SECTION 07: TRANSMISSION

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1. DESCRIPTION

H3 vehicles may be provided with either a manual or an automatic transmission.

1.1 Manual Transmission

The Spicer PS130-6B, 6-speed, has 6 forward speeds and 1 reverse speed.

The Spicer PS145-7A, 7-speed, has 7 forward speeds and 1 reverse speed.

1.2 Automatic Transmission

The B500(R) world transmission has 6 speeds with two top range (fifth and sixth) overdrives. Total coverage is determined by dividing the highest gear ratio by the lowest gear ratio. Total coverage expresses the transmission gear ratio versatility. Transmissions with larger total coverage number have a wider variety of available ratios.

An electronic control allows the transmission to shift at exactly the right point on the engine's fuel consumption curve for best economy. Early lockup maintains the highest possible mechanical efficiency through the closely-spaced gear steps, culminating in two overdrive ratios. This combination allows progressive shifting techniques, where engine speeds are reduced for higher efficiency and lower fuel consumption.

Gear selection and torque converter modes are controlled by a microcomputer-based electronic transmission management system. It is fed information regarding throttle position, operator range selection, engine speed, turbine speed, transmission output speed and various system pressures from special electronic sensors. With this information, it computes shift points and clutch pressures to meet immediate needs. Using closed loop adaptive logic, the electronic control looks at a number of parameters during the shift, and makes minute adjustments to match the shift to desired profile stored in its memory. It then looks at these adjustments and resets the parameters which allow the transmission to quickly compensate for variations in load, terrain or environment, and to adjust for clutch wear and engine power changes. A diagnostic Data Reader can be connected to the electronic control unit to provide a self-check of all systems in the transmission. Four-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to paragraph "10. TROUBLESHOOTING" in this section).

1.2.1 Retarder (if applicable)

This optional auxiliary braking device for the automatic transmission is integrated into the basic envelope of the transmission and transmits its braking force directly to the propeller shaft. It requires no additional length and adds only 75 pounds (34 kg) of weight. Operation of the retarder is controlled electronically by the driver's use of the brake and/or by hand control lever. When activated, fluid enters a cavity and provides resistance to the turning of rotor blades revolving with the output shaft. This effectively slows the vehicle to the point where the service brakes are needed only for final stopping. The retarder is fully modulated and is compatible with ABS.

2. WELDING PROCEDURES

The following precautions are to be taken to protect the electronic control components. Refer to Section 1, paragraph "8. WELDING PRECAUTION" in this manual.

3. MAINTENANCE

3.1 Manual Transmission

3.1.1 Oil Recommendations

The following lubricants are recommended in order of preference.

Temperature	Grade	Type
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 30, 40, or 50 SAE 30	Heavy Duty Engine Oil meeting MIL-L-2104D or MIL-L 46152 B, API-SF or API-CD specifications (MIL-L-2104 B & C, OR 46152 are also acceptable)
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	Straight Mineral Gear Oil R & O Type API-GL-1
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	* Mild EP Gear Oil MIL-L-2105 or API-GL-4
All	CD SAE 50 CD SAE 30	Synthetic Engine Oil meeting MIL-L-2104 D or MIL-L-46152 B, API-SF or API-CD specifications
All	EP SAE 75W90 EP SAE 75W140	* Synthetic Gear Oil meeting MIL-L-2105C or API-GL5 specifications

*EP gear oils are not recommended when lubricant operating temperatures are above 230°F (110°C).

3.1.2 Oil Check

Manual transmission oil should be checked when engine is stopped and cold. Check level, and add if necessary, every 6,250 miles (10 000 km) or twice a year, whichever comes first.

Warning: *Before servicing the coach, park safely over a repair pit, apply parking brake, stop engine and set battery master switch to the off position.*

Unscrew the fill plug and verify if the oil level is at plug thread level (Fig. 1).

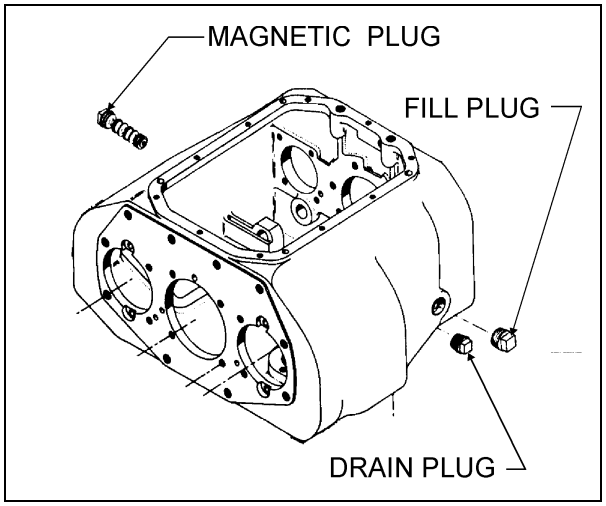


FIGURE 1: PLUGS 07010

3.1.3 Oil Change

Change break-in oil after 3,000 miles (4 800km) of initial operation, then every 50,000 miles (80 000 km) or once a year, whichever comes first.

Drain manual transmission as follows :

1. Unscrew the drain plug (Fig.1) and allow the oil to drain into a suitable container.

2. Inspect plug and replace if necessary. Reinstall plug.

Refill manual transmission as follows :

1. Remove fill plug.

2. Add oil until it overflows.

3. Clean oil from the transmission case and the fill plug.

4. Reinstall plug.

Caution: *Do not overfill transmission. Oil breakdown due to excessive heat and/or sludge deposits impairing proper operation of transmission may result.*

3.1.4 Metal Particles

The magnetic plug attracts metal particles. When metal particles are of abnormal size, the transmission must be disassembled

3.2 Automatic Transmission

To gain access to the dipstick, open the engine compartment rear door. The dipstick is located beside the engine (Fig. 2).

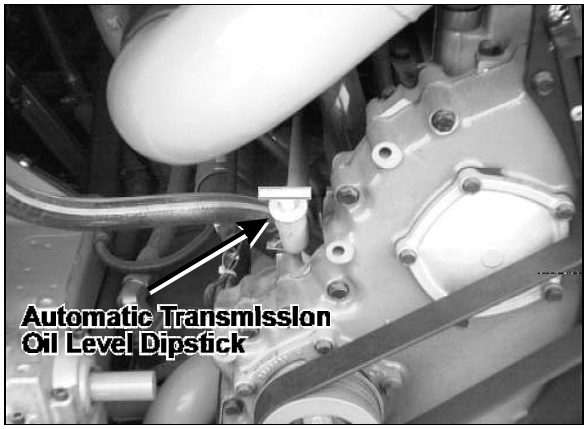


FIGURE 2: OIL LEVEL DIPSTICK OEH3B706

To check the transmission oil level, a cold check and a hot check must be performed. A cold check must be made between 60°F (16°C) and 140°F (60°C). The transmission oil temperature gauge indicates the operating temperature and it is located in the driver's area on the central dashboard with tachograph.

Note: *Perform the cold check first to verify the transmission oil level before performing the hot check.*

The hot check can be performed when the transmission oil reaches the normal operating temperature of 160°F (71°C) to 200°F (93°C).

Clean all dirt from around the end of the oil fill tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil system since it will cause valves to stick, undue wear of transmission parts, and clogged passages. Check the oil level in accordance with the following procedures and record any abnormal level on your maintenance records.

***Warning**: When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.*

Always check the oil level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

3.2.1 Cold Check

1. Park the vehicle on a level surface and apply the parking brake.

***Caution:** The oil level rises as sump temperature increases. DO NOT fill above the "Cold Run" band if the transmission oil is below normal operating temperature.*

2. Run the engine for at least one minute. Shift to Drive (D) and then to Reverse (R) to clear the hydraulic circuits of air. Then shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).

3. While the engine is running, remove the dipstick from the tube and wipe it clean (a typical dipstick is shown in Fig. 3).

4. Insert the dipstick into the tube and remove, checking the oil level reading. Repeat the check procedure to verify the reading. If the oil reading is within the "COLD RUN" band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a "HOT RUN" check. If the oil reading is not within the "COLD RUN" band, add or drain oil as necessary to bring the level to the middle of the "COLD RUN" BAND.

5. Perform a hot check at the first opportunity after the normal operating temperature of 160°F (71°C) to 200°F (93°C) is attained.

3.2.2 Hot Check

***Caution:** The oil must be hot to ensure an accurate check for this procedure. The oil level rises as temperature increases.*

1. Operate the transmission in drive range until normal operating temperature is reached 160°F (71°C) to 200ºF (93°C).

2. Park the vehicle on a level surface and shift to neutral. Apply the parking brake and allow the engine to idle (500 - 800 rpm).

3. While the engine is running, remove the dipstick from the tube and wipe it clean.

4. Insert the dipstick into the tube and remove, checking the oil level reading. Repeat the check procedure to verify the reading.

The safe operating level is anywhere within the "HOT RUN" band on the dipstick. (Typical dipsticks are shown in Figure 3).

5. If the oil level is not within the "HOT RUN" band, add or drain oil as necessary to bring the oil level within the band.

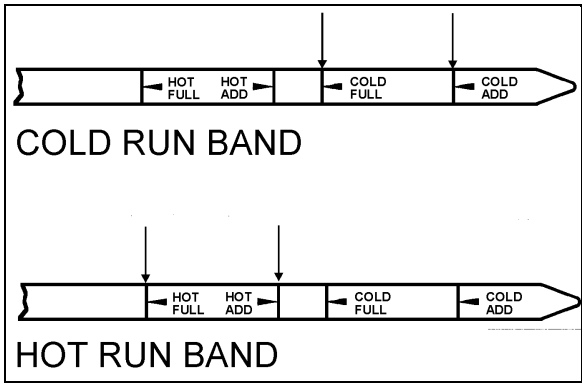


FIGURE 3: DIPSTICK 07006

***Note:** The cold check is more appropriate for verifying the oil level after the first fill-up. In case of conflict, the hot check has priority over the cold check; the automatic system of verification via the shift selector has priority over the hot check.*

3.2.3 Readout of the Oil Level Sensor

The oil level sensor (OLS) is designed to measure transmission oil level only when the following combination of operating conditions exist:

1. Engine must be at idle;
2. **NEUTRAL** must be selected;
3. Zero output speed;
4. Transmission oil must be within a "normal" temperature band (160-250°F; 70-120°C); and
5. Once the first four (4) conditions are met, there must be a "waiting" period (approx. 2 min., to facilitate consistent oil drainback) before oil level measurement begins.

To enter OLS readout mode (after meeting the conditions noted above), simultaneously press the UPSHIFT and DOWNSHIFT arrows on the shifter. If the five (5) conditions noted above are present, the display will immediately enter the reading mode. If the "waiting" period has not elapsed, the left digit of the display will become a "chasing" digit and the right digit will count down from (8) to (1) until the waiting period is complete.

After attaining the reading mode, the display will flash *"OL-OK"*, *"LO-01"*, *"HI-02"*, etc., where the suffix *"01"* or *"02"* indicates the volume of oil (in quarts) either low or high.

At any time in this sequence, simultaneously pressing the UPSHIFT and DOWNSHIFT arrows directs the ECU to enter the transmission diagnostic mode as described under *"10. TROUBLESHOOTING"* in this section. D, N, or R may also be selected on the shifter at any time - the OLS mode will abort and normal transmission will commence. Shifts are not inhibited.

Oil Level Sensor (OLS) Codes

CODE	CAUSE OF CODE
OL-OK	Oil Level Is Correct
LO-01	One Quart Low
LO-02	Two Quarts Low
HI-01	One Quart High
HI-02	Two Quarts High
OL-50	Engine Speed (RPM) Too Low
OL-59	Engine Speed (RPM) Too High
OL-65	Neutral Must Be Selected
OL-70	Sump Oil Temperature Too Low
OL-79	Sump Oil Temperature Too High
OL-89	Output Shaft Rotation
OL-95	Sensor Failure

3.2.4 Keeping Oil Clean

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Lay the dipstick in a clean place while filling the transmission.

Caution: *Containers or fillers that have been used to handle antifreeze or engine coolant must NEVER be used for handling transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if introduced into the transmission, can cause the clutch plates to fail.*

3.2.5 Oil Recommendations

Hydraulic oils used in the transmission have an important influence on transmission reliability and durability. In order of preference DEXRON-III and DEXRON-IIE, MIL-L-2104D, and type C-4 oils (Allison approved SAE 10W or SAE 30) are recommended. Type C-4 oil is the only oil approved for use in off-highway applications. Use type SAE 30 where ambient temperature is consistently above 86°F (30°C). Some DEXRON-II oils are also qualified as type C-4 oils and may be used in off-highway applications. However, a DEXRON-II fluid which is not a qualified type C-4 oil must never be used in off-highway applications. Consult your local Allison dealer or distributor to determine if a DEXRON-II oil is also a qualified type C-4 oil.

Ford Motor Company specification oils M2C33-F, M2C138-CJ and M2C166-H may be used and may be intermixed with DEXRON-II oil.

Oil specifications and ambient temperature operating conditions	
Oil type	Ambient temperature
MIL-L-2104D, DEXRON-II,C-4	120°F (48°C) to -25°F (-32 °C)
MIL-L-46167	-25°F (-32°C) to -60°F (-51°C)

The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the ECU will restrict full operation until the sump temperature is increased. The chart below shows the temperature ranges in which the transmission will operate. It should be noted that at lower sump temperature, the transmission's operation may be restricted.

Transmission Oil Temperature	**DO NOT SHIFT Light**	**Operation**
Below -26°F (-32°C)	ON	Neutral only
-24°F (-31°C) to +19°F (-7°C)	OFF	Start with neutral and reverse, normal upshifts
+20°F (-6°C) to 260°F (126°C)	OFF	Full operation in all ranges
Above 260°F (126°C)	ON	Inhibits 5th and 6th ranges

3.2.6 Oil Contamination

At each oil change, examine the drain oil for evidence of dirt or water. A nominal amount of condensation will emulsify during operation of the transmission. However, if there is evidence of water, check the cooler (heat exchanger) for other signs of leakage. This, however, may also indicate leakage from the engine oil system.

3.2.7 Metal Particles

Metal particles in the oil (except for the minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, coolers, and all other areas where the particles could lodge.

Caution: *If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.*

3.2.8 Coolant Leakage

If engine coolant leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant contamination must be removed. Friction clutch plates contaminated with ethylene glycol must be replaced.

3.2.9 Oil and Filter Change

Transmission oil change must be performed with the vehicle on a flat and level surface and with parking brake applied. Oil and oil filter change frequency is determined by the severity of service and operating conditions of the transmission and by the filter equipment installed. See table 1 for oil and filter change intervals.

More frequent changes may be required when operations are subject to high levels of contamination or overheating.

Table 1: Oil And Oil Filter Change Intervals
Change break-in oil after 3,000 miles (4 800 km) of initial operation and subsequently every 25,000 miles (40 000 km) or once a year, whichever comes first.

The procedure for changing the oil and oil filters for the transmission is as follows:

Drain

1. The transmission should be at an operating temperature of 160°F (71°C) to 200°F (93°C) when the oil is drained. This will ensure quicker and more complete fluid drainage.

2. Remove the drain plug from under the transmission (Fig. 4) and allow the oil to drain into a suitable container. Check the condition of the oil as described previously.

3. To replace the integral filters, remove twelve bolts, two filter covers, two O-rings, two square cut seals and the two filters from the bottom of the control module (Fig. 4).

4. To install filters, pre-lube and install the two O-rings, the two square cut seals followed by the filters (lube the O-ring in filter cartridge only) into the filter compartment. Index each filter/cover assembly to holes in channel plate/sump. Push the cover assembly in by hand to seat the seals.

Caution: *Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.*

5. Install six bolts into each cover and tighten to 38-45 lbf•ft (51-61 N•m).

6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 lbf•ft (25-32 N•m).

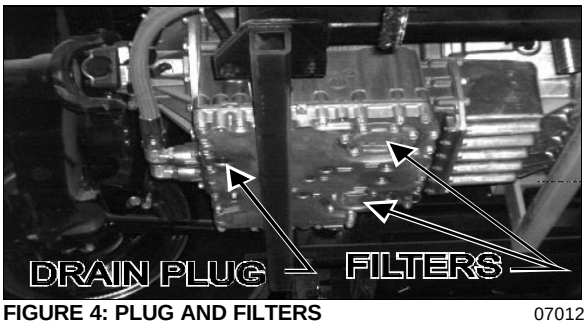


FIGURE 4: PLUG AND FILTERS 07012

Refill

Refill with 37 US qts (39 liters) and check the oil level using the previously described procedure. The refill amount is less than the initial fill because some of the oil remains in the external circuits and transmission cavities.

4. GEAR SHIFT LINKAGE ADJUSTMENT (Manual Transmission)

4.1 Adjustment

1. Put the transmission lever in "NEUTRAL" position.

2. Loosen nuts (1, Fig. 5) and nuts (2, Fig. 5).

3. Adjust the gear shift lever in neutral position:

   a. Put the shifter lever in first gear and measure the distance A on the gear shaft (Fig. 5).

   b. Put the shifter lever in second gear and measure the distance B on the gear shaft (Fig. 5).

4. Put the shifter lever in neutral. (The middle position between points A and B is the "NEUTRAL FRONT REAR" position).

5. Hold the lever at approximately 2 1/2" from the seat transverswise.

6. Adjust tolerance at shift lever pivot to the 1-1/5" (31 mm).

7. Rotate the rear shaft "C" to get the rear U-joint "D" at horizontal position.

8. Tighten all loose nuts (1) and (2).

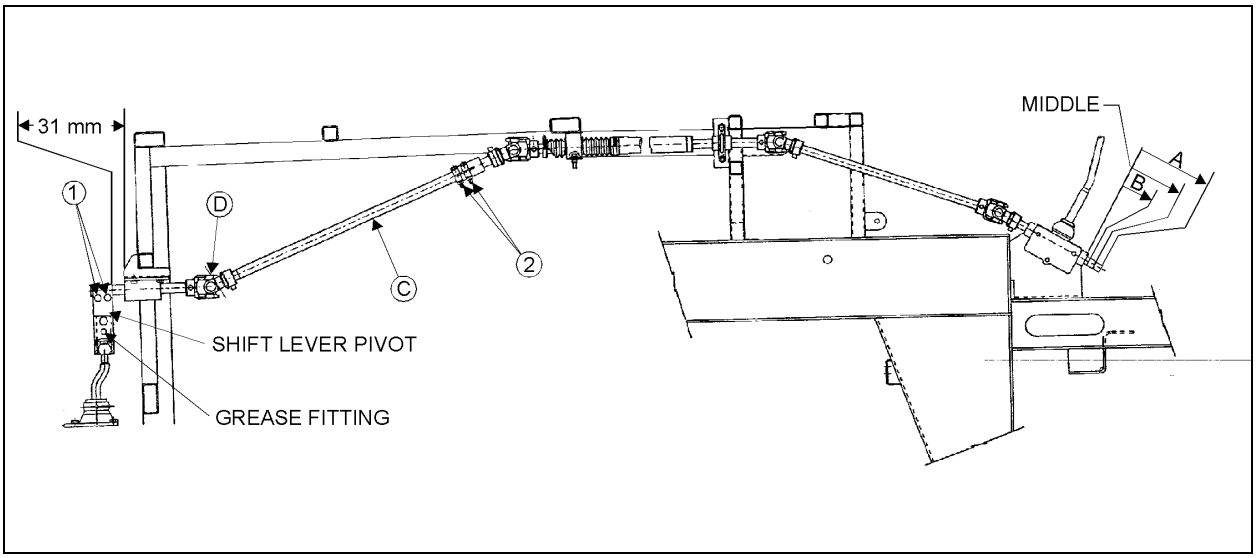


FIGURE 5: GEAR SHIFT LINKAGE 07013

4.2 Lubrication

Grease with good quality lithium-base grease NLGI No.1 (Fig. 5):

- The shift lever pivot: service every 6,250 miles (10 000 km), grease 1 fitting.
- Shift control rod universal joints: service every 25,000 miles (40 000 km); grease 4 fittings.

Only during disassembly, grease the following with NLGI No.1:

1. The shift lever housing;
2. Transmission lever ball; and
3. Axle bearing.

5. TRANSMISSION REMOVAL

5.1 Automatic Transmission

The following procedure deals with the removal of the transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission "NEUTRAL" position, apply parking brake, then turn main battery disconnect switches to the "OFF" position.
2. Jack up vehicle, then place safety support below body.

Caution: *Only the recommended jacking points must be used as outlined in Section 18, BODY.*

Note: *For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).*

3. Remove engine splash guards surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug and tighten to 33-41 lbf•ft (45-56 N•m) (see in this section under heading "3.2.9 OIL AND FILTER CHANGE".

Warning: *It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.*

6. Remove transmission dipstick and filler tube.

7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09,"Propeller Shaft".

8. Disconnect the two oil cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.

Warning: *A significant amount of oil may drain from oil lines when they are disconnected.*

9. Disconnect all sensors on L.H. side of the transmission.

10. Disconnect main wiring harness.

11. Disconnect the air supply line (steel-braided hose) from retarder control valve (if applicable).

12. Remove any locking tie, clamp and bracket that will interfere with removal of transmission.

13. Support transmission using a suitable transmission jack.

14. Remove the access plug from the flywheel housing on the R.H. side under the starter. From access plug, remove the 12 converter-to-flexible plate attaching screws. Rotate clockwise the alternator shaft to gain access to the attaching screws (Fig. 6).

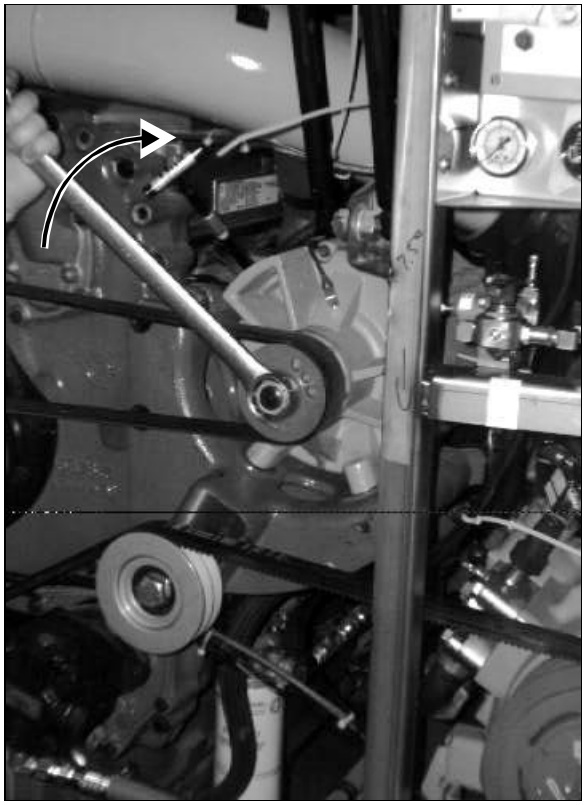


FIGURE 6: ENGINE COMPARTMENT 0701

Caution: *Do not rotate the alternator shaft counterclockwise to avoid loosening the shaft pulley retaining screw.*

15. Remove the 12 screws retaining the torque converter housing to the flywheel housing.

Caution: *Make sure transmission-to-engine alignment is maintained when removing screws to avoid damaging torque converter housing.*

16. Remove the transmission rubber mount above transmission by removing the nut, bolt and washer over the rubber and its support. Remove the bracket from transmission (only if the vehicle is equipped with a retarder).

17. Slowly pull transmission straight out to clear engine.

18. Remove the transmission.

5.2 Manual Transmission

The following procedures deal with the removal of the transmission without removing the power plant cradle from vehicle. The method used to support the transmission depends upon conditions and available equipment.

1. Set transmission shift lever to "neutral" position, apply parking brake, then turn main battery disconnect switches to the *"*OFF*"* position.

2. Jack up vehicle, then place safety supports below body.

Caution: *Only the recommended jacking points must be used as outlined in Section 18, Body.*

Note: *For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).*

4. Remove engine splash guards surrounding transmission.

5. Remove cross member from under transmission.

6. Remove the transmission drain plug and allow oil to drain. Reinstall drain plug.

Warning: *It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.*

7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, *"Propeller Shaft"*.

8. Remove fiberglass transmission protection.

9. Disconnect gear shift linkage as follows:

a. Remove the two bolts that secure the coupling lever to the shift rod (1, Fig. 5).

b. Push the shift rod all the way into bushing.

10. Remove return spring and disconnect yoke. Remove clutch slave cylinder from transmission without disconnecting hoses.

Note: *Removing clutch slave cylinder will enable the release yoke to turn up and pull free from the release bearing thrust pads.*

11. Disconnect speedometer sensor, back-up signal switch and neutral start switch.

12. Remove any locking tie, clamp and bracket that will interfere with the removal of transmission.

13. Support transmission using a suitable transmission jack, then remove the twelve clutch/engine mounting screws.

Caution: *Make sure transmission-to-engine alignment is maintained when removing transmission. Do not let the rear end of transmission drop down and hang unsupported in the spline hubs of the clutch discs to avoid bending or distorting the friction discs.*

14. Slowly pull transmission straight out to clear the input shaft. Remove transmission.

6. MANUAL TRANSMISSION DISASSEMBLY AND REASSEMBLY

Refer to the “Manual Transmission” service manual from Spicer, annexed to the end of this section.

7. CLEANING AND INSPECTION OF THE TRANSMISSION

7.1 Automatic Transmission

The exterior of the transmission should be cleaned and inspected at regular intervals. The length of service and severity of operating conditions will determine the frequency of such inspections. Inspect the transmission for:

1. Loose bolts (transmission and mounting components);
2. Oil leaks (correct immediately);
3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose oil lines;
5. Worn or frayed electrical harnesses, improper routing; and
6. Worn or out of phase drive line U-joint and slip fittings.
7. Worn ring gear teeth. Inspect ring gear teeth by the flywheel housing inspection hole (Fig. 7).

Caution: *DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.*

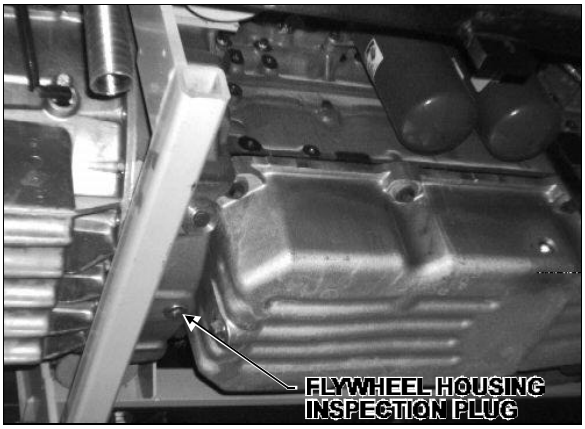


FIGURE 7: UNDER VEHICLE VIEW 01029

7.1.1 Breather

The breather is located at the top of the transmission. It serves to prevent pressure build-up within the transmission and must be cleaned and have the passage opened. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the transmission. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use a wrench of proper size to remove or replace the breather. Pliers or pipe wrench can crush or damage the stem and produce metal chips which could enter the transmission.

7.2 Manual Transmission

7.2.1 Cleaning

Warning*: Use a petroleum-based solvent.*

Warning: *Do not use gasoline to clean parts. Gasoline can explode, causing serious physical injury.*

Caution: *Do not use water or steam to clean internal components. It could cause corrosion of these components.*

8. TRANSMISSION INSTALLATION

8.1 Automatic Transmission

Note*: For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).*

1. With the access plug removed, align one of the 12 attaching screw holes in the flexible plate with the access opening, on the R.H. side under the starter. See figure 6 for attaching screws alignment.

2. Place the transmission on a transmission jack.

3. Install a headless guide bolt into one of the 12 threaded holes for flexible plate attaching screws in the flywheel.

4. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).

5. Raise transmission and position the flywheel pilot boss into the flexible plate adaptor. Align the guide bolt previously installed in the flywheel with the flexible plate hole facing the access opening in the flywheel housing.

Warning: *Severe damages and/or personal injury can occur if transmission is not adequately supported.*

6. Seat the transmission against the engine flywheel housing. NO FORCE IS REQUIRED. If interference is encoun-ered, move the transmission away from engine, then investigate the cause.

Caution: *The torque converter housing must be seated against the flywheel housing prior to tightening any screws. DO NOT USE SCREWS TO SEAT THE HOUSING.*

7. Start all torque converter housing screws, then tighten four of them gradually and in a criss-cross sequence around the housing. Tighten the 12 remaining screws. Recommended torque is between 42-50 lbf•ft (57-68 N•m).

8. Remove the guide bolt through the access opening in the flywheel housing. Replace it with a self-locking screw, finger-tight, start the remaining screws, then tighten to 17-21 lbf•ft (23-28 N•m).

9. Reinstall the access plug.

10. If the vehicle is equipped with a retarder; install the bracket on the transmission and tighten the bolt to 71-81 lbf•ft (96-110 N•m). Install the transmission rubber mount between the rubber support and the frame with a bolt, nut and washer. Tighten the nut until the tolerance of 2 9/32 ± 5/64 inches (58 ± 2 mm) is met (Fig. 8).

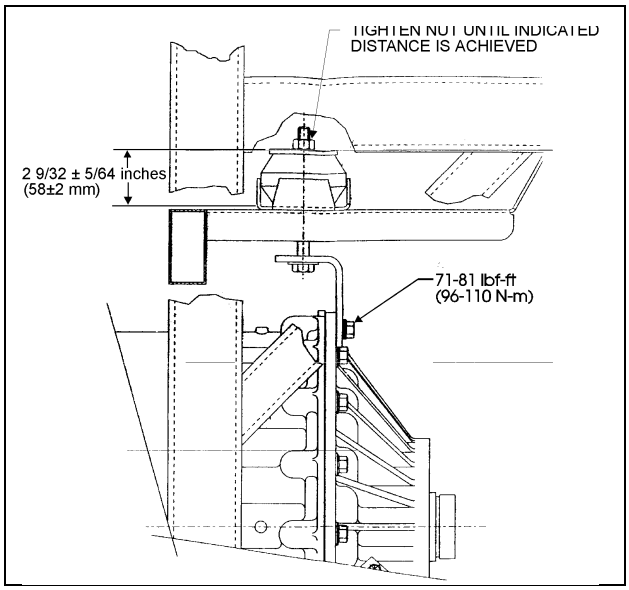


FIGURE 8: TRANSMISSION BRACKET 07014

11. Remove jack from under transmission.

12. Connect all sensors.

13. Connect the main wiring harness.

Note: *Refer to paragraph "4. GEAR SHIFT LINKAGE" of this section for proper adjustment.*

14. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).

15. Connect the two transmission oil cooler hoses as they were previously.

16. Reinstall clamps and brackets, and replace locking ties that had been removed during removal procedure.

17. Install propeller shaft and its safety guard. Refer to Section 09, "Propeller Shaft".

18. Install transmission dipstick and filler tube.

19. Install cross member under transmission.

20. Install engine splash guards.

21. Adjust the retarder pressure to 80 ± 3 psi with the air pressure regulator. For more information refer to Section 12, "Brake and Air System", under heading "8.PRESSURE REGULATING VALVES". The air pressure regulator is located in engine compartment R.H. side (Fig. 9).

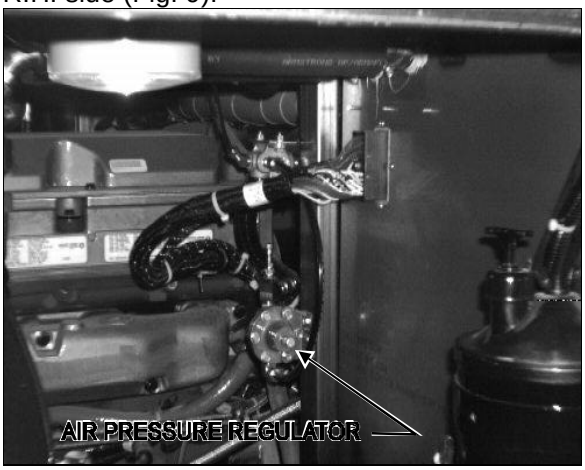


FIGURE 9: ENGINE COMPARTMENT R.H. SIDE 02003

22. Make sure that the drain plug is in place, then remove the transmission dipstick and pour approximately 37 US qts (39 L) of DEXRON-IIE or DEXRON-III automatic transmission fluid through the filler tube. Check and adjust oil level.

Caution: *Do not overfill the transmission. Overfilling can cause oil aeration (milky appearance) and overheating. If overfilling occurs, drain oil as required to bring it to the proper level.*

8.2 Manual Transmission

Note: For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).

1. Place the transmission on a transmission jack.

2. Ensure clutch brake is in position on transmission input shaft.

3. Position the clutch release bearing with the flat section on top.

4. Shift transmission into 5th gear, then raise it and position the input shaft into clutch discs. Align input shaft splines with those on clutch discs by rotating the output shaft. As the input shaft enters the clutch discs, rotate the clutch release yoke backwards until the release yoke fingers clear the pads on release bearing housing. Rotate the clutch release yoke into proper position as transmission is pushed into place.

Caution: *Avoid hanging the weight of the transmission on the clutch or forcing the transmission into the clutch or flywheel housing. This can cause bent or sprung clutch discs and prevent the clutch from releasing.*

Caution: *The clutch housing must be seated against the flywheel housing prior to tightening any screw. Do not use screws to seat the housing.*

5. Install in all clutch/engine screws, then tighten them gradually and in a criss-cross manner around the housing. Tighten the remaining screws. Recommended torque is 44-50 lbf•ft (60-68 N•m).

6. Remove jack from under transmission.

7. Install clutch slave cylinder and its return spring.

Note: *Refer to Section 02, "Clutch" for adjustment.*

8. Connect speedometer sensor, back-up signal switch and neutral start switch.

9. Reinstall clamps, brackets, and replace locking ties that had been removed during removal procedure.

10. Shift transmission to neutral, then secure the coupling lever bolts.

Note: *Refer to paragraph "4. GEAR SHIFT LINKAGE" of this section, for proper adjustment.*

11. Install fiberglass transmission protection.

12. Install propeller shaft and its safety guard. Refer to Section 09, *"Propeller Shaft"*.

13. Install cross member under transmission.

14. Install engine splash guards.

15. Install tag axle wheels.

16. Make sure that the drain plug is in place, then refill transmission. Check and adjust oil level.

17. Adjust the servo clutch pressure to 40 psi with the air pressure regulator. For more information, refer to Section 12, "Brake and Air System", under heading "8. PRESSURE REGULATING VALVES". The air pressure is located in the engine compartment R.H. side (Fig. 9).

9. ALLISON TRANSMISSIONS PRINCIPLES OF OPERATION

Refer to "Allison Transmission, MD Series, Principles of Operation, SA 2454".

10. TROUBLESHOOTING

10.1 Manual Transmission

Refer to the Troubleshooting section in the Spicer Service Manual PS130-6B (6-speed) or PS145-7A (7-speed) depending upon the transmission installed on your vehicle. Manuals are annexed to the end of this section.

10.2 Automatic Transmission

Refer to *"*Allison Transmission, MD Series, Troubleshooting Manual, SA 2158A".

10.2.1 Diagnostic Code Memory

Diagnostic codes are logged in a list in memory (sometimes referred to as the queue), positioning the most recently occurring code first and containing up to five codes. The codes contained in the list have the information recorded as shown in the chart below. Access to the code list position, main code, sub code and active indicator is available through either the shifter display or the Pro-Link Diagnostic Data Reader (DDR). Access to the ignition cycle counter and event counter is obtained through the DDR only.

Code List Position	Main Code	Sub Code	Active Indicator	Ignition Cycle Counter	Event Counter
d1	21	12	YES	00	10
d2	41	12	YES	00	04
d3	23	12	NO	08	02
d4	34	12	NO	13	01
d5	56	11	NO	22	02
Displayed on shifter display and DDR			YES= ACTIVE= "MODE ON"	Ignition cycle counter and event counter are not available on shifter display	

Note: *All information is available with a diagnostic tool.*

The following paragraphs define the different parts of the code list.

Code List Position

The position (1 through 5) which a code occupies in the code list in memory. Positions are shown as "d1" (Diagnostic Code #1) through "d5."

Main Code

The general condition or area of fault detected by ECU.

Sub Code

The specific area or condition under the main code in which the condition was detected.

Active Indicator

Will be turned "ON" when a fault condition is active (shifter will display "MODE ON" or the DDR will display "YES"). Will be set to "OFF" when conditions exist to indicate fault condition is gone.

Ignition Cycle Counter

Used to clear diagnostic codes that are inactive from the code list in memory. A counter is incremented each time a normal ECU power down occurs following clearing of the Active Indicator. A code will be cleared from the list when the counter exceeds 25.

Event Counter

Used to count the number of occurrences of a diagnostic code occurs prior to the incident being cleared from the code list. The most recent code will be in position "d1". If the most recent code is one which is already in the code list, that code will be moved to position "d1", the Active Indicator will be turned "ON" (shifter will display "MODE ON" or the DDR will display "YES"), the Ignition Cycle Counter is cleared and "1" is added to the Event Counter.

Clearing the Active Indicator and code Records from the Code List in Memory

If the conditions causing a diagnostic code to be set are cleared, the Active Indicator can be manually cleared by holding the "MODE" button down continuously for 3 seconds until a tone is heard from the shifter.

To clear code records from the list, hold the "MODE" button down continuously for ten seconds until a second tone sounds. All diagnostic records in the list that are not active will then be cleared and the remaining records will be moved up the list.

Code Reading and Code Clearing Procedures

Diagnostic codes can be read and cleared by two methods: by using the Pro-Link 9000 DDR plugged in the receptacle located on L.H. lateral console or by using the shifter display. The use of the Pro-Link 9000 DDR is described in the instruction manual supplied with each tool. The method for reading and clearing codes described in this section refers only to entering of the Diagnostic Display Mode by the proper button selection.

The Diagnostic Display Mode may be entered for viewing of codes at any speed. Codes can only be cleared when the output speed = 0 and no output speed sensor failure is active.

The following descriptions explain how to use the shifter to read and clear codes.

Reading Codes

1. Enter the diagnostic display mode by pressing the "↑" and "↓" (upshift and downshift arrows) buttons at the same time on the push-button shifter.

Note: *If a "DO NOT SHIFT" condition is present at this time, the lever should be in the same position as it was at the time of code detection. If not, this shifter tone will sound continuously.*

Note: *If an oil level sensor is present, the oil level will be displayed first. Diagnostic code display is achieved by depressing the upshift and downshift arrows or display mode button a second time.*

2. Read the first code in the first of five code positions on the digital display of the shifter. For example, we will read code every two seconds as follows:

a. Code list position --"d1";
b. Main code --"25";
c. Sub code --"11"; and
d. Display will repeat cycle of a., b. and c. above.

3. Press the "MODE" button momentarily to view the second position (d2) in the same way as 2. above.

4. To view the third, fourth and fifth positions (d3, d4 and d5), momentarily press the MODE button as explained above

5, Pressing the "MODE" button momentarily after the fifth position is displayed will cause the sequence of code positions to start over with the irst position.

6. Any code which is active will be i ndicated by the "MODE ON" indicator (active indicator) being turned on while in that code position (while in the normal opération.

7. Any code position in the list which does not have a diagnostic code logged will display "- -" for both the main and sub code displays. All positions after a code codes.

Clearing Codes

1. Clearing of the active indicator is automatically done at ECU power down on all but code 69 34.

   Some codes will clear the active indicator automatically when the condition causing the code is no longer detected by the ECU (see Diagnostic Code List and Description.

2. Manual clearing is possible while in the diagnostic display mode and after the condition causing the code is corrected (output speed must be zero).

a. To clear all active indicators, hold the "MODE" button down continuously for 3 seconds until the shifter tone sounds for 0.5 seconds.

b. Release the "MODE" button to return to normal operating mode. If the condition causing the code was not active at the time, the active indicator will turn off.

Caution: *If clearing a code while locked in a Forward or Reverse position (fail-to-range), the transmission will still be in Drive or Reverse when the clearing procedure is completed. Neutral must be selected manually.*

Exiting the Diagnostic Display Mode

The diagnostic display mode can be exited by any of the following procedures:

1. Press the "↑" and "↓" (upshift and downshift) buttons at the same time on the push-button shifter.

2. Press any range button, "D", "N" or "R", on the push-button shifter (the shift will be commanded if it is not inhibited by an active code).

3. Do nothing and wait until the calibrated time (approximately 10 minutes) has passed and the system automatically returns to the normal operating mode.

4. Turn off power to the ECU (turn off the vehicle at the ignition switch).

5. After the clearing of a code, the active indicator procedure described above has been performed.

Clearing Records from the Code List in Memory

If the requirements for Manual Clearing the Active Indicator have been satisfied, and the "MODE" button is held down continuously for ten seconds while in the display mode until a tone sounds, all diagnostic records in the code list that are not active will be cleared and the remaining records will be moved up in the code list.

Abbreviations Found in the Code Chart

The following responses are used throughout the following chart to command safe operation when diagnostic codes are set.

1. **DNS** (**D**o **N**ot **S**hift) Response

a. Turn off lockup clutch and inhibit lockup operation.

b. Inhibit all shifts.

c. Turn on *DO NOT SHIFT* light.

d. Pulse the tone generator for 8 seconds when the condition is first detected.

e. Blank the select digit in the display.

f. Ignore any range selection inputs and disable the button feedback tone for the push-button shifter.

2. **SOL OFF** (**Sol**enoid **Off**) Response

a. All solenoids are commanded off (turning solenoids "A" and "B" off electrically causes them to be on hydraulically).

3. **RPR** (**R**eturn to **P**revious **R**ange)Response

a. When the ratio or C3 pressure switch tests associated with a shift are not passed, the ECU commands the same range as commanded at the beginning of the shift.

4. **NNC** (**N**eutral **N**o **C**lutches) Response

a. When certain ratio or C3 pressure switch tests are not passed, the ECU commands a neutral condition with no clutches applied.

Diagnostic code list and description

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
12	12	Oil level, low	No	No upshift above a calibration range
12	23	Oil level,high	No	No upshift above a calibration range
13	12	ECU imput voltage, low	Yes	DNS, SOL OFF (Hydraulic default)
13	13	ECU imput voltage, medium low	No	None: Shift adaptive feature will not function.
13	23	ECU imput voltage, high	Yes	DNS, SOL OFF (Hydraulic default)
14	12	Oil level sensor, low	No	None
14	23	Oil level sensor, high	No	None
21	12	Throttle position sensor, low	No	Use Throttle default value
21	23	Throttle position sensor, high	No	Use Throttle default value
22	14	Engine speed sensor reasonableness test	No	Use default engine speed
22	15	Turbine speed sensor reasonableness test	Yes	DNS, Lock in current range
22	16	Output speed sensor reasonableness or rapid decel test	Yes	DNS, Lock in current range
23	12	Primary Shifter or RSI Link Fault	No	Hold in last valid direction
23	13	Primary Shifter Mode Function Fault	No	Mode change not permitted
23	14	Secondary Shifter or RSI Link Fault	No	Hold in last valid direction
23	15	Secondary Shifter Mode Function Fault	No	Mode change not permitted
24	12	Sump oil temperature, cold	Yes	DNS
24	23	Sump oil temperature, hot	No	No upshifts above a calibration range
25	00	Output speed reasonableness test, detected at 0 speed, (L)	Yes	DNS, Lock in current range (L)

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
25	11	Output speed reasonableness test, detected at 0 speed, (1st)	Yes	DNS, Lock in current range (1 st)
25	22	Output speed reasonableness test, detected at 0 speed 2nd	Yes	DNS, Lock in current range (2nd)
25	33	Output speed reasonableness test, detected at 0 speed, 3rd	Yes	DNS, Lock in current range (3rd)
25	44	Output speed reasonableness test, detected at 0 speed, 4th	Yes	DNS, Lock in current range (4th)
25	55	Output speed reasonableness test, detected at 0 speed, 5th	Yes	DNS, Lock in current range (5th)
25	66	Output speed reasonableness test, detected at 0 speed, 6th	Yes	DNS, Lock in current range (6th)
25	77	Output speed reasonableness test, detected at 0 speed, R	Yes	DNS, Lock in current range (R)
32	00	C3 pressure switch open, L range	Yes	DNS, Lock in current range (L)
32	33	C3 pressure switch open, 3rd range	Yes	DNS, Lock in current range (3rd)
32	55	C3 pressure switch open, 5th range	Yes	DNS, Lock in current range (5th)
32	77	C3 pressure switch open, R range	Yes	DNS, Lock in current range (R)
33	12	Sump oil temperature sensor, low	No	Use default value of 200ø F (93ø C)
33	23	Sump oil temperature sensor, high	No	Use default value of 200ø F (93ø C)
34	12	EEPROM, factory cal. compatibility number wrong	Yes	DNS, SOL OFF (Hydraulic default)
34	13	EEPROM, factory calibration block checksum	Yes	DNS, SOL OFF (Hydraulic default)
34	14	EEPROM, Power Off Block checksum	Yes	Use previous location, or factory calibration and reset adaptive
34	15	EEPROM, Diagnostic Queue Block Checksum	Yes	Use previous location, or clear diagnostic queue

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
34	16	EEPROM, Real Time Block Checksum	Yes	DNS, SOL OFF (Hydraulic default)
35	00	Power interruption (Code set after power restored)	No	NONE (Hydraulic default during interruption)
35	16	Real Time EEPROM Write Interruption	Yes	DNS, SOL OFF (Hydraulic default)
36	00	Hardware/Software not compatible	Yes	DNS, SOL OFF (Hydraulic default)
41	12	Open or short to ground, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	13	Open or short to ground, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	14	Open or short to ground, C solenoid circuit	Yes	DNS. SOL OFF (Hydraulic default)
41	15	Open or short to ground, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	16	Open or short to ground, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	21	Open or short to ground, F solenoid circuit	No	Lock-up inhibited
41	22	Open or short to ground, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	23	Open or short to ground, H solenoid circuit	No	Retarder allowed, differential lock inhibited
41	24	Open or short to ground, J solenoid circuit	No	Low and 1st inhibited
41	25	Open or short to ground, K solenoid circuit	No	K solenoid operation inhibited
41	26	Open or short to ground, N solenoid circuit	No	Low and 1st inhibited
42	12	Short to battery, A solenoid circuit	Yes	DNS, Lock in a range
42	13	Short to battery, B solenoid circuit	Yes	DNS, Lock in a range
42	14	Short to battery, C	Yes	DNS, Lock in a range

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
		solenoid circuit		
42	15	Short to battery, D solenoid circuit	Yes	DNS, Lock in a range
42	16	Short to battery, E solenoid circuit	Yes	DNS, Lock in a range
42	21	Short to battery, F solenoid circuit	No	Lock-up inhibited
42	22	Short to battery, G solenoid circuit	Yes	DNS, Lock in a range
42	23	Short to battery, H solenoid circuit	No	Retarder allowed, differential lock inhibited
42	24	Short to battery, J solenoid circuit	No	Low and 1st inhibited
42	25	Short to battery, K solenoid circuit	No	K solenoid operation inhibited
42	26	Short to battery, N solenoid circuit	No	Low and 1st inhibited
43	21	Low side driver, F solenoid circuit	No	Lock-up inhibited
43	25	Low side driver, K solenoid circuit	No	K solenoid operation inhibited
43	26	Low side driver, N solenoid circuit	No	Low and 1st inhibited
44	12	Short to ground,A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	13	Short to ground,B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	14	Short to ground,C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	15	Short to ground,D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	16	Short to ground,E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	21	Short to ground,F solenoid circuit	No	Lock-up inhibited

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
44	22	Short to ground,G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	23	Short to ground,H solenoid circuit	No	Retarder allowed. differential lock inhibited
44	24	Short to ground,J solenoid circuit	No	Low and 1st inhibited
44	25	Short to ground,K solenoid circuit	No	K solenoid operation inhibited
44	26	Short to ground,N solenoid circuit	No	Low and 1st inhibited
45	12	Open circuit,A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	13	Open circuit,B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	14	Open circuit,C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	15	Open circuit,D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	16	Open circuit,E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	21	Open circuit,F solenoid circuit	No	Lock-up inhibited
45	22	Open circuit,G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	23	Open circuit,H solenoid circuit	No	Retarder allowed differential lock inhibited
45	24	Open circuit,J solenoid circuit	No	Low and 1st inhibited
45	25	Open circuit,K solenoid circuit	No	K solenoid operation inhibited
45	26	Open circuit,N solenoid circuit	No	Low and 1st inhibited
51	10	Offgoing ratio test (during shift), 1 to L	Yes	Low and 1st inhibited
51	12	Offgoing ratio test (during shift), 1	Yes	DNS, RPR

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
		to 2		
51	21	Offgoing ratio test (during shift), 2 to 1	Yes	DNS, RPR
51	23	Offgoing ratio test (during shift), 2 to 3	Yes	DNS, RPR
51	43	Offgoing ratio test (during shift), 4 to 3	Yes	DNS, RPR
51	45	Offgoing ratio test (during shift), 4 to 5	Yes	DNS, RPR
51	65	Offgoing ratio test (during shift), 6 to 5	Yes	DNS, RPR
52	01	Offgoing C3PS test (during shift), L to 1	Yes	DNS, RPR
52	08	Offgoing C3PS test (during shift), L to N1	Yes	DNS, NNC
52	32	Offgoing C3PS test (during shift), 3 to 2	Yes	DNS, RPR
52	34	Offgoing C3PS test (during shift), 3 to 4	Yes	DNS, RPR
52	54	Offgoing C3PS test (during shift), 5 to 4	Yes	DNS, RPR
52	56	Offgoing C3PS test (during shift), 5 to 6	Yes	DNS, RPR
52	71	Offgoing C3PS test (during shift), R to 1	Yes	DNS, NNC
52	72	Offgoing C3PS test (during shift), R to 2	Yes	DNS, NNC
52	78	Offgoing C3PS test (during shift), R to N1	Yes	DNS, NNC
52	79	Offgoing C3PS test (during shift), R to 2 (R to NNC to 2)	Yes	DNS, NNC
52	99	Offgoing C3PS test (duringshift), N3 to N2	Yes	DNS, RPR
53	08	Offgoing speed test (during shift), L to N1	Yes	DNS, NNC

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
53	18	Offgoing speed test (during shift), 1 to N1	Yes	DNS, NNC
53	28	Offgoing speed test (during shift), 2 to N1	Yes	DNS, NNC
53	29	Offgoing speed test (during shift), 2 to N2	Yes	DNS, RPR
53	38	Offgoing speed test (during shift), 3 to N1	Yes	DNS, NNC
53	39	Offgoing speed test (during shift), 3 to N3	Yes	DNS, RPR
53	48	Offgoing speed test (during shift), 4 to N1	Yes	DNS, NNC
53	49	Offgoing speed test (during shift), 4 to N3	Yes	DNS, RPR
53	58	Offgoing speed test (during shift), 5 to N1	Yes	DNS, NNC
53	59	Offgoing speed test (during shift), 5 to N3	Yes	DNS, RPR
53	68	Offgoing speed test (during shift), 6 to N1	Yes	DNS, NNC
53	69	Offgoing speed test (during shift), 6 to N4	Yes	DNS, RPR
53	78	Offgoing speed test (during shift), R to N1	Yes	DNS, NNC
53	99	Offgoing speed test (during shift), N2 to N3 or N3 to N2	Yes	DNS, RPR
54	01	Oncoming ratio test (after shift), L to 1	Yes	DNS, RPR
54	07	Oncoming ratio test (after shift), L to R	Yes	DNS, NNC
54	10	Oncoming ratio test (after shift), 1 to L	Yes	DNS, RPR
54	12	Oncoming ratio test (after shift), 1 to 2	Yes	DNS, RPR
54	17	Oncoming ratio test (after shift),	Yes	DNS, NNC

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
		1 to R		
54	21	Oncoming ratio test (after shift), 2 to 1	Yes	DNS, RPR
54	23	Oncoming ratio test (after shift), 2 to 3	Yes	DNS, RPR
54	27	Oncoming ratio test (after shift), 2 to R	Yes	DNS, NNC
54	32	Oncoming ratio test (after shift), 3 to 2	Yes	DNS, RPR
54	34	Oncoming ratio test (after shift), 3 to 4	Yes	DNS, RPR
54	43	Oncoming ratio test (after shift), 4 to 3	Yes	DNS, RPR
54	45	Oncoming ratio test (after shift), 4 to 5	Yes	DNS, RPR or SOL OFF (Hydraulic default)
54	54	Oncoming ratio test (after shift), 5 to 4	Yes	DNS,RPR
54	56	Oncoming ratio test (after shift), 5 to 6	Yes	DNS,RPR
54	65	Oncoming ratio test (after shift), 6 to 5	Yes	DNS,RPR
54	70	Oncoming ratio test (after shift), R to L	Yes	DNS,NNC
54	71	Oncoming ratio test (after shift), R to 1	Yes	DNS,NNC
54	72	Oncoming ratio test (after shift), R to 2	Yes	DNS,NNC
54	80	Oncoming ratio test (after shift), N1 to L	Yes	DNS,RPR
54	81	Oncoming ratio test (after shift), N1 to 1	Yes	DNS,RPR
54	82	Oncoming ratio test (after shift), N1 to 2	Yes	DNS,RPR
54	83	Oncoming ratio test (after shift), N1 to 3	Yes	DNS,RPR

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
54	85	Oncoming ratio test (after shift), N1 to 5	Yes	DNS,RPR
54	86	Oncoming ratio test (after shift), Nl to 6	Yes	DNS, RPR
54	92	Oncoming ratio test (after shift), R to 2 (R to NNC to 2)	Yes	DNS, NNC
54	92	Oncoming ratio test (after shift), N1 to 2 (N1 to NNC to 2)	Yes	DNS, RPR
54	92	Oncoming ratio test (after shift), N2 to 2	Yes	DNS, RPR
54	93	Oncoming ratio test (after shift), N3 to 3	Yes	DNS, RPR
54	95	Oncoming ratio test (after shift), N3 to 5	Yes	DNS, RPR
54	96	Oncoming ratio test (after shift), N4 to 6	Yes	DNS, RPR
54	97	Oncoming ratio test (after shift), 2 to R (2 to NNC to R)	Yes	DNS, NNC
55	17	Oncoming C3PS test (after shift), 1 to R	Yes	DNS, NNC
55	27	Oncoming C3PS test (after shift), 2 to R	Yes	DNS, NNC
55	80	Oncoming C3PS test (after shift), N1 to L	Yes	DNS, RPR
55	87	Oncoming C3PS test (after shift), N1 to R	Yes	DNS, RPR
55	97	Oncoming C3PS test (after shift), 2 to R or NVL to R (2 to NNC to R)	Yes	DNS, NNC
56	00	Range verification test, L	Yes	DNS, 1st, Low, or SOL OFF (Low)
56	11	Range verification test, 1st	Yes	DNS, 6th
56	22	Range verification test, 2nd	Yes	DNS, 6th or 5th
56	33	Range verification test, 3rd	Yes	DNS, 5th or SOL
56	44	Range verification test, 4th	Yes	DNS, 3rd or 5th

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
56	55	Range verification test, 5th	Yes	DNS, SOL OFF (5th) or 3rd
56	66	Range verification test, 6th	Yes	DNS, 5th, 3rd, or SOL OFF (3rd)
56	77	Range verification test, R	Yes	DNS, N2 or N3
57	11	Range verification C3PS test, 1st	Yes	DNS, SOL OFF (3rd)
57	22	Range verification C3PS test, 2nd	Yes	DNS, 3rd
57	44	Range verification C3PS test, 4th	Yes	DNS, 5th or SOL OFF (3rd)
57	66	Range verification C3PS test, 6th	Yes	SOL OFF (5th), DNS
57	88	Range verification C3PS test, N1	Yes	DNS, N3
57	99	Range verification C3PS test, N2 or N4	Yes	DNS, N3
61	00	Retarder oil temperature, hot	No	None
62	12	Retarder oil temperature sensor, low	No	None
62	23	Retarder oil temperature sensor, high	No	None
63	00	Special function input	No	Depends on special function
64	12	Retarder modulation request sensor, low	No	Retarder operation inhibited
64	23	Retarder modulation request sensor, high	No	Retarder operation inhibited
65	00	Engine rating too high	Yes	DNS
66	00	Serial communications interface fault	No	Use default throttle values
69	12	ECU, A solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	13	ECU, B solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	14	ECU, C solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	15	ECU, D solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)

Main Code	Sub Code	Description	Do Not Shift Light	Inhibited Operation Description
69	16	ECU, E solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	21	ECU, F solenoid driver open	No	Lock-up inhibited
69	22	ECU, G solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default)
69	23	ECU, H solenoid driver open	No	Retarder allowed, differential lock inhibited
69	24	ECU, J solenoid driver open	No	Low and 1 st inhibited
69	25	ECU, K solenoid driver open	No	K solenoid operation inhibited
69	26	ECU, N solenoid driver open	No	Low and 1st inhibited
69	32	ECU, SPI communications link fault	No	Hold in last valid direction
69	33	ECU, Central Operating Processor (COP) timeout	Yes	Reset ECU, Shutdown ECU on 2nd occurrence (power loss: hydraulic defaults)
69	34	ECU, EEPROM write timeout	Yes	DNS, SOL OFF (Hydraulic default)
69	35	ECU, EEPROM checksum	Yes	Induce COP timeout (reset ECU)
69	36	ECU, RAM self test	Yes	Induce COP timeout (reset ECU)
69	41	ECU, I/O ASIC addressing test	Yes	Induce COP timeout (reset ECU)
70	35	Software, minor loop overrun	Yes	Induce COP timeout (reset ECU)
70	35	Software, illegal write to access $0000	Yes	Induce COP timeout (reset ECU)
70	35	Software, major loop overrun	Yes	Induce COP timeout (reset ECU)

11. SPECIFICATIONS

AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

Gross input power (maximum) ..... 450 hp (335 kW)
Gross input torque (maximum)..... 1460 lbf•ft (1978 N•m)
Rated input speed (minimum-maximum)..... 1600-2300 rpm

Mounting
Engine..... SAE #1 flywheel housing, flex disk drive

Torque converter
Type..... One stage, three element, polyphase
Stall torque ratio..... TC 521-2.4;TC 531-2.3;TC 541-1.9;TC 551-1.8;TC 561-1.6
Lockup clutch with torsional damper..... Integral/standard

Gearing

Type	Patented, constant mesh, helical, planetary
	Ratio*
First	3.51:1
Second	1.91:1
Third	1.43:1
Fourth	1.00:1
Fifth	0.74:1
Sixth	0.64:1
Reverse	4.80:1

Ratio coverage
6 speed..... 5.48:1

* Gear ratios do not include torque converter multiplication.

Oil System
Oil type..... DEXRON-IIE OR DEXRON III
Capacity (excluding external circuits)..... Initial fill 47 US qts (45 liters)
Oil change..... 37 US qts (39 liters)

Oil Filters
Make..... Allison Transmission
Type..... Disposable cartridge
Supplier number..... 29503829
Prévost number..... 571687

MANUAL TRANSMISSION

SIX-SPEED

Make ..... Spicer
Model PS130-6B
Ratio:

LO	8.53:1
1st	4.87:1
2nd	3.00:1
3rd	1.90:1
4th	1.33:1
5th	1.00:1
Rev	8.53:1

Fluid:
Type ..... Same as engine oil
Capacity ..... 41 Pints (19.4 liters) at 0° Installation
Torque Capacity ..... 1300 lbf•ft (1761 N•m)

SEVEN-SPEED

Make ..... Spicer
Model PS145-7A
Ratio:

LO	10.13:1
1st	5.99:1
2nd	3.56:1
3rd	2.57:1
4th	1.84:1
5th	1.33:1
6th	1.00:1
Rev	10.13:1

Fluid:
Type ..... Same as engine oil
Capacity ..... 48 Pints (22.7 liters) at 0° Installation
Torque Capacity ..... 1450 lbf•ft (1964 N•m)

SERVICE MANUAL

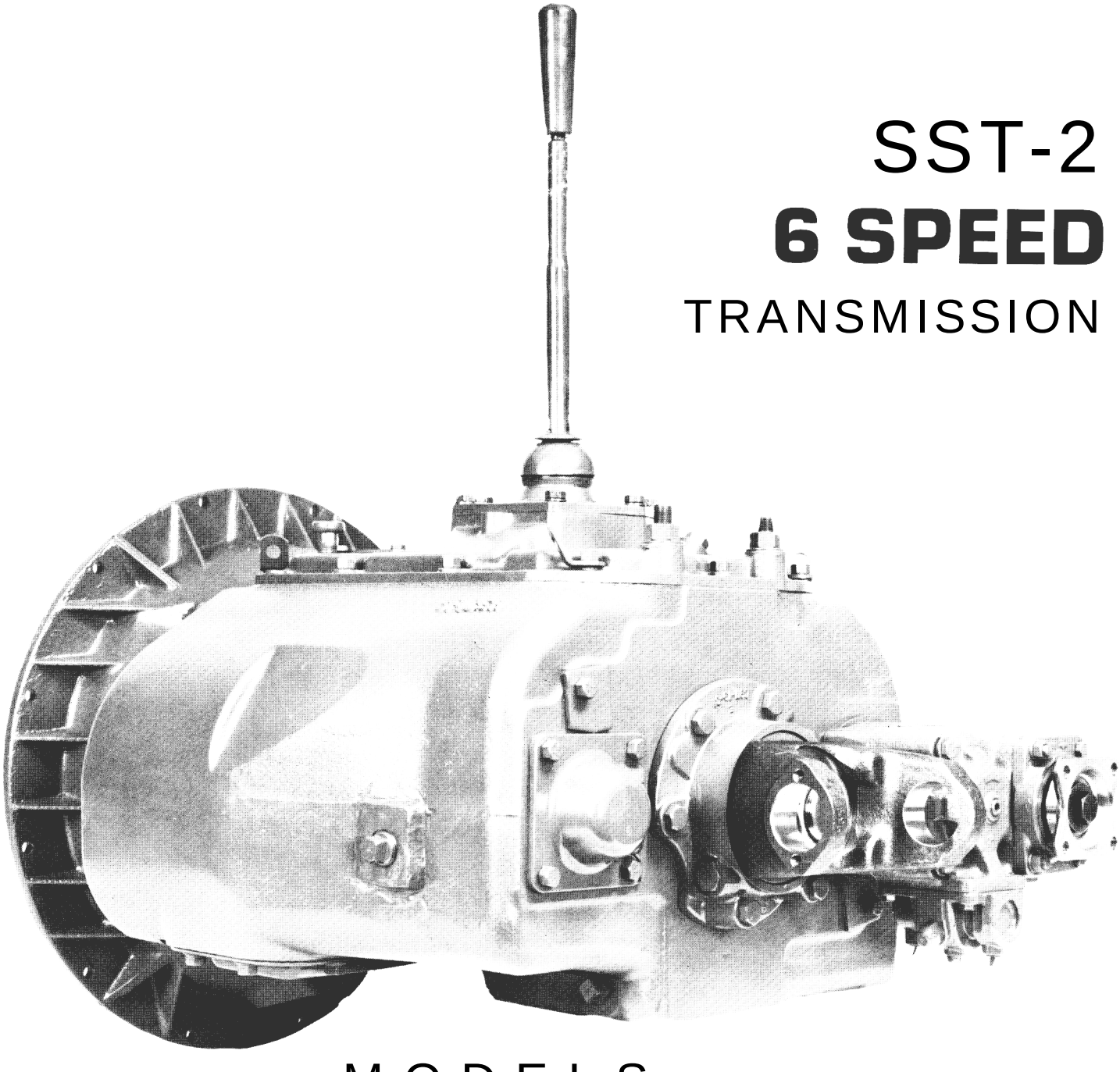
SPICER®

HEAVY DUTY

SST-2

6 SPEED

TRANSMISSION



MODELS

1362-A, **1362-B, 1362-C, 1364-C, 1463-A**

SERVICE MANUAL

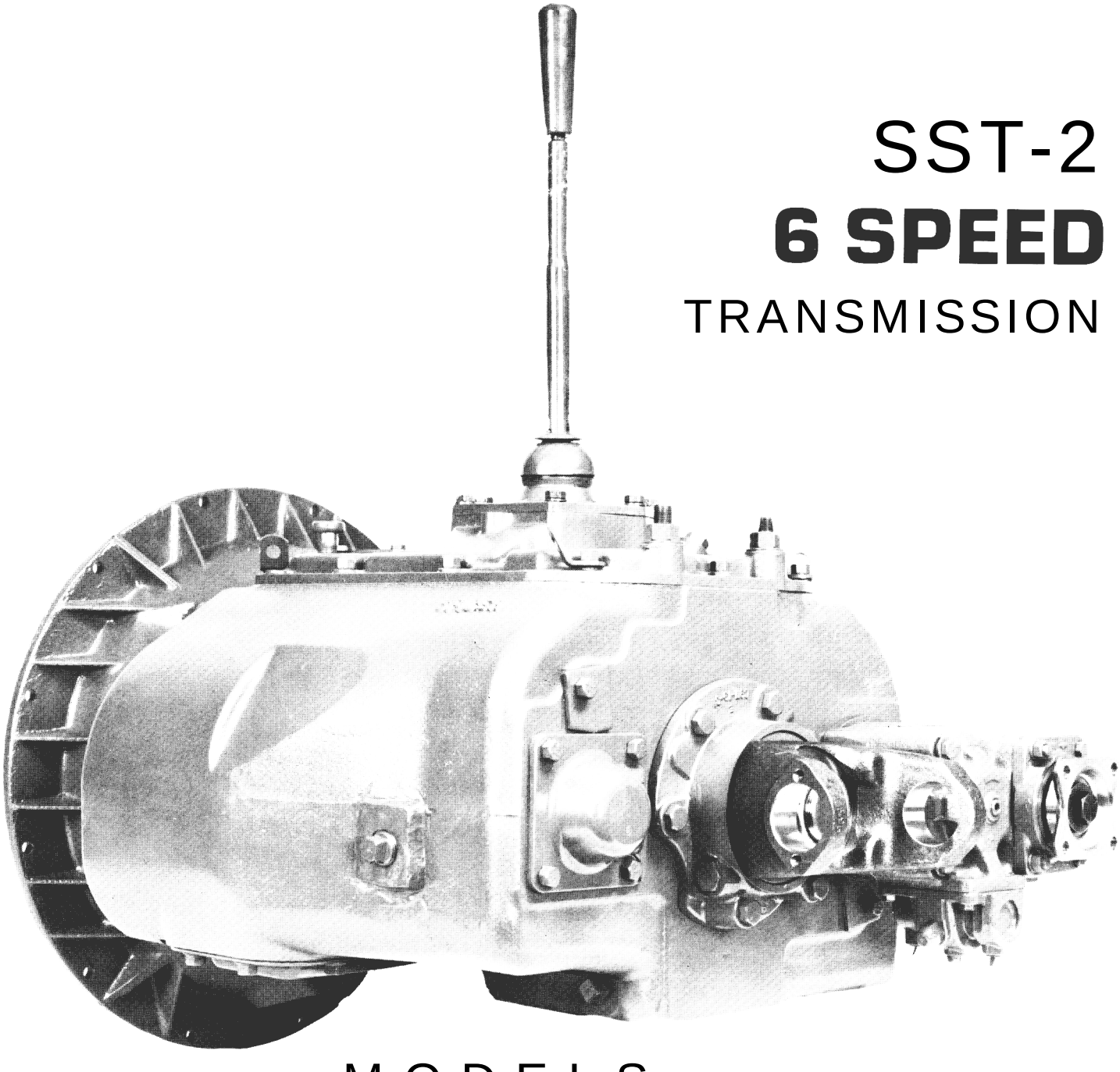
SPICER®

HEAVY DUTY

SST-2

6 SPEED

TRANSMISSION



MODELS

1362-A, **1362-B, 1362-C, 1364-C, 1463-A**

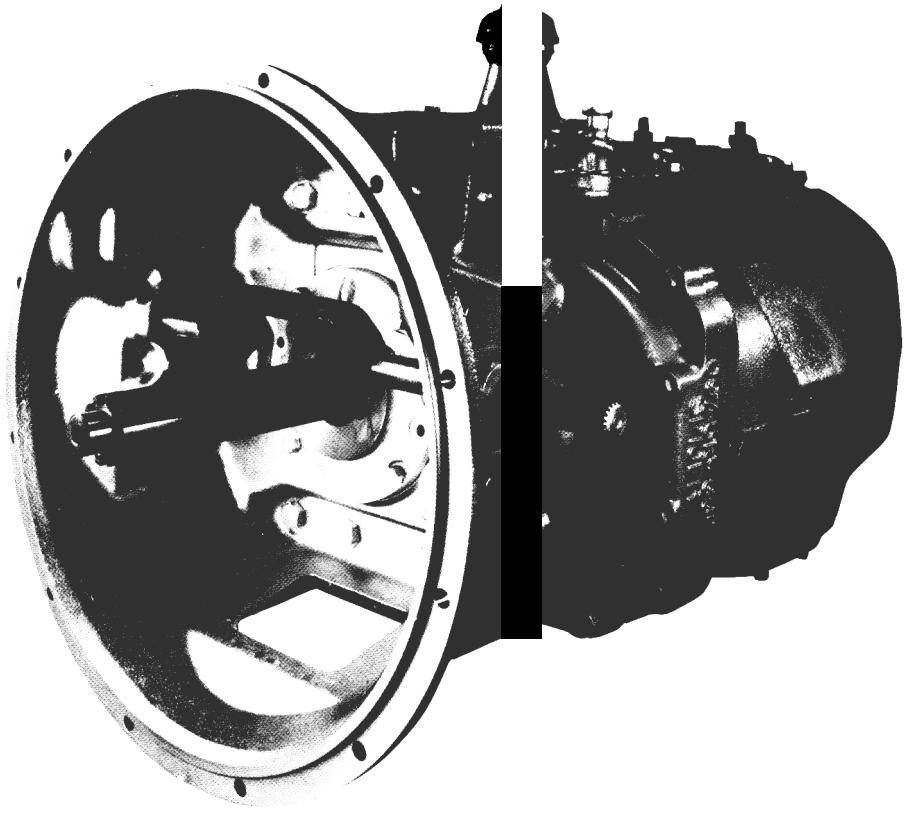
SERVICE MANUAL

SPICER®

HEAVY DUTY

7 SPEED

TRANSMISSIONS



MODELS PS140-7A
& PS125=7B

SPICER®

DANA

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SPECIFICATIONS

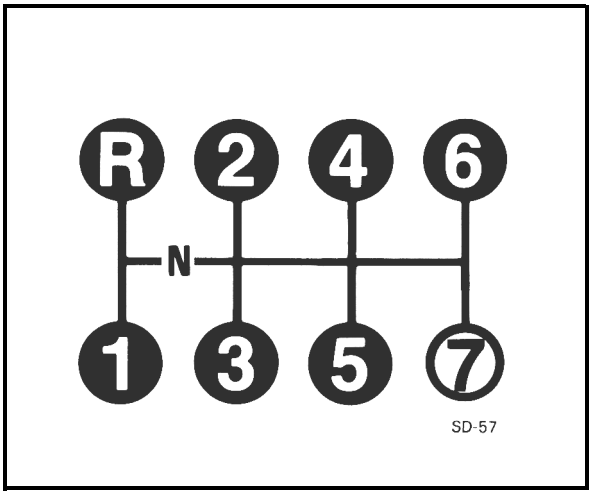
Spicer Seven Speed

MODELS PS140-7A & PSI 25-7B

PS 140-7A			PS125-7B		
Gear	Ratio	% Step	Gear	Ratio	% Step
1	10.13	6 9	1	12.27	7 5
2	5.99	6 8	2	7.00	6 9
3	3.56	3 9	3	4.13	6 3
4	2.57	4 0	4	2.54	3 8
5	1.84	3 8	5	1.84	3 8
6	1.33	3 3	6	1.33	3 3
7	1.00		7	1.00	
R	10.13		R	12.27	

Speeds:	**7 Forward, 1 Reverse**
Torque Capacity:	**PS140-7A 950-1400 lbs. ft. (1 290-1900 Nm)**
	PS125-7B 950-1250 lbs. ft, (1 290-1700 Nm)
Length:	**30.75" (781.05 mm)**
Weight:	**626 lbs. (284 kg)**
End Yokes:	**1710 6-4-7691 1760 6.3-4-1251 1810 6.5-4-3821**
Flanges:	**1710 6-1-5821**
Clutch:	**14" or 15½" (355.6 or 393.70 mm) 2-Plate**
Clutch Housing:	**S.A. E. Nos. 1 or 2 Nodal Mount Standard**
Oil Capacity:	**48 Pints (22.7 Liters) at 0° Installation**
Drive Gear:	**2" Standard**
Power Take-Off:	**6 Bold right and lower left. Countershaft P.T.O. provision, standard on the right side, optional on the left.**

SHIFT PATTERN
PS140-7A & PSI 25-7B



How to Shift Spicer Models PS140-7A & PS125-7B

Your vehicle has been equipped with the Spicer 7-Speed transmission. The Spicer 7-speed has seven forward speeds, engineered to make full use of engine output and to improve fuel economy, This single stick transmission has seven lever positions with no splitter or range necessary to provide superior performance. Here's how this transmission is designed to work for you in the driver's seat.

Starting

With the engine idling, depress the clutch and move stick into first gear. Gradually release the clutch and accelerate the engine to governed speed (1900-1950 RPM).

NOTE –A clutch brake is used to stop gear rotation to complete a shift into first or reverse when the vehicle is stationary. If a butt-toothed condition exists between the clutching teeth, a momentary re-engagement of the main clutch will allow the gear train to move into a smooth engagement.

NOTE – *The clutch brake on this transmission is actuated by depressing the clutch pedal all the way to the floor. For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.*

Upshifting

Once governed engine speed has been attained, to shift into second gear, depress the clutch and move the stick to neutral. Engage the clutch and allow RPM to drop approximately 750. (RPM drop may vary with engines of different governed speeds) *, depress the clutch and move the stick into second gear. Re-engage the clutch and accelerate to governed speed. Continue upshifting through seventh gear in this manner.

Downshifting

When downshifting from seventh gear, allow RPM to drop approximately 475*, depress clutch pedal and move stick to neutral. Engage the clutch, accelerate to governed speed, depress the clutch and move the stick into sixth gear, then re-engage the clutch. Continue downshifting through first gear in this manner.

***NOTE–All RPM drops are based on the PSI 40-7A and PS 125-7B transmission ratios and an engine governed speed of 1900-1950 RPM. These drops will vary with other transmission ratios or with engines of higher governed speeds.**

OPERATION

Clutches

A clutch brake is required for use with this transmission. It is recommended that the torque limiting clutch brake be used instead of the three-piece type. Attention is called to the fact that Spicer 14" and 15%" 2-plate clutch service manuals (Bulletins 1308 and 1309) are available for the asking, and contain complete information on all Spicer Heavy Duty Clutches.

Replacement Parts

The exploded views of subassemblies which are incorporated here are for the mechanic's convenience and show the latest material. The parts are arranged in their correct order and may also be used as a reference for assembly or disassembly of this unit.

Power Flow

The Spicer split torque transmission is designed for medium and heavy duty, on and off highway applications.

The two countershaft design allows the engine torque to be equally divided between the two countershafts. This provides a high ratio of torque capacity to transmission weight. This also allows a reduction in the face width of each gear involved in the transmission. All the gears are in constant mesh through spur teeth.

Spicer" Transmission Lubrication

To insure proper lubrication and operating temperatures in these units it IS most Important that the proper lubricants be used and that correct 011 levels be maintained

Recommended Lubricants

The lubricants listed below are recommended, in order of preference, for use in all Spicer mechanical transmissions, auxiliaries and transfer cases.

Oil Changes

We recommend an initial oil change and flush after the transmission is placed in *actual* service. This change should be made anytime following 3000 miles (4827 km), but *should not exceed 5000* miles (8045 km), of over-the-road service. In off-highway use, the change should be made after 24 and before 100 hours of service have elapsed. There are many factors that influence the following oil change periods, and we have not specified a definite mileage interval,

In general, it IS suggested that a drain and flush period be scheduled every 50,000 miles (80,450 km) for normal over-the-highway operations. Off-highway usually requires oil change every 1000 hours. The oil level in the transmission should be checked every 5000 miles (8045 km) on-highway, or every 40 hours in off-highway operation. When it is necessary to add oil, we recommend that types or brands of oil should not be mixed. The correct oil level in ail Spicer transmissions is established by the filler plug opening.

Refill

First, remove all dirt around the fliler plug Then refill with new oil of grade recommended for the existing season and prevailing service Fill to the bottom of the level testing plug positioned on the side of the transmission.

Overfilling

DO NOT OVERFILL the transmission. Overfilling usually results in oil breakdown because of excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy varnish and sludge deposits that plug up oil ports and build up on splines and bearings. Overflow of oil escapes onto clutch or parking brakes causing additional trouble.

NON-SYNCHRONIZED TRANSMISSION RECOMMENDED LUBRICANTS

The following lubricants are recommended, in order of preference.

TEMPERATURE	GRADE	TYPE
Above O°F (– 18°C) Below O°F (– 18°C)	SAE 30, 40, or 50 SAE 30	Heavy Duty Engine Oil meeting MIL-L-2104D or MIL-L-46152 B, API-SF or API-CD (MIL-L-2104 B & C, or 46152 are also acceptable)
Above O°F (–18°C) Below O°F (–18°C)	SAE 90 SAE 80	Straight Mineral Gear Oil R & O Type API-GL-1
Above O°F (– 18°C) Below O°F (– 18°C)	SAE 90 SAE 80	*Mild EP Gear Oil MIL-L-2105 or API-GL-4
All	CD SAE 50 CD SAE 30	Synthetic Engine Oil meeting MIL-L-2104 D or MIL-L-46152 B, API-SF or API-CD
All	EP SAE 75W90 EP SAE 75W140	*Synthetic Gear Oil meeting MIL-L-2105C or API-GL5

*EP Gear Oils are not recommended when lubricant operating temperatures are above 230°F (110°C).

General Precautions for Disassembly

IMPORTANT

Read this section before starting the detailed disassembly procedure.

Follow each procedure closely in each section, making use of both the text and the pictures.

Rebuild Facilities

A suitable holding fixture or overhaul stand is desirable, but not necessary, to rebuild this unit, The flat bottom of the transmission case provides a suitable working platform when the unit is placed on a sturdy shop table.

For easier working conditions, table height should be 28-30 inches. A light chain hoist should be used to handle the mainshaft and countershafts during removal and reassembly procedures.

Cleanliness

Transmissions should be steam cleaned prior to disassembly, Seal all openings before steam cleaning to prevent entry of dirt and water which can damage serviceable parts

Dirt is abrasive and will cause premature wear of bearings and other parts. We suggest that mechanics have a small wash tank to clean parts just prior to reassembly.

Front Bearing Retainer & Seal

When installing the front bearing retainer and seal to the transmission, the following precautions must be used.

Bearings

When a transmission is removed at relatively low mileage, bearings should be removed with pullers designed for this purpose. Wrap the bearings to keep out dirt. Clean, inspect and lubricate all bearings just prior to reassembly. If accumulated mileage is over 150,000 miles, we suggest that all bearings be replaced.

End Yokes and Flanges

Hammering on end yokes and flanges to remove or install them is not only destructive to the yoke or the flange itself, but can also cause serious Internal damage, Hammering destroys or mutilates the pilot diameters and warps or bends the flange. Hammering on end yokes will close-in the bearing bores or misalign yoke lugs and result in early failures of journal needle bearings, etc.

Serious damage can be done Internally to bearings, thrust faces and washes, pilot bearings, etc., by hammering on external parts In most designs when the yoke/flange locknuts are tightened and secure, the Internal bearings and gears are in proper location. When the yoke/flange is driven on the shaft, two conditions can exist.

(a) If the bearing fit *is tight* on the shaft, then usually the bearings will brinell as they must absorb the pounding force

(b) If the bearing IS loose, the shaft will keep moving inward until it IS stopped by the Internal parts such as pilot bearing thrust washers, etc.

Power Take-Off's

Refer to your owner's manual and installation procedures when installing any PTO on your transmission.

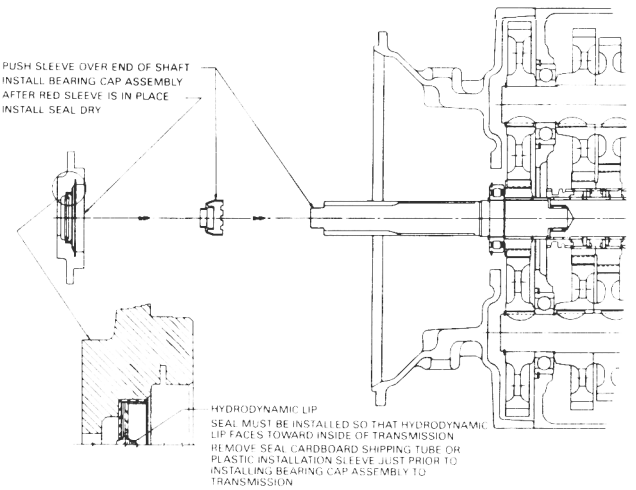
CAUTION

Do not tow vehicles equipped with Spicer transmissions without first pulling the axle shafts or disconnecting the drive shaft. Lubrication of the internal gear train is inadequate when the vehicle is towed. Also, do not pull or roll start vehicles in first or reverse gears.

INSTALL SEAL DRY

WARNING

RED SLEEVE MUST BE USED TO PREVENT SERIOUS DAMAGE TO OIL SEAL WHEN ASSEMBLING BEARING CAP. FAILURE TO COMPLY WILL VOID SEAL WARRANTY.

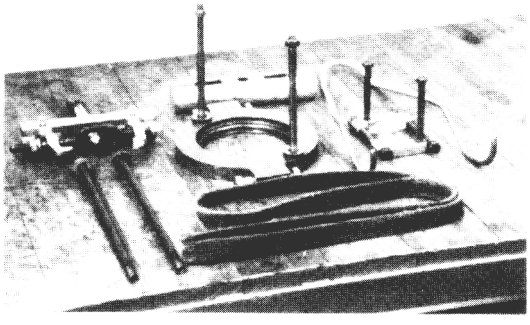


Tool Reference

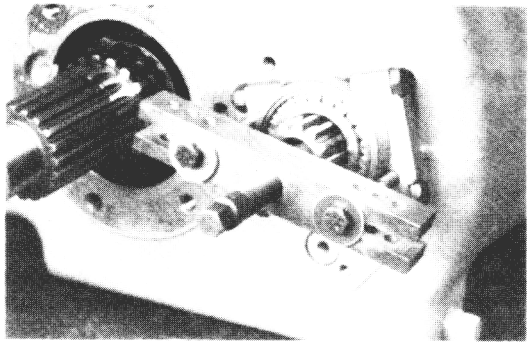
Tools

Spicer Transmissions can be repaired with ordinary mechanic's hand tools. However this procedure is not only time consuming, but could damage otherwise re-usable parts.

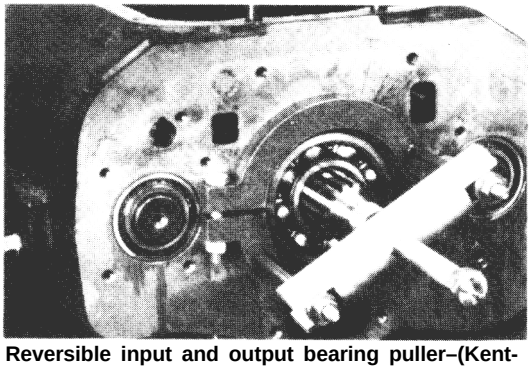
To reduce maintenance costs and vehicle downtime, we recommend using the special tools shown in this section.



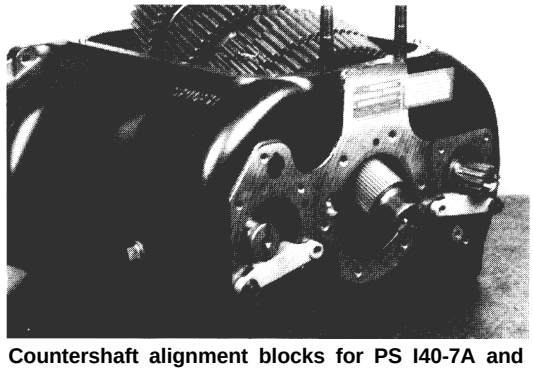
Suggested pullers and alignment tools,



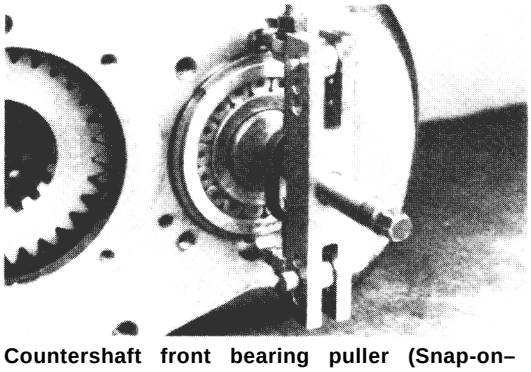
Countershaft rear bearing puller (Snap-on – CJ 950).



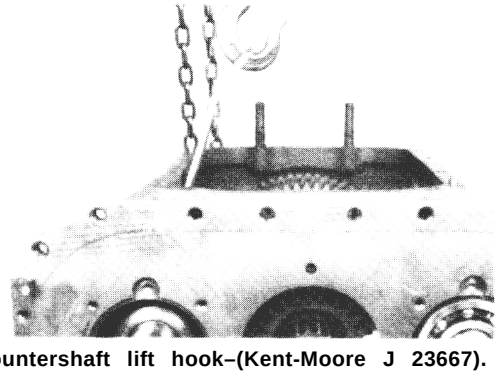
Reversible input and output bearing puller–(Kent-Moore J 24348). Used with end yoke remover (J 7804-01).



Countershaft alignment blocks for PS I40-7A and PS I25-7B (Kent-Moore J 28720). Provide maximum clearance for mainshaft assembly installation. Allow countershafts to be rotated for timing purposes.



Countershaft front bearing puller (Snap-on– CJ 80).



Countershaft lift hook–(Kent-Moore J 23667). Holds countershaft in time while centering the countershaft in the case bore for easier bearing installation.

Tools may be purchased through:
Kent-Moore
29784 Little Mack
Roseville, Michigan 48066-2298
Telephone: 1-800-328-6657

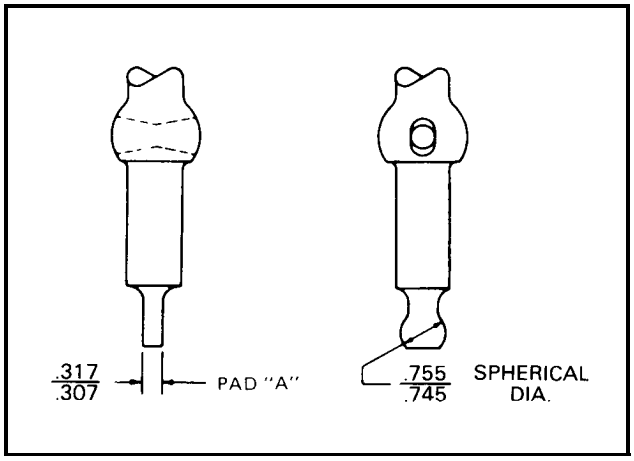
Shift Tower

Disassemble

1. Remove the six retaining capscrews and lockwashers, Separate the dome from the shifter housing and gasket and lift straight up.
2. Position shift lever dome on edge in vise.
3. Pull up grommet. Depress collar against spring and remove lock pin.
4. Slide the compression cup up shift lever and remove rock shaft snap ring.
5. Tap rock shaft free of dome and remove shift lever. Remove seal and discard.
6. Remove shift lever handle and slide grommet, collar, spring and cup off lever.

Inspection

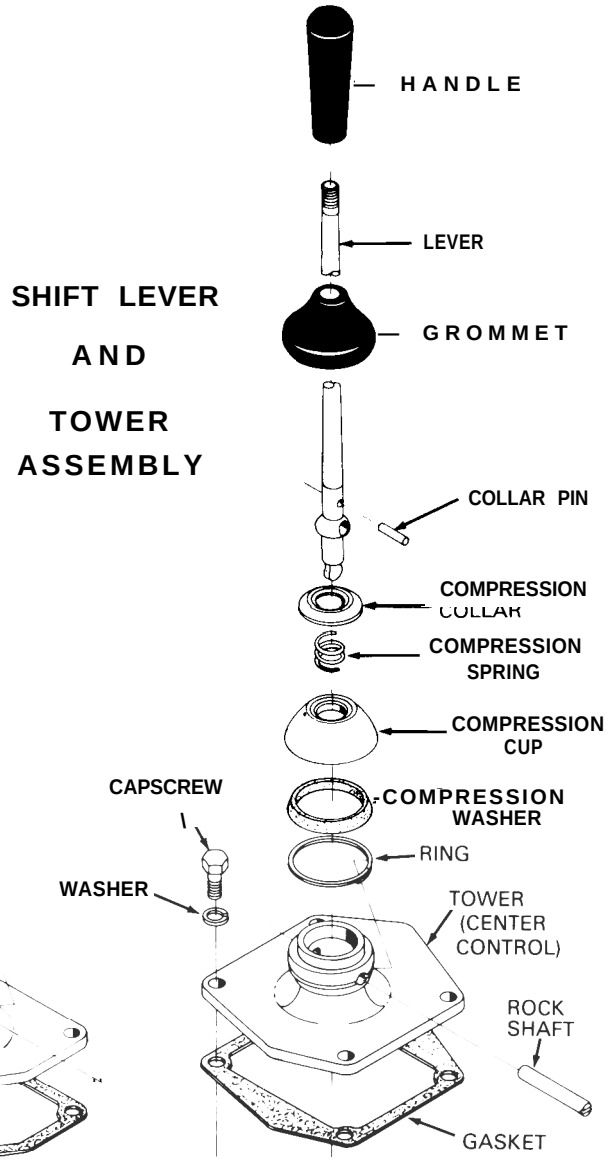
Wash all parts thoroughly and inspect for excessive wear at cross hole in lever and rock shaft. Inspect finger end of lever for excessive wear.



Check spring tension by comparing to a new part

Reassembly

1. Position shift lever dome on edge in vise,
2. Hold shift lever so that cross hole in lever aligns with rock shaft cross holes in dome,
3. Insert rock shaft through hole in dome and cross hole of shift lever.
4. Assemble rock shaft snap ring to groove of dome and lock rock shaft in place,
5. Grease lightly and assemble new seal to shift dome, Grease inner wall of cup and slide over lever into position on dome.
6. Assemble spring, collar and grommet over shift lever, Depress collar and insert lock pin through hole in lever,
7. Assemble shift lever handle,
8. Place shift lever and dome assembly on shifter housing with gasket, noting that finger enters the neutral position notches,
9. Secure with four capscrews and lockwashers.



Remote Control Assembly

Disassembly

Remove the capscrews and lockwashers and separate the remote control from the shifter housing.

1. **Remove setscrew from universal joint assembly and pull universal joint from the rod.**
2. **Remove four capscrews and lockwashers holding end cover and gasket in place.**
3. **Remove setscrew from joint shift rod finger and tap rod through cross holes in housing.**
4. **Remove finger from housing.**
5. **Remove setscrew from inner shift finger.**
6. **Slide rod and bracket assembly from inner shift finger.**
7. **Be careful not to lose key from rod or shift finger.**
8. **Remove seals from cross holes in housing.**

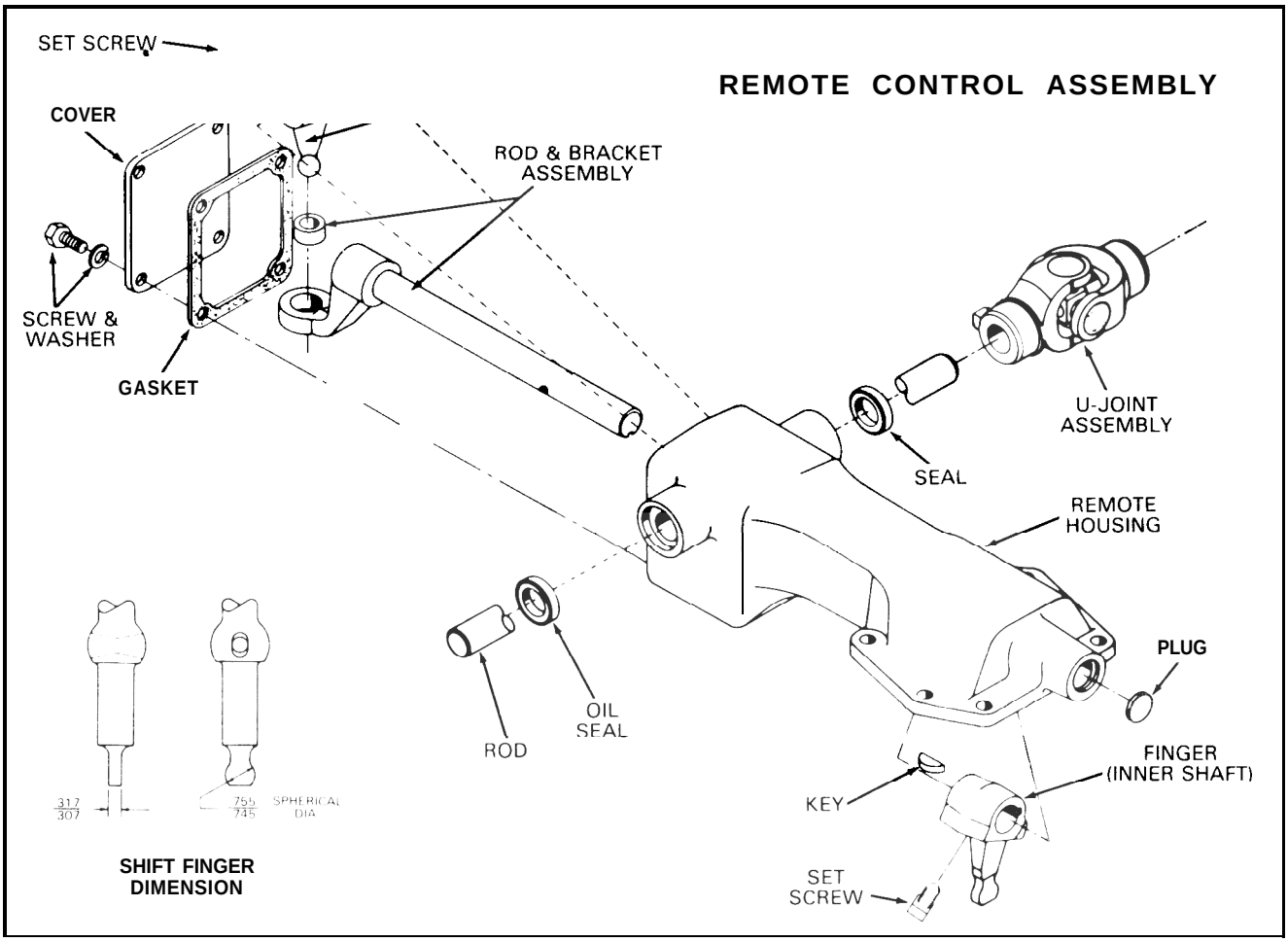
Inspection

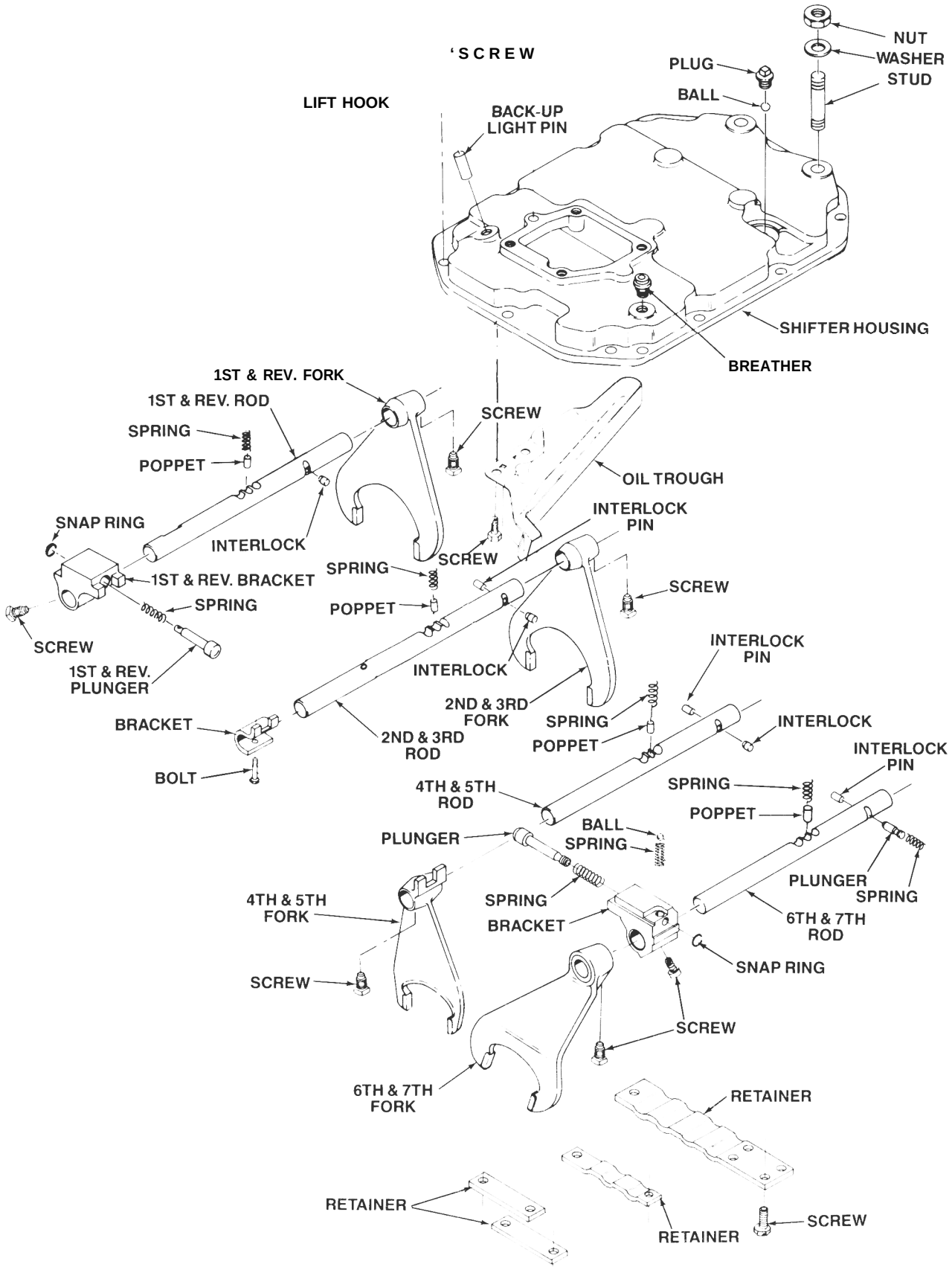
Check shift fingers for excessive wear. Check all bores and rods for excessive wear or scuffing.

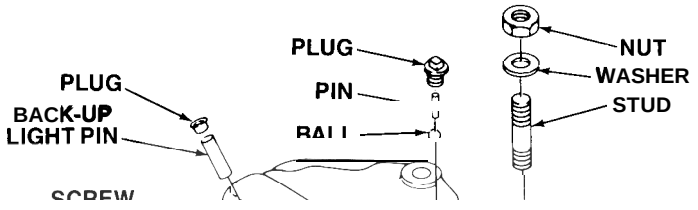
Clean parts thoroughly and apply light coat of grease to pivot points when reassembling.

Assembly

1. **Install new key in rod and bracket assembly and install into remote housng, sliding shift finger (inner) on end of rod.**
2. **Line up setscrew hole and install setscrew, and torque to 40 to 50 lbs. ft.**
3. **Install joint shift rod and through cross holes and through outer finger, making sure finger is inserted into bracket.**
4. **Align setscrew hole and install same. Torque to 40 to 50 tbs. ft.**
5. **Install end cover and secure with four capscrews and lockwashers,**
6. **Install two new oil seals in joint shift rod bores.**
7. **Install joint assembly and secure with setscrew.**

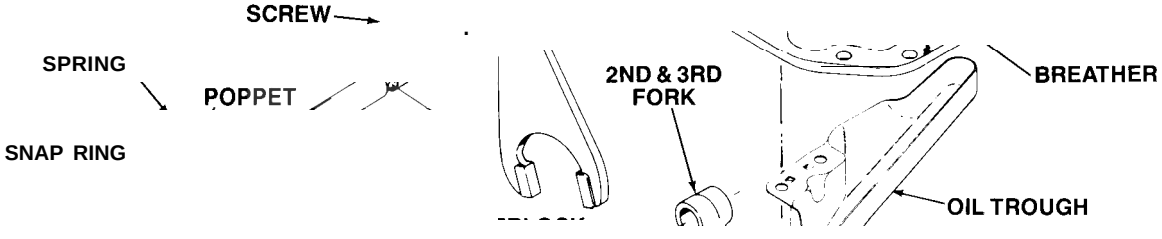


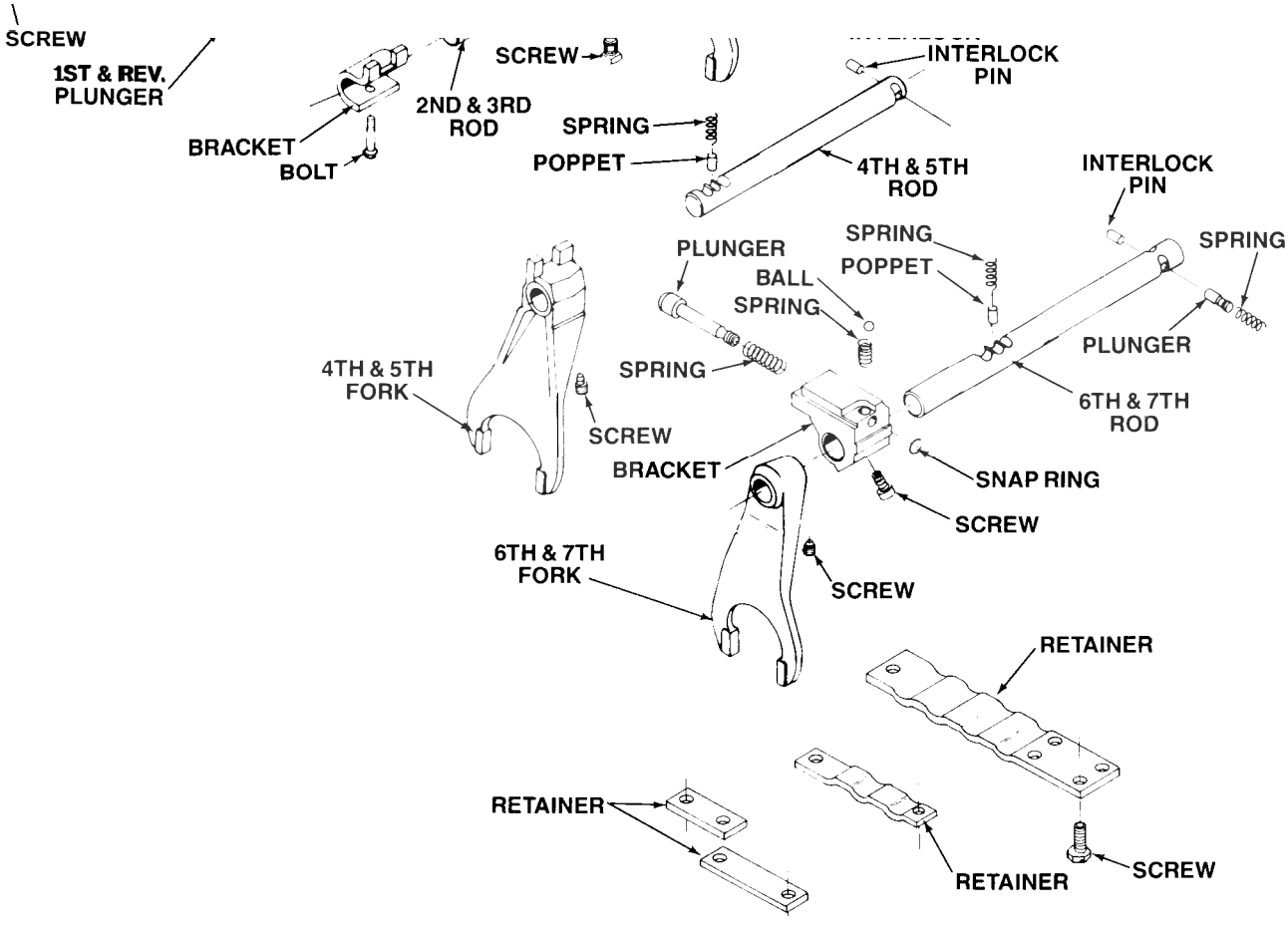

'SCREW
NUT
WASHER
STUD
PLUG
BALL
LIFT HOOK
BACK-UP
LIGHT PIN
SHIFTER HOUSING
BREATHER
1ST & REV. FORK
1ST & REV. ROD
SPRING
POPPET
SCREW
OIL TROUGH
SNAP RING
INTERLOCK
PIN
INTERLOCK
SPRING
SCREW
1ST & REV. BRACKET
SPRING
POPPET
SCREW
SCREW
INTERLOCK
PIN
1ST & REV.
PLUNGER
INTERLOCK
2ND & 3RD
FORK
SPRING
INTERLOCK
BRACKET
2ND & 3RD
ROD
POPPET
INTERLOCK
PIN
BOLT
4TH & 5TH
ROD
SPRING
POPPET
BALL
PLUNGER
SPRING
PLUNGER
SPRING
4TH & 5TH
FORK
SPRING
BRACKET
6TH & 7TH
ROD
SNAP RING
SCREW
SCREW
6TH & 7TH
FORK
RETAINER
RETAINER
RETAINER
SCREW

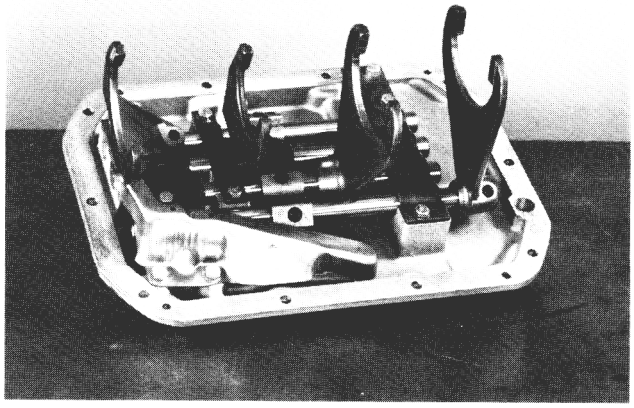


LIFT HOOK

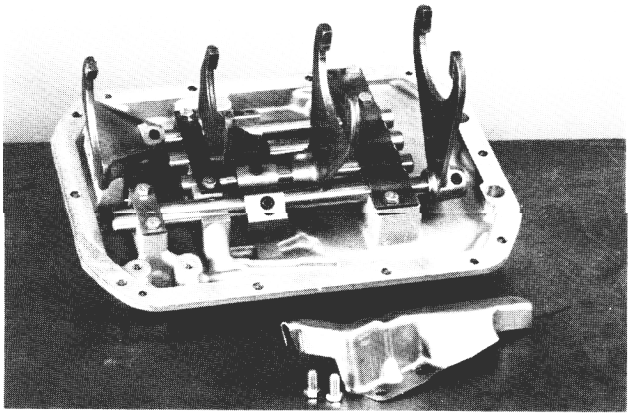
1ST & REV. FORK



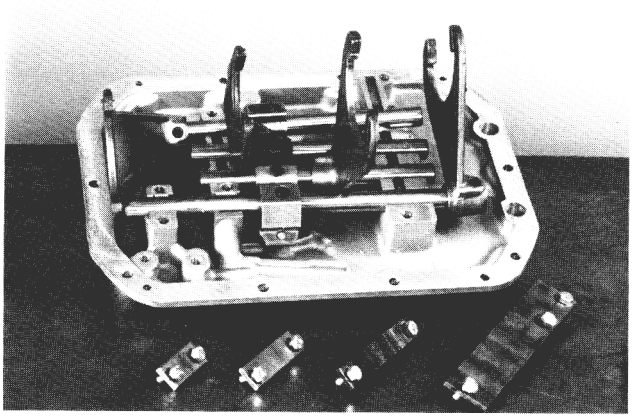




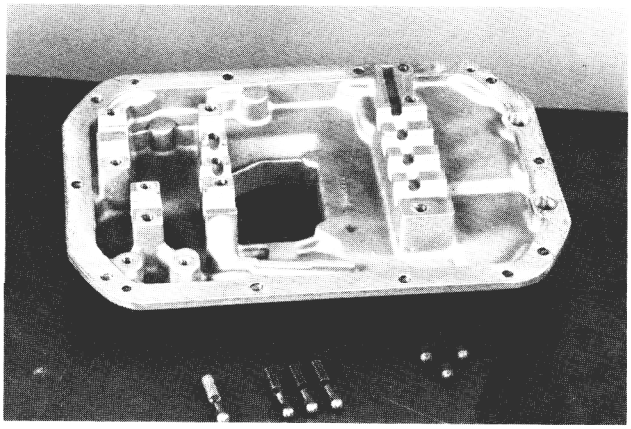
1. Disassembly of the cover begins by placing the cover on a bench with the forks up and in the neutral position.



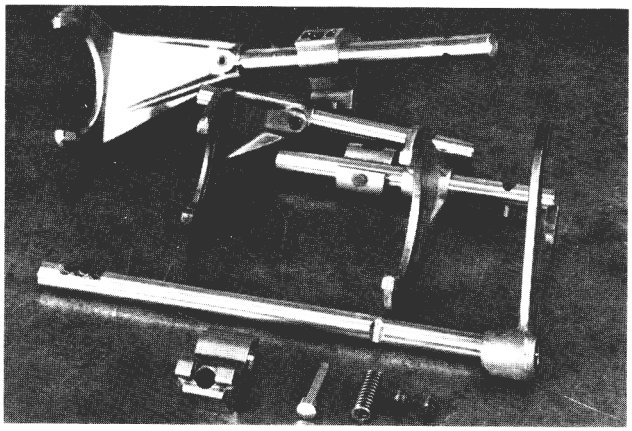
2. Remove the trough. It will make disassembling the rest of the cover easier.



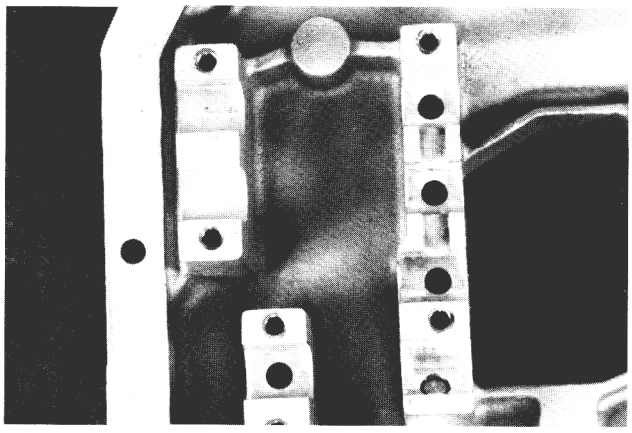
3. Loosen all fork and bracket setscrews, then remove the retainer straps.



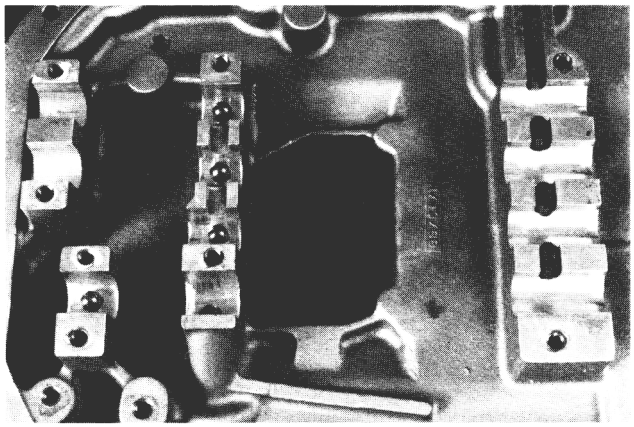
4. All forks lift easily from the cover, Remove the interlocks, poppets and springs. *The first-reverse spring has a different tension than the others, so don 't mix them up.*



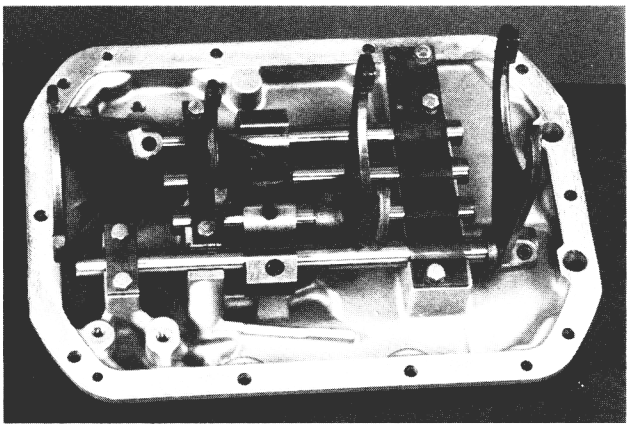
5. Next, disassemble the forks and brackets. Check all parts for wear or damage. Replace them if necessary.



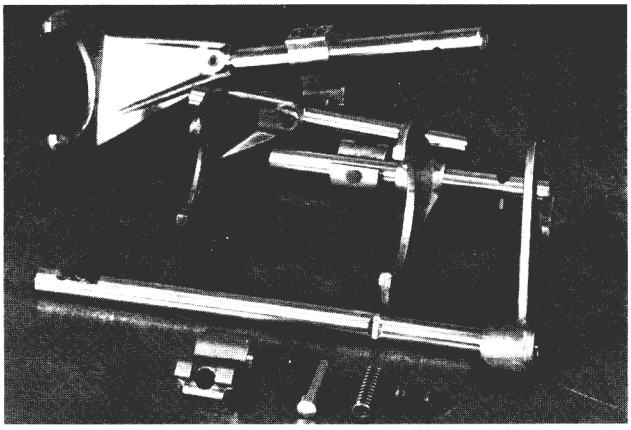
6. Check the poppet and detent holes for burrs or damage.



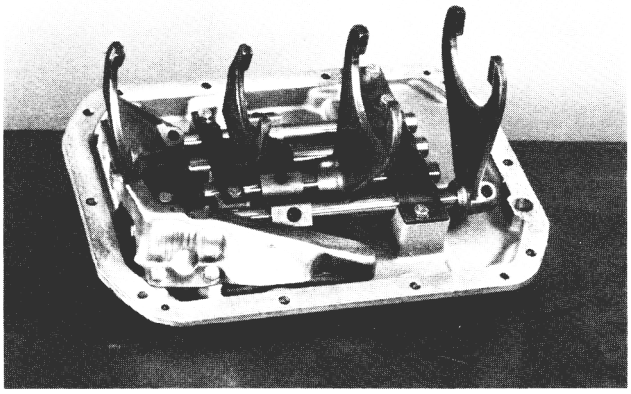
1. Lube all parts prior to reassembly. Clean the cover, then install the springs, poppets and interlocks.



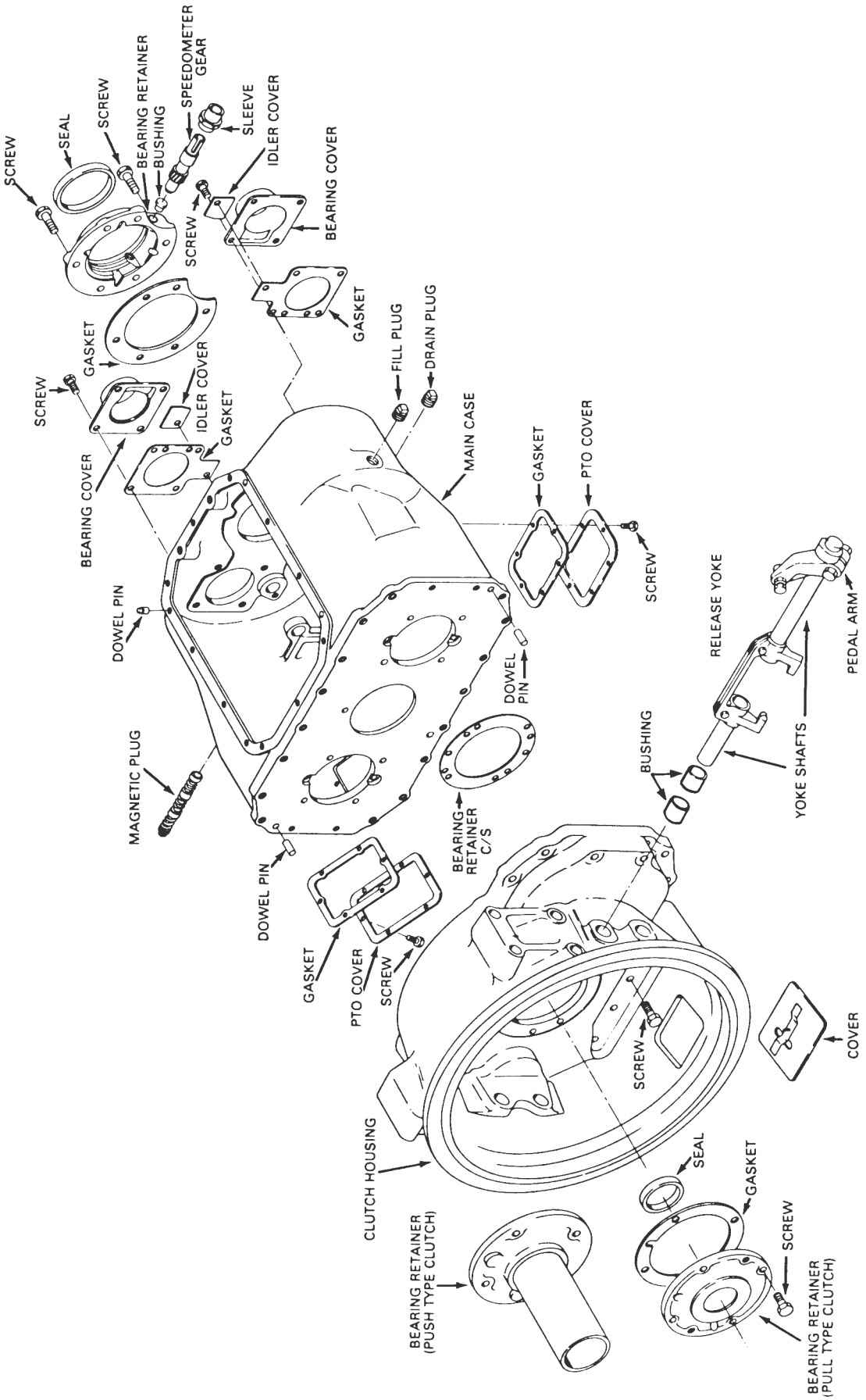
3. Place the fork assemblies into the case. Secure them with the retainer straps. Torque the strap bolts to 34-41 ft. lbs. Move each rod in the cover to confirm that it is moving freely.

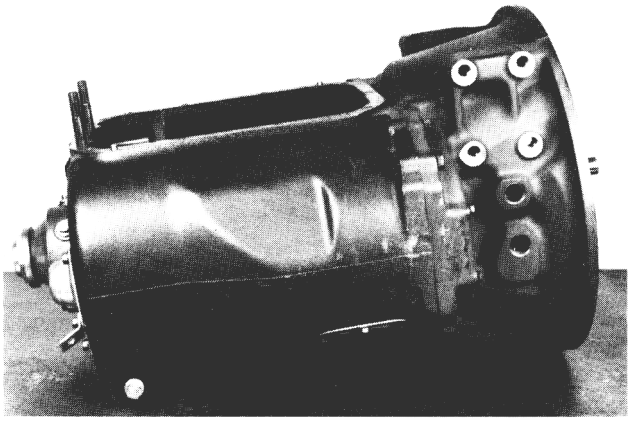


2. Reassemble the forks and brackets. Torque the allenhead setscrews to 26-32 ft. lbs. Torque the second-third bracket screws to 13-18 ft. tbs.

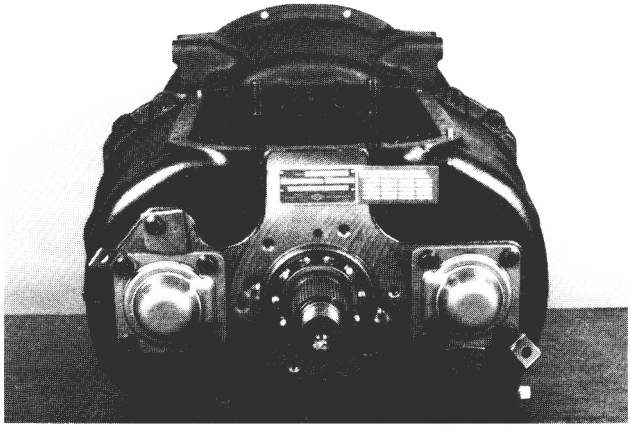


4. Next install the oil trough. Torque the bolts to 34-41 ft. lbs. Check the cover for correct functioning by shifting one fork into gear. If all interlocks were installed correctly, none of the other forks will shift into gear.

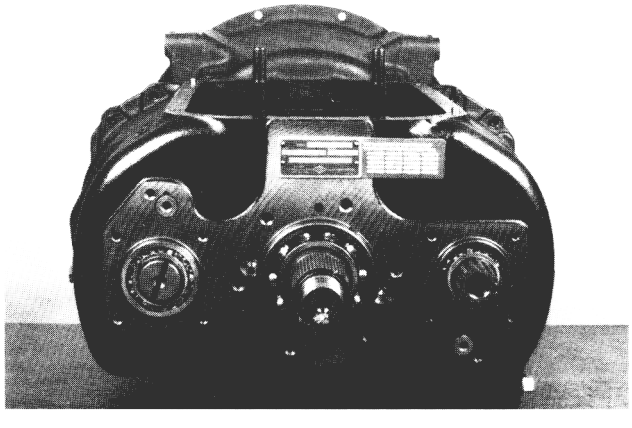

SCREW
SEAL
SCREW
BEARING RETAINER
BUSHING
SPEEDOMETER GEAR
SLEEVE
IDLER COVER
BEARING COVER
SCREW
GASKET
FILL PLUG
DRAIN PLUG
GASKET
IDLER COVER
SCREW
BEARING COVER
GASKET
MAIN CASE
GASKET
PTO COVER
SCREW
DOWEL PIN
DOWEL PIN
RELEASE YOKE
PEDAL ARM
BUSHING
YOKE SHAFTS
MAGNETIC PLUG
BEARING RETAINER C/S
DOWEL PIN
GASKET
PTO COVER
SCREW
SCREW
COVER
CLUTCH HOUSING
SEAL
GASKET
SCREW
BEARING RETAINER (PUSH TYPE CLUTCH)
BEARING RETAINER (PULL TYPE CLUTCH)



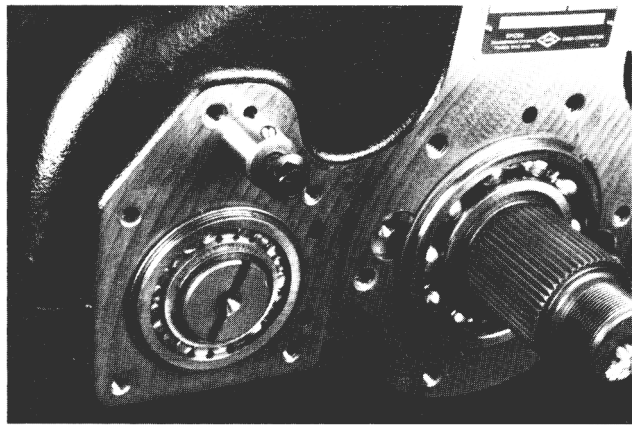
1. Remove the capscrews and shifter housing. If the shifter housing is a forward control, shift the transmission into sixth gear.



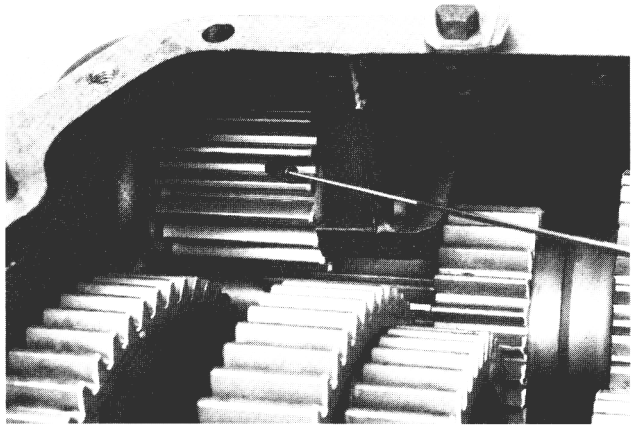
2. Remove the output bearing cap and gasket,



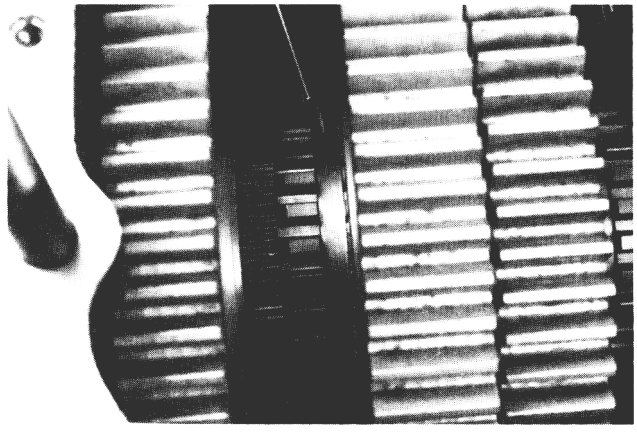
3. Remove the countershaft bearing retainers.



4. Insert a capscrew into the upper reverse idler shaft for removal. Don't lose the lockbail in the shaft.

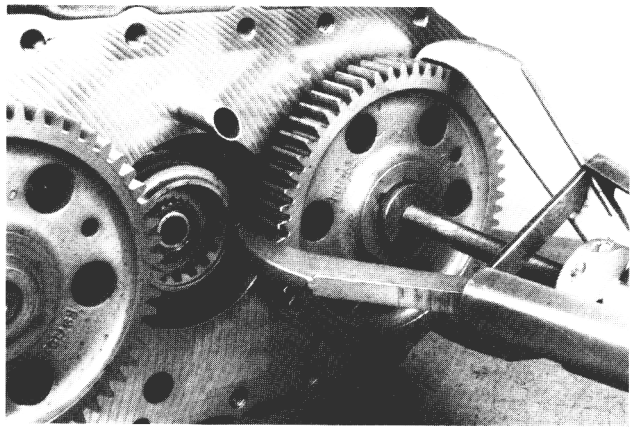


5. Roll the upper reverse idler gear toward the side of the case,

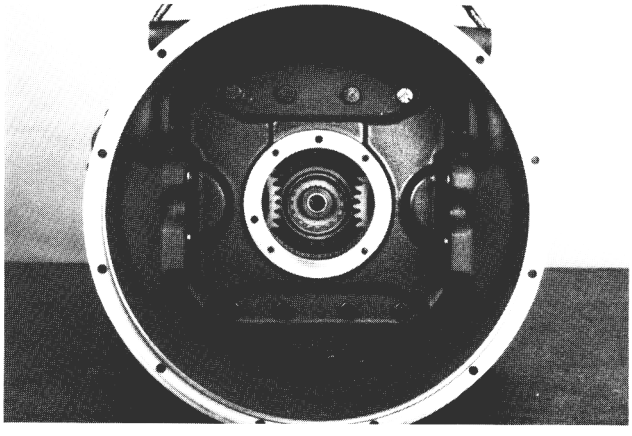


6. Engage the first-reverse collar into first gear,

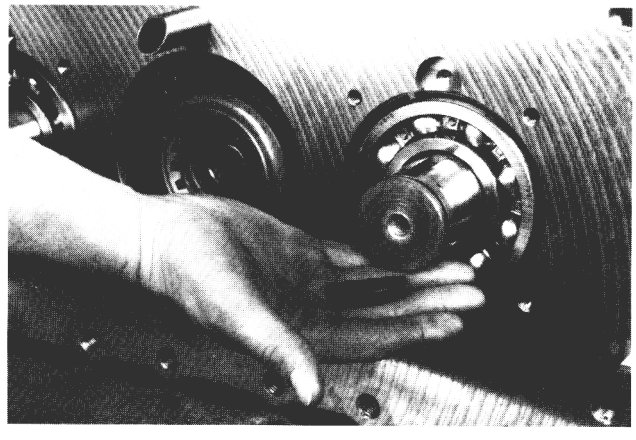
7. Remove the input bearing cap, gasket and input shaft,



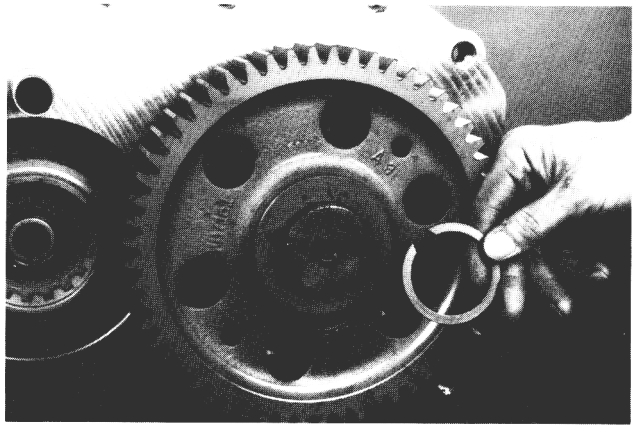
10. Remove the countershaft drive gears with the aid of a large puller.



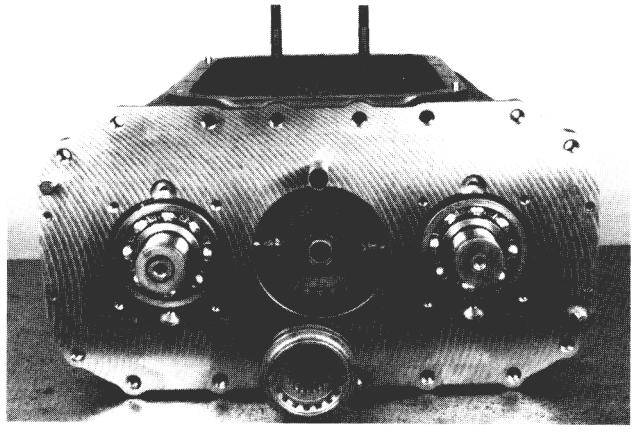
8. Next remove the clutch housing bolts and separate the housing from the case. Use of a chain hoist is recommended due to the weight of the housing.



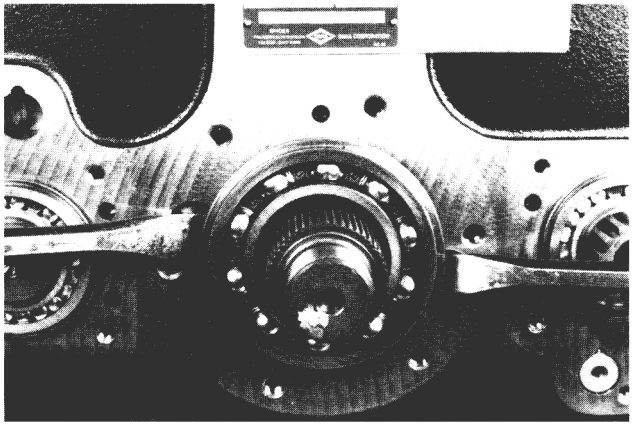
11. Continue by removing the countershaft driver gear countershaft keys.



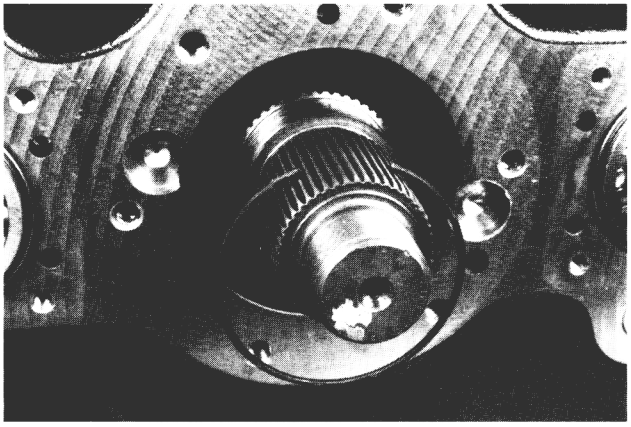
9. Remove the snap rings from the countershafts,



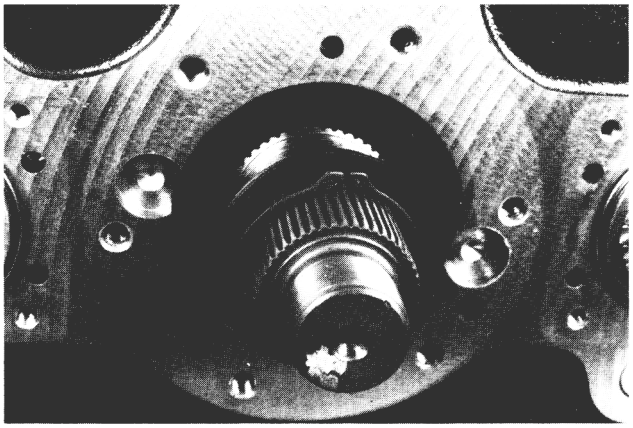
12. The sixth-seventh clutch collar may be removed from the mainshaft.



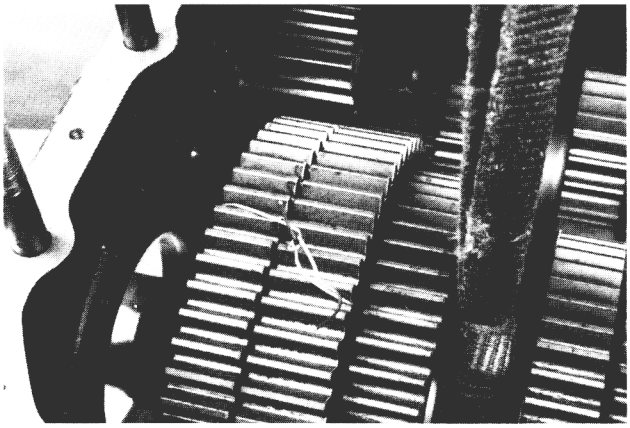
13. Place a sling around the second-third mainshaft collar and use a hoist to provide support during bearing removal. The milled slots also help make output bearing removal easier.



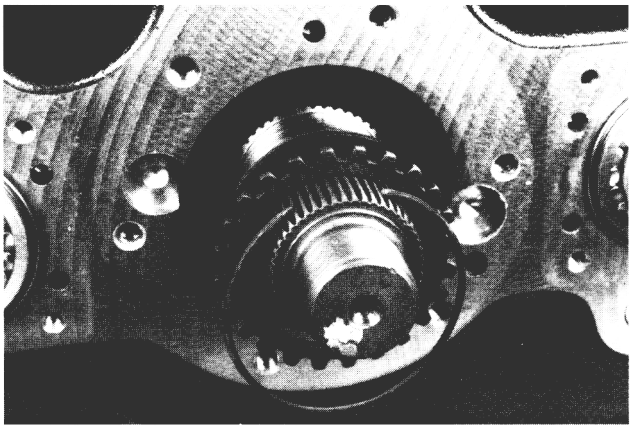
16. Remove the remaining gear bore snap ring.



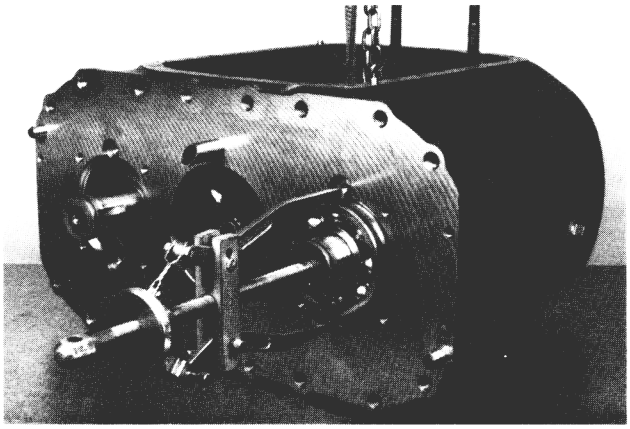
14. Remove the mainshaft snap ring and the internally splined thrust washer.



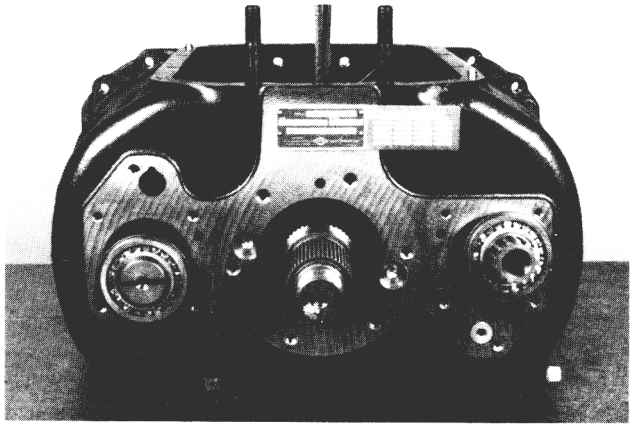
17. Butt first and reverse gears together. Secure them with lockwire to provide the necessary clearance for mainshaft removal.



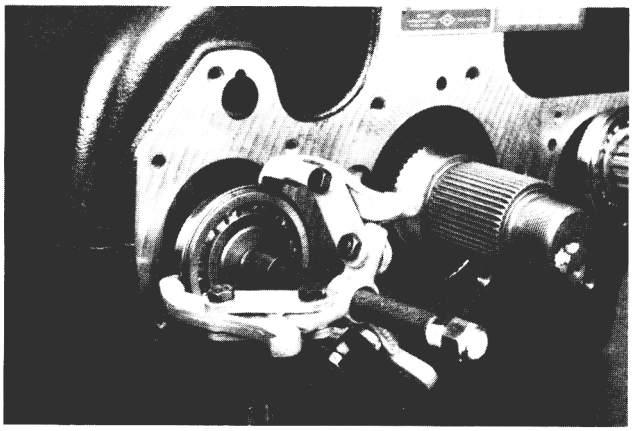
15. Next, remove the gear bore snap ring and both the externally and the internally splined thrust washers.



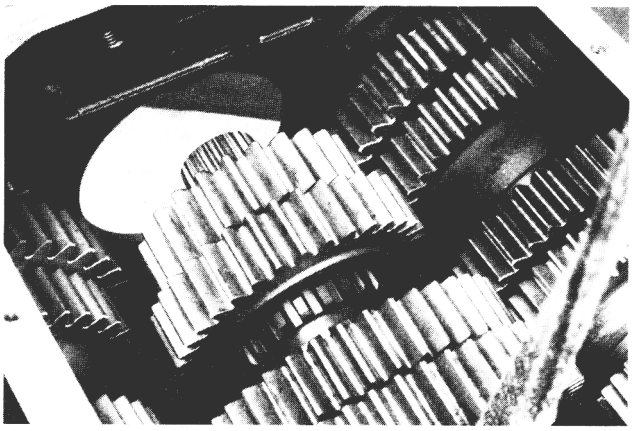
18. Use a puller to remove the countershaft front bearings.



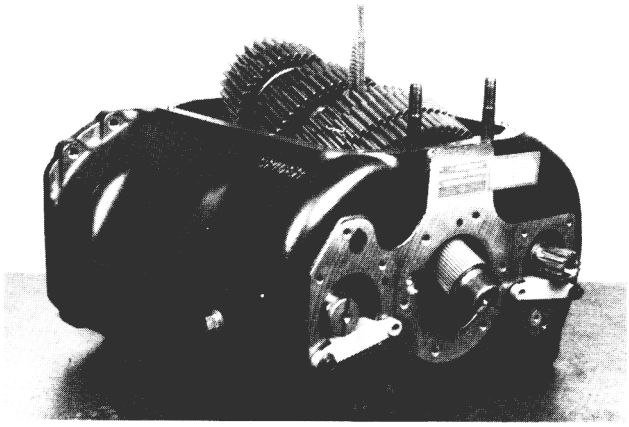
19. Move the countershafts to the rear as far as possible.



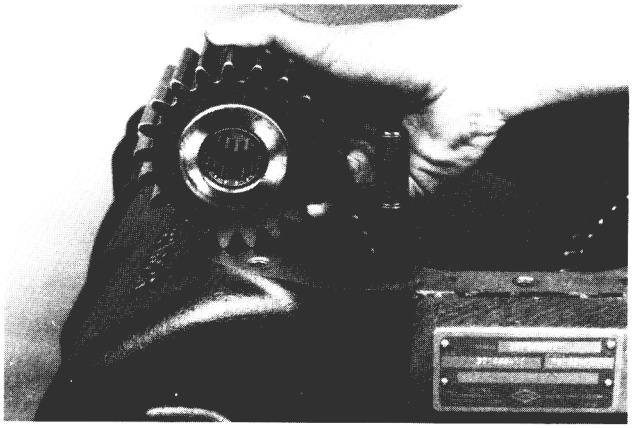
20. Install a puller for bearing removal.



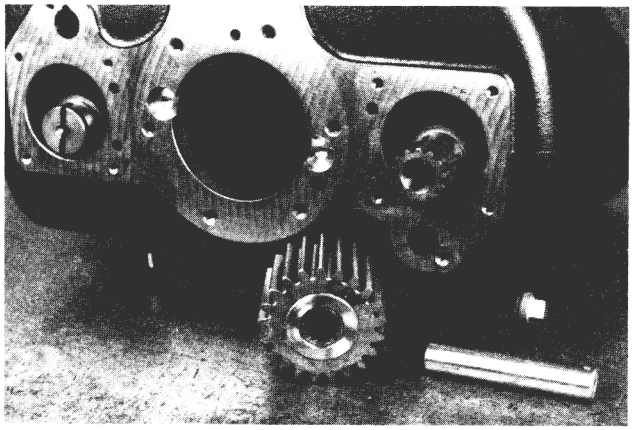
21. To provide necessary clearance for mainshaft removal, move both countershafts forward and toward the side of the case. Countershaft alignment blocks can also be used to help restrain the countershafts.



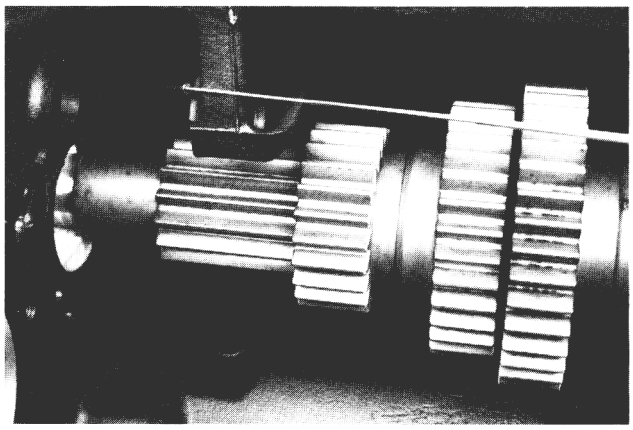
22. Lift the mainshaft assembly out of the case.



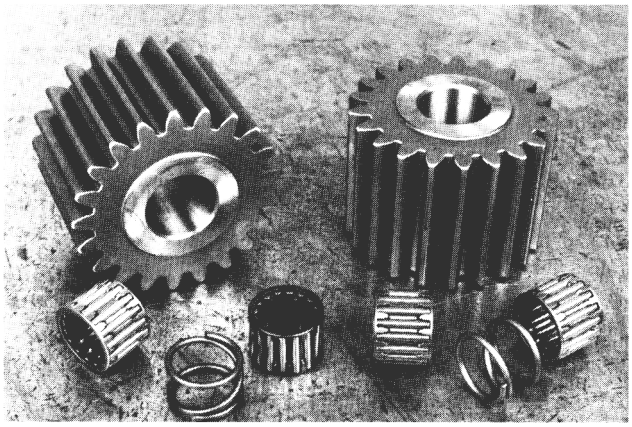
23. Remove the upper reverse idler gear.



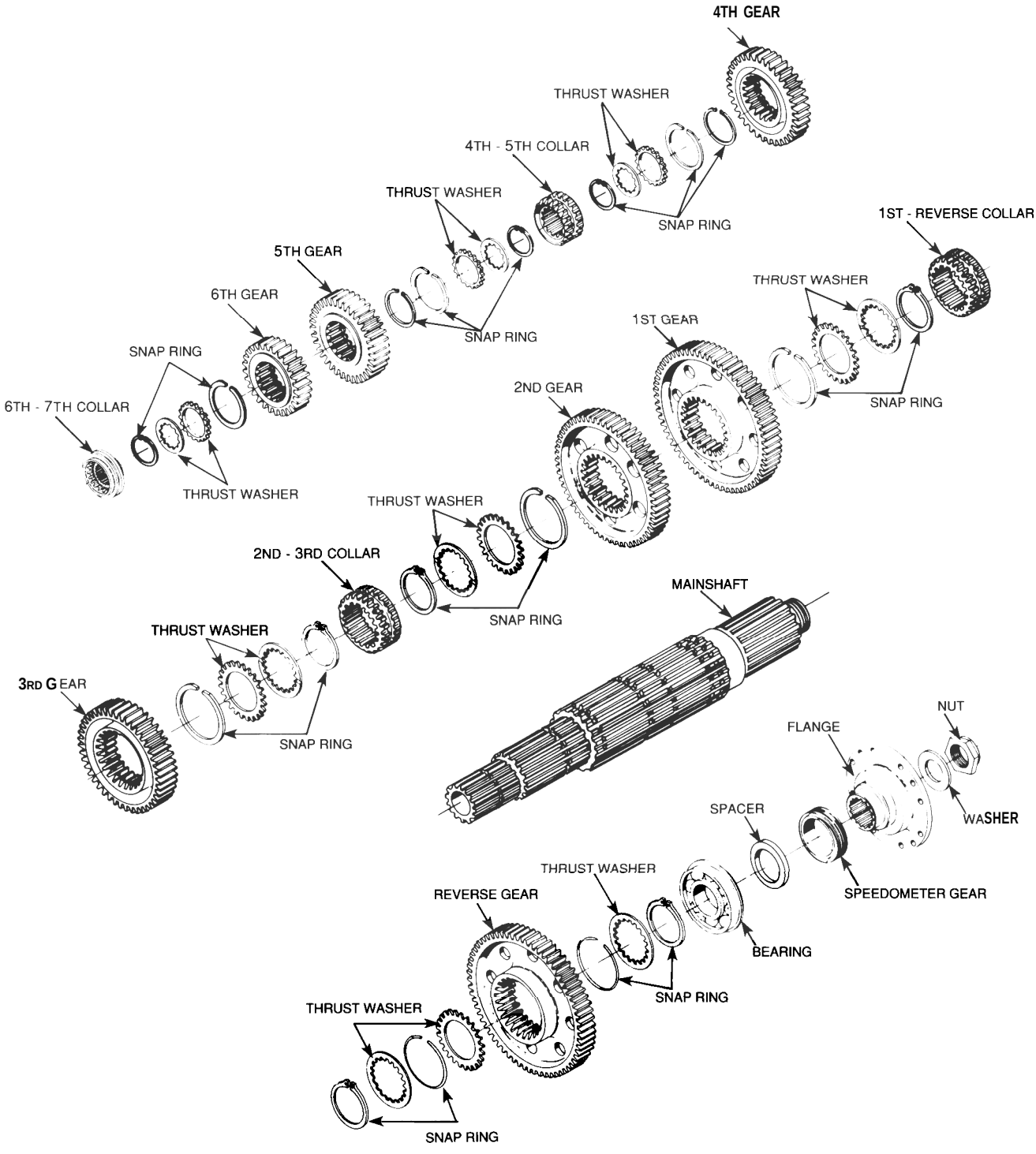
24. Remove the lower idler shaft and idler gear.

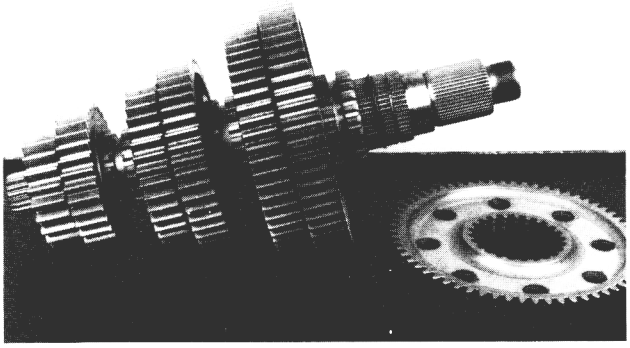


25. Because of this upper idler boss interference, it is easier to remove the right side countershaft first. Then remove the left side countershaft.

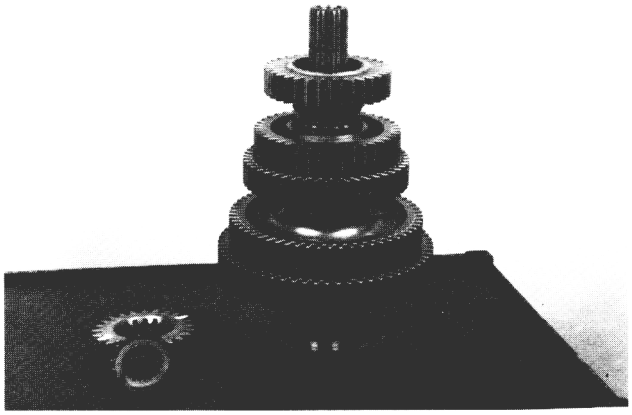


26. Check both idler gears and bearings for excessive wear.

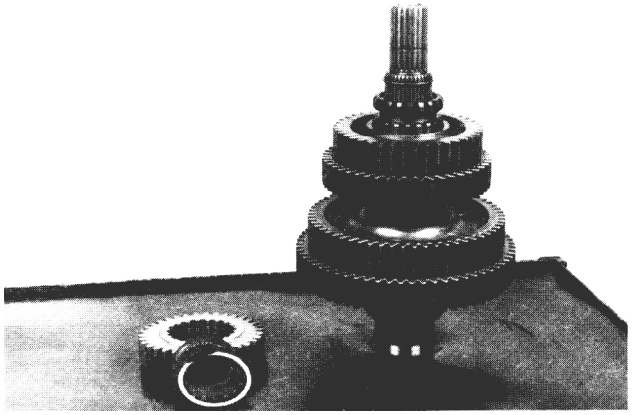

4TH GEAR
THRUST WASHER
4TH - 5TH COLLAR
THRUST WASHER
SNAP RING
1ST - REVERSE COLLAR
5TH GEAR
6TH GEAR
THRUST WASHER
1ST GEAR
SNAP RING
SNAP RING
SNAP RING
6TH - 7TH COLLAR
2ND GEAR
THRUST WASHER
THRUST WASHER
2ND - 3RD COLLAR
SNAP RING
MAINSHAFT
THRUST WASHER
3RD GEAR
SNAP RING
NUT
FLANGE
WASHER
SPACER
SPEEDOMETER GEAR
THRUST WASHER
REVERSE GEAR
BEARING
SNAP RING
THRUST WASHER
SNAP RING



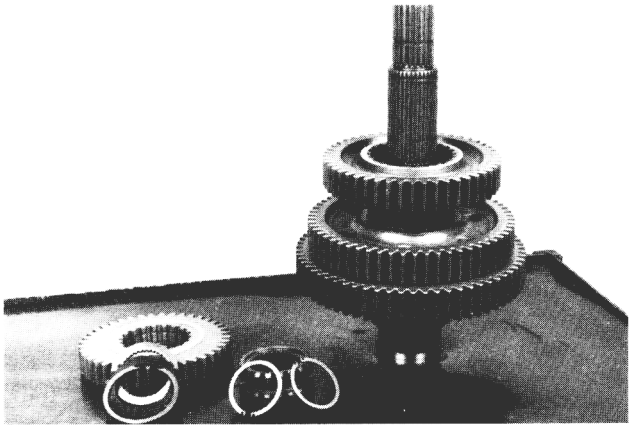
1. Begin disassembly of the mainshaft by cutting the lockwire and removing reverse gear.



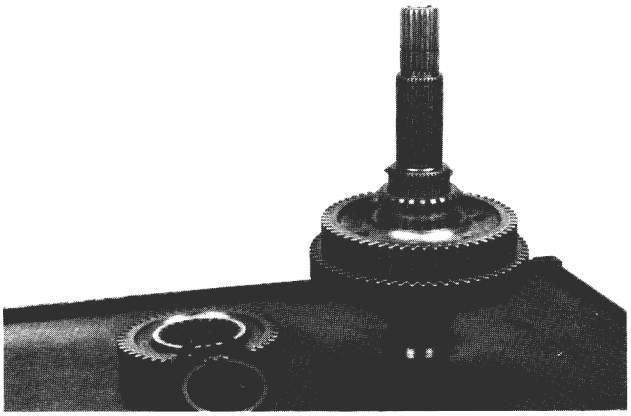
2. Remove the snap ring. Lift off sixth gear. Internally and externally splined thrust washers are in the gear. The internal washer teeth face toward the shaft. The external washer teeth face away from the shaft. A gear bore snap ring remains in the gear.



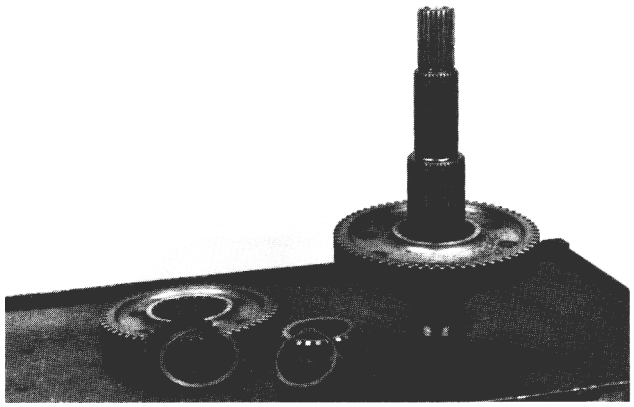
3. Remove fifth gear. There are two thrust washers and a snap ring inside the gear. There is also a gear bore snap ring inside each gear except reverse gear. This snap ring need not be removed unless otherwise specified.



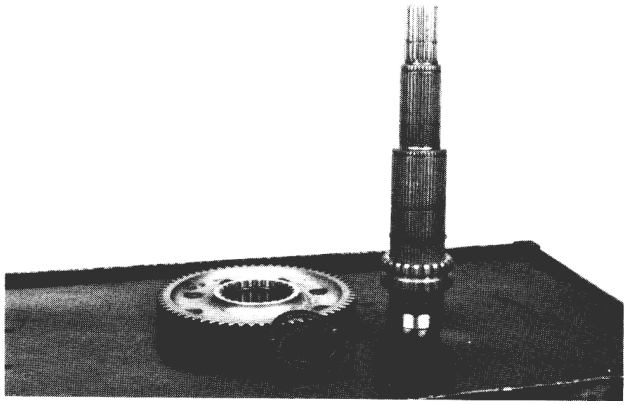
4. Remove the mainshaft snap ring. Lift fourth-fifth shift collar off the shaft. Remove the snap ring and fourth gear. inside the gear are two thrust washers and a snap ring.



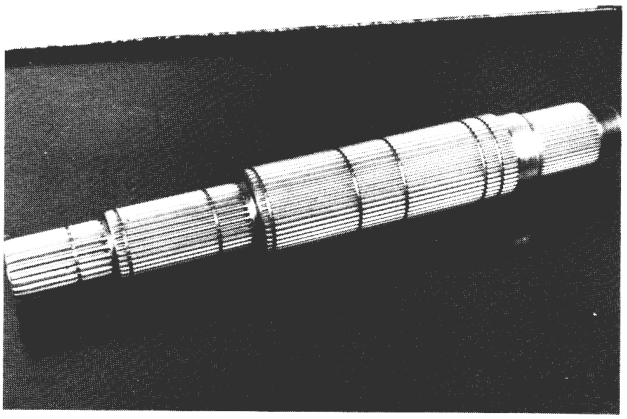
5, Continue by removing third gear. Two washers and a snap ring are inside it.



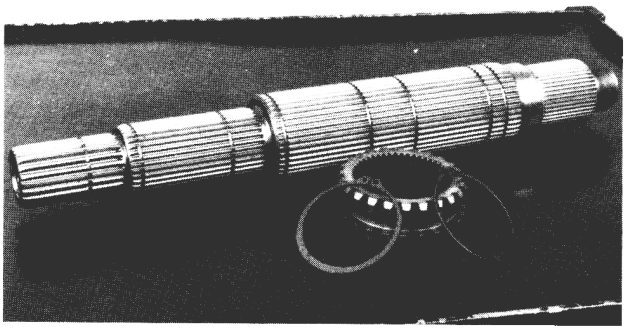
6. Remove the snap ring and second-third shift collar. Remove the next snap ring and lift second gear off the shaft. The gear contains two washers and a snap ring.



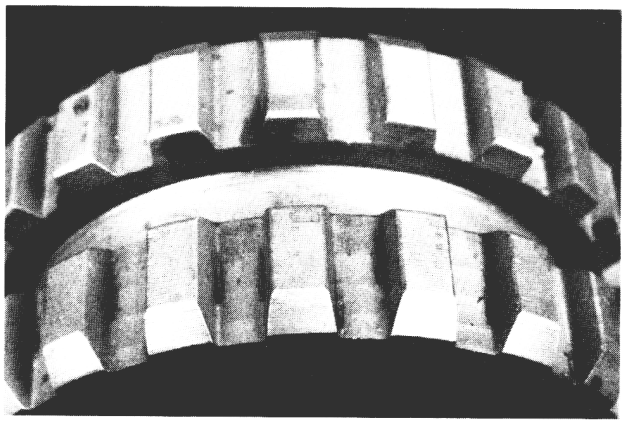
7. Continue by removing first gear. Again, there are two washers inside the gear. There is also a snap ring inside the gear, but there is no need to remove it.



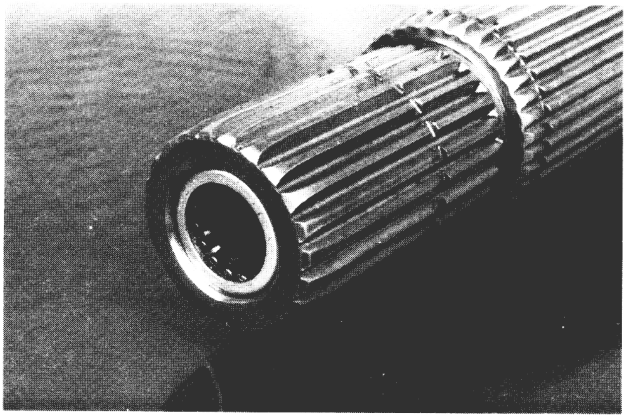
10. Notice that the mainshaft has rolled involute splines. They provide greater strength which means longer life.



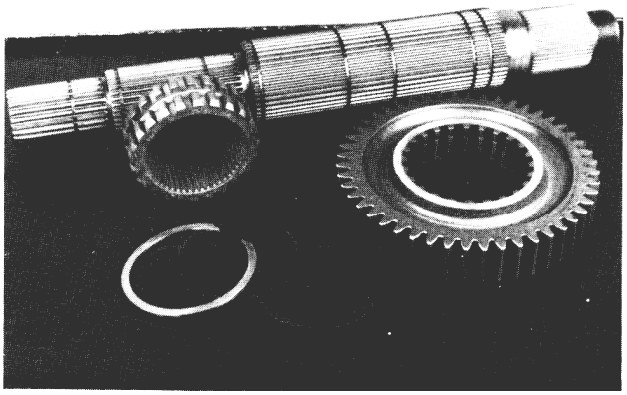
8. Remove the two snap rings and the first-reverse shift collar from the shaft.



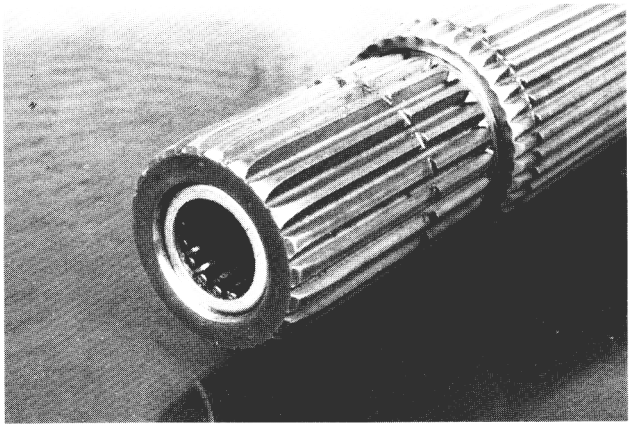
11. The fourth-fifth and sixth-seventh shift collars and gears have Taper-Lok™ gear locks. They are designed to draw gears into perfect alignment and eliminate gear jump-out.



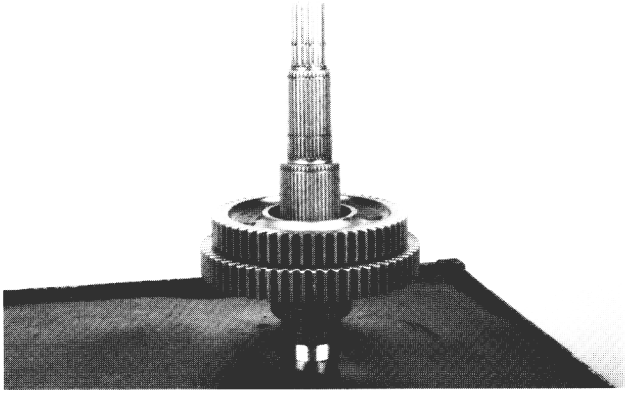
9. Remove the pocket bearing with an adequate puller.



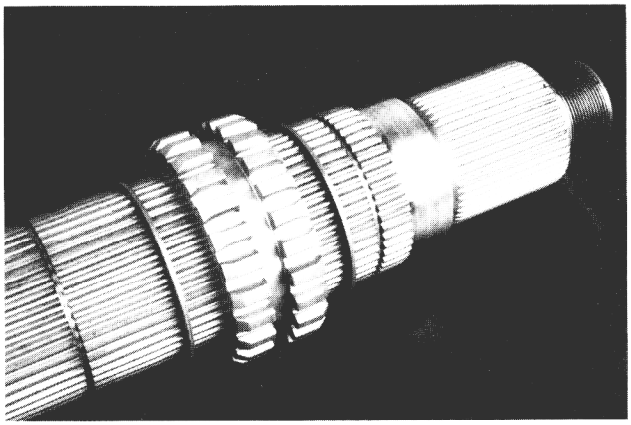
12. Clean all parts and inspect them for wear or damage. Replace them if necessary. Remember: if a gear is damaged and is going to be replaced, also replace its mating countershaft gears.



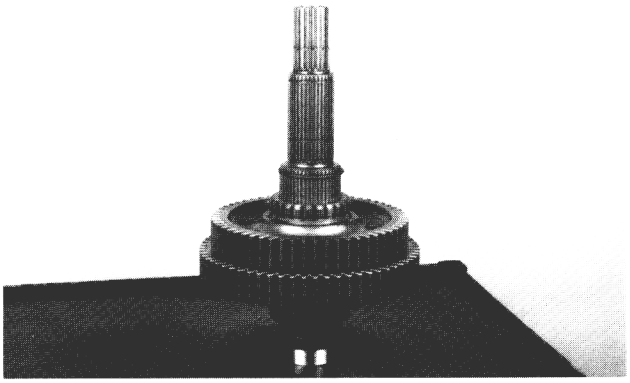
1, Install the pocket bearing to a depth of ,070".



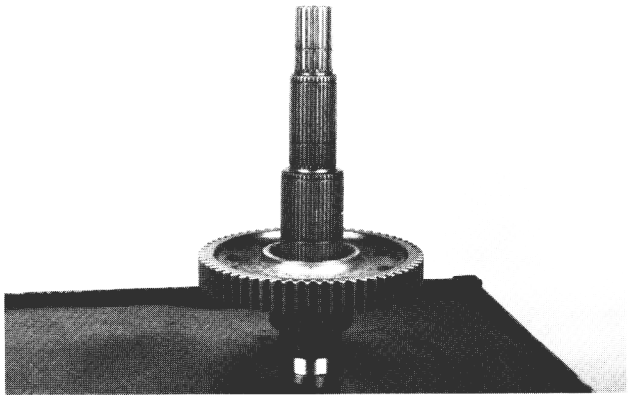
4. Place second gear on the shaft, Install the externally and internally splined thrust washers into the gear. Secure the assembly with a snap ring.



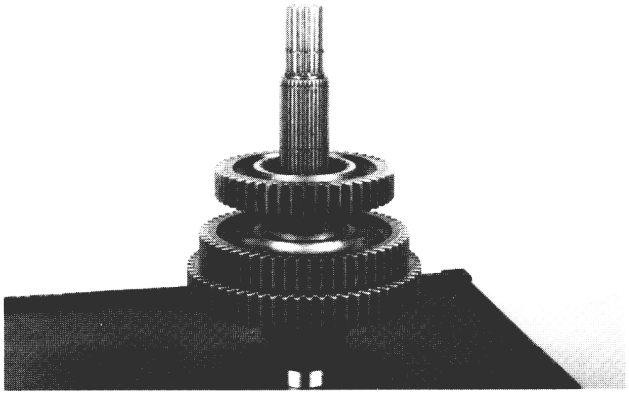
2. Lube all parts prior to reassembly. Install the first-reverse snap ring in the second groove from the bottom of the shaft. Slide the first-reverse collar into place and secure it with a snap ring.



5. Install the second-third shift collar and snap ring.



3. Place the internally and externally splined thrust washers on the shaft. The internally splined thrust washer should rest against the mainshaft snap ring.



6. Place an internally splined washer and externally splined washer on the shaft. Install third gear.

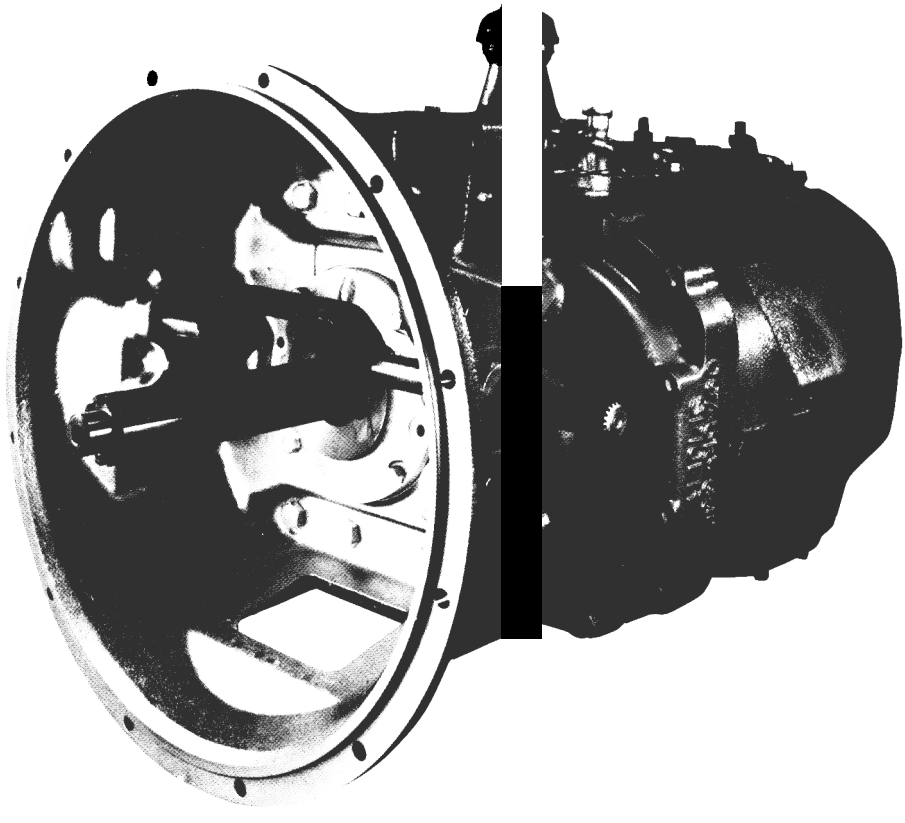
SERVICE MANUAL

SPICER®

HEAVY DUTY

7 SPEED

TRANSMISSIONS



MODELS PS140-7A & PS125-7B

SPICER®

DANA

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SPECIFICATIONS

Spicer Seven Speed

MODELS PS140-7A & PSI25-7B

PS140-7A			PS125-7B		
Gear	Ratio	% Step	Gear	Ratio	% Step
1	10.13	— 69	1	12.27	— 75
2	5.99	– 68	2	7.00	— 69
3	3.56	– 39	3	4.13	— 63
4	2.57	— 40	4	2.54	— 38
5	1.84	— 38	5	1.84	— 38
6	1.33	– 33	6	1.33	– 33
7	1.00		7	1.00	
R	10.13		R	12.27	

Speeds: 7 Forward, 1 Reverse

Torque Capacity: PS140-7A 950-1400 lbs. ft. (1 290-1900 Nm)

PS125-7B 950-1250 lbs. ft, (1 290-1700 Nm)

Length: 30.75" (781.05 mm)

Weight: 626 lbs. (284 kg)

End Yokes: *1710 6-4-7691*
1760 6.3-4-1251
1810 6.5-4-3821

Flanges: *1710 6-1-5821*

Clutch: *14"* or 15½" (355.6 or 393.70 mm) 2-Plate

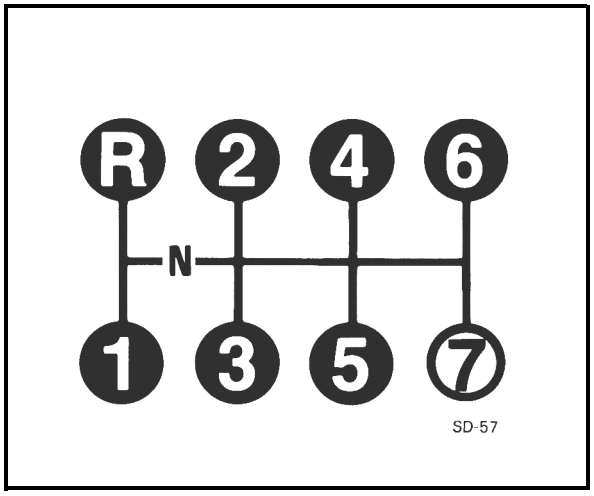
Clutch Housing: S.A.E. Nos. 1 or 2
Nodal Mount Standard

Oil Capacity: 48 Pints (22.7 Liters) at 0° Installation

Drive Gear: 2" Standard

Power Take-Off: 6 Bold right and lower left. Countershaft P.T.O. provision, standard on the right side, optional on the left.

SHIFT PATTERN
PS140-7A & PSI25-7B



How to Shift Spicer Models PS140-7A & PS125-7B

Your vehicle has been equipped with the Spicer 7-Speed transmission. The Spicer 7-speed has seven forward speeds, engineered to make full use of engine output and to improve fuel economy, This single stick transmission has seven lever positions with no splitter or range necessary to provide superior performance. Here's how this transmission is designed to work for you in the driver's seat.

Starting

With the engine idling, depress the clutch and move stick into first gear. Gradually release the clutch and accelerate the engine to governed speed (1900-1950 RPM).

NOTE –A clutch brake is used to stop gear rotation to complete a shift into first or reverse when the vehicle is stationary. If a butt-toothed condition exists between the clutching teeth, a momentary re-engagement of the main clutch will allow the gear train to move into a smooth engagement.

NOTE – ***The clutch brake on this transmission is actuated by depressing the clutch pedal all the way to the floor. For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.***

Upshifting

Once governed engine speed has been attained, to shift into second gear, depress the clutch and move the stick to neutral. Engage the clutch and allow RPM to drop approximately 750. (RPM drop may vary with engines of different governed speeds) *, depress the clutch and move the stick into second gear. Re-engage the clutch and accelerate to governed speed. Continue upshifting through seventh gear in this manner.

Downshifting

When downshifting from seventh gear, allow RPM to drop approximately 475*, depress clutch pedal and move stick to neutral. Engage the clutch, accelerate to governed speed, depress the clutch and move the stick into sixth gear, then re-engage the clutch. Continue downshifting through first gear in this manner.

***NOTE–All RPM drops are based on the PS I40-7A and PS 125-7B transmission ratios and an engine governed speed of 1900-1950 RPM. These drops will vary with other transmission ratios or with engines of higher governed speeds.**

OPERATION

Clutches

A clutch brake is required for use with this transmission. It is recommended that the torque limiting clutch brake be used instead of the three-piece type. Attention is called to the fact that Spicer 14" and 15%" 2-plate clutch service manuals (Bulletins 1308 and 1309) are available for the asking, and contain complete information on all Spicer Heavy Duty Clutches.

Replacement Parts

The exploded views of subassemblies which are incorporated here are for the mechanic's convenience and show the latest material. The parts are arranged in their correct order and may also be used as a reference for assembly or disassembly of this unit.

Power Flow

The Spicer split torque transmission is designed for medium and heavy duty, on and off highway applications.

The two countershaft design allows the engine torque to be equally divided between the two countershafts. This provides a high ratio of torque capacity to transmission weight. This also allows a reduction in the face width of each gear involved in the transmission. All the gears are in constant mesh through spur teeth.

Spicer" Transmission Lubrication

To insure proper lubrication and operating temperatures in these units it is most Important that the proper lubricants be used and that correct 011 levels be maintained

Recommended Lubricants

The lubricants listed below are recommended, in order of preference, for use in all Spicer mechanical transmissions, auxiliaries and transfer cases.

Oil Changes

We recommend an initial oil change and flush after the transmission is placed in *actual* service. This change should be made anytime following 3000 miles (4827 km), but *should not exceed 5000* miles (8045 km), of over-the-road service. In off-highway use, the change should be made after 24 and before 100 hours of service have elapsed. There are many factors that influence the following oil change periods, and we have not specified a definite mileage interval,

In general, it is suggested that a drain and flush period be scheduled every 50,000 miles (80,450 km) for normal over-the-highway operations. Off-highway usually requires oil change every 1000 hours. The oil level in the transmission should be checked every 5000 miles (8045 km) on-highway, or every 40 hours in off-highway operation. When it is necessary to add oil, we recommend that types or brands of oil should not be mixed. The correct oil level in ail Spicer transmissions is established by the filler plug opening.

Refill

First, remove all dirt around the fliler plug Then refill with new oli of grade recommended for the existing season and prevailing service Fill to the bottom of the level testing plug positioned on the side of the transmission.

Overfilling

DO NOT OVERFILL the transmission. Overfilling usually results in oil breakdown because of excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy varnish and sludge deposits that plug up oil ports and build up on splines and bearings. Overflow of oil escapes onto clutch or parking brakes causing additional trouble.

NON-SYNCHRONIZED TRANSMISSION RECOMMENDED LUBRICANTS

The following lubricants are recommended, in order of preference.

TEMPERATURE	GRADE	TYPE
Above O°F (–18°C) Below O°F (–18°C)	SAE 30, 40, or 50 SAE 30	Heavy Duty Engine Oil meeting MIL-L-2104D or MIL-L-461 52 B, API-SF or API-CD (MIL-L-2104 B & C, or 46152 are also acceptable)
Above O°F (–18°C) Below O°F (–18°C)	SAE 90 SAE 80	Straight Mineral Gear Oil R & O Type API-GL-1
Above O°F (–18°C) Below O°F (–18°C)	SAE 90 SAE 80	*Mild EP Gear Oil MIL-L-2105 or API-GL-4
All	CD SAE 50 CD SAE 30	Synthetic Engine Oil meeting MIL-L-2104 D or MIL-L-46152 B, API-SF or API-CD
All	EP SAE 75W90 EP SAE 75W140	*Synthetic Gear Oil meeting MIL-L-2105C or API-GL5

*EP Gear Oils are not recommended when lubricant operating temperatures are above 230° F (110°C).

General Precautions for Disassembly

IMPORTANT

Read this section before starting the detailed disassembly procedure.

Follow each procedure closely in each section, making use of both the text and the pictures.

Rebuild Facilities

A suitable holding fixture or overhaul stand is desirable, but not necessary, to rebuild this unit, The flat bottom of the transmission case provides a suitable working platform when the unit is placed on a sturdy shop table.

For easier working conditions, table height should be 28-30 inches. A light chain hoist should be used to handle the mainshaft and countershafts during removal and reassembly procedures.

Cleanliness

Transmissions should be steam cleaned prior to disassembly, Seal all openings before steam cleaning to prevent entry of dirt and water which can damage serviceable parts

Dirt is abrasive and will cause premature wear of bearings and other parts. We suggest that mechanics have a small wash tank to clean parts just prior to reassembly.

Front Bearing Retainer & Seal

When installing the front bearing retainer and seal to the transmission, the following precautions must be used.

Bearings

When a transmission is removed at relatively low mileage, bearings should be removed with pullers designed for this purpose. Wrap the bearings to keep out dirt. Clean, inspect and lubricate all bearings just prior to reassembly. If accumulated mileage is over 150,000 miles, we suggest that all bearings be replaced.

End Yokes and Flanges

Hammering on end yokes and flanges to remove or install them is not only destructive to the yoke or the flange itself, but can also cause serious Internal damage, Hammering destroys or mutilates the pilot diameters and warps or bends the flange. Hammering on end yokes will close-in the bearing bores or misalign yoke lugs and result in early failures of journal needle bearings, etc.

Serlous damage can be done Internally to bearings, thrust faces and washes, pilot bearings, etc., by hammering on external parts In most designs when the yoke/flange locknuts are tightened and secure, the Internal bearings and gears are in proper location. When the yoke/flange IS driven on the shaft, two conditions can exist.

(a) If the bearing fit *is tight* on the shaft, then usually the bearings will brinell as they must absorb the pounding force

(b) If the bearing IS loose, the shaft Will keep moving inward until it IS stopped by the Internal parts such as pilot bearing thrust washers, etc.

Power Take-Off's

Refer to your owner's manual and installation procedures when installing any PTO on your transmission.

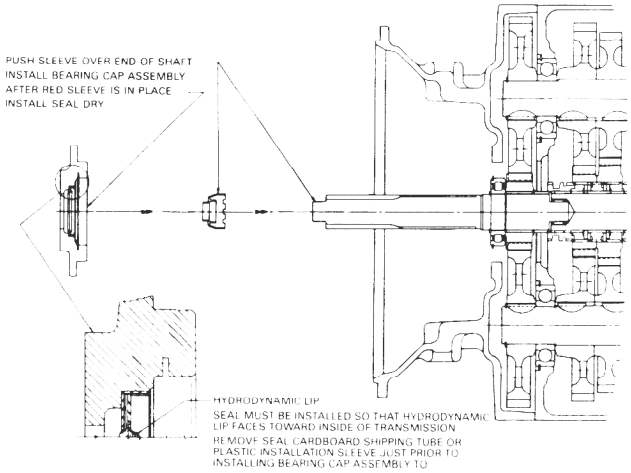
CAUTION

Do not tow vehicles equipped with Spicer transmissions without first pulling the axle shafts or disconnecting the drive shaft. Lubrication of the internal gear train is inadequate when the vehicle is towed. Also, do not pull or roll start vehicles in first or reverse gears.

INSTALL SEAL DRY

WARNING

RED SLEEVE MUST BE USED TO PREVENT SERIOUS DAMAGE TO OIL SEAL WHEN ASSEMBLING BEARING CAP. FAILURE TO COMPLY WILL VOID SEAL WARRANTY.

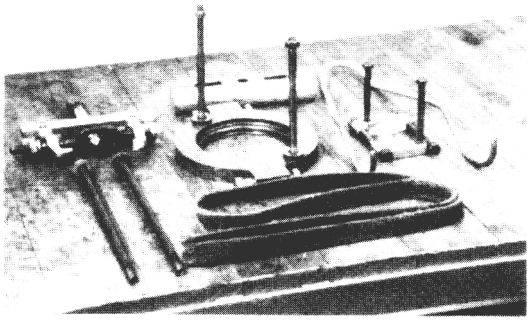


Tool Reference

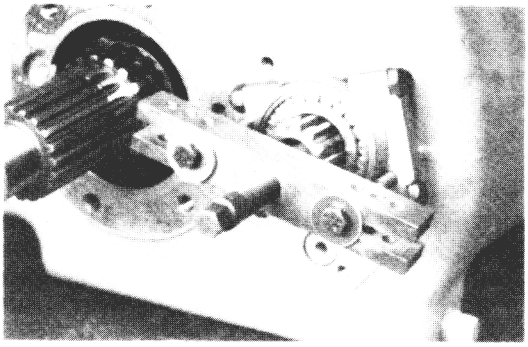
Tools

Spicer Transmissions can be repaired with ordinary mechanic's hand tools. However this procedure is not only time consuming, but could damage otherwise re-usable parts.

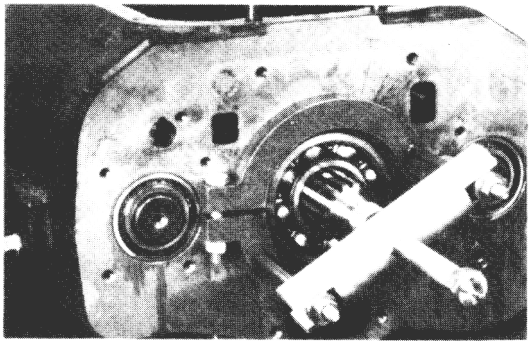
To reduce maintenance costs and vehicle downtime, we recommend using the special tools shown in this section.



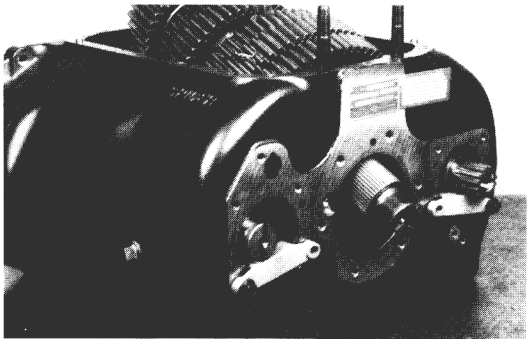
Suggested pullers and alignment tools,



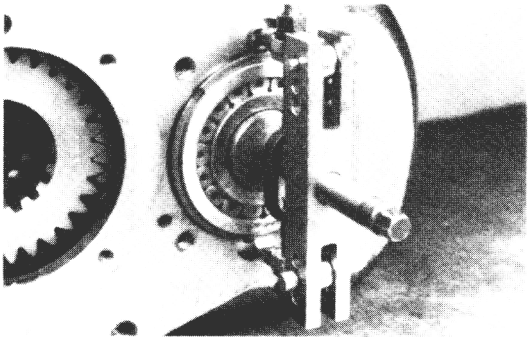
Countershaft rear bearing puller (Snap-on – CJ 950).



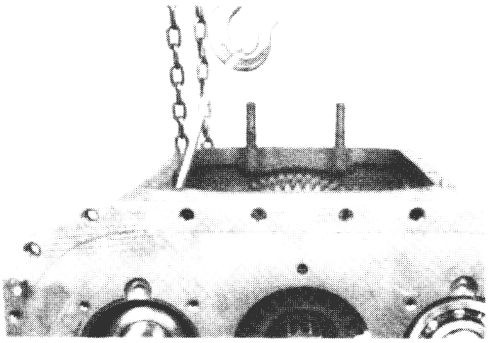
Reversible input and output bearing puller–(Kent-Moore J 24348). Used with end yoke remover (J *7804-01).*



Countershaft alignment blocks for PS 140-7A and PS125-7B (Kent-Moore J 28720). Provide maximum clearance for mainshaft assembly installation. Allow countershafts to be rotated for timing purposes.



Countershaft front bearing puller (Snap-on– CJ 80).



Countershaft lift hook–(Kent-Moore J 23667). Holds countershaft in time while centering the countershaft in the case bore for easier bearing installation.

Tools may be purchased through:
Kent-Moore
29784 Little Mack
Roseville, Michigan 48066-2298
Telephone: 1-800-328-6657

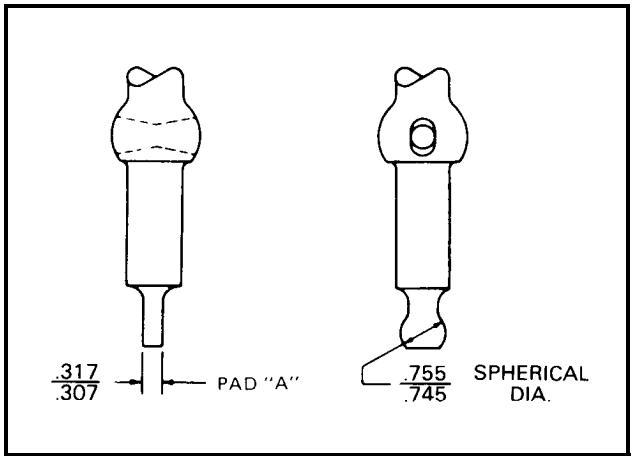
Shift Tower

Disassemble

1. Remove the six retaining capscrews and lockwashers, Separate the dome from the shifter housing and gasket and lift straight up.
2. Position shift lever dome on edge in vise.
3. Pull up grommet. Depress collar against spring and remove lock pin.
4. Slide the compression cup up shift lever and remove rock shaft snap ring.
5. Tap rock shaft free of dome and remove shift lever. Remove seal and discard.
6. Remove shift lever handle and slide grommet, collar, spring and cup off lever.

Inspection

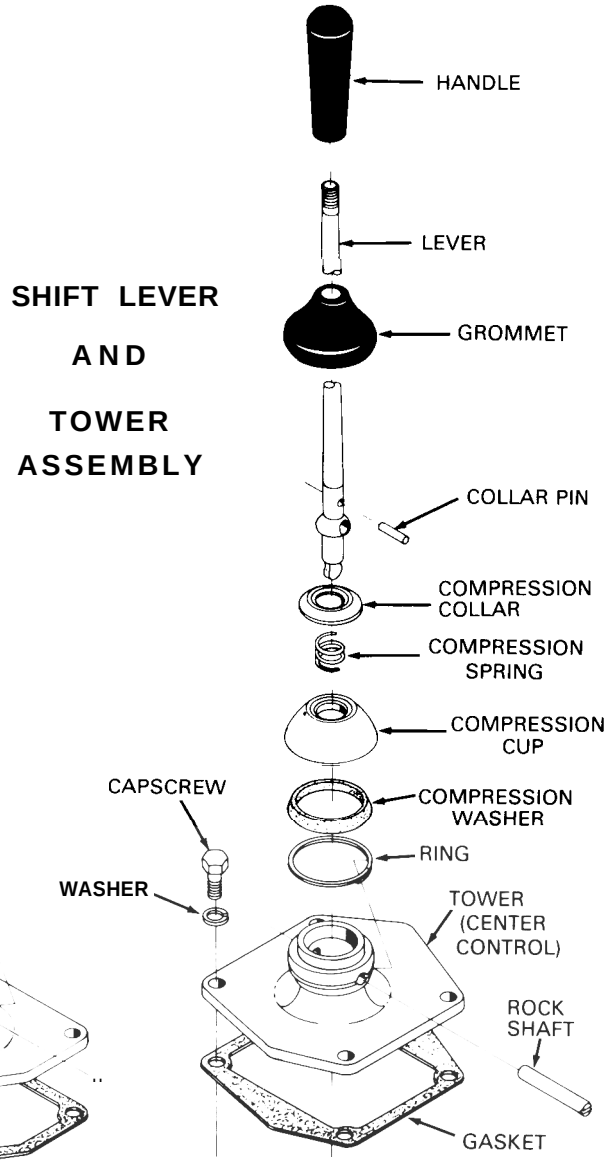
Wash all parts thoroughly and inspect for excessive wear at cross hole in lever and rock shaft. Inspect finger end of lever for excessive wear.



Check spring tension by comparing to a new part

Reassembly

1. Position shift lever dome on edge in vise,
2. Hold shift lever so that cross hole in lever aligns with rock shaft cross holes in dome,
3. Insert rock shaft through hole in dome and cross hole of shift lever.
4. Assemble rock shaft snap ring to groove of dome and lock rock shaft in place,
5. Grease lightly and assemble new seal to shift dome, Grease inner wall of cup and slide over lever into position on dome.
6. Assemble spring, collar and grommet over shift lever, Depress collar and insert lock pin through hole in lever,
7. Assemble shift lever handle,
8. Place shift lever and dome assembly on shifter housing with gasket, noting that finger enters the neutral position notches,
9. Secure with four capscrews and lockwashers.



Remote Control Assembly

Disassembly

Remove the capscrews and lockwashers and separate the remote control from the shifter housing.

1. **Remove setscrew from universal joint assembly and pull universal joint from the rod.**
2. **Remove four capscrews and lockwashers holding end cover and gasket in place.**
3. **Remove setscrew from joint shift rod finger and tap rod through cross holes in housing.**
4. **Remove finger from housing.**
5. **Remove setscrew from inner shift finger.**
6. **Slide rod and bracket assembly from inner shift finger.**
7. **Be careful not to lose key from rod or shift finger.**
8. **Remove seals from cross holes in housing.**

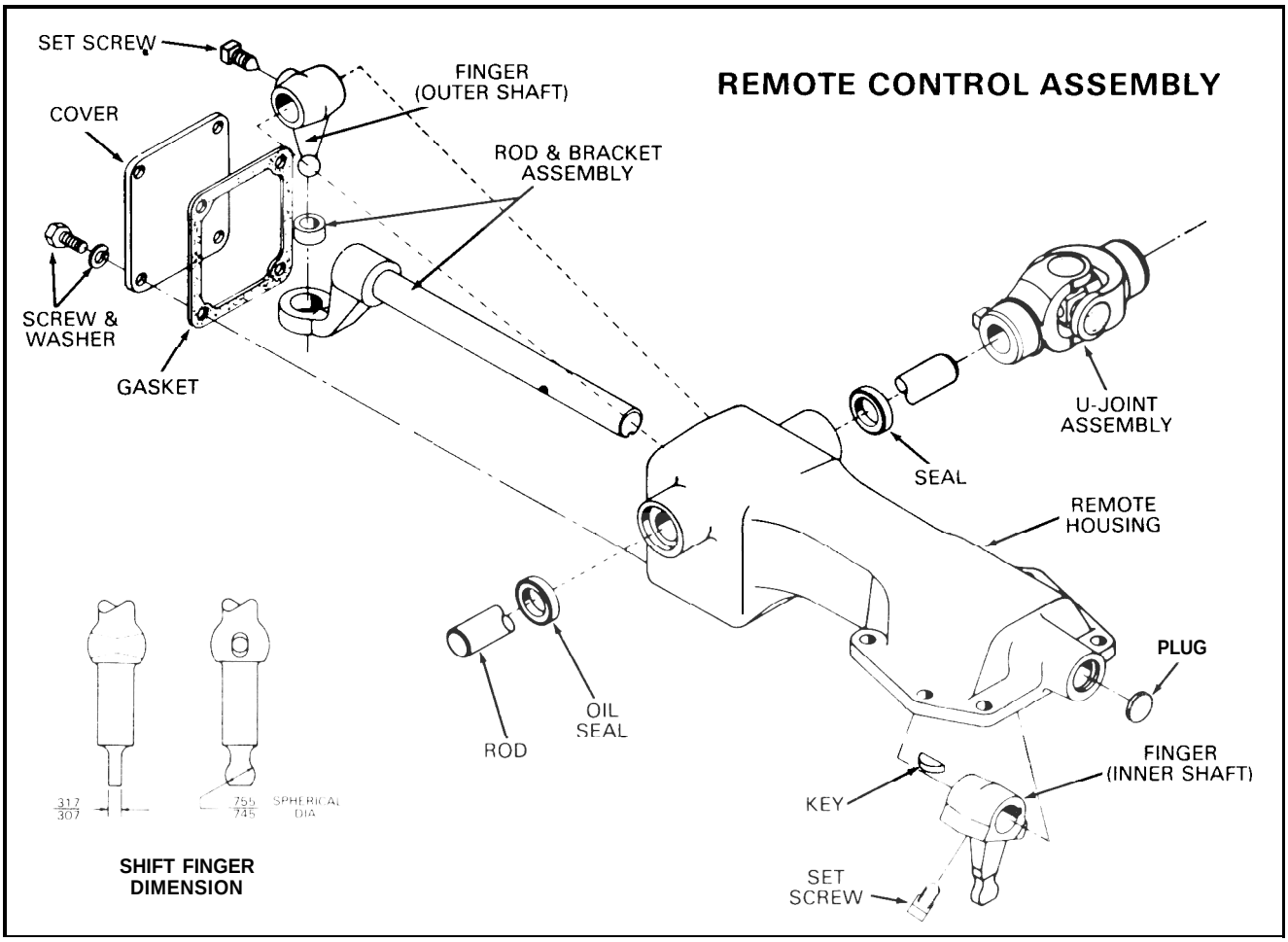
Inspection

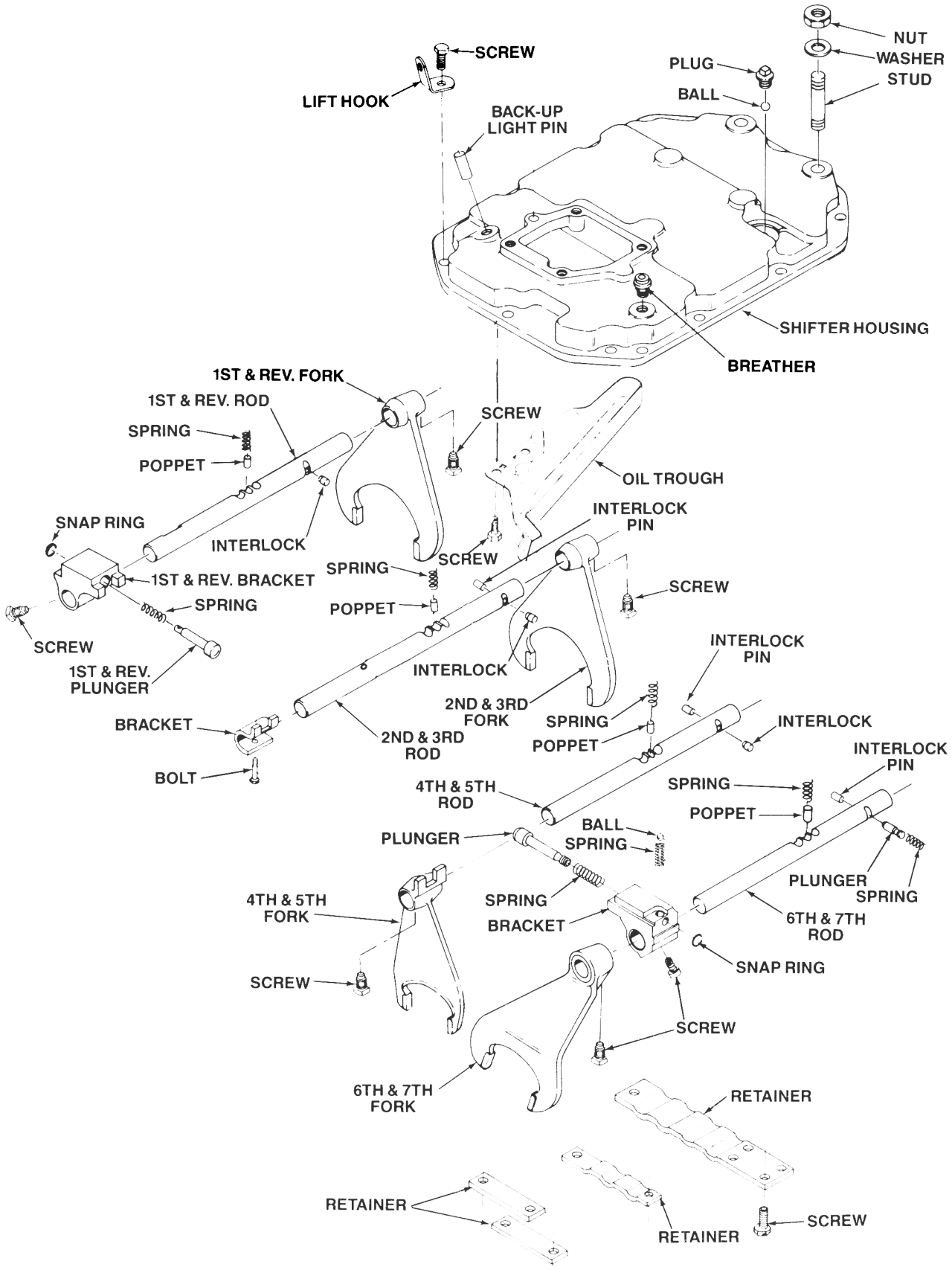
Check shift fingers for excessive wear. Check all bores and rods for excessive wear or scuffing.

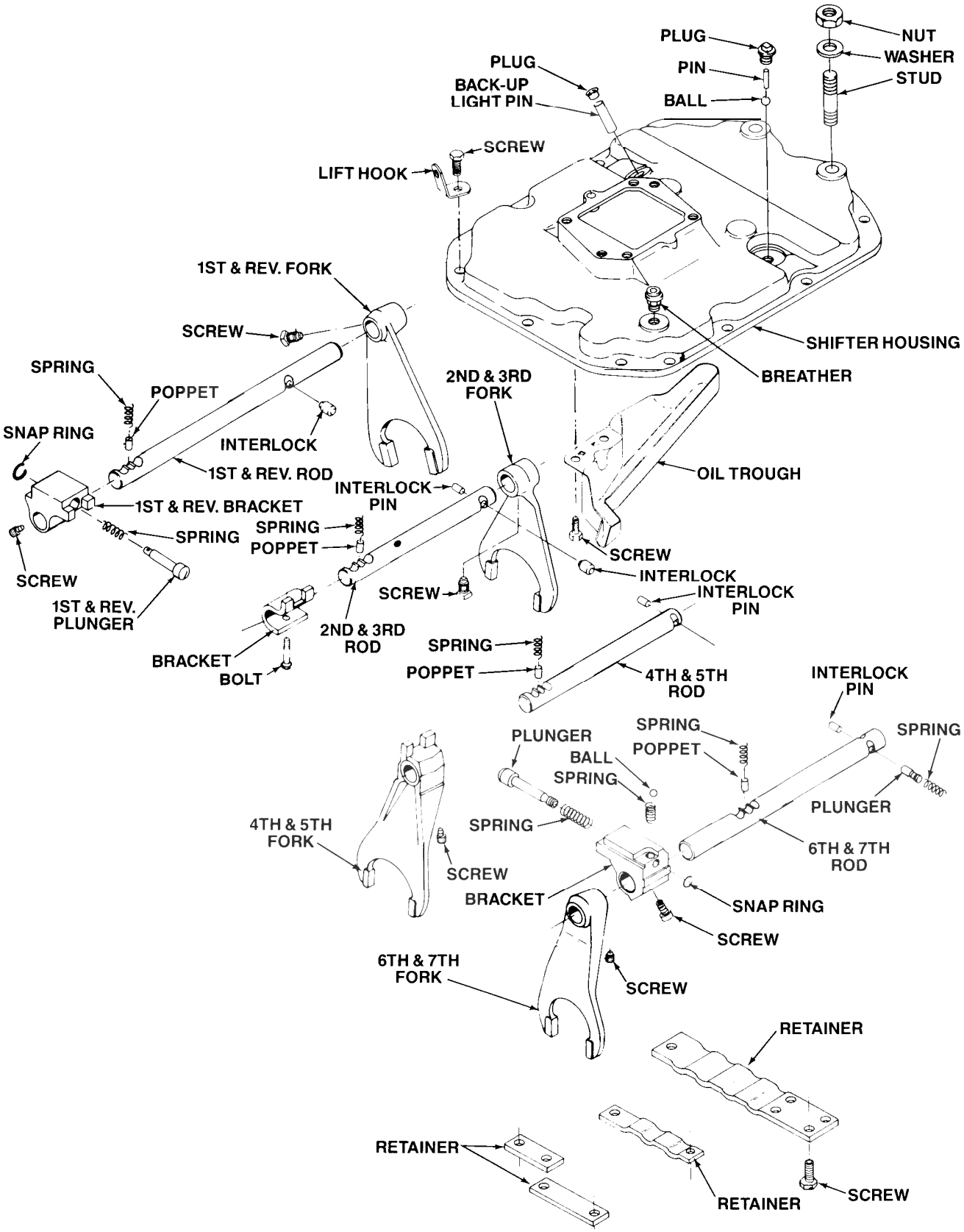
Clean parts thoroughly and apply light coat of grease to pivot points when reassembling.

Assembly

1. **Install new key in rod and bracket assembly and install into remote housng, sliding shift finger (inner) on end of rod.**
2. **Line up setscrew hole and install setscrew, and torque to 40 to 50 lbs. ft.**
3. **Install joint shift rod and through cross holes and through outer finger, making sure finger is inserted into bracket.**
4. **Align setscrew hole and install same. Torque to 40 to 50 tbs. ft.**
5. **Install end cover and secure with four capscrews and lockwashers.**
6. **Install two new oil seals in joint shift rod bores.**
7. **Install joint assembly and secure with setscrew.**




SCREW
LIFT HOOK
BACK-UP LIGHT PIN
PLUG
BALL
NUT
WASHER
STUD
SHIFTER HOUSING
BREATHER
1ST & REV. FORK
1ST & REV. ROD
SPRING
POPPET
SCREW
OIL TROUGH
SNAP RING
INTERLOCK
INTERLOCK PIN
1ST & REV. BRACKET
SPRING
SCREW
SCREW
POPPET
SCREW
1ST & REV. PLUNGER
INTERLOCK
INTERLOCK PIN
2ND & 3RD FORK
BRACKET
2ND & 3RD ROD
SPRING
INTERLOCK
POPPET
BOLT
INTERLOCK PIN
4TH & 5TH ROD
SPRING
POPPET
BALL
PLUNGER
SPRING
PLUNGER
SPRING
4TH & 5TH FORK
SPRING
BRACKET
6TH & 7TH ROD
SNAP RING
SCREW
SCREW
6TH & 7TH FORK
RETAINER
RETAINER
RETAINER
SCREW


PLUG
NUT
WASHER
STUD
PIN
BALL
PLUG
BACK-UP LIGHT PIN
SCREW
LIFT HOOK
1ST & REV. FORK
SCREW
SHIFTER HOUSING
BREATHER
SPRING
POPPET
SNAP RING
INTERLOCK
1ST & REV. ROD
2ND & 3RD FORK
OIL TROUGH
INTERLOCK PIN
1ST & REV. BRACKET
SPRING
SPRING
POPPET
SCREW
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INTERLOCK PIN
SCREW
1ST & REV. PLUNGER
2ND & 3RD ROD
SPRING
POPPET
4TH & 5TH ROD
BRACKET
BOLT
INTERLOCK PIN
SPRING
PLUNGER
SPRING
POPPET
BALL
SPRING
PLUNGER
4TH & 5TH FORK
SPRING
6TH & 7TH ROD
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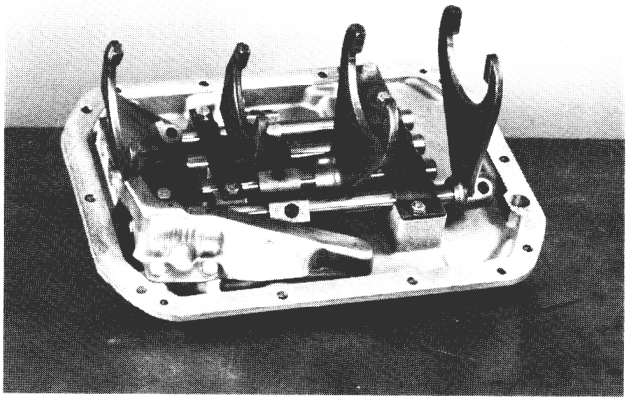
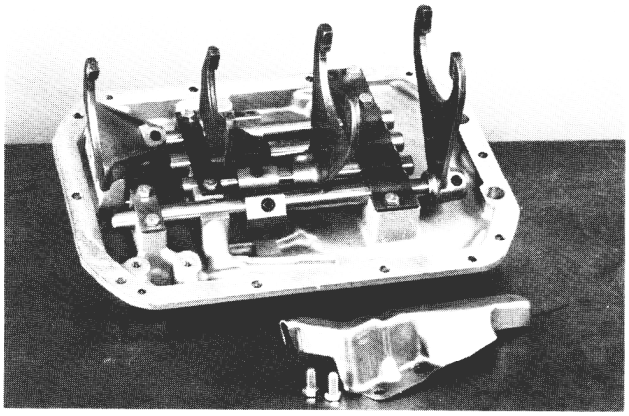
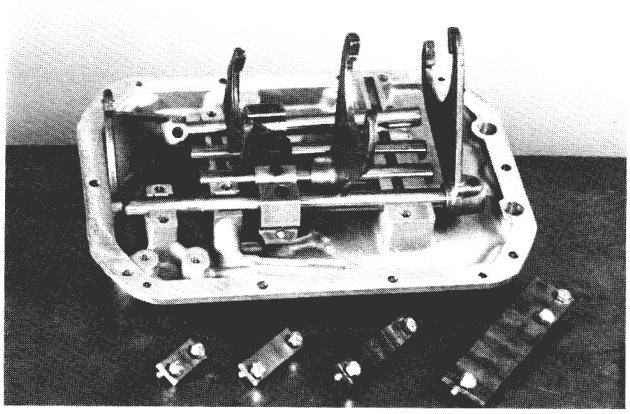
SCREW
6TH & 7TH FORK
SCREW
RETAINER
RETAINER
RETAINER
SCREW



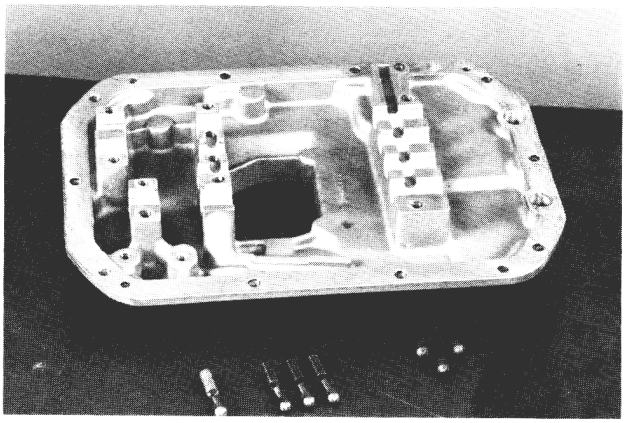
1. Disassembly of the cover begins by placing the cover on a bench with the forks up and in the neutral position.



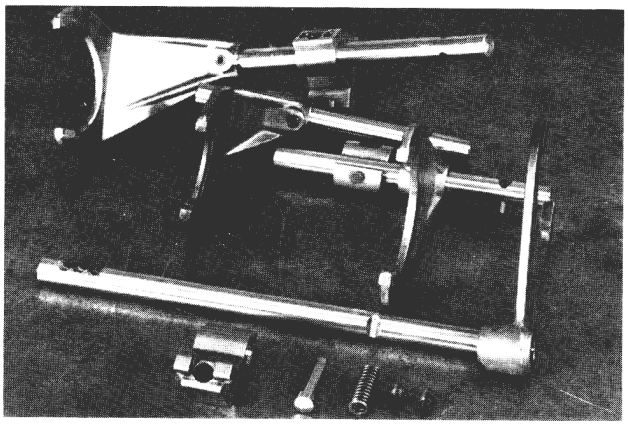
2. Remove the trough. It will make disassembling the rest of the cover easier.



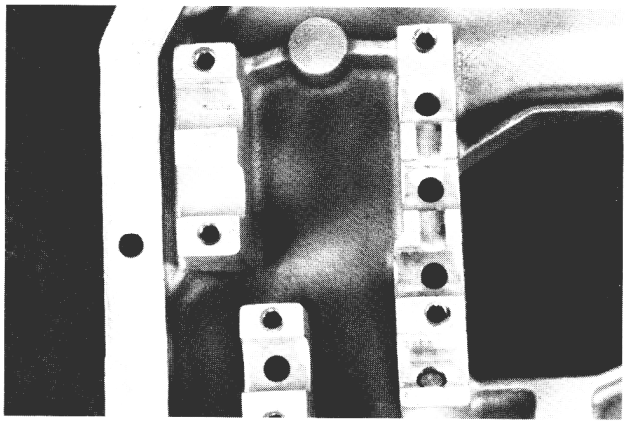
3. Loosen all fork and bracket setscrews, then remove the retainer straps.



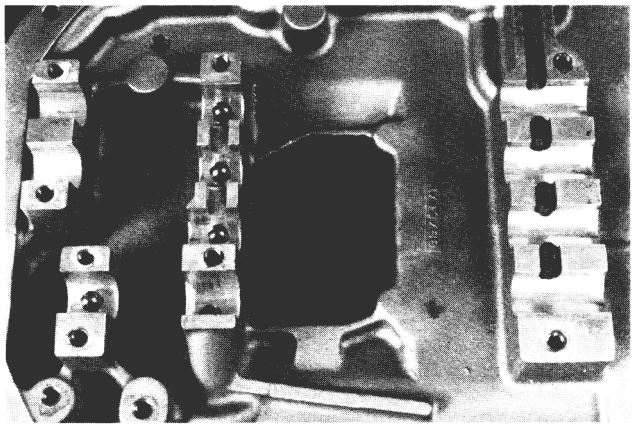
4. All forks lift easily from the cover, Remove the interlocks, poppets and springs. *The first-reverse spring has a different tension than the others, so don 't mix them up.*



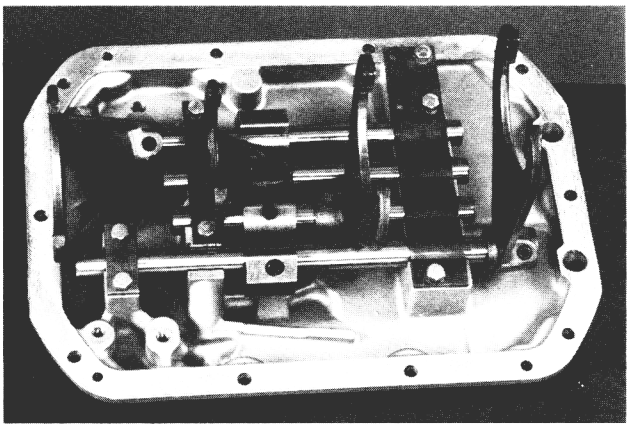
5. Next, disassemble the forks and brackets. Check all parts for wear or damage. Replace them if necessary.



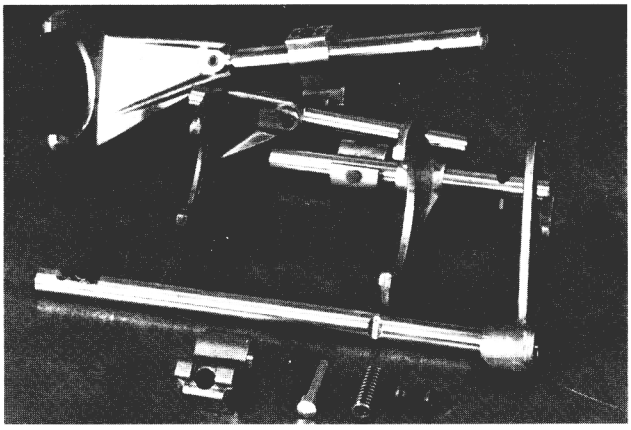
6. Check the poppet and detent holes for burrs or damage.



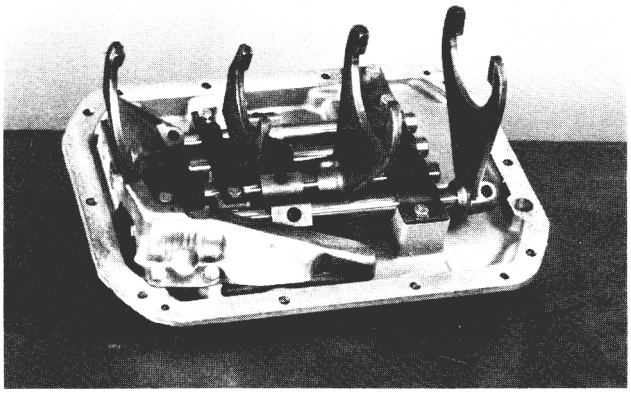
1. Lube all parts prior to reassembly. Clean the cover, then install the springs, poppets and interlocks.



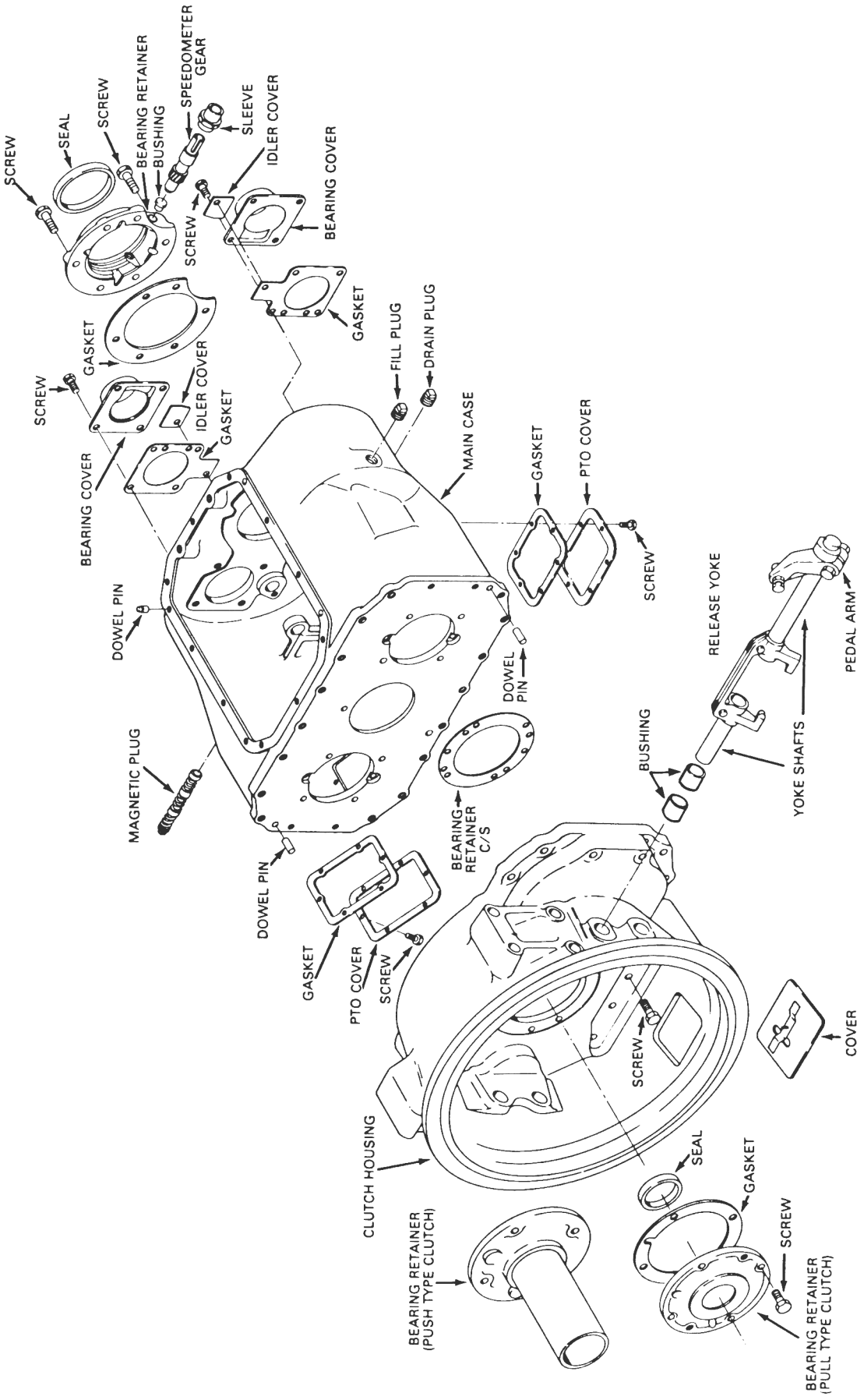
3. Place the fork assemblies into the case. Secure them with the retainer straps. Torque the strap bolts to 34-41 ft. lbs. Move each rod in the cover to confirm that it is moving freely.

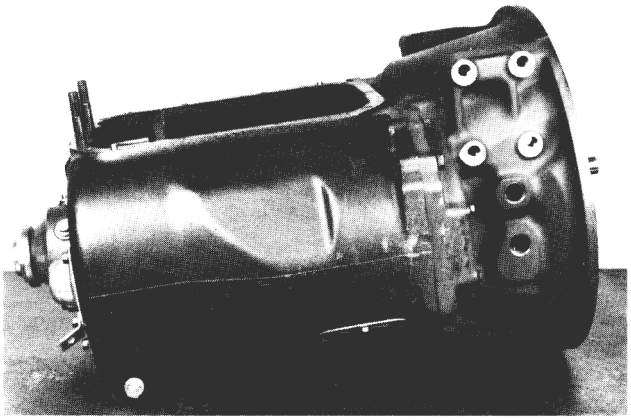


2. Reassemble the forks and brackets. Torque the allenhead setscrews to 26-32 ft. lbs. Torque the second-third bracket screws to 13-18 ft. tbs.

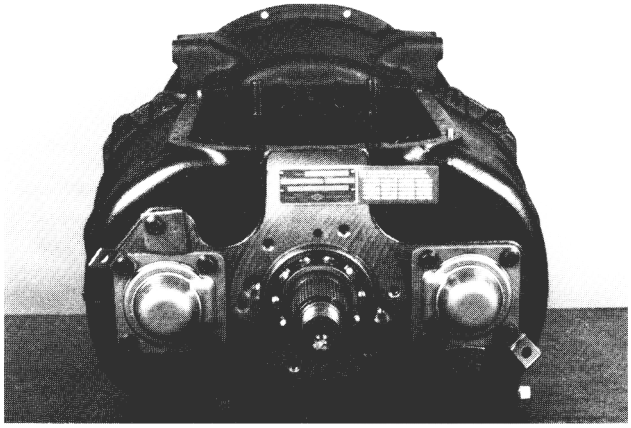


4. Next install the oil trough. Torque the bolts to 34-41 ft. lbs. Check the cover for correct functioning by shifting one fork into gear. If all interlocks were installed correctly, none of the other forks will shift into gear.

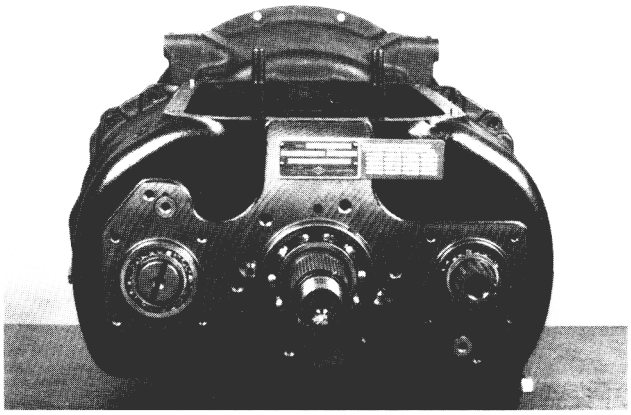

SCREW
SEAL
SCREW
BEARING RETAINER
BUSHING
SPEEDOMETER GEAR
SLEEVE
IDLER COVER
BEARING COVER
SCREW
GASKET
FILL PLUG
DRAIN PLUG
GASKET
IDLER COVER
SCREW
BEARING COVER
GASKET
MAIN CASE
GASKET
PTO COVER
SCREW
DOWEL PIN
DOWEL PIN
RELEASE YOKE
PEDAL ARM
BUSHING
YOKE SHAFTS
MAGNETIC PLUG
BEARING RETAINER C/S
DOWEL PIN
GASKET
PTO COVER
SCREW
SCREW
COVER
CLUTCH HOUSING
SEAL
GASKET
BEARING RETAINER (PUSH TYPE CLUTCH)
SCREW
BEARING RETAINER (PULL TYPE CLUTCH)



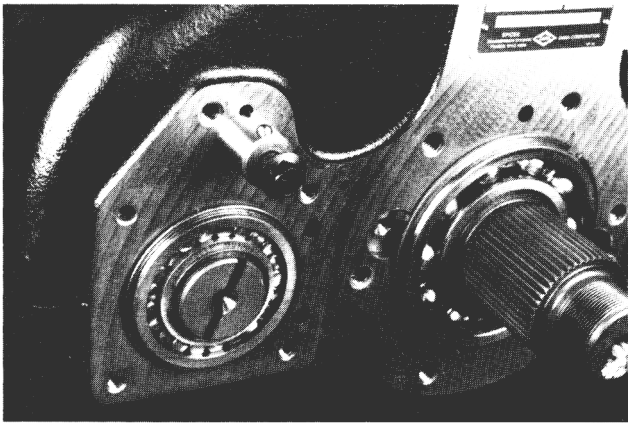
1. Remove the capscrews and shifter housing. If the shifter housing is a forward control, shift the transmission into sixth gear.



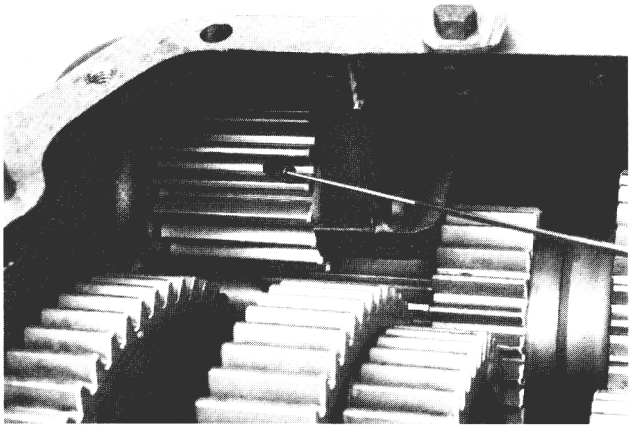
2. **Remove the output bearing cap and gasket,**



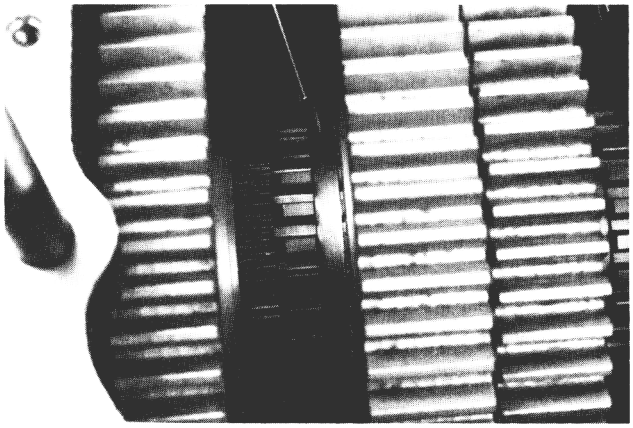
3. **Remove the countershaft bearing retainers.**



4. **Insert a capscrew into the upper reverse idler shaft for removal. Don't lose the lockball in the shaft.**

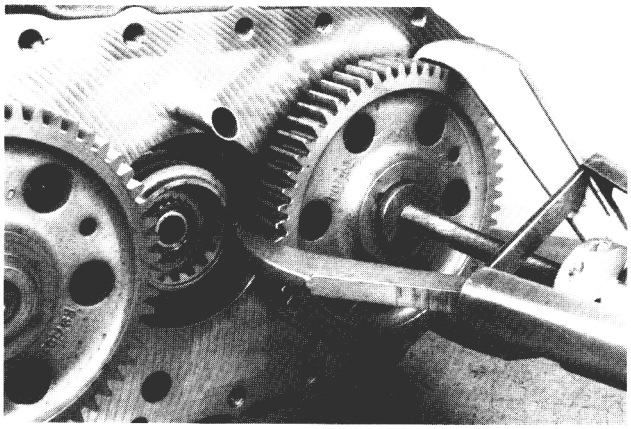


5. **Roll the upper reverse idler gear toward the side of the case,**

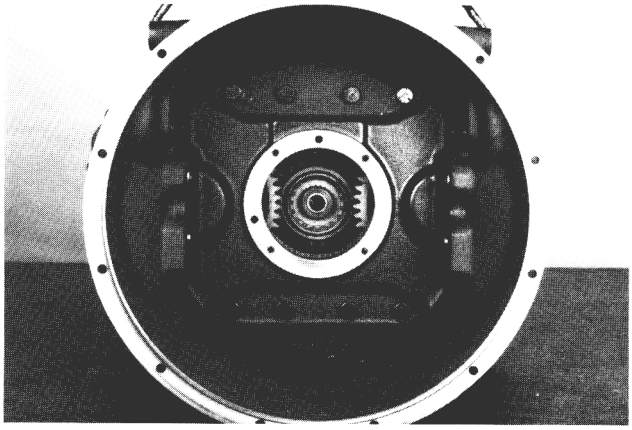


6. **Engage the first-reverse collar into first gear,**

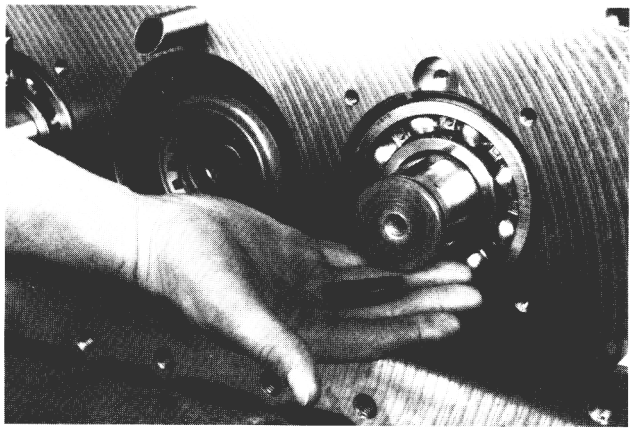
7. Remove the input bearing cap, gasket and input shaft,



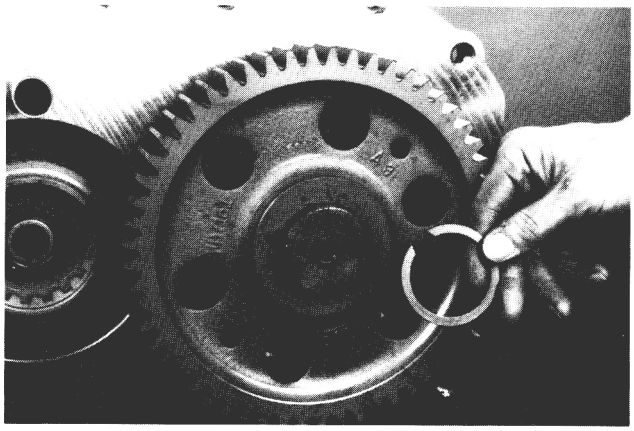
10. Remove the countershaft drive gears with the aid of a large puller.



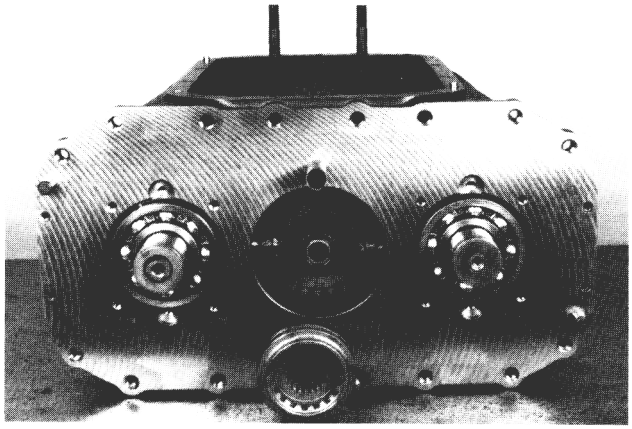
8. **Next remove the clutch housing bolts and separate the housing from the case. Use of a chain hoist is recommended due to the weight of the housing.**



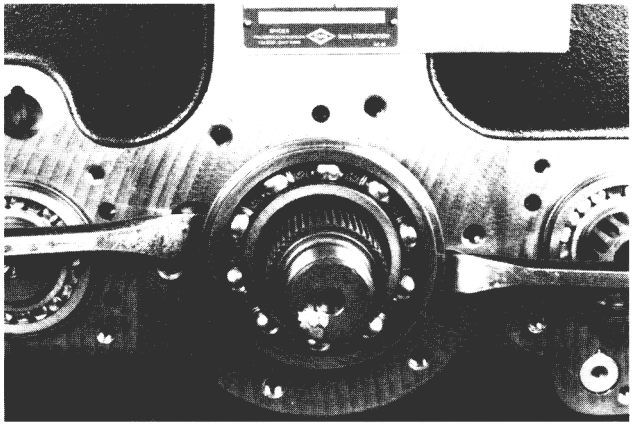
11. Continue by removing the countershaft driver gear countershaft keys.



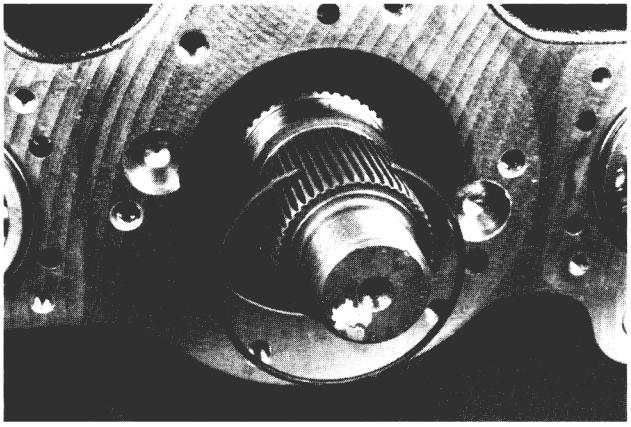
9. **Remove the snap rings from the countershafts,**



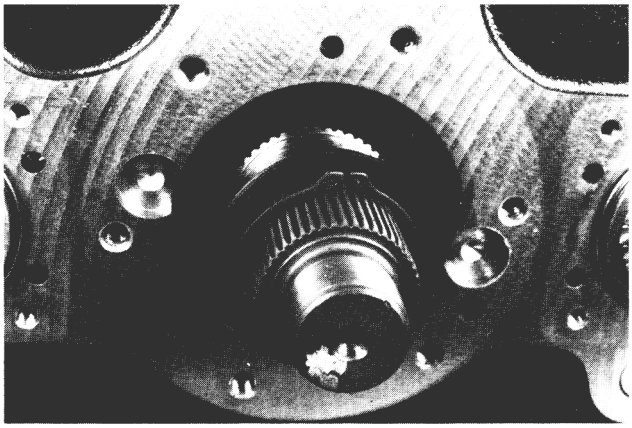
12. **The sixth-seventh clutch collar may be removed from the mainshaft.**



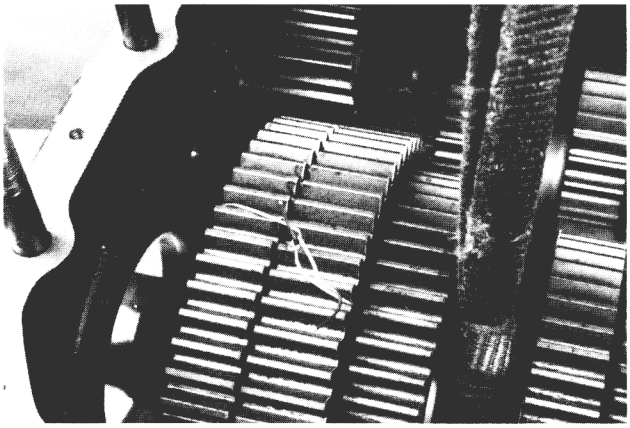
13. **Place a sling around the second-third mainshaft collar and use a hoist to provide support during bearing removal. The milled slots also help make output bearing removal easier.**



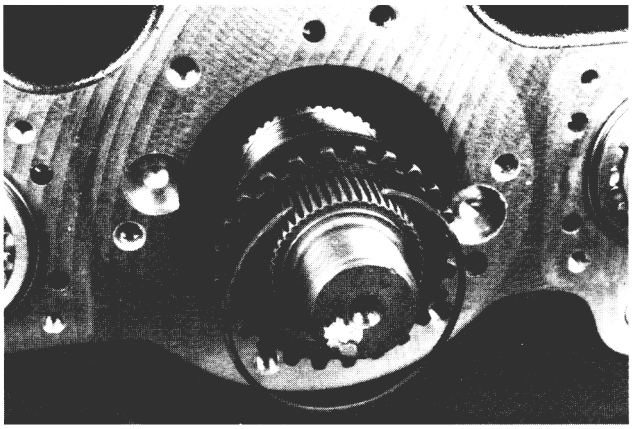
16. Remove the remaining gear bore snap ring.



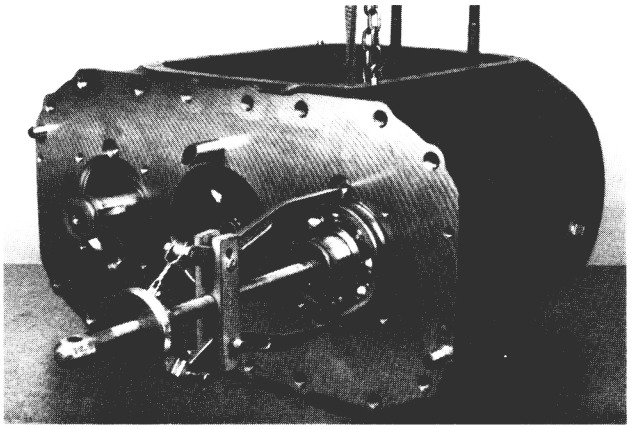
14. **Remove the mainshaft snap ring and the internally splined thrust washer.**



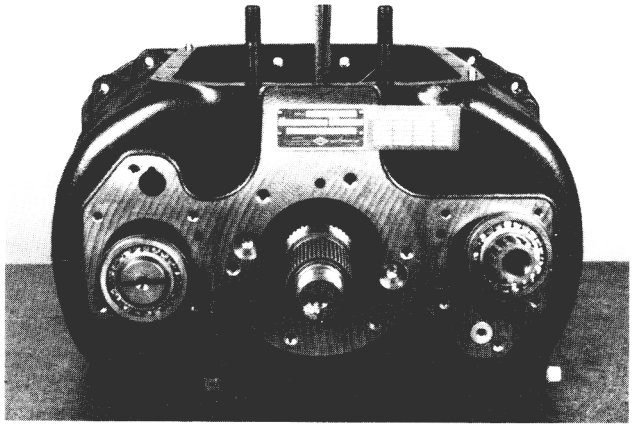
17. **Butt first and reverse gears together. Secure them with lockwire to provide the necessary clearance for mainshaft removal.**



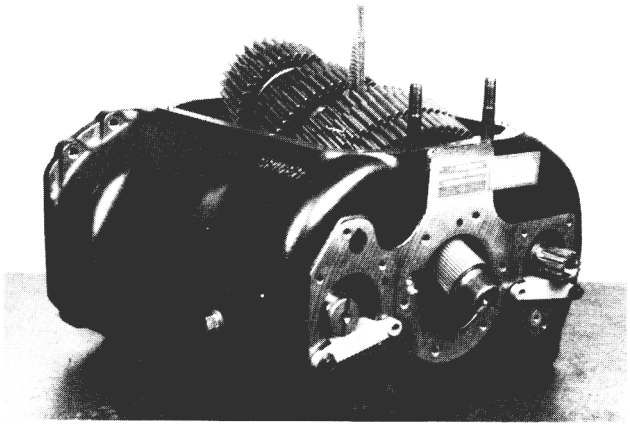
15. Next, remove the gear bore snap ring and both the externally and the internally splined thrust washers.



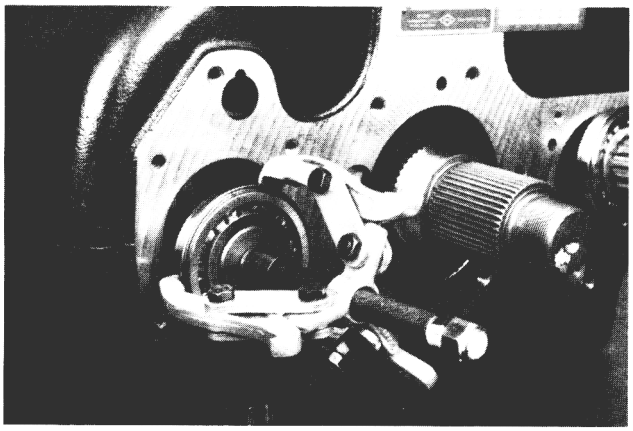
18. Use a puller to remove the countershaft front bearings.



19. **Move the countershafts to the rear as far as possible.**

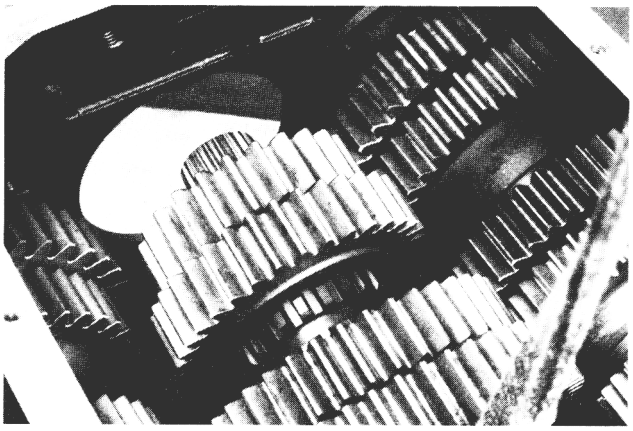


22. **Lift the mainshaft assembly out of the case.**

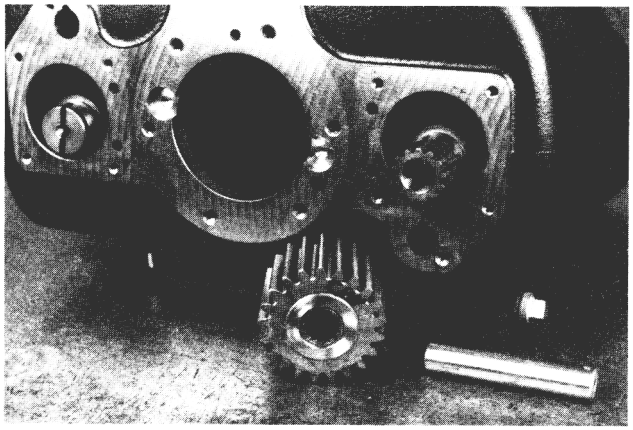


20. **Install a puller for bearing removal.**

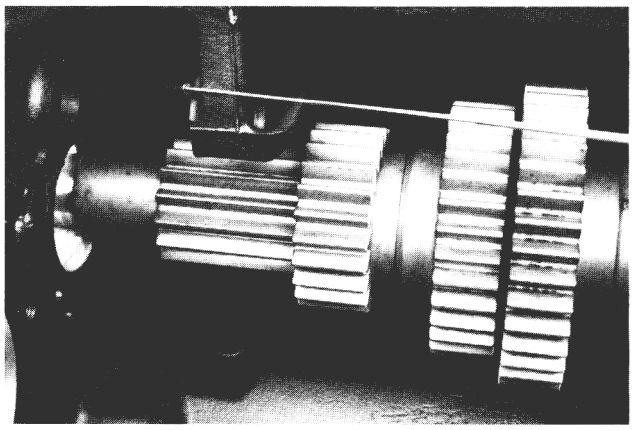
23. **Remove the upper reverse idler gear.**



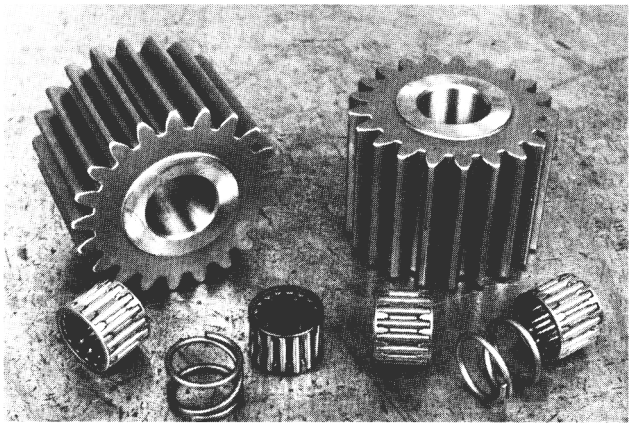
21. **To provide necessary clearance for mainshaft removal, move both countershafts forward and toward the side of the case. Countershaft alignment blocks can also be used to help restrain the countershafts.**



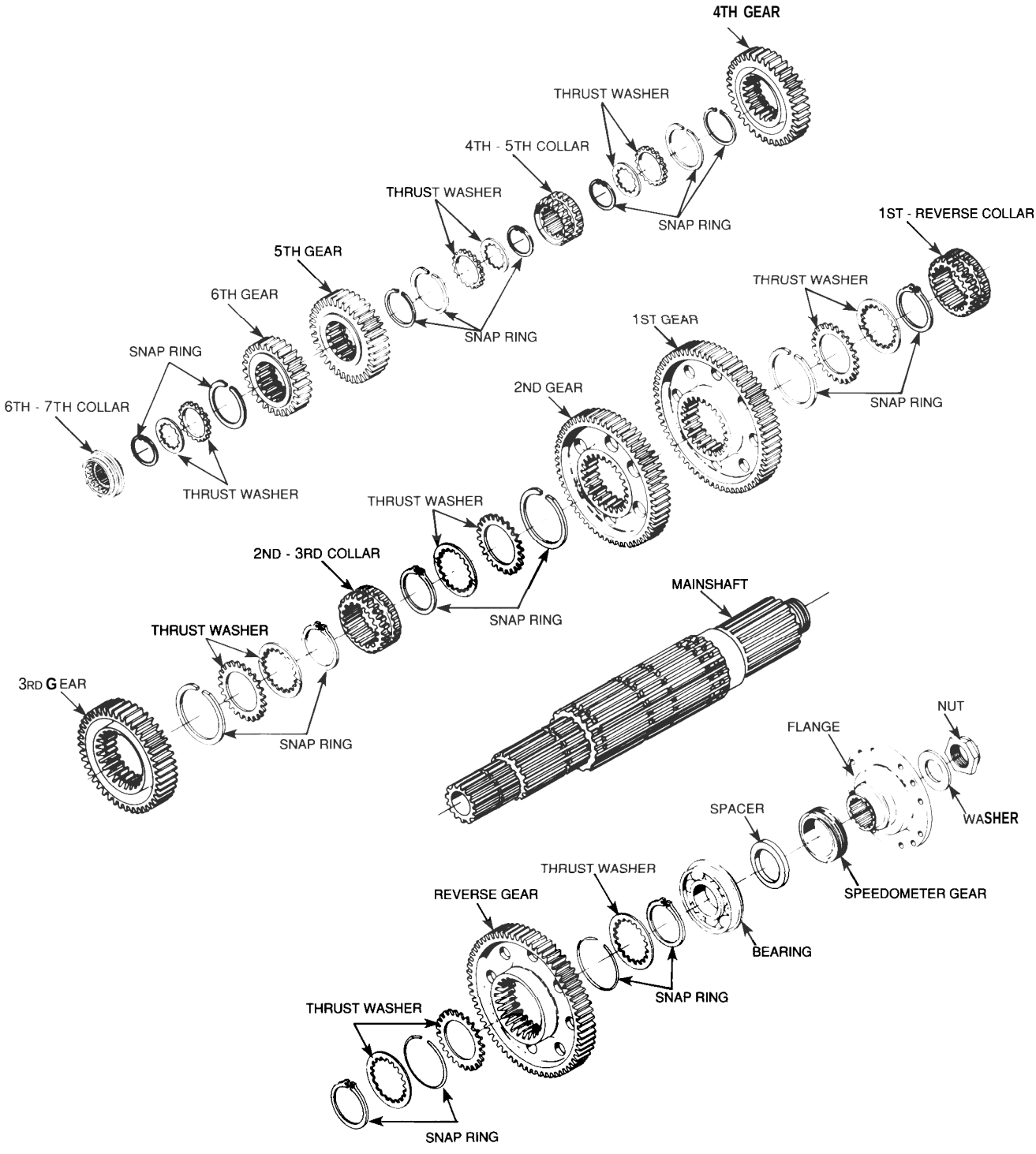
24. **Remove the lower idler shaft and Idler gear.**

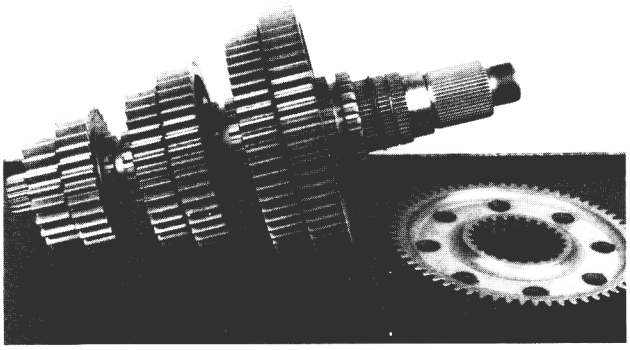


25. **Because of this upper idler boss interference, it is easier to remove the right side countershaft first. Then remove the left side countershaft.**

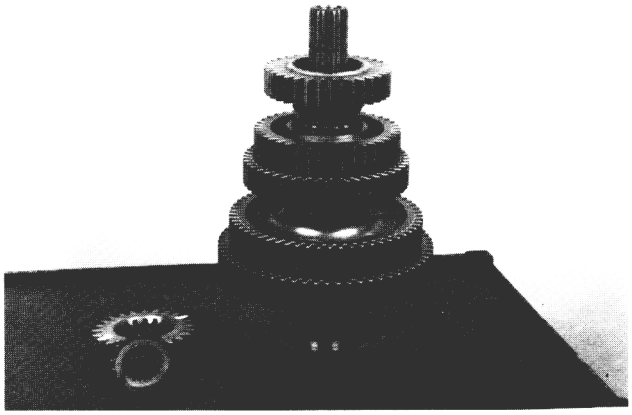


26. Check both idler gears and bearings for excessive wear.

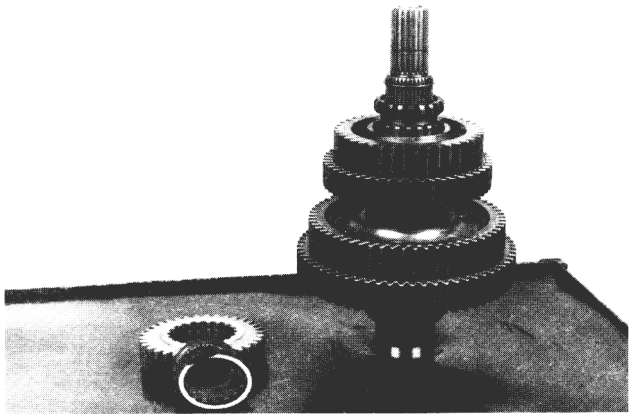

4TH GEAR
THRUST WASHER
4TH - 5TH COLLAR
THRUST WASHER
SNAP RING
1ST - REVERSE COLLAR
5TH GEAR
6TH GEAR
THRUST WASHER
1ST GEAR
SNAP RING
SNAP RING
SNAP RING
6TH - 7TH COLLAR
2ND GEAR
THRUST WASHER
THRUST WASHER
2ND - 3RD COLLAR
SNAP RING
MAINSHAFT
THRUST WASHER
3RD GEAR
SNAP RING
NUT
FLANGE
WASHER
SPACER
SPEEDOMETER GEAR
THRUST WASHER
REVERSE GEAR
BEARING
SNAP RING
THRUST WASHER
SNAP RING



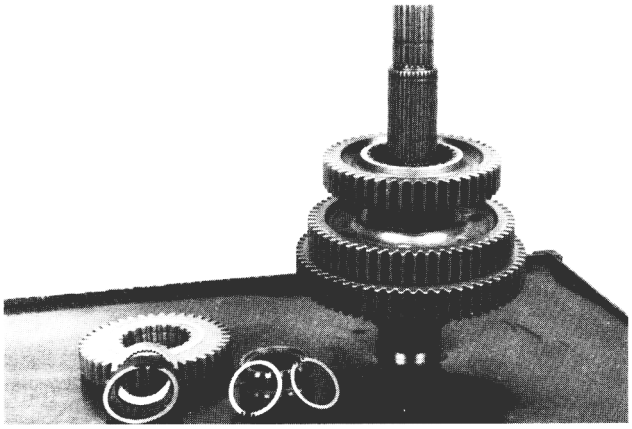
1. Begin disassembly of the mainshaft by cutting the lockwire and removing reverse gear.



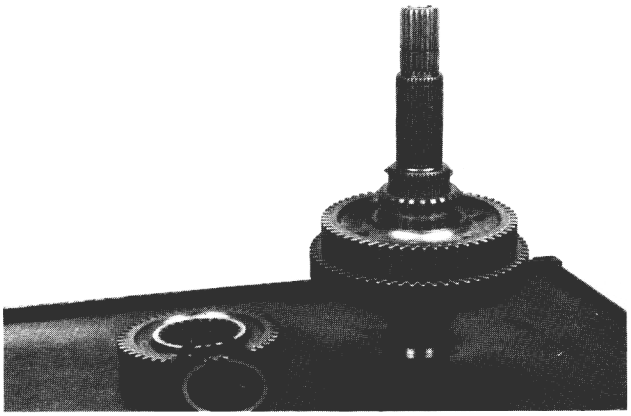
2. Remove the snap ring. Lift off sixth gear. Internally and externally splined thrust washers are in the gear. The internal washer teeth face toward the shaft. The external washer teeth face away from the shaft. A gear bore snap ring remains in the gear.



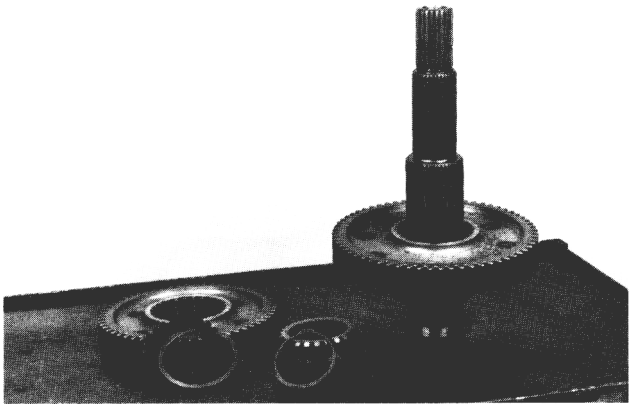
3. Remove fifth gear. There are two thrust washers and a snap ring inside the gear. There is also a gear bore snap ring inside each gear except reverse gear. This snap ring need not be removed unless otherwise specified.



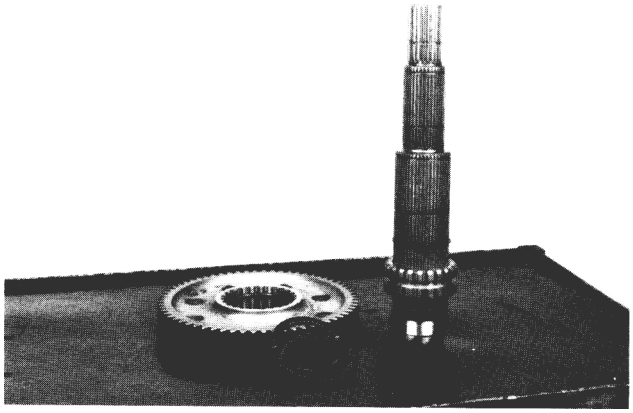
4. **Remove the mainshaft snap ring. Lift fourth-fifth shift collar off the shaft. Remove the snap ring and fourth gear. inside the gear are two thrust washers and a snap ring.**



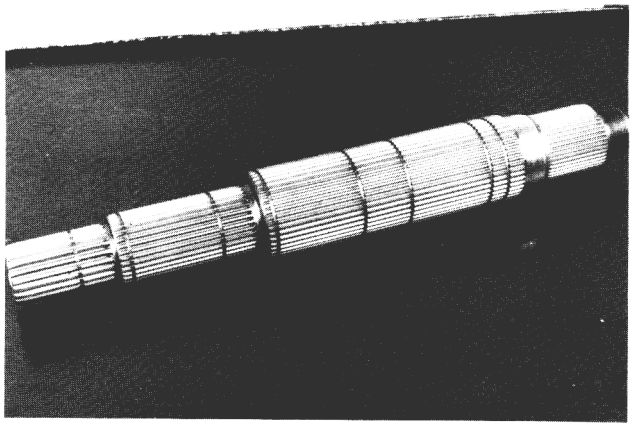
5. Continue by removing third gear. Two washers and a snap ring are inside it.



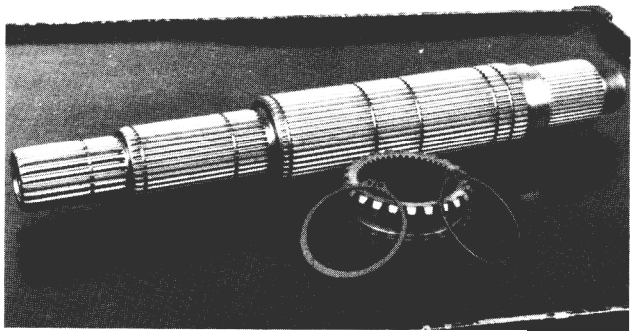
6. Remove the snap ring and second-third shift collar. Remove the next snap ring and lift second gear off the shaft. The gear contains two washers and a snap ring.



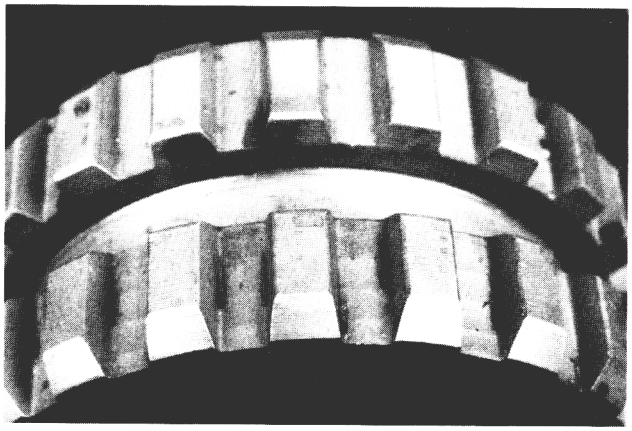
7. Continue by removing first gear. Again, there are two washers inside the gear. There is also a snap ring inside the gear, but there is no need to remove it.



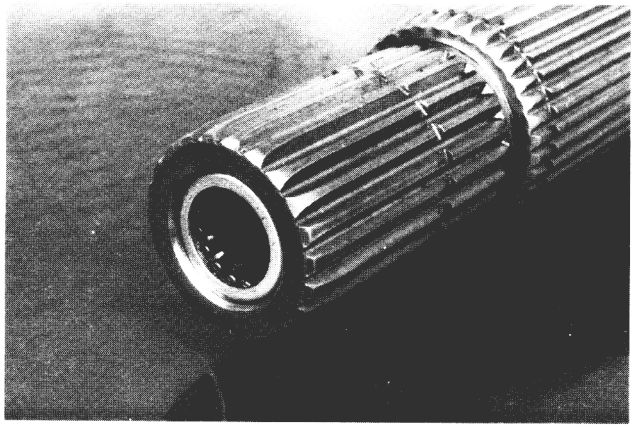
10. Notice that the mainshaft has rolled involute splines. They provide greater strength which means longer life.



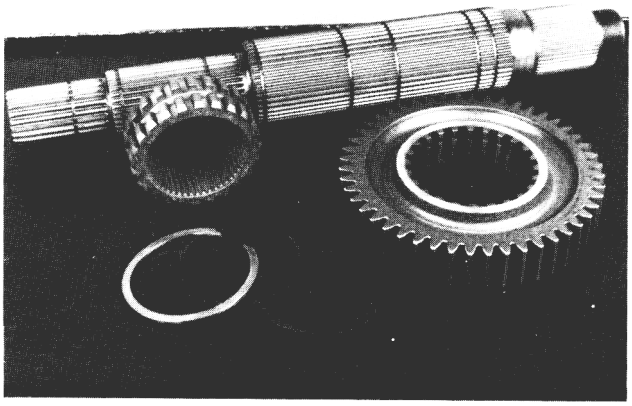
8. Remove the two snap rings and the first-reverse shift collar from the shaft.



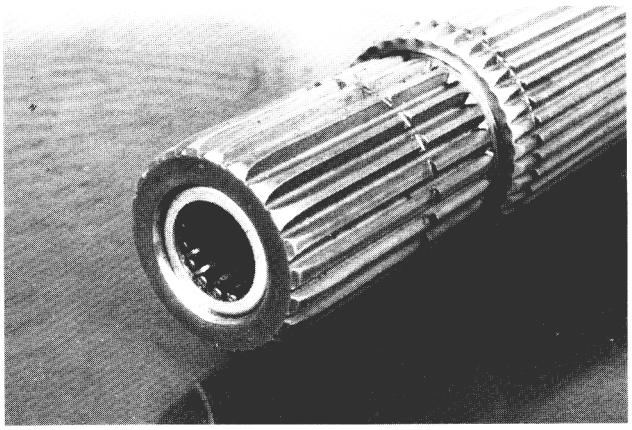
11. The fourth-fifth and sixth-seventh shift collars and gears have Taper-Lok™ gear locks. They are designed to draw gears into perfect alignment and eliminate gear jump-out.



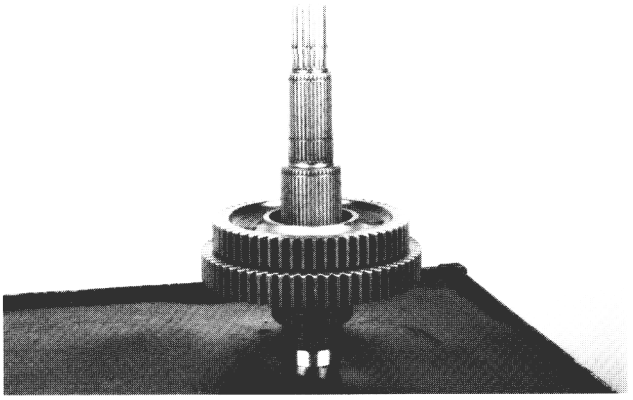
9. Remove the pocket bearing with an adequate puller.



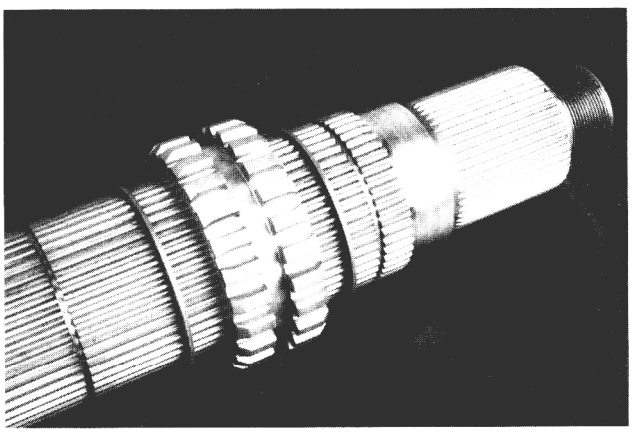
12. Clean all parts and inspect them for wear or damage. Replace them if necessary. Remember: if a gear is damaged and is going to be replaced, also replace its mating countershaft gears.



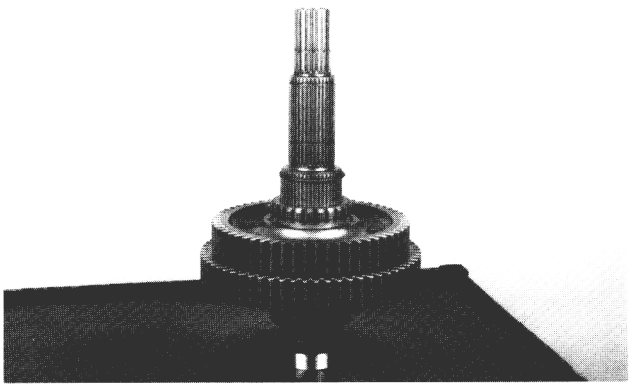
1, Install the pocket bearing to a depth of ,070".



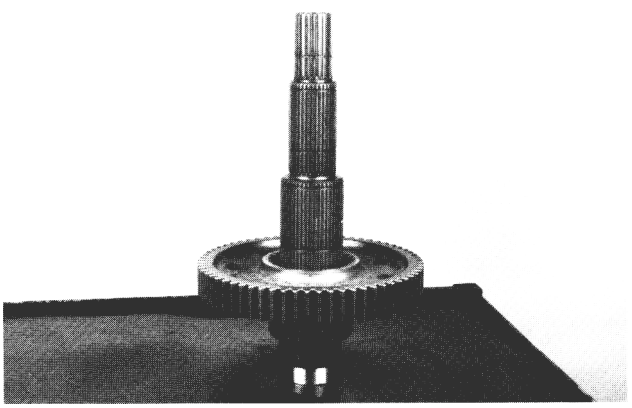
4. Place second gear on the shaft, Install the externally and internally splined thrust washers into the gear. Secure the assembly with a snap ring.



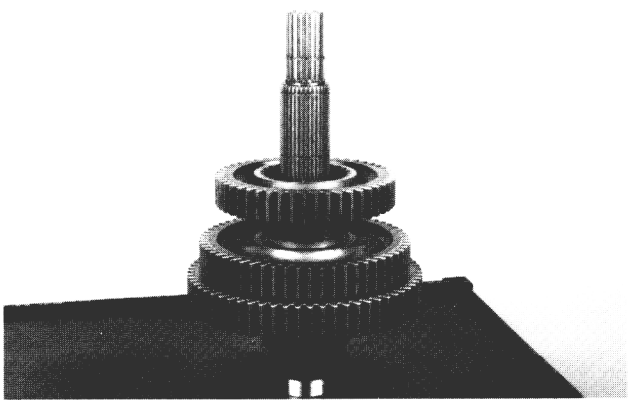
2. Lube all parts prior to reassembly. Install the first-reverse snap ring in the second groove from the bottom of the shaft. Slide the first-reverse collar into place and secure it with a snap ring.



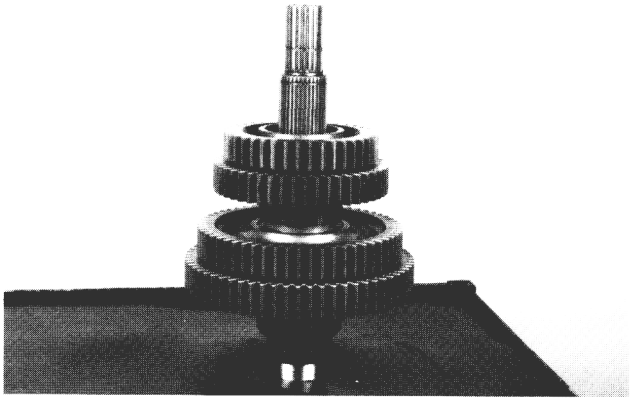
5. Install the second-third shift collar and snap ring.



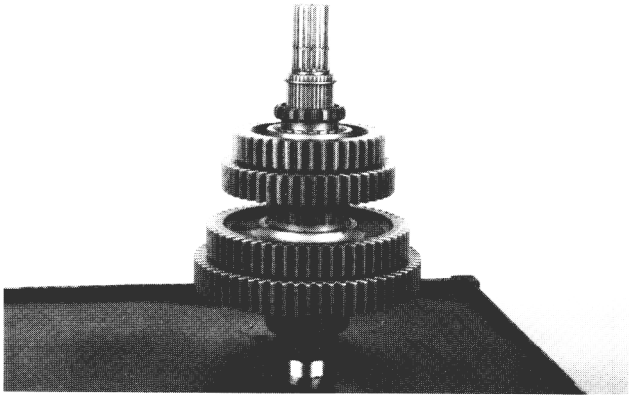
3. Place the internally and externally splined thrust washers on the shaft. The internally splined thrust washer should rest against the mainshaft snap ring.



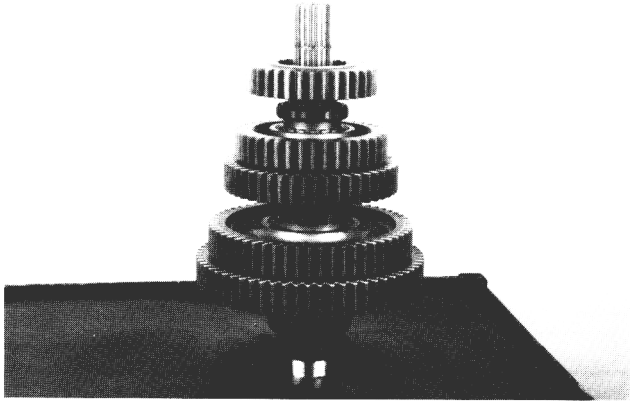
6. Place an internally splined washer and externally splined washer on the shaft. Install third gear.



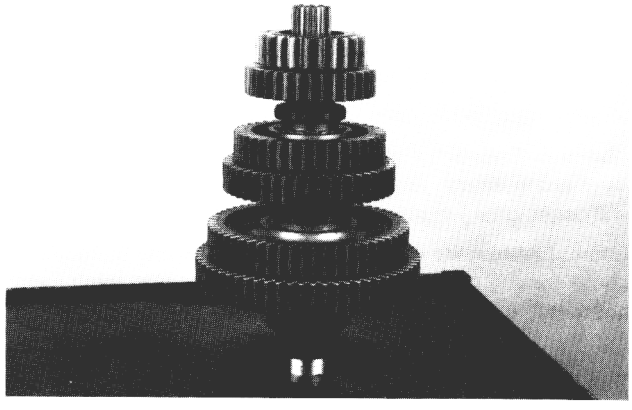
7. Place the externally splined thrust washer, snap ring and internally splined thrust washer in the gear. Slide fourth gear onto the shaft. Secure it with a snap ring.



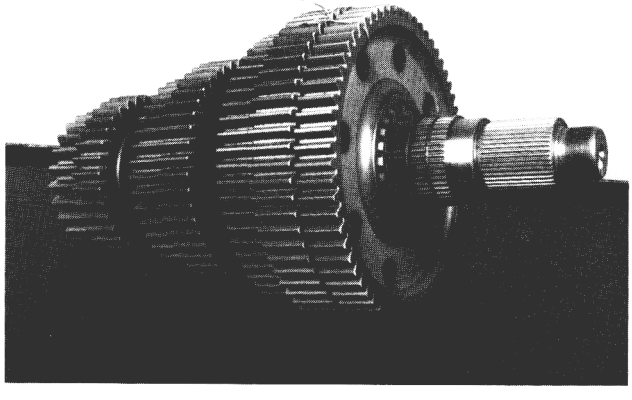
8. The fourth-fifth shift collar and snap ring are installed next.



9. Place the externally splined thrust washer, snap ring and internally splined thrust washer in the gear. Slide fifth gear onto the shaft. Secure it with a snap ring.



10. Place the externally splined thrust washer, snap ring and internally splined thrust washer in the gear. Slide sixth gear onto the shaft. Secure it with a snap ring.



11. Place the shaft on the bench. Install reverse gear, Butt first and reverse gears together, and secure them with lockwire. This will provide the necessary clearance to install the mainshaft back into the case.

Inspection

Prior to reassembling the mainshaft, certain individual parts should be examined. Parts damaged from previous service should be eliminated to insure maximum rebuild life.

These suggested inspection procedures should be followed:

Clutch Collars: Both the internal and external teeth must have sharp edges. Rounded corners or excessive chipping will cause gear jumping. Also, examine fork slots for wear.

Gears: Examine for broken or cracked operating teeth. Also, check for any unusual wear patterns. Clutching teeth must not show excessive wear.

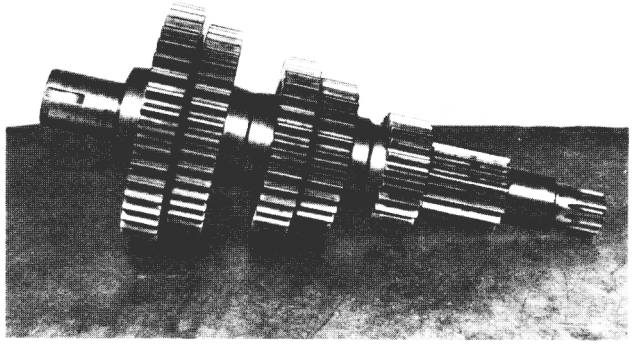
Thrust Washers: Check for flatness or excessive face wear (cracks, scoring, etc.)

Snap Rings: Examine for distortion or loss of tension. New snap rings are recommended with every rebuild.

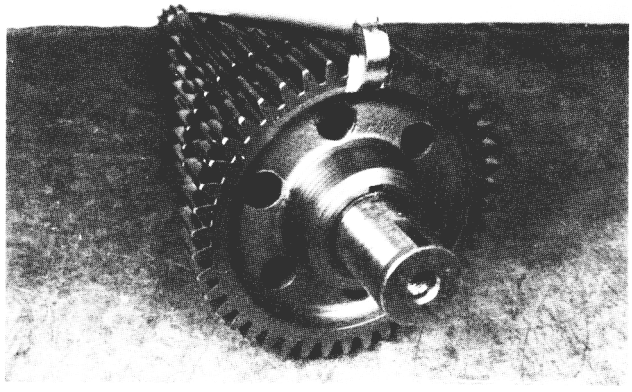
Mainshaft: Check spline gearlocks for sharp corners. Worn or ironed out gearlocks will produce gear jumping. Also, check for chipped splines at snap ring grooves.

NOM. THREAD SIZE (DIA.)		PART NAME	WRENCH TORQUE FT. LBS.			
			NON-LOCKING TYPE		LOCKING TYPE (Bonded Nylon Patch)	
in.	mm		MIN.	MAX.	MIN.	MAX.
.250	6	Capscrew or Nut	7	10	10	13
.312		"	13	17	20	24
.375	1 0	"	25	32	34	41
.438		"	40	50	52	62
	12	"			60	80
.500		"	60	80	78	98
	14	"			80	100
.562		"	90	115	112	137
.625		"	120	150	150	180
.750		"	200	250	240	290
1.250		Nut			400	450
1.375		"			550	600
1.750		"			550	600
		PTO Aperature Cover Capscrews				
.375		Capscrew	10	15	16	24
.438		Capscrew wlGasket 97-324-2	20	25	36	41
.438		Capscrevv wlGasket 22p22	20	25	29	34
		Shift Fork Or Brecket Setscrews	Lockwire Type			
.375		Setscrew	25	32	34	41
.436		"	25	32	34	41
.438		"	40	50	52	62
		Idler Cover	Self Tapping			
	10		25	32		

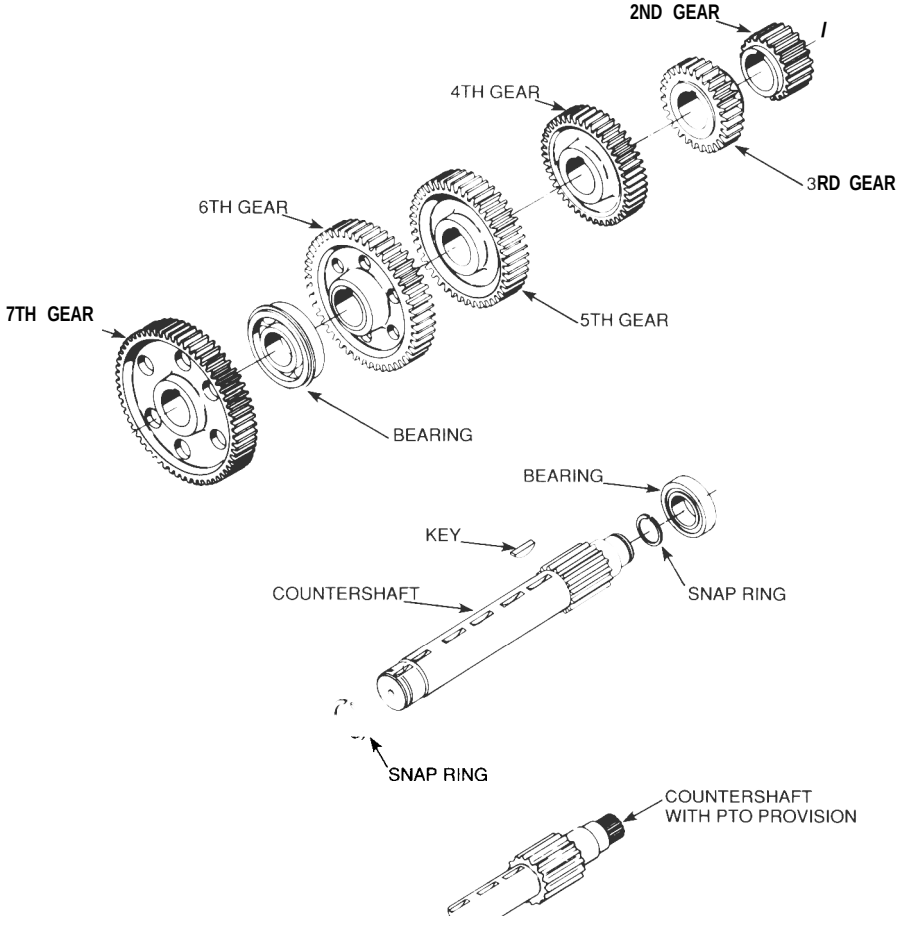
On all transmissions with .750-14 NPTF drain plugs, the drain plug torque should be 50-65 ft. lbs. The only exceptions are the ES42-5, ES52-5, CM40, CM49 and CM55 Models. The torque on these units should be 30-45 ft. lbs.

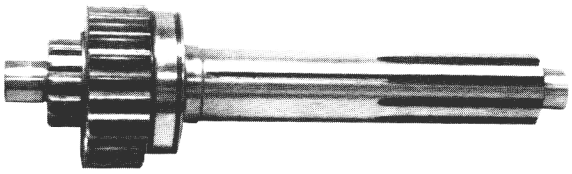


1. This view shows the hub direction of the gears. First-reverse gear is an integral part of the shaft, while the remaining gears are secured with individual woodruff keys under each gear.

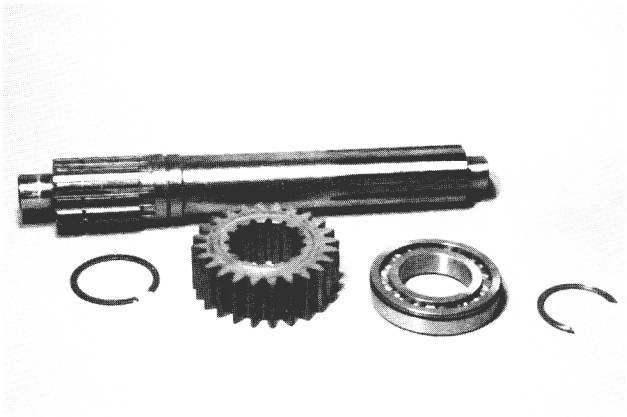


2. **If you place a straight edge between these painted teeth, every gear on the countershaft will be in line. When you set the countershafts in time, these marks will be directly across from each other.**

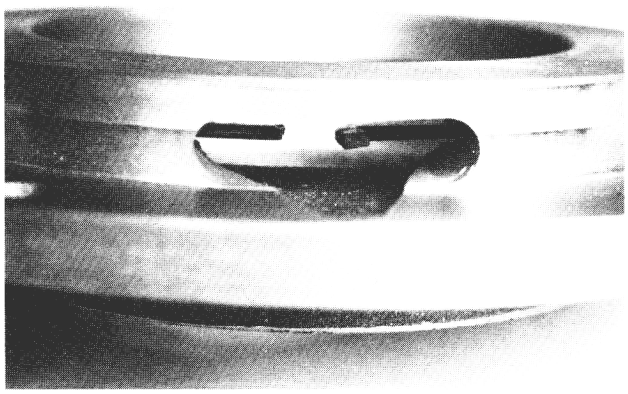




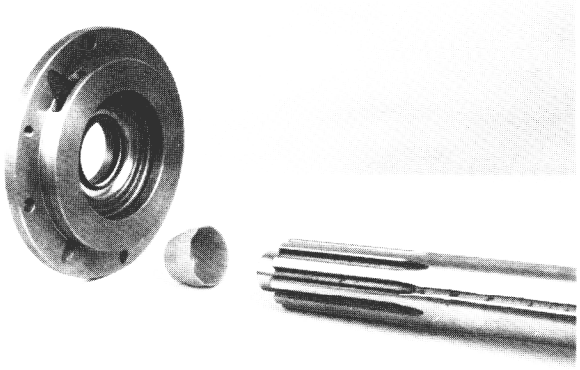
1. The input gear, shaft, and bearing are separate components secured with 2 snap rings.



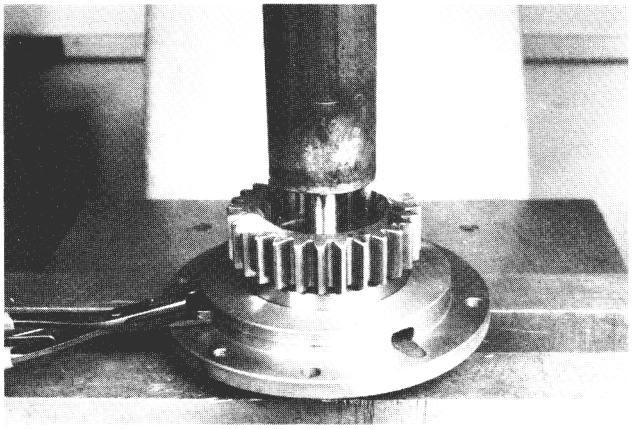
2. This view shows the input subassembly when disassembled.



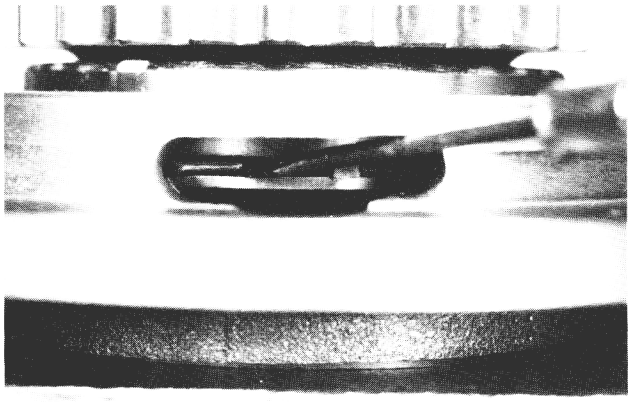
3. When reassembling, first install the snap ring into the input bearing cap.



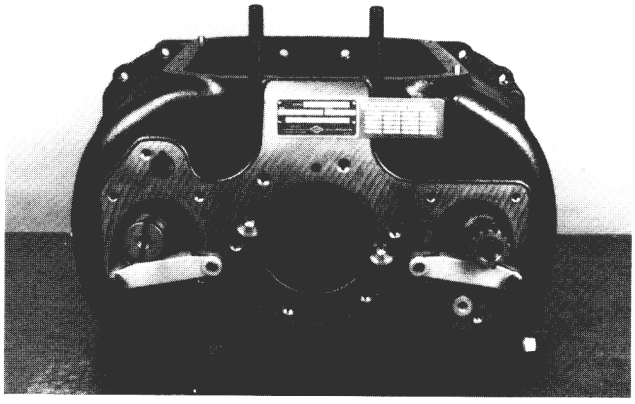
4. **Then insert the input shaft through the bearing retainer. Use an installation sleeve to protect the seal. Do not use grease on this seal. The shaft and seal must be oil free when mated to provide an effective seal.**



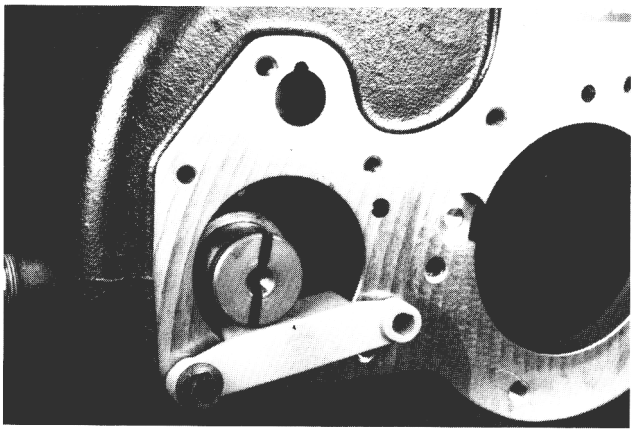
5. **Expand the snap ring through the provided slot, while pressing the input shaft assembly into the bearing retainer. CAUTION should be used during this procedure. (This procedure is the same for all 7-speed, 2-piece input gears.**



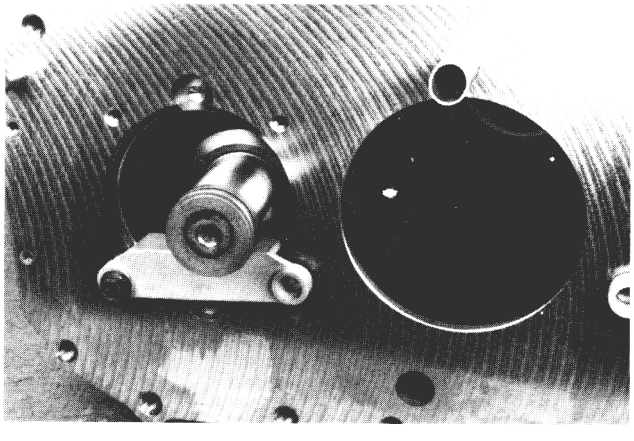
6. **When snap ring grooves on the input shaft bearing and bearing retainer are in proper alignment, discontinue pressing and seat the snap ring in place. Inspect the assembly to assure the snap ring is properly seated and secured.**



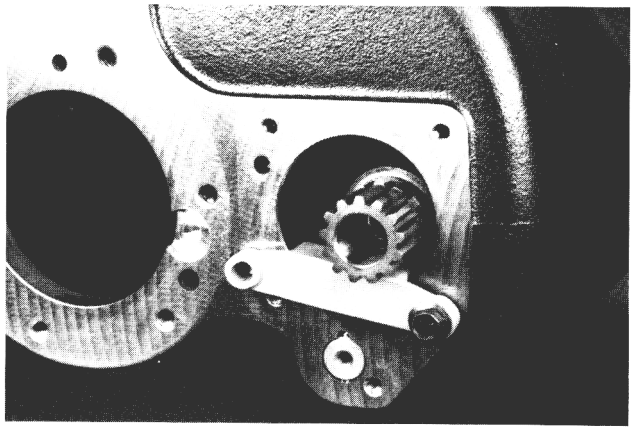
1. Reassembly of the unit begins by placing the lower reverse idler gear into the case. Then install the left side countershaft and the right side countershaft. Use of alignment blocks is recommended.



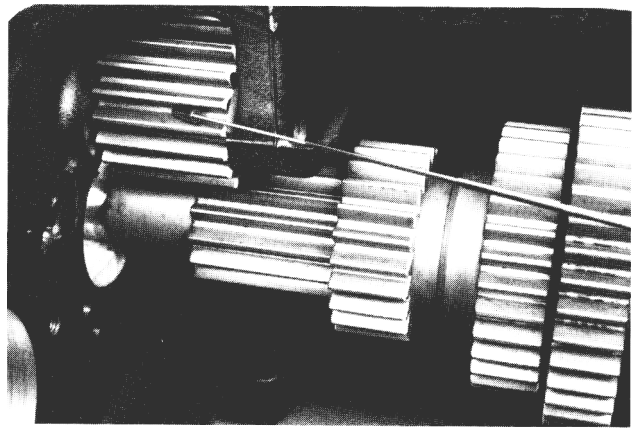
2. **These blocks make timing the gears easier, They also help provide the necessary clearance for mainshaft installation.**



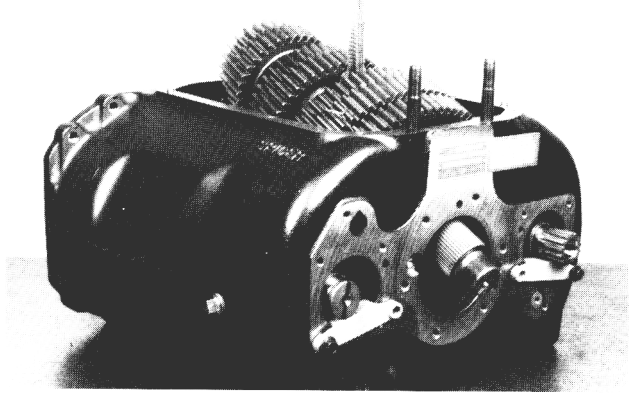
3. Align the countershaft timing marks toward the center of the case.



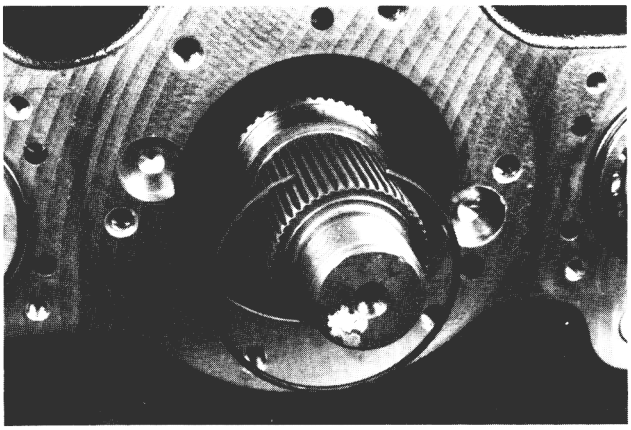
4. **Insert the lower idler shaft with lockball.**



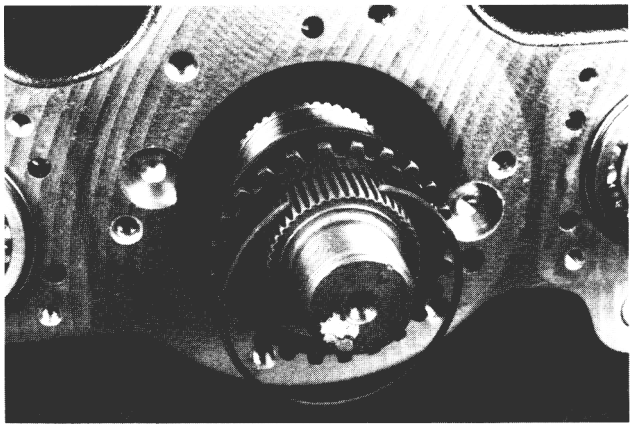
5. **Set the upper reverse idler gear into the case, but don't install the idler shaft yet.**



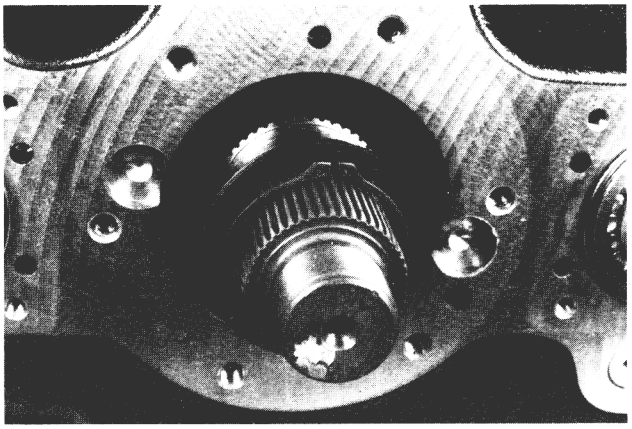
6. Lower the mainshaft assembly into the case.



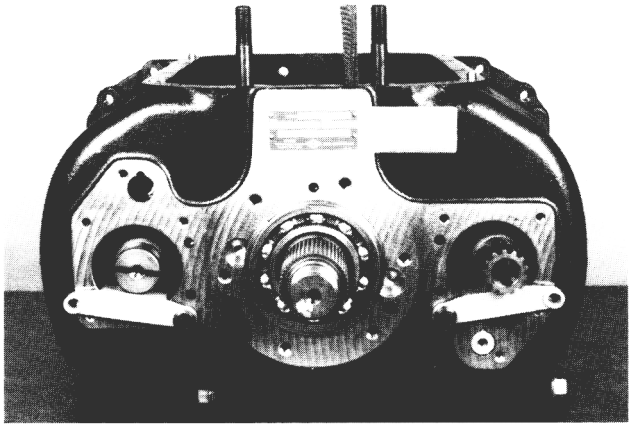
7. Cut the lockwire and slide the reverse gear rearward. install the first gear bore snap ring.



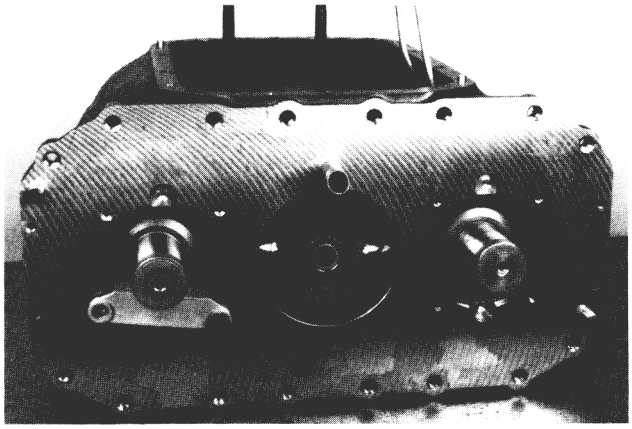
8. Next, install the internally and externally splined thrust washers. Secure them with the gear bore snap ring.



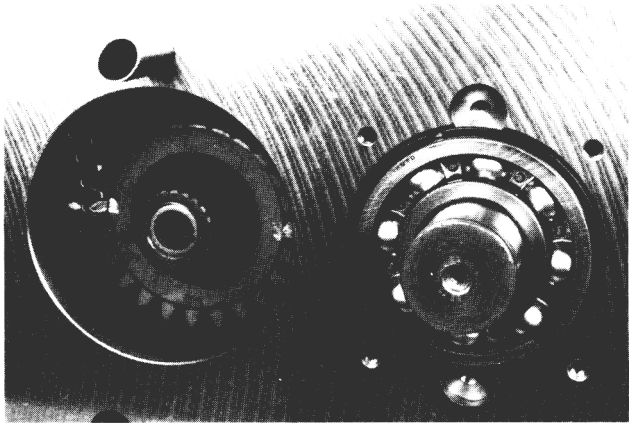
9. Install the internally splined thrust washer and secure it with the mainshaft snap ring.



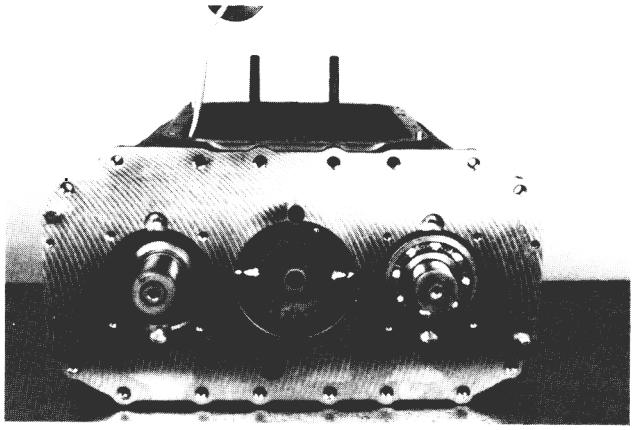
10. Slide the output bearing onto the shaft with a suitable driver. It is properly seated when the snap ring seats against the case.



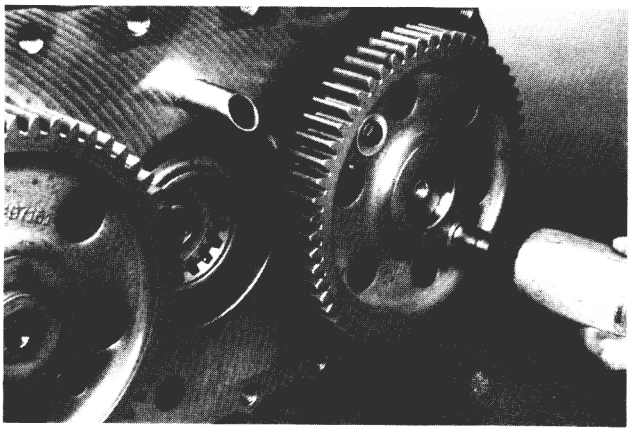
11. With the help of a lift hook, set the countershafts in time by matching the alignment marks.



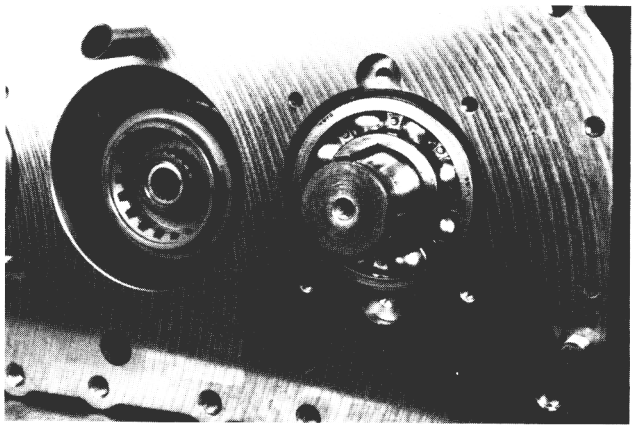
12. Install both the front and rear bearings on one of the countershafts.



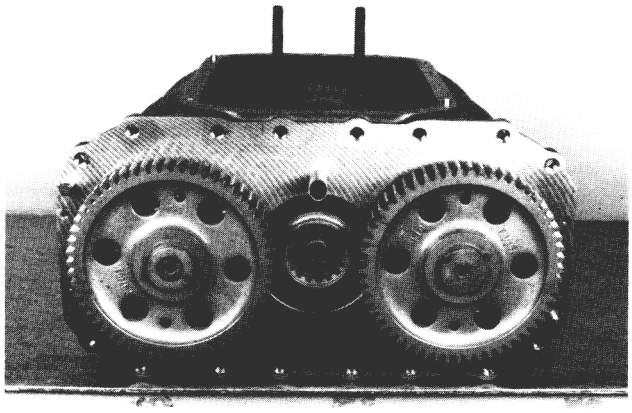
13. Repeat the procedure for the remaining countershaft.



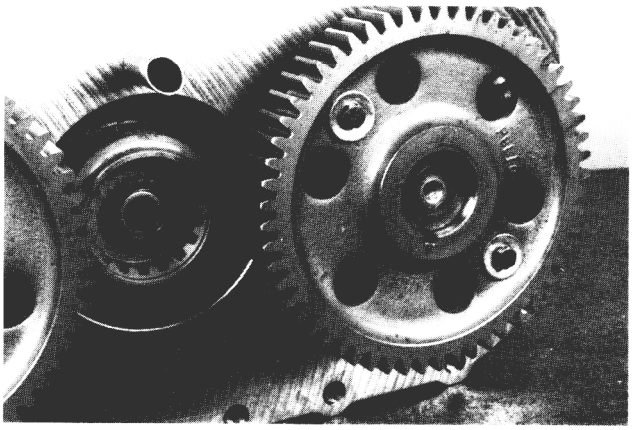
16. Using the alternating method, draw the gear onto the shaft, until it is seated behind the snap ring groove. Repeat this method for the other gear.



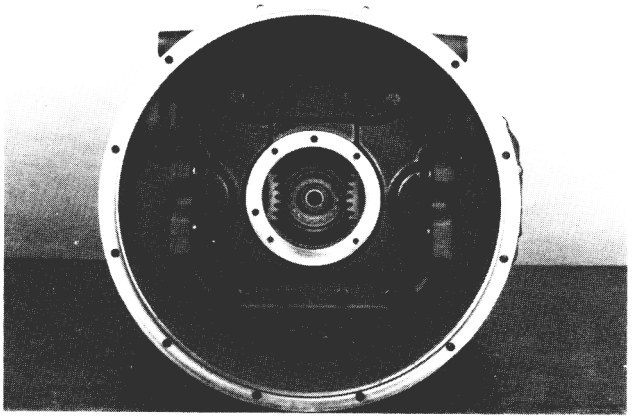
14. Next install the countershaft drive gear keys.



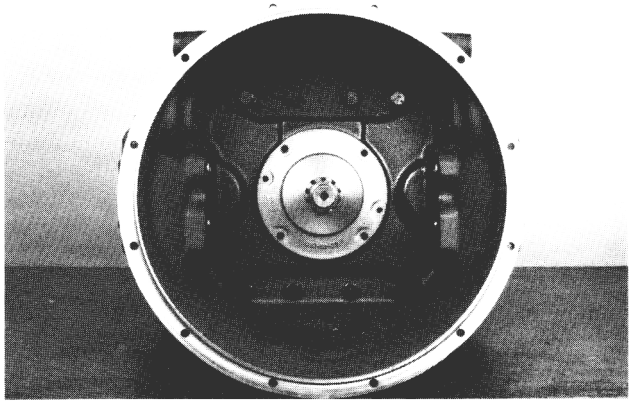
17. Once the gears are seated, install the snap rings and the sixth-seventh clutch collar.



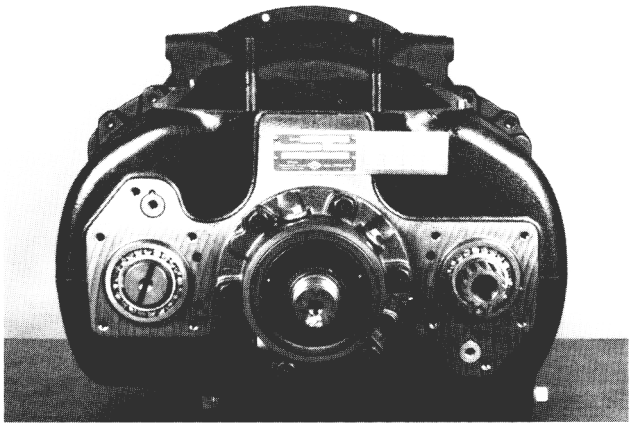
15. Slide the gear onto the shaft. Gather two of the 54103 (.375-1 6 x 3.00) grade eight bolts used for securing the clutch housing to the case, Place these in the two bolt holes in the gear, and thread them into the tapped installation holes provided in the case.



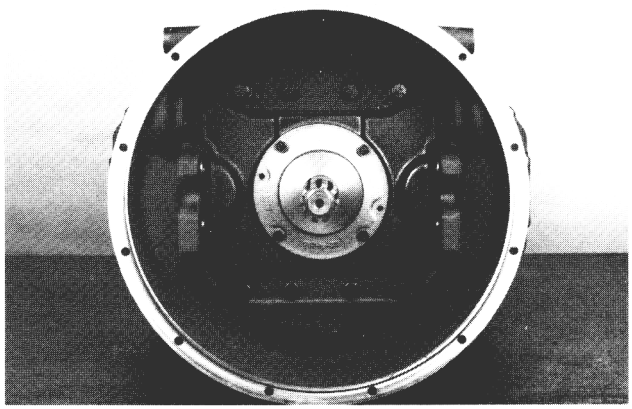
18. Apply a light coat of Loctite 51 5 to the clutch housing. Attach the housing to the case and secure it with capscrews. Torque them to 150-180 ft. lbs.



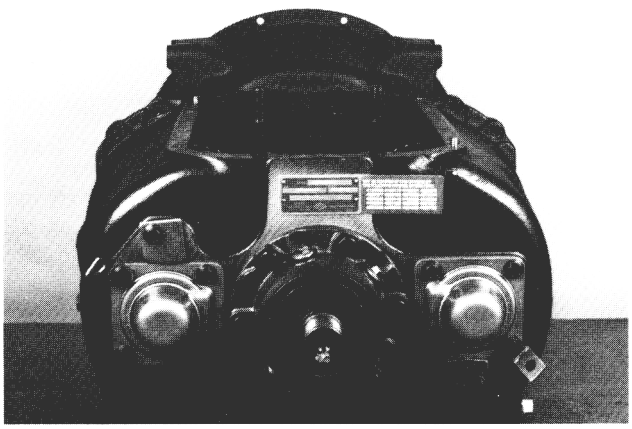
19. **Pre-lube the pocket bearing with Moly #2 before installing the input shaft.**



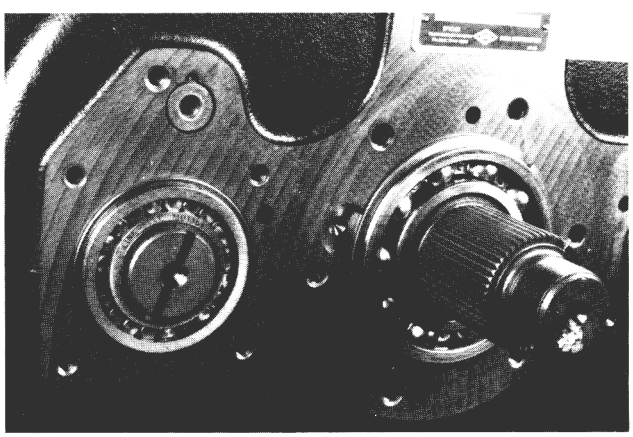
22. **The output bearing cap and gasket may be assembled to the case. Torque the capscrews to 78-98 ft. lbs.**



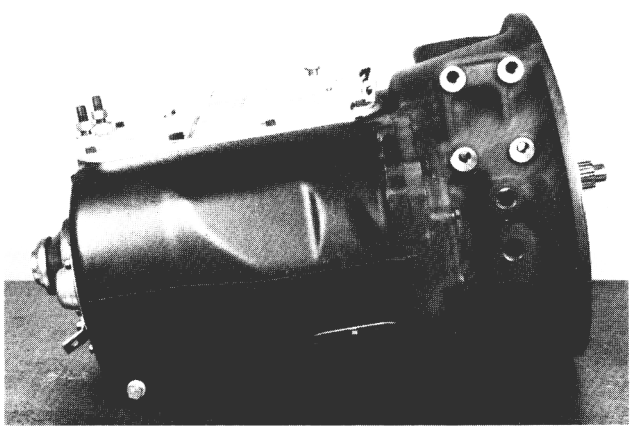
20. **Place the input bearing cap and gasket over the input shaft. Be careful to align it with the clutch housing oil hole. Torque the capscrews to 34-41 ft. lbs.**



23. Place the countershaft bearing caps on the case and secure them with capscrews. Torque to 34-41 ft. lbs.



21. Install the upper reverse idler shaft. It is difficult to align the gear with the case hole unless the input shaft is in the unit. It is also necessary to lift up on the mainshaft reverse gear to obtain proper alignment.



24. Bench shift the transmission to make sure everything is working properly. Then install the shifter housing and secure it with capscrews. Torque to 34-41 ft. lbs.

Important Procedure

When locating and correcting unit power or auxiliary transmission troubles, a systematic procedure should be followed.

Road test whenever possible. Mechanics usually get second or third hand reports of trouble experienced with the unit. These reports do not always accurately describe the actual conditions. Sometimes symptoms seem to indicate trouble in the transmission. The trouble actually may be caused by the axle, propeller shaft, universal joint, engine or clutch. This is especially true of complaints on noise. Therefore, before removing transmission or related components to locate trouble, always road test to check the possibility that trouble may exist in other closely associated units. If the mechanic can drive, road testing will be more effective; however, just riding with the driver can be very informative.

Check Functioning Prior to Disassembly

If remote controls are used, a careful check of the remote and connecting linkage to the transmission must be made. The remote unit must be in good working order if the transmission is expected to shift satisfactorily.

Many times the answer to the trouble is apparent when the unit is inspected prior to disassembly, but this evidence is often lost when the parts are separated. If possible, check the unit prior to disassembly. Bear in mind that a careful inspection of the unit should be made as each disassembly step is performed.

Inspect Thoroughly During Disassembly

It is poor practice to disassemble a unit or complete transmission as quickly as possible without bothering to examine the parts as they come down. It happens many times that a mechanic has completely disassembled a unit and failed to find the cause of the trouble because he did not bother to examine the parts as they came apart. After the transmission is disassembled, check the lubricant for foreign particles which often reveal sources of trouble that are overlooked during the disassembly.

Repair or Replace Worn Parts

Many times the parts or critical adjustments that have caused the trouble are not replaced or corrected because the mechanic will only inspect and replace parts that have failed completely. All pieces should be accurately examined because the broken parts are often just the result and not the cause of the trouble. All parts that are broken or worn and no longer meet specifications should be replaced. On large units, like a transmission, it is suggested that a mechanic replace parts that are worn to the extent that they do not have a long service life remaining. This avoids another teardown on the unit in the near future. It is also good practice, at this time, to make the changes or modifications recommended to bring the transmission up to date and increase the service life of the unit.

Noisy Operation

Noise is usually very elusive and generally not the fault of the transmission. Therefore, mechanics should road test to determine if the driver's complaint of noise is actually in the transmission.

In numerous instances, drivers have insisted that the noise was in the transmission. However, investigations revealed the noise to be caused by one of the following conditions:

(a) Fan out of balance or blades were bent.

(b) Defective vibration dampers.

(c) Crankshafts out of balance.

(d) Flywheels out of balance.

(e) Flywheel mounting bolts.

(f) Engine rough at idle producing rattle in gear train.

(g) Clutch assembly out of balance.

(h) Engine mounts loose or broken.

(i) Power take-off engaged.

(j) Universal joints worn out.

(k) Propeller shafts out of balance.

(l) Universal joint angles out of plane or at excessive angle.

(m) Center bearings in drive line dry, not mounted properly, etc.

(n) Wheels out of balance.

(0) Tire treads humming or vibrating at certain speeds.

(p) Air leaks on suction side of induction system, especially with turbo-chargers.

Mechanics should try to locate and eliminate noise by means other than transmission removal, or overhaul. However, if the noise appears to be in the transmission try to break it down into the following classifications. If possible, determine what position the gear shift lever is in when the noise occurs. If the noise is evident in only one gear position, the cause of the noise is generally traceable to the gears in operation.

(a) *Growling, humming or grinding.* These noises are caused by worn, chipped, rough or cracked gears. As gears continue to wear, the grinding noise will be noticeable, particularly in the gear position that throws the greatest load on the worn gear.

(b) *Hissing, thumping or bumping.* Hissing noises can be caused by bad bearings. As bearings wear and retainers start to break up, the noise could change to a thumping or bumping.

(c) *Metallic rattles* within the transmission usually result from a variety of conditions. Engine torsional vibrations are transmitted to the transmission through the clutch. In heavy duty equipment, clutch discs with vibration dampers are not used, so a rattle, particularly in neutral, is common with diesel equipment. In general, engine speeds should be 600 RPM or above to eliminate objectionable rattles and vibration during the idle. A defective or faulty injector would cause a rough or lower idle speed and a rattle in the transmission. Rattles could also be caused by excessive backlash in P.T.O. unit mounting.

(d) *Improper lubricants* or lack of lubricant can produce noises. Transmissions with low oil levels sometimes run hotter than normal, as there is insufficient lubricant to cool and cover the gears.

Improved highways permit sustained high speeds. The fact that engines and entire powertrains can now cruise at a higher RPM can introduce vibration frequencies that were not critical in the past. At slower speeds these items would get by or only pass through critical period while accelerating or decelerating through the gears.

In the past, drive line vibrations resulting from bent tubes, joints out of phase or alignment, bad angles to short couples, or clutches out of balance, were fairly obvious. These items become critical in vehicles running at sustained high speeds.

Critical vibrations associated with higher speeds are not the old thumping or bumping type but are high frequency vibrations which sting or tingle the soles of your feet, tickle the ends of your fingers, etc. This type of vibration will cause gear seizures, broken synchronizer pins, bearing failure due to retainer rivet failures, promote brinelling, fretting corrosion, etc.

(e) *Gear whine* is usually caused by lack of backlash between mating gears. Improper shimming of P.T.O. units is the big offender here.

Noise in Neutral

Possible Causes:

(a) Misalignment of transmission.

(b) Worn flywheel pilot bearing.

(c) Worn or scored countershaft bearings.

(d) Worn or rough reverse idler gear.

(e) Sprung or worn countershaft.

(f) Excessive backlash in gears.

(g) Worn mainshaft pilot bearing.

(h) Scuffed gear tooth contact surface.

(i) Insufficient lubrication.

(j) Use of incorrect grade of lubricant.

(k) Engine torsional.

Noise in Gear

Possible Causes:

(a) Worn or rough mainshaft rear bearing.

(b) Rough, chipped, or tapered sliding gear teeth.

(c) Noisy speedometer gears.

(d) Excessive end play of mainshaft gears.

(e) Refer to conditions listed under "Noise in Neutral".

Oil Leaks

Possible Causes:

(a) Oil level too high.

(b) Wrong lubricant in unit.

(c) Non-shielded bearing used as front or rear bearing cap. (Where applicable).

(d) Seals (if used) defective or omitted from bearing cap, wrong type seal used, etc.

(e) Transmission breather omitted, plugged internally, etc.

(f) Capscrews loose, omitted or missing from remote control, shifter housing, bearing caps, P.T.O. or covers, etc.

(g) Oil drain-back openings in bearing caps or case plugged with varnish, dirt, covered with gasket material, etc.

(h) Broken gaskets, gaskets shifted or squeezed out of position, pieces still under bearing caps, clutch housing, P.T.O. and covers, etc.

(i) Cracks or holes in castings.

(j) Drain plug loose.

(k) Also possibility that oil leakage could be from engine.

(l) Speedometer adaptor or connections.

Walking or Jumping Out of Gear

If the units are walking out of gear it could be caused by:

(a) Interference or resistance in the shift mechanism preventing full engagement of the sliding clutch gear, or

(b) If the gear has been shifted completely into position some other malfunction which could move the gear or the shift itself out of its proper location.

If remote controls are used, the mechanic must satisfy himself that the remote units are satisfactory and that the transmission is actually at fault. One other point that should be noted is whether the unit walks out of gear under drive (while pulling a load) or on a coast load. Also, does the gear hop occur on smooth or rough roads. A number of items that would prevent full engagement of gears are:

(a) Improperly positioned forward remote control which limits full travel forward and backward from the remote neutral position.

(b) Improper length shift rods or linkage that limits travel of forward remote from neutral position.

(c) Loose bell cranks, sloppy ball socket joints.

(d) Shift rods, cables, etc., too spongy, flexible, or not secured properly at both ends.

(e) Worn or loose engine mounts if forward unit is mounted to frame.

(f) Forward remote mount too flimsy, loose on frame, etc.

(g) Setscrews loose at remote control joints or on shift forks inside remote or even inside transmission unit.

(h) Shift fork pads or groove in sliding gear or collar worn excessively.

(i) Worn taper on gear clutch teeth.

(j) Transmission and engine out of alignment either vertically or horizontally:

A few items which could move the gear or shaft out of proper position, particularly on rough roads are:

(a) Use of heavy shift lever extension.

(b) Shift rod poppet springs broken.

(c) Shift rod poppet notches worn.

(d) Shift rod bent or sprung out of line.

(e) Shift fork pads not square with shift rod bore

(f) Excessive end-play in drive gear, mainshaft or countershaft, caused by worn bearings, retainers, etc.

(g) Thrust washers worn excessively or missing.

(h) Timing error on countershaft gears.

Hard Shifting

An improperly operating clutch will interfere with the proper shifting of gears in any transmission. It is important that the hydraulic, air or similar release mechanism (if used), also be used in proper working order. If the mechanic is sure that a full and complete clutch release is being made, the following could be a few of the possible causes for hard shifting complaints:

(a) No lubricant in remote control units. Forward remote is isolated and is often overlooked. However, many remote controls used on transmissions and auxiliaries require separate lubrication.

(b) No lubricant in (or grease fittings on) U-joints or swivels of remote controls.

(c) Lack of lubricant or wrong lubricant used, causing backup of sticking varnish and sludge deposits on splines of shaft and gears.

(d) Badly worn or bent shift rods.

(e) Improper adjustment on shifter linkage.

(f) Sliding clutch gears tight on splines of shaft.

(g) Clutch teeth burred over, chipped or badly mutilated because of improper shifting.

(h) Binding or interference of shift lever with other objects or rods inside the cab or near the remote control island.

(i) Driver not familiar with proper shifting procedure for the transmission. Also includes proper shifting if used with 2-speed axle, auxiliary, etc.

(j) Clutch or drive gear pilot bearing seized, rough, or dragging.

(k) Clutch brake engaging too soon when clutch pedal is depressed.

(l) Wrong lubricant, especially if E.P. type lubricant is added.

(m) Free running gears, seized or galled on either the thrust face or diameters.

(n) Worn or elongated shift rod poppet holes.

(o) Timing error on countershaft gears.

Sticking in Gear

(a) Clutch not releasing. Also check remote units such as hydraulic or air assist, etc. Note: On some units employing a full air control for clutch release, air pressure of approximately 60 lbs. or more must be secured before clutch can be released. Do not leave these vehicles parked in gear.

(b) Sliding clutch gears tight on splines.

(c) Chips wedged between or under splines of shaft and gear.

(d) Improper adjustment, excessive wear or lost motion in shifter linkage.

(e) Clutch brake set too high on clutch pedal, locking gears behind hopping guard

Bearing Failures

The service life of most transmissions, either main or auxiliaries, is governed by the life of the bearings. The majority of bearing failures can be attributed to vibration and dirt. Some of the more prominent reasons for unit removal with bearing failures are:

(a) Worn out because of excess dirt.

(b) Fatigue of raceways or balls.

(c) Wrong type or grade of lubricant.

(d) Lack of lubricant.

(e) Vibrations - breakup of retainer & brinelling of races, fretting corrosion.

(f) Bearings tied up because of chips in bearings.

(g) Bearings set-up too tight or loose.

(h) Improper assembly – brinelling bearing.

(i) Improper fit of shafts or bore.

(j) Acid etch of bearings because of water in lube.

(k) Overloading of vehicle. Overload from engine or engine too large for transmission.

Dirt

More than 90 percent of all bearing failures are caused by dirt which is always abrasive.

Dirt may enter the bearings during assembly of the units or be carried into the bearing by the lubricant while in service. Dirt may also enter through seals, breather, or even dirty containers used for addition or change of lubricant.

Softer materials such as dirt, dust, etc., usually form an abrasive paste or lapping compound within the bearings themselves, since the unit pressure between the balls and raceways make a perfect pulverizer. The rolling motion tends to entrap and hold the abrasives. As the balls and raceways wear, the bearings become noisy. The lapping action tends to increase rapidly as the fine steel from the balls and rollway adds to the lapping material.

Hard coarse material such as chips, etc., may enter the bearings during assembly from hammers, drifts, power chisels, etc., or be manufactured within the unit during service from raking teeth, etc. These chips produce small indentation in balls and races. Jamming of these hard particles between balls and races may cause the inner face to turn on the shaft, or the outer race to turn in the housing.

Fatigue

All bearings are subject to fatigue and must be replaced eventually. Your own operating experience will dictate mileage replacement of bearings showing only normal wear.

Corrosion

Water, acid and corrosive materials formed by deterioration of lubricant, will produce a reddish-brown coating and small etched holes over outer and exposed surfaces of the race. Corrosive oxides also act as a lapping agent.

Brinelling is caused by improper assembly or removal - usually hammering with off-center blows. Use drivers, preferably under an arbor press, or pullers for this type of work.

Shaft Fits

Excessive looseness under load is very objectionable because it produces a creeping or slipping of the inner ring on the rotating shaft. This causes the surface metal of the shafts to scrub or wear off.

Bearing fits on rotating shafts are usually specified as tight. When play or looseness, even .001 ", exists between the bearing and the shaft, there is a very powerful force which rotates the inner race on the shaft. This force is caused by the looseness or lost motion between the parts and disappears when no looseness exists.

Removal of Bearings

It is far more difficult to remove bearings from a shaft than to put them on. In most cases it is necessary to remove the bearing by pulling on the outer-race which can damage the balls or races. Since such damage is seldom visible, it does not become known until after complete reassembly. It is good preventative maintenance to replace most ball bearings during the overhaul period. If a bearing is not going to be replaced, avoid removal during low mileage rebuilds.

Interchangeability

All ball bearings (whether manufactured here or abroad) are interchangeable in regard to: standard dimensions, tolerances, and fits. However, for a given shaft size there are standard bearings for light, medium, and heavy-duty service.

Numbers and symbols stamped on inner and outer races of bearings designate size and type.

Numbering systems of different bearing manufacturers, however, have not been standardized. Consult interchangeable tables and use proper bearings for replacement parts.

Clutch Troubleshooting

Faulty clutch operation interferes with proper shifting of gears in any transmission. For complete information on Spicer Heavy Duty Clutches, refer to Bulletins No. 1308 and 1319. If a clutch other than a Spicer is used with this transmission, refer to the manufacturer's service manual for correct adjustment, maintenance, etc. The two following paragraphs describe the most common problems encountered with Spicer clutches.

(a) If the clutch slips or does not engage properly, first check the internal clutch adjustment. If adjustment does not remedy the situation, check for weak pressure springs, no free pedal, or worn or oily clutch facings and binding release mechanism.

(b) If the clutch drags or does not release properly, check the internal clutch adjustment. Some other causes for clutch drag are: intermediate plate sticking on drive pins or drive lugs; pressure plate not retracting; driven disc distored or warped; splines worn on main drive gear of transmission; clutch release bearing damaged, or bushing in release sleeve dragging on transmission drive gear.

NOTE

See "Transmission Installation" section of clutch manual for information on making the internal clutch adjustment to Spicer Heavy Duty Clutches.