. Usually the original spacer is installed for a trial build-up. Since the original spacer has no identifying mark, it must be measured with a micrometer to determine its length.

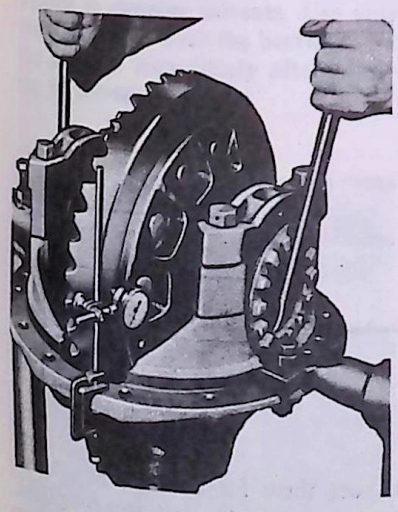

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FIG. 14 Differential End Play and Pre-Load Check

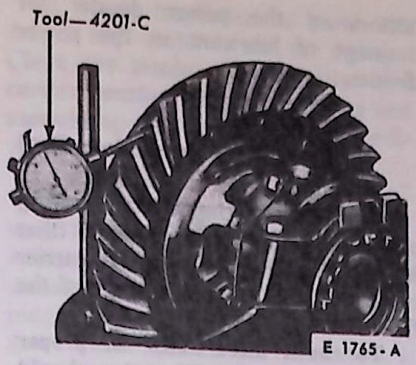



FIG. 15 Backlash Check

The other method of checking pinion bearing preload is to assemble the pinion and bearing retainer, except for the universal joint flange and pinion shaft nut and flat washer. A pinion bearing cone replacer tool is placed over the pinion shaft so that pressure from the press ram can be brought to bear on the tapered roller bearing cones and the bearing spacer. The assembly is then put under a press (Fig. 12). See Specifications at end of this Part. While the proper pressure (in tons) is being applied by the press ram, check the torque required to rotate the pinion retainer (Fig. 16). Use a strong cord and pound pull-scale to check the torque.

Note the pull required to keep the bearing retainer rotating. Disregard the pull required to start the retainer moving. The reading on the pull-scale multiplied by one-half the diameter (radius) of the bearing retainer at the point cord is wrapped (in inches) is the in-lb torque.

## RING GEAR REPLACEMENT

If a riveted ring gear is to be replaced, center punch the rivet heads on the ring gear end of the rivets. Drill through the rivet heads (Fig. 17) using a drill 1/32 inch smaller than the rivet body. Press out the rivets, then remove the ring gear.

Carefully examine the gear mounting surface and locating flange for high spots, which may have been caused by the old rivet removal. Remove any high spots with a flat hand stone.

Special bolts and nuts should be used instead of rivets to attach the new ring gear to the differential case.

On Eaton axles with riveted ring gears, be sure the bolts used to attach the new ring gear to the differential case are grade 8 bolts. These bolts can be identified by a 6-spoke marking forged on the head of the bolt. Torque to specifications.

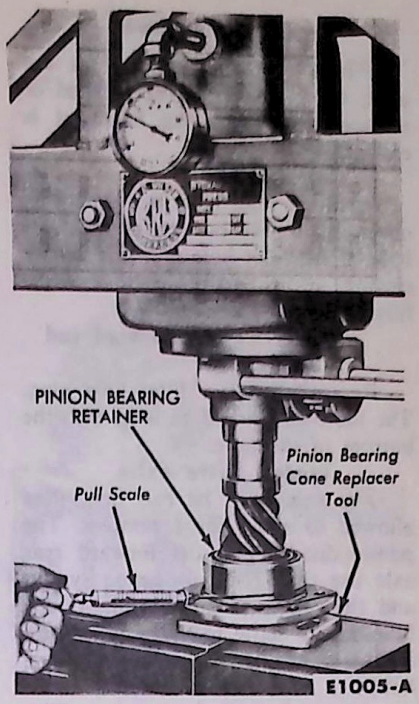



FIG. 16 Pinion Bearing Pre-Load Check

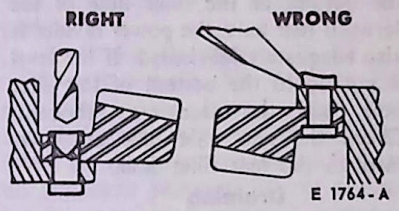



FIG. 17 Removing Ring Gear Rivets

Place the new ring gear on the differential case and insert the bolts through the ring gear and into the case.

**The bolt heads are installed in the counterbore on the gear tooth side of the ring gear.**

**The torque limits for these special bolts and nuts, apply to threads lubricated with engine oil. If the bolts and nuts are tightened while dry, add 10 to the limits. If the threads are lubricated with axle lubricant subtract 10 from the torque limits.**

## REAR AXLE LUBRICATION

The ability of any axle to deliver quiet trouble-free operation over a period of years is largely dependent upon the use of good quality gear lubricants. To insure long life for gears and bearings, use only gear lubricants specified.

### Checking Level

**Where magnetic drain plugs are used, the plugs should be cleaned or replaced each time the lubricant is changed.**

**Ford Axle**

With the filler hole in the housing cover, fill to the bottom of the filler hole. If the filler hole is in the carrier casting, also fill to the bottom of the filler hole.

**All Axles Except Ford and Tandem**

Remove the rear filler hole plug. The lubricant should be level with the bottom of the hole.

**Tandem Drive Axles**

The axle must be run first, then allowed to stand for 5 minutes. The power divider and the forward rear axle use the same lubrication system and the 5-minute interval allows the lubricant to settle to the proper levels in the power divider case and axle housing. After the 5 minutes, check the lubricant level in the rear filler hole in the forward rear axle only. It is not necessary to check the oil level in the power divider. If the level is up to the bottom of the filler hole of the forward rear axle, the power divider is also adequately lubricated. If the level is not up to the bottom of the filler hole, add the necessary lubricant. Check the rear axle lubricant level through the rear filler hole.

### Draining

**All Axles**

(Ford and Dana axles do not have a drain plug. The lubricant must be siphoned out, the cover loosened or the removable carrier broken away from the housing allowing drainage. For other axles, use the following procedures):

If possible, drain the lubricant when it is warm and it will run freely, allowing full drainage in minimum time. This is expecially desirable in cold weather.

To drain, unscrew the plug at the bottom of the housing and allow sufficient time for all the old oil to run out. On tandem drive axles, it is also necessary to unscrew the plug at the bottom of the power divider for drainage of lubricant in the power divider.

### Filling

**Single Reduction Axles . Ford Axle**

With the filler hole in the housing cover, fill to the bottom of the filler hole. If the filler hole is in the carrier casting, also fill to the bottom of the filler hole.

**To check these axles for proper lubricant level, the filler plug should be backed out slowly. If seepage occurs around the threads of the filler plug, the plug should immediately be turned back in to avoid any drainage. This condition indicates that the specified amount of lubricant is present in the axle.**

### Others

Fill the axle through the rear filler hole until oil flows from the bottom of the hole. After filling the axle with the specified amount of lubricant, install the oil filler hole plug.

**2-Speed and Planetary Double Reduction Axles**

Fill the axle through the rear filler hole with the specified amount of lubricant (lubricant should be at the level on the bottom of the filler hole), then install the filler hole plug. If the carrier assembly oil channels are dry, one pint of lubricant should be added through the front filler hole.

**Tandem Drive Axles**

Fill both axles with the specified amount until the lubricant is level with the bottom of the rear filler hole, and then add the specified amount to the inter-axle differential power divider through the filler hole located in the inter-axle differential power divider case.

**Eaton D-Series Tandem Drive Axles**

Fill the forward drive axle until the oil is level with the bottom of the filler hole in the rear cover. Then, add two pints through the forward filler hole located slightly offset to the right in the top portion of differential carrier. **Do not use the rear hole at top of the differential carrier as an oil filler hole. Fill the rear axle in accordance with instructions for single reduction, 2speed or planetary double reduction, depending on the type of axle used.**

## REAR WHEEL BEARING AND SEAL REMOVAL AND INSTALLATION

Two types of rear wheel bearing assemblies are used in Ford truck axles. In the semi-floating type axles used in the light series a single outer bearing is used, and is held in place by a retainer. This bearing is attached to the axle shaft and part of the vehicle load is carried on the axle shaft. Refer to Part 11-11 for Removal and Installation details. In the full-floating type axle used in the heavier series, double tapered roller bearings are mounted on the axle housing. Vehicle load is carried on the housing and not the shaft. The shaft can therefore be removed without disturbing the bearings.

Wheel bearings of the light Series, semi-floating axles are lubricated at assembly with a special lubricant, and require no further maintenance. A seal is installed behind the bearing to prevent axle lubricant leakage to the bearing. **Replace this seal whenever the hub and drum are removed from the axle. See Part 11-11.**

**On all the full-floating axle wheel hubs with tapered roller bearings, a seal is installed behind the inner bearing to keep the wheel bearing lubricant from the brake lining and brake drum. See Part 11-14.**

# 5 CLEANING AND INSPECTION

## INSPECTION BEFORE DISASSEMBLY OF CARRIER

An inspection of the adjustments and parts as the carrier is disassembled can assist in learning the cause of the trouble and in determining what corrections are needed.

Mount the carrier in a holding fixture. Wipe the lubricant from the internal working parts and visually inspect them for damage. Rotate the gears to see if there is any roughness which could indicate worn or damaged bearings or chipped gears. Look carefully at the surface of the gear

teeth for any scoring, flaking, or signs of abnormal wear.

Set up a dial indicator (Fig. 12) and check backlash at several points around the ring gear. Backlash limits for each axle are given in Fig. 13.

If no obvious misadjustment or damage is noted, inspect the gear tooth contact. Coat the gear teeth with the special compound furnished with each service ring gear and pinion (Fig. 18). Too fluid a mixture will run and smear. Too dry a mixture cannot be squeezed out from between the teeth. As shown in Fig. 19, rotate the ring gear back and forth (use a box wrench on the ring gear attaching bolts for a lever), until a clean tooth contact pattern is obtained.

On the larger axles (Fig. 18), it may be desirable to roll a pattern by turning the pinion gear with a wrench on the pinion shaft nut. A sharper pattern will be obtained if a flat steel bar is held lightly against the ring gear to act as a brake.

Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. A noise condition caused by incorrect adjustment can often be corrected by readjusting the gears. Typical patterns and the necessary corrections are shown in Figs. 1, 2, and 3. Gear tooth runout can be detected by an erratic pattern on the teeth. If ring gear runout is suspected, mount a dial indicator to measure the runout of the back face of the ring gear (Fig. 20).

## INSPECTION AFTER DISASSEMBLY OF CARRIER

Throughly clean all parts. Synthetic seals must not be soaked or **washed in cleaning solvents. Use only clean solvent to wash the bearings. Oil the bearings immediately after cleaning to prevent rusting.**


FIG. 18 Rear Wheel Hub-Ford Semi-Floating Axle

**A visual inspection of parts will detect any major wear or damage. Clean the inside of the carrier and carrier housing, before rebuilding and assembling the parts. Inspect individual parts as outlined below.**

### Gears

Examine the pinion and ring gear teeth for scoring or signs of excessive wear. The pattern taken during disassembly should be helpful in judging if gears can be reused. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring and flaking are the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be reused.

Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of the differential side gears can cause a chucking noise known as chuckle, when the vehicle is operated at low speeds. Wear of splines, thrust surfaces or thrust washers can contribute to excessive drive line backlash.

### Bearing Cups

Check the bearing cups for rings, scores, galling, or erratic wear patterns. The pinion cups must be solidly seated. Check by attempting to insert a 0.0015-inch feeler gauge between the cups and the bottom of their bores.

### Cone and Roller Assemblies

When operated in the cups, the cone and roller assemblies must turn without any roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates the bearings did not have enough preload, or the rollers were slightly cocked.

### Differential Bearing Adjusters

Temporarily install the bearing caps and test the fit of the bearing adjusters in their threads. The adjusters on a Rockwell axle should turn easily when the caps are tightened to specifications.

The faces of the adjusters that contact the bearing cups must be smooth and square. Polish these with a fine abrasive on a flat surface. Replace the adjusters or examine the threads in the carrier if their fit is not proper. **Be sure the bearing caps are on the side they were machined to fit.**

### Universal Joint Flange

Be sure the gears 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 or pinion front bearing or flange, must be smooth. Polish this face if necessary. Roughness Aggravates backlash noises, and causes wear on the slinger

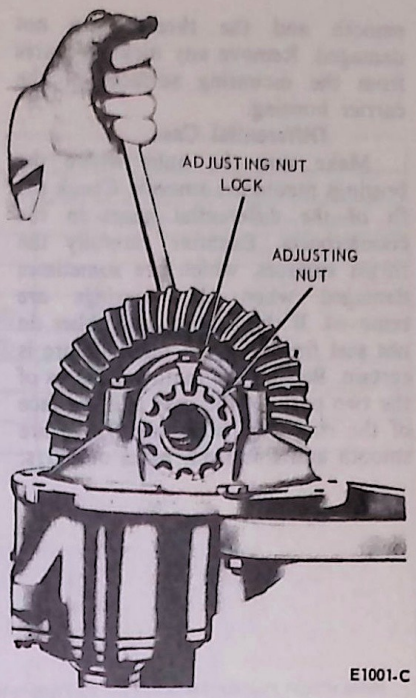



FIG. 19 Gear Tooth Contact Pattern Check—Ford

with a resultant loss in pinion bearing preload.

### Pinion Retainer

Inspect visually for damage. Be sure the pinion bearing cups are seated. Be sure there are not chips or burrs on the mounting flange. Clean all lubricant passages. If the pinion bearing cups were removed, examine the bores in the retainer carefully. Any nicks or burrs in these bores must be removed to permit proper seating of the cups.

### Carrier Housing

Inspect visually for damage. Make sure the differential bearing bores are

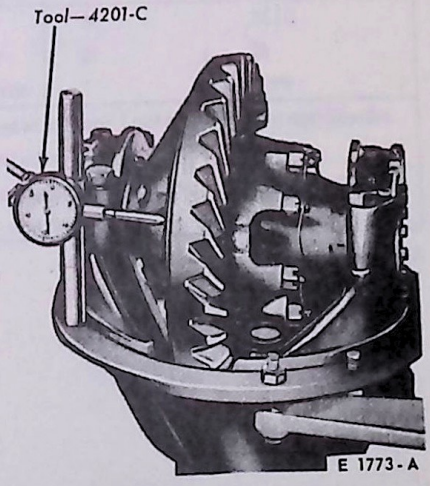



FIG. 20 Ring Gear Runout Check—Typical

smooth and the threads are not damaged. Remove any nicks or burrs from the mounting surfaces of the carrier housing.

**Differential Case**

Make sure the hubs where the bearings mount are smooth. Check the fit of the differential gears in the counterbores. Examine carefully the thrust surfaces, which are sometimes damaged when the bearings are removed. If the bearing assemblies do not seat firmly on the hubs, failure is certain. Be sure the mating surfaces of the two parts of the case and the face of the ring gear attaching flange are smooth and free from nicks or burrs.

**Ring Gear Runout**

If the ring gear runout check during disassembly exceeded specifications, the condition may be caused by a warped gear, a distorted or damaged case, or by excessively worn differential bearings.

To determine the cause of the excessive runout, assemble the differential case **without the ring gear,** and make the checks outlined in the following paragraphs.

Press the differential side bearings on the case hubs, and install the case in the differential carrier. Install the bearing caps and torque the cap bolts to specifications. Mount a dial indicator, and then check the runout of the case flange and ring gear pilot. If the runout does not now exceed specifications, install a new ring gear to the case. If the runout at either point is excessive, the gear is probably true and the condition is due to either the case or differential side bearings.

Install new differential side bearings on the case hubs and install the case in the carrier. Check the case runout. If the runout is still excessive, repair or replace the case.

# 9 SPECIFICATIONS

## REAR AND FRONT DRIVING AXLE LUBRICANT CAPACITIES

### Single-Speed Axle

| Make and Model | Approximate Capacity (Pints) ① | |
|---|---|---|
| | U.S. Measure | Imperial Measure |
| Ford All | 5 | 4-1/8 |
| Dana 441F | 3-3/4 | 3 |
| Dana 60, 60-3E and 70 | 6 | 5 |
| Dana 44-6BF & 44-6BFHD (Front Axles) | 3-3/4 ② | 3 |
| Dana 44-7F (Front Axle) | 4-1/2 ③ | 3-3/4 |
| Eaton 17101, 17121 ⑧ | 30.5 | 25 1/2 |
| Eaton 18101, 18121 ⑥ | 33 | 27 1/2 |
| Eaton 18301 ⑦ | 33 | 27 1/2 |
| Eaton 19121 ⑥ | 35 1/2 | 29 1/2 |
| Rockwell C-100 & D-100 ⑤ | 12-1/2 | 10-3/8 |
| Rockwell F-106 ⑤ | 13 | 10-7/8 |
| Rockwell H-170 ⑤ | 26 | 21 5/8 |
| Rockwell R-171B ⑦ | 44 | 37 1/2 |
| Rockwell Q-246A ④ ⑦ | 36 | 30 |

### Two-Speed Axle

| Make and Model | Approximate Capacity (Pints) ① | |
|---|---|---|
| | U.S. Measure | Imperial Measure |
| Eaton 15201 ④ ⑧ | 17 | 14-1/8 |
| Eaton 16244 ④ ⑧ | 22 | 18-3/8 |
| Eaton 17201, 17221 ④ ⑧ | 30 1/2 | 25 1/2 |
| Eaton 18201, 18221 ④ ⑦ | 33 | 27 1/2 |
| Eaton 19221 ④ ⑦ | 35 1/2 | 29 1/2 |
| Rockwell Q346A ⑥ | 34 | 28 1/2 |
| Rockwell RT-341-A ⑦ | 34 | 28 1/2 |

① Quantities listed are approximate. Axle should be filled until lubricant is level with bottom of filler hole with vehicle in normal operating position.

② F-250 4-Wheel Drive

③ F-100 4-Wheel Drive

④ Add one pint of lubricant to front filler in carrier assembly when new or reconditioned drive unit is installed. This quantity is included in the capacities shown.

⑥ If hubs have been removed an additional 1/2 pint of axle lubricant must be added. Add lubricant through the axle vent.

⑥ If hubs have been removed an additional 1 pint of axle lubricant must be added. Add lubricant through the axle vent.

⑦ If hubs have been removed an additional 1-1/2 pints of axle lubricant must be added. Add lubricant through the axle vent.

⑧ Fill to bottom of Filler hole.

## TANDEM AXLES REAR AND FRONT DRIVING AXLE LUBRICANT CAPACITIES

| Make and Model | | Approximate Capacity (Pints) ① | |
|---|---|---|---|
| | | U.S. Measure | Imperial Measure |
| Eaton 30DSC ② 30DTC, 30DPC | Forward | 28 | 23 3/8 |
| | Rearward | 27 | 22-1/2 |
| | Power Divider | 2 | 1 5/8 |
| Eaton 34DSC, 34DPC, 34DTC 34DSE, 34DTE 34DPE ③ | Forward | 33 | 27 1/2 |
| | Rearward | 33 | 27 1/2 |
| | Power Divider | 2 | 1-5/8 |
| Eaton 38DSC 38DTC, 38DSE, 38DPE ④ | Forward | 34 | 28 1/4 |
| | Rearward | 34 | 28 1/4 |
| | Power Divider | 2 | 1 5/8 |
| Eaton 42DPB, 42DPD ④ | Forward | 29 | 24 |
| | Rearward | 29 | 24 |
| Rockwell SLHD ③ | Forward | 32-1/2 | 27 |
| | Rearward | 32 | 26-5/8 |
| | Power Divider | 2 | 1-5/8 |
| Rockwell SHHD ④ | Forward | 32 | 26-3/4 |
| | Rearward | 28 | 23 3/8 |
| | Power Divider | 2 | 1-5/8 |
| Rockwell SQHD ④ | Forward | 34 | 28 1/2 |
| | Rearward | 31 | 26 |
| | Power Divider | 2 | 1-5/8 |

① Add two pints of lubricant to the inter-axle differential housing in addition to the specified amount when a new or reconditioned drive unit is installed.

② If hubs have been removed an additional 1/2 pint of axle lubricant must be added. Add lubricant through the axle vent.

③ If hubs have been removed an additional 1 pint of axle lubricant must be added. Add lubricant through the axle vent.

④ If hubs have been removed an additional 1-1/2 pints of axle lubricant must be added. Add lubricant through the axle vent.

CE 2169-A

# PART 15-21 2-Speed Double Reduction Axle — Rockwell

**Applies to L, C, and LN-800, L and C-8000, L-LN-900 and 9000**



## 1 DESCRIPTION

Rockwell Standard 2-Speed and double-reduction rear axles are available on 800-9000 Series trucks.

### RING GEAR, PINION AND DIFFERENTIAL ASSEMBLY

Both axles incorporate a hypoid helical drive with a 2-step gear reduction. The first or primary reduction is through the hypoid pinion and ring gears with the second reduction through the helical gears (Figs. 1 and 2).

The overhung-type hypoid pinion gear and shaft is supported in a pinion cage by opposed tapered roller bearings. The cage is mounted on the forward side of the diffferential carrier which is installed on the axle housing.

The hypoid ring gear is mounted on the right-hand end of a cross shaft which is supported in the differential carrier by tapered roller bearings.

In the single-speed axle, the helical pinion gear is integrally mounted on the cross shaft, and it meshes with the helical drive gear on the differential.

The 2-speed axle has two helical pinion gears - low-speed and high speed - both of which free-roll on the cross shaft. Each pinion gear meshes with a helical drive gear on the differential. A gear shift collar (Fig. 2), which is connected through a shift fork to an Eaton electric shift unit, rotates with the cross shaft between the two pinion gears. The collar engages the helical pinion gears, one at a times, with the cross shaft to provide either a low-speed reduction ratio or a high-speed ratio.

The rear axle housings are of the one-piece banjo type with full-floating axle shafts which are splined to the differential side gears.

### ROCKWELL ELECTRIC SHIFT UNIT

The Rockwell Standard shift unit consists of an electric motor, a worm shaft and wheel, an eccentric, and a connecting rod (Fig. 3).

The electric motor drives the worm shaft, wheel, and eccentric (Fig. 3). The connecting rod connects the eccentric to the Shift shaft which operates the push rod and shift collar (Fig. 47).

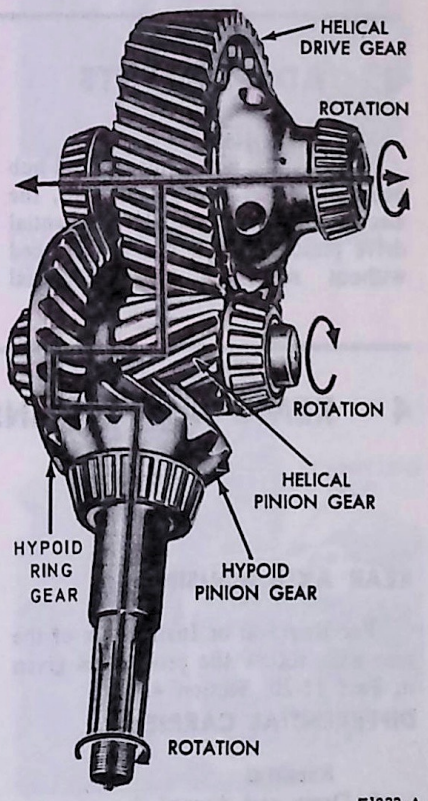



FIG. 1 Power Flow—Single-Speed Double-Reduction Rear Axle

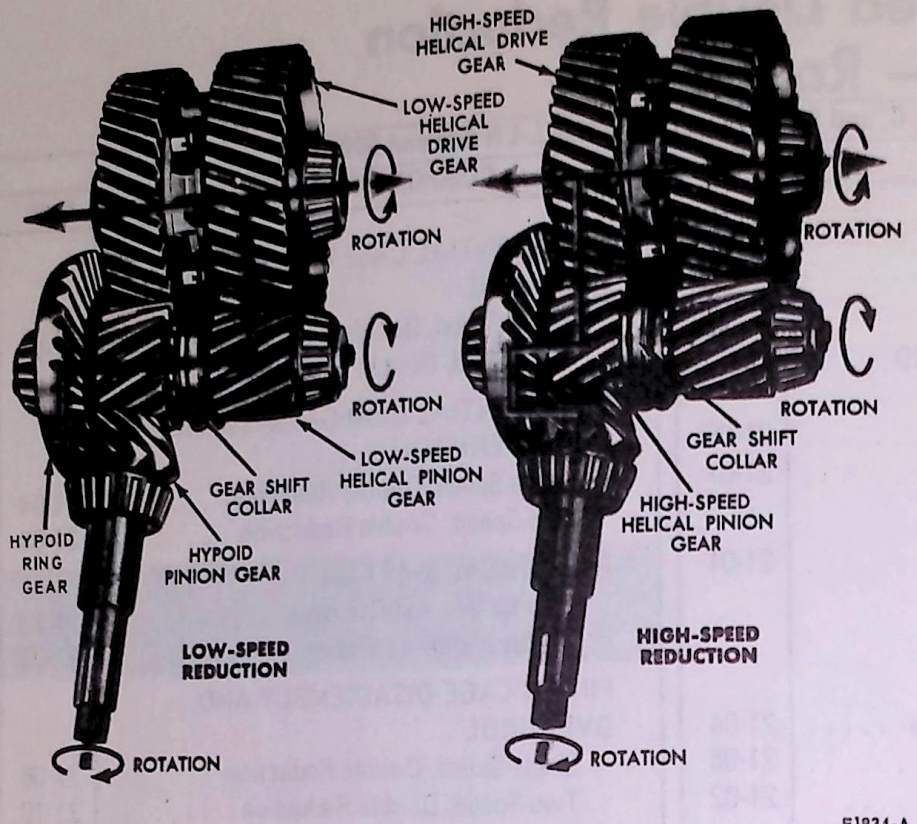



FIG. 2 Power Flow—2-Speed Double-Reduction Rear Axle

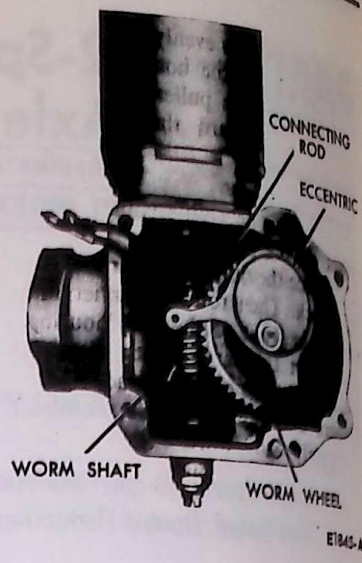



FIG. 3 Electric Shift Unit—Assembled View—Neutral Position

### EATON ELECTRIC SHIFT UNIT

Some Rockwell axles use a special Eaton electric shift unit which is basically the same as that used on Eaton axles. For Description and Operation, refer to Part 15-12. For Service procedures, refer to Section 4 in this Part 15-13.

## 3 ADJUSTMENTS

Axle shafts, wheel hubs, wheel hub bearings, wheel hub grease seals, the electric shift unit, and the differential drive pinion oil seal can be replaced without removing the differential carrier assembly from the axle housing or the rear axle assembly from the vehicle.

The axle shafts, wheel hub, bearings, and grease seals may be replaced, lubricated, or adjusted as outlined in Part 15-01, Section 2.

The electric shift unit can be replaced or overhauled as described in the following sections.

## 4 REMOVAL AND INSTALLATION

### REAR AXLE HOUSING

For Removal or Installation of the rear axle, follow the procedures given in Part 15-20, Section 4.

### DIFFERENTIAL CARRIER

#### Removal

1. Drain and discard the rear axle lubricant. The drain plug is at the bottom of the differential carrier.

2. Remove the nuts and lock washers from the axle shaft studs.

3. Pull the axle shafts with the proper tool. **Do not strike the studs. Pry bars, chisels, or wedges must not be used to remove the axle shafts.**

4. Disconnect the drive shaft from the U-joint flange on the rear axle. On a two-speed axle, disconnect the wires from the electric shift unit.

5. Remove all but the top two nuts from the axle housing studs around the differential carrier. Leave the top two nuts loosened on the studs to prevent the carrier from dropping accidentally.

6. Loosen the carrier from the axle housing by striking it with a rawhide mallet.

7. Position a roller jack under the carrier so that the carrier will be balanced when it rests on the jack. **Safety chains should be fastened around the carrier and jack before the carrier is removed from the axle housing.**

8. Remove the two top nuts from the axle housing studs, and install puller screws in the holes provided in the differential carrier for this purpose.

Tighten the screws evenly, and remove the carrier from the housing.

9. Remove the puller screws, and remove and discard the differential carrier gasket.

**Installation**

1. Place a new differential carrier gasket on the axle housing.

2. Place the differential carrier on a roller jack. Then roll the carrier into position in front of the axle housing.

3. Start the carrier onto the axle housing with 4 equally spaced lock washers and nuts. Tighten the nuts alternately to draw the carrier squarely onto the housing.

4. Install the remaining lock washers and nuts, and torque all the nuts to specifications.

5. Install new gaskets on the wheel hubs. Then install the axle shafts. Install the lock washers and nuts, and torque the nuts to specifications.

6. Connect the drive shaft to the U-joint flange on the rear axle. On a two-speed axle, connect the wires to the electric shift unit. The red wire connects to the terminal adjacent to the mounting flange of the shift unit. The black wire connects to the outer terminal.

7. Fill the axle housing with the specified grade and quantity of axle lubricant. Then install the filler plug and road test the axle.

## ROCKWELL ELECTRIC SHIFT UNIT

**Removal**

1. Disconnect the wires from the terminals on the shift unit cover.

2. Remove the retaining screws and filler plug from the cover.

3. Turn a threaded tool into the filler plug hole as shown in Fig. 4. and pull the cover from the housing. The tool can be made by welding a 1/8 x 27 pipe plug to the end of a T-handle. **Do not pry the cover from the housing.** Remove the cover to housing gasket.


FIG. 4 Removing Electric Shift Unit Cover

4. Drive the roll pin from the shift shaft and eccentric connecting rod as shown in Fig. 5. The tool shown in Fig. 5 has a 5/8 inch body and a 5/32 inch nose section.

**If the roll pin is in line with the worm shaft as shown in the insert of Fig. 6, it will be necessary to change the position of the shift shaft before the pin can be driven out.**

**To change the position of the shift shaft, turn on the ignition switch. Then shift the unit to the desired position by touching the hot lead of the electric harness to the appropriate terminal on the shift unit cover. It is not necessary to at tach the cover to the housing.**

**If the shift motor is not operating, disconnect the wires at the inside face of the cover and remove the shift motor (Fig. 44). Install a new motor, and shift the unit to the desired position.**

**In case a new motor is not available, use a slotted tool that fits over the tang of the worm shaft and turn it until the shift shaft changes position (Fig. 6).**

5. Remove the nuts and lock washers from the mounting studs, and remove the shift unit from the carrier (Fig. 7). **Do not damage the oil seal in the flange.**

**Installation**

1. If a new shift unit is being installed, remove the cover from the housing with the tool shown in Fig. 4 as described in step 3 under Removal.

2. Install a new shift unit housing to sleeve gasket, and position the shift unit over the mounting studs (Fig. 7). **Do not damage the oil seal that is**

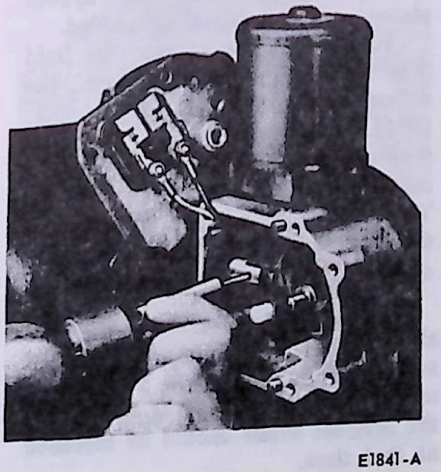



FIG. 5 Removing Roll Pin

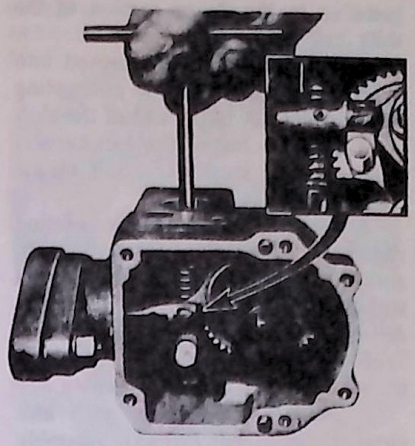



FIG. 6 Changing Position of Shift Shaft

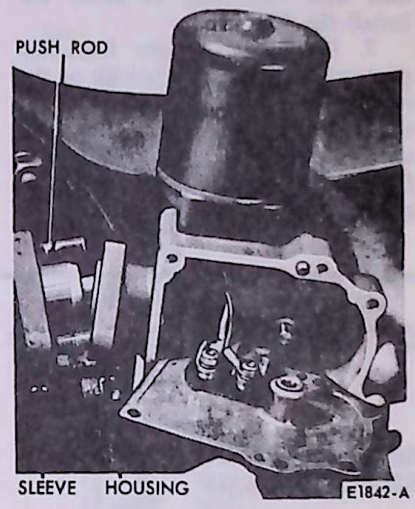



FIG. 7 Removing or Installing Shift Unit

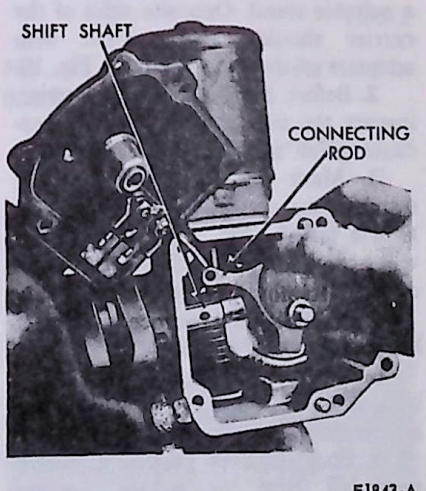



FIG. 8 Positioning Connecting Rod in Shift Shaft

installed in the flange section of the shift unit housing.

3. As the shift unit is moved into place, move the eccentric connecting rod into the slot in the end of the shift shaft (Fig. 8). Install the lockwashers and mounting studs nuts, and torque to specifications.

4. Align the hole in the connecting rod with the hole in the shift shaft, and drive the roll pin into place with a suitable driver as shown in Fig. 9. The driver shown has a hole in one end, 3/16 inch diameter by 1/4 inch deep, to hold the pin at the beginning.

5. **When installing the shift unit cover, the shift unit and axle assembly must be in the neutral position to avoid damaging the switches.** Install the gasket and cover, and secure with the retaining screws.

6. Fill the unit to the bottom of the filler hole with SAE 10 motor oil. Install the filler plug.

7. Connect the wires from the electric harness to the terminals on the outside of the shift unit cover. The red wire should be connected to the terminal nearest to the mounting flange of the shift unit. The black wire connects to the other terminal.

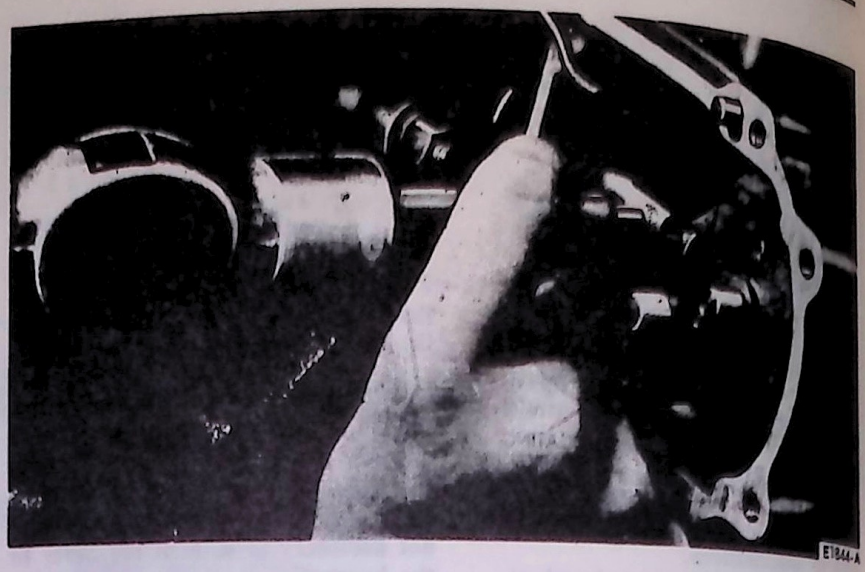



FIG. 9 Installing Roll Pin

### EATON ELECTRIC SHIFT UNIT

The Eaton unit used on Rockwell axles, has to be partially disassembled before it can be removed from the carrier. Refer to the combination Removal and Disassembly and Assembly and Installation procedures in Section 4 which follows.

## 5 DISASSEMBLY AND ASSEMBLY

### SINGLE SPEED DOUBLE REDUCTION AXLE

#### Disassembly of Rear Axle

**Differential Carrier**

1. Mount the differential carrier on a suitable stand. Opposite sides of the carrier should be supported with adapters of the type shown in Fig. 10.

2. Before disassembling the carrier, inspect the unit, following the procedures given in Part 15-01.

3. Mark one differential bearing cap and the corresponding carrier leg with a punch (Fig. 10). These marks will help to position the parts properly during assembly of the carrier.

4. Remove the locking wires and bolts from both bearing caps.

5. Remove the locking wires and bolts from both bearing adjuster locks, and remove both locks.

6. Back off both bearing adjusters one full turn to reduce bearing preload. Then remove and wire together the bearing cap and the adjuster from each side of the carrier.

7. Lift the differential out of the carrier.

8. Remove and discard the cotter pin from the U-joint flange nut. Then remove the nut with the tools shown in Fig. 11.

9. Drive the U-joint flange off the splines with a rawhide mallet. **If the flange cannot be easily driven off the splines, it can be pressed off by a hydraulic press when the hypoid pinion cage is being disassembled.**

10. Remove the screws that hold the hypoid pinion cage on the differential carrier.

11. Install two 3 inch 3/8-16 puller screws (Fig. 12) in the holes provided in the pinion cage for this purpose. Tighten the screws evenly, and remove the cage and pinion gear from the carrier.

12. Remove the pinion adjusting shims (Fig. 12) from the carrier. **If the same hypoid gear set is to be used again when the carrier is assembled, the original shims should be installed at that time.**

13. Place a wooden block under the helical pinion gear to support the cross shaft. Then remove the bolts that hold the cross shaft bearing cap (Fig. 13) in the differential carrier on the side opposite the hypoid ring gear.

14. Force the bearing cap out of the carrier about 1/4 inch by prying the hypoid ring gear away from the side of the carrier.

15. Position metal strips under both puller screw holes in the bearing cap. Then thread the puller screws into the cap (Fig. 13) so that they hold the strips in place against the adjusting shims. **Do not tighten the screws directly onto the adjusting shims.**

16. Tighten the puller screws evenly against the metal strips, and remove the bearing cap and the adjusting shims from the carrier.

17. Carefully slide the hypoid ring gear and cross shaft toward the bearing cap bore, and then remove them from the carrier as shown in Fig. 14.

18. Inspect both cross shaft bearing cups, and replace either cup if necessary. Remove the damaged or worn cup from the bearing cap with a suitable puller similar to the tool


FIG. 10 Differential Carrier Mounted on Stand

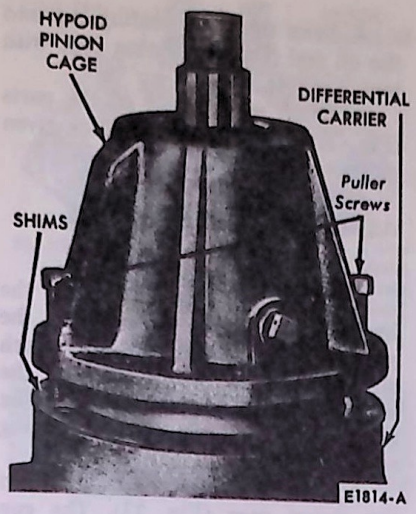



FIG. 12 Removing Drive Pinion Gear and Cage

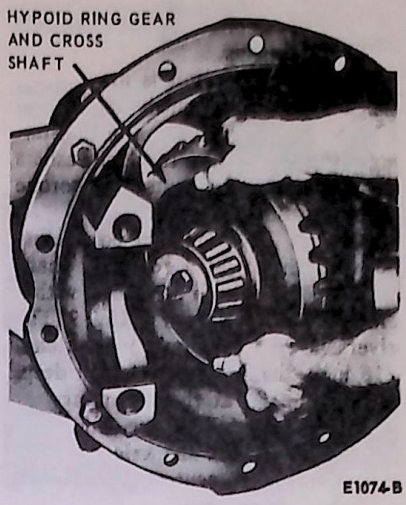



FIG. 14 Removing Rear Gear and Cross Shaft

shown in Fig. 15. To operate the cup in the bearing cap remaining in the differential carrier, tap the cap out of the carrier about 1/4 inch with a soft drift against the inside of the cap. Then remove it from the carrier, using the same procedure for removing the other cap.

### Cross Shaft

1. Remove the locking wire, two screws, and the bearing retaining plate from the hypoid ring gear end of the cross shaft.

2. Press the cross shaft out of the hypoid ring gear and the bearing next to the gear (Fig. 16). Remove the Woodruff key that holds the gear on the shaft.

3. Press the remaining bearing from the cross shaft as shown in Fig. 17.

### Differential Gear and Case

1. Mount the differential in a softjawwed vise. Then, if necessary, remove both differential side bearings with the type of tool shown in Fig. 18.

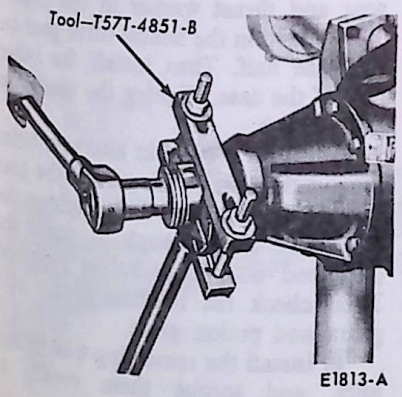



FIG. 11 Removing U-Joint Flange Nut

2. Check the original alignment marks on both case halves. If the marks cannot be seen clearly, punch a new mark on each case half to help position the parts properly during assembly of the differential.

3. Separate the helical drive gear and the two case halves. If rivets are used to hold these parts together, center-punch the head of each rivet as close to the center of the rivet head as possible (Step 1, Fig. 19). Drill a 1/8 inch pilot hole at each center punch mark (Step 2), and then drill a 1/2 inch hole into each pilot hole to a depth of 1/2 inch (Step 3). Press out all the rivets with a 1/2 inch punch (Step 4). **Do not attempt to remove the rivets with a hammer and chisel.**

4. Remove the spider, pinion gears, thrust washers, and side gears.

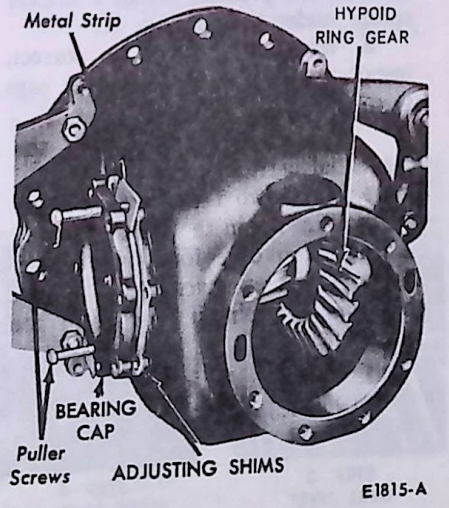



FIG. 13 Removing Cross Shaft

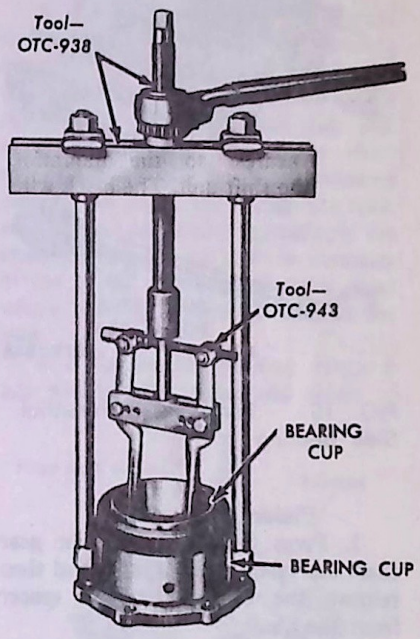



FIG. 15 Removing Cross Shaft Bearing Cup

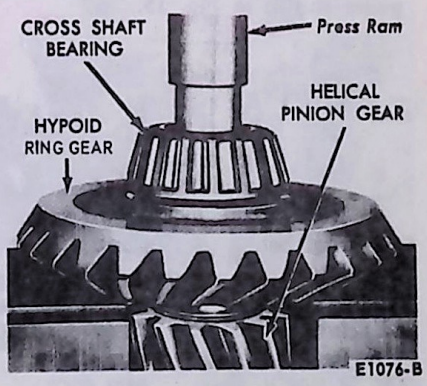



FIG. 16 Removing Cross Shaft Bearing and Hypoid Ring Gear

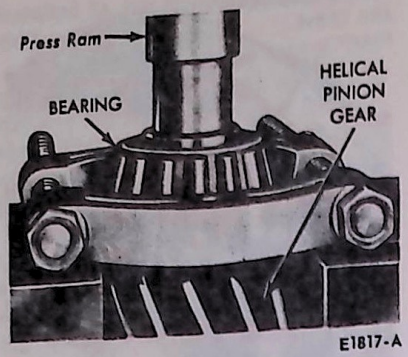



FIG. 17 Removing Cross Shaft Bearing


FIG. 18 Removing Differential Side Bearing

**Pinion Cage**

1. Press the hypoid pinion gear shaft out of the pinion cage, and then remove the bearing preload spacer from the shaft.
2. Remove the rear bearing from the pinion shaft as shown in Fig. 20.
3. Remove the rear bearing cup from the pinion cage with the type of puller shown in Fig. 15.
4. Press the front bearing cup and the oil seal from the pinion cage with tool T56T-4616-B.
5. Clean and inspect all the parts (Fig. 21), using the procedures given in Part 15-01.

## ASSEMBLY OF REAR AXLE

**Pinion Cage**

1. Install the rear bearing on the hypoid pinion gear shaft against the gear shoulder (Fig. 22). **Use a 3 inch sleeve about one inch long under the bearing race so that the thrust of the press ram is not against the bearing roller cage.**
2. Install the rear bearing cup in the pinion cage (Fig. 23). **The cup must be firmly seated against the shoulder in the cage.**
3. Install the front bearing cup in the pinion cage with the tool shown in Fig. 24, making sure that the cup seats firmly against the shoulder in the cage.
4. Coat the pinion rear bearing with axle lubricant, and position the pinion gear in the cage.
5. Place the pinion cage and gear in a hydraulic press so that the gear rests on the press bed. Then position the original bearing preload spacer (Fig. 21) on the pinion gear shaft.
6. Press the pinion front bearing onto the pinion gear shaft against the spacer. **Use a 3 inch sleeve about 5 inches long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**
7. Rotate the pinion cage several times to be sure that the bearings are properly seated. Then check the pinion bearing preload, using the checking procedure given in Part 15-01. If the preload is too low, install a thinner spacer under the front bearing. To decrease the preload, install a thicker spacer under the bearing.
8. When the preload is correct, install the oil seal in the pinion cage (Fig. 25).

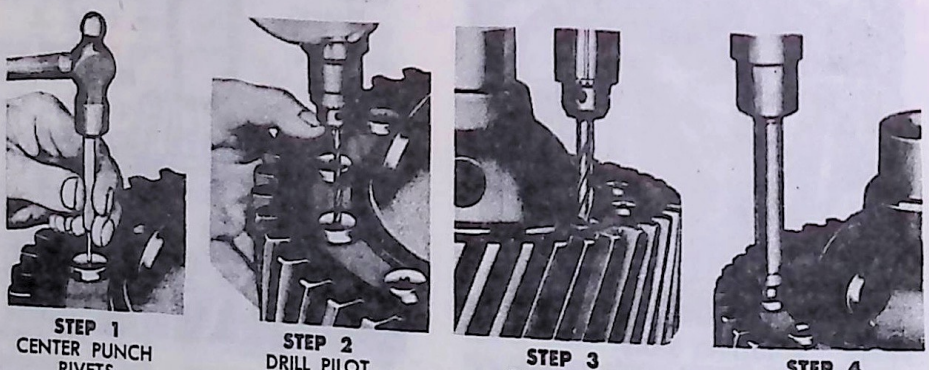



FIG. 19 Removing Differential Case Rivets

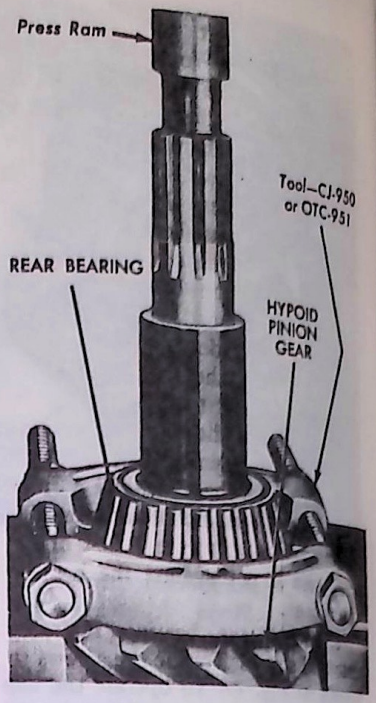



FIG. 20 Removing Hypoid Pinion Rear Bearing

**Differential Gear and Case**

1. Check the mating surfaces of the differential case halves and the helical drive gear to be sure they are clean and free of burrs. Then coat all the differential parts (Fig. 26), including the inner walls of the case, with axle lubricant.
2. Install the differential side bearings, making sure they are properly seated (Fig. 27). **Use a 3 1/4 inch sleeve about one inch long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**
3. Position a thrust washer and a side gear in one of the differential case halves. Then place the spider, the pinion gears, and their thrust washers in position. Install the remaining side gear and thrust washer in the case.
4. Position the helical drive gear on the case half. Then install the other half of the case, aligning the marks on both halves.
5. Install 6 bolts in alternate holes around the case on the side of the gear having the smaller offset. Tighten the bolts and nuts enough to draw the gear and both case halves together. Then check the rotation of the side gears and pinion gears.
6. Install the remaining 6 bolts and nuts, and torque them evenly to specifications.
7. Install locking wires on the bolts.

**Cross Shaft**

1. Position the Woodruff key in the cross shaft with the tapered end of the key toward the helical pinion gear on the shaft. Then align the keyway in the hypoid ring gear with the key in the shaft, and press the gear on the shaft. **The gear must be seated against the shoulder on the shaft.**

2. Position the bearing for the hypoid ring gear end of the shaft on the press bed under the shaft. Then carefully press the shaft into the bearing so that the bearing seats squarely against the shaft shoulder.

3. Install the remaining bearing on the other end of the shaft. **Use a 3inch sleeve about one inch long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**

4. Install the bearing retaining plate and screws. Torque the screws to specification, and install a new locking wire on the screws.

5. Press the cross shaft bearing cups into the bearing caps. **Be sure that the cups are properly seated, against the shoulders in the cap bores.**

**Differential Carrier**

1. Coat all parts with axle lubricant before assembly.

2. Position the original shim pack on the right cross shaft bearing cap. Then install the cap on the differential carrier with the bolts and lockwashers. Torque the bolts to specifications.

3. Install the cross shaft in the differential carrier so that the end of the shaft opposite the hypoid ring gear enters the bore of the left bearing cap. The right bearing should enter and seat in its bearing cap. Place a wooden block under the helical pinion gear to support the cross shaft.

4. Position the original shim pack on the left cross shaft bearing cap. Then install the cap on the differential carrier with the bolts and lock washers. Torque the bolts to specifications.

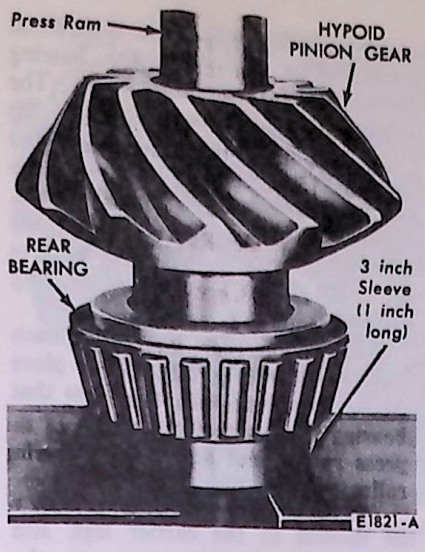



FIG. 22 Installing Hypoid Pinion Rear Bearing

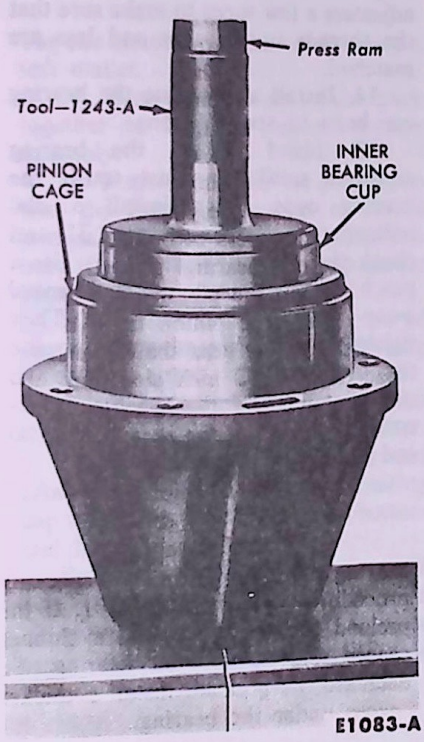



FIG. 23 Installing Hypoid Pinion Rear Bearing Cup

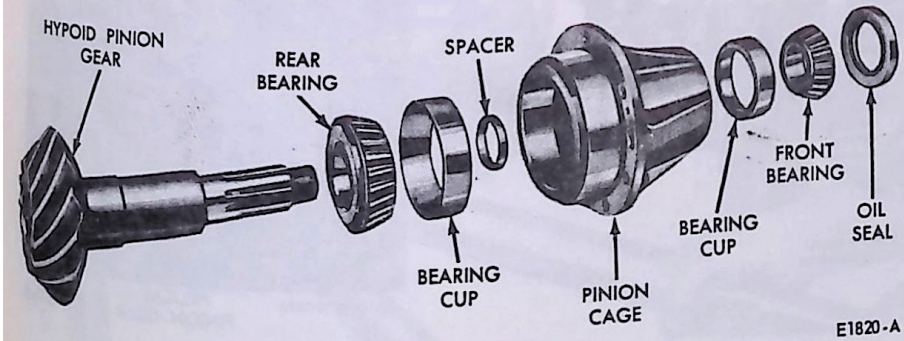



FIG. 21 Hypoid Pinion Cage Disassembled

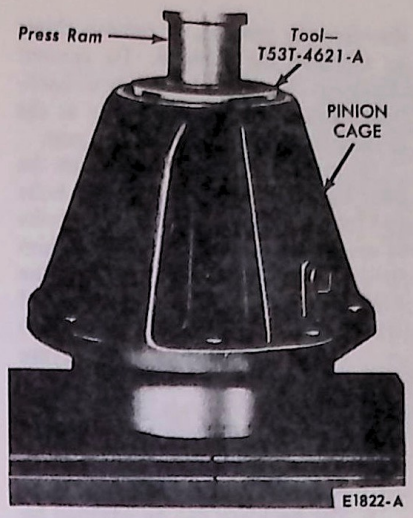



FIG. 24 Installing Hypoid Pinion Front Bearing Cup

5. Rotate the cross shaft several times to be sure that the bearing contact is normal. Then check the cross shaft bearing preload as shown in Fig. 28. **Do not read the pull required to start the cross shaft rotating. Read only the steady rotating pull on the scale.** To change the scale reading into in-lbs torque, multiply the scale reading by one-half the diameter of the helical pinion gear at the point where the cord is wound around the gear.

6. If the bearing preload torque is not within 5-15 in-lbs, add shims to

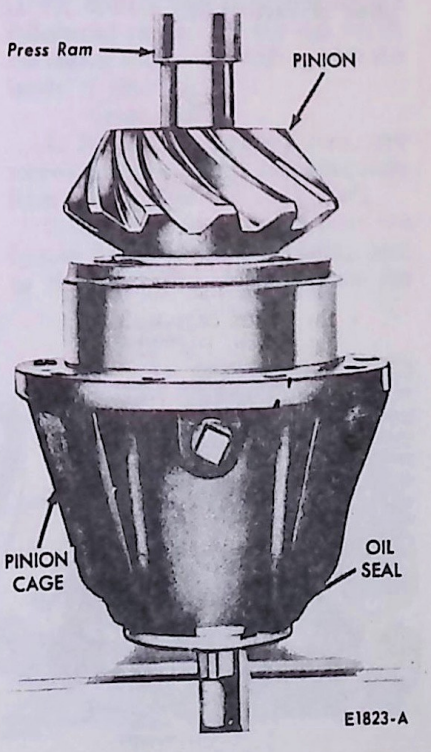



FIG. 25 Installing Pinion Oil Seal

decrease the preload, or remove shims to increase the preload. To prevent changing the hypoid ring gear backlash setting, change shims only at the bearing cap opposite the ring gear.

7. Install the pinion cage with the filler hole at the top. Install the bolts and lock washers, and torque the bolts to specifications. Use the original shim pack between the pinion cage and the differential carrier if the original hypoid gears (ring gear and pinion set) are used. If new hypoid gears are installed, follow the shim selection procedure given in Part 15-01.

8. Install the U-joint flange (Fig. 29). Torque the pinion flange nut to specifications. Install a new cotter pin.

9. The backlash can be adjusted by transferring shims from one cross shaft bearing cap to the other. To move the hypoid ring gear away from the hypoid pinion gear, transfer shims from the right cap to the left cap. To move the ring gear closer to the pinion gear, transfer shims from left to right. For each 0.010 inch movement of the ring gear, the backlash changes about 0.008 inch.

Adjust backlash to 0.010 inch and check the gear tooth contact pattern (Fig. 30). After a satisfactory pattern has been obtained at 0.010 backlash, increase backlash to 0.020-0.026 inch regardless of the backlash marking on the ring gear.

10. Check and adjust the tooth contact pattern, using the procedure given in Part 15-01.

11. Check the fit of the differential side bearing cups and the bearing adjusters in the bearing caps. The adjusters should thread freely into the caps, and they should move the bearing cups into the bores with the cap bolts tightened to normal torque. If the cups do not move when the adjusters are hand tightened, remove the caps and clean the bearing surfaces.

12. Position a bearing cup on each differential side bearing. Then place the differential on the carrier so that the bearing cups rest in the carrier legs. Be sure that the helical drive gear is centered on the helical pinion gear.

13. Place the bearing adjusters on the threads in the carrier legs, and position the bearing caps on the carrier leg with the matching marks (Fig. 10) aligned. Turn the bearing adjusters a few turns to make sure that the threads in the caps and legs are matched.

14. Install and torque the bearing cap bolts to specifications.

15. Hand tighten the bearing adjusters until they just touch the bearing cups. Then install a dial indicator as shown in Fig. 31 and check the differential end play. Use a pinch bar to move the differential away from the dial indicator. Then tighten the bearing adjuster opposite the dial indicator until there is no side-to-side movement of the differential, and the dial indicator shows no end play.

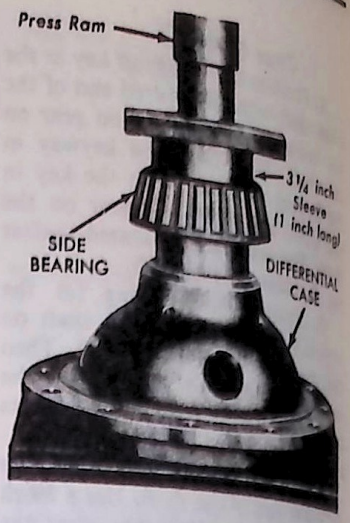



FIG. 27 Installing Differential Side Bearing

16. After obtaining the correct end play adjustment, adjust the differential bearing preload by tightening the bearing adjusters an additional 1 3/4-2 1/2 notches (total for both adjusters) with the tool shown in Fig. 32.

17. Install the bearing adjuster locks and cap screws.

18. Install locking wires on the lock cap screws and bearing cap bolts.

## TWO-SPEED DOUBLE REDUCTION REAR

### Disassembly of Rear Axle

#### Differential Carrier

1. Mount the differential carrier on a suitable stand. Opposite sides of the carrier should be supported with adapters of the type shown in Fig. 33.

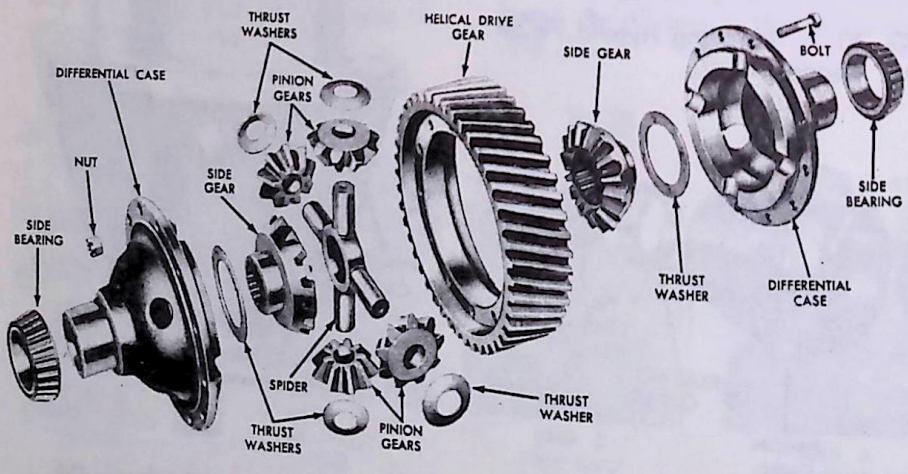



FIG. 26 Differential Gear and Case Disassembled


FIG. 28 Checking Cross Shaft Bearing Pre-Load

2. Before disassembling the carrier, inspect the unit, following the procedures given in Part 15-01.

3. Mark one differential bearing cap and the corresponding carrier leg with a punch (Fig. 33). These marks will help to position the parts properly during assembly of the carrier.

4. Remove the locking wires and bolts from both bearing caps.

5. Remove the bearing caps, cap screws, and the split rings.

6. Lift the differential out of the carrier.

7. Remove and discard the cotter pin from the U-joint flange nut. Then remove the nut with the tools shown in Fig. 11.

8. Drive the U-joint flange off the splines with a rawhide mallet. **If the flange cannot be easily driven off the splines, it can be pressed off by a hydraulic press when the hypoid pinion cage is being disassembled.**

9. Remove the screws that hold the hypoid pinion cage on the differential carrier.

10. Install two 3 inch 3/8-16 puller bolts (Fig. 34) in the holes provided in the pinion cage for this purpose. Tighten the bolts evenly, and remove the cage and pinion gear from the carrier.

11. Remove the pinion adjusting shims from the carrier. **If the same, hypoid gear set is to be used again when the carrier is assembled, the original shims should be installed at that time.**

12. Remove the locking wire from the shift fork lock screw, and remove the screw and nut.

13. Remove the shift unit stud nuts and lockwashers.

14. Remove the shift unit and shaft assembly and lift out the shift fork.


FIG. 30 Checking Hypoid Gear Backlash

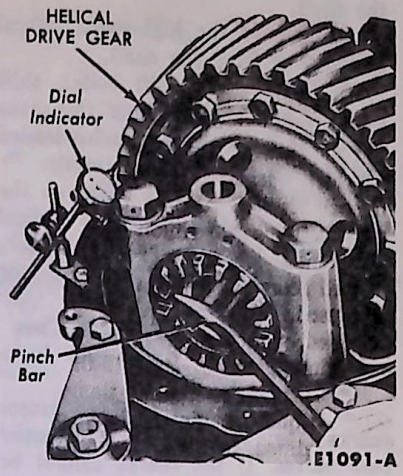



FIG. 31 Adjusting Differential End Play

Tap the sleeve from the carrier with a soft mallet.

15. Wire the shift unit shim pack together to facilitate adjustment on assembly.

16. Turn the carrier on its side so that the hypoid ring gear is at the bottom. Then remove the bolts that hold the cross shaft bearing cap on the upper side of the carrier.

17. Force the bearing cap out of the carrier by prying the hypoid ring gear upward.

18. Remove the bearing cap and the adjusting shims from the carrier.

19. Lift the hypoid ring gear and cross shaft out of the lower bearing cap bore, and remove the unit, bottom end first, from the carrier.

**Some wide range ratio carriers will require the removal of the high speed helical pinion and bearing from the cross shaft before removing the cross shaft assembly from the carrier.** On these carriers proceed as follows: Raise the cross shaft assembly through the cage bore. Clip the lock wire and remove the cap screws and bearing retaining plate. Remove the bearing with a suitable puller, and then remove the high speed helical pinion from the cross shaft.

20. Inspect both cross shaft bearing cups, and replace either cup if necessary. Remove the damaged or worn cup from the bearing cap with a suitable puller similar to the tool shown in Fig. 15. To replace the cup in the bearing cap remaining in the differential carrier, tap the cap out of the carrier with a soft drift against the inside of the cap.

**Cross Shaft**

1. Remove the locking wire, two screws, and the bearing retaining plate from each end of the cross shaft.

2. Press the cross shaft out of the hypoid ring gear and the bearing next to the gear (Fig. 16). Remove the

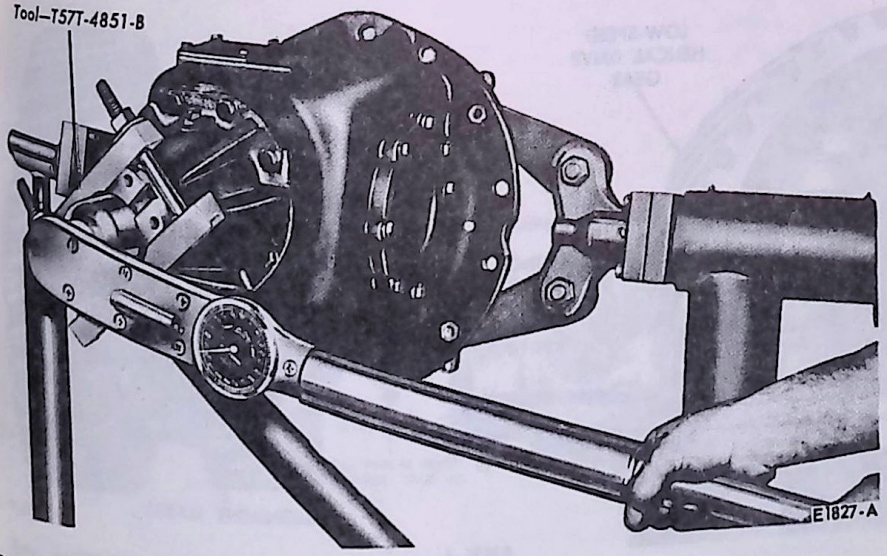



FIG. 29 Installing U-Joint Flange

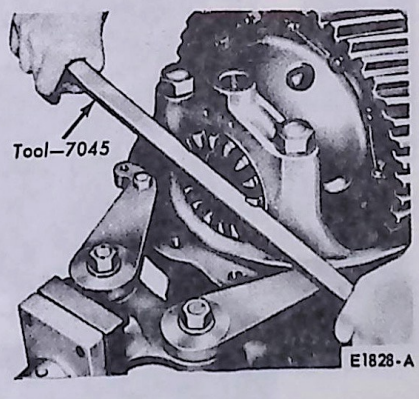



FIG. 32 Adjusting Differential Bearing Pre-Load

Woodruff key that holds the gear on the shaft.

3. Remove the high-speed helical pinion gear from the shaft.

4. Remove the shift collar, shift poppets, and springs from the cross shaft. **The 3 poppets are spring-loaded and should be removed carefully.**

5. Position the shift collar on the shaft next to the low-speed helical pinion gear. Using the collar as a base, press the shaft through the pinion gear and the cross shaft bearing.

**Differential Gears and Case**

1. Mount the differential in a softjawwed vise.

2. Check the original alignment marks (Fig. 35) on both differential case halves. If the marks cannot be seen clearly, punch a new mark on each case half to help position the parts properly during assembly of the differential.

3. Remove the locking wires. Then remove the long bolts, and separate the two case halves.

4. Remove the spider, pinion gears, thrust washers, and side gears.

5. Mark the helical drive gears and the two case halves for identification during assembly. Then remove the gears from the case halves.

6. If the differential side bearings require replacement, remove them with the type of tool shown in Fig. 18.

**Pinion Cage**

1. Press the hypoid pinion gear shaft out of the pinion cage, and then remove the bearing preload spacer from the shaft.

2. Remove the rear bearing from the pinion shaft as shown in Fig. 20.

3. Remove the rear bearing cup from the pinion cage with the type of puller shown in Fig. 15.

4. Press the front bearing cup and the oil seal from the pinion cage with tool T56T-4616-B.

5. Clean and inspect all the parts, using the procedures given in Part 15-01.

## ASSEMBLY OF REAR AXLE

**Pinion Cage**

1. Install the rear bearing on the hypoid pinion gear shaft against the gear shoulder (Fig. 22). **Use a 3 inch sleeve about one inch long under the bearing race so that the thrust of the press ram is not against the bearing roller cage.**

2. Install the rear bearing cup in the pinion cage (Fig. 23). **The cup must be firmly seated against the shoulder in the cage.**

3. Install the front bearing cup in the pinion cage with the tool shown in Fig. 24 making sure that the cup seats firmly against the shoulder in the cage.

4. Coat the pinion rear bearing with axle lubricant, and position the pinion gear in the cage.

5. Place the pinion cage and gear in a hydraulic press so that the gear rests on the press bed. Then position the original bearing preload spacer (Fig. 21) on the pinion gear shaft.

6. Press the pinion front bearing onto the pinion gear shaft against the spacer. **Use a 3 inch sleeve about 5 inches long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**

7. Rotate the pinion cage several times to be sure that the bearings are properly seated. Then check the pinion bearing preload, using the checking procedure given in Part 15-01. If the preload is too low, install a thinner spacer under the front bearing. To decrease the preload, install a thicker spacer under the bearing.

8. When the preload is correct, install the oil seal in the pinion cage (Fig. 25).

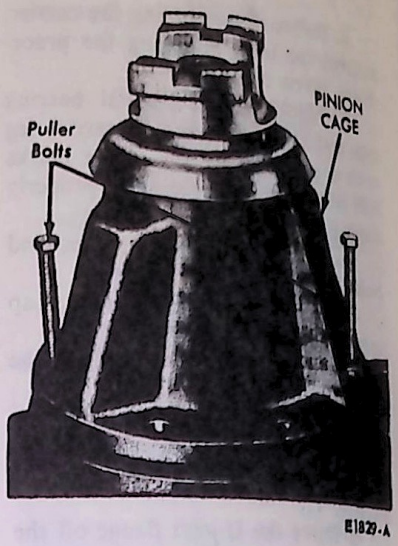



FIG. 34 Removing Hypoid Pinion Cage and Gear

**Differential Gears and Case**

1. Check the mating surfaces of the differential case halves and both helical drive gears to be sure they are clean and free of burrs. Then coat all the differential parts (Fig. 36), including the inner walls of the case, with axle lubricant.

2. Install the differential side bearings, making sure they are properly seated (Fig. 27). **Use a 3 1/4 inch sleeve about one inch long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**

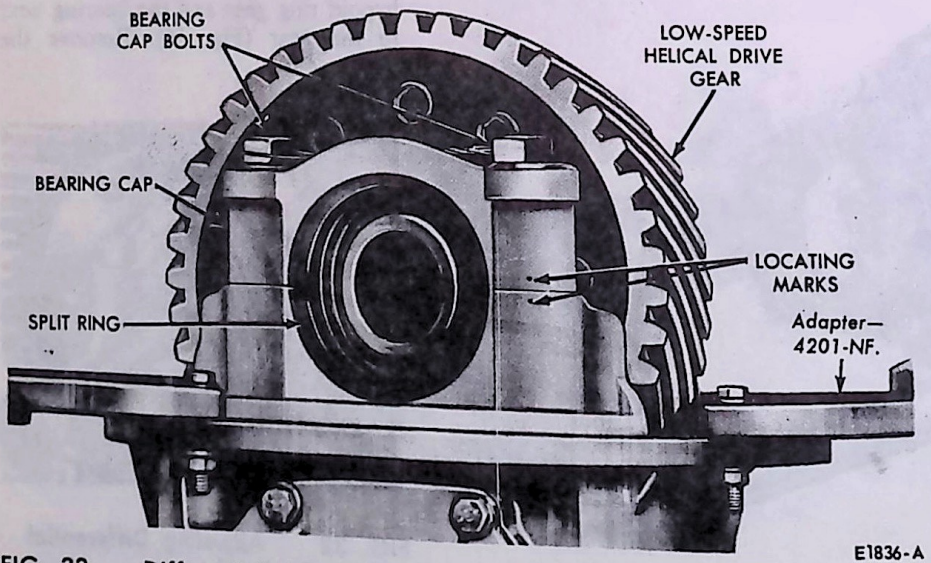



FIG. 33 Differential Carrier Mounted on Stand

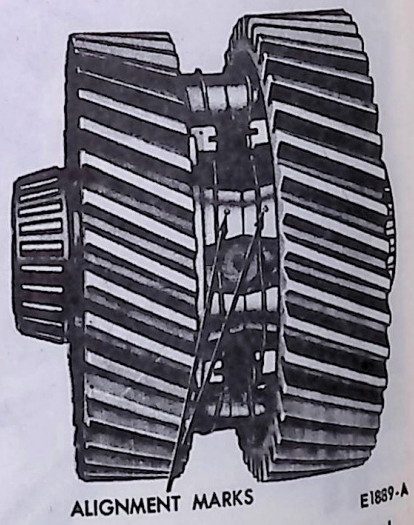



FIG. 35 Differential Case and Gear Alignment Marks

3. Attach both helical drive gears to their respective case halves with short bolts. Torque the nuts to specifications, and install locking wires on the bolts.

4. Position a thrust washer and a side gear in one of the differential case halves. Then place the spider, the pinion gears, and their thrust washers in position. Install the remaining side gear and thrust washer in the case.

5. Align the marks on both case halves, and install 4 long bolts to draw the two halves together. Check the differential side gears and pinion gears to make sure they rotate freely.

6. Install the remaining 4 bolts and nuts, and torque all the nuts evenly to specifications.

7. Install locking wires on the bolts.

### Cross Shaft

1. Place the high-speed helical pinion gear (larger of the two pinion gears) on the hypoid ring gear end of the cross shaft (Fig. 37). The clutching teeth of the gear hub should face toward the splined teeth on the shaft.

On the wide range ration carriers that require the installation of the cross shaft assembly in the carrier before installing the high speed helical pinion and bearing on the cross shaft, omit the steps that do not apply.

2. Position the Woodruff key in the cross shaft with the tapered end of the key toward the helical pinion gear on the shaft. Then align the key way in the hypoid ring gear with the key in the shaft, and press the gear on the shaft. If the cross shaft has a shoulder, **the gear must be seated against the shoulder.**

3. Insert a feeler gauge between the inner end of the high-speed helical pinion gear and the cross shaft shoulder (Fig. 38), and check the end play of the pinion gear. If the end play is not within 0.010-0.020 inch, check the cross shaft, the high-speed helical pinion gear, and the hypoid ring gear for excessive wear. Replace all worn parts.

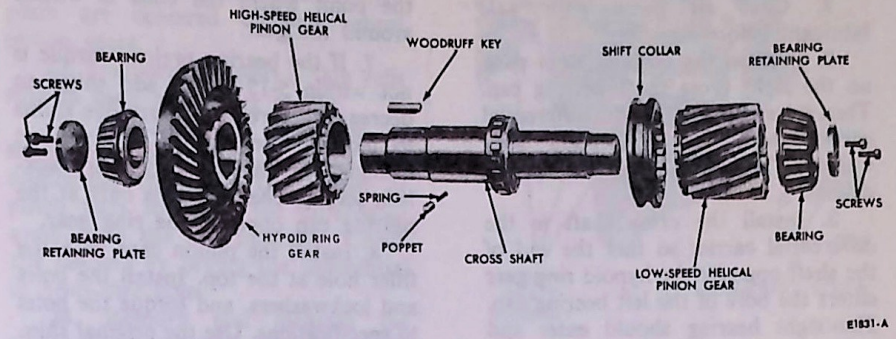



FIG. 37 Cross Shaft Disassembled

4. Position the bearing for the hypoid ring gear end of the shaft on the press bed under the shaft. Then carefully press the shaft into the bearing so that the bearing seats squarely against the shaft shoulder.

5. Install the bearing retaining plate and screws. Torque the screws to specifications, and install a new locking wire on the screws.

6. Coat the poppets and springs with axle lubricant, and install them in the holes between the cross shaft splined teeth. Then slide the shift collar over the splined teeth and the poppets. The side of the collar marked LOW SIDE should face toward the low speed helical pinion gear end of the shaft.

7. Place the low-speed helical pinion gear on the cross shaft. The clutching teeth of the gear hub should face toward the splined teeth on the shaft.

8. Install the remaining bearing on the cross shaft. **Use a 3 inch sleeve about one inch long over the bearing race so that the thrust of the press ram is not against the bearing roller cage.**

9. Check the end play of the lowspeed helical pinion gear (Fig. 38). If the end play is less than 0.010 inch, the shoulder on the cross shaft or the helical pinion gear may be oversize. If necessary, replace the parts.

10. Install the bearing retaining plate and screws. Torque the screws to specifications, and install a new locking wire on the screws.


FIG. 38 Checking Helical Pinion End Play

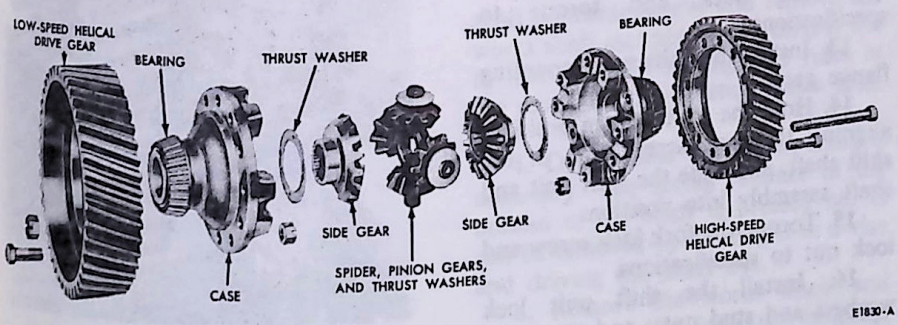



FIG. 36 Differential Case and Gears Disassembled

11. Install the cross shaft bearing cups in the bearing caps. **Be sure that the cups are properly seated against the shoulders in the cap bores.**

**Differential Carrier**

1. Coat all parts with axle lubricant before assembly.

2. Position the original shim pack on the right cross shaft bearing cap. Then install the cap on the differential carrier with the bolts and lock washers. Torque the bolts to specifications.

3. Install the cross shaft in the differential carrier so that the end of the shaft opposite the hypoid ring gear enters the bore of the left bearing cap. The right bearing should enter and seat in its bearing cap.

**On a wide-range ratio carrier requiring assembly of the high-speed helical pinion and bearing after the cross shaft is in the carrier, proceed as follows:** Install the cross shaft into the carrier. Install the high-speed helical pinion and place in a press so that the bearing retaining plate at the hypoid side of the cross shaft is resting on a support at the cover or cage opening. Install the bearing, bearing retaining plate, and cap screws. Tighten the cap screws to specifications and install the locking wire.

4. Tap the bearing cage into position, on the side opposite the hypoid gear, with a soft mallet. Install the cap screws and lock washers.

5. Position the original shim pack on the left-hand cross shaft bearing cap. Then install the cap on the differential carrier with the bolts and lock washers. Torque the bolts to specifications.

6. Rotate the cross shaft several times to be sure that the bearing contact is normal. Then check the cross shaft bearing preload as shown in Fig. 39. **Do not read the pull required to start the cross shaft rotating. Read only the steady rotating pull on the scale.** To change the scale reading into in-lbs. torque, multiply the scale reading by one-half the diameter of the helical pinion gear at the point where the cord is wound around the gear.

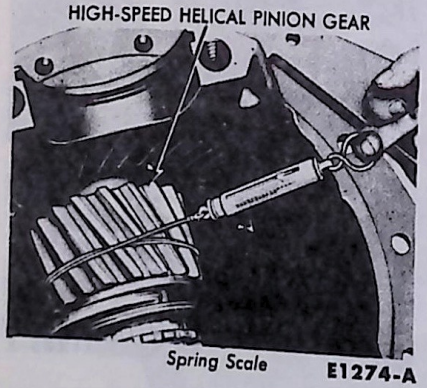



FIG. 39 Checking Cross Shaft Bearing Pre-Load

7. If the bearing preload torque is not within 5-15 in-lbs, add shims to decrease the preload, or remove shims to increase the preload. To prevent changing the hypoid ring gear backlash setting, change shims only at the bearing cap opposite the ring gear.

8. Install the pinion cage with the filler hole at the top. Install the bolts and lockwashers, and torque the bolts to specifications. Use the original shim pack between the pinion cage and the differential carrier if the original hypoid gears (ring gear and pinion set) are used. If new hypoid gears are installed, follow the shim selection procedure given in Part 15-01.

9. Install the U-joint flange and dust shield (Fig. 29). Torque the flange nut to specifications. Install a new cotter pin.

10. The backlash can be adjusted by removing shims from one cross shaft bearing cap and adding the same shim thickness to the other cap. To move the hypoid ring gear away from the hypoid pinion gear, transfer shims from the right cap to the left cap. To move the ring gear closer to the pinion gear, transfer shims from left to right. For each 0.010 inch movement of the ring gear the backlash changes about 0.008 inch.

Adjust backlash to 0.010 inch and check the gear tooth contact pattern. After a satisfactory pattern has been obtained at 0.010 inch backlash, increase backlash to 0.020-0.026 inch regardless of the backlash marking on the ring gear.

11. Check the tooth contact pattern, using the procedure given in Part 15-01.

12. Tap the shift unit sleeve into the carrier housing over the original shim pack. Install the lock washers and stud nuts, and torque to specifications.

13. Install the shift unit mounting flange gasket.

14. Hold the shift fork in position, aligning the lock screw hole in the shift shaft, and slide the shift unit and shaft assembly into position.

15. Torque the fork lock screw and lock nut to specifications.

16. Install the shift unit lock washers and stud nuts, and torque to specifications.


FIG. 40 Checking Shift Fork Clearance

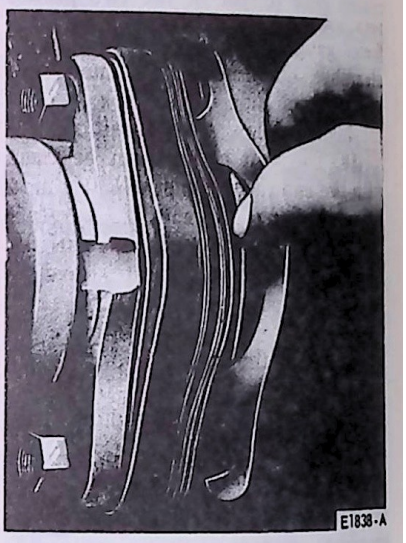



FIG. 41 Adjusting Shift Unit

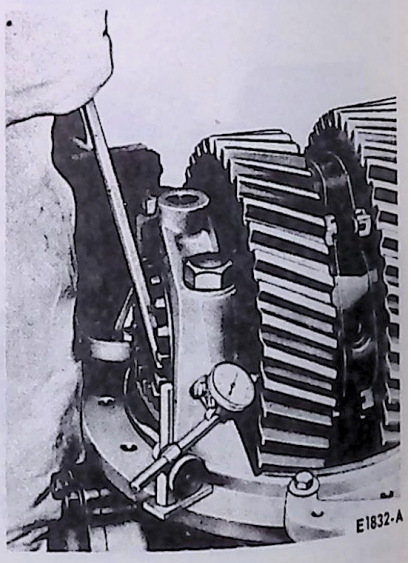



FIG. 42 Adjusting Typical Differential Bearing Pre-Load

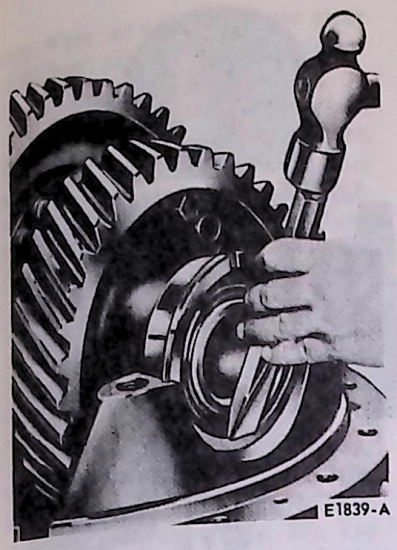



FIG. 43 Installing Split Ring

17. Check the clearance of the shift fork pads in the shift collar with a feeler gauge (Fig. 40). The minimum clearance should not be less than 0.010 inch on each side of the fork in both the high and low speed positions.

18. **The shift collar must be flush with the end face of the helical pinion when checking the shift fork clearance.** Add or remove shims from the pack under the shift unit sleeve to obtain the correct adjustment (Fig. 41).

19. Check the operation of the shift unit.

20. Check the fit of the differential side bearing cups in the bearing caps with the cap bolts tightened to normal torque. The bearing cups must be of a hand push fit in the bores. If the cups do not move by hand, remove the caps and clean the bearing surfaces.

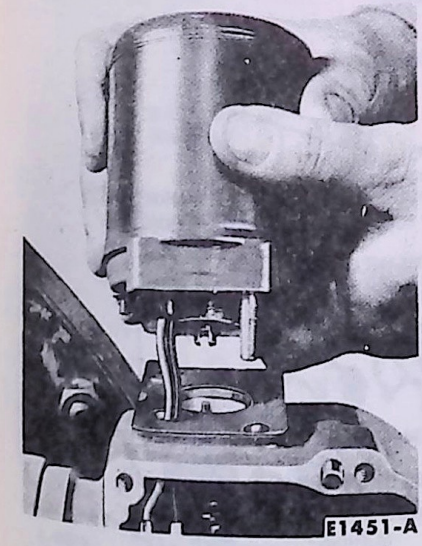



FIG. 44 Removing or Installing Shift Motor

21. Remove the bearing caps, and position a bearing cup on each differential side bearing. Then place the differential on the carrier so that the bearing cups rest in the carrier legs. Be sure that the helical drive gears are centered on the helical pinion gears.

22. Temporarily insert a thin split ring in each carrier leg groove.

23. Install a dial indicator as shown in Fig. 42, and check the differential end play. Use a pair of pinch bars to move the differential away from the dial indicator. Check the reading by prying the differential in both directions.

24. Remove and measure the thickness of the two split rings, add the end play, then add 0.017-0.022 inch to obtain the proper bearing preload. Divide the total measurement between the two split rings.

**Hardened split rings are ground in increments of 0.005 inch.**

25. Insert the required split ring in the carrier leg groove. Move the differential assembly so that the face of the bearing cup is held tightly against the split ring.

26. Install the other split ring by tapping it into the carrier leg groove with a blunt end drift. Tap on the lower inside diameter of the split ring (Fig. 43).

27. Position the differential bearing caps in place, and check their alignment.

28. Install the cap screws and torque to specifications.

## ROCKWELL ELECTRIC SHIFT UNIT

### Disassembly

1. Disconnect the wires from the terminals on the inside face of the housing cover (Fig. 5).

2. Remove the two stud nuts and star washers that hold the shift motor to the shift housing (Fig. 44), and carefully break loose the motor from the housing. Remove the gasket.

3. Loosen the lock nut and worm shaft adjusting screw, and remove the worm shaft assembly being careful not to lose the ball bearing that rides in the recess of the adjusting screw (Fig. 45).

4. Disassemble the worm shaft if necessary. The spring retainer at the bottom of the shaft is pressed on. It can be removed by holding it in a vise and driving the shaft out.

5. Remove the worm wheel and eccentric assembly from the housing. While holding the assembly in a vise, remove the cap screws and lock-

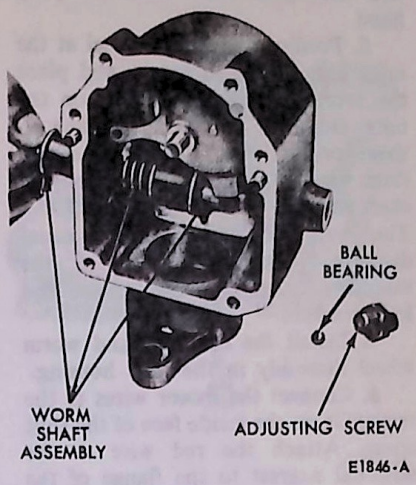



FIG. 45 Removing Worm Shaft

washers and drive the eccentric shift out of the assembly (Fig. 46).

### Assembly

1. Assemble the worm, springs, spring washers, and thrust washer to the worm shaft and press on the lower spring retainer (Fig. 47). Position the worm shaft assembly in the shift housing.

2. Position the gasket, and install the shift motor on the shift housing so that the slot in the motor shaft fits over the tang of the worm shaft (Fig. 44).

3. Install the two star washers and stud nuts that hold the motor to the housing.

4. Place the ball bearing in the recess of the adjusting screw, and turn in the adjusting screw until the ball bearing is snug against the end of the worm shaft assembly (Fig. 48). Back off the adjusting screw 1/8 turn for proper adjustment.

5. Hold the adjusting screw in place, and tighten the lock nut to secure the adjustment. Check to see

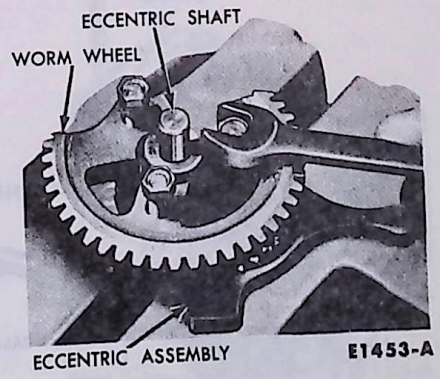



FIG. 46 Worm Wheel and Eccentric Components

that the worm shaft turns freely by hand.

6. Position the worm wheel at the inner side of the eccentric, and place the connecting rod and cover on the outer side (Fig. 47). While holding all these components in a vise, secure them together by driving the eccentric shaft through the assembly (Fig. 46). The shaft should protrude an equal distance from each side of the assembly. Install the cap screws and lock washers.

7. Install the eccentric and worm wheel assembly in the shift housing.

8. Connect the motor wires to the terminals on the inside face of the shift cover. Attach the red wire to the terminal nearest to the flange of the shift unit.

## EATON ELECTRIC SHIFT UNIT USED ON ROCKWELL AXLES

### Removal and Disassembly

1. Remove the axle shift unit cover and drain the lubricant.

2. Loosen but do not remove the shift unit to carrier stud nuts to relieve tension on the torsion spring.

3. Disconnect the shift unit wires at the quick disconnects on the left frame rail.

4. Turn the drive screw by hand to center the drive screw nut (Fig. 49).

5. Pull the spring winding lever shaft out of the shift unit housing.

6. Disengage the torsion spring end from the shifter shaft, and then remove the torsion spring and spring winding lever from the housing.

7. Remove the shift unit to carrier stud nuts and remove the shift unit from the carrier.

8. Remove the screws and lock washers, which attach the drive screw bearing cover to the housing and remove the cover and gasket.

9. Push down on the screw assembly until the bearing is forced out of the housing. Remove the bearing retainer nut and bearing as shown in Fig. 50.

10. Remove the lock nuts from the automatic switch terminals (Fig. 51), and remove the motor wires from the terminals.

11. Remove the motor cover screws, and remove the motor and the cover gasket from the housing (Fig. 49).

12. Remove the jam nuts and fiber washers from the terminals at the rear of the housing. Remove the automatic switch center screw, and lift the switch out of the housing.

13. Clamp the spring winding lever in a vise (Fig. 52). Insert a 6-inch rod or tube through the spring-winding

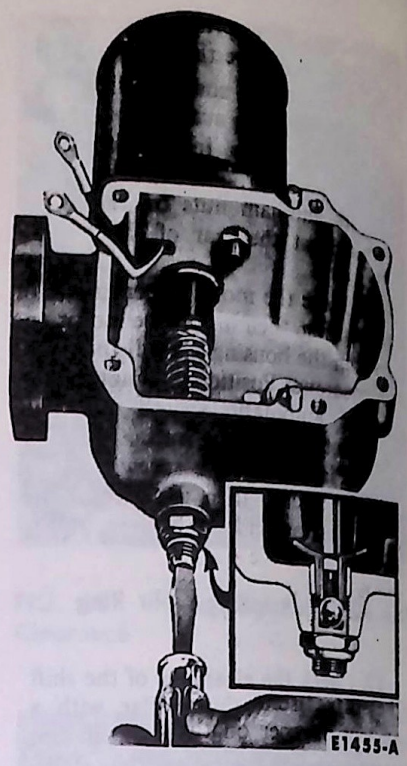



FIG. 48 Adjusting Worm Shaft

lever hub. This rod is installed for safety, should the spring get out of control during removal or installation. With two lengths of tubing over the spring ends, pull the spring ends apart so that the spring can be lifted off the

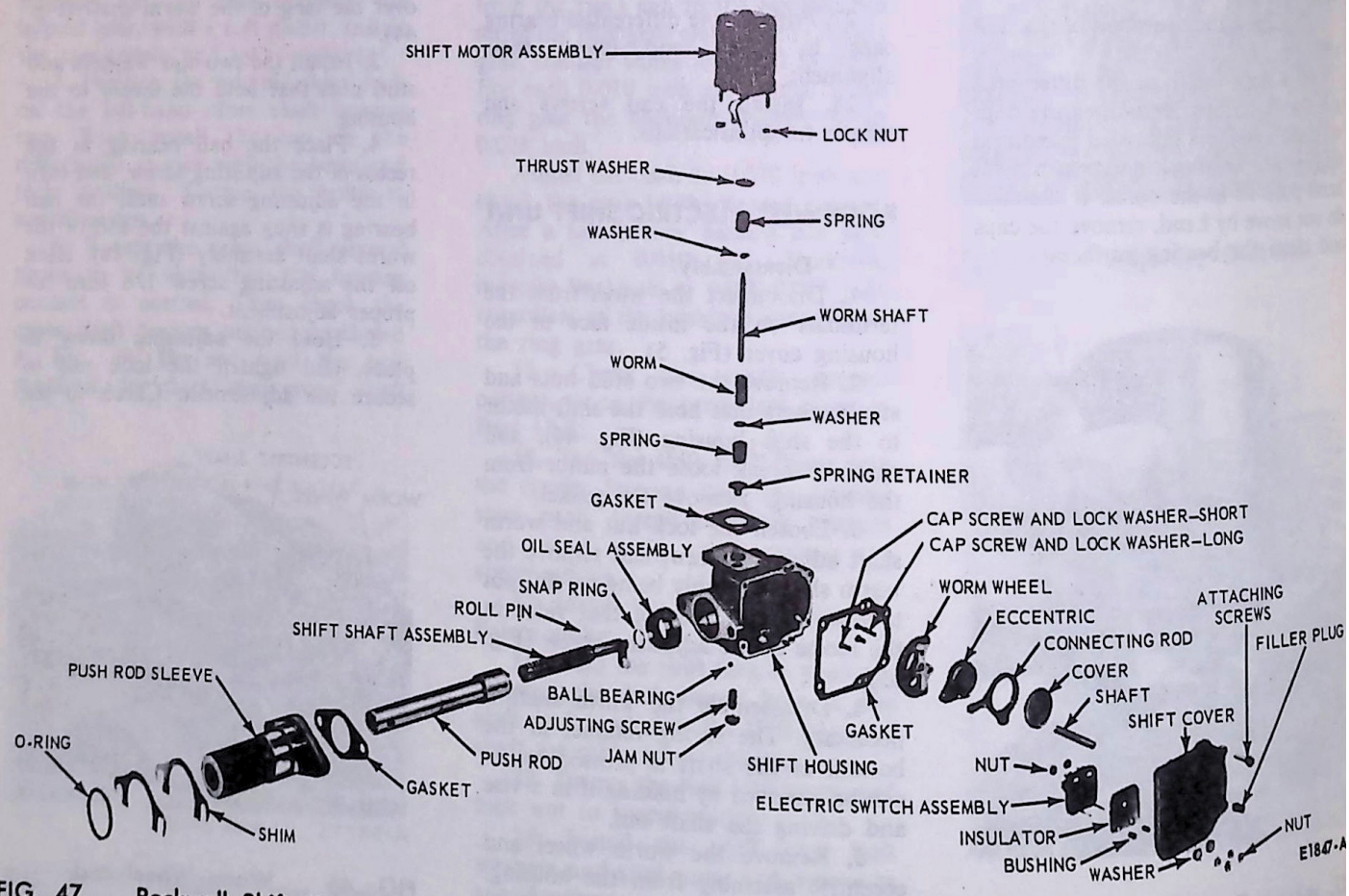



FIG. 47 Rockwell Shift Unit Disassembled

lever. When the spring ends are clear of the lever, relieve the spring tension.

**Assembly and Installation**

1. Position the automatic switch in the housing, then install the switch attaching screw. Install the fiber washers and jam nuts on the switch terminals at the rear of the housing (Fig. 49).

2. Place the motor cover gasket on the housing, then install the motor and cover in the housing. Install the motor cover screws. Position the motor wires on the automatic switch terminals, then install the lock nuts.

3. Place the drive screw assembly in the housing, then install the drive screw bearing and the bearing retainer nut on the drive screw (Fig. 50). Tap the bearing into the bearing seat in the housing. Install the bearing cover gasket and cover on the housing.

4. Center the drive screw nut on the drive screw, making sure the contact bumper on the nut is toward the automatic switch (Fig. 49).

5. Install the lead wires on the housing terminals. **The red wire goes on the top terminal.**

6. Install the partially assembled unit on the carrier housing studs. Start but do not tighten the stud nuts.

7. Assemble the torsion spring to the spring winding lever as shown in Fig. 52. Place the spring winding lever and spring assembly in the housing.

8. Make sure that the drive screw nut is in the center position and that the plastic bumper on the nut is toward the automatic switch.

9. Engage the spring winding lever with the drive screw nut pins, and then engage the spring ends in the shifter shaft slot.

10. Install the spring winding lever shaft.

11. Install the unit housing cover gasket and cover.

12. Tighten the unit to carrier housing stud nuts.

13. Connect the lead wires at the quick disconnects, and install the harness clips on the frame rail.

14. Fill the shift unit, to the level of the filler plug, with the proper lubricant.

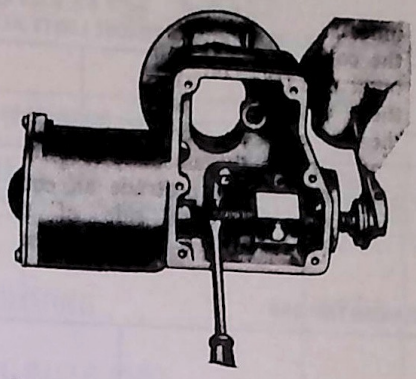



FIG. 50 Removing Drive Screw Bearing

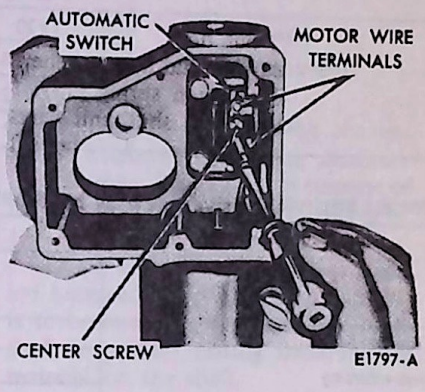



FIG. 51 Disconnecting Motor Wires

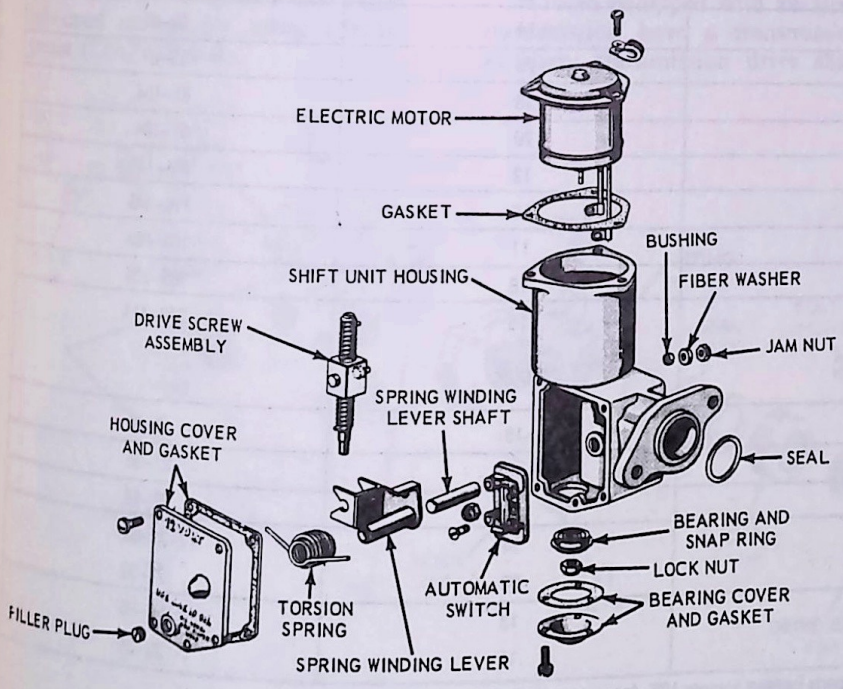



FIG. 49 Eaton Shift Unit Used on Rockwell Axles

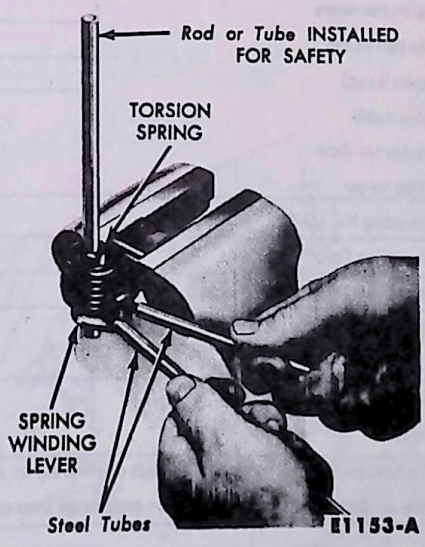



FIG. 52 Torsion Spring and Winding Lever

# 9 SPECIFICATIONS

**AXLE SHAFT FLANGE STUD NUT TORQUE LIMITS (ALL AXLES)**

| Thread Size | Torque Limits (Ft-Lbs) | Thread Size | Torque Limits (Ft-Lbs) |
|---|---|---|---|
| 7/16-20 | 35–45 | 5/8-18 | 100-120 |
| 1/2–20 | 50–60 | 3/4–16 | 130–170 ① |

① 160–200 Ft-Lbs on all 22000 pound and 23000 pound capacity axles.

**BEARING PRELOAD**

| Axle Model | Pinion Shaft Nut-Thread Size and Torque Limits (Foot-Pounds) | | Press Ram Pressure for Preload Check (Tons) | Pinion and Cross Shaft Bearing Preload (Inch-Pounds) | Backlash Limits (Inches) | Differential Bearing Preload Adjusting Nut Notches Tighten from Zero End Play (each Adjusting Nut) |
|---|---|---|---|---|---|---|
| Single-Speed Double Reduction | 1-1/4–18 | 700–900 | 11 | 5–15 | 0.020–0.026 | 1 |
| | 1-1/2–12 | 800–1100 | 14 | 5–15 | 0.020–0.026 | 1 |
| | 1-1/2–18 | 800–1100 | 14 | 5–15 | 0.020–0.026 | 1 |
| 2-Speed Double Reduction | 1 x 20 | 300–400 | 6 | 5–15 | 0.020–0.026 | 1 |
| | 1-1/4–18 | 700–900 | 11 | 5–15 | 0.020–0.026 | 1 |
| | 1-1/2 x 12 | 800–1100 | 14 | 5–15 | 0.020–0.026 | 1 |
| | 1-3/4–12 | 800–1100 | 14 | 5–15 | 0.020–0.026 | 1 |

**TORQUE SPECIFICATIONS FOR ALL ROCKWELL STANDARD AXLES**

| Cap Screws or Stud Nuts | | | |
|---|---|---|---|
| Location | Diameter | Threads per in. | Torque-Lb. Ft. Min.-Max. |
| These torques are given according to diameter and threads per inch. The torque will be the same for a specific size no matter where the bolt or cap screw is used on the axle except for those listed below | 3/8 | 24 | 38–49 |
| | 3/8 | 16 | 33–43 |
| | 7/16 | 14 | 53–67 |
| | 7/16 | 20 | 53–67 |
| | 1/2 | 13 | 81–104 |
| | 1/2 | 20 | 81–104 |
| | 9/16 | 12 | 116–149 |
| | 9/16 | 18 | 116–149 |
| | 5/8 | 11 | 160–205 |
| | 5/8 | 18 | 185–235 |
| | 3/4 | 16 | 320–415 |
| Adjusting Nut Lock | 5/16 | 18 | 16–20 |
| Inspection Cover | 3/8 | 16 | 27–35 |
| Shift Unit (Mounting) | 3/8 | 16 | 27–35 |
| Shift Unit Lock Nut, Set Screw and Clamp Screw | 3/8 | 24 | 31–39 |
| | 7/16 | 20 | 31–39 |
| Shift Unit-Travel Limiting Screws | 1/2 | 13 | 55–60 |
| | 5/8 | 11 | 30–35 |

Torques given apply to parts coated with machine oil; for dry (as received) parts increase torques 10%, for parts coated with multi-purpose gear oil decrease torques 10%. Nuts on studs to use same torque as for driving the stud.

# PART 15-62 Drive Shaft — Single Bearing Cap and Bolt Type U-Joint

**Applies To All Models Except F-100-350, Econoline, Bronco, L-N-W-9000 Series**



## 1 DESCRIPTION

The drive shaft or coupling shaft is composed of the universal joints, connecting shafts, and the attaching flanges. The number of shafts and universal joints used depends on the vehicle wheelbase.

All the vehicle universal joint spiders and sliding splines are equipped with lubrication fittings. These spiders and splines should be lubricated periodically using lithium grease (C1AZ19590-B).

The majority of vehicles are equipped with center support bearings that are prelubricated and sealed for the life of the bearing. However, some vehicles have center support bearings equipped with lubrication fittings which should be lubricated periodically using lithium grease (C1AZ-19590-B).

Trucks equipped with an auxiliary transmission have a transmission to auxiliary transmission drive shaft to transmit the power from the conventional transmission to the auxiliary transmission. This assembly consists of two close-coupled universal joints (Fig. 1).

Drive shafts and coupling shafts are balanced; therefore, if the vehicle is to be undercoated, cover the drive shaft to prevent getting undercoating material on the shaft.

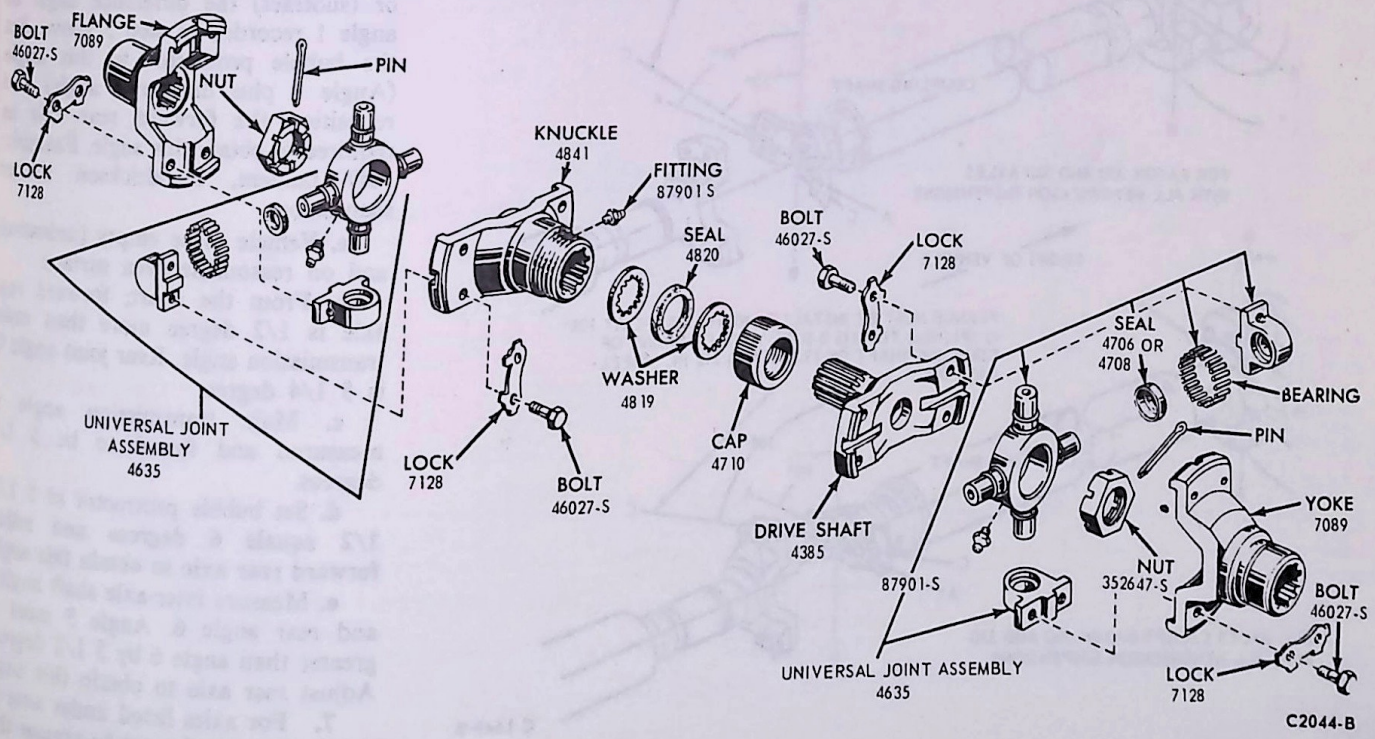



FIG. 1 Transmission-to-Auxiliary Universal Joints

# 3 ADJUSTMENTS

## U-JOINT PHASING

When U-joint yokes are assembled to their shafts in the same plane, they are in phase (Fig. 2). When they are assembled to the shafts in different planes, they are out of phase.

To obtain vibration-free operation, check and correct as necessary according to the following specifications (Fig. 3).

**1.** The U-joints between the main and auxiliary transmission must be in phase (Fig. 3).

**2.** The main drive shaft U-joint flanges are to be in phase as shown in Fig. 10.

**3.** Tandems which require a specific inter-axle driveshaft phasing, are identified by arrows which are stamped on slip yoke and stud end. The arrows must be in line (Eaton 30D-2 or 3 speed, Eaton 34D-2 or 3 speed, and Eaton 42D).

## DRIVE SHAFT ALIGNMENT

To properly adjust drive line angles, a spirit level protractor is necessary. When angles are read from the 0 degree mark (for example, measuring inter-axle shaft angle) record and use the angle shown on the protractor since the 90 degree marks must be treated as 0 degree. For example, a protractor reading of 85 degrees is actually 5 degrees. See Fig. 4 or 5.

All angles should be read within 1/4 degrees (15 minutes) and they should be measured with the protractor held plumb on a clean, flat surface.

The following procedures should be followed to check drive shaft angles and adjust as required:

**1.** Inflate all tires to the pressure at which they normally operate.

**2.** Park the empty vehicle on a surface which is fairly level—both front and rear and side to side. The truck must be in its normal operating position. Do not attempt to level the truck by jacking up the front or rear axles of the frame.

**3.** Check and record the angle of the engine and main transmission (Angle 1). This reading can be taken at the rear of the main transmission to the left of the bearing retainer or output flange. Lock the protractor at this reading.

**4.** Remove the drive shaft or coupling shaft from the auxiliary transmission output flange. Place the locked protractor on the output flange of the auxiliary transmission (Fig. 6) and adjust the auxiliary transmission as necessary to center the bubble. Loosen the front trunnion clamping bolt on the auxiliary transmission before attempting to adjust the angle of the auxiliary transmission. The adjusting bolts should be adjusted evenly so that the same amount of thread is showing on both bolts. This will put the angle of the auxiliary transmission (Angle 3) the same as the main transmission (Angle 1), Fig. 7.

**5.** Check and record the angle of the shaft between the main and auxiliary transmission (Angle 2). Take this reading by placing the protractor on the inter-transmission shaft. Angle 2 must be 1 degree less than Angle 1, plus or minus 1/2 degree. Adjust the engine or the auxiliary transmission to bring the inter-transmission shaft 1 degree less than Angle 1, plus or minus 1/2 degree, keeping the mian and auxiliary transmissions parallel. Tighten the front clamping bolts on the auxiliary transmission.

**6.** From the chart in Fig. 8, add or (subtract) the difference angle to angle 1 recorded in step 3 above. Set the bubble protractor to this angle (Angle 1 plus difference angle) and reposition the forward rear axle as required to obtain this angle. Example: 30D tandem, Hendrickson rubber suspension.

**a.** Vehicle to be empty (unloaded) and on reasonable even surface.

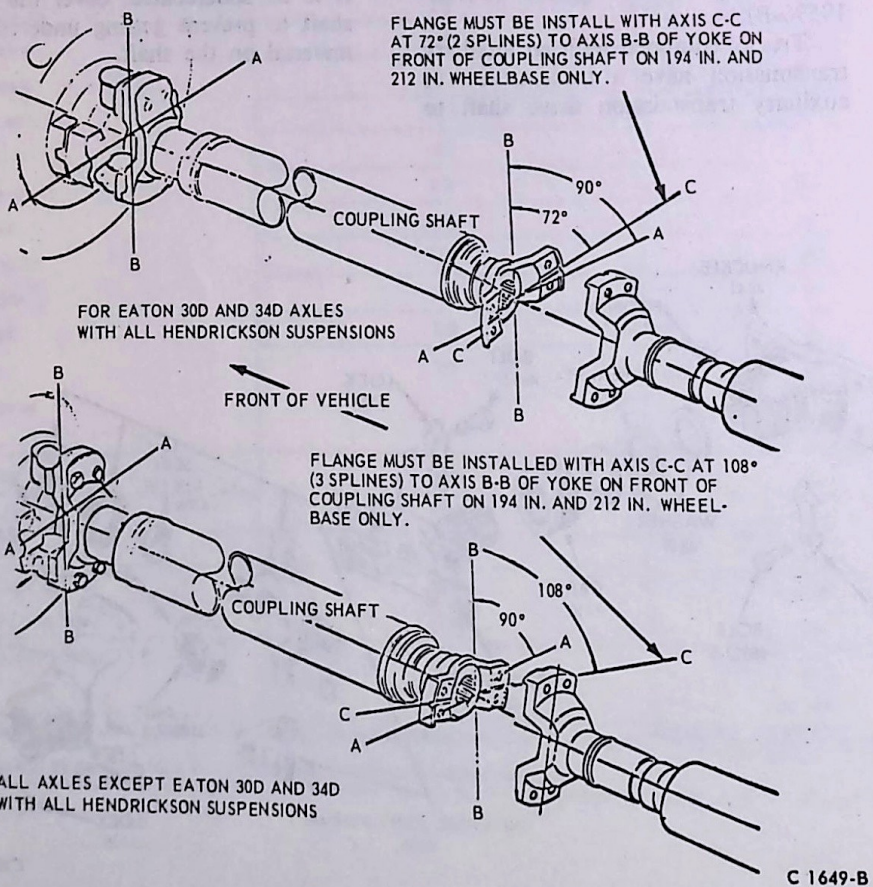
**b.** From the chart; forward rear axle is 1/2 degree more than main transmission angle. Rear joint angle G is 5 1/4 degree.

**c.** Main transmission angle is measured and found to be 5 1/2 degrees.

**d.** Set bubble protractor at 5 1/2; **1/2 equals 6 degrees and adjust forward rear axle to obtain this angle.**

**e.** Measure inter-axle shaft angle 5 and rear angle 6. Angle 5 must be greater than angle 6 by 5 1/2 degrees. Adjust rear axle to obtain this angle.

**7.** For axles listed under note (1) in Fig. 8, angle 5 must be greater than



(2), angle 6 must be greater than angle 5. The difference of these two angles is equal to angle G.

**Torque Arm Shimming**

The adding or removing of shims from the forward rear axle torque arm will change angle 4. The 1/4 inch shims will change this angle by approximately 3/4 degree. The addition or removal of a 1/2 inch shim from rear axle torque arm will change angle G approximately 1 1/4 degree.

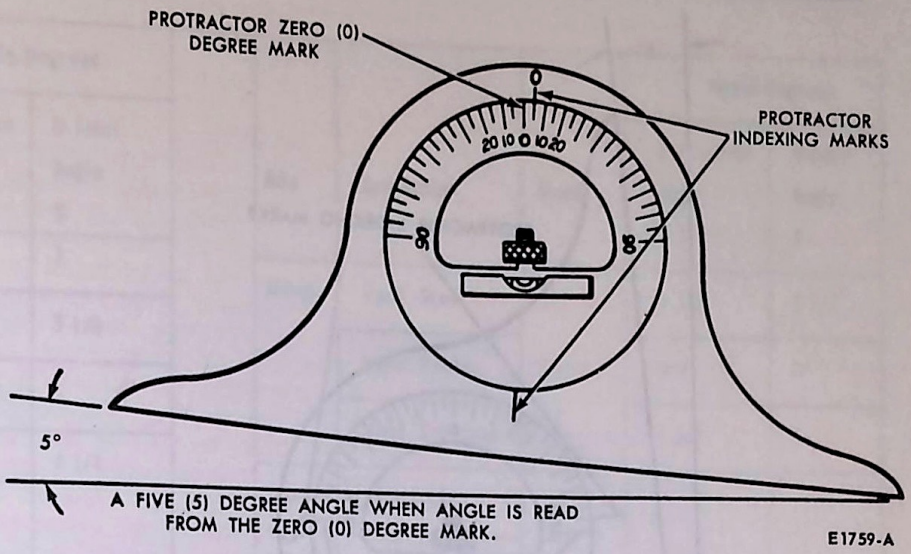



FIG. 4 Drive Shaft Angle—Read from Zero Mark—Horizontal Position

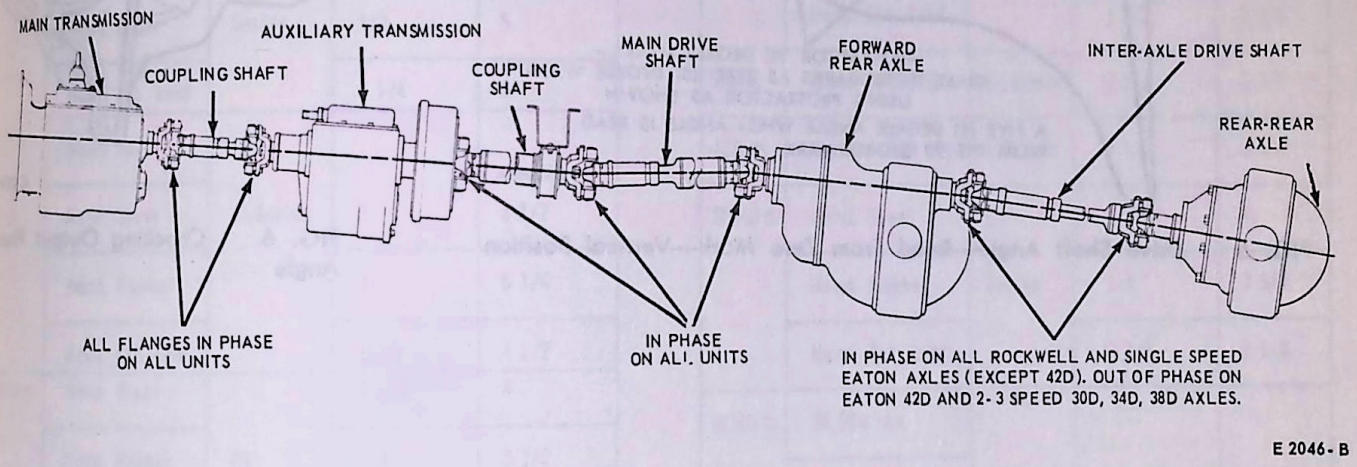



FIG. 3 Typical Tandem Axle Drive Shaft

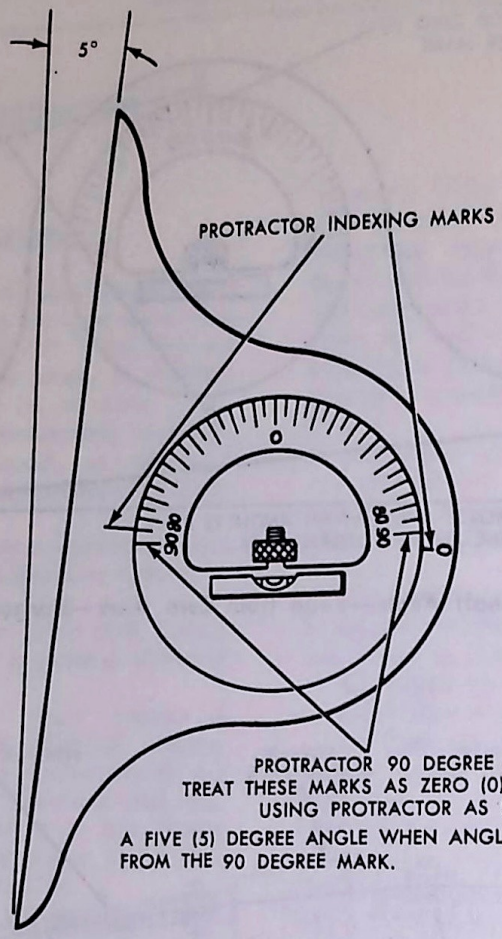



FIG. 5 Drive Shaft Angle—Read From Zero Mark—Vertical Position

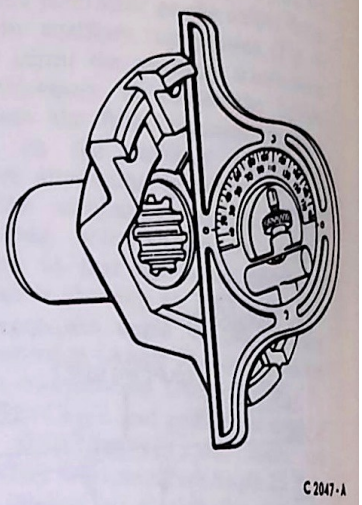



FIG. 6 Checking Output Flange Angle

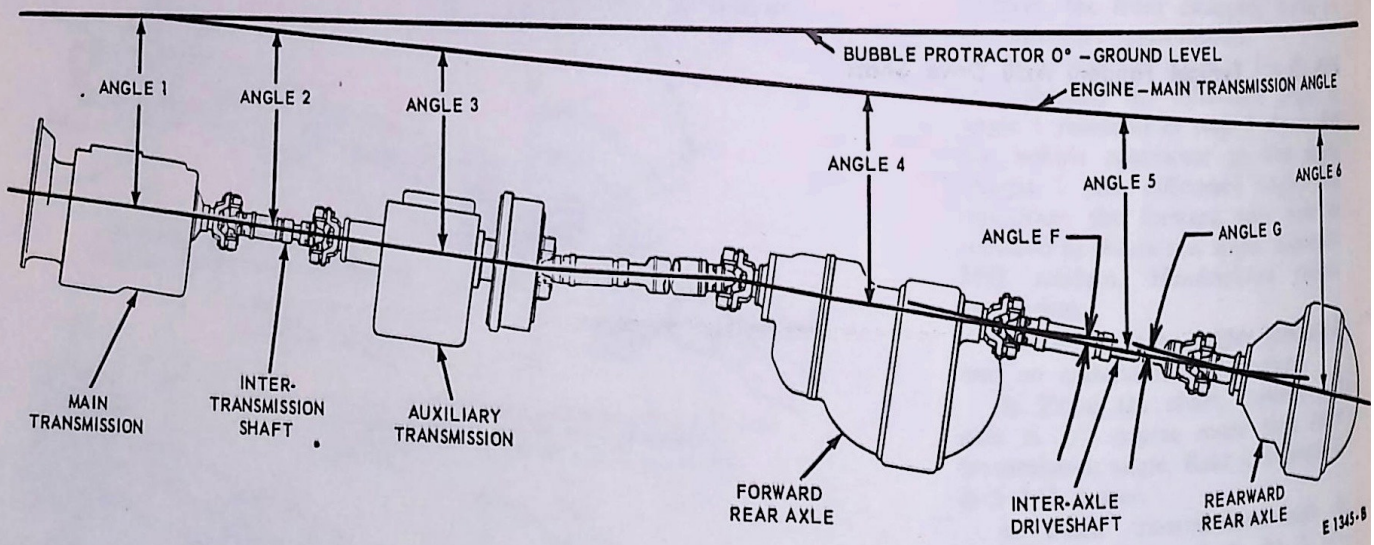



FIG. 7 Checking and Adjusting Drive Shaft Angles

| Axle | Suspension | Model | Angle-Degrees | |
|---|---|---|---|---|
| | | | Difference Angle 4 | U-Joint Angle G |
| 30D① | Hend. Steel | CT Series | 1 1/2 | 3 |
| | Hend. Rubber | | 1/2 | 5 1/4 |
| | Hend. Steel | | 1/2 | 5 |
| | Hend. Ext. Leaf | | 1 1/2 | 4 1/4 |
| 34D① | 34000 Lb. | CT Series | | |
| | Hend. Steel② | | 1 1/2 | 5 1/4 |
| | Hend. Rubber | | 3/4 | 5 1/2 |
| | Hend. Shear | | 1/2 | 5 |
| | Hend. Ext. Leaf | | 1 1/4 | 5 |
| | 34000 Lb. | W-Series | | |
| | Hend. Steel | | 2 | 3 1/2 |
| | Hend. Rubber | | 1 | 5 1/4 |
| | Hend. Ext. Leaf | | 1 3/4 | 4 1/2 |
| SHHD① | Hend. Steel | CT Series | 1 1/4 | 4 |
| | Hend. Rubber | | 1/4 | 3 1/2 |
| | Hend. Shear | | 1/4 | 3 1/4 |
| | Hend. Ext. Leaf | | 1 1/4 | 3 1/2 |
| SLHD① SQHD① | 34000 Lb. | CT Series | | |
| | Hend. Steel② | | 1 1/4 | 4 1/4 |
| | Hend. Rubber | | 1/4 | 3 1/2 |
| | Hend. Shear | | 1/4 | 3 1/4 |
| | Hend. Ext. Leaf | | 1 1/4 | 3 1/2 |
| | 34000 Lb. | W-Series | | |
| | Hend. Steel | | 2 | 4 |
| | Hend. Shear | | 1/2 | 3 3/4 |
| | Hend. Ext. Leaf | | 1 1/4 | 4 |

| Axle | Suspension | Model | Angle-Degrees | |
|---|---|---|---|---|
| | | | Difference Angle 4 | U-Joint Angle G |
| 30D③ | Hend. Steel | L Series | 1 1/2 | 3 1/2 |
| | Hend. Rubber | | 3/4 | 3 |
| | Hend. Ext. Leaf | | 1 1/2 | 3 |
| 34D③ 38D③ | 34,000 Lbs. | L Series | | |
| | Hend. Steel | | 1 1/2 | 3 3/4 |
| | Hend. Rubber | | 1 1/2 | 3 1/4 |
| | Hend. Ext. Leaf | | 1 1/2 | 3 1/4 |
| 38D③ | Hend. 38000 Lbs. | L-Series | 1 1/4 | 3 1/2 |
| 42D③ | Hend. 44000 Lbs. | L-Series | 1 1/4 | 3 3/4 |
| SHHD③ | Hend. Steel | L Series | 1 1/2 | 4 |
| | Hend. Rubber | | 1/2 | 3 3/4 |
| | Hend. Ext. Leaf | | 1 1/2 | 3 1/2 |
| SLHD③ | 34,000 Lbs. | L Series | | |
| | Hend. Steel④ | | 1 1/2 | 4 1/2 |
| | Hend. Rubber | | 1 1/2 | 4 |
| | Hend. Ext. Leaf | | 1 1/2 | 4 |
| SQHD③ | 34,000 Lbs. | L Series | | |
| | Hend. Steel④ | | 1 1/4 | 4 1/2 |
| | Hend. Rubber | | 1 1/4 | 4 |
| | Hend. Ext. Leaf | | 1 1/4 | 4 |
| SQHD③ | Hend. 38000 Lbs. | L-Series | 1 1/4 | 4 1/4 |

① Angle G determine by subtracting angle 6 from angle 5 (angle 5 must be greater than angle 6).
② Angle G determine by subtracting angle 5 from angle 6 (angle 6 must be greater than angle 5).
③ 34000 & 32000 Lb. (low rate)
All angles are ±1/4°
④ Difference angle-amount greater than engine or transmission angle.

CE1988-A

FIG. 8 Tandem Axle Alignment Angles

# 4 REMOVAL AND INSTALLATION

## DRIVE SHAFT

### Removal

1. Disconnect the drive shaft from the flange at the rear axle.
2. If working on a vehicle equipped with a coupling shaft, slide the drive shaft off the coupling shaft splines.
3. Working from the center support nearest to the rear of the vehicle, remove the two attaching bolt and support the bearing.
4. If working on a vehicle equipped with more than one coupling shaft, disconnect the rear shaft from the front one.
5. Remove the remaining center support attaching bolts and support the bearing.
6. Remove the nuts that attach the coupling shaft flange to the transmission and remove the shaft and center bearing as an assembly.
7. Thoroughly clean old grease and dirt from the drive shaft splines and then check the splines for wear, warpage, and cracks. If the shaft is worn, warped, or cracked, replace it.

Using a suitable cleaning fluid, clean all dirt from the slip yoke, slip yoke splines, and shaft splines. Carefully inspect the slip yoke splines for wear or evidence of twisting. Check the clearance between the slip yoke splines and the shaft splines.

Wash all parts except the sealed ball bearing and rubber cushion in suitable cleaning fluid. **Do not immerse the sealed bearing in cleaning fluid.** Wipe the bearing and cushion clean with a cloth dampened with cleaning fluid.

Check the bearing for wear or rough action by rotating the inner race while holding the outer race. If wear or roughness is evident, replace the bearing.

Examine the rubber cushion for evidence of hardening, cracking, or deterioration. Replace it if damaged in any way.

Grease retainers and slingers are serviced only as a part of the bearing assembly.

### Installation

1. Connect the front flange or joint of the drive shaft or coupling shaft to the flange on the transmission. Torque the nuts to specifications.
2. Secure the center bearing to the frame bracket with the center support and attaching bolts. Torque the bolts to specification.
3. If working on a truck with more than one coupling shaft, connect the rear shaft to the forward one, then install the remaining center support.
4. Connect the rear universal to the rear axle flange and torque the nuts or bolts to specifications. Be sure all drive shaft and coupling shaft yokes are properly in phase.

## BEARING CAP AND BOLT TYPE UNIVERSAL JOINT

### Removal

1. Remove the cap screws which attach the bearing caps to the universal joint flange and yoke. Remove the bearing caps and bearings from the spider.
2. Remove the grease seals, and retainers, from the spider.

Wash all parts in cleaning fluid. Make sure the lubricant passages in the journal cross are clean. Check the needle bearings and journals for evidence of wear or excessive heat.

Soak the needle bearings and cages in a commerical cleaning fluid to soften particles of hardened grease. Then, wash these parts in cleaning fluid using a stiff brush if necessary to remove all old lubricant. Check each bearing for missing rollers.

After the needle bearing assemblies are thoroughly clean, apply clean lubricant to the rollers. Rotate them on the trunnion of the journal to check wear. Fill the journal passages with C1AZ-19590-B lubricant and fill the bearings approximately 1/3 full of C1AZ-19590-B lubricant before reassembly.

### Installation

1. To install, pack the recess in the spider with the recommended lubricant.
2. Install the grease seals on the spider.
3. Position the needle bearings in the bearing caps, then position the caps on the spider. Place the spider on the yokes, and then install the bearing caps. Torque the bolts to specifications.
4. Secure the locks to the yokes with cap screws.
5. Lubricate the universal joints with long life lithium grease (C1AZ-19590-B).

## TRANSMISSION TO AUXILIARY TRANSMISSION UNIVERSAL JOINTS

### Removal

1. To replace the transmission to auxiliary transmission input shaft U-joint assembly (Fig. 1), remove the universal bearing cap bolts from the auxiliary trasnmission input shaft yoke and the transmission output shaft yoke.
2. After the universal joint assembly has been removed from the truck, separate the two universal joints by loosening and removing the dust cap, washers, and seal from the U-joint knuckles. Pull the assemblies apart.
3. Remove the bearing caps and spiders from their respective yokes.

### Installation

1. Clean and inspect the spiders, bearings, and shields. Replace with new parts as required, and assemble the spiders onto the U-joint knuckle and coupling shaft respectively.
2. Install the dust cap, washers, and seal over the splined end of the drive shaft. Install the drive shaft into the knuckle so that the universal joint spiders are on the same plane. Tighten the dust cap on the knuckle until it is snug.
3. Install the universal joint with the slip yoke toward the front of the vehicle. Be sure the companion flanges on the transmissions are on the same plane. Attach the spider bearing caps to the respective flanges with bolts. Torque the bolts to specifications.
4. Lubricate the universal joints with long life lithium grease (C1AZ-19590-B).

## 9 SPECIFICATIONS

**DRIVESHAFT – TORQUE LIMITS**

| Nomenclature | Bolt Size and Ft-Lbs | | |
|---|---|---|---|
| Bolt-Yoke to Coupling Shaft or Intermediate Shaft | 3/4–16<br>175-240 ①<br>5/8–18<br>148-164 ② | 7/8–14<br>250-300 ③ | 1–20<br>160 ④ |
| Nut-U-Joint Flange to Main and Aux. - Input or Output Shaft | 1–20<br>90-130<br>2-16<br>425-525 | 1 1/4–18<br>350-420 | 1 1/2–18<br>380-470 |
| Nut-Universal Joint - U-Bolt | | 3/8–24<br>17-26 | 7/16–20<br>30-40 |

| Nomenclature | Bolt Size and Ft-Lbs | | |
|---|---|---|---|
| Bolt and Nut – Parking Brake Drum to Universal Joint Flange | | 7/16–20<br>37-49 | 1/2–20<br>55-75 |
| Bolt – U-Joint Cap | 3/8–24<br>37-50 ① | 7/16–20<br>58-78 ③ | 1/2–20<br>100-115 ① |
| Driveshaft Center Bearing Coupling to Support | 40-50 | | |
| Bolt - Drive Shaft U-Joint to Rear Yoke | 1/2–20<br>90-110 ① | | |
| Bolt and Nut - U-Joint Adapter to Rear Axle | 1/2–20<br>60-70 | | |

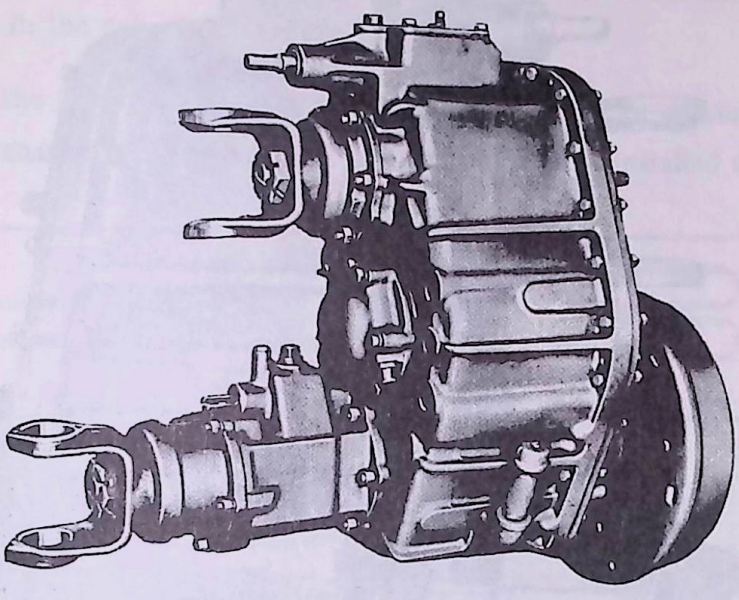
① Mechanics ② Dana ③ Rockwell ④ Cleveland

CE1989-A

FIELD MAINTENANCE MANUAL No. 3

# TRANSFER CASES

## THREE SHAFT DESIGN



**Use Only Genuine ROCKWELL-STANDARD Parts**


Automotive Divisions
North American Rockwell

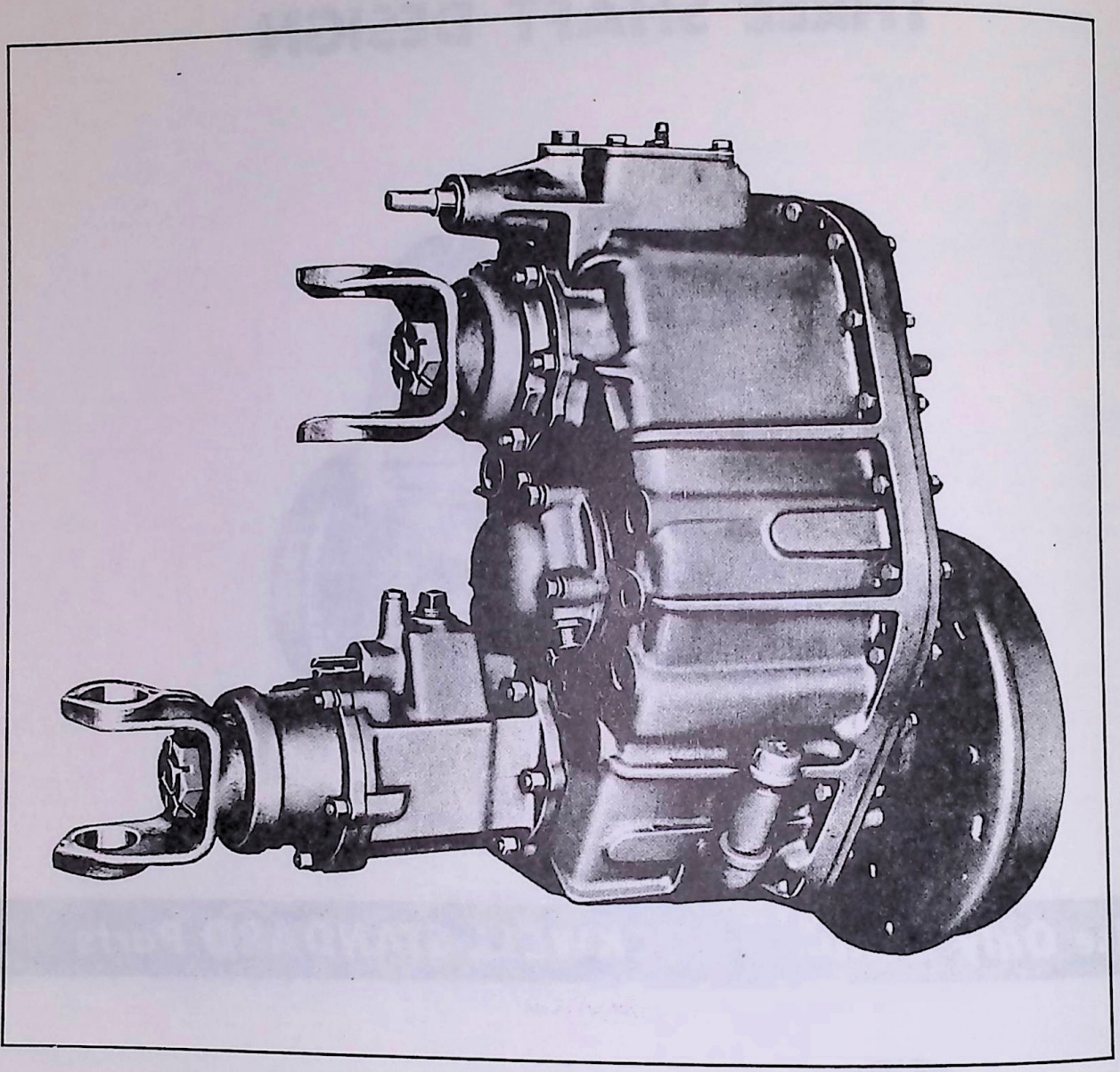
Transmission and Axle Division
Detroit, Michigan 48232



REV. 6-63

PRINTED IN U.S.A.

# THREE SHAFT DESIGN



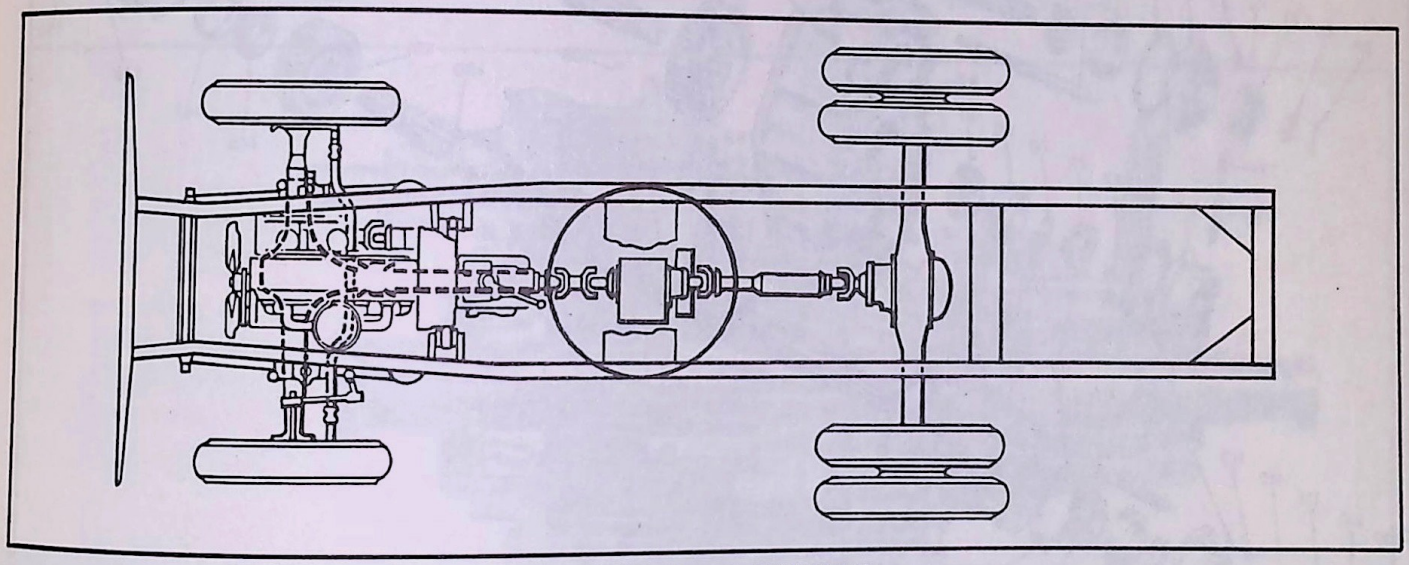
# ROCKWELL-STANDARD TRANSFER CASE

## FUNCTION AND DESIGN

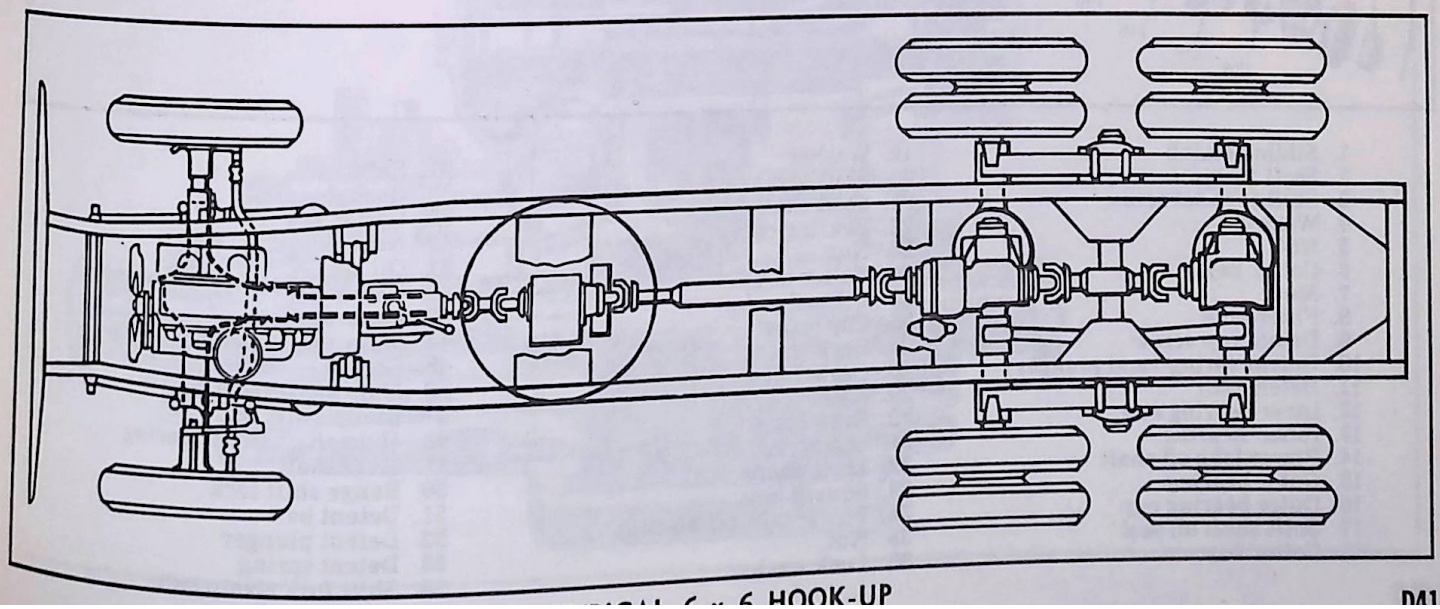
A transfer case is a gear box located between the main transmission and the rear axle. Its purpose is to transfer power from the transmission to the front driving axles as well as the rear driving axles. It also provides an extra gear reduction (Lo) in the power train of the vehicle. The drop box design enables the front axle drive line to clear the underside of the engine.

All Rockwell-Standard Transfer Cases incorporate the counter shaft design; each shaft is mounted on roller or ball bearings. Most units are available with a power take-off (with or without an auxiliary oil pump for stationary operation) and a front axle declutch, which is used to drive the front axle whenever the vehicle encounters steep grades or rough terrain. These accessories are actuated by separate shift levers located in the cab of the vehicle.

In addition, the transfer case unit may be equipped with an optional parking brake, as shown on the opposite page, and a speedometer drive gear, which can be installed on the idler assembly.



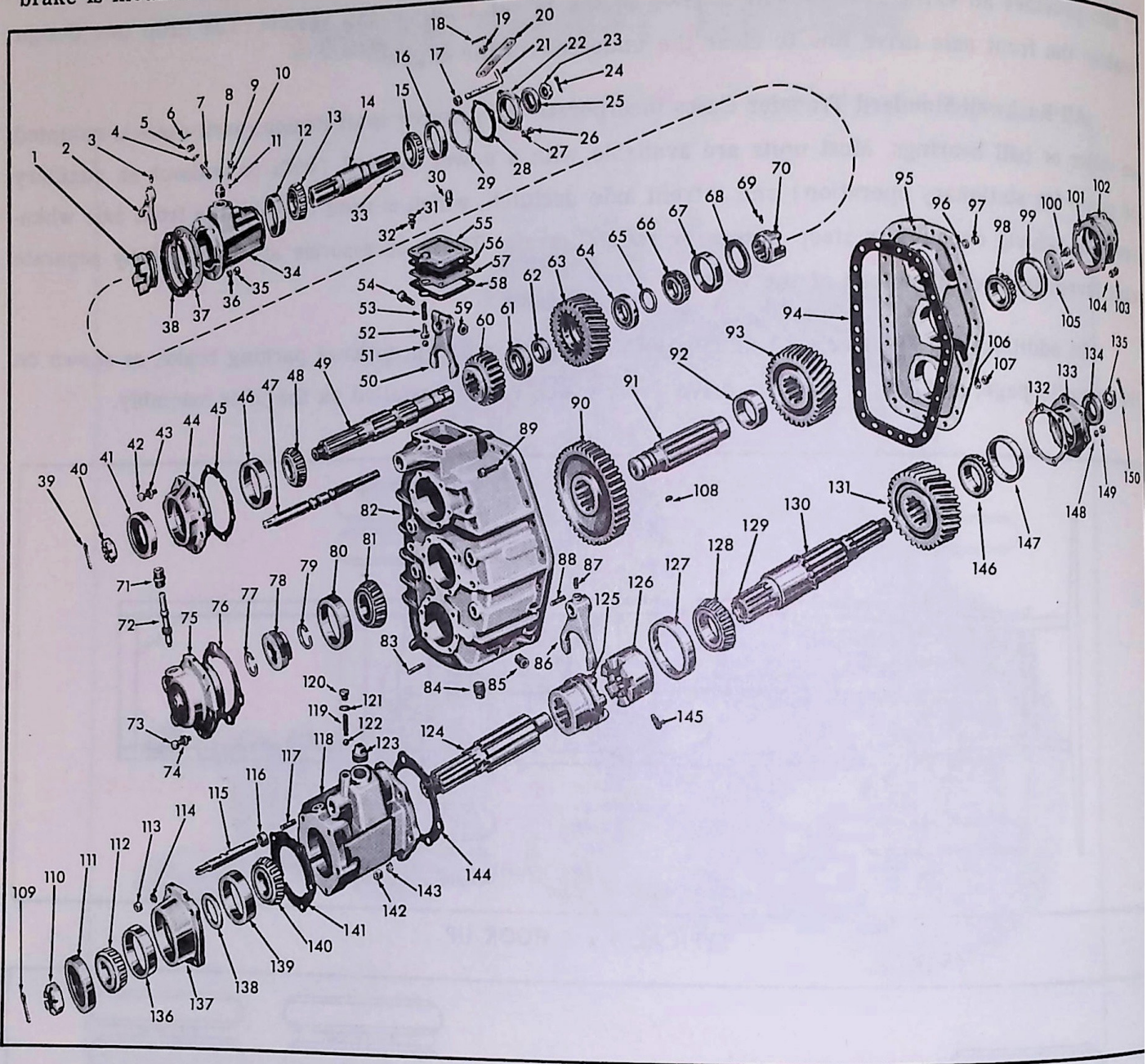
TYPICAL 4 x 4 HOOK-UP



TYPICAL 6 x 6 HOOK-UP

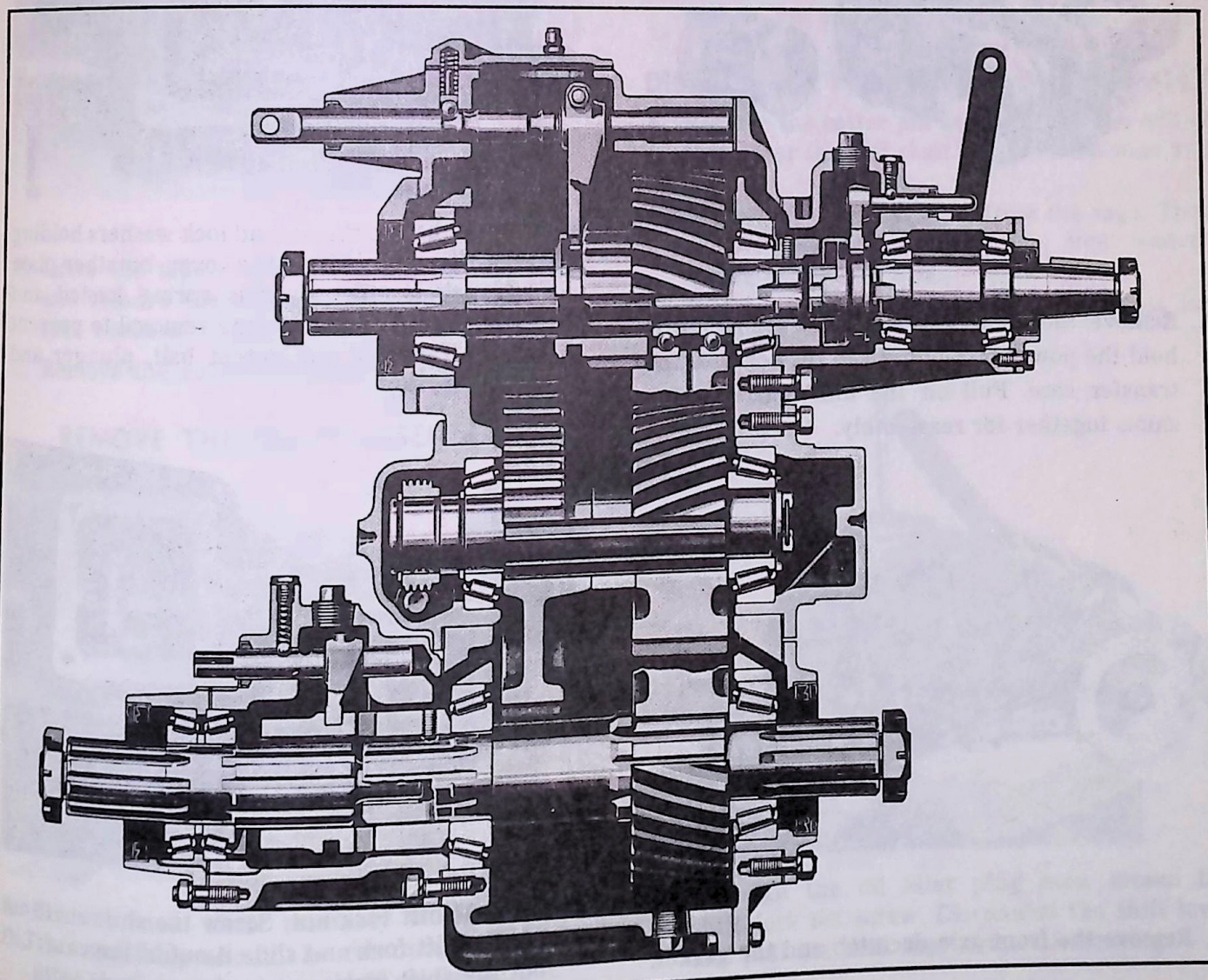
# CONVENTIONAL THREE SHAFT DESIGN

The Conventional Type Transfer Case is the two-speed, three shaft design. It can be adapted to incorporate a power take-off and front axle declutch as optional equipment. A mechanical type auxiliary brake is mounted on the rear axle drive shaft as optional equipment.



1. Sliding clutch
2. Shift fork
3. Shift fork set screw
4. Washer
5. Nut
6. Cotter key
7. Stud
8. Filler plug
9. Detent cap screw
10. Detent spring (and plunger)
11. Detent ball
12. Inner bearing cup
13. Inner bearing
14. Power take-off shaft
15. Outer bearing
16. Outer bearing cup
17. Shift shaft oil seal
18. Cotter key
19. Washer
20. Shift lever
21. Shift shaft
22. Bearing cap
23. Nut
24. Cotter key
25. Oil seal
26. Cap screw
27. Lock washer
28. Gasket
29. Shim
30. Breather
31. Cap screw
32. Lock washer
33. Square key
34. Power take-off housing
35. Nut
36. Lock washer
37. Shim
38. Gasket
39. Cotter key
40. Nut
41. Oil seal
42. Cap screw
43. Lock washer
44. Main shaft front bearing cage
45. Gasket
46. Main shaft front bearing cup
47. Range shift shaft
48. Main shaft front bearing
49. Main shaft
50. Range shift fork
51. Detent ball
52. Detent plunger
53. Detent spring
54. Shift fork clamp bolt

55. Shift cover
56. Gasket
57. Shift cover breather plate
58. Gasket
59. Shift fork clamp bolt nut
60. Main shaft sliding gear
61. Main shaft drive gear ball bearing
62. Main shaft dr. gear ball brg. spacer
63. Main shaft drive gear
64. Main shaft drive gear ball bearing
65. Main shaft rear bearing spacer
66. Main shaft rear bearing
67. Main shaft rear bearing cup
68. Oil dam
69. Set screw
70. Power take-off driving clutch
71. Speedometer driven gear bushing
72. Speedometer driven gear
73. Cap screw
74. Lock washer
75. Idler shaft front bearing cap
76. Gasket
77. Snap ring
78. Speedometer drive gear
79. Snap ring
80. Idler shaft front bearing cup
81. Idler shaft front bearing
82. Transfer case housing
83. Stud
84. Drain plug
85. Oil level plug
86. Declutch shift fork
87. Set screw
88. Cover to housing stud
89. Cover to housing bolt
90. Idler shaft Lo gear
91. Idler shaft
92. Idler shaft gear spacer
93. Idler shaft Hi gear
94. Cover to housing gasket
95. Transfer case cover
96. Lock washer
97. Nut
98. Idler shaft rear bearing
99. Idler shaft rear bearing cup
100. Cap screw
101. Shim
102. Idler shaft rear bearing cap
103. Cap screw
104. Lock washer
105. Bearing retainer
106. Lock washer
107. Nut
108. Woodruff key
109. Cotter key
110. Nut
111. Oil seal
112. Front axle declutch outer bearing
113. Nut
114. Lock washer
115. Declutch shift shaft
116. Oil seal
117. Stud
118. Declutch housing
119. Detent spring
120. Detent cap screw
121. Detent cap screw washer
122. Detent ball
123. Filler plug
124. Front axle drive shaft
125. Declutch sliding clutch
126. Fr. axle drive shaft driving clutch
127. Axle drive shaft front bearing cup
128. Axle drive shaft front bearing
129. Axle drive shaft bushing
130. Axle drive shaft
131. Driven gear
132. Shim
133. Drive shaft rear bearing cage
134. Oil seal
135. Nut
136. Declutch outer bearing cup
137. Declutch bearing cage
138. Bearing spacer
139. Declutch inner bearing cup
140. Declutch inner bearing
141. Gasket
142. Nut
143. Lock washer
144. Gasket
145. Set screw
146. Axle drive shaft rear bearing
147. Axle drive shaft rear bearing cup
148. Lock washer
149. Nut
150. Cotter key



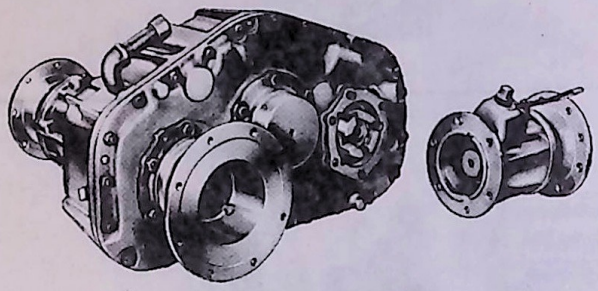
# GENERAL MAINTENANCE

## REMOVAL AND DISASSEMBLY

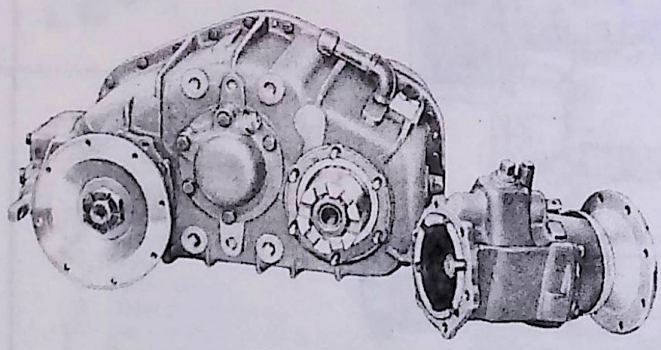
A. After removing the unit from the vehicle, thoroughly clean the exterior portion before disassembling.

B. Remove the drain plug at the bottom and drain the lubricant.

### REMOVE THE POWER TAKE-OFF AND FRONT AXLE DECLUTCH



A. Remove the stud nuts and lock washers that hold the power take-off unit to the cover of the transfer case. Pull off the unit and wire the shims together for reassembly.

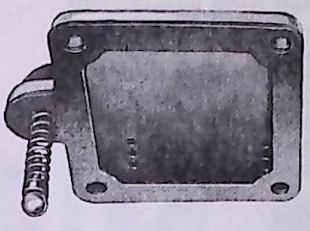


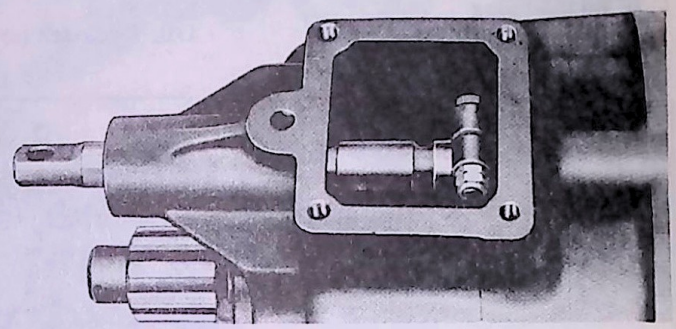
B. Remove the front axle declutch and the gasket.

C. Remove the cotter pin and nuts from front input shaft and rear output shaft. Remove the yokes or companion flanges.

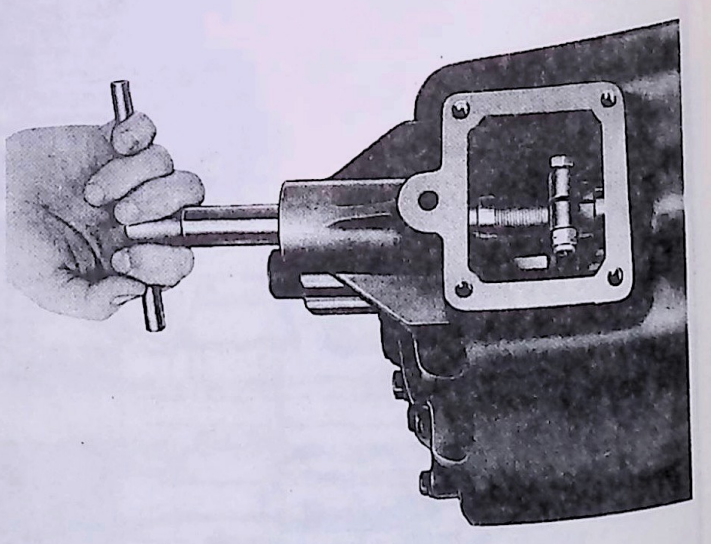
### DISASSEMBLE THE CASE ASSEMBLY

**Remove range shift shaft and shift fork**



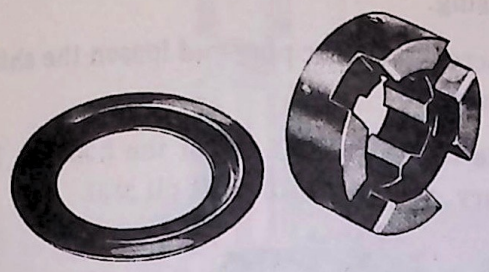


A. Remove the cap screws and lock washers holding the shift cover. Lift off the cover, breather plate and gaskets; the cover is spring loaded and should be held down during removal to prevent injury. Take out the detent ball, plunger and detent spring.

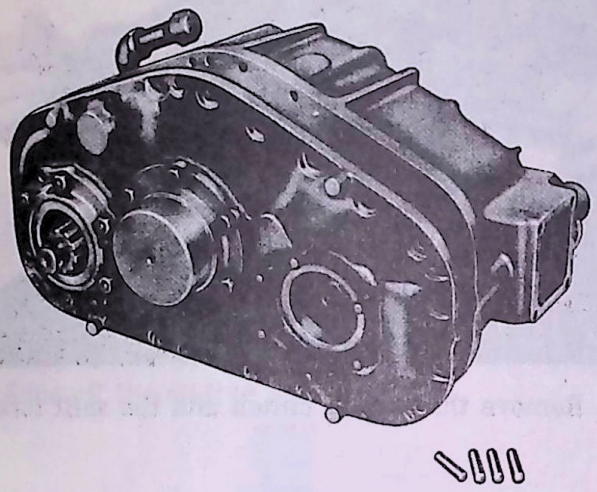


B. Loosen shift fork nut. Screw the shift shaft out of the shift fork and slide it out of the case. Lift out the shift fork.

## REMOVE THE CASE COVER



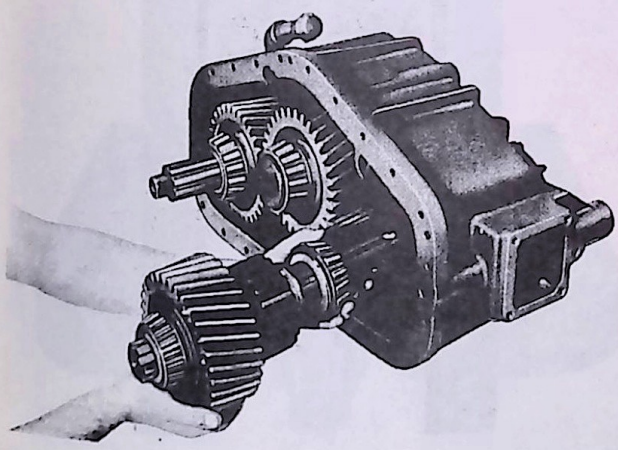
A. Loosen the set screw in the main shaft driving clutch and remove the clutch. Remove the oil dam.



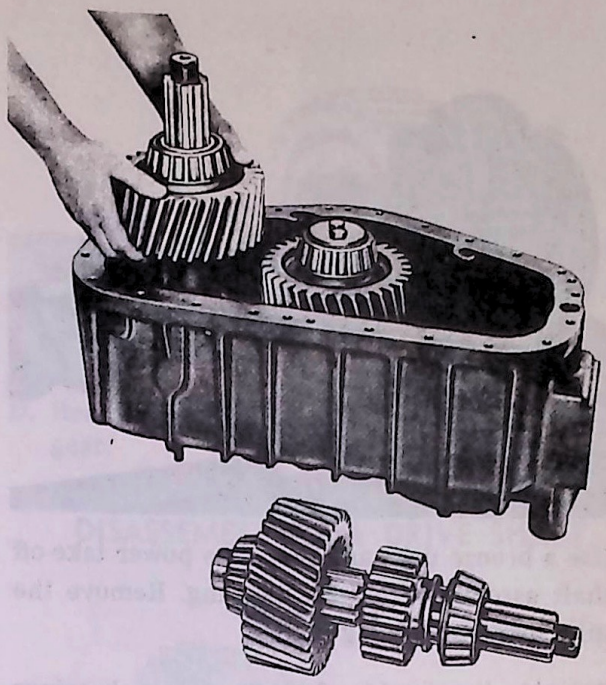
B. Drive the tapered dowel pins from the cover and remove the cover to case bolts, nuts and lock washers.

C. Remove the cover and take off the gasket.

## REMOVE THE SHAFT ASSEMBLIES



A. Lift the main shaft assembly from the case. This assembly should be removed before the idler shaft or axle drive shaft are taken out.



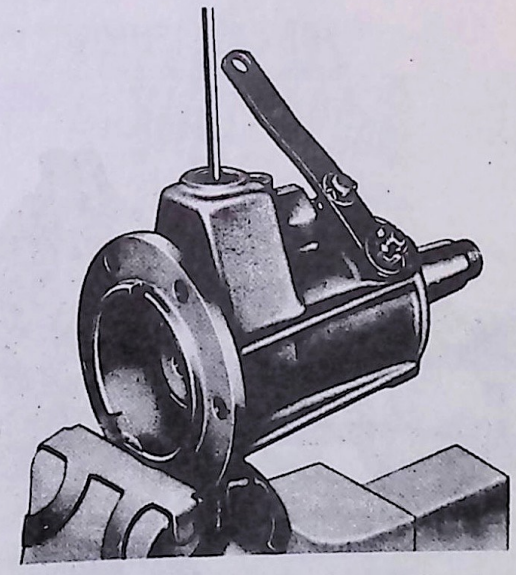
B. Lift out the axle drive shaft assembly and then remove the idler assembly.

## DISASSEMBLE POWER TAKE-OFF ASSEMBLY

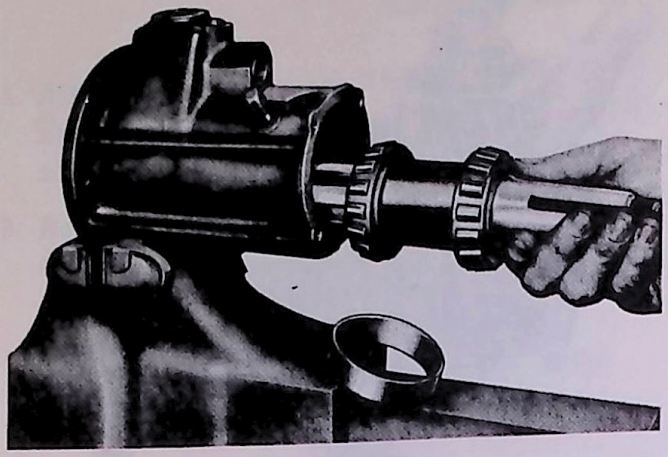
A. Remove the cotter pin and nut from the end of the power take-off shaft. Remove the yoke and key.

B. Remove the oil filler plug from the cage. Then remove the detent cap screw, lock washer, spring and detent ball.

C. Remove the oil seal cage assembly, shims and gasket.



D. Through the oil filler plug hole, loosen the shift fork set screw. Disconnect the shift lever and pull the shift shaft from the housing.

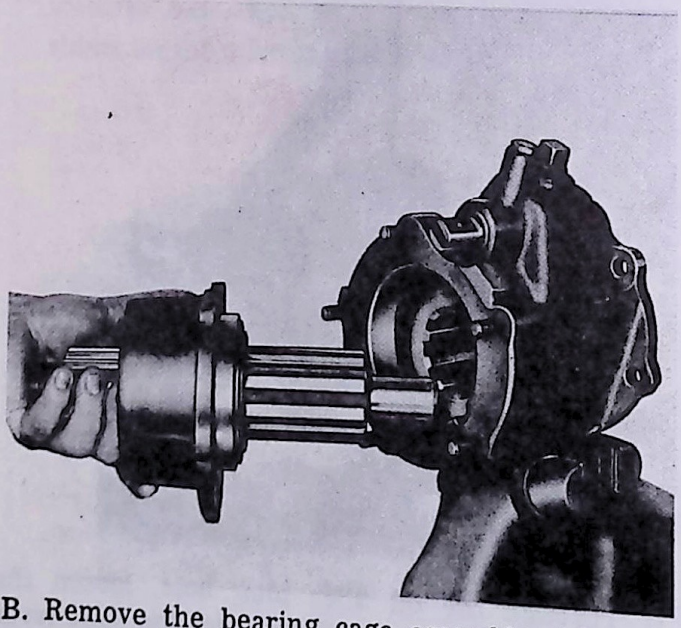


E. Use a bronze drift and drive the power take-off shaft assembly from the housing. Remove the shift fork and sliding clutch.

Do not disassemble further unless bearings need replacing. Remove and replace the bearing cups if necessary.

## DISASSEMBLE FRONT AXLE DECLUTCH UNIT

A. Take out the cotter key and remove the nut from the declutch shaft. Remove the yoke with a suitable puller.

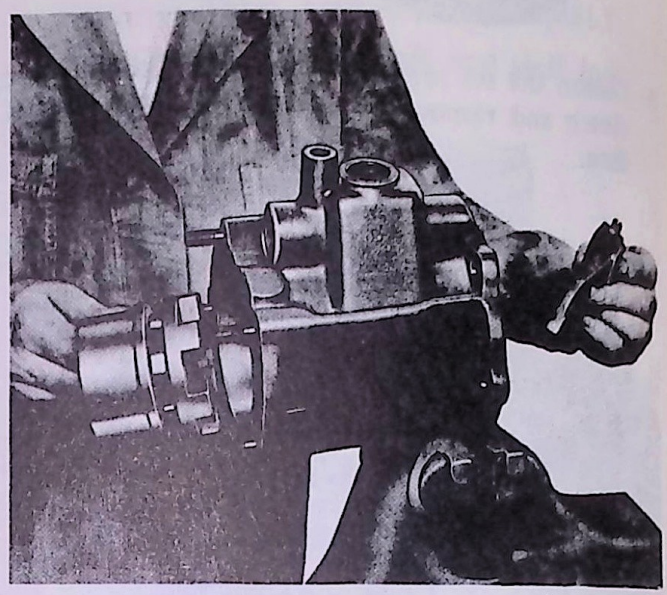


B. Remove the bearing cage assembly from the declutch housing.

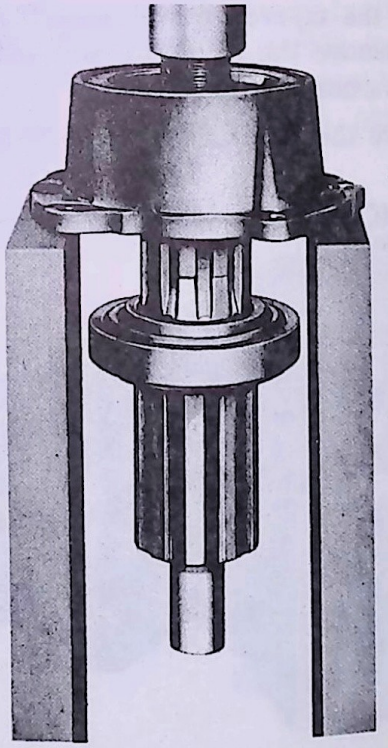
C. Remove the detent cap screw, star washer, detent spring and detent ball from the declutch housing.

D. Unscrew the filler plug and loosen the shift fork set screw.

E. Slide the shift shaft out of the housing. If necessary, remove shift shaft oil seal.

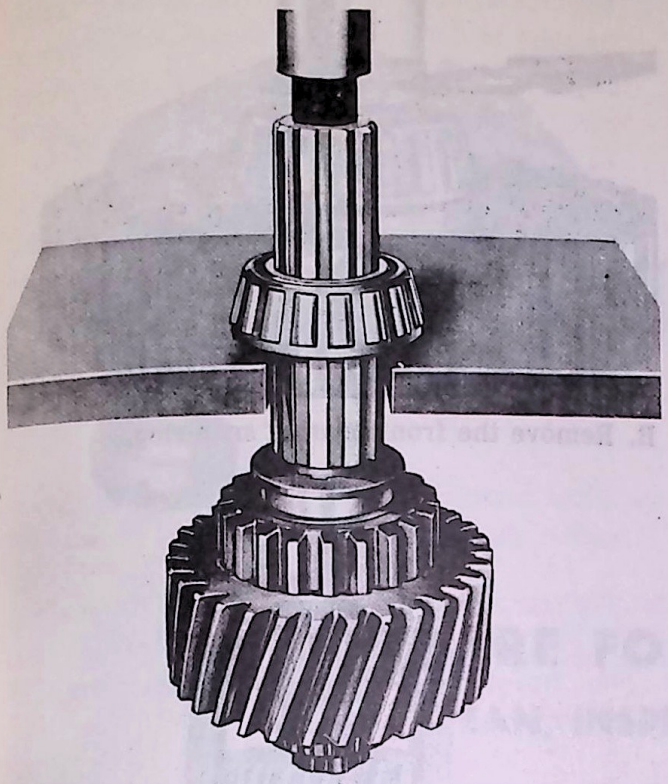


F. Remove the sliding clutch and the shift fork.

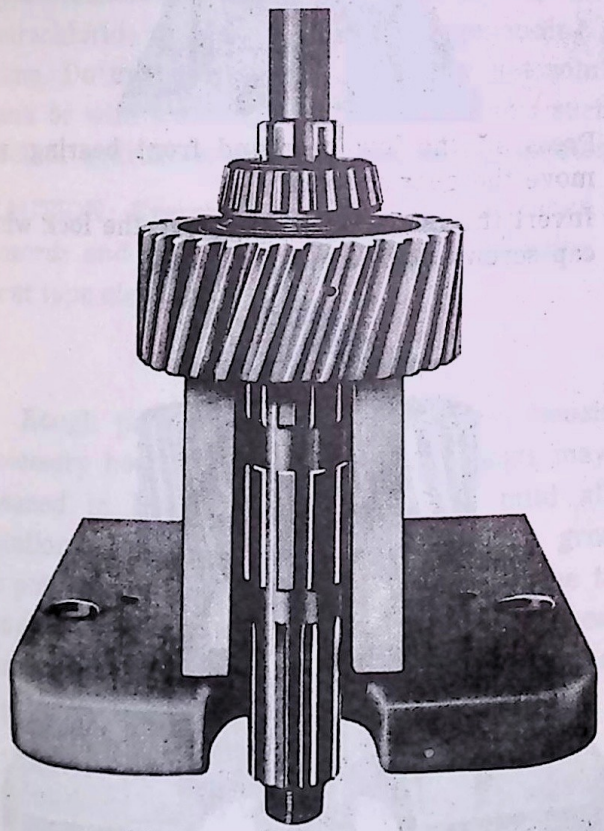


G. If necessary, press apart the bearing cage assembly. Remove the outer bearing cup and oil seal.

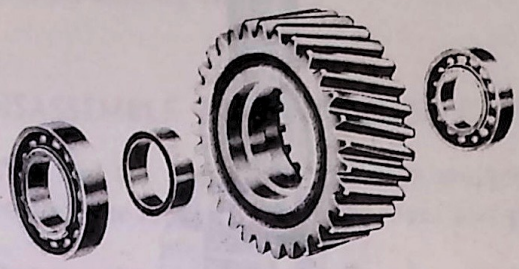
## DISASSEMBLE MAIN SHAFT



A. Press front bearing from shaft.
B. Slide off the sliding gear.

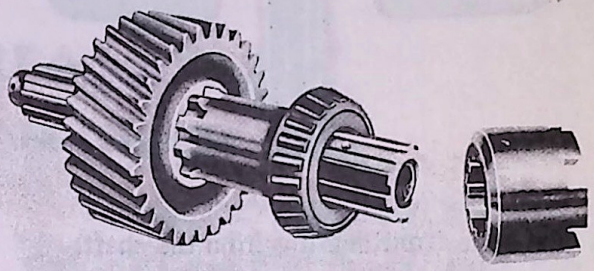


C. Press the main shaft drive gear assembly, bearing spacer and rear tapered bearing from the shaft.

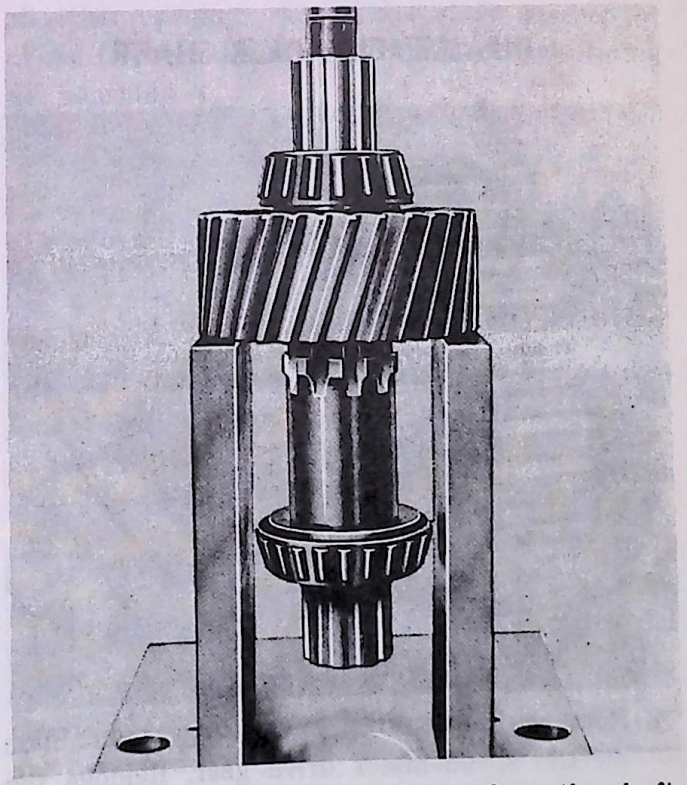


D. Remove ball bearings and spacer from the drive gear.

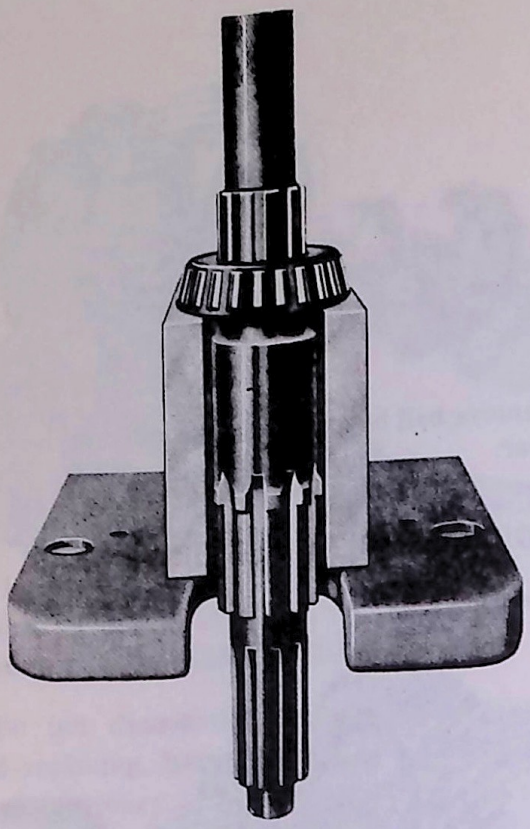
## DISASSEMBLE AXLE DRIVE SHAFT



A. Remove the set screw and pull off the driving clutch.



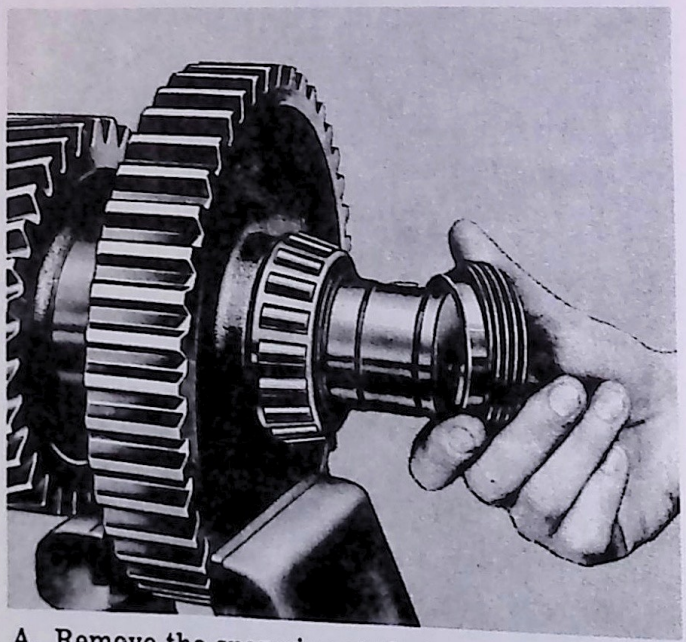
B. Press the rear bearing and gear from the shaft.



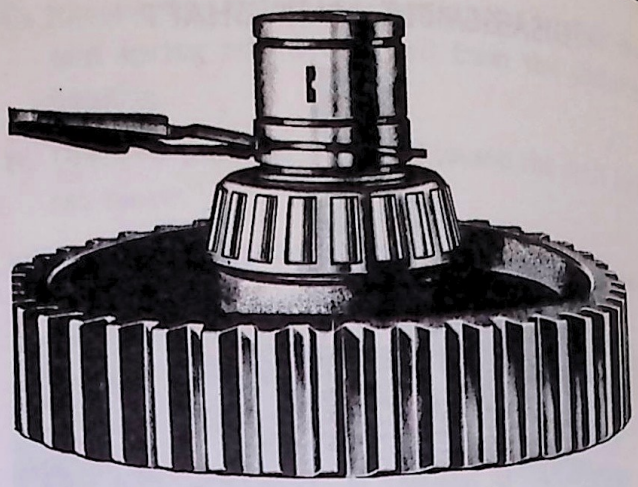
C. Press the front bearing from the shaft.

D. Remove the pilot bushing from the shaft with a suitable puller if necessary.

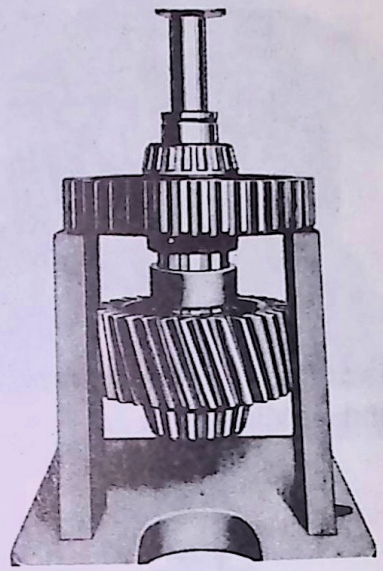
## DISASSEMBLE IDLER SHAFT



A. Remove the snap ring at the low gear end. Slide off the speedometer drive gear. Remove the Woodruff key.

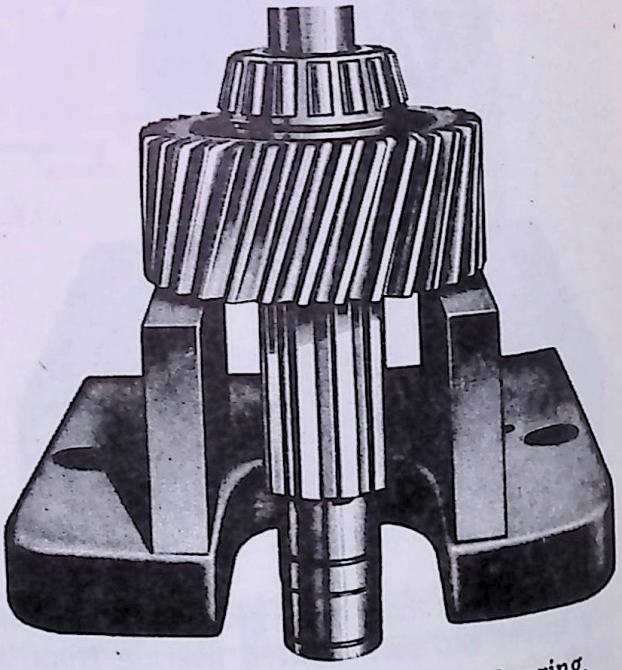


B. Remove the front bearing snap ring.



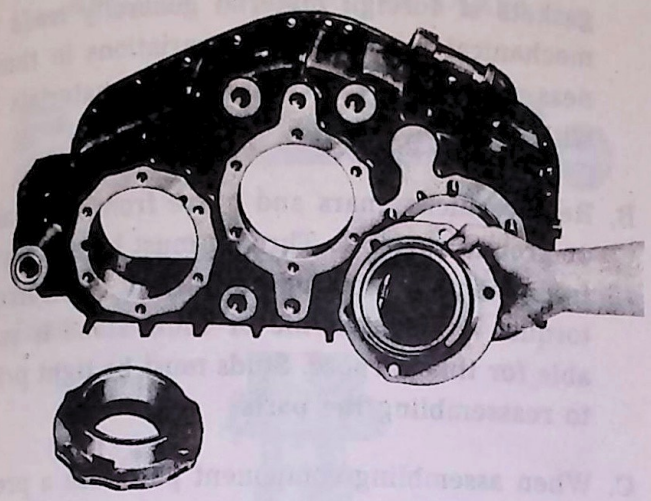
C. Press off the low gear and front bearing; remove the gear spacer.

D. Invert the assembly and remove the lock wire, cap screws and bearing retainer.



E. Press off the high gear and rear bearing.

## DISASSEMBLE TRANSFER CASE HOUSING



Remove the main shaft front seal cage and idler shaft front bearing cap.

## DISASSEMBLE TRANSFER CASE COVER

A. Take out the cap screws and lock washers and remove the idler shaft bearing cover and gasket.

B. Remove the nuts and lock washers from the axle drive shaft rear bearing cage. Pull the cage, using puller screws. Wire the shims together for reassembly.

Press the main shaft rear bearing cup from the cover, if necessary.

# PREPARE FOR REASSEMBLY

## CLEAN, INSPECT AND REPAIR

Clean parts having ground and polished surfaces, such as gears, bearings and shafts, with solvent type cleaners such as emulsion cleaners, carbon tetrachloride or petroleum solvents excluding gasoline. Do not clean these parts in a hot solution tank or with water and alkaline solutions such as sodium hydroxide, orthosilicates or phosphates.

CAUTION: *Exercise care to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.*

### ROUGH PARTS

Rough parts such as transfer case housings, accessory housings and some brake parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts are not ground or polished. The parts should remain in the tank long enough to be thoroughly cleaned and heated through. This will aid the evaporation of the cleaning solution and the rinse water.

CAUTION: *Exercise care to avoid skin rashes and inhalation of vapors when using alkali cleaners.*

Parts cleaned in solution tanks or with alkali cleaners should be thoroughly rinsed after cleaning to remove all traces of alkali.

### COMPLETE ASSEMBLIES

Completely assembled transfer cases may be steam cleaned, on the outside only, to facilitate initial removal and disassembly, providing all openings are closed. Breathers, vented shift units, and all other openings should be tightly covered or closed to prevent the possibility of water entering the assembly.

### DRYING

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless absorbent paper towels or wiping rags free of abrasive material such as lapping compound, metal filings or contaminated oil. Bearings should never be dried by spinning with compressed air.

### CORROSION PREVENTION

Parts that have been cleaned, dried, inspected and are to be immediately reassembled should be coated with light oil to prevent corrosion. If these parts are to be stored for any length of time, they should be treated with a good RUST PREVENTIVE and wrapped in special paper or other material designed to prevent corrosion.

## INSPECT

It is impossible to overstress the importance of careful and thorough inspection of drive unit parts prior to reassembly. Thorough visual inspection for indications of wear or stress, and the replacement of such parts as are necessary will eliminate costly and avoidable drive unit failure.

A. Inspect all bearings, cups and cones, including those not removed from parts of the drive unit, and replace if rollers or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Avoid the use of drifts and hammers. They may easily mutilate or distort component parts.

B. Inspect spur gears and clutches for wear or damage. Gears which are scored, pitted, ridged or worn should be replaced.

## REPAIR

A. Replace all worn or damaged parts. Hex nuts with rounded corners, all lock washers, oil seals and gaskets should be replaced at the time of overhaul.

Use only genuine Timken replacement parts for satisfactory service. For example, using gaskets of foreign material generally leads to mechanical trouble due to variations in thickness and the inability of certain materials to withstand compression, oil, etc.

B. Remove nicks, mars and burrs from machined or ground surfaces. Threads must be clean and free to obtain accurate adjustment and correct torque. A fine mill file or India stone is suitable for this purpose. Studs must be tight prior to reassembling the parts.

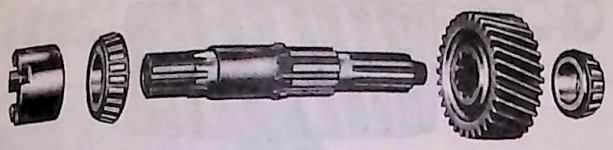
C. When assembling component parts use a press where possible.

D. Tighten all the nuts to the correct torque. (See torque limits following service instructions.) Use soft iron locking wire to prevent possibility of wire breakage.

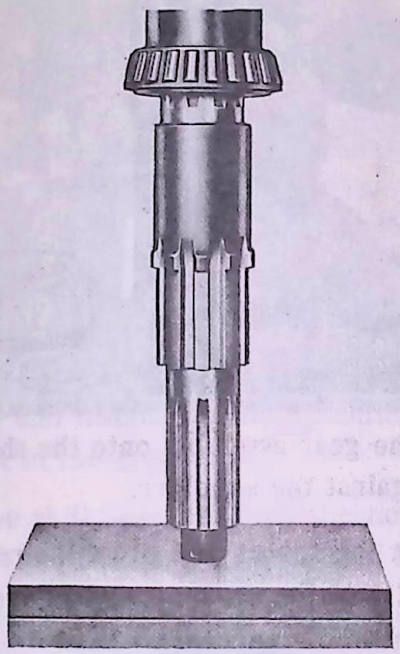
E. The burrs, caused by lock washers, at the spot face of stud holes of cages and covers should be removed to assure easy reassembly of these parts.

# REASSEMBLE

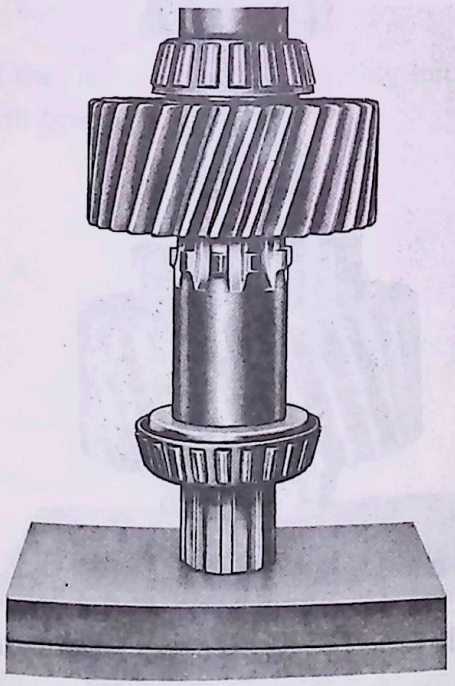
## REBUILD AXLE DRIVE SHAFT



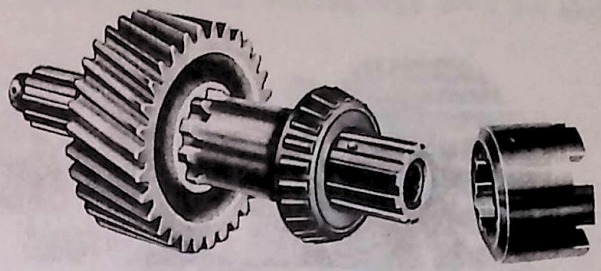
A. Press the pilot bushing into the bore at the front of the shaft.



B. Press the front bearing into place.

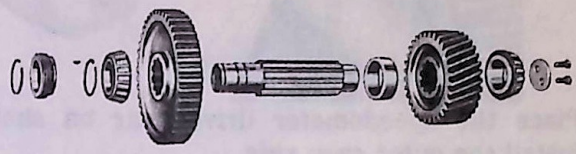


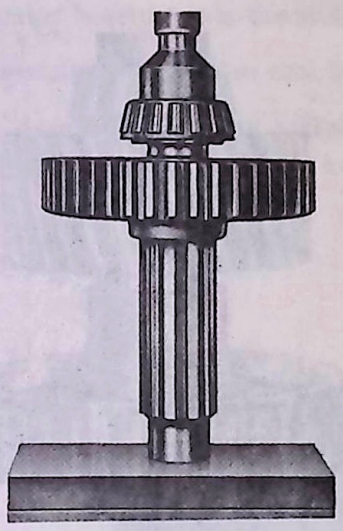
C. Press the driven gear and the rear bearing into place using a suitable sleeve that bears against the inner race.



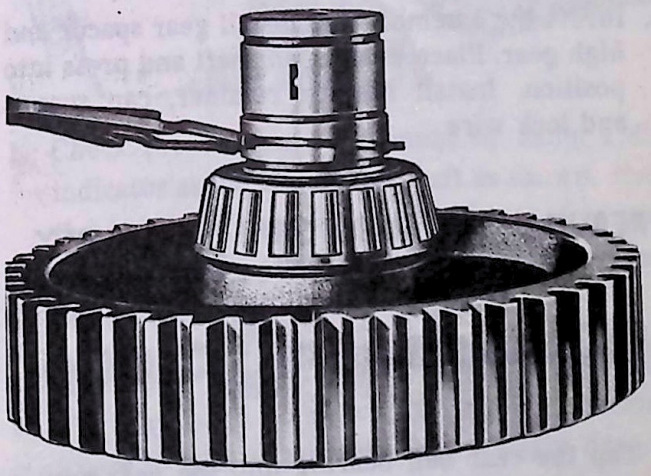
D. Slide the driving clutch onto the shaft and install the set screw. The screw must enter the recess in the shaft.

## REBUILD THE IDLER SHAFT ASSEMBLY



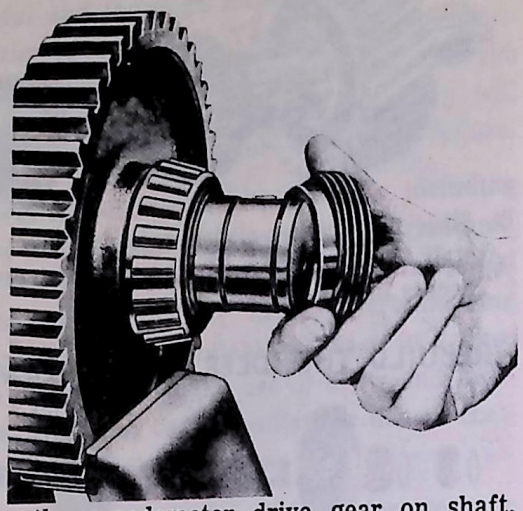


A. Press low speed gear and tapered bearing into place on idler shaft. *Use a sleeve that will clear the bearing journal.*

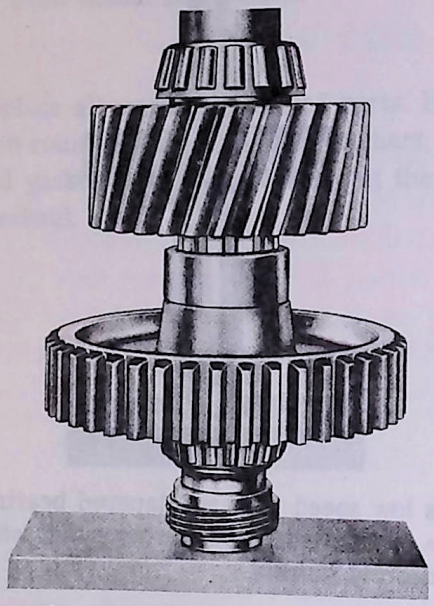


B. Install the bearing snap ring.

C. Install the Woodruff key in the keyway.

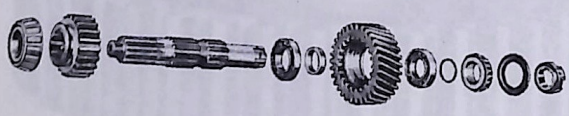


D. Place the speedometer drive gear on shaft. Install the outer snap ring.



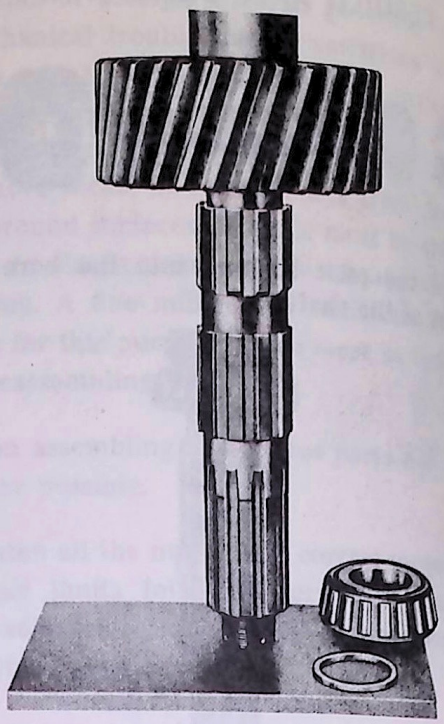
E. Invert the assembly and install gear spacer and high gear. Place bearing on shaft and press into position. Install bearing retainer, cap screws and lock wire.

## REBUILD THE MAIN SHAFT ASSEMBLY



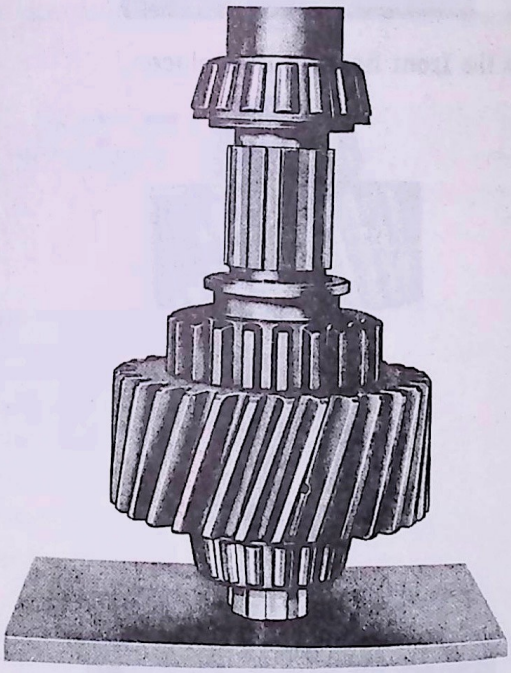
A. Tap the rear ball bearing into the gear with a suitable sleeve against outer race.

B. Position the bearing spacer in gear and tap front ball bearing into the gear.



C. Press the gear assembly onto the shaft until it seats against the shoulder.

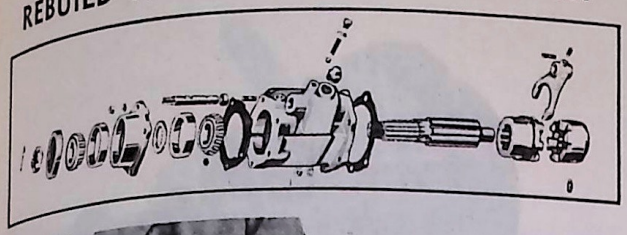
D. Position the spacer and press the rear tapered bearing onto the shaft.

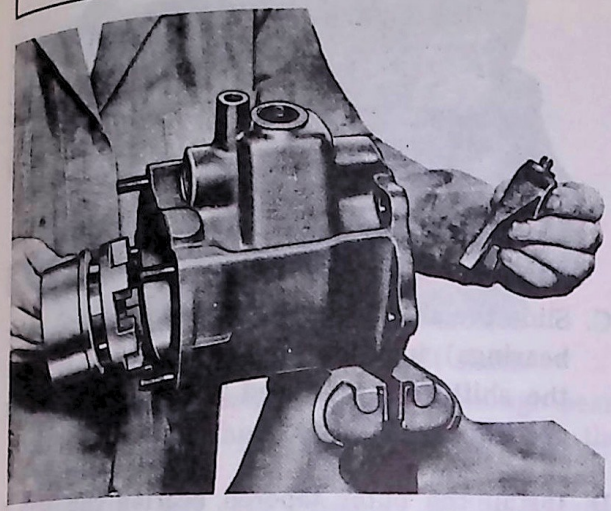


E. Install the sliding gear and front bearing.

*Do not install the oil dam and power take-off driving clutch until after the transfer case cover has been attached.*

## REBUILD THE FRONT AXLE DECLUTCH



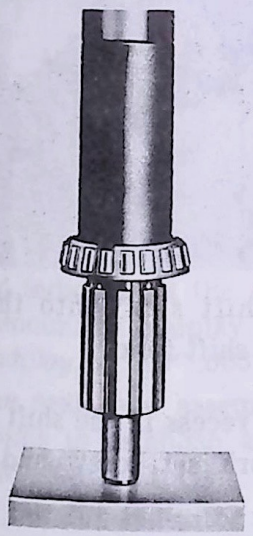


A. Hold the shift fork in place inside the declutch housing and install the sliding clutch. Position the fork in the groove.

B. Slide the shift shaft through the housing bore and into the shift fork. Install and tighten the set screw. Install the oil filler plug.

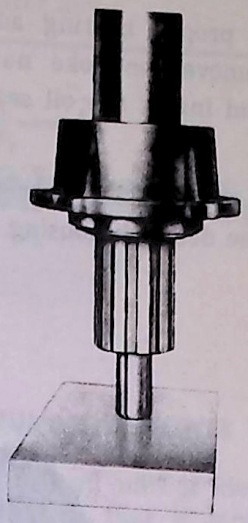
C. Install the detent ball, spring, lock washer and lock screw in the housing. Tighten the lock screw.

D. Install the inner and outer bearing cups in the declutch bearing cage.



E. Press the inner bearing on the shaft with a suitable sleeve.

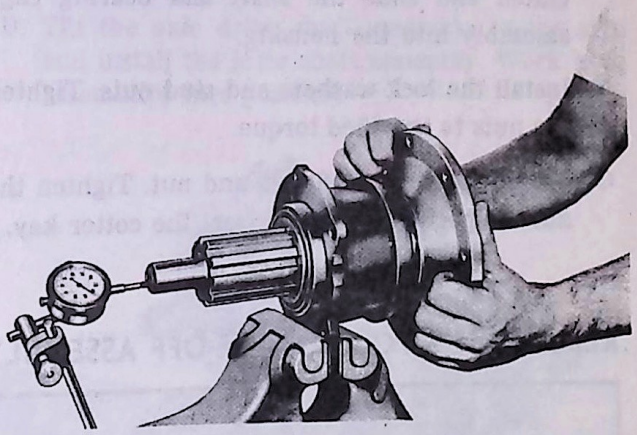
F. Position the bearing spacer on the shaft and then position the bearing cage over the shaft.



G. Press the outer bearing onto the shaft.

*Do not install the oil seal at this time.*

H. Mount the cage in a vise and install the yoke or flange and the nut. Tighten the nut to specified torque.



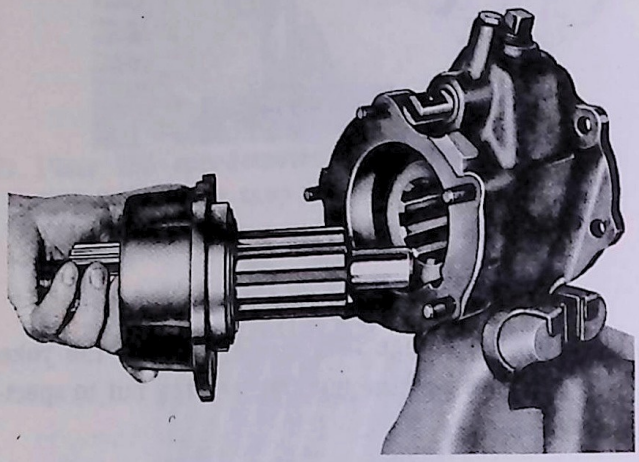
I. Check the bearing adjustment by using a dial indicator at the end of the shaft as shown. *Since the specified bearing adjustment is zero endplay and zero preload, there should be no reading on the indicator.*

J. If there is no endplay in the assembly, turn the shaft by hand to check for bearing preload. There should be no more than a slight drag on the shaft.

If there is endplay in the assembly, use a thinner spacer between the bearings; if there is preload, use a thicker spacer.

K. Once the proper bearing adjustment is obtained, remove the yoke nut and yoke (or flange) and install the oil seal in the bearing cage.

L. Position a new gasket over the studs at the front of the declutch housing.

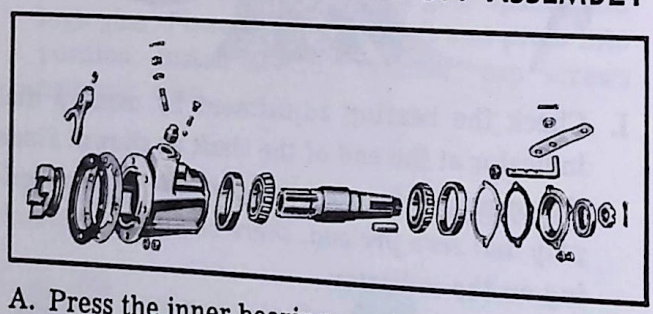


M. Line up the declutch shaft with the sliding clutch and slide the shaft and bearing cage assembly into the housing.

N. Install the lock washers and stud nuts. Tighten the nuts to specified torque.

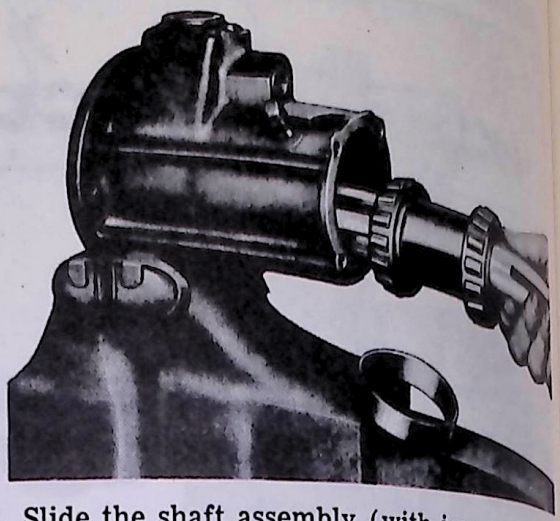
O. Install the yoke or flange and nut. Tighten the nut to specified torque. Insert the cotter key.

## REBUILD THE POWER TAKE-OFF ASSEMBLY



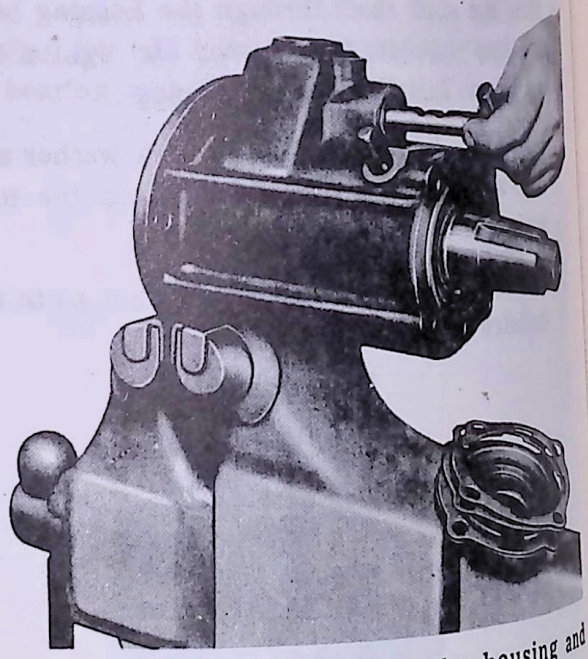
A. Press the inner bearing cup into the power take-off housing with a suitable sleeve.

B. Hold the shift fork and sliding clutch in place inside the housing.



C. Slide the shaft assembly (with inner and outer bearings) into the housing. Check to see that the shift fork is seated in the sliding clutch groove.

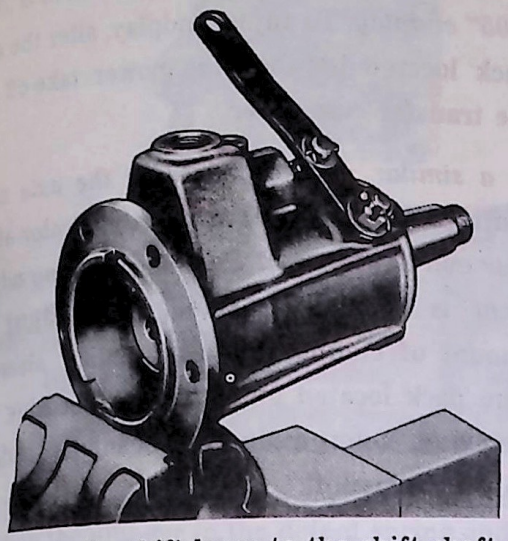
D. Install the outer tapered bearing cup with a suitable sleeve.



E. Slide the shift shaft into the housing and through the shift fork.

F. Line up the recess in the shift shaft and install the shift fork set screw and tighten with a screwdriver.

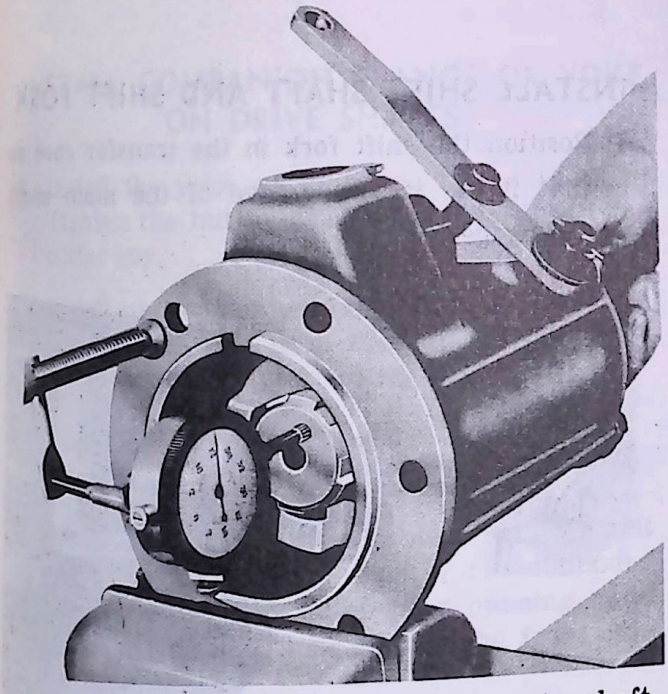
G. Install the detent ball, spring, lock washers and cap screw. Tighten the cap screw.



H. Attach the shift lever to the shift shaft.

I. Position a new gasket and install enough bearing adjustment shims to set up endplay in the assembly.

J. Attach the seal cage assembly to the housing and tighten the cap screws.

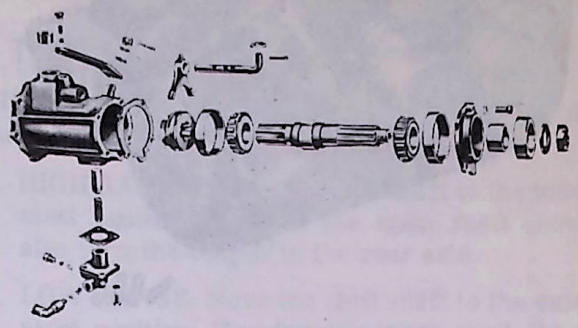


K. Using a dial indicator at the end of the shaft, check the amount of endplay in the assembly. *Specified endplay is .003″-.005″.*

L. Take off the seal cage assembly and remove sufficient shims to establish a bearing adjustment of .003″-.005″ endplay.

*Example:* If the dial indicator reading is .009″, it will be necessary to remove .005″ shims to arrive at an adjustment of .004″, which is within specified limits.

M. Reinstall the seal cage assembly and tighten the cap screws to specified torque. Install the yoke or flange and nut. Tighten the nut and install the cotter key.



**OPTIONAL PUMP TYPE POWER TAKE-OFF**

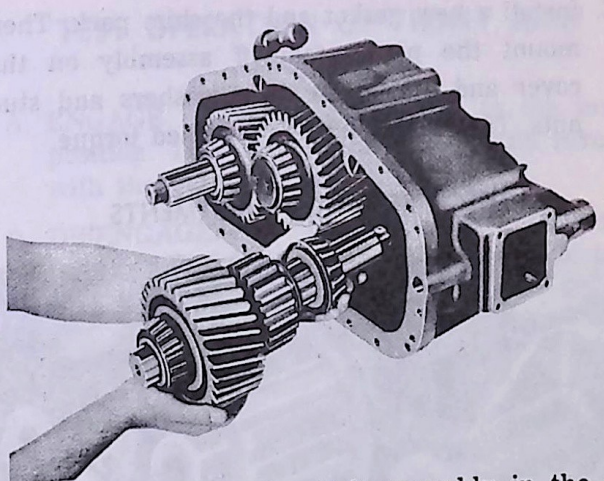
This power take-off unit is identical to the standard unit except that it incorporates an auxiliary spring loaded plunger type oil pump.

The pump, which is actuated by an eccentric located on the power take-off shaft, insures proper lubrication during "stationary" operation of the power take-off.

## INSTALL THE SHAFT ASSEMBLIES

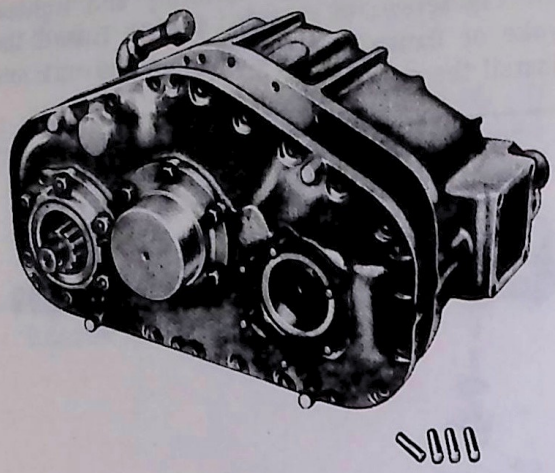
A. Position the axle drive shaft assembly in the transfer case.

B. Tilt the axle drive shaft assembly to the side and install the idler shaft assembly. Work both assemblies into position.



C. Position the main shaft assembly in the case and work it into place.

D. Reassemble the transfer case cover if it was disassembled. Use the original shim packs under the idler shaft and axle drive shaft rear bearing caps.



E. Install a new case to cover gasket and position the cover over the case. Install the bolts, lock washers and nuts; do not tighten the nuts at this time.

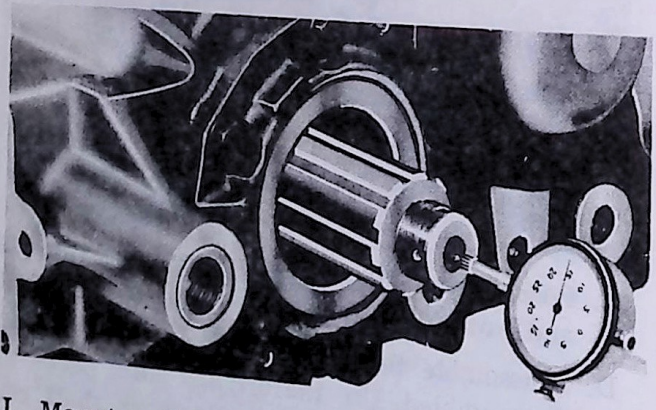
Line up the dowel holes and install the dowels; then tighten the nuts to specified torque.

F. Position a new gasket and the front axle declutch unit on the transfer case. Install the lock washers and stud nuts; tighten the nuts to specified torque.

G. Position the oil dam and power take-off driving clutch on the main shaft and install the set screw to hold.

H. Install a new gasket and the shim pack. Then mount the power take-off assembly on the cover and install the lock washers and stud nuts. Tighten the nuts to specified torque.

## CHECK BEARING ADJUSTMENTS



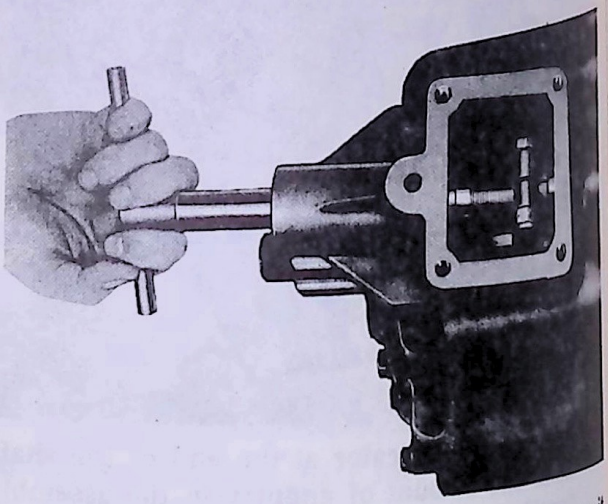
I. Mount a dial indicator at the forward end of the main shaft and measure the endplay in the assembly. *Specified bearing adjustment is .003"-.005" endplay.* To adjust endplay, alter the shim pack located between the power take-off and the transfer case cover.

J. *In a similar manner, measure the axle drive shaft assembly endplay with an indicator at the rear end of the shaft. Specified bearing adjustment is .003"-.005" endplay.* To adjust the amount of endplay in the assembly, alter the shim pack located under the rear bearing cap. Removing shims reduces the endplay, adding shims increases it.

K. Idler shaft endplay can be checked by inserting a prybar through the shift cover hole at the top of the case and working the idler shaft low gear back and forth. No more than a very slight bit of endplay should be felt.

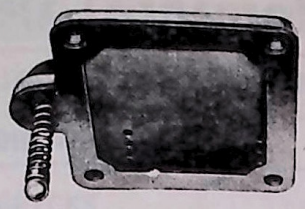
## INSTALL SHIFT SHAFT AND SHIFT FORK

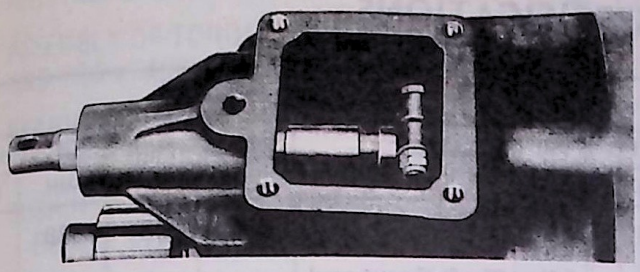
A. Position the shift fork in the transfer case so that it fits in the groove of the main shaft sliding gear.



B. Slide the shift shaft into the case and screw it into the shift fork. *The shift fork should be centered in the groove of the sliding gear (check spacing of fork in both Hi and Lo positions).*

C. Tighten the bolt in the shift fork.





D. Install the detent ball in the transfer case. Position the plunger in the detent spring and install in case.

E. Place the shift cover, breather plate and gaskets on the case. Hold the cover down to compress the detent spring and install the lock washers and cap screws.

## INSTALL COMPANION FLANGE OR YOKE ON DRIVE SHAFTS

A. Install the yoke or flange on the main shaft. Tighten the nut to specified torque. Insert the cotter key.

B. Install the companion flange at the rear of the axle drive shaft. Install the nut and tighten to specified torque. Insert cotter key.

## LUBRICATION

Install the drain plug and tighten. Turn the unit upright and pour one-half pint of recommended gear lubricant through filler plug opening. Add some oil to the power take-off and the front axle declutch. Do not fill the unit to specified level until it is installed under the vehicle.

*Gear lubricant specifications are listed in Rockwell-Standard Field Maintenance Manual No. 1, "Lubrication."*

## TEST THE OPERATION OF THE UNIT

SHIFT TEST — power take-off and front axle declutch disengaged:

A. HIGH RANGE. Move the shift shaft to the innermost position; turning the main shaft should also turn the output to the rear axle.

B. LOW RANGE. Move the shift shaft to the outermost position. Turning the main shaft should also turn the output to the rear axle.

C. NEUTRAL. Move the shift shaft to the intermediate position between Lo and Hi. Turning the main shaft should not turn the output to the rear axle.

## TEST OPERATION OF POWER TAKE-OFF UNIT

A. ENGAGE. Move the shift shaft to the inner position. The power take-off shaft should revolve with the main shaft.

B. DISENGAGE. Move the shift shaft to the outer position. The power take-off shaft should not revolve with the main shaft.

## TEST OPERATION OF FRONT AXLE DECLUTCH

A. ENGAGE. Move the shift shaft to the inner position. The front drive shaft should revolve with the output to the rear axle.

B. DISENGAGE. Move the shift shaft to the outer position. The front drive shaft should not turn with the output to the rear axle.

# TORQUE SPECIFICATIONS

| BOLT AND STUD NUTS | | | | |
|---|---|---|---|---|
| LOCATION ON UNIT | DIA. INCH | NO. THDS. | TORQUE—LB. FT. MIN. | TORQUE—LB. FT. MAX. |
| Case and Cover | 3/8" | 16 | 38 | 42 |
| Main Shaft and Rear Bearing Cap | 7/16" | 14 | 60 | 66 |
| P.T.O. to Cover | 7/16" | 14 | 60 | 66 |
| Drive Shaft Rear Bearing Cap | 7/16" | 14 | 60 | 66 |
| Declutch to Case | 7/16" | 14 | 60 | 66 |
| Declutch Housing Cap | 3/8" | 16 | 38 | 42 |
| Main Shaft Yoke Nut | 1¼" | 18 | 300 | 400 |
| Declutch Shaft Yoke Nut | 1¼" | 18 | 300 | 400 |
| Drive Shaft Yoke Nut | 1¼" | 18 | 300 | 400 |
| P.T.O. Shaft Yoke Nut | 1" | 20 | 300 | 400 |

| CAP SCREWS | | | |
|---|---|---|---|
| LOCATION ON UNIT | DIA. INCH | NO. THDS. | TORQUE MIN. |
| Shift Cover | 3/8" | 16 | 38 |
| Idler Shaft Front and Rear Bearing Caps | 7/16" | 14 | 60 |
| Main Shaft Front Bearing Cap | 7/16" | 14 | 60 |
| Idler Shaft Bearing Retainer | 7/16" | 14 | 60 |
| P.T.O. Housing Cap | 5/16" | 18 | 22 |

Torques given apply to parts coated with machine oil; for dry (or "as received") parts, increase 10%; for parts coated with multi-purpose gear oil, decrease torques 10%. Nuts on studs to u torque as for driving the stud.

# PART 17-30 Transmatic Drive Transmission

**Applies To C-750, C-CT-800, C-900, C-7000-8000, L-LT-LTS-LN-LNT-800-8000 and L-LT-LTS-900 Only**

Applies To C-750, C-CT-800, C-900, C-7000-8000, L-LT-LTS-LN-LNT-800-8000 and L-LT-LTS-900 Only



## 1 DESCRIPTION

The Transmatic Drive is a hydraulically operated automatic transmission with six forward gear ratios and one reverse gear ratio. Figure 1 shows the location of the converter, gear train and most of the internal parts used in the transmission.

The transmission consists basically of a torque converter, a planetary gear train, and a hydraulic control system for shifting gears (Fig. 2).

An oil cooler, located in the vehicle radiator and connected to the transmission by tubing, cools the transmission fluid. A warning light located on the instrument panel beneath the speedometer, indicates overheated fluid.

Two SAE regular-duty power takeoff openings are located at the sides of the transmission housing

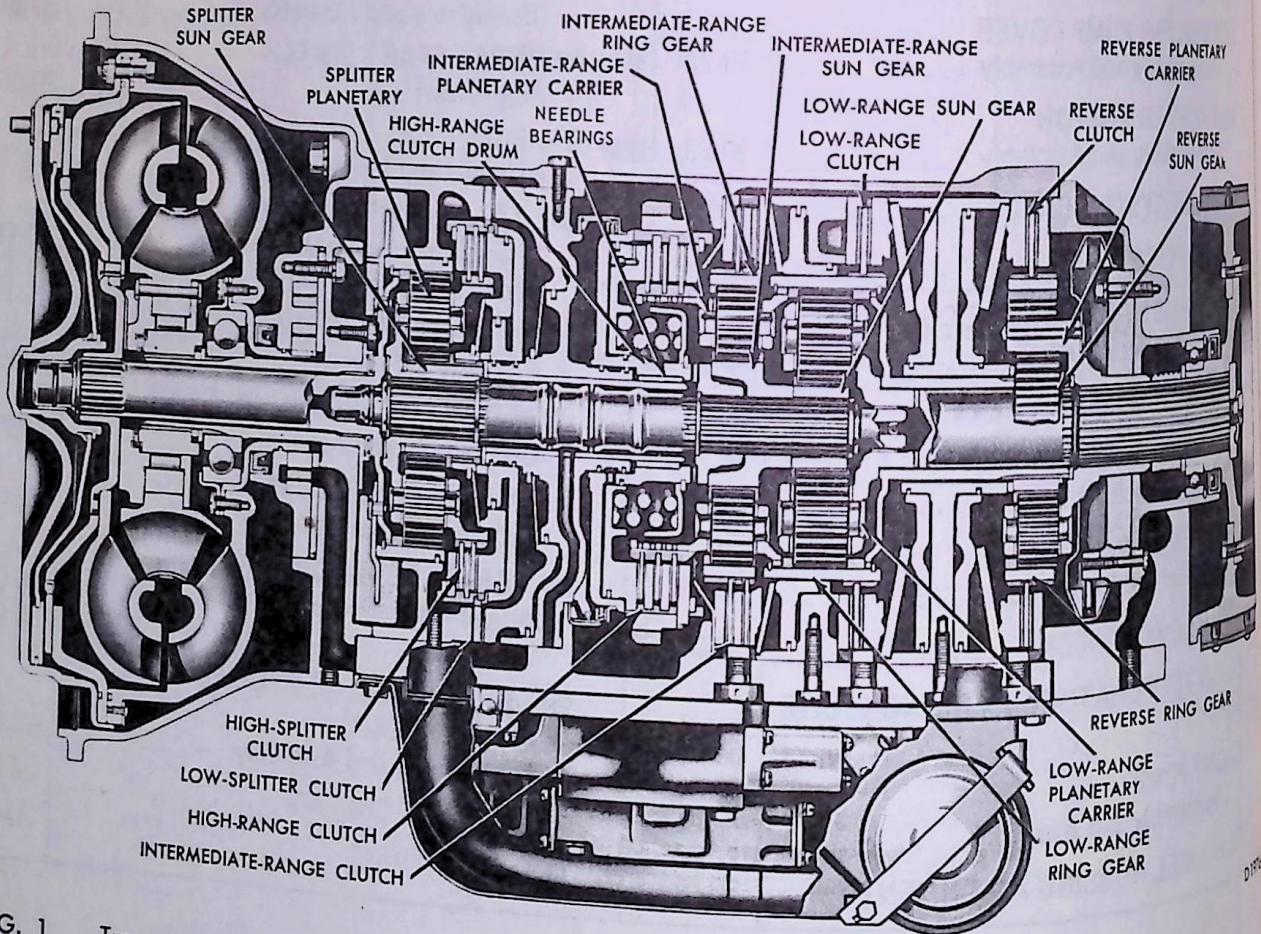



FIG. 1 Transmission Gear Train—Typical

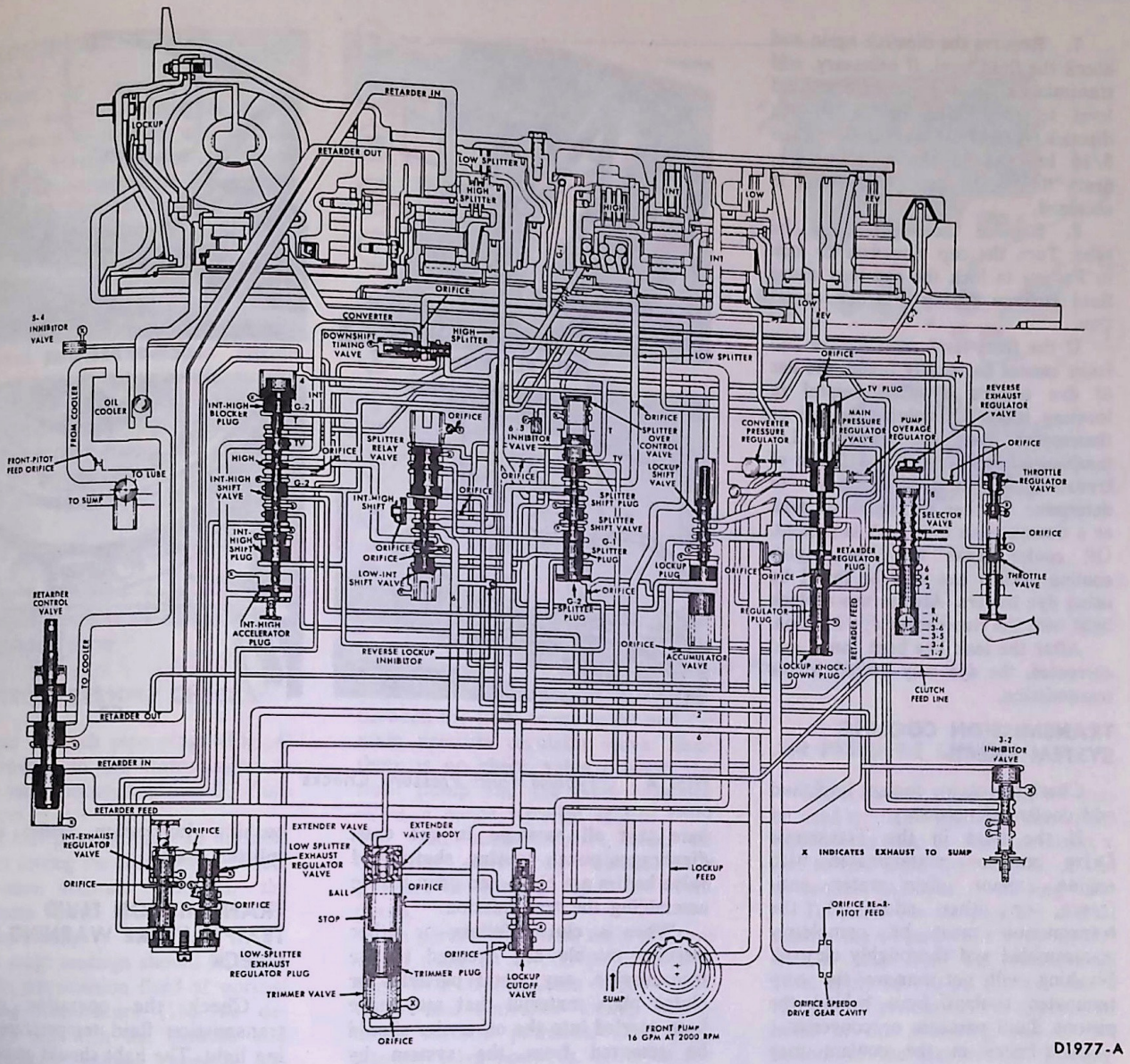



FIG. 2 Hydraulic Control System—Typical

## 2 TESTING

When diagnosing transmission problems, refer to the Truck Diagnosis Manual for the detailed information on the items that could be causing the problem.

### TRANSMISSION FLUID LEVEL CHECK

1. With the vehicle standing, level, apply the parking brake, and place the range selector lever in N. Start the engine.

2. If the transmission fluid is cold, operate the transmission until normal operating temperature (150 degrees to 200 degrees F) are reached. **Do not operate the hydraulic retarder to warm the transmission fluid. Operating the hydraulic retarder when the vehicle is not moving will aerate the fluid, making an accurate fluid level check impossible.**

3. When the engine and transmission have reached their normal operating temperatures, move the selector lever through all the range positions to make sure that warm fluid is distributed throughout the transmission.

4. With the hand throttle, adjust the engine to idle speed with the selector lever at N.

5. Clean around the transmission fluid dipstick cap before removing the dipstick.

6. Twist the dipstick counterclockwise to unlock the cap from the tube. Pull the dipstick out of the tube, wipe it clean, and insert it back into the tube. On a C-Series truck, the dipstick can be removed through the opening in the panel behind the seat back cushion with the cab in its normal position.

7. Remove the dipstick again and check the fluid level. If necessary, add transmission fluid to raise the fluid level to the FULL mark on the dipstick. **If the fluid level is more than 5/16 inch above the FULL mark, drain fluid until the FULL level is obtained.**

8. Replace the dipstick in the tube. Turn the cap clockwise to lock it. **Failure to lock the cap may cause fluid leakage during retarder operation.**

**If the fluid level remains low and leaks cannot be readily found, the use of dye tracers is often helpful in locating leaks. Oil-soluble aniline or fluorescent dyes, pre-mixed at 1/2 teaspoon of dye powder to 1/2 pint of transmission fluid, can help to determine whether an engine oil leak or a transmission fluid leak is present. Oil cooler leaks into the engine cooling system can also be found by using dye tracers. Always use a black light with the fluorescent dye solution.**

**After the leak has been found and corrected, the dye may be left in the transmission.**

## TRANSMISSION COOLING SYSTEM CHECK

Check the engine coolant level, and add coolant if necessary.

If the fluid in the Transmatic Drive becomes contaminated with engine coolant (plain water, anti-freeze, or other additives), the transmission must be completely disassembled and thoroughly cleaned. Flushing will not remove the contaminated coolant from behind the pistons, fluid passages or converter.

Anti-freeze in the coolant may cause the transmission parts to be coated with gum. When this condition is encountered use either Butyl-Cellosolv or Methyl-Cellosolv (paint and varnish remover can be used as a substitute) to clean the metal parts. Be

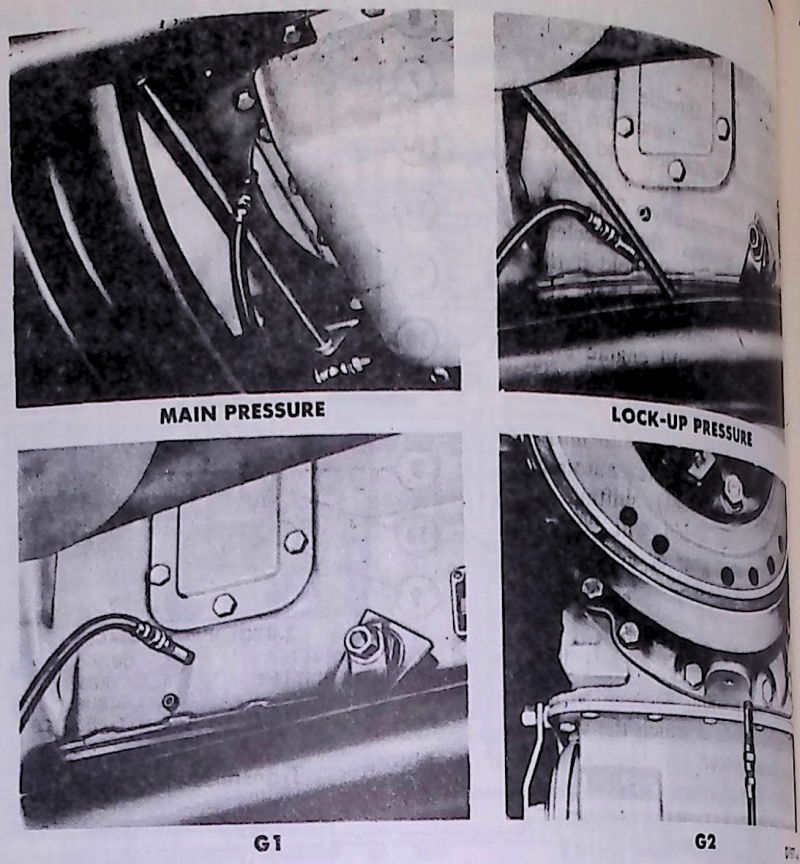



FIG. 4 Typical Fluid Pressure Checks

**sure that all passages in the case, diaphragm, piston housing, shafts, and valve bodies are clean and open before assembling the transmission.**

**When a clutch failure or other internal trouble has occured in the transmission, any metal particles or clutch plate material that may have been carried into the oil cooler should be removed from the system by flushing the cooler before the transmission is put back into service. Foreign matter in the oil cooler system could block off the front pitot feed hole, get into various gears and clutches, or block off the output bushing lubrication orifice in the splitter shaft.**

## TRANSMISSION FLUID TEMPERATURE WARNING LIGHT CHECK

Check the operation of the transmission fluid temperature warning light. The light should go on when the ignition key is turned to START and it should go out when the ignition key is turned back to ON. The warning light circuit diagram is shown in Fig. 3.

## RANGE SELECTOR LINKAGE CHECK

Move the range selector lever from 1-2 to R. Six definite detent positions (1-2, 3-4, 3-5, 3-6, N, and R) should be felt as the lever moves from front to rear.

## HYDRAULIC RETARDER LINKAGE CHECK

The hydraulic retarder valve must travel a full 1/2 inch toward the rear just before the retarder pedal hits the stop bolt. When the pedal is released the retarder valve must travel 1/2 inch forward stop.

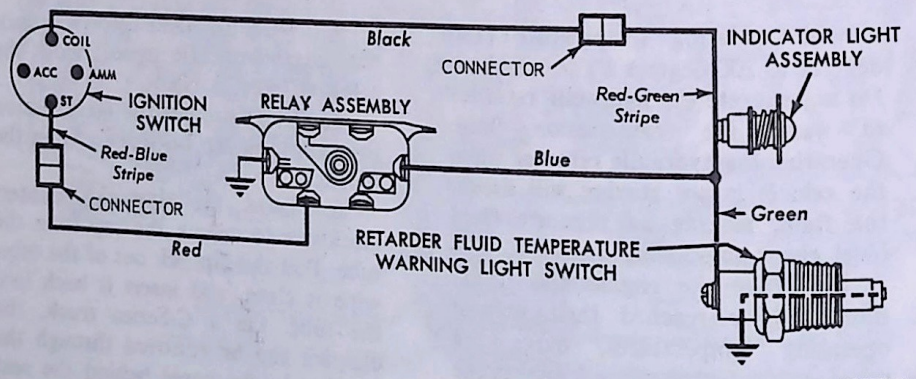



FIG. 3 Warning Light Circuit

### THROTTLE LINKAGE CHECK

When the throttle linkage is properly adjusted, maximum engine performance in starting and accelerating a heavily loaded truck is obtained automatically. The driver need only depress the accelerator pedal to the detent and hold it there. With the accelerator pedal held at the detent, the transmission will stay in the starting gear until engine crankshaft speed approaches the engine governed speed (maximum engine performance), then it will shift into the next higher gear. The automatic, fullthrottle (at detent) shifting just under governed speed will continue until the highest gear or desired road speed is reached.

### SHIFT POINTS CHECK

The Specification Section outlines the engine speeds at which the various shifts should occur.

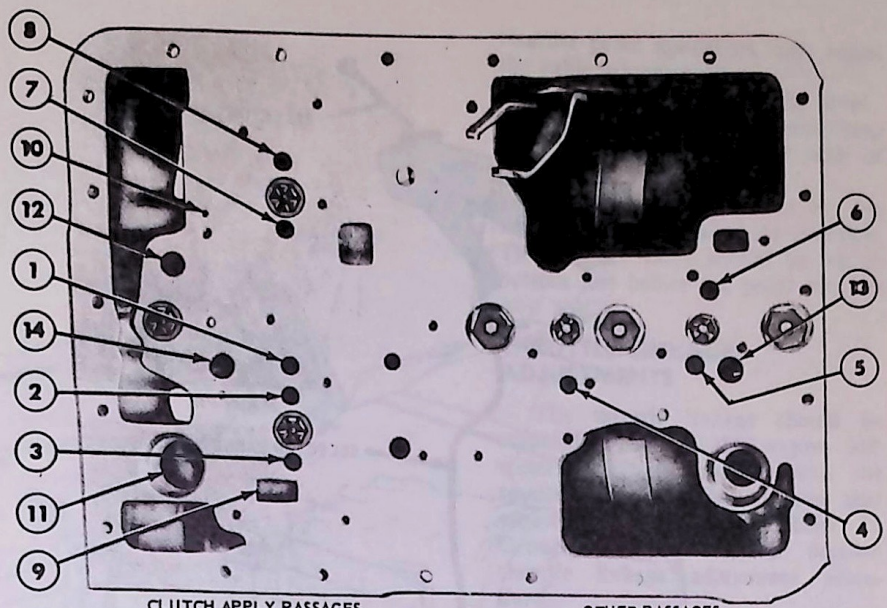
### CONTROL PRESSURE CHECKS

Four 1/8-inch pipe plugs (Fig. 4) are provided in the transmission to check main, lockup, G1, and G2 fluid pressures.

All four pressures can be checked without driving the truck on the road. To obtain accurate readings, the procedures given below must be followed exactly.

All gauge readings should be taken with the transmission fluid at normal operating temperature (160-180 degrees F) and with the throttle and range selector linkage properly adjusted. The test point for main pressure (Fig. 4) is in the passage between the front pump outlet and the main pressure regulator valve. Since there is no check valve between the front pump and the main regulator valve, a gauge installed at this point will read main pressure under all operating conditions whether the pressure is coming from the front pump.

In normal operation, main pressure varies from 65 to 300 psi. Pressures vary with transmission model, converter and converter lockup operations, throttle positions, and range selector valve positions. Refer to the Specification Section for the fluid pressure checks.




CLUTCH APPLY PASSAGES

1. LOW-SPLITTER
2. HIGH-SPLITTER
3. HIGH-RANGE
4. INTERMEDIATE-RANGE
5. LOW-RANGE
6. REVERSE
7. LOCKUP
8. FRONT PITOT

OTHER PASSAGES

9. RETARDER IN
10. RETARDER PRESSURE
11. FRONT PUMP IN
12. FRONT PUMP OUT
13. REAR PITOT
14. CONVERTER IN

D1972-B

FIG. 5 Transmission Housing Fluid Passage Holes

### AIR PRESSURE CHECKS

Moisture-free compressed air may be used to check the operation of the various clutches in the transmission, and to find leaks that may be caused by broken, damaged, or missing seals.

To make the air pressure checks, remove the oil pan, valve body, and oil transfer plate from the transmission. Then apply 85-100 psi (do not exceed 150 psi) air pressure at the appropriate holes in the mounting pad at the bottom of the transmission housing. These holes are identified and shown in Figure 5.

## 3 ADJUSTMENTS

### RANGE SELECTOR LINKAGE ADJUSTMENT

1. Place the range selector lever at R.

2. Check the distance that the control cable adjusting threads extend above the sleeve assembled to the range selector arm (Fig. 6 or 7). This distance should not exceed 1/4 inch.

3. At the transmission, disconnect the range selector cable from the transmission control lever.

4. Shift the transmission control lever to R (all the way forward and upward).

5. Push the selector lever is at R. Adjust the threaded sleeve so that the sleeve pin just fits the hole in the control lever.

6. Assemble the sleeve on the lever.

7. From the driver's seat, feel for full engagement at each detent position before the lever hits its stops.

### NEUTRAL START SWITCH ADJUSTMENT

Check the starter circuit at all selector lever positions. The circuit must be open at all positions except N (neutral). To adjust, loosen the neutral switch to bracket attaching screws. Position the switch so that the starter circuit is closed when the selector

### HYDRAULIC RETARDER LINKAGE ADJUSTMENT

#### L, LT, LTS, LN or LNT-Series Truck

1. Check the hydraulic retarder pedal stop bolt height against the dimension shown in Fig. 8. Adjust as required. 801.FIG. 6 Range Selector Linkage on L, LT, LN OR LNT-Series Trucks 2 x 30 D2199-A

2. Disconnect the hydraulic retarder control rod at the transmission end.

3. Pull the retarder lever toward the rear of the transmission until the

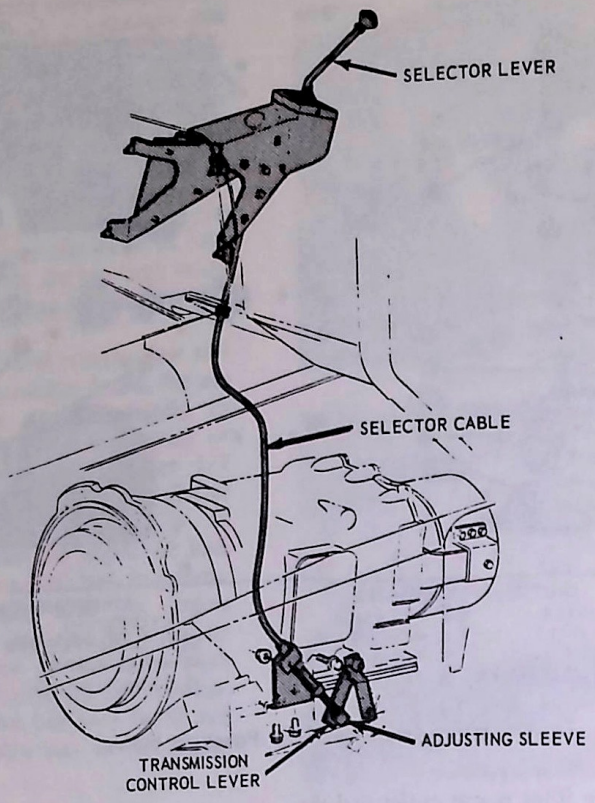



FIG. 6 Range Selector Linkage on L, LT, LM, or LNT-Series Trucks

retarder valve is heard and felt to bottom in the retarder casting.

4. Pull the control rod down until the pedal contacts its stop bolt.

5. With the retarder valve bottomed in its casting and the pedal against its stop bolt, adjust the control rod threaded sleeve.

6. Attach the control rod to the lever. Tighten the locknut.

7. Readjust the retarder pedal stop bolt height to provide 1/2 inch of travel at the retarder valve.

8. Check the adjustment by depressing the pedal against the stop bolt. Just before the pedal hits the stop bolt, the retarder valve should be felt to bottom in its body. Check for full release. Readjust if necessary.

### C-Series Truck

1. Adjust the retarder pedal stop bolt height as shown in Fig. 9.

2. Disconnect the retarder control cable at the transmission.

3. Pull the retarder lever toward the rear of the transmission until the retarder valve is heard and felt to bottom in its body.

4. Pull the retarder cable toward the transmission until the pedal is against its stop bolt.

5. With the retarder valve bottomed (all the way to the rear) and the

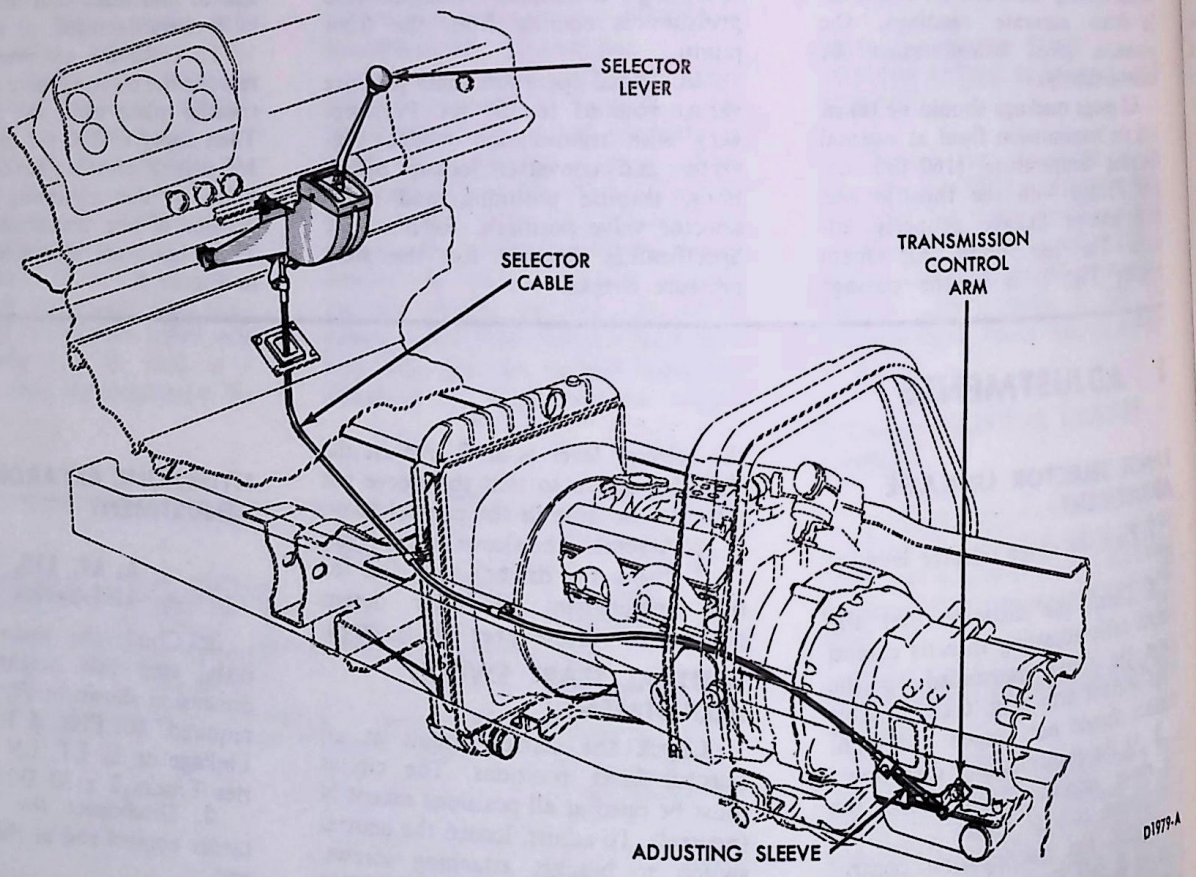



FIG. 7 Range Selector Linkage on C-Series Truck

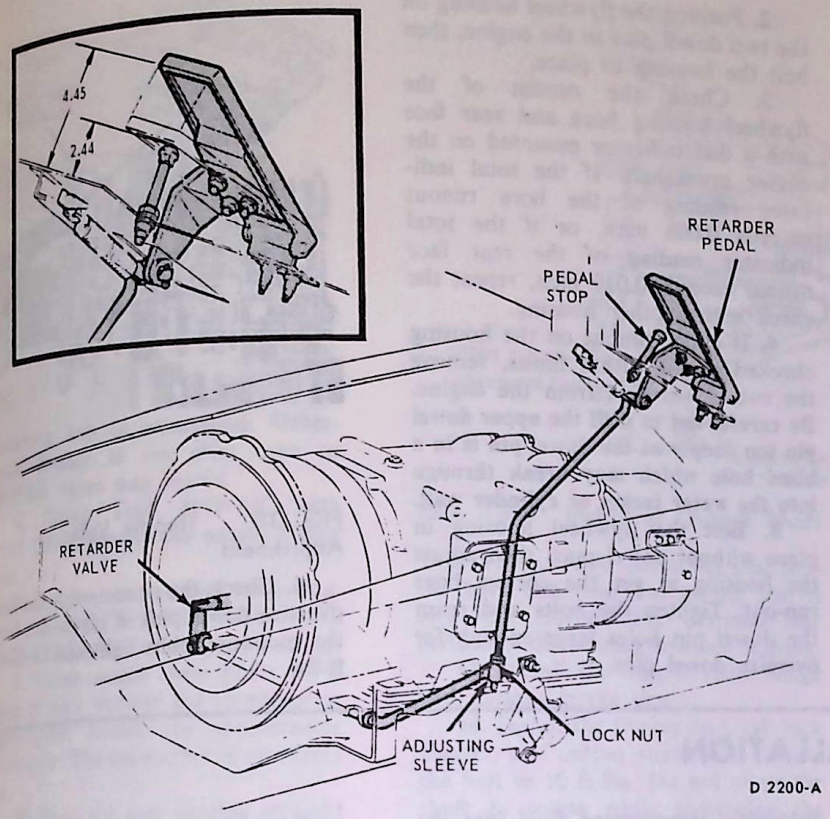



FIG. 8 Hydraulic Retarder L, LT, LN or LNT-Series Truck

retarder pedal against its stop, adjust the cable adjusting sleeve.

6. Attach the cable to the lever.

7. Readjust the retarder pedal stop bolt height to provide 1/2 inch of travel at the retarder valve.

8. Check the adjustment by dep ressing the pedal against the stop bolt. The retarder valve should be felt to bottom just before the pedal hits the stop bolt.

## THROTTLE LINKAGE ADJUSTMENTS

The throttle linkage should be adjusted whenever the engine idle speed is changed, and whenever the transmission operation indicates that adjustment is required. Refer to Groups 24 or 25 for the detailed throttle linkage adjustment procedures.

## CLOSED THROTTLE STOP ADJUSTMENT

The closed throttle stop is accurately adjusted to each individual transmission in production. New service control valve bodies are **not preset. Therefore, whenever a new service control valve body is being installed, the closed throttle stop must be adjusted as follows:**

1. On the **removed** valve body, bottom the throttle valve.

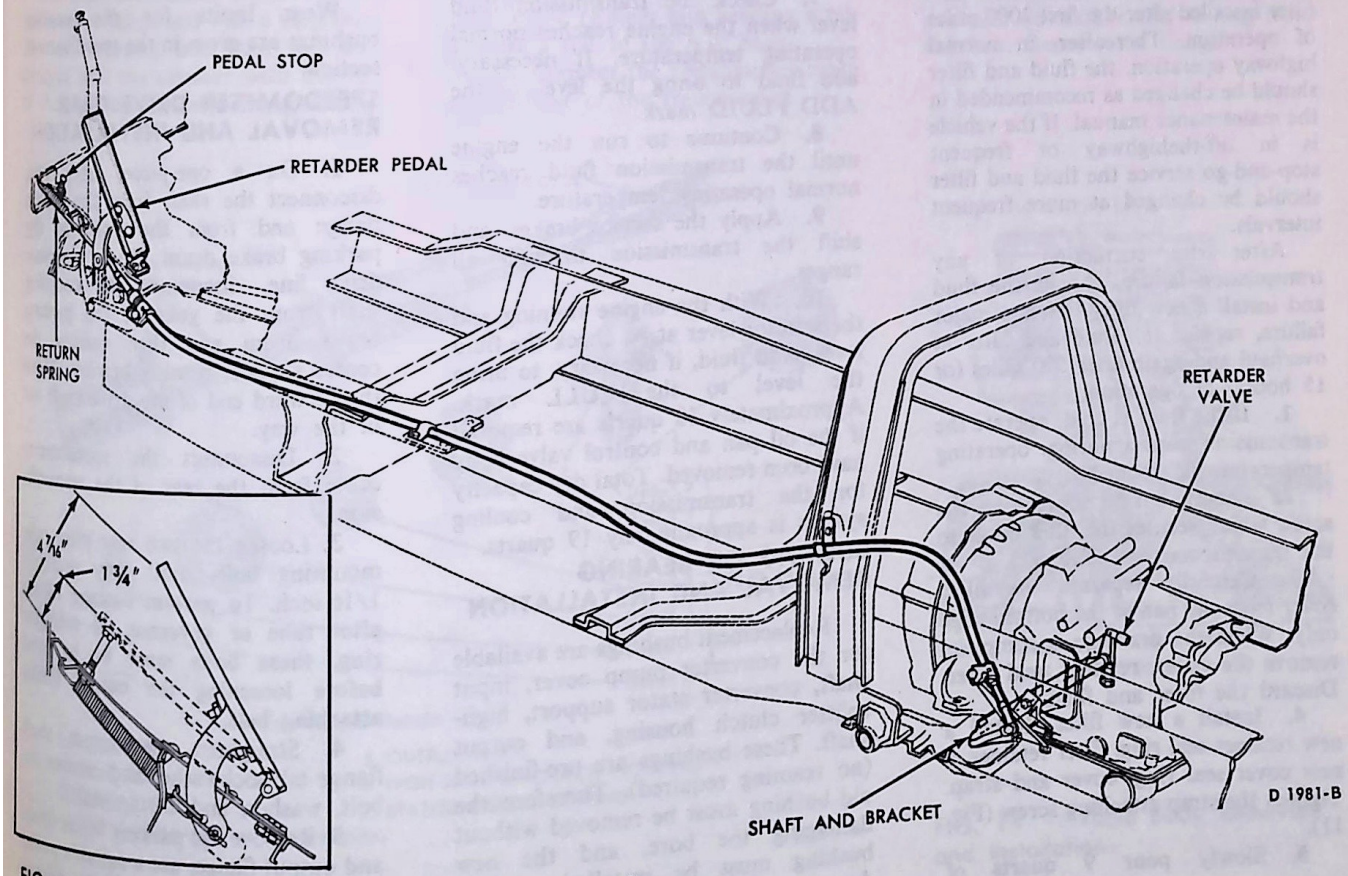



FIG. 9 Hydraulic Retarder Linkage on C-Series Truck

2. Accurately measure the distance from the end of the valve to the end of the adjusting screw (Fig. 10.

3. On the new valve body, bottom the throttle valve and adjust the screw to get the dimension measured in step 2.

4. Crimp the sleeve against the adjusting screw to hold the adjustment.

### FLYWHEEL HOUSING ALIGNMENT

Whenever the flywheel housing has been replaced, or when the original housing is to be used on another engine, check the alignment of the housing bore and rear face with the engine crankshaft.

1. Check the mating surfaces of the engine and the flywheel housing for raised metal, paint, nicks, or burrs. Remove any marks or material that would affect alignment.

2. Position the flywheel housing on the two dowel pins in the engine, then bolt the housing in place.

3. Check the runout of the flywheel housing bore and rear face with a dial indicator mounted on the engine crankshaft. If the total indicator reading of the bore runout exceeds 0.008 inch, or if the total indicator reading of the rear face runout exceeds 0.010 inch, repeat the check with another housing.

4. If either runout on the housing checked is not within limits, remove the two dowel pins from the engine. **Be careful not to drill the upper dowel pin too deeply as the dowel pin is in a blind hole which may break through into the water jacket or cylinder wall.**

5. Bolt the flywheel housing in place without dowel pins, then adjust the housing to get the correct bore run-out. Tighten the bolts and ream the dowel pin holes large enough for oversize dowel pins.

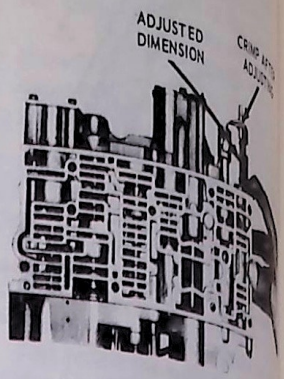



FIG. 10 Throttle Valve Adjustment

6. Check the runout with the [illegible] oversize dowel pins in place, and [illegible] the mounting bolts tightened to [illegible] ft-lbs.

## 4 REMOVAL AND INSTALLATION

### TRANSMISSION FLUID CHANGE AND FLUID FILTER REMOVAL AND INSTALLATION

On a new vehicle the transmisssion fluid should be drained and a new filter installed after the first 2000 miles of operation. Thereafter, in normal highway operation, the fluid and filter should be changed as recommended in the maintenance manual. If the vehicle is in off-thehighway or frequent stop-and-go service the fluid and filter should be changed at more frequent intervals.

After the correction of any transmission failure, change the fluid and install a new filter. After a major failure, replace the fluid and filter at overhaul and again after 500 miles (or 15 hours) of operation.

1. If the fluid is cold, operate the transmission until a normal operating temperature is reached.

2. Loosen, but do not remove, the screw which secures the filter cover to the transmission pan (Fig. 11).

3. Carefully separate the filter cover from the pan at the bottom edge only. When the drainage is complete, remove the cover, retainer, and filter. Discard the filter and fluid.

4. Install a new filter. Install a new retainer seal ring, filter retainer, a new cover seal ring, cover and strap. Tighten the strap attaching screw (Fig. 11).

5. Slowly pour 9 quarts of automatic transmission fluid into the transmission. Apply the parking brake securely then start the engine.

6. With the hand throttle, set engine speed at idle speed rpm with the selector lever at N.

7. Check the transmission fluid level when the engine reaches normal operating temperature. If necessary, add fluid to bring the level to the ADD FLUID mark.

8. Continue to run the engine until the transmission fluid reaches normal operating temperature.

9. Apply the service brakes, and shift the transmission through all ranges.

10. With the engine running and the selector lever at N, check the fluid level. Add fluid, if necessary, to bring the level to the FULL mark. Approximately 13 quarts are required if the oil pan and control valve body have been removed. Total dry capacity for the transmission and cooling system is approximately 19 quarts.

### BUSHING OR BEARING REMOVAL AND INSTALLATION

Replacement bushings are available for the converter pump cover, input shaft, converter stator support, high-splitter clutch housing, and output shaft. These bushings are pre-finished (no reaming required). Therefore the old bushing must be removed without damaging the bore, and the new bushing must be installed without damaging it.

Tools for removing and replacing the bushings are shown in Fig. 12. The bushing replacer tools should be used in a press. They are so designed that the bushings are properly located when the tool bottoms.

Wear limits for the various bushings are given in the specifications section.

### SPEEDOMETER DRIVE GEAR REMOVAL AND INSTALLATION

1. On a one-piece drive line, disconnect the shaft from the pinion flange and from the yoke at the parking brake drum. On a two-piece drive line, disconnect the coupling shaft from the yoke at the parking brake drum and then remove the center support bearing bracket. Move the forward end of the drive shaft out of the way.

2. Disconnect the speedometer cable from the rear of the transmission.

3. Loosen the two rear pitot tube mounting bolts until they protrude 1/16-inch. **To prevent damage to the pitot tube or governor oil collector ring, these bolts must be loosened before loosening the output flange attaching bolt.**

4. Straighten the output shaft flange tab lockwasher and remove the bolt, washer, and O-ring seal.

5. Remove the parking brake drum and output flange; use a suitable puller if necessary. **Do not turn the output shaft until the output shaft flange**

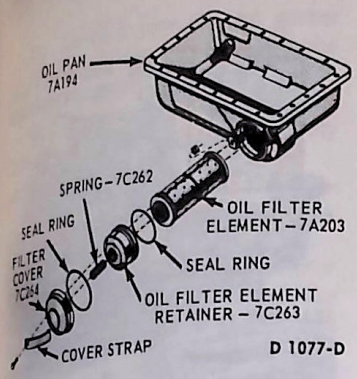



FIG. 11 Fluid Filter Assembly

attaching bolt is reinstalled. Otherwise, damage to the pitot tube or governor vanes may result.

6. Using Tool 1175-AE with T50T-100-A, remove the output flange seal.

7. Remove the internal snap ring.

8. Using Tool 1175-AE with T50T-100-A, remove the rear bearing.

9. Using needle nose pliers or a piece of wire, remove the speedometer drive gear. Install the speedometer drive gear. The counterbored end faces out.

10. Start the rear bearing straight into the bore of the retainer and, using Tool T57L-600-A, drive the bearing tight against the shoulder in the retainer.

11. Install the internal snap ring.

12. Coat the outside diameter of a new output flange seal with a very thin film of Permatex, and start the seal straight into the retainer with the lip of the seal toward the bearing. Using Tool T57L-600-A, press the seal into the bore until the rear of the seal is 3/4 inch beyond the extreme rear surface of the bearing retainer housing.

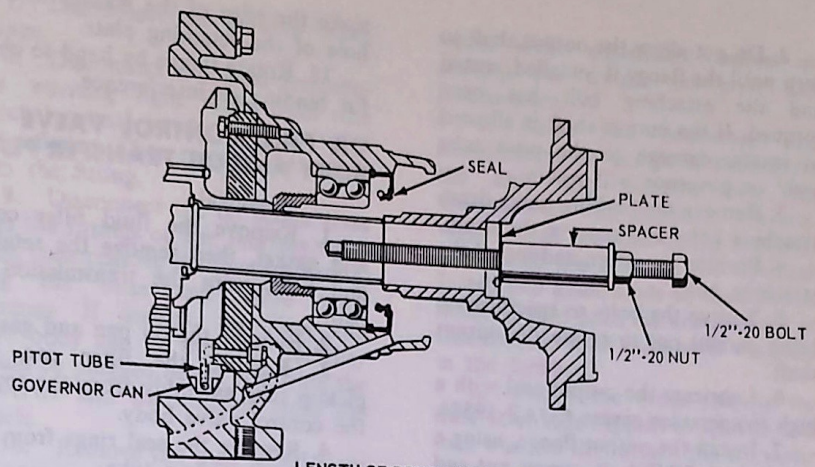



FIG. 13 Installing Output Shaft Flange

13. Install the output shaft flange and parking brake drum.

14. Install the O-ring seal, tab lock washer, and output shaft bolt. Torque the bolt to 10 ft-lbs. **Do not allow the shaft to rotate while tightening the bolt.**

15. Torque the rear pitot tube bolts to 8-10 ft-lbs.

16. Torque the output shaft flange bolt to 83-100 ft-lbs, and lock it by staking the tab lock washer into the hole in the retainer and bending a tab against a flat of the bolt head.

17. Connect the speedometer cable to the rear of the transmission.

18. Connect the drive shaft or the coupling shaft and center support bearing bracket. Torque the nuts and/or bolts to specification.

## UNIVERSAL JOINT FLANGE AND PARKING BRAKE DRUM REMOVAL AND INSTALLATION

Before removing the parking brake drum, it is necessary to remove the universal joint flange.

1. The transmission may be placed in either a vertical or horizontal position on the input drive cover or sump pan. Remove flange attaching bolt, with washer and O-ring seal. Do not remove washer and O-ring from the bolt. Remove the flange.

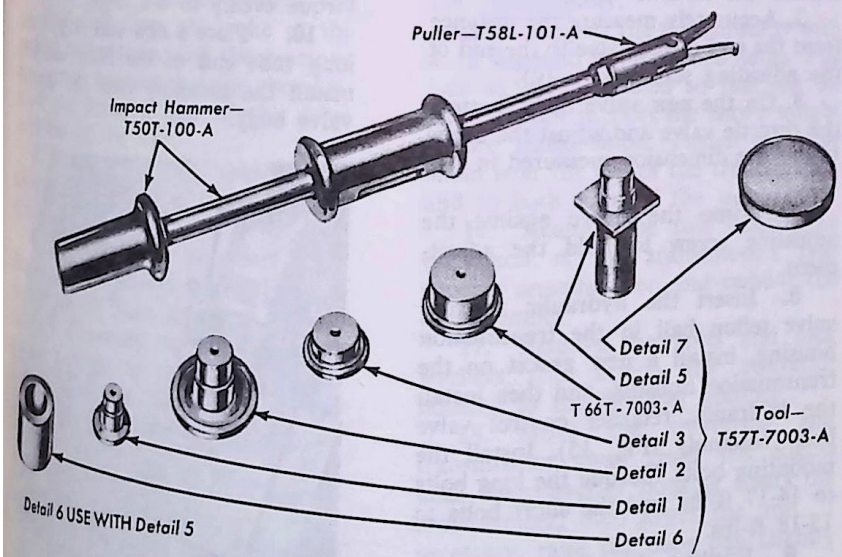



FIG. 12 Bushing Replacing Tools

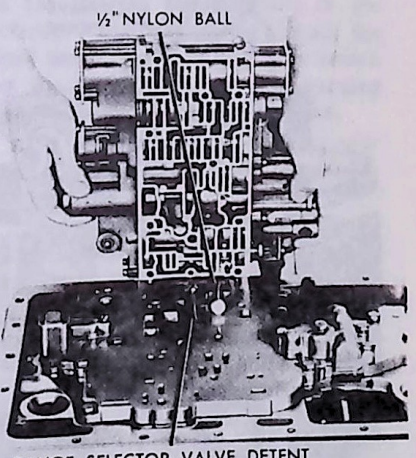



FIG. 14 Valve Body Removal and Installation

2. Do not allow the output shaft to turn until the flange is installed, seated and the attaching bolt has been torqued. If the output shaft is allowed to rotate, damage to the pitot tube and/ or governor will result.

3. Remove the parking brake drum attaching bolts and remove the drum.

4. Position the drum and install the attaching bolts.

5. Torque the bolts to specification being careful not to rotate the output shaft.

6. Lubricate the output seal with a high temperature grease COAZ-19584.

7. Install the output flange, using a 1/2-20 inch UNF bolt, spacer nut and flange retaining plate as shown in Fig. 13. The length of the bolt and spacer will vary depending on the type of flange being installed.

8. During installation, care should be exercised to avoid damage to the seal journal or the oil seal. Inspect the flange seal journal for nicks or scratches and seal for cuts and tears.

9. Seat the flange by tightening the 1/2-20 inch nut. Remove the installation bolt, nut, and spacer. Install attaching bolt including O-ring seal and washer. Locate the tab of the washer opposite the hole in the flange retaining plate.

10. Prevent the output flange from rotating then torque the bolt to 83-100 ft-lbs. Bend the tab of the washer against a flat of the bolt head and stake the edge of the washer into the hole of the retaining plate.

11. Rotate flange by hand to check for binding or interference.

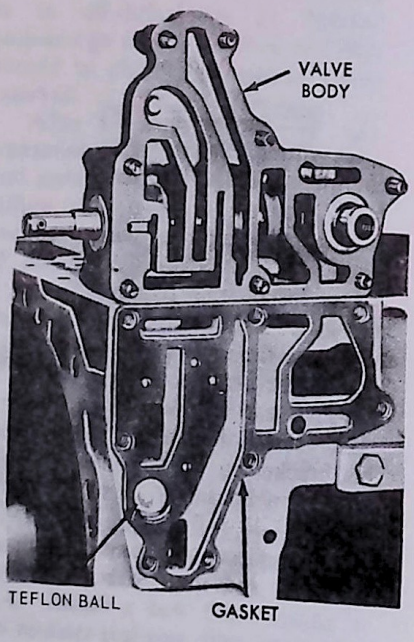



FIG. 15 Valve Retarder Removal and Installation

## OIL PAN, CONTROL VALVE BODY AND OIL TRANSFER PLATE

### Removal

1. Remove the fluid filter cover and gasket, then remove the retainer and filter from the transmission oil pan.

2. Remove the oil pan and gasket.

3. Remove the filter can and pickup tube assembly from the top of the control valve body.

4. Remove the seal rings from the front pump pickup tube.

5. Remove the eight bolts that hold the range selector valve body on the oil transfer plate, and lift the body from the plate (Fig. 14). The shift valve steel detent ball and spring and the nylon ball are free to fall out of the valve body when it is removed from the transfer plate.

6. Remove the downshift timing valve body from the transfer plate.

7. Remove the transfer plate from the transmission housing. A nylon ball in the plate is free to fall when the plate is removed.

8. Remove the hydraulic retarder valve body and gasket. Remove the nylon ball from the housing.

### Installation

If a new control valve body is being installed, the closed throttle stop must be adjusted as described in Steps 1 thru 4 below.

1. On the **removed** valve body, bottom the throttle valve.

2. Accurately measure the distance from the end of the valve to the end of the adjusting screw (Fig. 10).

3. On the **new** valve body, bottom the throttle valve and adjust the screw to get the dimension measured in step 2.

4. Crimp the sleeve against the adjusting screw to hold the adjustment.

5. Insert the hydraulic retarder valve teflon ball in the transmission housing, install a new gasket on the transmission housing, and then install the hydraulic retarder control valve body assembly (Fig. 15). Install the mounting bolts. Torque the long bolts to 14-17 ft-lbs and the short bolts to 15-18 ft-lbs.

6. Position the oil transfer plate on the housing (Fig. 16).

7. Coat the lube line check valve nylon ball with oil-soluble grease and insert it into the oil transfer plate. Install the oil transfer plate and secure it with the 10 bolts and lock washers

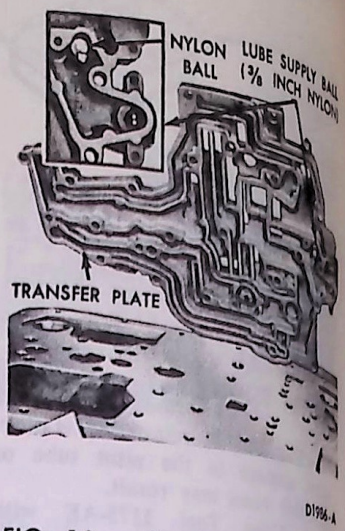



FIG. 16 Transfer Plate Installation

(Fig. 17). Install the two short bolts at the thin section of the oil transfer plate. Torque the bolts to 8-10 ft-lbs.

8. Position the downshift timing valve body on the oil transfer plate and install the three short bolts and lock washers. Torque the bolts to 8-10 ftlbs.

9. Place the detent shift valve spring in the oil transfer plate and the steel ball in the range selector valve body. Hold the ball in place with the oil-soluble grease. Position the range selector valve body on the plate, making sure that the range selector shaft enters the hole in the range selector valve and that the TV lever is against the valve. Install the attaching bolts, sleeves and lock washers and torque evenly to 4-6 ft-lbs.

10. Place a new seal ring on the long tube end of the filter can and install the assembly over the control valve body.

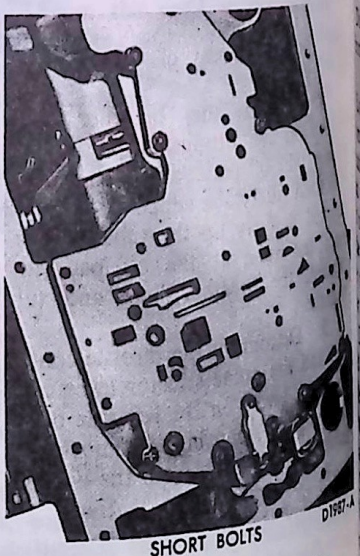



FIG. 17 Transfer Plate Bolts

11. Install a new oil pan gasket on the transmission housing with the bolt holes properly aligned.

12. Inspect the oil pan for damage. If the pan is severely damaged, replace it.

13. Install the oil pan on the housing. Install the oil pan bolts and lock washers and torque to 15-18 ft-lbs.

10. Install a new fluid filter element in the oil pan and install the fluid filter retainer, a new gasket, and the cover.

## TRANSMISSION

### Removal

The torque converter and transmission must be removed from and installed in the vehicle as a unit. The transmission cannot be removed from or installed on the converter in the vehicle.

Except where noted, these removal and installation procedures apply generally to all vehicles.

1. If necessary raise the vehicle on a hoist. Loosen the filter cover and drain the transmission. The torque converter cannot be completely drained until it has been removed from the vehicle. **Do not remove the filter cover from the oil pan as the transmission fluid may gush out too quickly.** When the fluid stops flowing tighten the filter cover nut.

2. On a one-piece drive line, disconnect the shaft from the pinion flange and from the yoke at the parking brake drum. **Do not remove the bolt that attaches the flange on the transmission output shaft.** On a two-piece drive line, disconnect the coupling shaft from the yoke at the parking brake drum, and then remove the center support bearing bracket. Move the forward end of the drive shaft out of the way.

3. Disconnect the speedometer cable from the rear of the transmission.

4. Loosen the breather hose clamp on the fittings above the left power take-off plate, and then remove the fluid filler tube support strap bolt located halfway up the tube. Disconnect the tube at the oil pan, and remove the breather hose and tube together.

5. Disconnect the throttle control rod and the range selector lever cable from the levers on the left side of the transmission housing. Remove the cable clamp bracket from the housing.

6. Disconnect the hydraulic retarder linkage from the linkage cross shaft, and remove the cross-shaft from the front of the oil pan.

7. Disconnect the parking brake linkage.

8. Disconnect the fluid temperature warning light wire from the switch terminal on the retarder valve outlet fitting. Then remove the switch from the fitting.

9. Disconnect the oil cooler lines from the fittings on the retarder valve body, then remove the forward fitting. Plug the lines and valve body openings. If desired, the lines and valve body can be drained, but they should be plugged before removing the converter and transmission from the vehicle.

10. Remove the dust shield from the bottom front side of the flywheel housing.

11. Remove the six nuts and flat washers that hold the converter pump cover on the engine flywheel. The nuts and washers can be reached through an opening in the lower right side of the flywheel housing. The flywheel must be turned to remove all nuts and washers. **The ignition system should be disconnected during this operation to prevent accidental starting of the engine.**

12. Cut the lock wires and remove the two bolts and nuts that hold the converter housing to the frame cross member.

13. Cut the lock wire and remove the two bolts, washers, insulators from the top of the transmission rear support and crossmember.

14. Place an engine support under the rear end of the engine, then raise the engine to take the weight off the crossmember.

15. Support the transmission with a 1000-pound transmission jack. The jack should be placed so that the oil pan does not support the entire weight of the transmission. Fasten a safety chain over the top of the transmission and to both sides of the jack.

16. Remove the two bolts from each end of the transmission rear support crossmember, and remove the crossmember.

17. Remove the bolts and lock washers that attach the converter housing to the flywheel housing.

18. Move the converter and transmission away from the engine until the converter housing clears the crossmember, then lower the unit. If necessary, raise the floor pan slightly to permit the converter housing to clear the crossmember.

### Installation

If the engine, flywheel, or flywheel housing has been replaced, check the flywheel housing alignment and flywheel shim adjustment before installing the torque converter and transmission.

1. Raise the converter and transmission on the jack, then move the unit into position over the crossmember that supports the converter. Align the studs in the converter cover with the holes in the flywheel. Install two guide studs in the flywheel housing, then push the unit forward so that the converter studs enter the holes in the flywheel.

2. Install the bolts, except the fluid filler tube support strap bolt, and lock washers that attach the converter housing to the flywheel housing. Torque them 23-28 ft-lbs.

3. Install six new self locking nuts and flat washers that hold the converter on the engine flywheel, and torque them to 33-40 ft-lbs.

4. Install the dust shield on the bottom front side of the flywheel housing .

5. Install the transmission rear support crossmember on top of the frame brackets, then install the two bolts on each end of the crossmember. Torque the bolts to 40-45 ft-lbs.

6. Lower the jack, remove it from under the vehicle, then remove the engine support from under the rear end of the engine.

7. Install the two bolts and nuts that hold the converter housing to the frame crossmember, and torque them to 70-91 ft-lbs. Install the lock wires.

8. Install the two bolts, washers, and insulators at the transmission rear support. Torque the bolts to 40-60 ft-lbs and install the lock wire.

9. Install the oil cooler line fitting in the forward fluid opening of the retarder valve body. **Then install the fluid temperature warning light switch on the fitting. Connect the warning light wire to the switch terminal.**

10, Connect the two oil cooler lines to the retarder valve body fittings.

11. Install the retarder linkage cross-shaft on the front of the oil pan, and torque the screws to 15-18 ft-lbs. Connect the retarder linkage to the cross-shaft and the valve.

12. Install the range selector lever cable bracket on the left side of the transmission housing, and torque the screws to 8-10 ft-lbs.

13. Connect the range selector lever cable and the TV rod to the levers on the left-hand side of the housing. **Be sure to install the TV rod in the outer hole of the lever.**

14. Connect the fluid filler tube to the oil pan, then install the tube

support strap bolt in the converter housing.

**15.** Push the breather hose across the top of the transmission and connect it to the fitting above the left power take-off plate. Tighten the hose clamp.

**16.** Connect the parking brake linkage.

**17.** If the exhaust system was removed or disconnected during removal, install and connect the parts.

**18.** Install the drive shaft, the center bearing support bracket, and the coupling shaft. Connect the coupling shaft to the parking brake drum. Torque all nuts and bolts to specifications.

**19.** Connect the speedometer cable to the rear of the transmission.

**20.** Adjust the retarder, throttle control rod, and range selector lever linkages.

**21.** Check all fluid line connections and the filter cover for tightness, then lower the vehicle to the floor.

**22.** Add enough automatic transmission fluid to the converter and transmission to bring the fluid level to the full mark on the dipstick.

## 5 OVERHAUL

**1.** Proper equipment must be available before disassembly is started. This equipment includes a suitable hoist of at least 1/2-ton capacity, proper hand tools and special tools, and a press.

**2.** Gaskets, lock wires, lock strips, and cotter pins should be discarded as they are removed. New parts of this type should always be installed.

**3.** Care must be used to avoid damage to transmission components during disassembly, cleaning, inspection, repair, and assembly operations. Nicks, and scratches caused by careless handling may cause fluid leakage or improper functioning and could result in transmission failure. All worn or damaged parts must be repaired or replaced. Where special torque requirements apply, refer to the specifications section.

**4.** Cleanliness is important in servicing the transmission. All components must be thoroughly cleaned and kept clean throughout the rebuild process. The presence of dirt can cause malfunction, and possible failure of the transmission.

**5.** Every component should be thoroughly cleaned after the transmission is disassembled. Cleaning is necessary to insure effective inspection for wear, damage, and serviceability of components.

**6.** Crocus cloth may be used to remove minor surface irregularities.

**7.** A soft wire (brass or copper) may be used to clean fluid passages. Always flush such passages thoroughly after cleaning.

**8.** If steam cleaning is used, dry the cleaned parts immediately with compressed air and apply a film of oil to prevent rusting. Never use lye or caustics which will corrode or etch metal surfaces.

**9.** Do not clean the lubricant from new bearings. Keep new bearings wrapped until they are to be installed. Soak bearings which have been in service, in dry cleaning solvent or mineral spirits paint thinner to loosen deposits of dirt. Do not spin the bearings during cleaning or drying. After cleaning, turn the bearings by hand and note any evidence of grit. Clean them if grit is present.

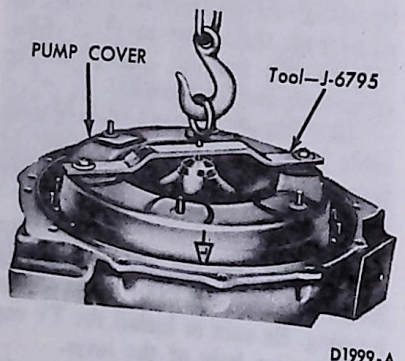



FIG. 18 Converter Pump Cover Removal

### DISASSEMBLY OF TORQUE CONVERTER AND TRANSMISSION

**1.** With the transmission assembly removed from the vehicle remove the fluid filter, oil pan, valve body, oil, transfer plate, and hydraulic retarder valve and gasket.

**2.** Remove the converter pump cover, lockup clutch reaction plate, and clutch plate (Fig. 18). Remove the seal ring from the reaction plate and pump.

**3.** Remove the hook-type seal ring and the snap ring from the turbine shaft, and remove the turbine from the shaft (Fig. 19).

**4.** Rotate the stator counterclockwise to lock it on the freewheel roller race. Then lift the stator and roller race off the converter pump together. **Do not let the roller race drop out of the stator.**

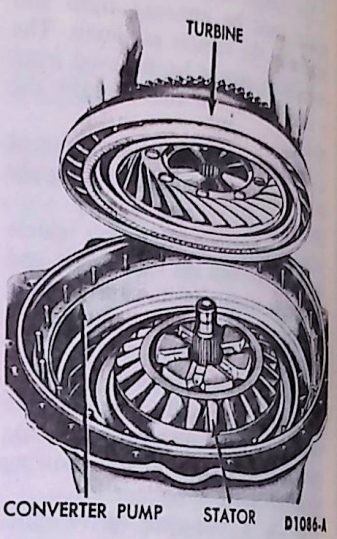



FIG. 19 Turbine Removal or Installations

**5.** Remove the snap ring and spacer from the converter stator support, and lift out the converter pump assembly.

**6.** Remove the converter housing mounting bolts and lift off the housing and gasket. **Lift the housing carefully to avoid dropping the retarder rotor and shaft assembly. If this assembly lifts with the housing, tap the end of the shaft to dislodge it from the housing so it will remain in the transmission.**

**7.** Remove the thrust bearing from the rear face of the converter stator support assembly. The bearing race may remain on the retarder rotor and shaft assembly.

**8.** Lift out the retarder rotor and shaft (Fig. 20). Remove the hook-type seal ring and thrust washer.

**9.** Remove the low-splitter clutch reaction plate anchor bolt. Loosen the bolt at the top of the transmission housing which anchors the diaphragm assembly in the housing.

**10.** Remove the lowsplitter clutch reaction plate.

11. Remove the anchor bolts that hold the low-splitter piston housing and diaphragm assembly. Then install the lifting hook in the end of the splitter outshaft and remove the assembly (Fig. 21).

12. Position the transmission with the rear bearing retainer up.

13. Remove the two pitot tube bolts and the speedometer plug.

14. Remove the brake drum. Hold the output flange to prevent rotation and remove the flange retaining bolt, tab lock washer and the O-ring seal.

15. Use a suitable puller and remove the output shaft flange.

16. Remove four bolts and lift the brake assembly and apply lever from the transmission.

17. Remove the reverse, low, and intermediate range clutch reaction housing anchor bolt nuts. Remove the Low-range piston housing anchor bolt and the intermediate-range piston housing anchor bolt. Remove the cap screws securing the rear bearing retainer to the transmission housing and remove the retainer and gasket. Lift out the loose pitot tube.

18. Remove the reverse palnetary carrier and rear pitot collector ring from the output shaft. **Various clutch parts are color coded, and should be assembled in the same locations when the transmission is serviced to insure proper fitting. Parts marked yellow are for the intermediate range clutch, those marked green are for the lowrange clutch, and those marked red are for the reverse clutch.**

19. Remove the thrust washer and snap ring from the output shaft and the snap ring from the reverse sun gear and the internal-splined thrust washer.

20. Remove the reverse clutch reaction housing, backing plate, clutch plate(s) and ring gear. Then take out the reverse clutch Belleville spring. Remove the reverse range reaction housing anchor bolt.

21. Working through the openings in the transmission housing, remove the low-range and reverse-range clutch piston housing.

22. Remove the low-range clutch Belleville spring.

23. Remove the low-range clutch apply palte and the low-range clutch plate(s).

24. Remove the low-range clutch reaction housing (Fig. 22).

25. Remove the low-range anchor bolt.

26. Remove the large internal snap ring that holds the reverse sun gear shaft to the low-range ring gear, then remove the reverse range sun gear shaft.

27. Remove the output shaft assembly.

28. Remove the low-range ring gear and intermediate-range planetary carrier (Fig. 23).

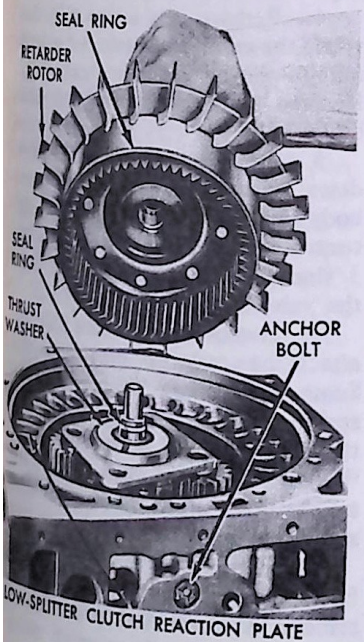
29. Remove the intermediate-range housing and piston assembly from the transmission housing.

30. Remove the intermediater-ange clutch Belleville spring. Then remove the apply plate, the clutch plates, and ring gear.

31. Remove the intermediate clutch reaction housing from the transmission housing.

32. Remove the intermediate-range square head anchor bolt.

33. Remove the oil collector.




G. 20 Retarder Rotor Removal Installation

## RANGE SELECTOR AND THROTTLE CONTROL LEVERS

When removing or installing the selector and throttle levers, be careful not to push the shafts back inside the transmission housing. When this happens, the shafts lose their index location with their corresponding valves of the control valve body in the housing. It will then be necessary to remove the transmission oil pan and reposition the shafts.

### Disassembly

1. Install a new O-ring seal on the selector shaft.

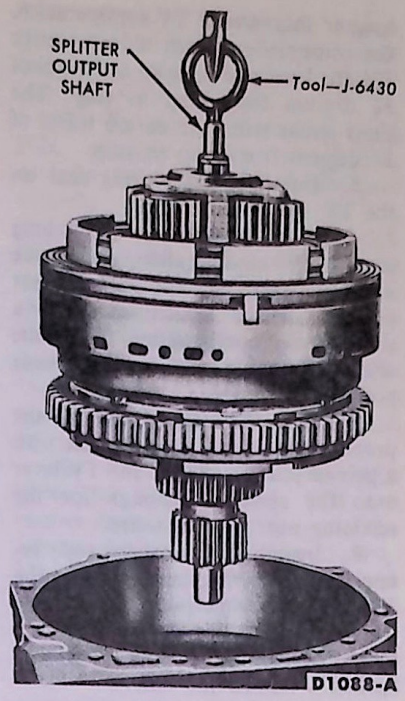



FIG. 21 Removing Splitter Mechanism

2. With the selector shaft in the 3-6 detent position, hold the shaft with a pair of pliers and slide the selector lever onto the shaft far enough for the retaining nut to be installed.

3. Install the washer and retaining nut. Then, grasp the end of the selector lever and while pulling out (away from the transmission), tighten the retaining nut to 14-17 ft-lbs torque. Bend the washer against a flat on the nut.

4. Before installing the TV lever, determine if the transmission has a

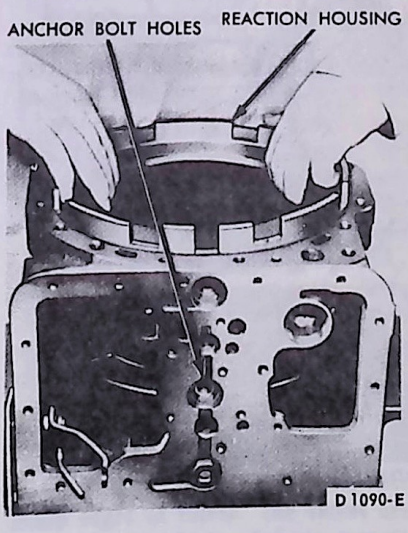



FIG. 22 Low-Range Clutch Reaction Housing Removal or Installation

long or short stroke TV configuration. On transmissions with a long stroke TV, the lever will have an arc travel of 32 degrees from stop to stop. The short stroke will have an arc travel of 16 degrees from stop to stop.

5. Install a new O-ring seal on the TV shaft.

6. If the transmission has a long stroke TV configuration, leave the selector lever in the 3-6 detent position. If the transmission has a short stroke configuration, place the selector lever in the reverse detent position.

7. With the selector lever in the proper detent, hold the TV shaft with a pair of pliers and slide the TV lever onto the shaft far enough for the retaining nut to be installed.

8. Install the washer and retaining nut. Then, grasp the end of the TV lever and while pulling out (away from the transmission) tighten the nut to 14-17 ft-lbs torque. Bend the washer against a flat on the nut.

**Assembly**

1. Place the selector lever in the 3-6 detent position.

2. Straighten the TV lever washer on the TV shaft. Remove the TV nut and washer and remove the lever from the shaft. **Always hold the lever when removing or installing lever retaining nuts. Do not use the mechanical stop inside the transmission as the reaction member for removal of lever retaining nuts. The stop is used for making a calibrated adjustment and could be damaged.**

3. Straighten the shift selector lever washer on the selector shaft. Remove the nut and washer and remove the lever.

4. Remove the O-ring seals from the shafts.

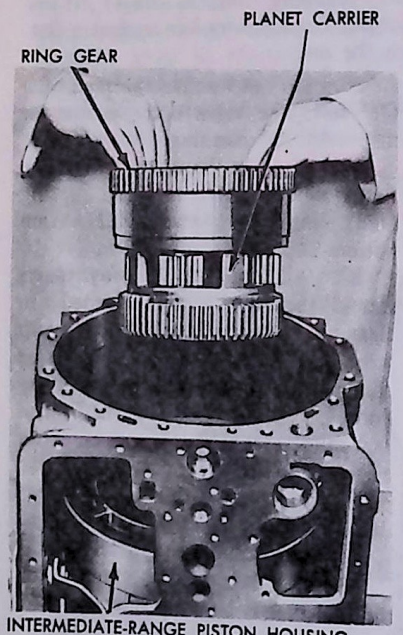



FIG. 23 Ring Gear and Planet Carrier Removal and Installation

## OIL TRANSFER PLATE

**Disassembly**

1. Remove the two screws which attach the converter lube supply cover to the oil transfer plate and remove the cover.

2. Remove the two screws which attach the converter pressure regulator valve retainer to the oil transfer plate. Remove the retainer, spring, seat, and the steel ball.

3. The low-range clutch exhaust regulator valve and orifice cup should not be removed unless it is to be replaced. Check the operation of the valve while cleaning the transfer plate. The valve should hold the cleaning solvent on the side opposite the spring for at least 15 seconds.

**Assembly**

1. When replacing the low-range clutch exhaust regulator valve and orifice cup, press the cup, convex side first, into the recess of the exhaust regulator valve. Be sure the cup is entered.

2. Press the regulator valve, wide end first, into its bore in the transfer plate. Exert pressure only on the shoulder of the valve next to the closed portion of the spring cover. Do not let the cup slide from its recess while the valve is being installed. When the valve is in place, the spring cover must be flush with or slightly below the outer surface of the transfer plate.

3. Install the lube supply ball seat in the lube supply cover. Install the lube supply cover with the ball seat end toward the rear. Torque the screws to 24-36 in-lbs. **The nylon ball is installed from the other side of the oil transfer plate when the plate is assembled to the transmission housing.**

4. Assemble the steel ball, seat, spring, and converter pressure regulator valve retainer to the oil transfer plate and install the two screws. Torque the screws to 24-36 in-lbs.

## DOWNSHIFT TIMING VALVE

**Disassembly**

1. Remove the downshift timing valve cover (Fig. 24).

2. Remove the spring and downshift timing valve.

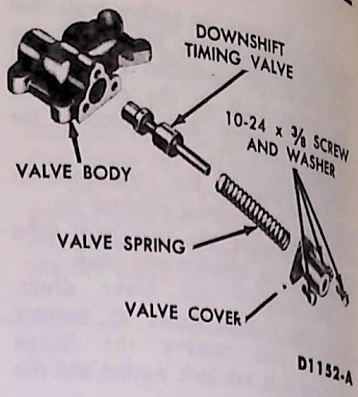



FIG. 24 Downshift Timing Valve

**Assembly**

1. Insert the valve in the body and place the spring on the stem of the valve.

2. Install the valve cover over the spring and torque the three screws to 24-36 in-lbs.

## CONTROL VALVE BODY

**Disassembly**

1. Place the control valve body on the bench, flat side down.

2. Remove the screw (68) which retains the signal tube clip (127) (Figs. 25 and 26). Remove the clip and replace the screw finger tight. Remove the screws (88) and (24) that retain the drive and high transfer tube clips (10) and (13).

3. Remove the signal tube (126) and transfer tubes (11) and (12) with the clips attached. Do not remove the clips from tubes (11) and (12).

4. Remove two screws (77) that retain the exhaust regulator valve body (63) to the control valve body (102). Remove the exhaust regulator valve body.

5. Remove the selector valve detent spring (100) and lift the valve body separator plate (97) off the control valve body (102). Remove the 3/8inch steel detent ball (101) from the valve body.

6. Remove three screws (52) that attach the accelerator plug cover (48). Some models use a bracket (51), spring (50) and ball (49), retained by two screws (52). If the valve body has these parts, remove them. Remove the accelerator plug cover and the accelerator plug (47).

7. Remove the four screws (58) from the regulator cover (57) and remove the cover, lockup knockdown plug (55), accumulator valve spring (56) and the accumulator valve (54).

8. Remove the two screws (59) and (62), and remove the throttle valve retainer (61) from the valve

body. **Do not turn or remove the screw (60) from the retainer.** The screw (62) is 3/8inch long and should not be mixed with 7/16-inch screws. Keep the screw (62) separated from the longer screws to insure that they are installed in the proper locations when the valve body is reassembled.

**9.** The valve body rear cover is spring-loaded and must be held while the screws are being removed. Remove the remaining three screws (53) that attach the valve body rear cover (46) to the valve body, and remove the rear cover.

**10.** Remove the intermediate shift valve spring (44), which is exposed when the rear cover is removed.

**11.** Remove the regulator plug (41) from the rear cover.

**12.** Remove the throttle valve (98) and spring (99) from the control valve body (102).

**13.** Remove the manual selector valve (43) from the rear of the control valve body.

**14.** From the same side of the control valve body, remove the hydraulic retarder regulator plug (42), lockup plug (40), rear pitot (G2) plug (39) and front pitot (G1) splitter plug (36), low-to-intermediate shift valve (38) and the intermediate-to-high shift plug (37).

**15.** Position the control valve body (102) on the rear surface and remove the two screws (23) that attach the splitter overcontrol valve body (19) to the valve body front cover (32). Remove the splitter overcontrol valve body.

**16.** Remove the screw (22) that attaches the overcontrol valve cover (21) to the overcontrol valve body. Remove the cover and the splitter overcontrol valve (20) from the body.

**17.** Remove the splitter shift plug spring (28) and the splitter shift plug (29), which are exposed upon removal of the overcontrol valve body (19) from the front cover (32) (Fig. 25).

**18.** Remove the three screws (24) and (25) which attach the intermediateto-high shift valve cover (26) to the valve body front cover (32). Remove the cover (26), intermediate-to-high shift valve spring (27) and intermediateto-high blocker plug (30).

**19.** Hold the valve body front cover against the spring pressure and remove the three attaching screws (15). Remove the front cover (32) from the valve body.

**20.** Remove the 1/4-inch nylon ball (34) that is loose when the front cover is removed. Remove the inhibitor valve (115) and the spring (114) from the cover (32). Remove the main-pressure regulator spring (35) (and secondary spring 35A, used in some models), splitter relay valve spring (111) and lockup shift valve spring (108).

**21.** Remove the throttle valve plug (33) from the valve body front cover (32).

**22.** Remove the retainer spring (17) and remove the pump overage valve (18) from the front cover.

**23.** Remove the two pump overage regulator valve spring retainers (16) and spring (14) from the front cover.

**24.** Remove the throttle regulator valve, (106), main-pressure regulator valve, (107), lockup shift valve (109), splitter shift valve, (110), splitter relay valve (113) and intermediate-to-high shift valve (112) from the front of the control valve body (102).

**25.** Do not remove the reverse-ange clutch exhaust pressure regulator valve (105) unless replacement is necessary. Check the operation of the valve while cleaning the valve body. The valve should retain solvent on the side opposite the spring for 15 seconds. If the solvent leaks through sooner, replace the valve.

**26.** Do not remove the reverse lock-up inhibitor check valve retainer (103) and the 7/32-inch nylon ball (104). If the retainer, the ball or valve body (102) is worn or damaged, all three items must be replaced.

**27.** On a model which includes a valve guide bracket (89), remove two screws (88), bracket (89), spring (90), and ball (91). Remove the remaining nine screws (88) which attach the exhaust regulator valve body cover (80) to the exhaust regulator valve body (63). Remove the cover. The cover is spring loaded and must be held while the screws are being removed.

**28.** On a model which does not include the valve guide bracket (89), remove ten screws (88) and one screw (88A). Remove the cover (80). One screw (88A) is shorter, separate it from the longer screws to insure proper installation.

**29.** Removal of the cover will expose the intermediate exhaust regulator valve spring (94), low-splitter valve spring (93) and lockup cutoff valve spring (81). Remove these springs from the exhaust regulator valve body.

**30.** Remove the inhibitor plug (116), inhibitor valve (117), inhibitor spring (118), inhibitor spring retainer (119), nut (120) and screw (121). Do not remove the inhibitor spring adjusting screw (121) from the nut. Also, remove the intermediate exhaust regulator valve (96), lockup cutoff valve (82), and low-splitter exhaust regulator valve (95).

**31.** Remove the extender valve (87), extender valve spring (86), extender valve ball spring (85), and extender valve ball (84). Do not remove the extender valve body (83) and roll pin (92) unless replacement is necessary. Check the operation of the valve while cleaning the extender valve. If replacement is necessary, remove the roll pin and tap out the extender valve body toward the nearest opening (front) of the exhaust regulator valve body (63).

**32.** Remove the four screws (72) from the trimmer cover (73) and remove the cover from the rear of the exhaust regulator valve body (63) (Fig. 27). **The cover is spring loaded and must be held while the screws are being removed.**

**33.** Remove the trimmer valve (74), trimmer valve inner (75) and outer (78) springs, trimmer plug (79), trimmer primary spring (71), trimmer stop (70) and trimmer secondary spring (69) from the exhaust regulator valve body (63).

**34.** Remove the screw (68) retainer (67) and remove low-splitter exhaust regulator stop plug (65) and low splitter exhaust regulator plug (64) (Fig. 27). A model using a set screw (45A) at bottom of the valve body (63) does not use a regulator plug (64). Remove the intermediate exhaust regulator stop plug (66) from the rear of the exhaust regulator valve body (63).

**35.** Do not remove the pipe plug (76) from the valve body except for inspections or cleaning.

**36.** Remove the cotter pin (125), flat washer (124), inhibitor spring (123), inhibitor valve (122) from bottom of the body (63).

**37.** All the valve body parts should be thoroughly cleaned in cleaning solvent and dried with compressed air. All passages must be completely free of dirt and obstructions. Use a soft bristle brush. **Do not use abrasives or scraping tools.** After cleaning, place the parts on clean paper and cover with paper to keep the dust out.

**38.** Inspect all the parts closely for wear, breaks, cracks, burrs, and dirt. Burrs may be removed with a soft abrasive stone. **Do not destroy the sharp edges of valves. The valves are designed with sharp edges to prevent them from sticking in their bores.**

**39.** Inspect all the springs and check them for free length. Correct

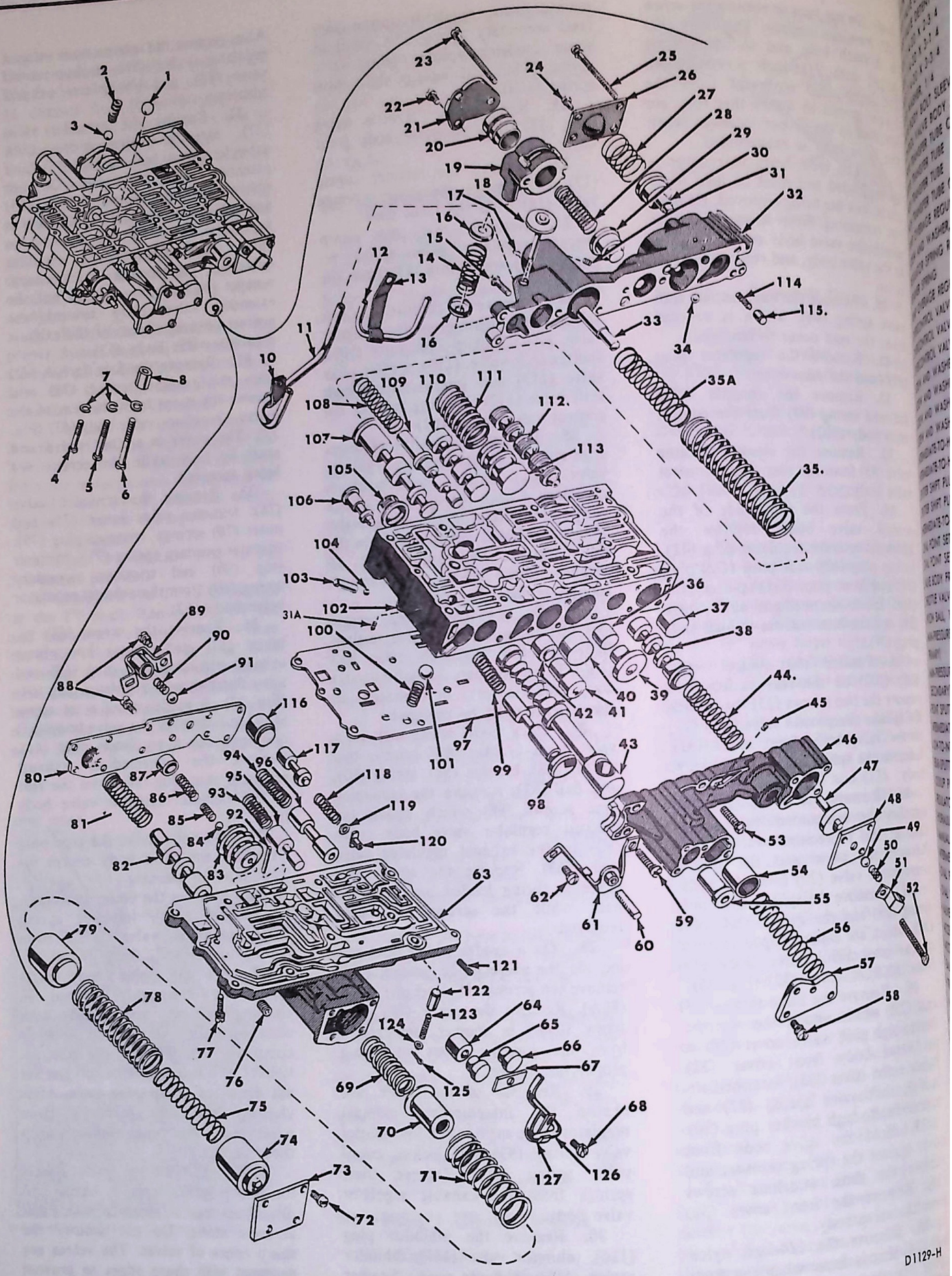



FIG. 25 Control Valve—Disassembled

## CONTROL VALVE COMPONENT IDENTIFICATION

1. NYLON BALL, 1/2
2. SHIFT VALVE DETENT SPRING
3. SHIFT VALVE DETENT BALL
4. BOLT, 1/4-20 X 2-3/4
5. BOLT, 1/4-20 X 3-1/4
6. BOLT, 1/4-20 X 3-3/4
7. LOCK WASHER, 1/4
8. VALVE BODY BOLT SLEEVE
9. CONTROL VALVE BODY ASSY
10. DRIVE TRANSFER TUBE CLIP
11. DRIVE TRANSFER TUBE
12. HIGH TRANSFER TUBE
13. HIGH TRANSFER TUBE CLIP
14. PUMP OVERAGE REGULATOR SPRING
15. SCREW AND WASHER, 10-24 X 3/4
16. REGULATOR SPRING RETAINER
17. RETAINER SPRING
18. PUMP OVERAGE REGULATOR VALVE ASSY
19. OVERCONTROL VALVE BODY
20. OVERCONTROL VALVE
21. OVERCONTROL VALVE COVER
22. SCREW AND WASHER, 10-24 X 7/16
23. SCREW AND WASHER, 10-24 X 2-3/8
24. SCREW AND WASHER, 10-24 X 7/16
25. SCREW AND WASHER, 10-24 X 2-3/8
26. INTERMEDIATE-TO-HIGH SHIFT VALVE COVER
27. INTERMEDIATE-TO-HIGH SHIFT VALVE SPRING
28. SPLITTER SHIFT PLUG SPRING
29. SPLITTER SHIFT PLUG
30. INTERMEDIATE-TO-HIGH BLOCKER PLUG
31. OVAL POINT SETSCREW, 10-24
31A. OVAL POINT SETSCREW, 10-24
32. VALVE BODY FRONT COVER
33. THROTTLE VALVE PLUG
34. NYLON BALL, 1/4
35. MAIN-PRESSURE REGULATOR VALVE SPRING (PRIMARY)
35A. MAIN-PRESSURE REGULATOR VALVE SPRING (SECONDARY)
36. FRONT SPLITTER SHIFT (G10) PLUG
37. INTERMEDIATE-TO-HIGH SHIFT PLUG
38. LOW-TO-INTERMEDIATE SHIFT VALVE
39. REAR-SPLITTER SHIFT (G2) PLUG
40. LOCKUP PLUG
41. REGULATOR PLUG
42. HYDRAULIC RETARDER REGULATOR PLUG
43. MANUAL SELECTOR VALVE
44. INTERMEDIATE-TO-LOW SHIFT VALVE SPRING
45. OVAL POINT SETSCREW, 10-24
45A. OVAL POINT SETSCREW, 10-24
46. VALVE BODY REAR COVER
47. ACCELERATOR PLUG
48. ACCELERATOR PLUG COVER
49. BALL
50. TRIMMER BALL REGULATOR SPRING
51. VALVE GUIDE BRACKET ASSY
52. SCREW AND WASHER, 10-24 X 1-5/8
53. SCREW AND WASHER, 10-24 X 3/4
54. ACCUMULATOR VALVE
55. LOCKUP KNOCKDOWN PLUG
56. ACCUMULATOR VALVE SPRING
57. REGULATOR COVER
58. SCREW AND WASHER, 10-24 X 7/16
59. SCREW AND WASHER, 10-24 X 3/4
60. THROTTLE VALVE ADJUSTING SCREW
61. THROTTLE VALVE RETAINER
62. SCREW AND WASHER, 10-24 X 3/8
63. EXHAUST REGULATOR VALVE BODY
64. LOW-SPLITTER EXHAUST REGULATOR PLUG
65. LOW-SPLITTER EXHAUST REGULATOR STOP PLUG
66. INTERMEDIATE-EXHAUST REGULATOR STOP PLUG
67. PLUG RETAINER
68. SCREW AND WASHER, 10-24 X 7/16
69. TRIMMER SECONDARY SPRING
70. TRIMMER STOP
71. TRIMMER PRIMARY SPRING
72. SCREW AND WASHER, 10-24 X 7/16
73. TRIMMER COVER
74. TRIMMER VALVE
75. TRIMMER RETURN INNER SPRING
76. PIPE PLUG, 1/4
77. SCREW AND WASHER, 10-24 X 3/4
78. TRIMMER RETURN OUTER SPRING
79. TRIMMER PLUG
80. EXHAUST REGULATOR VALVE COVER
81. LOCKUP CUTOFF VALVE SPRING
82. LOCKUP CUTOFF VALVE
83. EXTENDER VALVE BODY
84. EXTENDER VALVE BALL
85. EXTENDER VALVE BALL SPRING
86. EXTENDER VALVE RETURN SPRING
87. EXTENDER VALVE
88. SCREW AND WASHER, 10-24 X 7/16
89. VALVE GUIDE BRACKET ASSY
90. TRIMMER BALL REGULATOR SPRING
91. BALL
92. EXTENDER VALVE BODY ROLL PIN
93. LOW-SPLITTER EXHAUST REGULATOR VALVE SPRING
94. INTERMEDIATE EXHAUST REGULATOR VALVE SPRING
95. LOW-SPLITTER EXHAUST REGULATOR VALVE
96. INTERMEDIATE EXHAUST REGULATOR VALVE
97. VALVE BODY SEPARATOR PLATE
98. THROTTLE VALVE
99. THROTTLE VALVE (TV) SPRING
100. SELECTOR VALVE DETENT SPRING
101. SELECTOR VALVE DETENT BALL
102. CONTROL VALVE BODY
103. REVERSE LOCKUP INHIBITOR CHECK VALVE RETAINER
104. NYLON BALL, 7/32
105. REVERSE-RANGE CLUTCH EXHAUST REGULATOR VALVE ASSY
106. THROTTLE REGULATOR VALVE
107. MAIN-PRESSURE REGULATOR VALVE
108. LOCKUP SHIFT VALVE SPRING
109. LOCKUP SHIFT VALVE
110. SPLITTER SHIFT VALVE
111. SPLITTER RELAY VALVE SPRING
112. INTERMEDIATE-TO-HIGH SHIFT VALVE
113. SPLITTER RELAY VALVE
114. 6-5 INHIBITOR SPRING
115. 6-5 INHIBITOR VALVE
116. LOW INHIBITOR PLUG
117. LOW INHIBITOR VALVE
118. 3-2 INHIBITOR SPRING
119. INHIBITOR SPRING RETAINER
120. TEE NUT
121. INHIBITOR SPRING ADJUSTING SCREW
122. 5-4 INHIBITOR VALVE
123. 5-4 INHIBITOR SPRING
124. SPRING RETAINER WASHER
125. COTTER PIN
126. SIGNAL TUBE
127. SIGNAL TUBE CLIP

CD1129-G

FIG. 26 Control Valve—Legend

performance of the transmission depends upon the good condition of springs. **Refer to specifications section for valve body spring identification and specifications.**

**40.** Before assembly, try all the valves in their bores. When parts are clean and dry, the valves should move in their bores by their weight only. Do not force them into the bores.

**41.** Reclean the parts, if necessary after inspection. Lubricate the parts with specified fluid.

**Assembly**

**1.** Install the intermediate exhaust regulator stop plug (66), small diameter first, in the exhaust regulator valve body (63), (Fig. 27).

**2.** Install the low splitter exhaust regulator plug (64).

Some models do not use a plug in this location. Such models are identified by the presence of a socket-head set screw (45A).

**3.** Install the low splitter exhaust regulator stop plug (65), small diameter first.

**4.** Install the plug retainer (67) and screw (68) finger tight.

**5.** Install the trimmer secondary spring (69), trimmer stop (70), trimmer primary spring (71) and plug (79).

**6.** Install the trimmer return inner and outer springs (75) and (78) and trimmer valve (74).

**7.** Install the trimmer cover (73) and four screws (72). Torque the screws to 24-36 in-lbs.

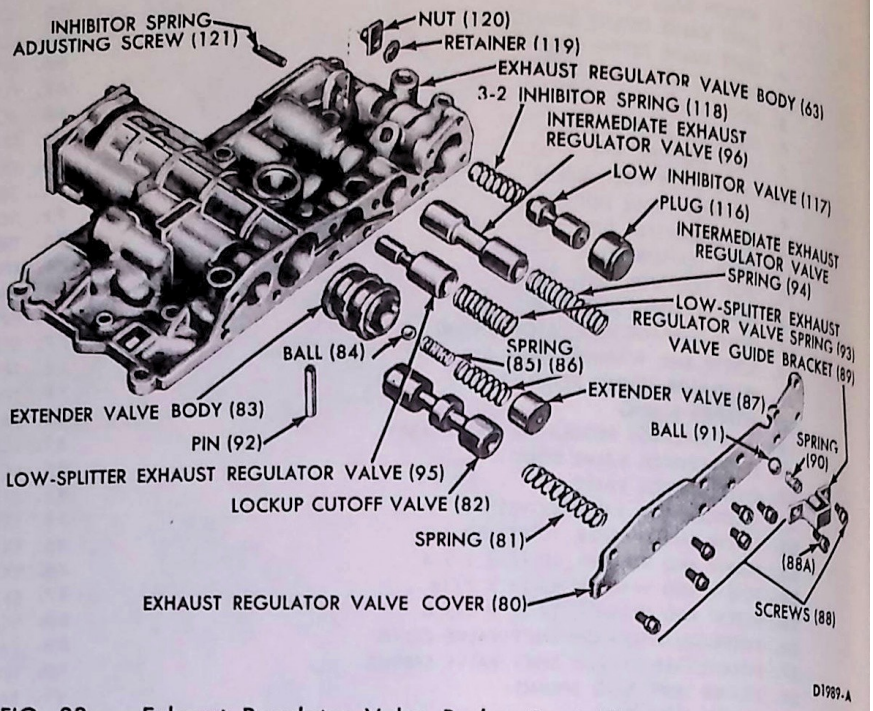



FIG. 28 Exhaust Regulator Valve Body—Front View

**8.** If the pipe plug (76) was removed, reinstall.

**9.** Install the inhibitor valve (122), inhibitor spring (123), flat washer (124) and new cotter pin (125) in the bottom of the exhaust regulator body (63).

**10.** If the extender valve body (Fig. 28) (83) was removed, install it with the roll pin (92). Press the pin (92) into the valve body (63) until it is slightly below the flat surface of the body.

**11.** Install the low splitter and intermediate exhaust regulator valves (95) and (96).

**12.** Install the low splitter and intermediate exhaust regulator springs (93) and (94).

**13.** Install the extender valve ball (84), springs (85) and (86) and extender valve (87), recessed end first.

**14.** Install the lockup cutoff valve (82) and spring (81).

**15.** Install the adjusting screw (121) and nut (12) (assembled) through slot into small end of inhibitor bore in cover (63). Also install the inhibitor spring retainer (119) with recessed center over the end of the adjusting screw (121), inhibitor spring (118), inhibitor valve (117) and inhibitor plug (116).

**16.** Install the exhaust cover (80) and nine regulator valve screws (88).

**17.** On a model which uses a valve guide bracket (89), trimmer ball regulator spring (90) and ball (91), install these parts and attach them with two screws (88).

**18.** On a model which does not use a valve guide bracket, trimmer ball regulator (89), spring (90) and ball (91), install one screw (88) in the hole at the right end of cover (80) and one screw (88A) in the remaining threaded hole. The short (3/8-inch) screw (88A) must be installed in the fifth threaded hole from the right end of the cover when valve guide bracket (89) is not

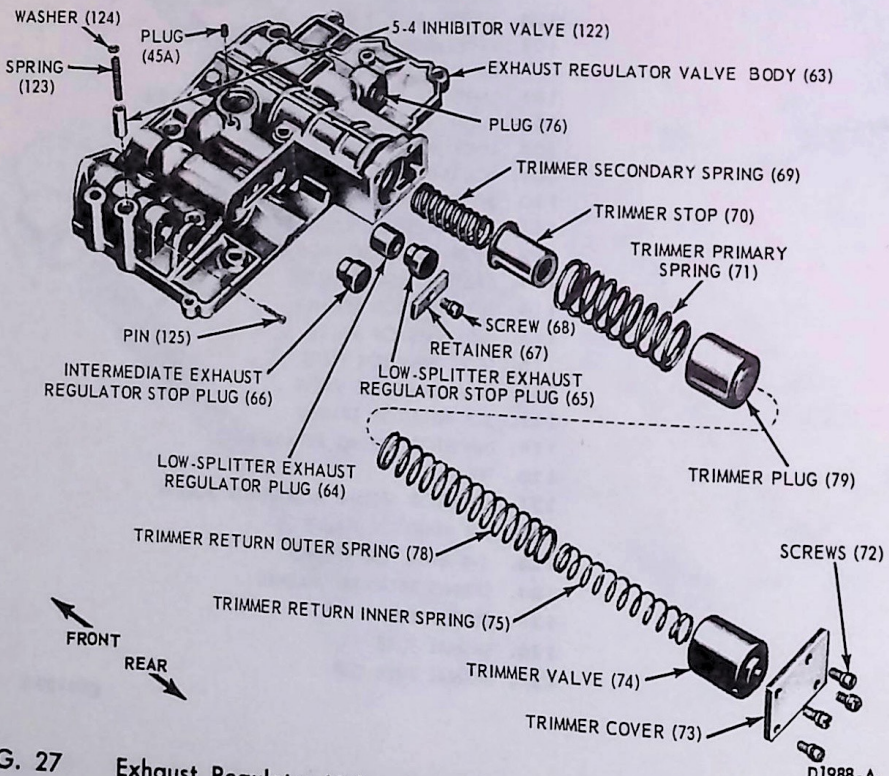



FIG. 27 Exhaust Regulator Valve Body—Rear View

19. Torque the cover screws to 24-36 in-lbs.
Do not install the screw that attaches the drive transfer tube clip at this time.

20. Install the throttle regulator, main pressure, lockup shift, splitter shift, intermediate-to-high and splitter relay valves (106), (107), (109), (110), (112), and (113) in their respective bores and in the positions illustrated in the valve body (102), (Fig. 29).

21. Install the lockup shift valve spring (108) on the stem of the valve (109).

22. If removed for replacement, install a new reverse-range clutch exhaust regulator valve (105) in the control valve body (102).

23. Install the nylon ball (34) (Fig. 30) in the small bore at the upper left of the bore which receives the splitter relay valve spring. Hold it in place with oil-soluble grease.

24. Install the throttle valve plug (33), large diameter first, in the small bore at the bottom of the recess which receives the main-pressure regulator valve spring (35).

25. Install the main pressure regulator primary and secondary springs (35) and (35A). Some models do not include the secondary spring (35A).

26. Install the inhibitor valve (115) and the inhibitor valve spring (114) in the valve body front cover (32).

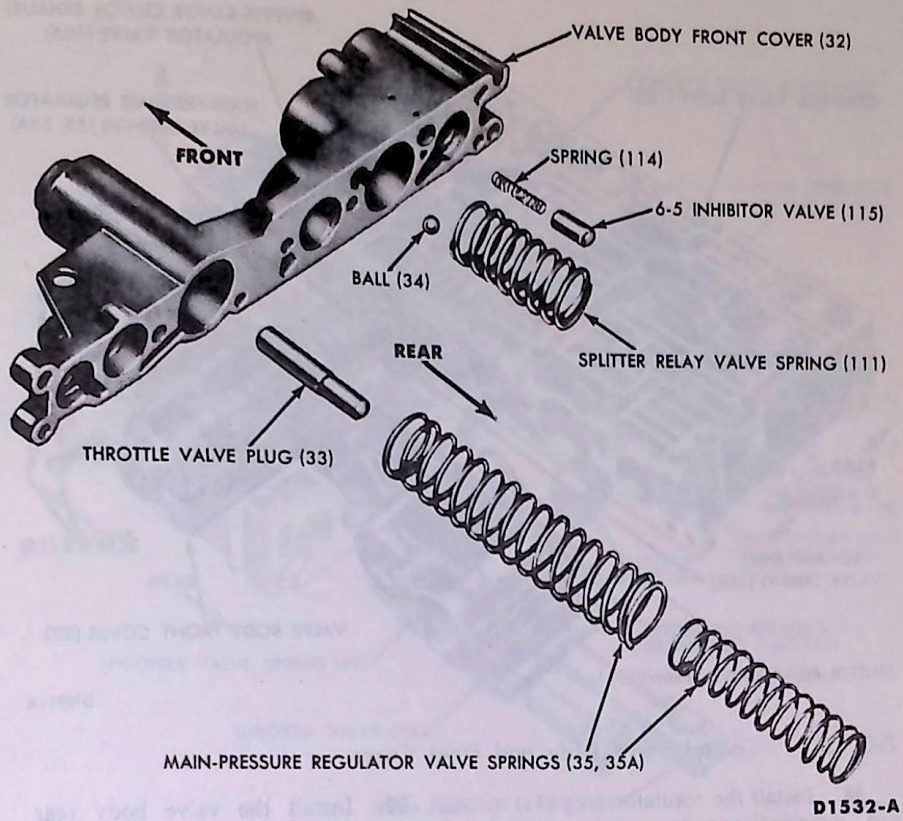



FIG. 30 Control Valve Body Front Cover—Rear View

27. Install the valve body front cover (Fig. 31), and its related components on the control valve body (102).

28. Compress the springs and install the three screws (15). Do not tighten the screws at this time.

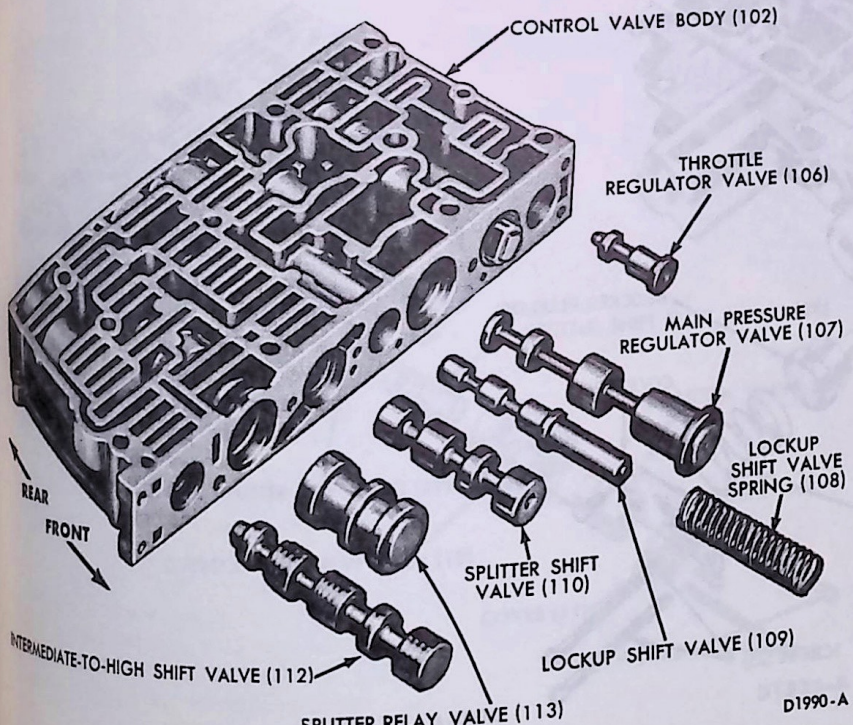



FIG. 29 Control Valve Body

29. Install the intermediate-to-high blocker plug (30) (Fig. 32) and shift valve spring (27).

30. Install the cover (26), two long screws (25) and one short screw (24) but do not tighten the screws at this time.

31. Install the splitter shift plug (29) in the valve body front cover (Fig. 33).

32. Install overcontrol valve (20) in the overcontrol valve body (19).

33. Install the cover (21) on the overcontrol valve body (19) and retain it with one screw (22).

34. Install the splitter shift plug spring (28) in the recessed end of the overcontrol valve (20), previously installed in the body (19).

35. Install the splitter shift plug spring (28) overcontrol valve body (19), valve (20), over (21) and screw (22) on the valve body front cover. Install two screws (23), but do not tighten them at this time.

36. Install the intermediate-to-high shift plug (37) (Fig. 34) low-to-intermediate shift valve (38), front splitter plug (36), rear-splitter shift plug (39), lockup plug (40) and the hydraulic retarder regulator plug (42).

37. Install the manual selector valve (43), the throttle valve spring (99) and throttle valve (98).

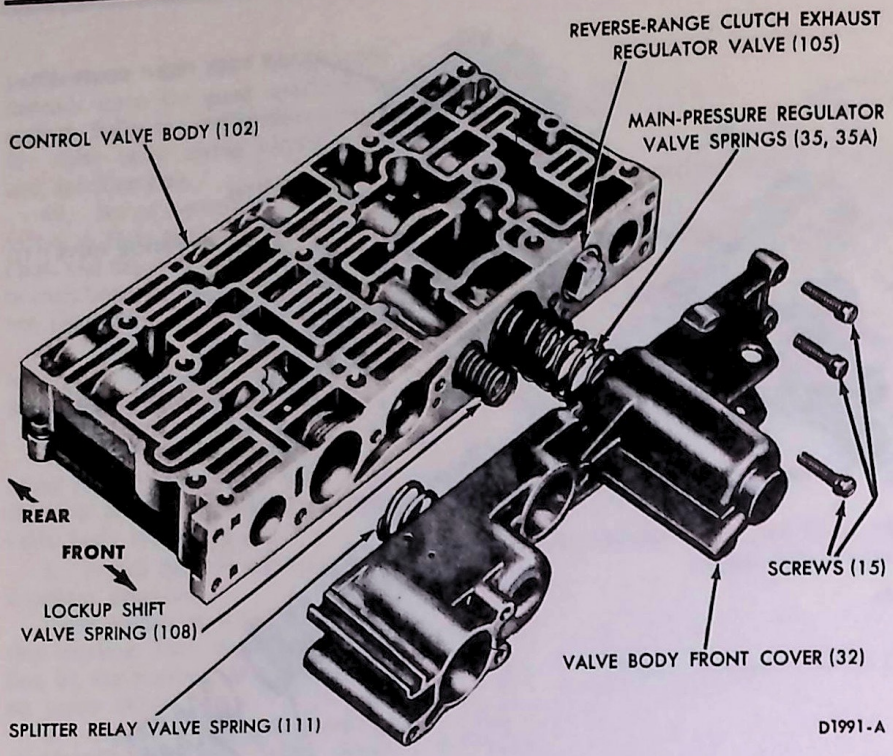



FIG. 31 Control Valve Body and Front Cover

**38.** Install the regulator plug (41) and intermediate-to-low shift valve spring (44) in the valve body rear cover (46) (Fig. 35). nto the assembled valve body (Fig. 36).

**39.** Install the valve body rear cover (46) and its assembled components onto the assembled valve body (Fig. 36).

**40.** Install the three screws (53) which retain the valve body rear cover (46). Do not install the screw (59) that attaches the throttle valve retainer (61). Do not tighten the screws at this time.

**41.** Install the throttle valve retainer (61) and secure it with two screws (62) and (59). Do not tighten the screws at this time.

**42.** Install the lockup knockdown plug (55) (Fig. 37). Install the plug by inserting the small end of the plug into the housing.

**43.** Install the accumulator valve (54). Make sure the open end of the valve is outward, for the spring to fit into.

**44.** Install the accumulator valve spring (56) and regulator cover (57).

**45.** Secure the regulator cover (57) with four screws. Torque the screws (58) to 24-36 in-lbs.

**46.** Install the accelerator plug (47) and cover (48) (Fig. 38).

**47.** On a model which includes a ball (49), trimmer ball regulator spring (50) and the valve guide bracket (51), install these parts and secure them with two screws (52). Install a third screw (52) to secure the cover (48). Do not tighten the screws at this time.

**48.** On a model which does not include the ball, spring, and bracket,

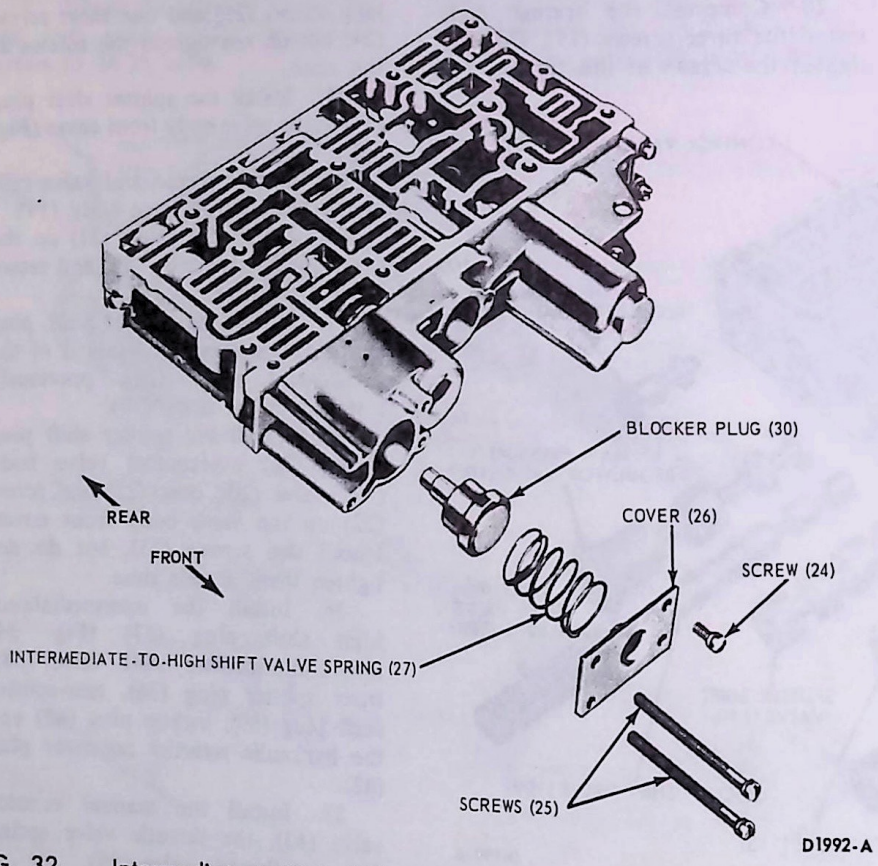



FIG. 32 Intermediate-to-High Shift Valve Components

install three screws (52) to secure the accelerator plug cover (48). Do not tighten the screws at this time.

Install the selector valve ball (101) and spring (100) in the hole which registers with the manual selector valve indentations (Fig. 25).

49. Install the valve body separator plate (97) on the valve body assembly (Fig. 25).

50. Install the assembled regulator valve body and secure it with two screws (77). Torque the screws to 24-36 in-lbs.

51. Place the control valve body, flat (top) side downward, on a flat surface. Check to determine if the end covers project below the valve body. Tap the valve body downward to correct any such projection. Torque all screws at the front and rear of the valve body to specification. This check is important. The valve body must seat tightly against the oil transfer plate, on which it mounts, to prevent fluid leakage.

52. Assemble a spring retainer (16) to each end of pump overage valve spring (14) (Fig. 25). Compress the spring and install it between the ribs on the valve body front cover (32). Install pump overage valve assembly (18) and fasten it with retainer spring (17). The seat face of the valve assembly must protrude at least 0.005 inch beyond the valve body mounting plate to assure seating of the valve against the oil transfer plate.

53. Install the high-transfer tube (12) with the clip (13). Fasten the clip with its attaching screw (24) (Fig. 25).

54. Install the drive-transfer tube (11) with its clip (10). Fasten the clip with a screw (88).

55. Install the signal tube (126) and tube clip (127) with a screw (68).

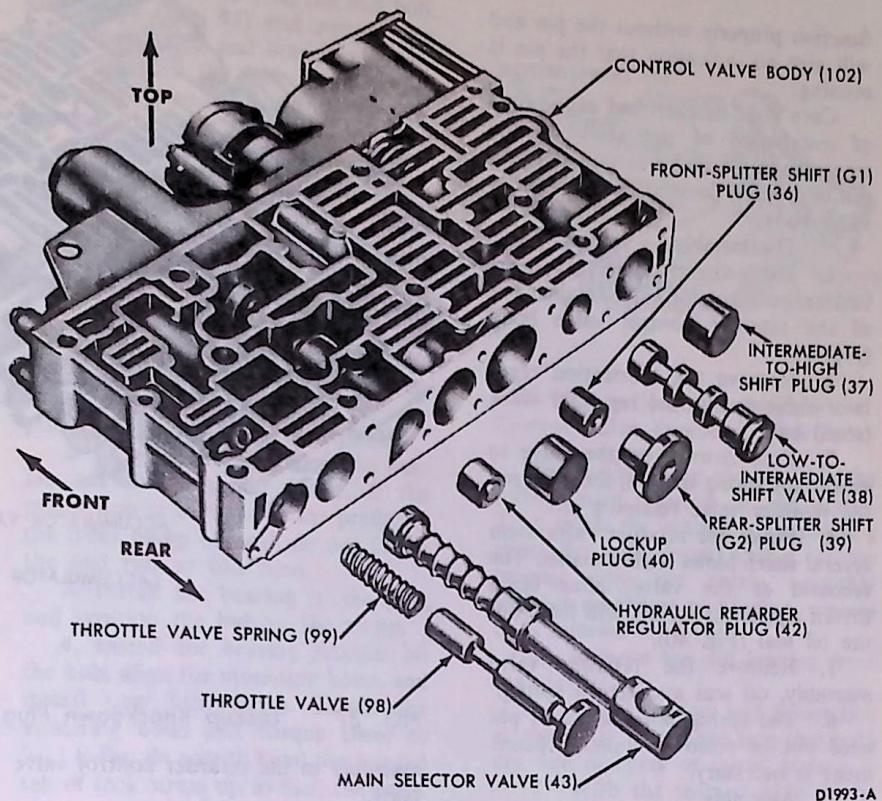



FIG. 34 Control Valve Body—

56. Torque the screws (24), (68) and (88) to 24 to 36 in-lbs.

## HYDRAULIC RETARDER CONTROL VALVE

The retarder valve stop pin in the retarder valve has been changed from a tight fit to a loose fit in the valve body for ease of removal or installation. The loose stop pin can easily drop out of the valve body when it is separated from the transmission if the valve is held inward.

The absence of the stop pin will result in improper oil circulation within the transmission, resulting in overheating and damage to the transmission. The valve will still

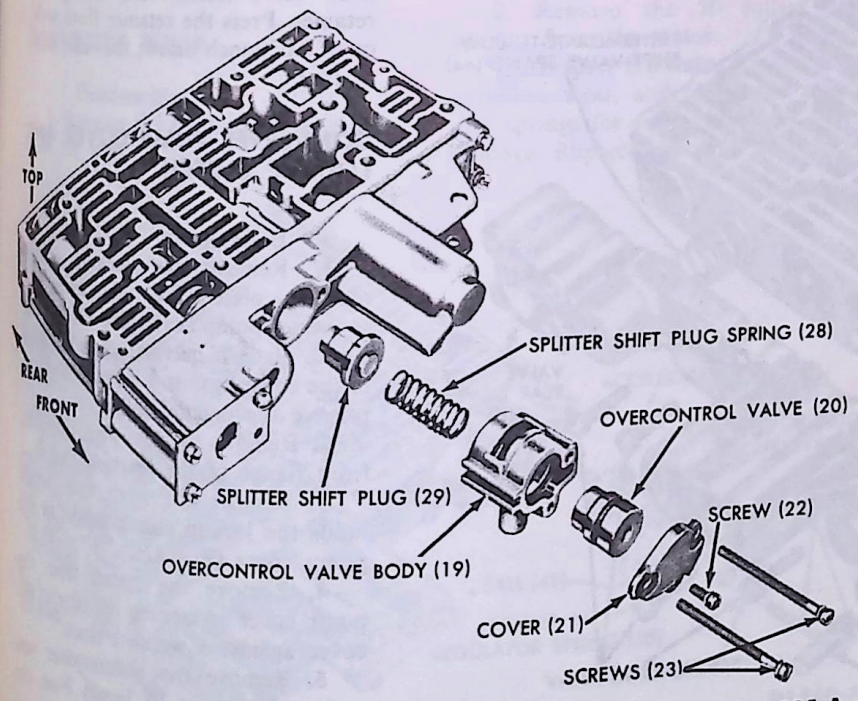



FIG. 33 Splitter Overcontrol Valve Components

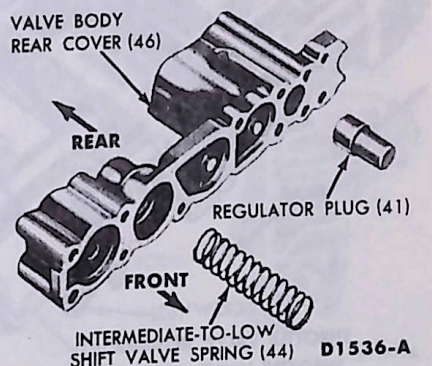



FIG. 35 Control Valve Body Rear Cover—Front View

function properly without the pin and will give no indication that the pin is missing.

Care must be exercised at the time of installation of the valve on the transmission to make certain that the pin is properly located in the retarder valve body.

**Disassembly**

**1.** Using vise-grip pliers, twist the lubrication regulator valve retainer out of the retarder control valve body (Fig. 39).

**2.** Remove the lubrication regulator valve spring and regulator valve (steel) ball.

**3.** Press inward on the valve to relieve the spring tension, then, lift out the retarder valve retaining pin.

**4.** Strike the retarder valve stem several sharp blows with a mallet. The rebound of the valve, after being driven against its spring, will force out the oil seal (Fig. 40).

**5.** Remove the retarder valve assembly, oil seal and return spring.

**6.** The spring pin and clevis pin need not be removed unless replacement is necessary.

**Assembly**

**1.** If the clevis pin and spring pin were removed, replace them.

**2.** Install the retarder valve return spring and retarder valve assembly in the retarder control valve body.

**3.** By inserting a thin fiber strip into one of the valve body ports while the valve is compressed against the spring, hold the valve in its inward position. From the ported side of the valve body, place the pin in the valve body. Remove the fiber stirp.

**4.** Press the seal into the housing until the top of the seal is 1/16-inch above the body. **Do not press the seal flush with the body or against the pin. Be sure there are no sharp edges or burrs on the slotted area of the retarder control valve.**

**5.** Install the lubrication regulator valve (steel) ball, spring and retainer. Press the retainer flush with, or to 0.030 inch below, the valve body surface.

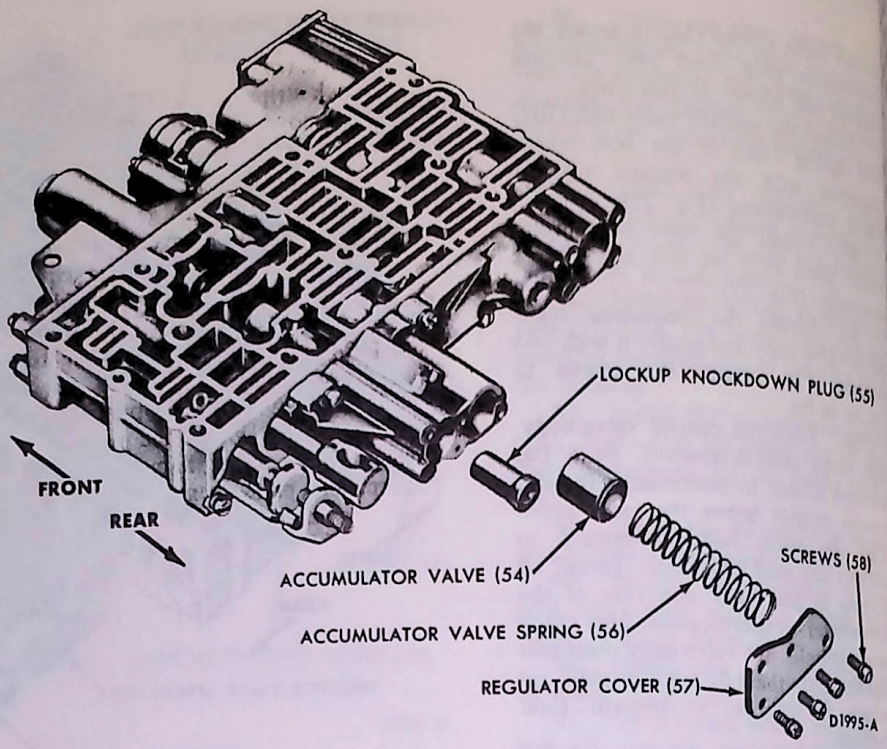



FIG. 37 Lockup Knockdown Plug and Accumulator Valve

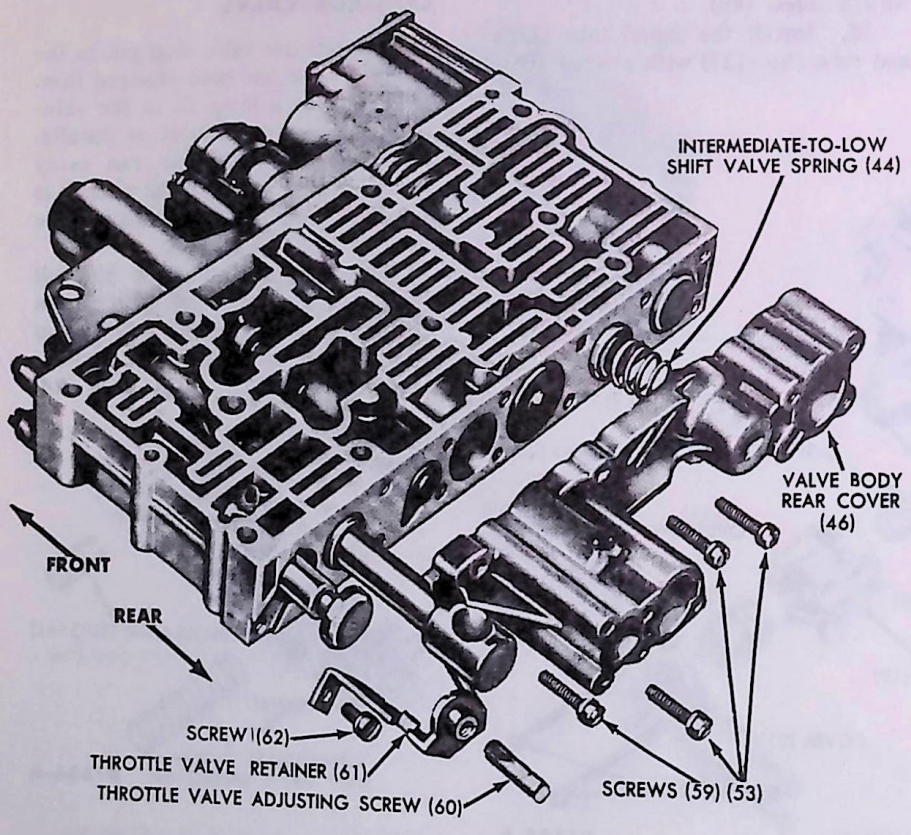



FIG. 36 Control Valve Body Rear Cover—Rear View

## CONVERTER PUMP COVER AND LOCKUP CLUTCH

**Disassembly**

**1.** Remove the lockup clutch reaction plate (Fig. 41) from the converter pump cover, and lift out the clutch plate. If necessary, tap the edge of the cover against a wooden block to remove the reaction plate.

**2.** Remove the seal ring from the front flange of the reaction plate.

**3.** Remove the snap ring which holds the lockup clutch piston in the pump cover (Fig. 42).

**4.** Remove the piston from the pump cover by tapping the edge of the cover against a wooden block.

**5.** Remove the piston inner seal and seal retainer (if loose) from the pump cover hub.

**6.** Remove the seal ring from the outer groove of the piston.

7. Clean all of the converter cover and lockup clutch parts, and inspect them for wear or damage. Replace all parts that are worn beyond the specified limits or that are damaged.

Check the orifice in the lockup piston. This orifice is drilled through one of the dowel holes.

The converter pump cover bushing can be replaced if it is excessively worn.

**Assembly**

1. Install the seal ring (Fig. 41) in the outer groove of the lockup clutch piston. Then apply a light coat of oil to the seal.

2. Install the piston inner seal retainer and seal on the pump cover hub.

3. Install the piston in the converter pump cover so that the dowel holes in the piston engage the dowels in the cover (Fig. 43). The balance marks on both parts must also be aligned. To align the parts correctly, place a heavy pencil mark in line with a dowl on the bolt circle of the cover, then match this mark with another mark on the piston in line with a dowel hole on the reverse side. If the dowels do not enter the dowel holes, the lockup clutch will not disengage and the converter will not function.

4. Install the snap ring. If the piston does not push far enough into the pump cover to install the snap ring, use the tool shown in Fig. 42 to compress the piston.

## CONVERTER PUMP

**Disassembly**

1. Remove the hook-type seal ring from the hub.

2. Flatten the tabs on the hub bolt lock strips (Fig. 41) and remove the bolts, lock strips, and bearing retainer.

3. Remove the hub and bearings from the pump. Then lightly tap the bearing from the hub.

4. Remove the hub gasket.

5. Tap out all damaged or worn converter pump to converter cover bolts. Only damaged bolts should be removed from the pump. Do not lose the positions of the balance weights.

**Assembly**

1. If any converter pump bolts were removed, insert the new bolts around the outer diameter of the pump, and press them into place.

2. Install a new gasket on the hub. **Do not use a gasket sealer.** If the pump hub is to be used for prefitting the front pump oil seal, do not install the seal ring at this time.

3. Install the bearing in the hub, and position the hub in the pump.

4. Install the bearing retainer on the hub, align the mounting holes, and install new lock strips. Install the attaching bolts and torque them to 9-11 ft-lbs. Be sure to bend the pointed tab of lock strips up to lock the bolts.

## CONVERTER STATOR

**Disassembly**

1. Place the stator on a clean bench, with the freewheel roller race facing upward.

2. Remove the roller race by rotating it clockwise while lifting it out of the stator.

3. Remove the 10 rollers and springs from the stator.

4. Inspect the stator for cracks or excessive wear, and check the rollers and springs for nicks, burrs, or other damage. Replace the parts as needed.

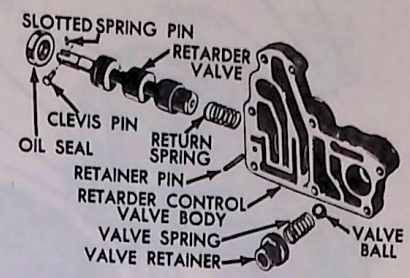



FIG. 39 Hydraulic Retarder Control Valve Exploded View

Thoroughly clean and lubricate the roller thrust bearing in the stator. Then rotate the bearing while pressing upon the rear thrust washer. If the bearing does not rotate smoothly without roughness or binding, replace it as follows:

5. Remove the old bearing from the stator.

6. Clean the bore and thrust face of the stator, and make sure that both are free of burrs or raised metal.

7. With the seamed edge of the thrust bearing outer shell facing the stator thrust washer, start the bearing into its bore.

8. Using tool (T57T-7003-A7) with a diameter slightly larger than that of the thrust bearing and which is smooth and flat on the side that contacts the bearing outer shell, press the bearing into its bore until the upper edge of the outer shell is 0.025-0.035 inch above the surface next to the outside diameter of the bearing. **Do not bottom the outer shell in the stator.**

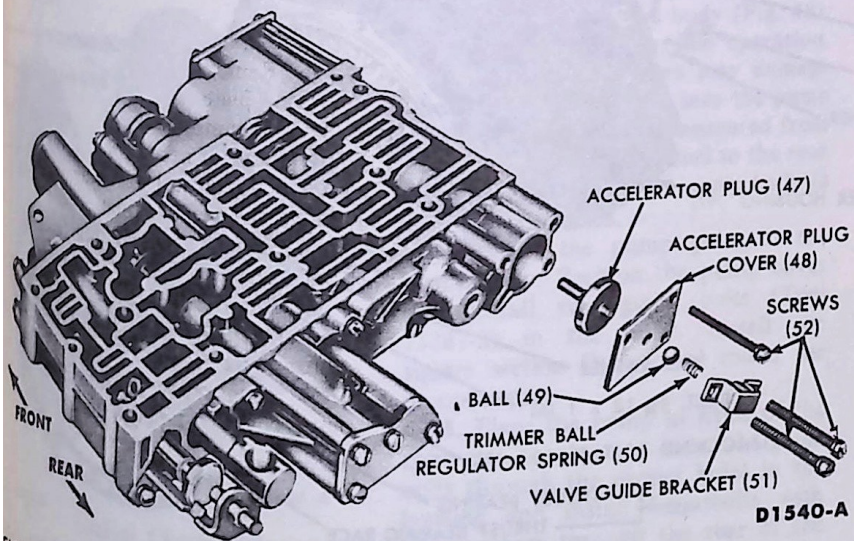



FIG. 38 Accelerator Plug and Cover

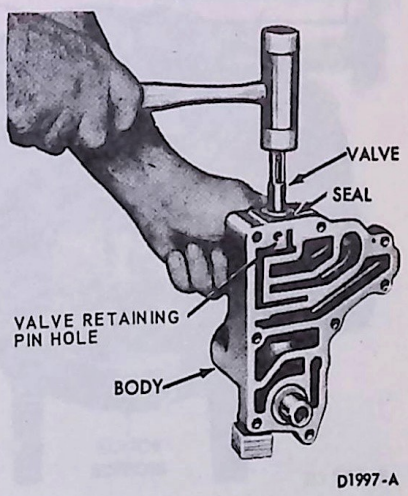



FIG. 40 Removing Hydraulic Retarder Valve Seal

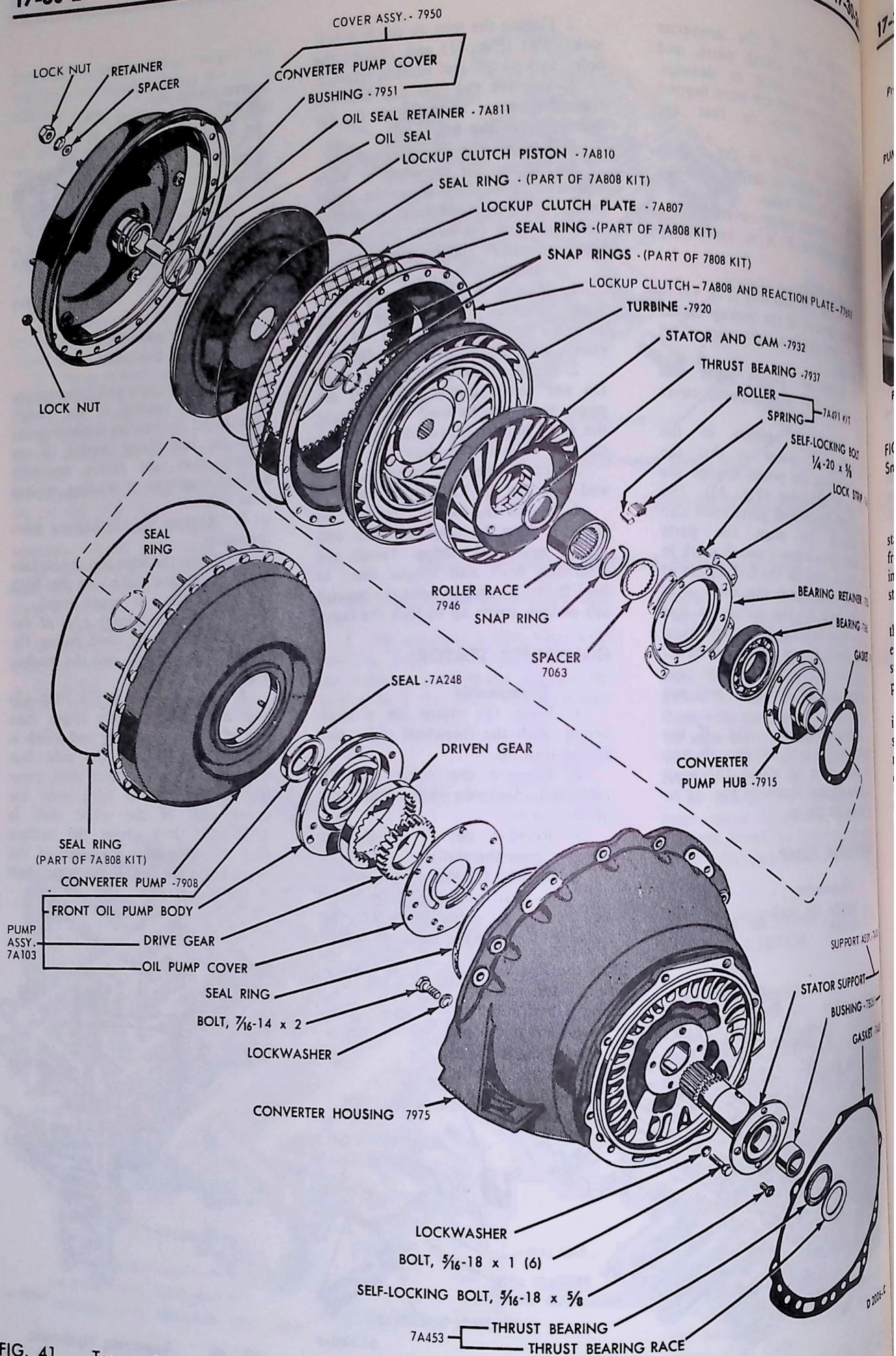



FIG. 41 Torque Converter, Lockup Clutch and Front Pump

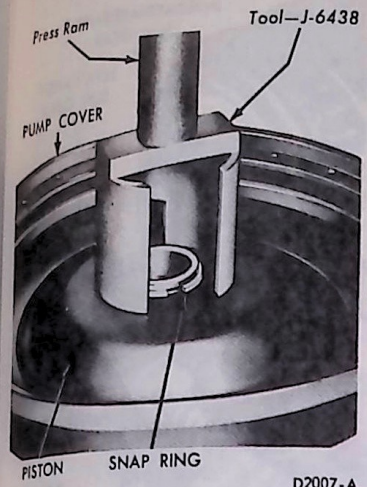


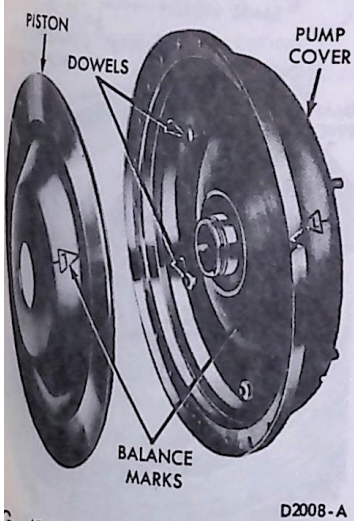

FIG. 42 Lockup Clutch Piston Snap Ring Removal or Installation

**Assembly**

1. Apply oil-soluble grease to the stator cam pockets, and place the freewheel roller springs in the openings with the open ends facing the stator bore (Fig. 44).

2. Compress the springs to allow the roller to be inserted in the shallow end of each cam pocket. Install one spring and roller in each of the ten pockets in the stator.

3. Install the freewheel roller race in the stator with the counterbored side facing away from the stator needle bearing. Rotate the race clockwise while installing it. When the race is fully seated, twist it firmly in a counterclockwise direction to lock it in the stator. Then place the stator with the freewheel inner race facing upward until installation.




G. 43 Lockup Clutch Piston d Converter Pump Cover Balance rks and Dowels

## CONVERTER HOUSING AND FRONT PUMP

**Disassembly**

1. Remove the bolts and lock washers that hold the front pump on the housing, and remove the pump body and gears (Fig. 45).

2. Lift the front pump cover and seal ring out of the converter housing.

3. Remove the gears from the pump body. Drive the seal out the front of the pump body.

4. Remove the bolts that hold the converter stator support assembly on the converter housing. Using a wood block, drive the support from the housing (Fig. 46).

The converter stator support bushing and the roller thrust bearing at the end of the stator support can be replaced. Refer to Section 4 for information on bushing replacement.

**Assembly**

1. Align the holes in the stator support with the holes in the converter housing by installing two headless bolts in the converter housing. Place a new support through the rear of the converter housing and over the headless bolts. The bolt holes are offset and the support cannot be rotated after it is driven into place. Using a wood block against the rear of the support, drive the support tightly against the housing (Fig. 47). Remove the two headless bolts. Then install the attaching bolts and torque them to 17-20 ft-lbs.

2. Coat the outer diameter of a new front pump seal with a very thin film of Permatex. Start the seal into the front bore of the pump body.

3. Support the machined rear face of the pump body on a flat surface and press the seal into the body (Fig. 48). **Use a hand press for this operation. Using a hydraulic press may damage the seal. Press the seal into the pump body until the distance measured from the front surface of the seal to the rear machined surface of the pump body is 1.595-1.605 inches.**

4. Place the pump gears in the pump body. Position the pump cover and install two guide bolts (Tool J3387-2) in the body. Install the square section O-ring seal round the pump cover.

5. Place the pump in front of the converter housing and insert the guide bolts through the proper holes in the housing and install four bolts with lock washers through the rear of the converter housing into the pump body.

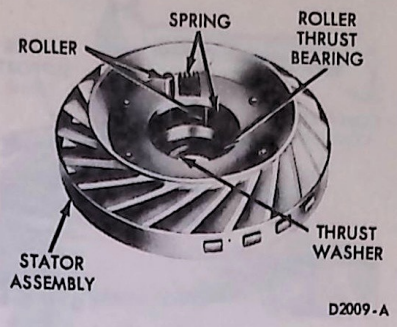



FIG. 44 Converter Stator

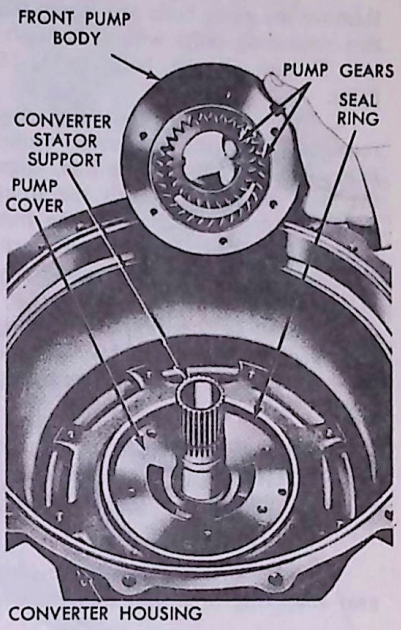



FIG. 45 Front Pump Body Removal

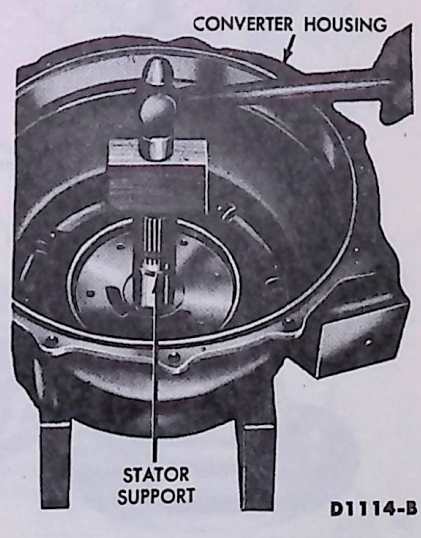



FIG. 46 Converter Stator Support Removal

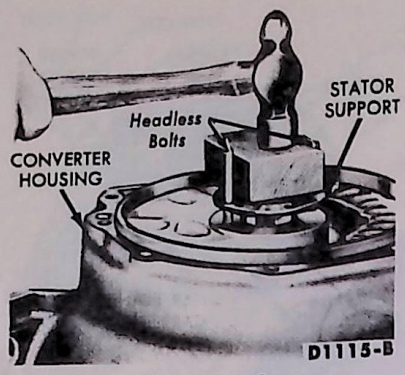



FIG. 47 Converter Stator Support Installation

Remove the guide bolts and install the two remaining bolts with lock washers. Torque all the bolts to 15-18 ft-lbs.

**6.** With the hook-type seal ring removed from the converter pump hub, align the flats on the hub, align the flats on the hub with the front pump drive flats and insert the hub through the seal. Leave these parts assembled in this manner until ready for final assembly.

**7.** Install the needle roller bearing and needle bearing assembly. Be sure the rollers in the assembly are facing down.

## SPLITTER MECHANISM, HIGH-RANGE CLUTCH, AND POWER TAKE-OFF DRIVE GEAR

### Disassembly

**1.** Remove the low-range sun gear snap ring (Fig. 49), then remove the low-range sun gear and intermediate range sun gear.

**2.** Grasp the unit with the fingers under the high-range clutch and the thumbs over the low-splitter clutch friction plate to prevent it falling apart, then place it on blocks.

**3.** Remove the thrust washer from the front of the splitter planetary carrier assembly, then remove the snap ring which holds the splitter planetary carrier assembly to the splitter output shaft assembly (Fig. 50).

**4.** Remove the splitter planetary carrier assembly and thrust washer in front of the splitter sun gear.

**5.** Remove the high-splitter clutch and low-splitter clutch friction plate on models having an 8-tanged low-splitter clutch plate (Fig. 51).

**6.** Remove the high-splitter clutch plate retaining snap ring, then remove the high-splitter clutch back plate.

**7.** In 3-plate clutch assemblies, remove the two internal-splined plates and one external-splined plate. In 5-plate clutch assemblies, remove three internal-splined plates and two external-splined plates. Remove the low-splitter clutch friction plate on models having a 6-tanged plate.

**8.** Place the high-splitter clutch housing in a press, support the rear of the housing, compress the piston Belleville return spring, then remove the snap ring (Fig. 52). Remove the housing from the press. **When releasing the Belleville spring pressure, be sure that the spring does not catch in the snap ring groove.**

**9.** Remove the Belleville spring and tap the forward edge of the clutch housing against a wood block to remove the high-splitter piston.

**10.** Remove the teflon seal ring and seal ring expander from the piston. Remove the hook-type seal ring from the housing.

**11.** Remove the thrust washer and the two hook-type seal rings from the diaphragm (Fig. 53).

**12.** Remove the splitter output shaft assembly. **Remove the splitter output shaft slowly so that the hook ends of the seal rings do not break off. Remove the two wire snap rings and the three hook-type seal rings, if necessary.**

**13.** Support the rear of the high-range clutch housing assembly in a press and compress the low-splitter clutch piston Belleville spring, using the tool shown in Fig. 54, then remove the snap ring. Carefully release the pressure on the Belleville spring to keep the inner edge of the spring from catching in the snap ring groove. Do not attempt to lift the diaphragm from the assembly at this time, as the vanes in the front-fluid velocity governor may be damaged by the pitot tube.

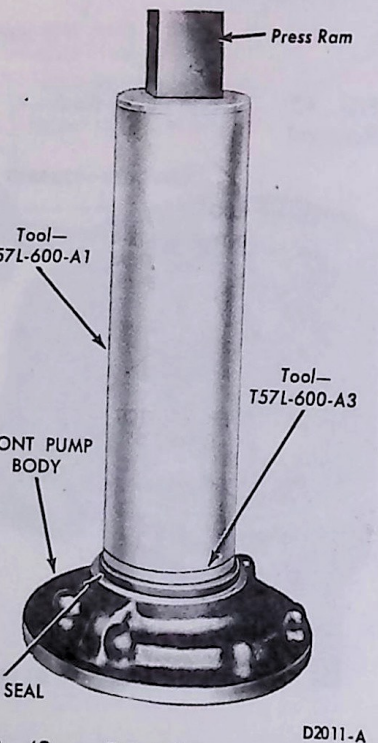



FIG. 48 Front Pump Seal Installation

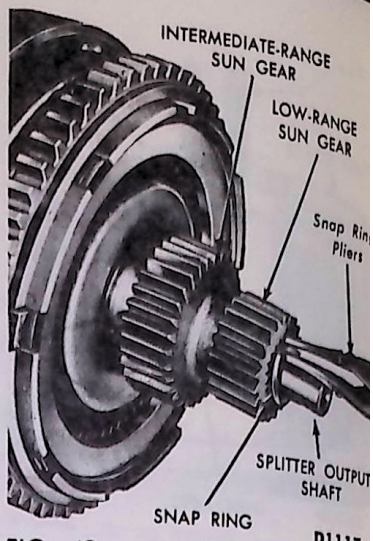



FIG. 49 Low-Range Sun Gear Snap Ring Removal

**14.** Remove the assembly from the press and lift out the Belleville Spring.

**15.** Remove the low-splitter clutch piston from the high-range clutch diaphragm and remove the teflon seal ring and seal ring expander from the piston. Remove the hook-type seal ring from the diaphragm. Do not attempt to remove the diaphragm from the assembly.

**16.** Remove the two frontpitot tube mounting screws and lock washers from the front surface of the diaphragm to allow the pitot tube to drop into the front governor collector ring (Fig. 55). Lift the diaphragm from the assembly and remove the two hook- type seal rings from the rear of the diaphragm. Remove the pitot tube from the collector ring.

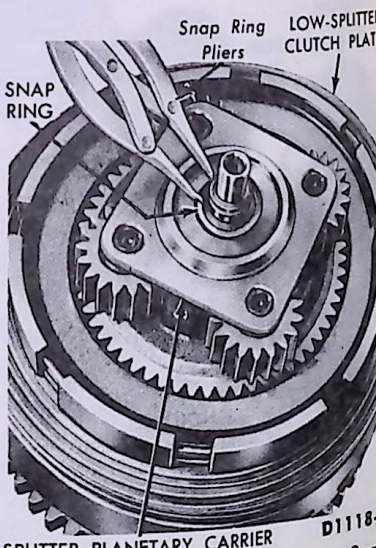
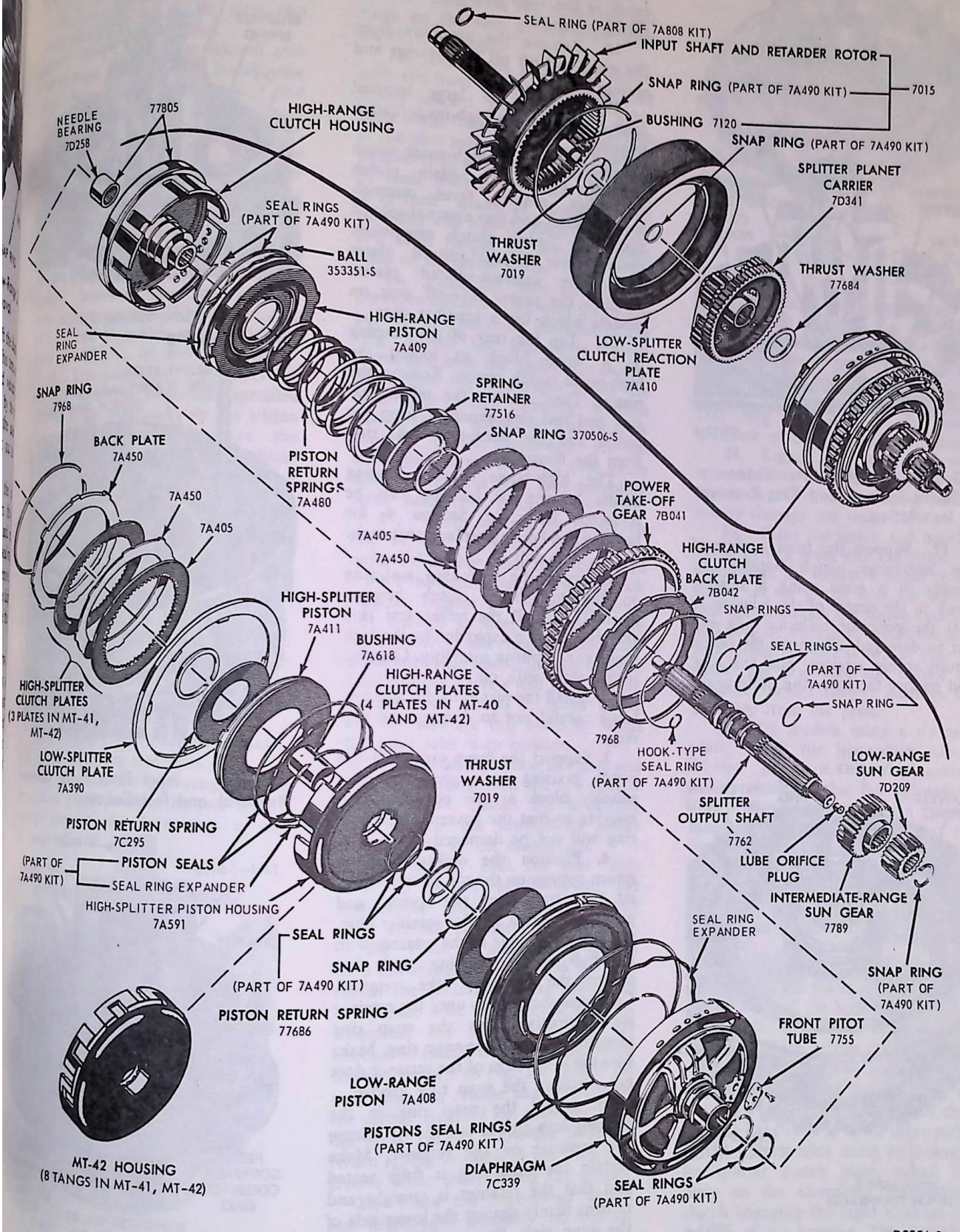



FIG. 50 Splitter Planetary Snap Ring Removal




Splitter Mechanism, High-Range Clutch and Power Take-off Drive Gear

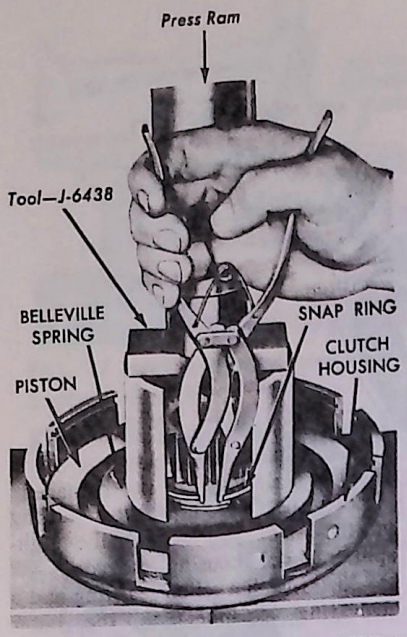



FIG. 52 High-Splitter Piston Belleville Spring Snap Ring Removal or Installation

**17.** Support the front surface of the high-range clutch housing assembly in a press using a suitable block in the center of the housing so that the governor collector ring will not be damaged. Compress the piston return spring retainer with the tool, and remove the snap ring. Release the pressure on the piston return spring retainer slowly, making sure the inner edge of the spring retainer does not catch in the snap ring groove as the spring expands.

**18.** Remove the assembly from the press and lift off the retainer and springs.

**19.** Remove the large internal snap ring from the high-range clutch housing.

**20.** Remove the high-range clutch reaction plate. In 5-plate clutch assemblies, remove three internal-splined plates and two external-splined plates. In 7-plate clutch assemblies, remove four internal-splined plates and three external-splined plates. Remove the power take-off gear on models which use a separate gear.

**21.** Tap the rear of the housing on a wood block to loosen the high-range clutch piston. Remove the piston. Then remove the teflon seal ring and seal ring expander from the piston and the hook-type seal ring from the housing.

The high-range clutch housing needle bearing or bushing can be replaced. Refer to Section 4 for bushing and bearing replacement tools.

**Assembly**

**1.** Install the hook-type seal ring on the high-range clutch housing assembly. Install the teflon seal ring and the seal ring expander on the high range clutch piston assembly. Coat the seals lightly with oil.

**2.** Install the piston in the housing, being careful not to damage the seal rings.

**3.** Support the front surface of the piston housing in a press, using a suitable block at the center of the housing so that the governor collector ring will not be damaged.

**4.** Position the coil-type piston return springs on the top of the piston, set the retainer on the springs and position the tool on the retainer (Fig. 56). Align the hole in the retainer with the hub of the housing, and then center the tool on the retainer. Compress the springs until the retainer is sufficiently below the snap ring groove and install the snap ring. Make sure the inner edge of the retainer does not catch in the snap ring groove.

**5.** Install the snap ring in the housing hub groove and slowly release the pressure on the retainer. Make certain the snap ring is fully seated and that the retainer is straight and returns firmly against the lower side of the snap ring. Remove the assembly from the press and place it gently on the bench, with the front governor collector ring down.

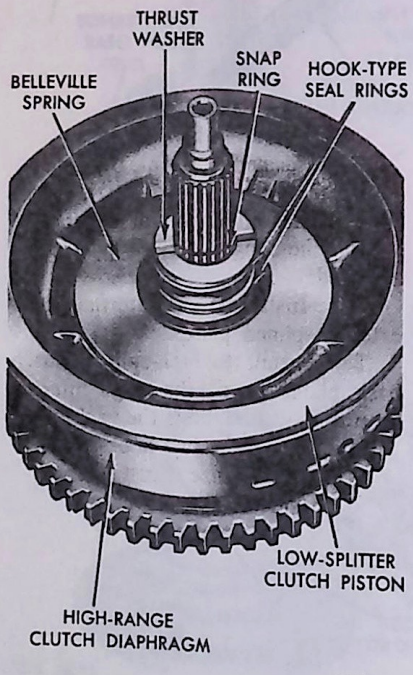



FIG. 53 Low Splitter Clutch Piston

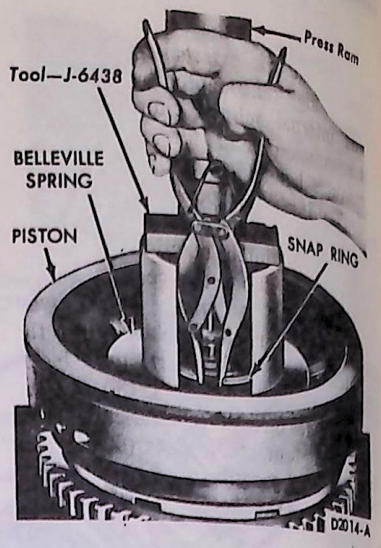



FIG. 54 Low-Splitter Piston Belleville Spring

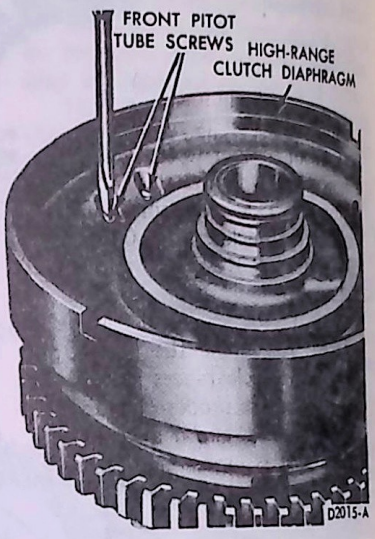



FIG. 55 Front Pitot Tube Screw Removal and Installation

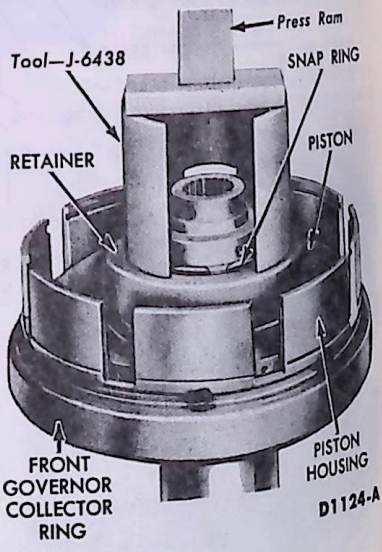



FIG. 56 High-Range Clutch Piston Return Spring Retainer Installation

6. Install the internal-splined plates and the external-splined plates in the high-range clutch housing. Soak the internal splined clutch plates in transmission fluid for at least two minutes before installation.

7. If a loose power take-off gear is used, temporarily install the high-range clutch reaction plate and snap ring without the gear.

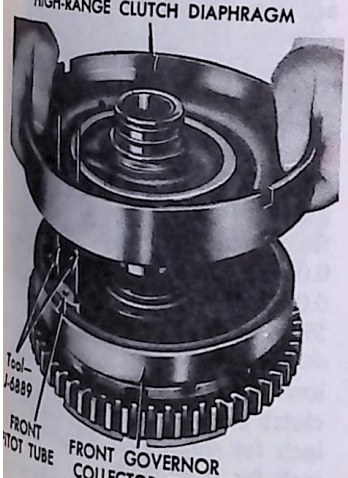
8. Using a small screwdriver, separate the reaction plate from the clutch plate and insert two feeler gauges through the slots 180 degrees apart. Measure the clearances in the clutch at four of the slots (90 degrees apart) and record the measurements (Fig. 59). **Do not force the feeler gauge between the plates.** This clearance must be 0.030-0.040 inch on MT-30 and 31 models and 0.040-0.050 inch on MT-40, 41 and 42 models.

9. Compare the clearances recorded with the clearances specified above. If the clearances are not within the specified limits, measure the reaction plate at its maximum thickness (from contour to flat side). Select a new plate with the thickness range required. The reaction plate is available in thickness of: 0.296-0.298, 0.304-0.306, 0.312-0.314 and 0.320-0.322.

10. If the reaction plate is replaced, reassemble the clutch pack and check the clearances as described above. After the proper clearance has been established, and if a loose power take-off gear is used, remove reaction plate snap ring and plate.

11. Install the loose power take-off gear with the end slots up.

12. Install the high-range clutch reaction plate so that the two longer tangs engage the drive slots in the power take-off gear.




IG. 57 High-Range Clutch
iaphragm Installation

13. Install the internal-snap ring in the high-range clutch housing to retain the clutch reaction plate.

14. Install the two hook-type seal rings on the rear of the high-range clutch diaphragm.

15. Install the high-range clutch with the front governor collector ring facing upward. Install the two guide bolts in the front pitot tube on the side of the pitot tube that the drilled port is located (Fig. 57). **The guide bolts can be made from two 5 -inch lengths of 3/16-inch diameter brazing rod threaded with a 10-32 die a distance of 3/8 inch. Round off the unthreaded ends of the guide bolts.**

16. Place the pitot tube in the governor collector ring with the intake port toward the outer diameter of the ring. Install the high-range clutch diaphragm over the high-range clutch. Make sure the diaphragm enters the high-range clutch housing without damaging the hook-type seal rings at the rear of the diaphragm. At the same time, direct the pitot tube guide bolts through the pitot tube mounting screw holes (Fig. 55).

17. While holding up firmly on one of the pitot tube guide bolts, remove the other guide bolt and install a pitot tube mounting screw and lock washer. Tighten the mounting screw just enough to keep the pitot tube from moving and remove the other guide bolt, then install the second pitot tube mounting screw and lock washer. Torque both screws to 30-48 in-lbs. Do not separate this assembly while the pitot tube is in position.

18. Install the teflon seal ring and seal ring expander on the low-splitter clutch piston. Install the hook-type seal ring on the low-splitter piston housing side of the diaphragm.

19. Lightly coat the seal rings with oil and carefully install the low-splitter piston so that the seal rings are not damaged.

20. Place the assembly in a press with low-splitter clutch piston up, then install the Belleville return spring on the piston with the convex side up. Compress the spring carefully far enough to install the snap ring, using the tool shown in Fig. 54. Install the snap ring and release the pressure on the spring. Remove the assembly from the press. Do not allow the Belleville return spring to catch in the snap ring groove while compressing the spring.

21. Place the high-range clutch and diaphragm assembly on blocks. Install the two wire snap rings and the three hook-type seal rings on the splitter output shaft assembly. Lightly coat the seal rings with oil and carefully install the splitter shaft so that the seal rings are not damaged.

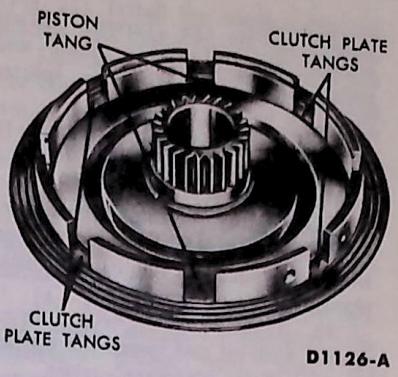



FIG. 58 Low-Splitter Clutch Plate Installation

22. Install the hook-type seal ring on the inner diameter of the high-splitter clutch housing and gear.

23. Install a teflon seal ring and a seal ring expander on the outer diameter of the high-splitter piston.

24. Lightly coat the seals with transmission fluid and install the piston in the housing, being careful not to damage the seals.

25. Place the piston and housing assembly in a press with the piston up, then install the Belleville piston return spring on the piston with the convex side up. Compress the spring carefully and only far enough to install the snap ring, using the tool shown in Fig. 52. Install the snap ring and release the pressure on the spring. Remove the assembly from the press.

26. On models using a six tang plate, install the low-splitter clutch friction plate on the high-splitter clutch housing so that the high-splitter clutch housing so that the six internal tangs do not engage the slots in the housing where the high-splitter piston tangs are located (Fig. 58). If the tangs are installed in the same slots, in error, both splitter clutches will be applied when the high-splitter piston is actuated.

27. Install the internal and external-splined plates.

28. Install the high-splitter clutch back plate. Install the large internal snap ring which retains the back plate.

29. Install the two hook-type seal rings and the bronze thrust washer on the front side of the diaphragm, then apply a light coat of oil to these parts.

30. On models using an 8-tanged low-splitter clutch plate, install the plate on the assembled high-splitter clutch engaging the eight slots on the outside of the housing. The sixtanged plate is installed at the time of the high-splitter clutch assembly, being careful not to damage the ring seals.

31. Coat the bronze thrust washer with oil-soluble grease and install the washer in the splitter planetary carrier assembly.

32. Install the splitter planetary carrier assembly, splining it on the splitter output shaft and meshing the external teeth with those of the splitter clutch plates. Install the snap ring on the splitter shaft to retain the splitter planetary carrier assembly.

33. Lightly coat the bronze thrust washer with oil and install the washer on the splitter planetary carrier.

34. Remove the splitter assembly from the blocks and place it on its side. **Be careful in handling the assembly until the low- and intermediate-range sun gears are installed and retained by snap rings so that the front pitot tube will not damage the front governor collector ring.**

35. Install the intermediate- and low-range sun gear with the chamfered end of teeth outward (Fig. 51).

36. While holding the splitter shaft by the opposite end, install the snap ring to retain the sun gears.

## REVERSE RANGE CLUTCH PLATE AND RING GEAR (MT-30 AND MT-31 MODELS)

### Disassembly

1. Straighten the clutch plate retainer ring at either side of the plate, and remove the ring.

2. Lift the plate off the gear. Then straighten and remove the other ring.

### Assembly

1. Engage the internal splines of the clutch plate with the external splines of the ring gear, and position the plate between the two grooves cut around the outside diameter of the ring gear.

2. Place a new clutch plate retainer ring in one of the two grooves and crimp the ring at five evenly spaced intervals around the gear. Be sure that the ring is installed well below the clutch plate surface. **Do not crimp the retainer ring at points where cutouts are made in the friction facings.**

3. Turn the assembly over and install a second new retainer ring in the same manner as the first ring.

## LOW-RANGE AND REVERSE PISTON HOUSING OR intermediate-RANGE PISTON HOUSING

### Disassembly

1. Tap the edge of the housing on a wood block to loosen the pistons, then remove the pistons from the housings.

2. Remove the seal ring and seal ring expander from the outer groove of the piston, and the hook-type seal ring from the housing, or from the piston in the case of the intermediate-range piston.

To remove the teflon seals, loosely tie a piece of heavy cord around the seal. Then, twist a screwdriver into the cord and work the cord around the seal until the seal bulges out from the piston enough to insert a screwdriver under the seal. Remove the seal and expander from the piston.

### Assembly

1. Install a new seal and expander in the outer groove of the piston, and a hook-type seal ring on the housing, or on the piston, in the case of the intermediate-range piston.

2. Lightly coat the seals with oil and install the piston, pushing them all the way into the housings. **Be careful not to damage the seals.**

## LOW-RANGE RING GEAR AND INTERMEDIATE-RANGE PLANETARY CARRIER

### Disassembly

1. Remove the internal-snap ring from the low-range ring gear, using a sharp pointed drift pin.

2. Lift out the intermediate-range planetary carrier.

### Assembly

1. Mesh the external teeth of the planetary carrier with the internal teeth of the ring gear and push the carrier into the ring gear.

2. Install the internal-snap ring to hold the assembly together.

## PROCEDURE FOR CHECKING RANGE CLUTCH CLEARANCES PRIOR TO TRANSMISSION ASSEMBLY

Check the clutch clearances if any pistons, piston housings, apply plates, reaction housings. Belleville springs, or clutch plates have been replaced in the low-range, intermediate-range or reverse clutches. Perform this check before assembling these clutches in the transmission housing, using the tool shown in Fig. 59. These clutches should be checked on every rebuild or disassembly to be certain they meet the proper clearance specifications of:

Low-Range
(3-plate)-0.020 to 0.030
(Single Plate)-0.010 to 0.015
Intermediate-Range
0.030 to 0.040
High-Range
(5-Plate)-0.030 to 0.040
(7-Plate)-0.040 to 0.050
Reverse-Range
(3-Plate)-0.020 to 0.030
(Single Plate)-0.010 to 0.015

### Assembly of Clutches in Tool

1. Place the intermediate-range clutch reaction housing (yellow marked) in the tool with four of the slots adjacent to the four posts of the tool (Fig. 59). **Refer to the note concerning color coding of the clutch parts in the Specification Section.**

2. Place an intermediate-range internally splined clutch plate in the intermediate-range reaction housing. Position the externally splined plate and the other internally splined plate. Install the intermediate-range clutch apply plate, the intermediate-range clutch Belleville spring with the convex side up, the intermediate-range clutch piston and the piston housing with the piston down.

3. Install the low-range clutch reaction housing with the slots up, the low-range clutch plate(s) and the lowrange clutch apply plate with the flat side down.

4. Install the low-range Belleville spring with the convex side up, and then install the low-range and reverse piston and housing assembly with the red marking up.

5. Install the reverse Belleville spring with the convex side down, and install the reverse clutch apply plate with the flat side up.

6. Install the reverse clutch plate(s), and then install the reverse clutch reaction housing with the slots down.

7. Place the top plate of the tool on the clutch stack, then install the tool bearing, flat washer, and the nut.

8. Use a 1 5/8-inch socket wrench to torque the nut to 30 ft-lbs. Make certain that all clutch parts are perfectly centered. Torque must cause metal-to-metal contact at outside diameters of piston housing and clutch plate reaction housings to insure accurate measurement of clutch clearance.

### Checking Clutch Clearance

1. Use a small screw driver to separate the plates, and then measure the clearances between the clutch friction plates and the clutch apply plates of the reverse clutch with a feeler gauge. This clearance should be 0.010-0.015 inch for single plate and 0.020-0.030 inch for three plate (Fig. 59).

2. Repeat this operation for the low-range clutch. The low-range clutch clearance should be 0.010-0.015 inch for single plate and 0.020-0.030 inch for three plate.

3. Check the intermediaterange clutch in the same way. The clearance should be 0.030-0.040 inch.

4. If the clutches do not have the specified clearances, it will be necessary to replace the apply plates. The apply plates are available for reverse, and low-ranges in nine thicknesses: 0.458-0.462, 0.465-0.469, 0.472-0.476, 0.312-0.316, 0.298-0.302, 0.284-0.288, 0.270-0.274, 0.291-0.295, and 0.277-0.281 inch. The intermediaterange apply plates are available in six thicknesses: 0.312-0.316, 0.302-0.298, 0.288-0.284, 0.270-0.274, 0.291-0.295 and 0.277-0.281 inch.

5. Measure the maximum thickness of the apply plate from the clutch stack and, by considering the clearance measurement taken while the stack is assembled, choose the correct plate to bring the clearance to specifications.

6. Establish the correct clutch clearance for the three ranges, then remove the clutch pack from the fixture and stack them on a bench in the reverse order. Now, each part may be selected in the correct order for assembly in the transmission housing.

## ASSEMBLY OF TORQUE CONVERTER AND TRANSMISSION

**Do not use gasket sealer when assembling the transmission, except on the power take-off cover (use sparingly). As mating parts are pulled together, the excess sealer is squeezed out of the splitline into the tranmission. A very small amount of this material can affect the functioning of the various valves which control the operation of the transmission.**

**Soak all-clutch plates in transmission fluid for at least two minutes before installation.**

**1.** If a housing shim was removed during disassembly, install the same shim. **If a new housing (case) is used, do not use the old shim.** Install the oil collector with the conical portion facing toward the front of the housing.

**2.** Install the intermediate-range clutch reaction housing so that the anchor bolt hole or slot is aligned with the hole in the bottom of the transmission housing. Install, but do not tighten the intermediaterange clutch reaction housing anchor bolt and nut. **Refer to the disassembly procedure for the color coding of the clutch components.**

**3.** Position an internal-splined plate in the reaction housing.

**4.** Position the externally splined plate in the reaction housing, mating the plate with the housing slots.

**5.** Install the ring gear. **The ring welded to the gear is not centered, and the gear must be installed so that the longer spline teeth engage the front clutch plate splines (Fig. 60).**

**6.** Position the other internally splined clutch plate, meshing the plate splines with the spline teeth of the ring gear.

**7.** Install the apply plate. The intermediate-range apply plate is available in six thicknesses, ranging from 0.270 to 0.316 inch.

**8.** Install the intermediate-range clutch Belleville spring with the convex side toward the rear of the transmission. The spring must be entered perfectly on the clutch apply plate so that the intermediate-range piston housing will seat properly around it.

**9.** Install the intermediate-range piston housing with the piston facing the Belleville spring and with the tapped hole in the piston housing in line with the corresponding anchor bolt hole in the bottom of the transmission housing.

**10.** Install, but do not tighten, the intermediate-range clutch piston housing anchor bolt.

**11.** Install the low-range ring gear and intermediate-range planetary carrier (Fig. 23). Rotate the assembly until the planetary pinion teeth engage the internal teeth of the intermediater-range ring gear.

**12.** Install the low-range clutch reaction housing, aligning the tapped hole or slot in the plate with its corresponding anchor bolt hole in the bottom of the transmission housing (Fig. 22). Install the reaction housing anchor bolt and nut. **Do not tighten.**

**13.** Install the clutch plate(s) and the clutch apply plate. The low-range apply plate is available in three thicknesses on MT30 and 31 models, ranging from 0.458 to 0.476 inch thick. On MT40, 41 and 42 models there are six thicknesses available, ranging from 0.270 to 0.316 inch thick.

**14.** Install the transmission output shaft assembly, engaging the planetary pinion teeth with the internal teeth of the low-range ring gear.

**15.** Install the reverse sun gear shaft over the output shaft. Mesh the teeth on the flange with the internal teeth of the low-range ring gear.

**16.** Install a new snap ring in the internal groove of the low-range ring gear, install the low-range clutch Belleville spring with the convex side toward the rear of the transmission. The spring must be centered perfectly on the clutch apply plate so that the low-range and reverse clutch piston housing will seat around it.

**17.** Install the low-range and reverse clutch piston housing assembly, aligning the tapped hole in the piston housing with the corresponding anchor bolt hole in the bottom of the transmission housing. **Refer to the disassembly procedure for the correct color code.** Do not install the anchor bolt at this time.

**18.** Install the reverse clutch Belleville spring with the concave side toward the rear of the transmission. Depress the Belleville spring edge and install the square head anchor bolt from inside the transmission.

**19.** Before installing the reverse clutch pack in the housing, assemble it as follows:

Place the clutch apply plate on a bench with the flat surface up. Position the reverse ring gear and clutch plate assembly on the apply plate with the longer section of the ring gear external teeth up. Over these parts, position the reverse reaction housing with the slots down so the slots engage the clutch apply plate tangs.

Install this assembly in the transmission housing, aligning the tapped hole or slot in the reaction housing with the corresponding anchor bolt in the bottom of the transmission housing. **Do not install the anchor bolt at this time.**

**20.** Install the reverse sun gear splined thrust washer on the reverse sun gear shaft.

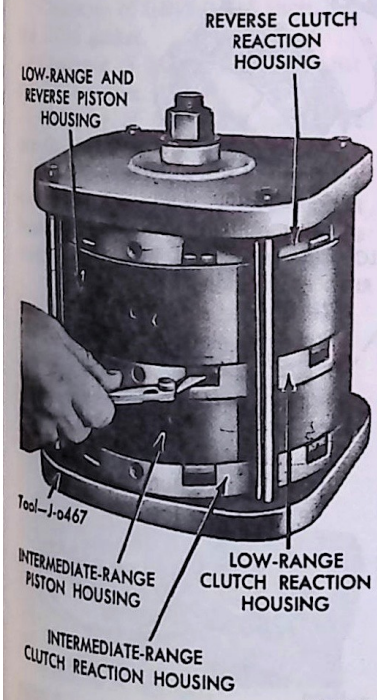



FIG. 59 Check Range Clutch Clearance

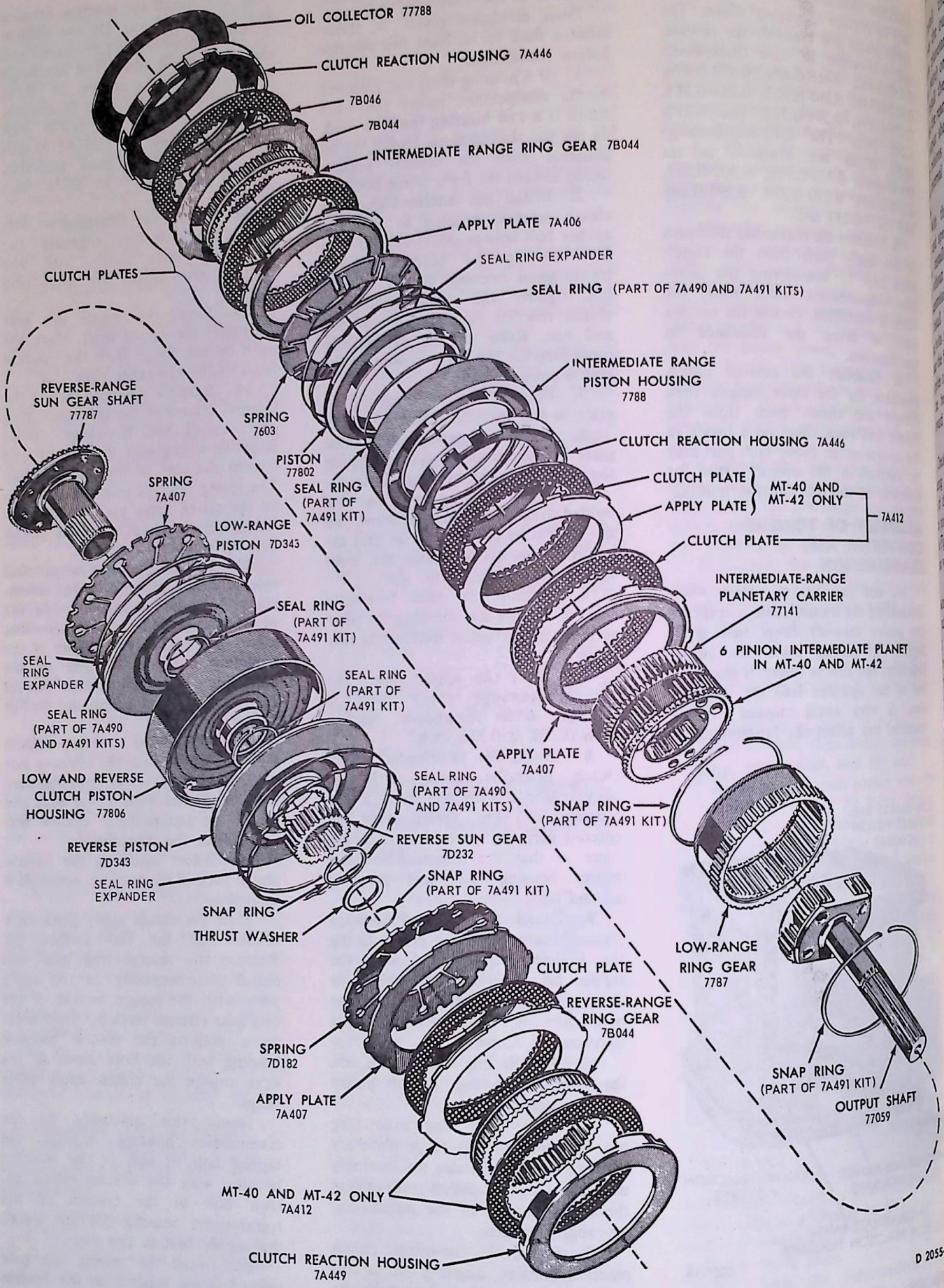



FIG. 60 Typical Range Clutches and Gears (Intermediate, Low and Reverse)

Install the reverse sun gear on the sun gear shaft, then install a new snap ring.

**21.** Install the bronze thrust washer over the output shaft. Install the reverse planetary carrier locating snap ring (wire) on the output shaft.

**22.** Install the reverse planetary carrier and the rear pitot collector ring on the output shaft. Make sure the planetary pinions mesh with the sun gear and internal teeth of the reverse ring gear.

**23.** With the rear pump (or adapter) and speedometer drive gear removed, install the rear bearing retainer, without a gasket, on the rear of the transmission housing.

**24.** Install four bearing retainer mounting bolts at 90 degree intervals, and torque the bolts to 85 in-lbs. This torque applies to gasket selection only. Draw the bearing retainer down evenly toward the transmission housing.

**25.** Check the clearance between the bearing retainer and the rear surface of the transmission housing near the points where the bolts are installed (Fig. 61). This clearance will determine which gasket or gaskets to use.

Gaskets are avilable in 0.012, 0.016, and 0.021 inch thickness. If the gaskets are not clearly marked, measure them with a micrometer. The gasket thickness for various clearances is given below:

Clearance of 0.005-0.015 inch, use the 0.012 gasket.

Clearance of 0.015-0.021 inch, use the 0.016 gasket.

Clearance of 0.022-0.027 inch, use the 0.021 gasket.

Clearance of 0.028.033 inch, use one 0.012 and one 0.016 gasket.

**26. Install, but do not tighten, the low-range and reverse clutch piston housing anchor bolt and the reverse clutch reaction housing anchor bolt.**

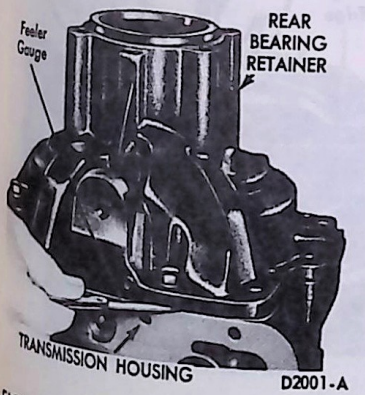



FIG. 61 Rear Bearing Retainer Gasket Measurement

**27. Remove the four bearing retainer bolts and remove the bearing retainer.**

**28.** Torque the five anchor bolts installed in the bottom of the transmission housing to 10 ft-lbs. **This torque is temporary.**

**29.** Install the correct rear bearing retainer gasket. Install two guide bolts in the rear pitot tube. Make sure the open (drilled Port) side of the pitot tube is toward the bolts. To make a guide bolt, thread one end of a 6-inch long by 1/4-inch diameter brazing rod. Use a 1/4-inch-28 die and thread a distance of 3/8-inch. Round off the unthreaded end.

If guide bolts are not available, install the pitot tube as follows:

Place the pitot tube on the mounting pad of the rear pump body. Using a pair of side-cutting pliers, crimp two or three threads near the end of a soft 1/4-28 bolt. Insert the crimped thread through the rear of the bearing retainer and screw it into the pitot tube until it binds enough to control the movement of the pitot tube. Swing the pitot tube toward the center of the bearing retainer so that it will clear the pitot collector ring when the retainer is installed, then install the retainer. Turn the pitot tube to its normal position and start a mounting bolt. Pull the pitot tube tight and remove the crimped installation bolt. Install the other pitot mounting bolt. Leave 1/16-inch or more of the mounting bolts protruding at the rear of the retainer.

**30.** Place the pitot tube in the rear pitot collector ring with the tube portion toward the vanes and the guide bolts toward the rear of the transmission (Fig. 62).

**31.** Carefully lower the rear bearing retainer over the output shaft while guiding the ends of the guide bolts through the pitot tube mounting bolt holes in the retainer. It also will be necessary to guide the rear pump drive lugs into the driving slots in the reverse palnetary carrier and to start the speedometer drive gear on the output shaft. Do not remove the pitot tube guide bolts at this time. Do not turn the output shaft until the output flange (retaining) attaching bolt is installed. Otherwise, damage to the pitot tube or governor vanes may result.

**32.** Install the rear bearing retainer bolts and lock washers. At this time, tighten the piston housing anchor bolts 3-10 ft-lbs torque to seat the housings firmly. Then torque the retainer bolts to 42-50 ft-lbs.

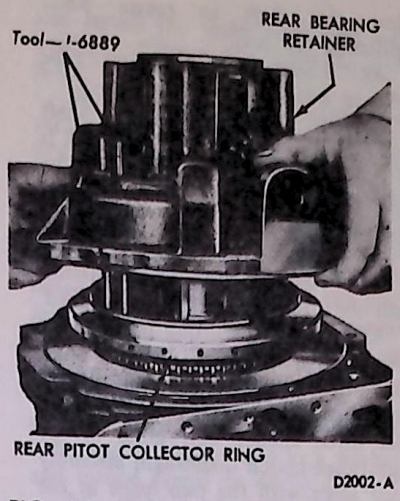



FIG. 62 Rear Bearing and Pitot Tube Installation

**33.** Tighten the three low- and intermediate-range and reverse clutch reaction housing anchor bolts to 35-40 ft-lbs. Tighten the nuts to 65-75 ft-lbs. Be sure to use new nuts only. The old nuts are not reusable.

**34.** Torque the two piston housing anchor bolts to 20-23 ft-lbs.

**35.** While pulling outward on one pitot tube guide bolt, replace the other guide bolt with a mounting bolt, replace the second guide bolt in the same way. Do not tighten the mounting bolts at this time. The mounting bolts should protrude 1/16-inch or more.

**36.** Install the brake support plate assembly on the bearing retainer and at the same time, install the brake apply lever and cam (Fig. 63). Tighten the bolts to 67-80 ft-lbs torque.

**37.** Install the output shaft flange and parking brake drum. Do not turn the output shaft while installing the flange and drum. If the shaft is turned, damage to the pitot tube or governor may result.

**38.** Install the O-ring seal, tab lock washer, and output shaft bolt. Torque the bolt to 10 ft-lbs. Do not

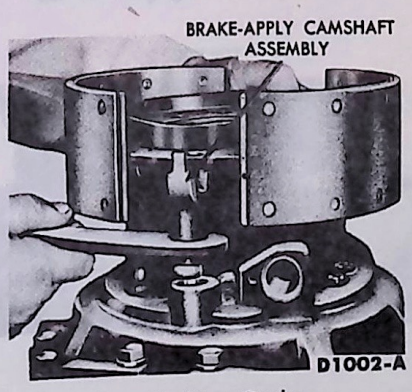



FIG. 63 Parking Brake Installation

allow the shaft to rotate while tightening the bolt.

**39.** Torque the rear-pitot tube bolts to 8-10 ft-lbs.

**40.** Torque the output shaft flange bolt to 83-100 ft-lbs and lock it by staking the tab lock washer into the hole in the retainer and bending a tab against a flat of the bolt head.

**41.** Adjust the parking brake.

**42.** Position the transmission with the front surface facing upward.

**43.** Install the lifting hook in the front end of the splitter output shaft and install the splitter section and highrange clutch assembly (Fig. 21). The three anchor bolt holes in the high-range clutch diaphragm assembly must align with the two holes in the bottom of the transmission and one hole in the top of the housing.

**44.** Start all three anchor bolts. On the top bolt (Fig. 64), leave approximately 1/8-inch gap between the bolt head and the transmission housing. Using a speed wrench, tighten bolt A. Loosen the bolt, then pull it up snug.

**45.** Tighten bolt B to 20-23 ft-lbs torque.

**46.** Tighten bolt A to 20-23 ft-lbs torque.

**47.** If the top bolt is finger loose, tighten it to 20-23 ft-lbs torque. If it is not finger loose, loosen bolts A and B and re-torque reversing the torque sequence. The top bolt should be torqued to 20-23 ft-lbs only if it is finger loose. Failure to tighten the bolts in the order described, may cause internal fluid leaks, resulting in low pressures and erratic shifts.

**48.** Install the low-splitter clutch reaction plate with the vanes toward the front of the housing and the anchor bolt hole in line with the hole in the bottom of the housing.

**49.** Install the reaction plate anchor bolt and torque it to 20-23 ft-lbs.

**50.** Install the hook-type seal ring around the splitter ring gear of the turbine shaft and hydraulic retarder rotor (Fig. 20).

**51.** Make sure that the thrust washer is in front of the splitter planetary carrier assembly and that the hook-type seal ring is in the groove at the front of the splitter output shaft assembly (Fig. 20). Oil the thrust washer and the hook-type seal ring then install the turbine shaft and hydraulic retarder rotor assembly. Be careful to avoid damaging the hook-type seal ring at the front of the splitter output shaft.

**52.** Position the converter housing gasket on the front of the transmission housing.

**53.** Install the needle roller bearing and needle bearing assembly. Be sure the rollers in the assembly are facing down. Then install the converter housing on the tranmission housing assembly and secure it with the 10 mounting bolts and lock washers. Torque the bolts to 42-50 ft-lbs.

**54.** Install the hook-type seal ring on the converter pump hub.

**55.** Install the converter pump in the converter housing. Make sure the flats on the hub mate with the front pump drive flats and that the hooktype seal ring on the hub passes through the front pump seal without damage to the seal ring or seal.

**56.** Install the splined spacer and the snap ring which retains it.

**57.** Hold the freewheel roller race in the stator, and install the stator on the stator support as shown in Fig. 65. The stator should rotate freely in the direction of engine rotation (clockwise) and should lock up when rotated in the other direction.

**58.** Install the torque converter turbine on the turbine shaft (Fig. 66).

**59.** Install the snap ring and hooktype seal ring on the turbine shaft (Fig. 66).

**60.** Install a polyacrylate seal ring in the groove just inside the bolt circle in the converter pump and a second

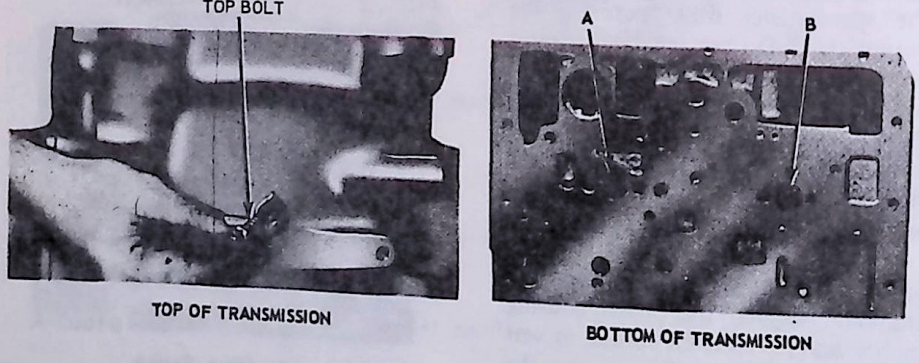



FIG. 64 Diaphragm Bolts— Tightening Sequence

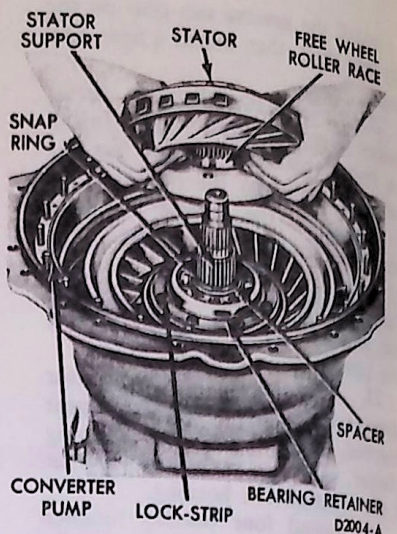



FIG. 65 Converter Stator Installation

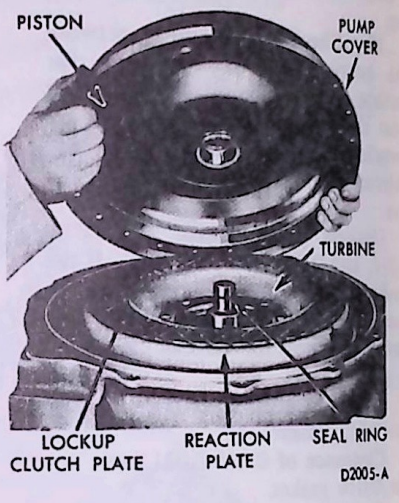



FIG. 66 Converter Pump Cover Installation

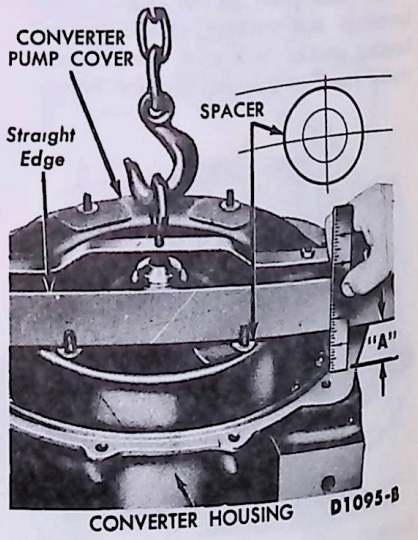



FIG. 67 Converter Slack Control Spacer Measurement

ring on the front of the lockup clutch reaction plate. Be sure the seal is in place inside the groove of the converter pump and plate so they cannot squeeze out during cover assembly.

61. Install the reaction plate (Fig. 66). **If inked balance marks are found on the reaction plate, converter pump, lockup piston and pump cover, assemble and parts with the marks aligned.**

62. **Install the lockup clutch plate on the reaction plate with internal teeth engaging the turbine splined ring. The clutch plate should be soaked in transmission fluid for at least two minutes before installation**

63. Install the converter pump cover assembly on the converter pump studs. If balance marks are on the cover and pump, align the balance marks (Fig. 43). Install four nuts at 90 degree intervals and torque alternately to 10 ft-lbs to prevent the polyacrylate seals from being forced out of their grooves. Install the remaining nuts and torque all nuts to 19-23 ft-lbs.

64. If any of the parts listed below are replaced during transmission assembly, the dimension A in Fig. 67 must check.

Parts replacement which may affect the dimension A are:

Converter pump cover assembly
Converter pump
Converter pump hub
Converter stator support assembly
Converter housing

The dimension A may be checked by fastening a sling to two opposite converter pump cover studs and applying a pull of 100 pounds or more to remove all end play. While the pull is applied, measure the distance A as shown in Fig. 67. If the dimension is not within 1.572-1.592 inches, remove the spacer retainer(s) and install or remove converter stack control spacers at the pump cover studs as needed. In determining the spacers required, be sure to include the spacer retainer flat thickness (0.015-0.018 inch). The correct dimension should be established at each of the six stud positions. The spacers are serviced as follows:

| Thickness | Color Code |
|---|---|
| 0.027-0.029 inch | Gold |
| 0.045-0.047 inch | Silver |
| 0.063-0.065 inch | Copper |
| 0.081-0.083 inch | Black |
| 0.099-0.101 inch | Plain |

After the correct spacers have been installed or removed install the spacer retainers(s).

65. If a new control valve body is being installed, the closed throttle stop must be adjusted following the procedures given under Adjustments in Section 3.

66. Insert the hydraulic retarder valve teflon ball in the transmission housing, install a new gasket on the transmission housing, and then install the hydraulic retarder control valve body assembly install three long (2 1/4-inch) and five short (1 1/4-inch) mounting bolts. Torque the 1 1/4-inch bolts to 15-18 ft-lbs and the 2 1/4-inch bolts to 14-17 ft-lbs.

67. Coat the lube line check valve nylon ball with oil-soluble grease and insert it into the oil transfer plate. Install the oil transfer plate and secure it with the 10 bots and lock washers. Install the two short bolts at the thin section of the oil transfer plate. Torque the bolts to 8-10 ft-lbs.

68. Position the downshift timing valve body on the oil transfer plate and install the three bolts and lock washers. Torque the bolts to 8-10 ft-lbs.

69. Place the detent shift valve spring in the oil transfer plate and the 3/8-inch diameter steel ball and the 1/2-inch diameter rear pump cut-off valve nylon ball in the range selector valve body. Hold the balls in place with oil-soluble grease. Position the range selector valve body on the plate making sure that the range selector shaft enters the hole in the range selector valve and that the TV lever is against the valve and inside adjusting screw bracket. Install the attaching bolts, spacer sleeves, and lock washers and torque evenly to 48-72 in-lbs.

70. Place a new seal ring on the long tube end of the filter can and install the assembly over the control valve body. Install the attaching bolts. Torque the 3 3/4-inch bolt, located near the end of the long tube, to 4-6 ft-lbs. Torque the remaining two bolts to 8-10 ft-lbs.

71. Install a new oil pan gasket on the transmission housing with the bolt holes properly aligned.

72. If the pan is damaged, replace it.

73. Install the oil plan on the housing. Install the self locking oil pan bolts and torque to 15-18 ft-lbs.

74. Install a new fluid filter element in the oil pan and install the fluid filter retainer and seal ring, a new cover seal ring, and the cover.

75. Remove the transmission from the repair stand and install the covers and gaskets on the power take-off openings. Install the cover bolts and torque them to 15-20 ft-lbs.

# 9 SPECIFICATIONS

## IDENTIFICATION AND APPLICATION

| Transmission Model | MT-40 | MT-40 | MT-42 | MT-40 | MT-41 |
|---|---|---|---|---|---|
| Engine Application | 361-EFW<br>391-EFY | 175 CAT. | 477EDM<br>534EDN | 401EDL | 200CAT. |
| Truck Model | C-750<br>C-CT-800<br>L-LT-LTS-<br>LN-LNT-800 | C-7000<br>L-LT-LTS-<br>LN-LNT-<br>8000 | C-900<br>L-LT-<br>LTS-900 | C-900<br>L-LT-LTS-<br>900 | C-7000-8000<br>L-LT-LTS-<br>LN-LNT-<br>8000 |

## GENERAL SPECIFICATIONS

Dry Weight (including Parking Brake) ..... 510 lbs.
Front Pump Capacity ..... 16 gpm at 2000 rpm
Power Take-Off Mountings .... 2 SAE Regular Duty
Power Take-off Drive Gear .... 57-Tooth, 6/8 Pitch
Power Take-off Drive Gear Maximum Speed ..... Engine Speed
Lubricant Capacity (less external system) ..... 18 quarts (approx)

## STALL SPEED LIMITS

| Engine | Transmission Model | Convertor Ratio | Stall Speed (rpm) |
|---|---|---|---|
| 361 CID | MT-40 | 2.8:1 | 2200–2400 |
| 361 CID | MT-40 | 3.5:1 | 2150–2350 |
| 391 CID | MT-40 | 2.8:1 | 2300-2550 |
| 391 CID | MT-40 | 3.5:1 | 2250–2450 |
| 401 CID | MT-40 | 2.8:1 | 2300–2500 |
| 401 CID | MT-40 | 3.5:1 | 2200–2400 |
| 477 CID | MT-42 | 3.0:1 | 1700–1900 |
| 534 CID | MT-42 | 2.5:1 | 1800–2000 |
| 175 CAT. | MT-40 | 3.5:1 | 2390 |
| 200 CAT. | MT-41 | 3.0:1 | 1955 |

## RANGES AND GEARS

| Selector-Lever Position | Range | Gears In Range |
|---|---|---|
| 1-2 | Low | 1st, 2nd |
| 3-4 | Intermediate | 3rd, 4th |
| 3-5 | Drive | 3rd, 4th, 5th |
| 3-6 | Drive | 3rd,4th,5th,6th |
| N | Neutral | |
| R | Reverse | |

## FLUID PRESSURE CHECKS
## MAIN PRESSURE CHECK – CONVERTER OPERATION AT ENGINE IDLE

| Selector Lever Position | Gear | Throttle Position At Transmission | Gauge Readings (psi) |
|---|---|---|---|
| N | | Closed | 50 Minimum |
| R | | Closed | 50 Minimum |
| 3-4, 3-5, 3-6 | Third | Closed | 50 Minimum |
| 1-2 | First | Closed | 50 Minimum |

## MAIN PRESSURE CHECK – CONVERTER OPERATION

| Selector Lever Position | Engine Speed (rpm) | Gauge Readings (psi) | |
|---|---|---|---|
| | | Closed Throttle | Full Throttle |
| All Positions | 1200 | 155 Minimum | 200 Minimum |

## MAIN PRESSURE CHECK – HYDRAULIC RETARDER OPERATION

| Selector Lever Position | Throttle Position at Transmission and Engine | Retarder Pedal Position | Minimum Main Pressure (psi) |
|---|---|---|---|
| N | Wide-Open | At Stop | 125 |

## PRESSURE CHECK – CONVERTER LOCKUP OPERATION AT MAXIMUM THROTTLE

| Selector Lever Position (Drive Shaft Disconnected) | Gear | Clutches Applied | Engine Speed (rpm) | Throttle Position at Transmission | Gauge Readings (psi) |
|---|---|---|---|---|---|
| 3-6 | Third | Lockup, Low-Splitter, Intermediate-Range | 2700 | Maximum① | 107-125 |

① Depress accelerator pedal through detent. The carburetor link is disconnected.

## PRESSURE CHECK FOR RANGE AND HIGH-SPLITTER CLUTCHES – CONVERTER LOCK UP OPERATION AT CLOSED THROTTLE

| Selector Lever Position (Drive Shaft Disconnected) | Gear | Clutches Applied | Engine Speed (rpm) | Throttle Position at Transmission | Gauge Readings (psi) |
|---|---|---|---|---|---|
| 1-2 | Second | Lockup, High-Splitter, Low-Range | 2000 | Closed | 65-75 |
| 3-4 | Fourth | Lockup, High-Splitter, Intermediate Range | 2000 | Closed | 65-75 |
| 3-6 | Sixth | Lockup, High-Splitter, High-Range | 2000 | Closed | 65-75 |

## GOVERNOR PRESSURE CHECK – G1 AND G2

| Selector Lever Position (Drive Shaft Disconnected) | Gear | Engine Speed (rpm) | Throttle Position at Transmission | Gauge Readings (psi) | |
|---|---|---|---|---|---|
| | | | | G1 Limits | G2 Limits |
| 3-6 | Sixth | 2800 | | 60-70 | 60-70 |

### RANGE AND SPLITTER PLANETARY COMBINATION AND GEAR RATIOS

| Range | Gear | Range Clutch Applied | Splitter Ratio | Output Ratio |
|---|---|---|---|---|
| Low | 1st | Low | Low | 5.296:1 |
| Low | 2nd | Low | High | 3.810:1 |
| Intermediate or Drive | 3rd | Intermediate | Low | 2.691:1 |
| Intermediate or Drive | 4th | Intermediate | High | 1.936:1 |
| Drive | 5th | High | Low | 1.390:1 |
| Drive | 6th | High | High | 1.000:1 |
| Neutral | | None | Low | 1.390:1 ① |
| Reverse | | Reverse | Low | 6.046:1 |

① At Power Take-off Drive Gear

### SHIFT POINTS AT FULL THROTTLE AND FULL LOAD – ALL MODELS

| Engine Full Load Governed RPM | Engine And Transmission Model | | Upshift 5-6 |
|---|---|---|---|
| 3800 | MT-40 Transmission 361-391 Engines Only | At Detent | 3750 |
| 3600 | MT-40 Transmission 401 Engines Only | At Detent | 3550 |
| 3400 | MT-42 Transmission 477 Engines Only | At Detent | 3350 |
| 3200 | MT-42 Transmission 534 Engines Only | At Detent | 3150 |
| 3200 | MT-40 Transmission 175 CAT. Engine Only | At Detent | 3150 |
| 3000 | MT-41 Transmission 200 CAT. Engine Only | At Detent | 2950 |

### HYDRAULIC RETARDER HORSEPOWER ABSORPTION

| Engine Speed (rpm) | Horsepower Absorption (hp) |
|---|---|
| 2000 | 54 |
| 3000 | 164 |
| 3400 | 230 |

### PRESSURE CHECKS – ALL MODELS

| Pressure Checks | FT ① (PSI) Model MT-40 | FT ① (PSI) Model MT-41 | FT ① (PSI) Model MT-42 |
|---|---|---|---|
| First Converter | 251 | 263 | 300 |
| First Lockup | 100 | 104 | 126 |
| Second Lockup | 100 | 104 | 126 |
| Third Converter | 251 | 263 | 300 |
| Third Lockup | 120 | 126 | 153 |
| Fourth Lockup | 100 | 104 | 126 |
| Fifth Lockup | 100 | 104 | 126 |
| Sixth Lockup | 100 | 104 | 126 |
| Reverse Converter | 251 | 263 | 300 |

① Full Transmission Throttle Valve

### TRANSMATIC TRANSMISSION RANGE CLUTCH INSTALLED CLEARANCE

| Clutch | Transmission Model | Clearance (Inches) |
|---|---|---|
| Reverse and Low Range | MT-40-41-42 | 0.020–0.030 |
| Intermediate Range | MT-40-41-42 | 0.030–0.040 |
| High Range | MT-40-41-42 | 0.040–0.050 |

### CONTROL VALVE BODY SPRING IDENTIFICATION TRANSMISSION MODEL MT-40

| Spring | No. of Coils (To Nearest 1/2 Coil) | Diameter of Wire (Inches) | Outside Diameter (Inches) | Free Length (Inches) |
|---|---|---|---|---|
| Selector valve detent | 9 | 0.053–0.055 | 0.345 | 0.77 |
| Pump overage regulator | 9 1/2 | 0.062–0.064 | 0.060 | 1.40 |
| Intermediate-to-high shift valve | 6 | 0.0615–0.0635 | 0.97 | 1.41 |
| Splitter shift plug | 14 | 0.053–0.055 | 0.56 | 1.99 |
| Main pressure regulator valve (primary) | 16 | 0.0905–0.0935 | 1.00 | 4.46 |
| Main pressure regulator valve (secondary) | 12 1/2 | 0.062–0.064 | 0.78 | 2.92 |
| Intermediate-to-low shift valve | 13 1/2 | 0.0465–0.0485 | 0.62 | 2.34 |
| Accumulator valve | 14 | 0.052–0.056 | 0.654 | 2.85 |
| Trimmer (primary) | 9 1/2 | 0.1035–0.1075 | 0.855 | 2.66 |
| Trimmer (secondary) | 10 | 0.1035–0.1075 | 0.70 | 1.88 |
| Trimmer return (inner) | 12 | 0.0465–0.0485 | 0.667 | 3.26 |
| Trimmer return (outer) | 15 | 0.0615–0.0635 | 0.85 | 4.50 |
| Lockup cutoff valve | 11 1/2 | 0.040–0.042 | 0.44 | 1.45 |
| Extender valve ball (also Trimmer valve ball) | 8 | 0.027–0.029 | 0.312 | 0.63 |
| Extender valve return | 7 | 0.031–0.033 | 0.426 | 1.059 |
| Low-splitter exhaust regulator valve | 11 | 0.053–0.055 | 0.48 | 1.24 |
| Intermediate exhaust regulator valve | 14 | 0.040–0.042 | 0.48 | 2.03 |
| TV (Throttle valve) | 14 | 0.040–0.042 | 0.397 | 1.83 |
| Lock up shift valve | 18 1/2 | 0.062–0.064 | 0.61 | 2.22 |
| Splitter relay valve | 8 1/2 | 0.118–0.122 | 0.95 | 2.00 |
| 6–5 inhibitor (2 white coils) | 16 1/2 | 0.031–0.033 | 0.210 | 0.914 |
| 5–4 inhibitor | 16 | 0.031–0.033 | 0.210 | 0.847 |
| 3–2 inhibitor | 14 | 0.0432–0.0452 | 0.395 | 1.52 |

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**CONTROL VALVE BODY SPRING IDENTIFICATION TRANSMISSION MODEL MT-41**

| Spring | No. of Coils (To Nearest 1/2 Coil) | Diameter of Wire (Inches) | Outside Diameter (Inches) | Free Length (Inches) |
|---|---|---|---|---|
| Selector Valve detent | 11 | 0.053–0.055 | 0.345 | 1.06 |
| Pump overage regulator | 9 1/2 | 0.062–0.064 | 0.60 | 1.40 |
| Int-to high shift valve | 6 | 0.0615–0.0635 | 0.97 | 1.41 |
| Splitter shift plug | 14 | 0.053–0.055 | 0.56 | 1.99 |
| Main pressure regulator valve | 14 | 0.104–0.107 | 1.02 | 3.94 |
| Int-to-low shift valve | 13 1/2 | 0.0465–0.0485 | 0.62 | 2.34 |
| Accumulator valve | 13 | 0.0465–0.0485 | 0.654 | 3.02 |
| Trimmer (secondary) | 10 | 0.1035–0.1075 | 0.70 | 1.88 |
| Trimmer (primary) | 9 1/2 | 0.1035–0.1075 | 0.855 | 2.66 |
| Trimmer return (inner) | 12 | 0.0465–0.0485 | 0.667 | 3.26 |
| Trimmer return (outer) | 15 | 0.0615–0.0635 | 0.85 | 4.50 |
| Lockup cutoff valve | 11 1/2 | 0.040–0.042 | 0.44 | 1.454 |
| Extender valve ball (also Trimmer Ball) | 8 | 0.027–0.029 | 0.312 | 0.63 |
| Extender valve return | 7 | 0.043–0.045 | 0.43 | 0.867 |
| Splitter exhaust regulator valve | 11 | 0.053–0.055 | 0.48 | 1.24 |
| Intermediate exhaust regulator valve | 14 | 0.040–0.042 | 0.48 | 2.03 |
| TV (throttle valve) | 12 | 0.040–0.042 | 0.38 | 1.28 |
| Lockup shift valve | 18 1/2 | 0.062–0.064 | 0.61 | 2.22 |
| Splitter relay valve | 8 1/2 | 0.118–0.122 | 0.95 | 2.00 |
| 6-5 inhibitor valve | 16 1/2 | 0.031–0.033 | 0.21 | 0.914 |
| 3-2 inhibitor valve | 15 | 0.040–0.042 | 0.395 | 1.654 |
| 5-4 inhibitor valve | 18 1/2 | 0.027–0.029 | 0.210 | 0.982 |

**CONTROL VALVE BODY SPRING IDENTIFICATION MODEL MT-42**

| Spring | No. of Coils (To Nearest) 1/2 Coil) | Diameter of Wire (Inches) | Outside Diameter (Inches) | Free Length (Inches) |
|---|---|---|---|---|
| Selector valve detent | 9 | 0.053–0.055 | 0.345 | 0.77 |
| Pump overage regulator | 9 1/2 | 0.062–0.064 | 0.060 | 1.40 |
| Intermediate-to-high shift valve | 6 | 0.0615–0.0635 | 0.97 | 1.41 |
| Splitter shift plug | 14 | 0.053–0.055 | 0.56 | 1.99 |
| Main pressure regulator valve (primary) | 16 | 0.100–0.103 | 1.02 | 4.40 |
| Main pressure regulator valve (secondary) | 12 1/2 | 0.062–0.064 | 0.78 | 2.92 |
| Intermediate-to-low shift valve | 13 1/2 | 0.0465–0.0485 | 0.62 | 2.34 |
| Trimmer ball | 7 | 0.0247–0.0253 | 0.312 | 0.793 |
| Accumulator valve | 13 | 0.0465–0.0485 | 0.654 | 3.02 |
| Trimmer (primary) | 9 1/2 | 0.1035–0.1075 | 0.855 | 2.66 |
| Trimmer (secondary) | 10 | 0.1035–0.1075 | 0.70 | 1.88 |
| Trimmer return (inner) | 12 | 0.0465–0.0485 | 0.667 | 3.26 |
| Trimmer return (outer) | 15 | 0.0615–0.0635 | 0.85 | 4.50 |
| Lockup cutoff valve | 11 1/2 | 0.040–0.042 | 0.44 | 1.454 |
| Extender valve ball (also Trimmer ball) | 8 | 0.027–0.029 | 0.312 | 0.63 |
| Extender valve return | 7 | 0.031–0.033 | 0.426 | 1.059 |
| Low-splitter exhaust regulator valve | 11 | 0.053–0.055 | 0.48 | 1.24 |
| Intermediate exhaust regulator valve | 11 | 0.053–0.055 | 0.48 | 1.24 |
| TV (throttle valve) | 15 1/2 | 0.040–0.042 | 0.397 | 1.83 |
| Lockup shift valve | 18 1/2 | 0.062–0.064 | 0.61 | 2.22 |
| Splitter relay valve | 8 1/2 | 0.118–0.122 | 0.95 | 2.00 |
| 6-5 inhibitor valve | 17 1/2 | 0.032–0.034 | 0.210 | 0.855 |
| 5-4 inhibitor valve | 18 1/2 | 0.027–0.029 | 0.210 | 0.982 |
| 3-2 inhibitor valve | 15 | 0.040–0.042 | 0.395 | 1.654 |

**TRANSMATIC TRANSMISSION CLUTCH CLEARANCE (INCHES)**

| Clutch | MT-40 | | MT-42 | |
|---|---|---|---|---|
| | New Dimension | Wear Limit | New Dimension | Wear Limit |
| Splitter low | 0.010–0.068 | – | 0.010–0.068 | – |
| Splitter High | 0.025–0.071 | – | 0.022–0.064 | – |
| High | 0.040–0.050 | 0.070 | 0.040–0.050 | 0.070 |
| Intermediate | 0.030–0.040 | 0.050 | 0.030–0.040 | 0.050 |
| Low | 0.020–0.030 | 0.040 | 0.020–0.030 | 0.040 |
| Reverse | 0.020–0.030 | 0.040 | 0.020–0.030 | 0.040 |

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**TRANSMATIC TRANSMISSION WEAR LIMITS**

| Part No. | Models | Part Name | New Dimension (Inch) | Wear Limit (Inch) |
|---|---|---|---|---|
| 6770678 | All | Lockup Clutch Friction Plate | 0.190–0.180 | 0.175 |
| 6770845 | All | Lockup Clutch Piston Assembly | No Score Permissible | |
| 6756778 | All | Lockup Clutch Backing Plate | No Score Permissible | |
| 6770309 or 6772854 | All | Splitter Low Clutch Plate | 0.244–0.250 | 0.239 |
| 6770289 or 6773303 | All | High and Splitter High Friction Plates | 0.154–0.150 | 0.145 |
| 6770917 | All | Splitter High Reaction Plate | 0.095–0.091 | 0.005 Cone |
| 6770917 | MT-40, 41 & 42 | High Reaction Plate | 0.095–0.091 | 0.005 Cone |
| 6769892 | MT-40 | Splitter High Backing Plate | 0.300–0.290 | 0.003 Cone |
| 6771753 | MT-40, 41 & 42 | Splitter High Backing Plate | 0.240–0.236 | 0.003 Cone |
| 6770765 or 6772093 | All | High Backing Plate | 0.296–0.298 | 0.003 Cone |
| 6770766 or 6772094 | All | High Backing Plate | 0.304–0.306 | 0.003 Cone |
| 6770767 or 6772095 | All | High Backing Plate | 0.312–0.314 | 0.003 Cone |
| 6770768 or 6772096 | MT-40, 41 & 42 | High Backing Plate | 0.320–0.322 | 0.003 Cone |
| 6773305 | All | Intermediate Clutch Friction Plate | 0.156–0.150 | 0.145 |
| 6773305 | MT-40, 41 & 42 | Low and Reverse Clutch Friction Plate | 0.156–0.150 | 0.145 |
| 6770265 | All | Intermediate Clutch Apply Plate | 0.316–0.312 | 0.010 Cone |
| 6770266 | All | Intermediate Clutch Apply Plate | 0.302–0.298 | 0.010 Cone |
| 6770267 | All | Intermediate Clutch Apply Plate | 0.288–0.284 | 0.010 Cone |
| 6771436 | All | Intermediate Clutch Apply Plate | 0.295–0.291 | 0.010 Cone |
| 6770268 | All | Intermediate Clutch Apply Plate | 0.274–0.270 | 0.010 Cone |
| 6770265 | MT-40, 41 & 42 | Low and Reverse Clutch Apply Plates | 0.316–0.312 ① | 0.010 Cone |
| 6770266 | MT-40, 41 & 42 | Low and Reverse Clutch Apply Plates | 0.302–0.298 ① | 0.010 Cone |
| 6770267 | MT-40, 41 & 42 | Low and Reverse Clutch Apply Plates | 0.288–0.284 ① | 0.010 Cone |
| 6770268 | MT-40, 41 & 42 | Low and Reverse Clutch Apply Plates | 0.274–0.270 ① | 0.010 Cone |
| 6771436 | MT-40, 41 & 42 | Low and Reverse Clutch Apply Plates | 0.295–0.291 ① | 0.010 Cone |
| 6770264 | All | Intermediate Clutch Reaction Plate | 0.204–0.196 | 0.003 Cone |
| 6770264 | MT-40, 41 & 42 | Low and Reverse Reaction Plate | 0.204–0.196 | 0.003 Cone |
| – | All | I.D. of Side Plates in Stator Assembly | 2.853–2.849 | 2.857 |
| – | All | Stator Thrust Washer in Stator Assembly (measure across face and Torrington needle bearing with bearing in installed position) | 0.4561–0.4439 | 0.435 |
| 6770088 | All | O. D. of Race | 2.8435–2.8430 | 2.841 |
| 6755581 | All | Splitter Sun Gear to Carrier Thrust Washer | 0.095–0.091 | 0.085 |
| 6769128 | All | Thrust Washer | 0.095–0.091 | 0.085 |
| 6769016 | All | Thrust Washer | 0.095–0.091 | 0.085 |
| 6772853 | All | Thrust Washer | 0.095–0.091 | 0.085 |
| 6772575 or 6772574 | All | Front Oil Pump Assembly — Drive Gear Side Clearance | 0.0005–0.0015 | 0.003 |
| 6772576 or 6772574 | All | Front Oil Pump Assembly — Driven Gear Side Clearance | 0.001–0.002 | 0.003 |
| 6772576 or 6772574 | All | Diametral Clearance between the Front Pump Body and the O. D. of Driven Gear | 0.005–0.008 | 0.010 |
| 6756782 | All | Converter Cover (Bushing Running Clearance) | 0.0005–0.0035 | 0.006 |
| 6756861 | All | Ground Sleeve (Bushing Running Clearance) | 0.0005–0.0035 | 0.005 |
| 6756822 | All | Converter Output Shaft (Bushing Running Clearance) | 0.0015–0.0045 | 0.007 |
| 6759975 | All | Splitter High Housing (Sun Gear Bushing Running Clearance) | 0.004–0.011 | 0.015 |
| 6756587 | All | Splitter Planet Carrier Assembly (Journal) | (No Score Permissible) | |
| 6756863 | All | High Range Clutch Housing (Bushing Running Clearance) | 0.0020–0.0045 | 0.008 |
| 6756835 | All | Output Shaft (Bushing Running Clearance) | 0.0015–0.0045 | 0.007 |

①Dimension from Belleville fulcrum to opposite face.

CD 2206-B

## TRANSMATIC TRANSMISSION WEAR LIMITS

| Torque Converter, Lockup Clutch, and Front Pump | Inches |
|---|---|
| Converter cover bushing-maximum clearance between bushing and turbine shaft | 0.006 |
| Lockup clutch plate-minimum thickness | 0.170 |
| Roller race-minimum O.D. | 2.841 |
| Stator thrust washer wear-front face | 0.010 |
| **Transmission Rear Sub-Assemblies** | **Inches** |
| Intermediate, low, and reverse clutch plates minimum thickness | 0.286 |
| Intermediate low reverse clutch apply plates-maximum coning | 0.008 |
| **Splitter Mechanism, High-Range Clutch, and Power Take-Off Drive Gear** | **Inches** |
| Turbine shaft bushing-maximum clearance between bushing and output shaft | 0.007 |
| Thrust washers-minimum thickness | 0.085 |
| Splitter planet carrier-no scoring permissible | |
| High-range and high-splitter internal teeth clutch plates-minimum thickness | 0.140 |
| Low-splitter clutch plate-minimum thickness | 0.234 |

| Torque Converter, Lockup Clutch, and Front Pump | Inches |
|---|---|
| Stator support bushing-maximum clearance between bushing and turbine shaft | 0.005 |
| Thrust washer-minimum thickness | 0.085 |
| Front pump driven gear-minimum O.D. | 4.743 |
| Front pump gear side clearance | 0.003 |
| **Transmission Rear Sub-Assemblies** | **Inches** |
| Thrust washers-minimum thickness | 0.085 |
| Output shaft bushing-maximum clearance between bushing and splitter output shaft | 0.010 |
| **Splitter Mechanism, High-Range Clutch, and Power Take-Off Drive Gear** | **Inches** |
| High-range and high-splitter external teeth clutch and reaction plates-maximum coning | 0.005 |
| High-range clutch housing bushing-maximum clearance between bushing and diaphragm hub | 0.009 |
| Splitter sun gear bushing-maximum clearance between bushing and planet carrier | 0.015 |
| High-range, high-splitter and low-splitter clutch pistons-no scoring permissible | |

## TORQUE LIMITS

| Description | Ft-Lbs |
|---|---|
| Screwdriver slotted screws | 24–36 ① |
| Allen Head Set screw | 8–12 ① |
| Front pitot screw | 30–48 ① |
| Brake adjusting nut (1/4 - 20) | 6–8 |
| Filter can cover strap bolt | 11–14 |
| Manual selector shaft nut | 14–17 |
| Brake adjusting nut (7/16 - 14) | 42–50 |
| TV shaft nut | 14–17 |
| Converter pump nut | 19–23 |
| Oil sump pan bolt | 15–18 |
| Front oil pump bolt | 15–18 |
| Brake control valve body bolt 5/16-18 x 1 1/4 | 15–18 |
| 5/16-18 x 2 1/4 | 114–17 |
| PTO cover bolt | 15–20 |
| Rear bearing retainer bolt | 42–50 |
| Converter housing bolt | 42–50 |
| Rear Pitot adapter (or pump) bolt | 15–18 |
| Brake assembly bolt (1/2-13) | 67–80 |
| (5/8-11) | 164–192 |

| Description | Ft-Lbs |
|---|---|
| Parking brake bracket bolt | 42–50 |
| Output flange bolt | 83–100 |
| Main valve body to housing bolt | 4–6 |
| Oil transfer plate to housing bolt | 8–10 |
| Downshift timing valve body to housing bolt | 8–10 |
| Converter ground sleeve bolt | 17–20 |
| Converter pump hub bolt | 9–11 |
| Rear pitot bolt | 8–10 |
| Anchor - Splitter low reaction plate bolt | 17–20 ② |
| Anchor - High clutch diaphragm bolt | 17–20 ② |
| Anchor - Intermediate piston housing bolt | 17–20 ② |
| Anchor - Low and reverse piston housing bolt | 17–20 ② |
| Anchor - Intermediate reaction plate-nut | 65–75 |
| -bolt | 35–40 |
| Anchor - Low reaction plate-nut | 65–75 |
| -bolt | 35–40 |
| Anchor - Reverse reaction plate-nut | 65–75 |
| -bolt | 35–40 |

① Inch-Pounds

② These bolts are to be torqued to approximately 10 lb ft when assembled with mating parts into housing. After final torquing of rear bearing retainer bolts and converter housing bolts, loosen bolts and retighten to the **SPECIFIED** torque. **CAUTION:** The bolt on top of transmission is to be tightened after the two bolts are tightened in bottom of high clutch diaphragm.

## SPECIAL TOOLS

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T50T-100-A | ..... | Impact Hammer |
| T58L-101-A | ..... | Puller Attachment |
| T57L-600-A | ..... | Driver |
| T00L-1175 and | ..... | Grease Seal Remover (Head Only) |
| T50T-100-A | ..... | Seal Remover |

| Ford Tool No. | Former No. | Description |
|---|---|---|
| T66T-7003-A (Details 1 thru 7 | ..... | Bushing Replacing Tools |
| J6795 | Kent-Moore | Converter Pump Cover Removal |
| J6430 | Kent-Moore | Splitter Removal |
| J6889 | Kent-Moore | Guide Bolts |
| J6438 | Kent-Moore | Lockup Clutch Removal or Installing Tool |
| J3387-2 | Kent-Moore | Guide Studs |
| J6467 | Kent-Moore | Range Clutch Holding Fixture |

CD 220

# THREE STEPS FOR GOOD INSTALLATION
## MORSE MODEL "M-A" CONTROL
## Morse Part Number H43717
## With Morse Type 63-B Red-Jaket Cable
## For
## Allison MT & HT Transmission

1.0 INSTALLATION

1.1 FIRST, LAY OUT CABLE PATCH

1.1.1 Ths Morse Type 63-B Red-Jaket cable must not be bent sharper than the recommended 10" radius. For optimum performance, keep bends in cable path as few in number and as gradual as possible.

1.1.2 The control cable must be at right angles to the transmission selector arm when the arm is at the mid-point of its arc of travel. See Figure 1-1.

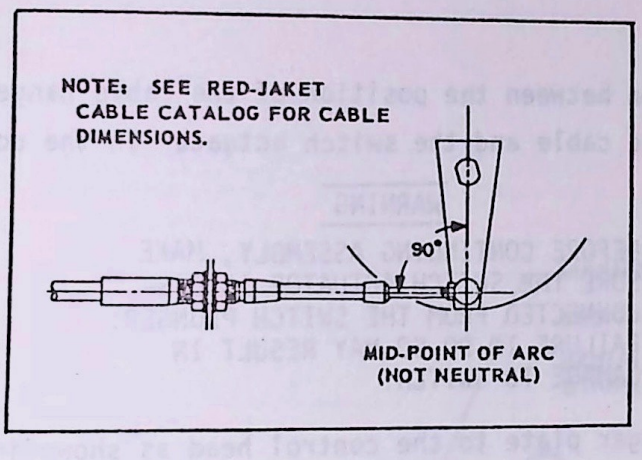



FIGURE 1-1

1.1.3 A mounting bracket is required to anchor the cable hub. Refer to Morse Red-Jaket cable catalog for cable dimensions.

1.1.4 . Selector arm with 3.64 inch center distance must be used. See Allison Drawing AS-30-070.

1.2 SECOND, DETERMINE WHETHER CABLE PUSHES OR PULLS TRANSMISSION SELECTOR ARM INTO REVERSE

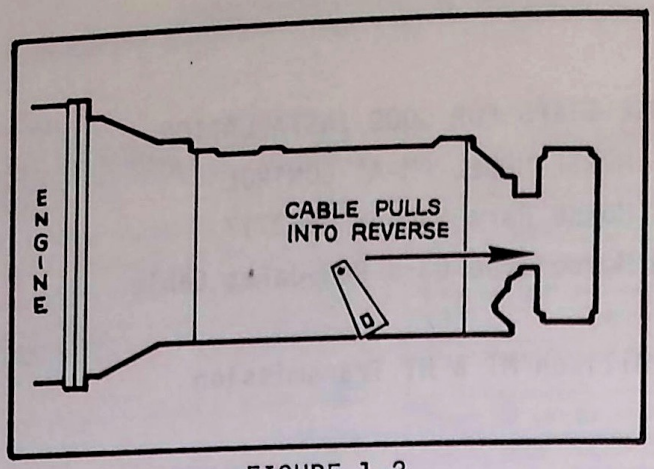



FIGURE 1-2

1.3 THIRD, DECIDE WHETHER REVERSE ON THE CONTROL HEAD SHOULD BE TOWARD THE FRONT OR REAR OF VEHICLE.

1.3.1 See block diagram (Figure 1-3) for control head assembly.

NOTE

Although the control head is shown as mounted on a horizontal plane, it may be inclined for more convenient installation or operation.

1.4 ASSEMBLY

1.4.1 Note the relation between the position of the cable hanger plate and the connection points for the cable and the switch actuator in the control hand lever.

WARNING

BEFORE CONTINUING ASSEMBLY, MAKE SURE THE SWITCH ACTUATOR IS DISCONNECTED FROM THE SWITCH PLUNGER. FAILURE TO DO SO MAY RESULT IN DAMAGE TO SWITCH.

1.4.2 Assemble the hanger plate to the control head as shown in Figure 1-3.

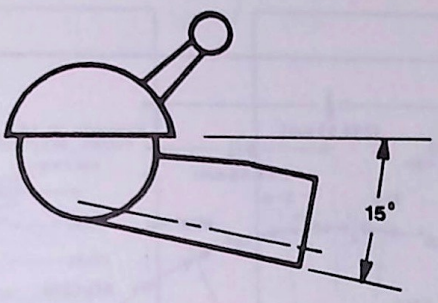
1.4.3 Attach the cable to the cable hanger and the control lever as shown in Figure 1-3.

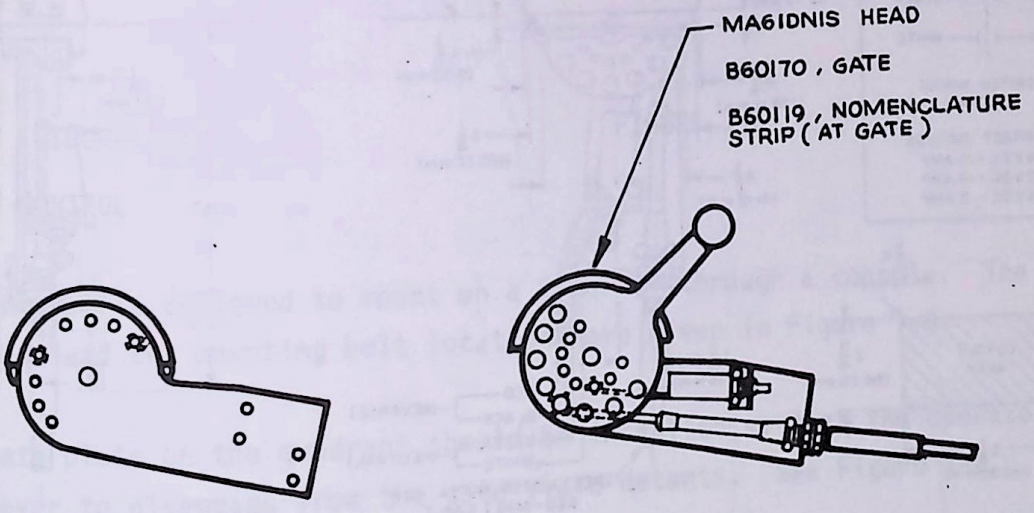
1.4.4 Adjust cable at the control and the transmission to insure that the control hand lever and the transmission selector arm coincide at the various gear positions.

1.4.5 Attach the switch actuator to the control hand lever as shown in Figure 1-3. Turn the elastic stop nut until it contacts the "O" ring. (Do not compress "O" ring)

Cable pulls transmission arm into reverse.

Hand lever positioned in reverse at rear of housing, when right hand mounted; and in reverse at front of housing, when left hand mounted.




H43717-ID

FIGURE 1-3

1.4.6 Assemble the switch mounting bracket to the cable hanger plate as shown.

1.4.7 Place the control hand lever in reverse position. Push the switch plunger all the way into the switch.

1.4.8 Adjust the switch in it's mounting bracket until the actuator aligns with the hole in the switch plunger. Secure with "O" ring and elastic stopnut, turning until nut contacts "O" ring. (Do not compress "O" ring)

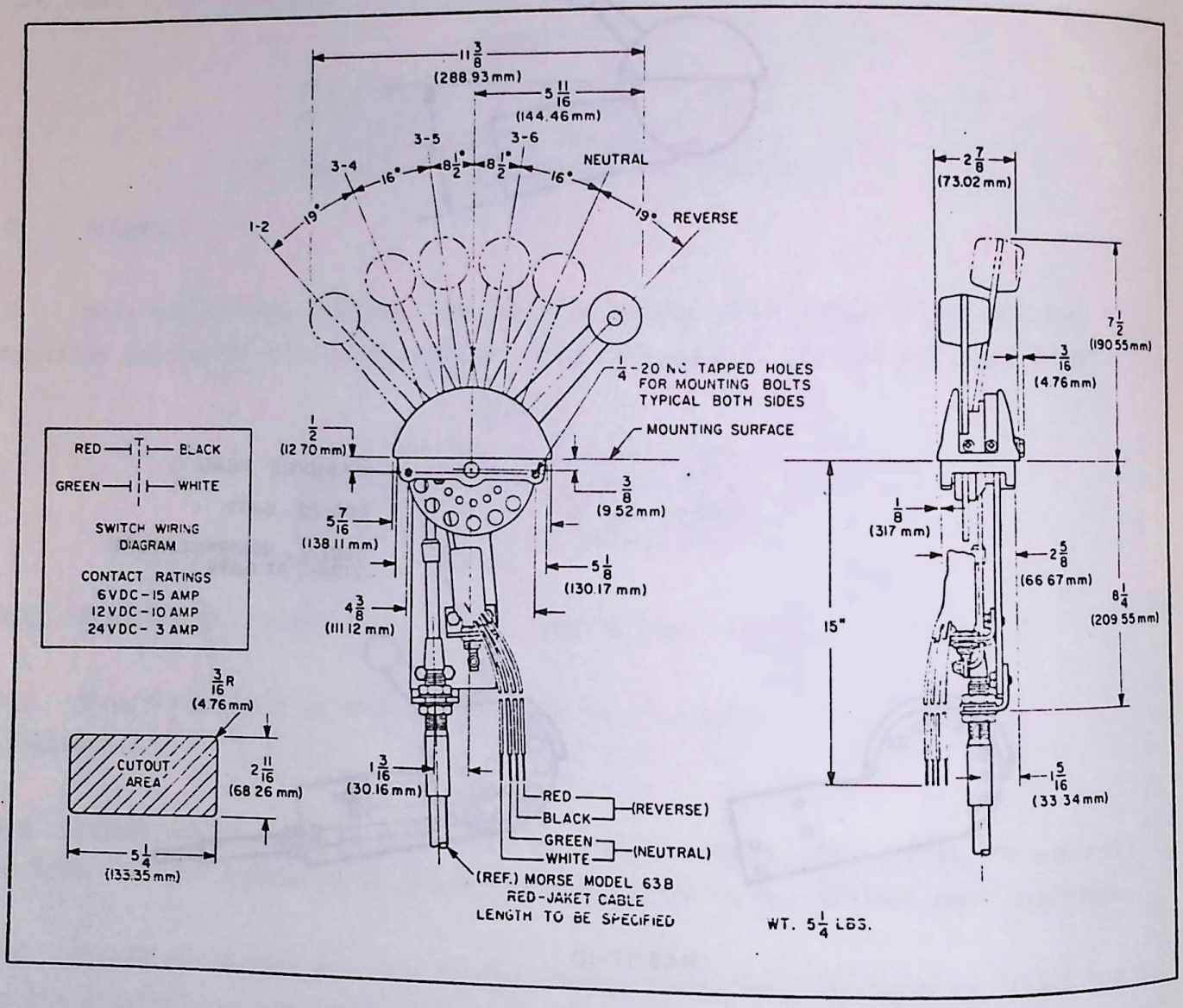



FIGURE 1-4

1.5 ADJUST SWITCH

1.5.1 Adjust the switch in it's bracket until the neutral safety circuit ,and the backup light circuits are complete in the appropriate positions. See Figure 1-5.

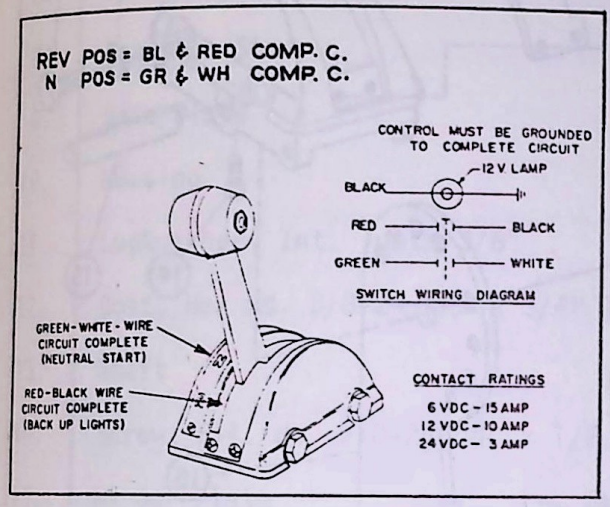



FIGURE 1-5

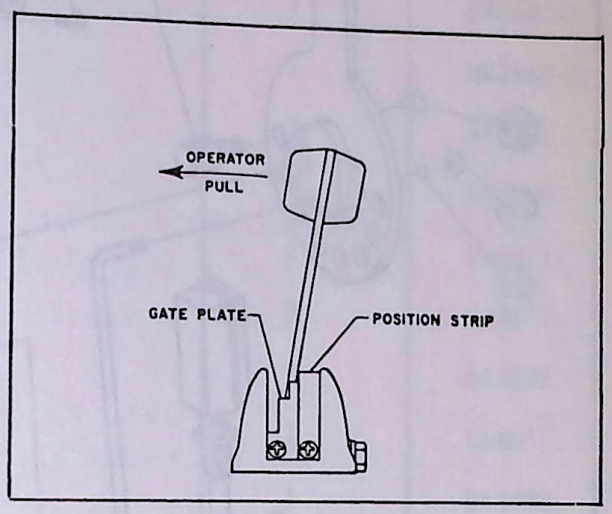



FIGURE 1-6

1.6 MOUNT CONTROL

1.6.1 The control is designed to mount on a tower or through a console. The cutout dimension and the mounting bolt locations are given in Figure 1-4.

1.6.2 The gate plate on the quadrant should be installed so that the operator pulls on the hand lever to disengage from the gate plate detents. See Figure 1-6.

1.6.3 Make sure the position strip figures coincide with the same positions of the transmission detents. See Figure 1-7.

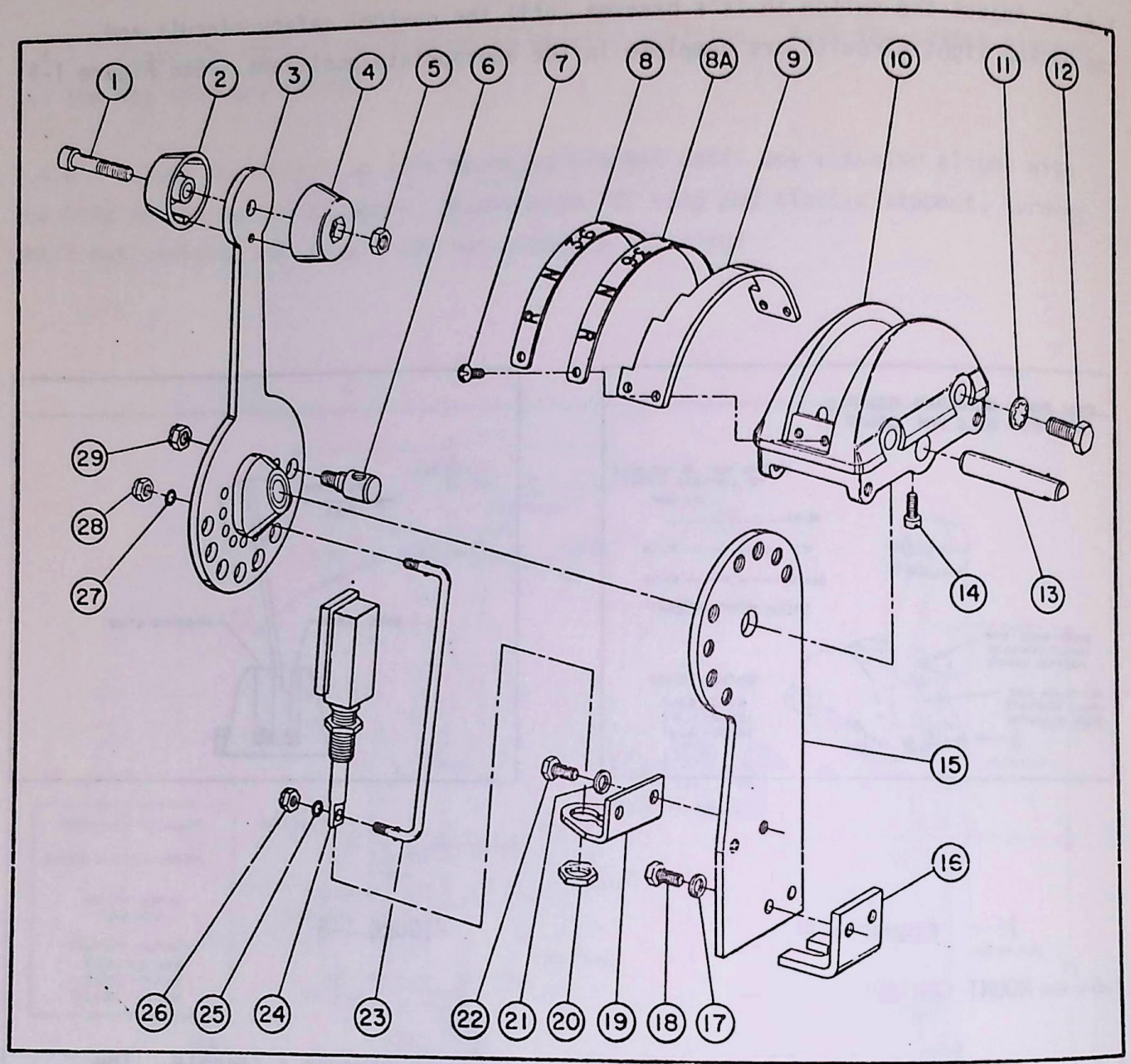

1
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FIGURE 1-7

| ITEM | DESCRIPTION | NUMBER REQUIRED | PART NUMBER |
|---|---|---|---|
| 1. | Screw, Phillips Fil. Hd. 5/16-18 UNC x 1-3/8" | 1 | Comm'l. |
| 2. | Knob, Handle | 2 | B43671 |
| 3. | Lever Assembly | 1 | D43274 |
| 4. | Knob (See Item #2) | --- | ------- |
| 5. | Nut, Reg. Hex 5/16-18 UNC | 1 | Comm'l. |
| 6. | Shift Trunnion | 1 | B43197 |
| 7. | Screw, Phillips Truss Hd. #10-24 UNC x 5/16" lg. | 4 | Comm'l. |
| 8. | Position Strip | 1 | B43187-1 |
| 8A | Position Strip | 1 | B43187-2 |
| 9. | Gate Plate | 1 | B43292 |
| 10. | Housing | 1 | E43696 |
| 11. | Lockwasher, Int. Tooth 3/8" | 2 | Comm'l. |
| 12. | Bolt, Hex Hd. 3/8-24 UNF x 3/4" lg. | 2 | Comm'l. |
| 13. | Shaft | 1 | A43698 |
| 14. | Screw, Fil. Hd. #10-24 UNC x 1/2 lg. | 1 | Comm'l. |
| 15. | Hanger Plate | 1 | D43683 |
| 16. | Cable Support | 1 | B43685 |
| 17. | Lockwasher, Split 1/4 | 4 | Comm'l. |
| 18. | Bolt, Hex Hd. 1/4-28 UNF x 1/2" lg. | 4 | Comm'l. |
| 19. | Switch Support | 1 | B43684 |
| 20. | Nut, Switch | 2 | A43716 |
| 21. | Lockwasher (See Item #17) | --- | ------- |
| 22. | Bolt (See Item #18) | --- | ------- |
| 23. | Switch Actuator | 1 | B43681 |
| 24. | Switch | 1 | B45184 |
| 25. | "O" Ring, 3/16 I.D. x 5/16 O.D. x 1/16 thk. | 2 | Comm'l. |
| 26. | Elastic Stop Nut | 2 | H43717-21 |
| 27. | "O" Ring (See Item #25) | --- | ------- |
| 28. | Elastic Stop Nut (See Item #26) | --- | ------- |
| 29. | Elastic Stop Nut | 1 | H43717-22 |

TRANSMISSION KIT FOR ALLISON "MT" SERIES

Part Number A45478

(With Lever #6775467)

Use with Morse "M-A" Control

and

Type 63-B Red-Jaket Cables

NOTE

This kit includes lever #6775467 which is designed for "MT" transmissions. The lever contained in this kit must be attached to transmission before connection kit may be assembled. See lever installation and removal instructions enclosed with kit.



## 2.0 INSTALLATION

2.1 This kit is for use with Allison "MT" transmissions equipped with lever #6775467 (Allison Drawing AS-30-070). The Morse "M-A" Control must be assembled as shown in Figure 1-3 with the cable pulling the transmission shift lever into Reverse.

These instructions cover only the connection of the cable to the transmission. Illustrations covering control head installation are packed with the control head.

2.1.1 Attach bracket (1) to transmission, using the two bolts on rear flange, as shown in Figure 2-1. Retighten bolts to original torque setting.

2.1.2 Loosen the larger of the two rubber seals on cable end to allow the outer hub nut and washer to pass over and off the cable end. Place cable end through the hole in bracket (1) and replace washer, nut and seal. Do not tighten nut.

2.1.3 Thread cable terminal (2) into cable end until cable end is flush with terminal. Hold the terminal to prevent it from turning the tighten cable nut against terminal.

2.1.4 Place control head hand lever and transmission shift lever in Reverse position.

2.1.5 Adjust position of cable hub in bracket (1) until shank of cable terminal aligns with hole in transmission shift lever. Tighten cable hub nuts securely.

NOTE 1

If shank of cable terminal cannot be aligned by adjusting cable hub in bracket, check:

A. to be sure that both control head and transmission are in Reverse.

B. to be sure that shift lever is No. 6775467.

C. to be sure control is correctly assembled.

2.1.6 Lubricate the shank of the cable terminal and insert the shank in the hole of the transmission shift lever. Test shift the transmission, removing cable terminal in each detent to be sure that the terminal shank aligns with the hole in the shift lever at each position. If it does not, check as in step 2.1.5 and Note 1.

2.1.7 Secure cable terminal (2) to transmission shift lever with cotter pin (3).

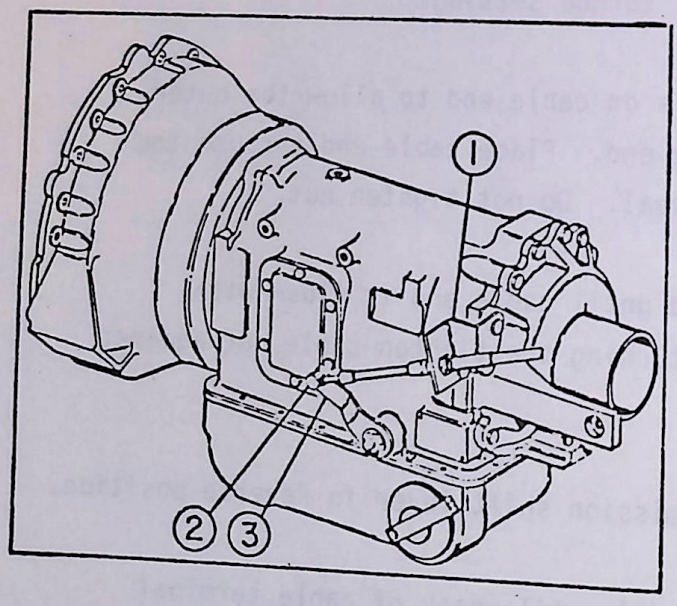


FIGURE 2-1

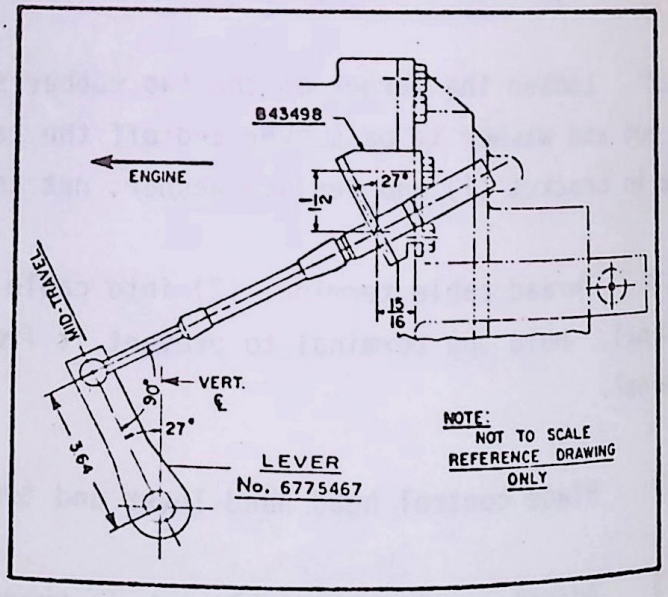


FIGURE 2-2

# REMOVAL AND INSTALLATION OF OUTSIDE SELECTOR VALVE AND THROTTLE VALVE LEVERS FOR ALLISON "MT" TRANSMISSIONS

**WARNING**

IT IS POSSIBLE WHEN REMOVING OR INSTALLING THE SUBJECT LEVERS (FIGURE 3-1) TO PUSH THEIR MATING SHAFT BACK INSIDE THE TRANSMISSION HOUSING. WHEN THIS HAPPENS THE SHAFTS WILL LOSE INDEX LOCATION WITH THEIR CORRESPONDING VALVES OF THE CONTROL VALVE BODY IN THE HOUSING (FIGURE 3-2). IT IS THEN NECESSARY TO REMOVE THE TRANSMISSION OIL PAN AND POSITION THE SHAFTS WITH THEIR RESPECTIVE CONTROL BODY VALVES.

TO AVOID THIS SITUATION, THE FOLLOWING REMOVAL AND INSTALLATION PROCEDURES SHOULD BE FOLLOWED:

## 3.0 GENERAL

First determine if the transmission has a "long stroke" or "short stroke" TV configuration. On transmission with a "long stroke" TV, the lever will have an arc travel of $32^{o}$ (degrees) from stop to stop. The "short stroke" configuration will have an arc travel of $16^{o}$ (degrees) from stop to stop. Outside appearance of the TV levers may be the same. How far the lever travels ($16^{o}$ or $32^{o}$) determines the type incorporated. See Figure 3-1. At all times, it is important that shafts do not move too far into the transmission housing. Placing the levers in the positions as outlined in Figures 3-1, 3-2 and 3-3, will reduce the possibility of losing indexed locations. Paint, dirt collection or other may bind levers on the shaft. If so, loosen the throttle valve (TV) and selector shaft nuts approximately 1/8 inch and tap lightly with a hammer to loosen.


FIGURE 3-1. Transmission TV and Selector Levers.

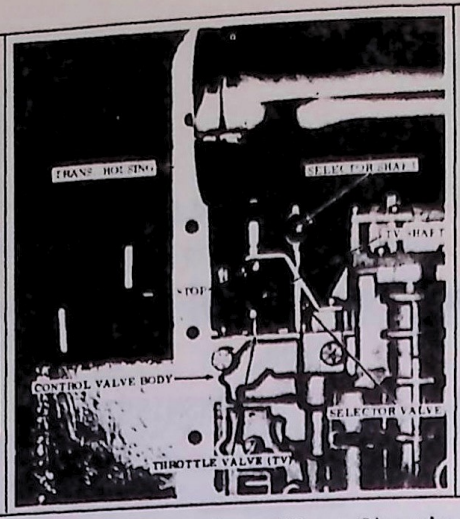


FIGURE 3-2. View Showing TV and Selector Control Linkage - Oil Pan Removed.

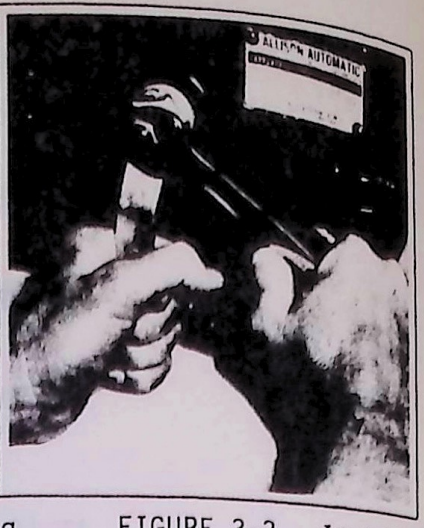


FIGURE 3-3. Installing (or Removing) TV Lever Retaining nut.

CAUTION

DO NOT USE THE MECHANICAL "STOP" (FIGURE 3-2) INSIDE THE TRANSMISSION AS THE REACTION MEMBER FOR REMOVAL OF LEVER RETAINING NUTS. THE "STOP" IS USED FOR MAKING A CALIBRATED ADJUSTMENT AND COULD BE DAMAGED OR ALTERED. HOLD THE LEVER WHEN REMOVING OR INSTALLING NUTS (FIGURE 3-3).

3.1 REMOVAL

3.1.1 Place selector lever in the 3-6 detent position (3-6 position is the third detent position from the front of the transmission). Leave TV lever as "rest" (present) position.

3.1.2 Having freed levers, remove TV retaining nut, washer and lever from shaft (Figure 3-3).

3.1.3 Remove manual selector retaining nut, washer and lever from shaft (Figure 3-3).

3.2 INSTALLATION

3.2.1 Manual Selector Lever

a. Selector shaft is in the 3-6 detent position (Refer to 3.1 above). Hold the shaft with a pair of pliers, being sure jaws contact the "flats" of shaft and not the threaded area. See Figure 3-4.

b. Slide the selector lever onto its shaft far enough for the retaining nut to be installed (Figure 3-4). Then run nut onto shaft far enough to install washer.

NOTE

Be careful not to cross-thread. This can easily occur on a threaded shank with flats.

c. Remove nut, install washer and then nut. Grasp lever at the end and while pulling out (away from the transmission) run nut onto shaft (Figure 3-5). Keep tension on end of lever until nut is fully installed. HOLDING LEVER in position (3-6), torque the nut 14-17 lb. ft.

3.2.2 Throttle Valve (TV) Lever

a. "Long Stroke" TV Models

1. Leave selector lever in the same position (3-6).
2. Using pliers to hold TV shaft, slide the TV lever onto shaft far enough for the retaining nut to be installed (Figure 3-6). Then run nut onto shaft far enough to install washer.

NOTE

Be careful not to cross-thread.

3. Remove nut, install washer and then nut. Grasp lever at the end and while pulling OUT (away from the transmission) run nut onto shaft. Keep tension on end of lever until nut is fully installed. Refer to Figure 3-3.
4. HOLD LEVER and torque the nut 14-17 lb. ft.
5. Bend the edge of the selector retaining washer and TV washer against a flat of their respective retaining nuts.

b. "Short Stroke" TV Models

1. Place the manual selector lever in the reverse range detent position (Reverse foremost position toward front).
2. Now, follow 3.2.2a (2) through 3.2.2a (5), above for installation of the lever.


FIGURE 3-4. Installing Selector Valve Lever.

FIGURE 3-5. Installing Selector Lever Retaining Nut.

FIGURE 3-6. Installing TV Lever.