Eaton Fuller FS-4205B Transmission service manual

This is the Pro Gear's Eaton Fuller FS-4205B Transmission service manual to assist you servicing your Eaton / Fuller transmission unit.

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Service Manual

Fuller Mid-Range Transmissions TRSM0130

October 2007

FS-4005A
FS-4005B
FS-4005C
FS-4205A
FS-4205B
FS-4205C
FS-5005A
FS-5005B
FS-5005C

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⚠ WARNING

Before starting a vehicle always be seated in the drivers seat, place the transmission in neutral, set the parking brakes and disengage the clutch.

Before working on a vehicle place the transmission in neutral, set the parking brakes and block the wheels.

Before towing the vehicle place the transmission in neutral, and lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

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FOREWORD

This manual is designed to provide detailed information necessary to service and repair the Eaton® Fuller® Transmission listed on the cover.

As outlined in the Table of Contents, the manual is divided into 3 main sections:

a. Technical information and reference
b. Removal, disassembly, reassembly, and installation
c. Options

The format of the manual is designed to be followed in its entirety if complete disassembly and reassembly of the transmission is necessary. But if only one component of the transmission needs to be repaired, see the Table of Contents for the page numbers showing that component. For example, if you need to work on the Shifting Controls, you will find instructions for removal, disassembly, and reassembly on page 15. Instructions for installation are on page 58. Service Manuals, Illustrated Parts Lists, Drivers Instructions, and other forms of product service information for these and other Eaton Fuller Transmissions are available upon request. A Product Literature Order Form, Service Bulletins (detailing information on product improvements), repair procedures, and other service-related subjects can be obtained by writing to the following address:

EATON CORPORATION
TRANSMISSION DIVISION
Technical Service Department
P.O. Box 4013
Kalamazoo, Michigan 49003
(616) 342-3344

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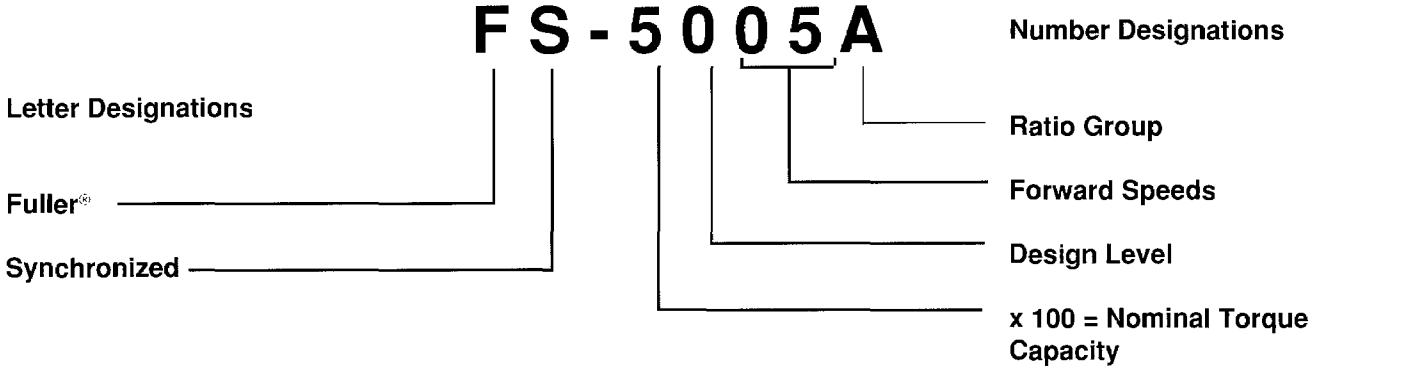
MODEL DESIGNATIONS AND SPECIFICATIONS

Nomenclature:



IMPORTANT: All Eaton Fuller Transmissions are identified by the model and serial number. This information is stamped on the transmission identification tag and affixed to the case.

DO NOT REMOVE OR DESTROY THE TRANSMISSION IDENTIFICATION TAG.

Specifications:

Model	No. Speeds	Gear Ratios						Relative Speed PTO Gear to Input R.P.M.		Note 1 Length in. (mm)	Note 2 Weight Lbs. (Kg.)	Note 3 Oil Capacity Pints (Liters)
		1 st	2 nd	3 rd	4 th	5 th	Reverse	Right	Left			
FS-5005A	5	7.52	2.54	2.54	1.52	1.00	6.27	.460	.435	21.9 (556.0)	280 (127.0)	10.5 (5.0)
FS-5005B	5	6.82	2.15	2.15	1.28	1.00	5.30	.543	.515	21.9 (556.0)	280 (127.0)	10.5 (5.0)
FS-5005C	5	6.82	1.99	1.99	1.17	1.00	5.30	.543	.515	21.9 (556.0)	280 (127.0)	10.5 (5.0)

1. Lengths measured from clutch housing face to speedo gear rear.

2. Weights include shift bar housing, clutch housing, less tower assembly, and clutch release parts. For more information on available clutch housings, see the transmission's Illustrated Parts List or the Super Parts Book. All weights are approximate.

3. Oil capacities are approximate, depending on inclination of engine and transmission. Always fill transmission, with proper grade and type of lubricant, to level of filler opening. See LUBRICATION.

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LUBRICATION

Proper Lubrication. . . the Key to long transmission life

Proper lubrication procedures are the key to a good all-around maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life.

Eaton Fuller Transmissions are designed so that the internal parts operate in an oil circulating bath by the motion of the gears and shafts.

Thus, all parts are amply lubricated if these procedures are closely followed:

1. **Maintain oil level. Inspect regularly.**
2. **Change oil regularly.**
3. **Use the correct grade and type of oil.**
4. **Buy from a reputable dealer.**

Lubrication Change and Inspection

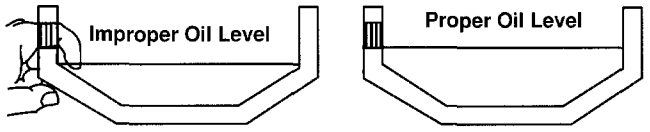
Eaton® Roadranger® CD50 Transmission Fluid	
HIGHWAY USE	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill initial drain.
Every 10,000 miles (16090 Km)	Check fluid level. Check for leaks.
Every 250,000 miles (402336 Km)	Change transmission fluid.
OFF-HIGHWAY USE	
First 30 hours	Factory fill initial drain.
Every 40 hours	Inspect fluid level. Check for leaks.
Every 500 hours	Change transmission fluid where severe dirt conditions exist.
Every 1,000 hours	Change transmission fluid (Normal off-highway use.)
Heavy Duty Engine Lubricant or Mineral Gear Lubricant	
HIGHWAY USE	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill initial.
Every 10,000 miles (16090 Km)	Inspect lubricant level. Check for leaks.
Every 50,000 miles (80450)	Change transmission lubricant.
OFF-HIGHWAY USE	
First 30 hours	Change transmission lubricant on new units.
Every 40 hours	Inspect lubricant level. Check for leaks.
Every 500 hours	Change transmission lubricant where severe dirt conditions exist.
Every 1,000 hours	Change transmission lubricant (Normal off-highway use.)

Recommended Lubricants		
Type	Grade (SAE)	Fahrenheit (Celsius) Ambient Temperature
Eaton® Roadranger® CD50 Transmission Fluid	**50**	**All**
Heavy Duty Engine Oil MIL-L-2104B, C or D or API-SF or API-CD (Previous API designations acceptable)	50 40 30	**Above** 10° F (-12°C) **Above** 10°F (-12°C) **Below** 10°F (-12°C)
Mineral Gear Oil with rust and oxidation inhibitor API-GL-1	90 80W	**Above** 10°F (-12°C) **Below** 10°F (-12°C)

The use of mild EP gear oil or multi-purpose gear oil is not recommended, but if these gear oils are used, be sure to adhere to the following limitations.

Do not use mild EP gear oil or multi-purpose gear oil when operating temperatures are above 230° F (110° C). Many of these gear oils, particularly 85W140, break down above 230° F and coat seals, bearings, and gears with deposits that can cause premature failures. If these deposits are observed (especially a coating on seal areas causing oil leakage), change to Eaton Roadranger CD50 transmission fluid, heavy duty engine oil, or mineral gear oil to assure maximum component life and to maintain your warranty with Eaton. (Also see "Operating Temperatures".)

Additives and friction modifiers are not recommended for use in Eaton Fuller Transmissions.



Proper Oil Level

Make sure oil is level with the filler opening. Because you can reach oil with your finger does not mean oil is at proper level. **(One inch of oil level is about one gallon of oil.)**

Draining Oil

Drain transmission while oil is warm. To drain oil remove the drain plug at case bottom. Clean the drain plug before re-installing.

Refilling

Clean case around filler plug and remove plug from case side. Fill the transmission to the level of the filler opening. If the transmission has two filler openings, fill to the level of both openings.

The exact amount of oil depends on the transmission inclination and model. Do not over fill—this causes oil to be forced out of the case through the front bearing cover. **When adding oil, types and brands of oil should not be mixed because of possible incompatibility.**

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LUBRICATION

Operating Temperatures —With Eaton Roadranger CD50 Transmission Fluid Heavy Duty Engine Oil and Mineral Oil

The transmission should not be operated consistently at temperatures above 250° F (120° C). However, intermittent operating temperatures to 300° F (149° C) do not harm the transmission. Operating temperatures above 250° F increase the lubricant's oxidation rate and shorten its effective life. When the average operating temperature is above 250° F, the transmission can require more frequent oil changes or external cooling.

The following conditions in any combination can cause operating temperatures of over 250° F: (1)operating consistently at slow speeds, (2) high ambient temperatures, (3) restricted air flow around transmission, (4) exhaust system too close to transmission, (5) high horsepower, overdrive operation.

External oil coolers are available to reduce operating temperatures when the above conditions are encountered.

Transmission Oil Coolers are:

Recommended

—With engines of 350 H.P. and above with overdrive transmissions

Required

—With engines 399 H.P. and above with over drive transmissions and GCW's over 90,000 lbs.

—With engines 399 H.P. and above and 1400 lbs-ft or greater torque

—With engines 450 H.P. and above

With EP or Multipurpose Gear Oil

Mild EP gear oil and multipurpose gear oil are not recommended when lubricant operating temperatures are above 230° F (110° C). In addition, transmission oil coolers are not recommended with these gear oils since the oil cooler materials can be attacked by these gear oils. **The lower temperature limit and oil cooler restriction with these gear oils generally limit their success to milder applications.**

Proper Lubrication Levels as Related to Transmission Operating Angles

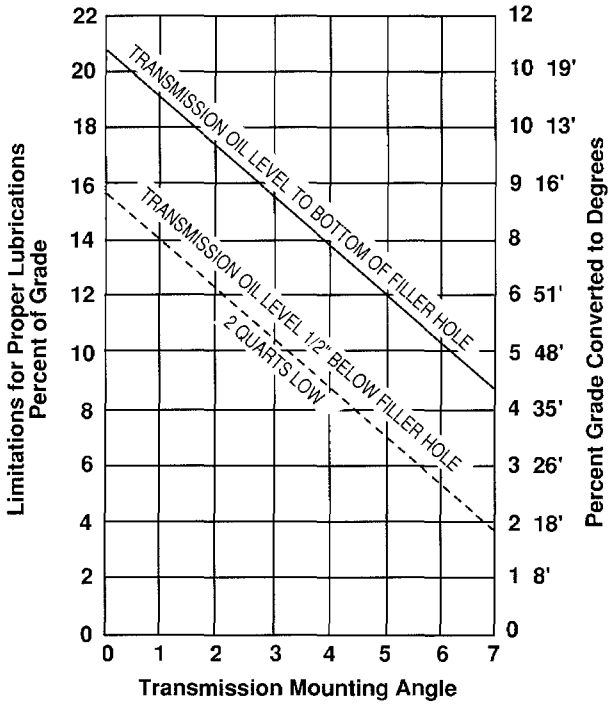
If the transmission operating angle is more than 12 degrees, improper lubrication can occur. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees).

The chart below illustrates the safe percent of upgrade on which the transmission can be used with various chassis mounting angles. For example: if you have a 4 degree transmission mounting angle, then 8 degrees (or 14 percent of grade) is equal to the limit of 12 degrees. If you have a 0 degree mounting angle, the transmission can be operated on a 12 degree (21 percent) grade.

Anytime the transmission operating angle or 12 degrees is exceeded for an extended period of time the transmission should be equpped with an oil pump or cooler kit to insure proper lubrication.

Note on the chart the effect low oil levels can have on safe operating angles. Allowing the oil level to fall 1/2" below the filler plug hole reduces the degree of grade by approximately 3 degrees (5.5 percent).

Proper Lubrication Levels are Essential!



Dotted line showing "2 Quarts Low" is for reference only. Not recommended

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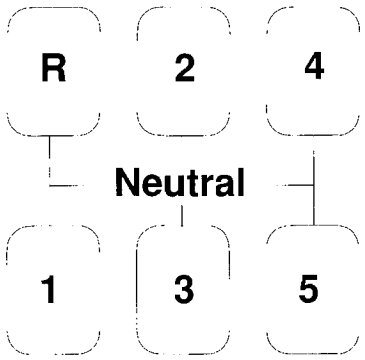
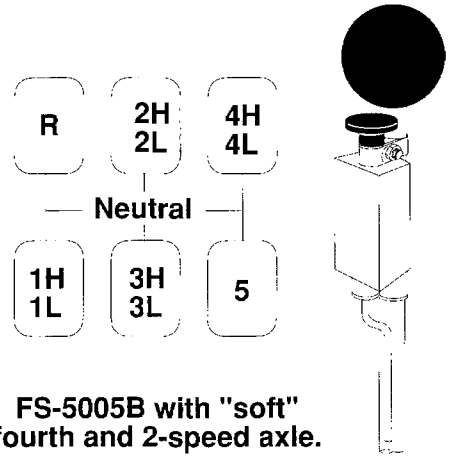
OPERATION

Gear Shift Lever Pattern and Shifting Instructions

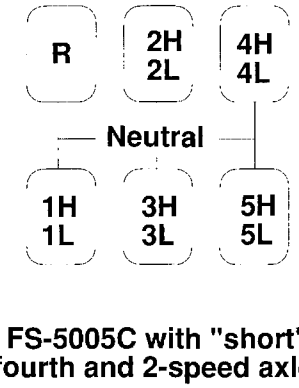
Follow the simple 5-speed shift pattern. . .

Simple progressive shift pattern





FS-5005B with "soft" fourth and 2-speed axle.



FS-5005C with "short" fourth and 2-speed axle.

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General Information

FS-5005 transmissions have five forward speeds and one reverse, and are shifted as you would shift any synchronized manual transmission, following the simple 5-speed shift pattern.

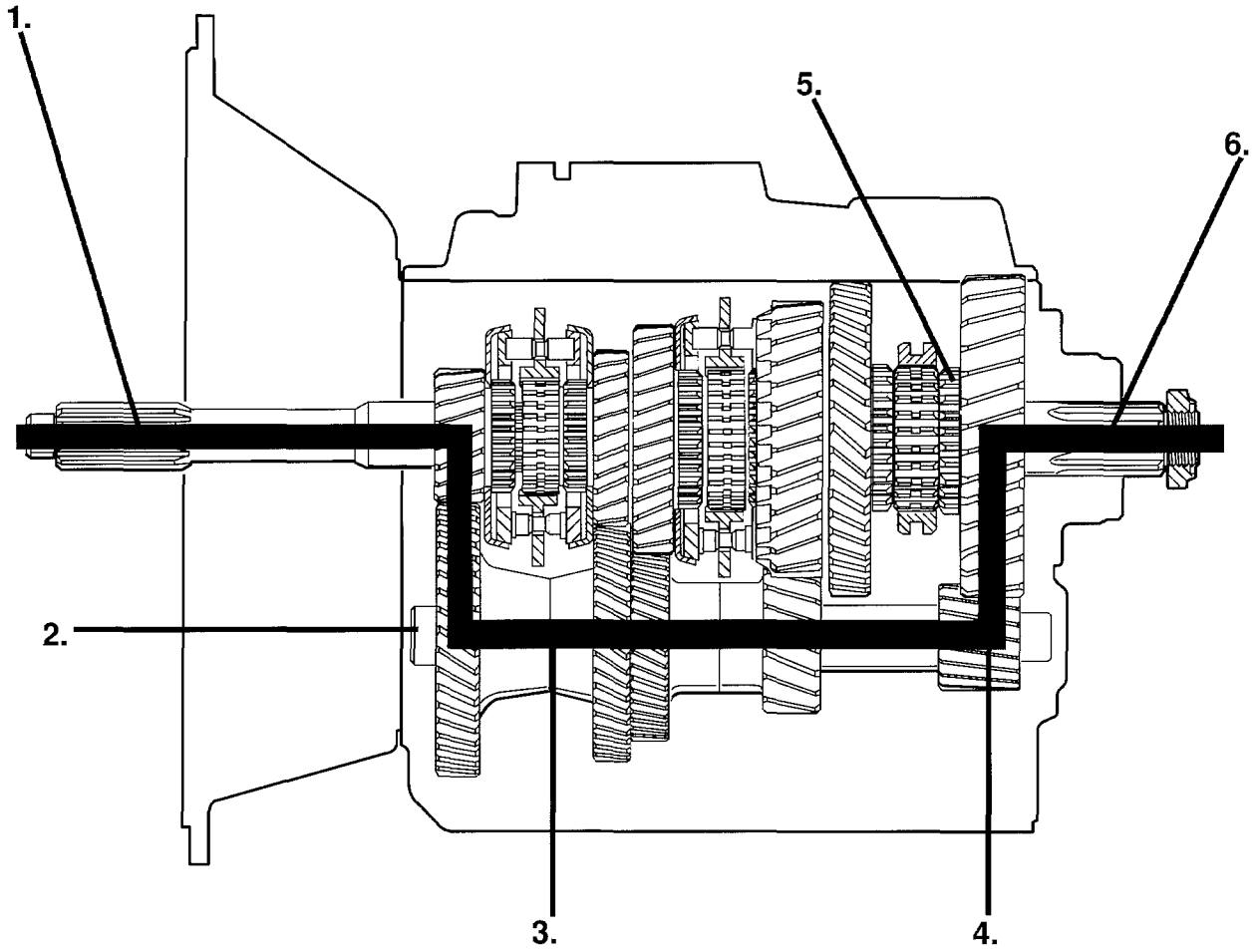
Driving Tips

- Always use the clutch when making upshifts or downshifts. Premature synchronizer failure can result from not using the clutch.
- Always select a starting gear that provides sufficient reduction for the load and terrian.
- Never downshift at road speed too high.
- Never slam or jerk the shift lever to complete gear engagement.
- Never coast with the transmission in neutral and the clutch dis-engaged.

POWER FLOW

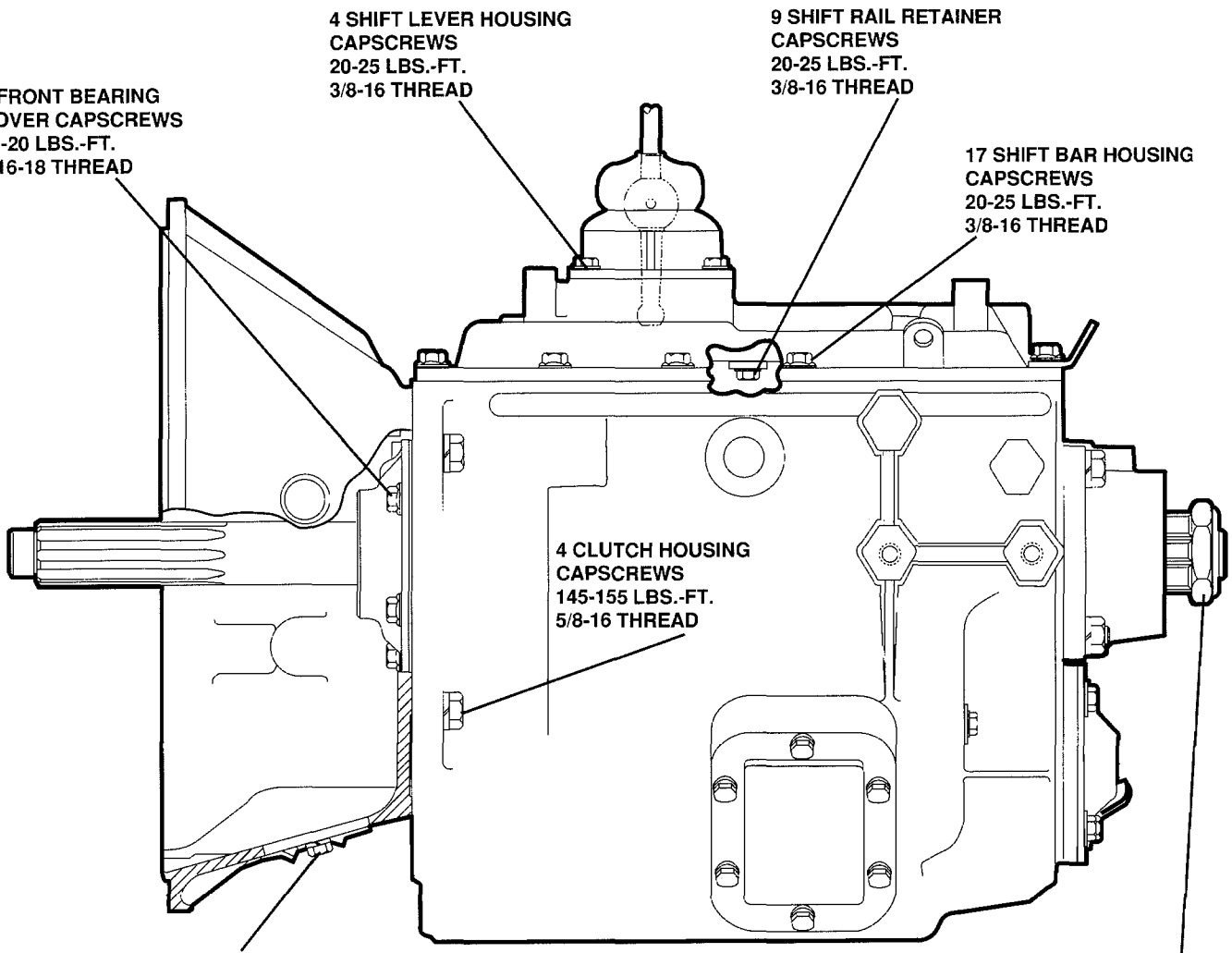
The transmission must efficiently transfer the engine's power, in terms of torque, to the vehicle's rear wheels. Knowledge of what takes place in the transmission during torque transfer is essential when troubleshooting and making repairs.

1. Power (torque) from the engine is transferred to the input shaft and drive gear.
2. Torque is transferred to the countershaft drive gear.
3. Torque is delivered along the countershaft to all countershaft gears.
4. Torque is transferred to "engaged" mainshaft gear. The cross section illustrates 1st speed gear position.
5. Engaged mainshaft gear internal clutching teeth transfers torque to mainshaft through synchronizer assembly.
6. Mainshaft transfers torque directly to driveshaft through rear yoke.



TORQUE RECOMMENDATIONS

Correct torque application is important to assure long transmission life. Over or under tightening of fasteners can result in a loose installation and, in many instances, can eventually cause damage to the transmission. Use a torque wrench to obtain recommended torque ratings. Do not torque capscrews dry.



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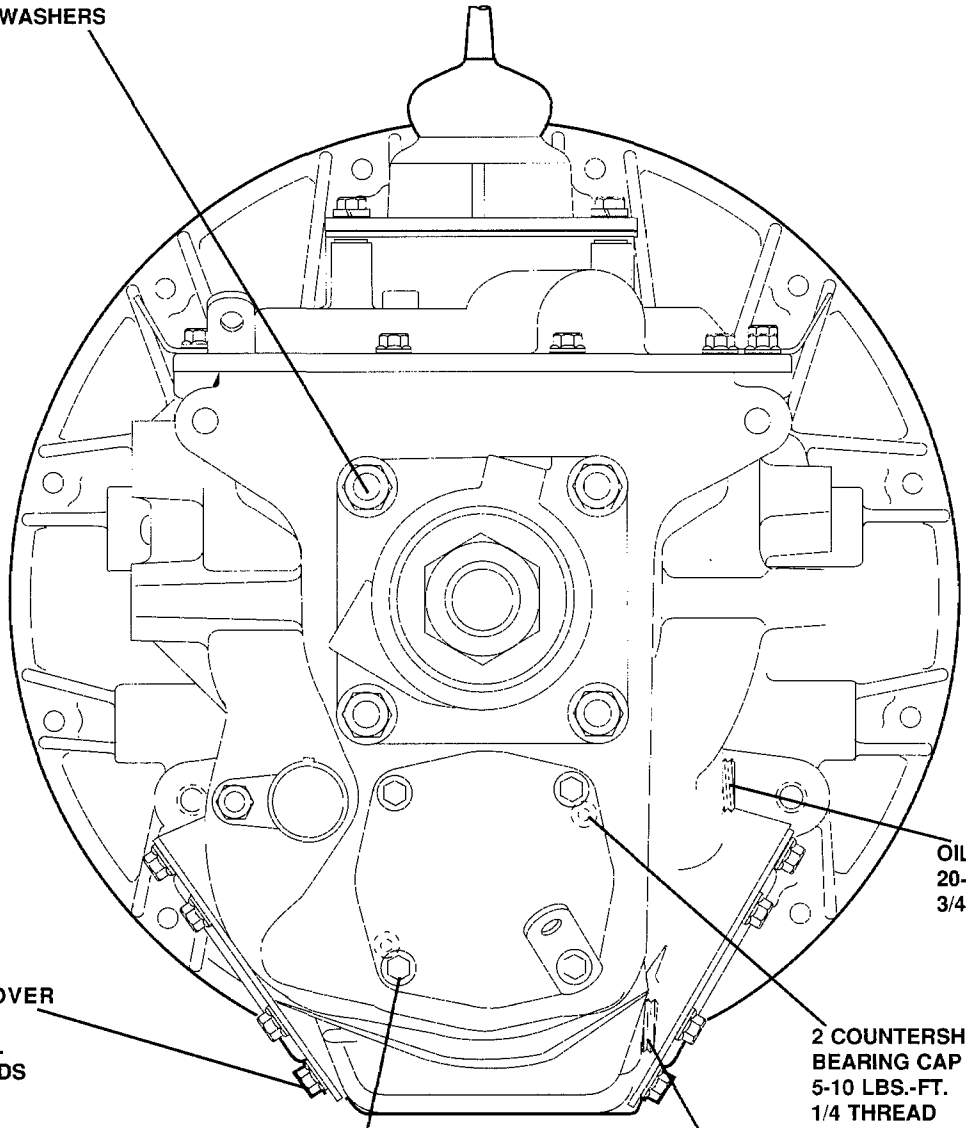
TORQUE RECOMMENDATIONS



NOTE: APPLY LOCTITE #262 TO THREADS OF ALL CAPSCREWS BEFORE INSTALLING.

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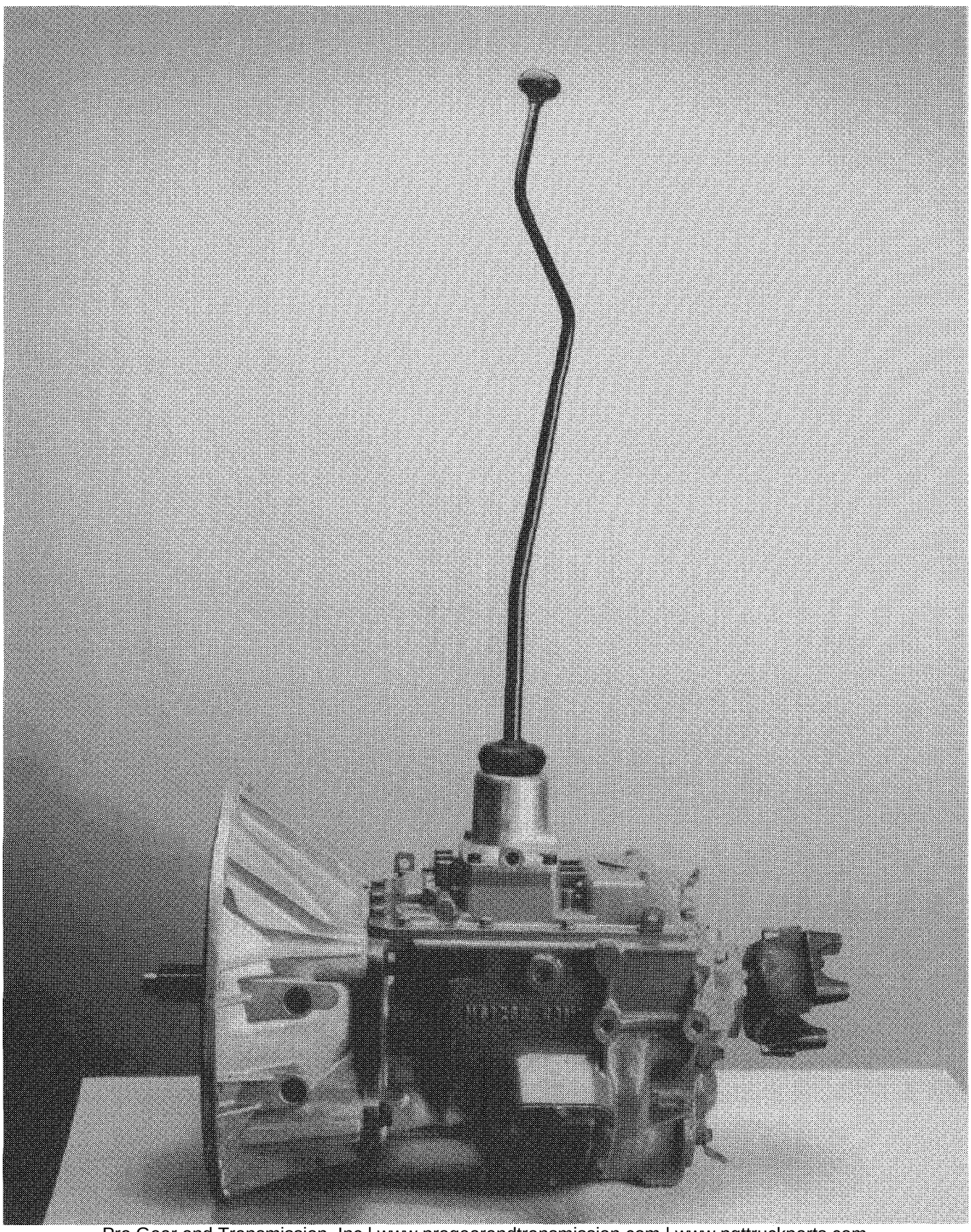
PREVENTIVE MAINTENANCE



PREVENTIVE MAINTENANCE

Preventive Maintenance Check Chart

CHECKS WITHOUT PARTIAL DISASSEMBLY OF CHASSIS OR CAB

1. Clutch Housing Mounting
- a. Check all capscrews of clutch housing flange for looseness.

2. Clutch Release Bearing (Not Shown)
- a. Remove hand hole cover and check radial and axial clearance in release bearing.
- b. Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.

3. Clutch Pedal Shaft and Bores
- a. Pry upward on shafts to check wear.
- b. If excessive movement is found, remove clutch release mechanism and check bushings in bores and wear on shafts.

4. Lubricant
- a. Change at specified service intervals.
- b. Use only the types and grades as recommended. See LUBRICATION.

5. Filler and Drain Plugs
- a. Remove filler plug and check level of lubricant at specified intervals. Tighten filler and drain plugs securely.

6. Capscrews and Gaskets
- a. Check all capscrews, especially those on PTO covers, front and rear bearing covers for looseness which can cause oil leakage. See TORQUE RECOMMENDATIONS.
- b. Check PTO opening and rear bearing covers for oil leakage.

7. Gear Shift Lever
- a. Check for looseness and free play in housing. If lever is loose in housing, proceed with Check No. 8.

8. Gear Shift Lever Housing Assembly
- a. Remove the gear shift lever housing assembly from transmission.
- b. Check tension spring and washer for set and wear.
- c. Check gear shift lever bottom end for wear of slots. Also check finger assembly for wear.

CHECKS WITH DRIVE LINE DROPPED

9. Universal Joint Companion Flange or Yoke Nut
- a. Check for tightness. Tighten to recommended torque rating.

10. Output Shaft (Not Shown)
- a. Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

CHECKS WITH UNIVERSAL JOINT COMPANION FLANGE OR YOKE REMOVED

NOTE: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. **DO NOT USE CROCUS CLOTH, EMERY PAPER, OR OTHER ABRASIVE MATERIALS THAT WILL MAR SURFACE FINISH.**

11. Splines on Output Shaft (Not Shown)
- a. Check for wear from movement and chucking action of the universal joint companion flange or yoke.

12. Mainshaft Rear Bearing Cover
- a. Check oil seal for wear.

PRECAUTIONS

Disassembly

It is assumed in the detailed assembly instructions that the lubricant has been drained from the transmission, the necessary linkage disconnected and the transmission has been removed from vehicle chassis. Removal of the gear shift lever housing assembly is included in the detailed instructions (Disassembly and Reassembly—Shifting Controls); however, this assembly must be detached from shift bar housing before transmission can be removed.

FOLLOW CLOSELY EACH PROCEDURE IN THE DETAILED INSTRUCTIONS, MAKING USE OF THE TEXT, ILLUSTRATIONS, AND PHOTOGRAPHS PROVIDED.

1. **BEARINGS**—Carefully wash and relubricate all reuseable bearings as removed and protectively wrapped until ready for use. Remove bearings planned to be reused with pullers designed for this purpose.

2. **ASSEMBLIES**—When disassembling the various assemblies, such as the mainshaft, countershafts, and shift bar housing, lay all parts on a clean bench in the same order as removed. This procedure simplifies reassembly and reduces the possibility of losing parts.

3. **SNAP RINGS**—Remove snap rings with pliers designed for this purpose. Snap rings removed in this manner can be reused, if they are not sprung or loose.

4. **CLEANLINESS**—Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. Dirt is an abrasive and can damage bearings. It is always good practice to clean the outside of the unit before starting the planned disassembly.

5. **WHEN USING TOOLS TO MOVE PARTS**—Always apply force to shafts, housings, etc, with restraint. Movement of some parts is restricted. Never apply force to the part being driven after it stops solidly. The use of soft hammers, bar, and mauls for all disassembly work is recommended.

Inspection

Before reassembling the transmission, check each part carefully for abnormal or excessive wear and damage to determine reuse or replacement. When replacement is necessary, use only genuine Eaton Fuller Transmission parts to assure continued performance and extended life from your unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, avoid reusing a questionable part which could lead to additional repairs and expense soon after reassembly. To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the unit's history, mileage, application, etc.

Recommended inspection procedures are provided in the following checklist.

A. BEARINGS

1. Wash all bearings in clean solvent. Check balls, rollers, and raceways for pitting, discoloration, and spalled areas. Replace bearings that are pitted, discolored, spalled, or damaged during disassembly.

2. Lubricate bearings that are not pitted, discolored, or spalled and check for axial and radial clearances.

   Replace bearings with excessive clearances.

3. Check bearing fit. Bearing inner races should be tight to shaft; outer races slightly tight to slightly loose in case bore. If bearing spins freely in bore, case should be replaced.

B. GEARS

1. Check gear teeth for frosting and pitting. Frosting of gear teeth faces present no threat of transmission failure. Often in continued operation of the unit, frosted gears "heal" and do not progress to the pitting stage. In most cases, gears with light to moderate pitted teeth have considerable gear life remaining and can be reused, but gears with advanced stage pitting should be replaced.

2. Check for gears with clutching teeth abnormally worn, tapered, or reduced in length from clashing in shifting. Replace gears found in any of these conditions.

Inspection (cont.)

3. Check axial clearance of gears. Where excessive clearance is found, check gear snap ring, split washer, clutch hub, and gear hub for excessive wear.

C. SPLINES

1. Check splines on all shafts for abnormal wear. If sliding clutch gears, companion flange, or clutch hub have worn into the sides of the splines, replace the specific shaft affected.

D. WASHERS

1. Check surfaces of all washers. Washers scored or reduced in thickness should be replaced.

E. REVERSE IDLER GEAR ASSEMBLIES

1. Check for excessive wear from action of roller bearings.

F. GRAY IRON PARTS

1. Check all gray iron parts for cracks and breaks. Replace or repair parts found to be damaged. Heavy castings may be welded or brazed provided the cracks do not extend into the bearing bores or bolting surfaces. When welding, never place the ground so current passes through the transmission.

G. CLUTCH RELEASE PARTS

1. Check clutch release parts. Replace yokes worn at cam surfaces and bearing carrier worn at contact pads.

2. Check pedal shafts. Replace those worn at bushing surfaces.

H. SHIFT BAR HOUSING ASSEMBLY

1. Check for wear on shift yokes and finger assembly at pads and lever slot. Replace excessively worn parts.

2. Check yokes for correct alignment. Replace sprung yokes.

3. Check lockscrews in yoke assembly retainer plates. Tighten those loose.

I. GEAR SHIFT LEVER HOUSING ASSEMBLY

1. Check spring tension on shift lever. Replace tension spring if lever moves too freely.

2. If housing is disassembled, check gear shift lever bottom end and shift finger assembly for wear. Replace both gears if excessively worn.

J. BEARING COVERS

1. Check covers for wear from thrust of adjacent bearing. Replace covers damaged from thrust of bearing outer race.

2. Check cover bores for wear. Replace those worn oversized.

K. OIL SEALS

1. Check oil seal in input shaft and rear bearing cover. If sealing action of lip has been destroyed, replace seal.

L. SYNCHRONIZER ASSEMBLY

1. Check synchronizer for burrs, uneven and excessive wear at contact surface, and metal particles.

2. Check blocker pins for excessive wear or looseness.

3. Check synchronizer contact surfaces on the synchronizer cups for wear.

PRECAUTIONS

Reassembly

Make sure that case interiors and housings are clean. It is important that dirt and other foreign materials are kept out of the transmission during reassembly. Dirt is an abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during reassembly.

1. **GASKETS**—Use new gaskets throughout the transmission as it is being rebuilt. Make sure all gaskets are installed. An omission of any gasket can result in oil leakage or misalignment of bearing covers.

2. **CAPSCREWS**—To prevent oil leakage and loosening, use Loctite #262 thread sealant on all capscrews. For recommended torque ratings, see TORQUE RECOMMENDATIONS.

3. **SHIMS**—Apply a light coat of Loctite 510 to both sides of shims before final installation to prevent leakage.

4. **ASSEMBLY**—See the illustrations provided in the detailed disassembly instructions as a guide to reassembly.

5. **INITIAL LUBRICATION**—Coat all thrust washers, synchronizers, and bearings with transmission lubricant during reassembly to prevent damage during initial start up.

6. **AXIAL CLEARANCES**—Maintain original axial clearances for mainshaft gears.

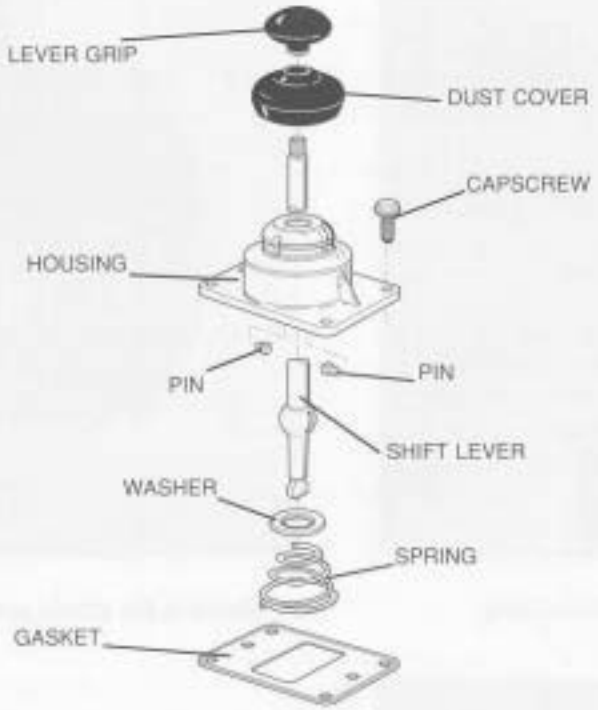
7. **BEARINGS**—Using a sleeve type driver that contacts the bearing inner race prevents damage to the rollers and cage.

8. **UNIVERSAL JOINT COMPANION FLANGE OR YOKE**—Pull the companion flange or yoke into place with the output shaft nut, using 300-350 lbs.-ft. (407-475 Nm) of torque. Make sure the speed ometer drive gear or a replacement spacer has been installed. Failure to properly torque the nut can result in damage to the mainshaft rear bearing.

IMPORTANT: SEE THE APPROPRIATE ILLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.

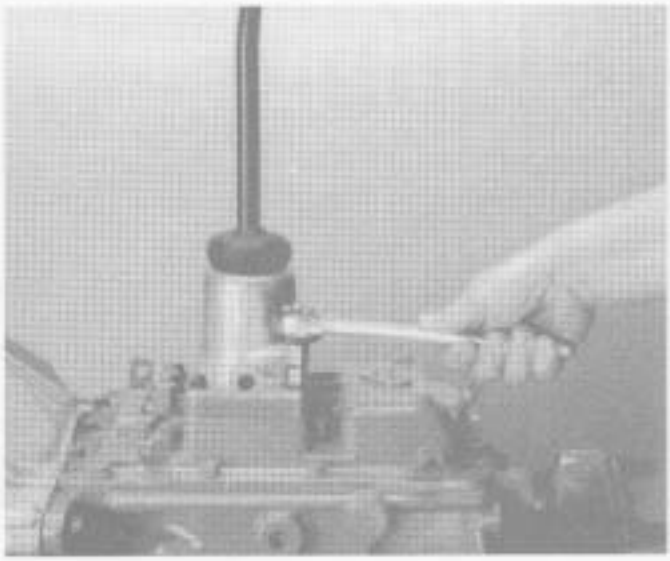
DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

Gearshift Lever Housing Assembly

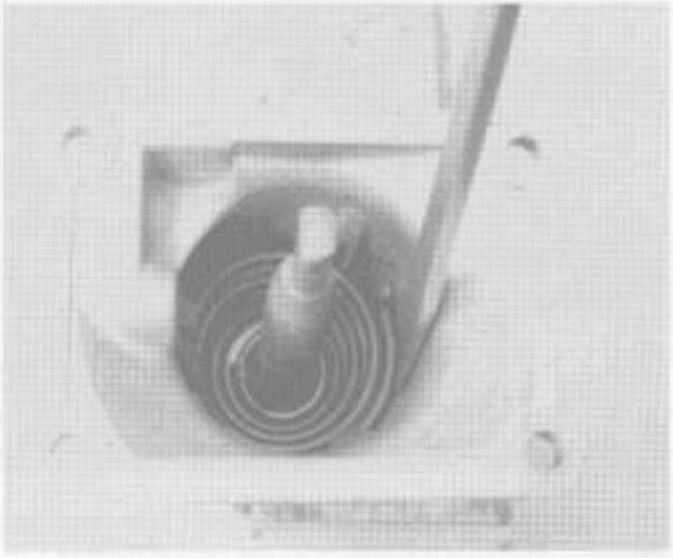


Adobe 0004-2/88

A. Removal and Disassembly of Gearshift Lever Housing



1. Turn out four capscrews and remove the tower assembly and gasket from the shift bar housing.

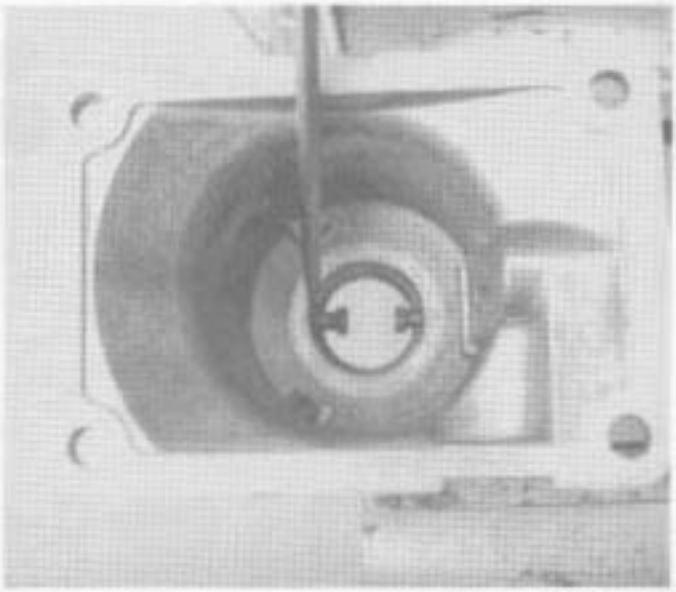


2. Remove the shift lever grip and boot from the shift lever, secure assmbly in a vise with the housing bottom up. Use a large screwdriver to twist between spring and housing, forcing the spring from under the housing lugs. Do one coil at a time.

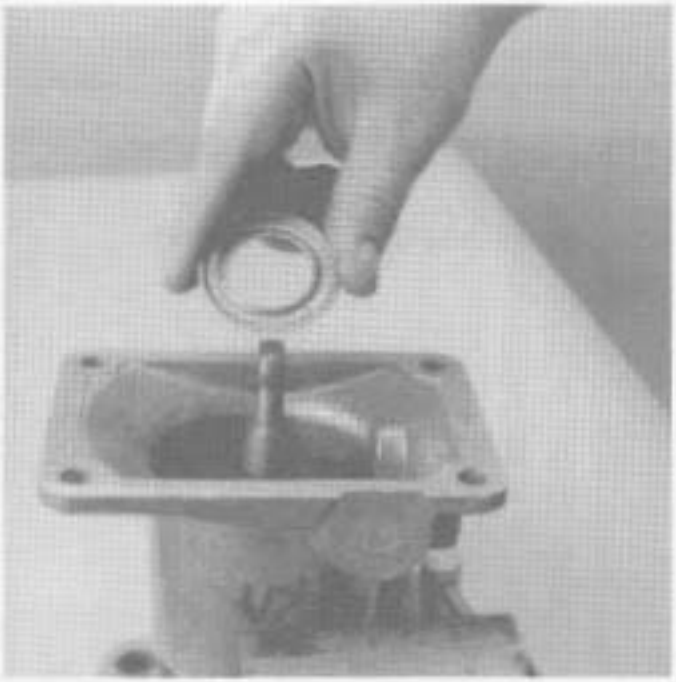
DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

Gearshift Lever Housing Assembly (cont.)

3. Remove the tension spring from the housing.

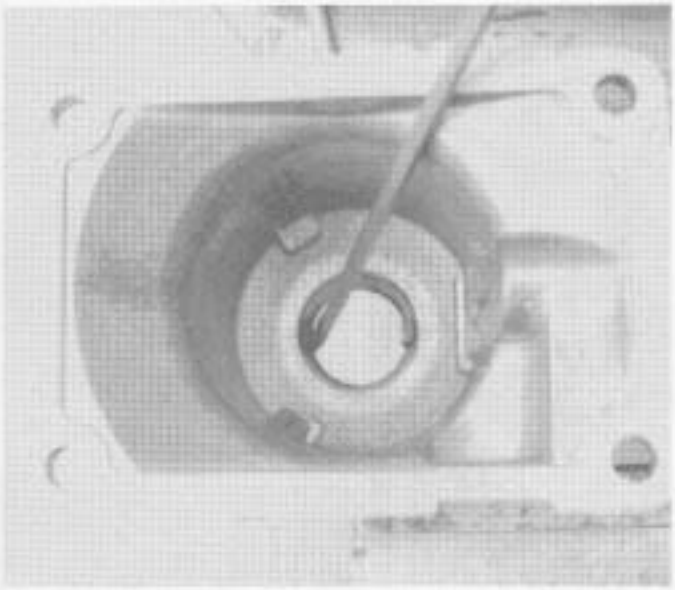


5. Remove the spade pins from housing bore.

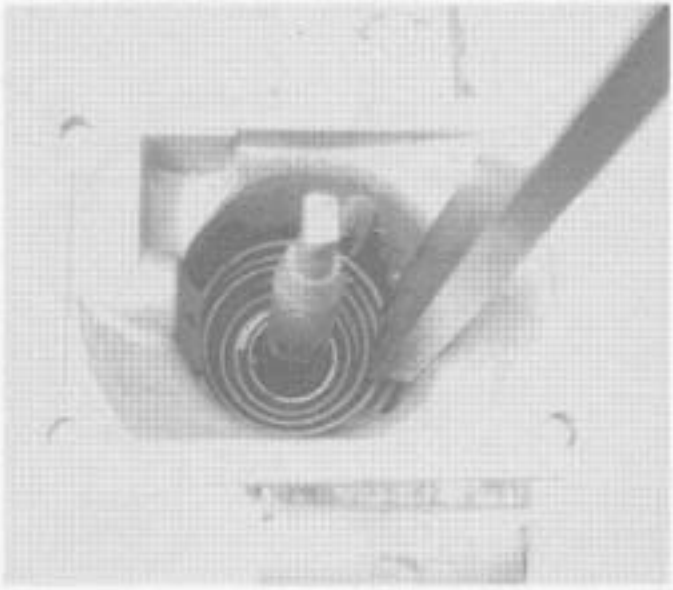


4. Remove the washer and gearshift lever from the housing. Remove the boot from the gear shift lever.

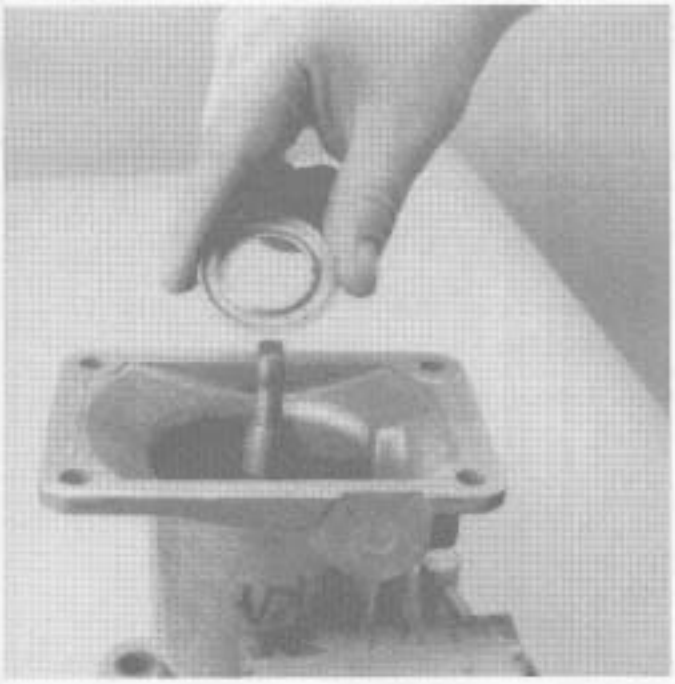
B. Reassembly of Gearshift Lever Housing Assembly



1. Secure the gearshift lever housing in a vise, install the spade pins in housing bore.



3. Use a spring driving tool to install the tension spring under the housing lugs, seating one coil at a time.

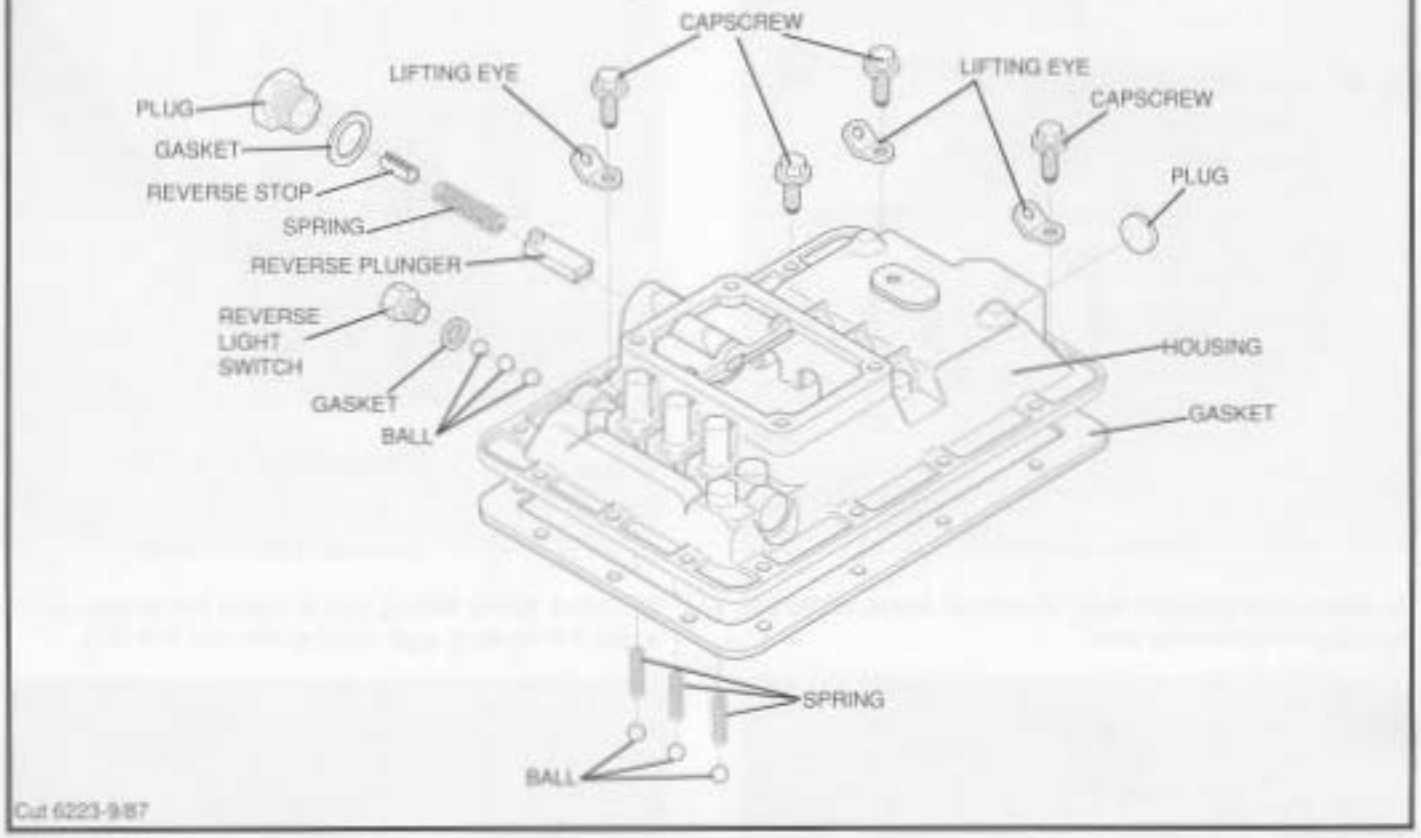


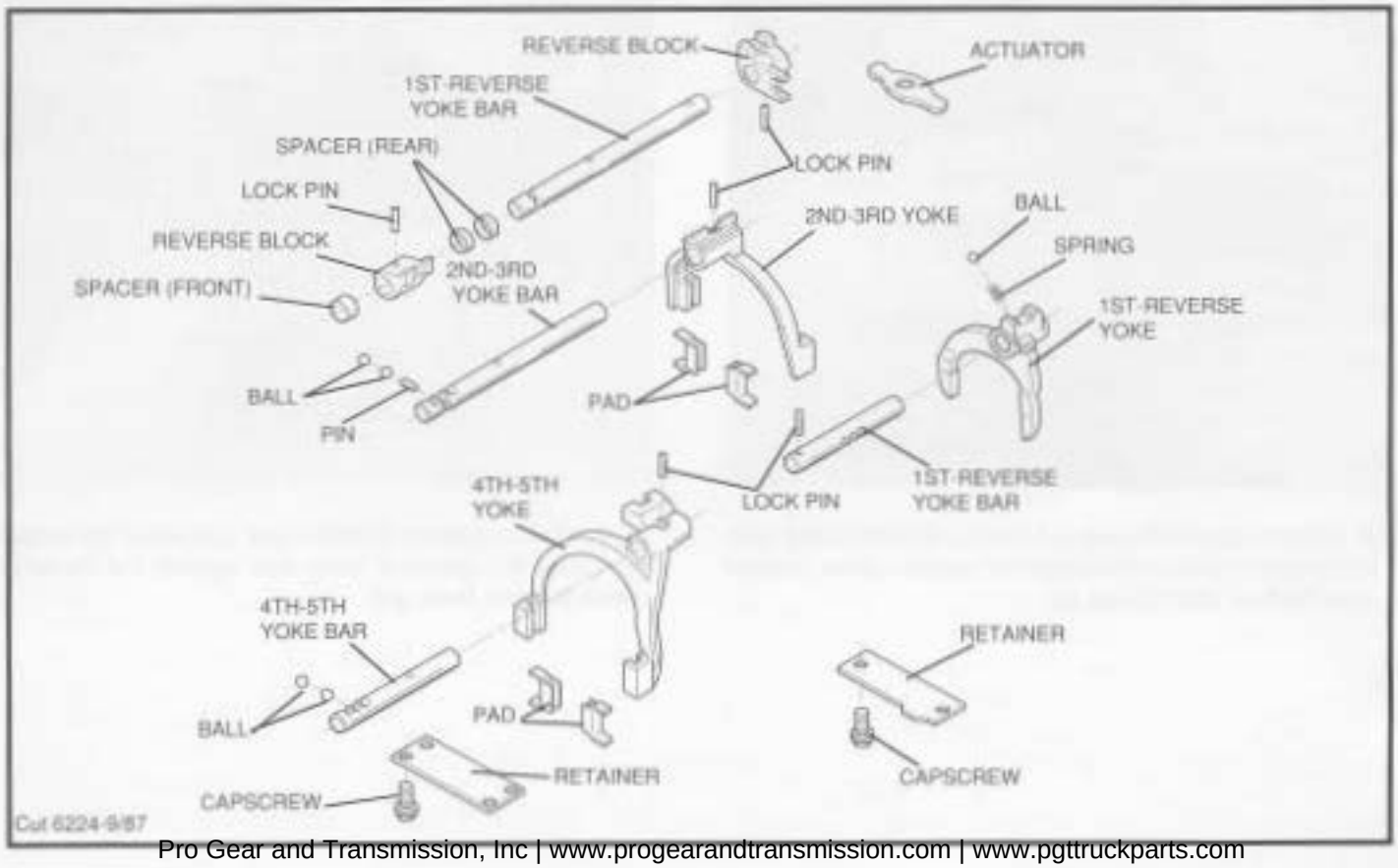
2. Position gearshift lever in housing with the spade pins in the lever ball slot and install the tension spring washer over the ball, dished side up.

4. Remove assembly from the vise and install the rubber boot over the gearshift lever and against the housing. Install the shift lever grip.

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

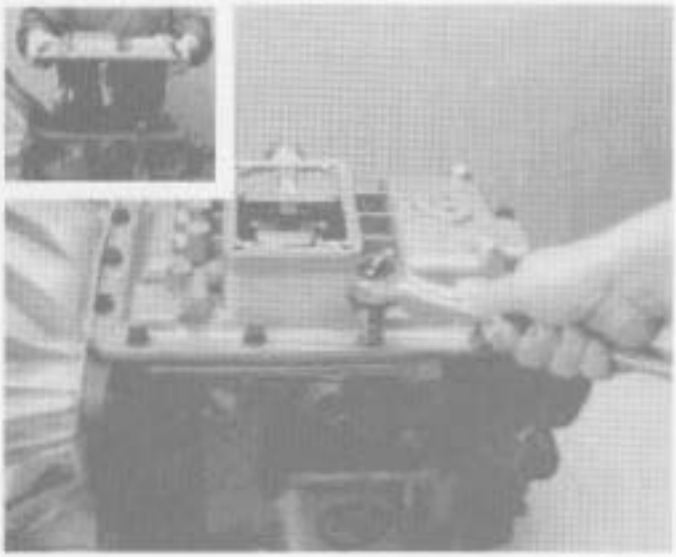
Shift Bar Housing Assembly



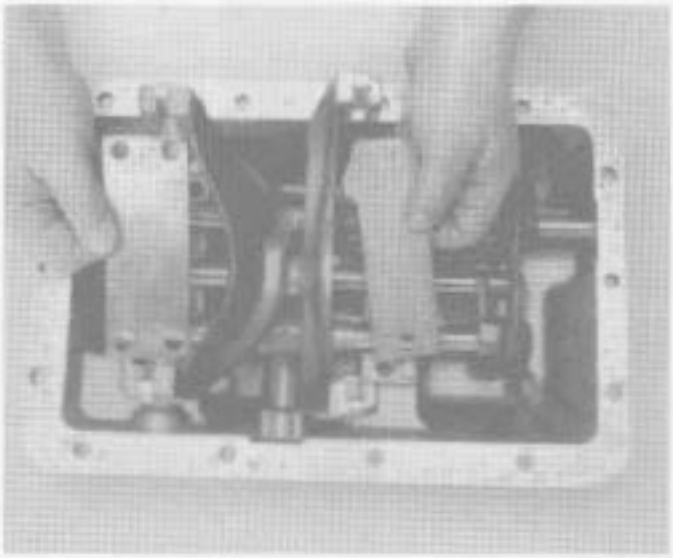


DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

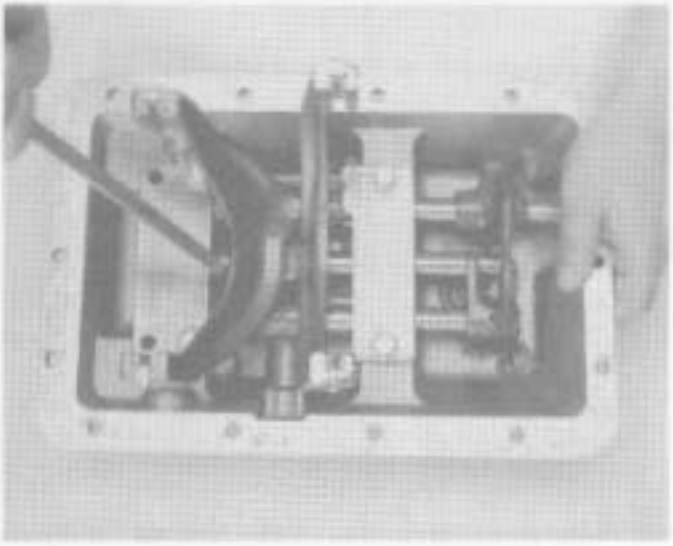
C. Removal and Disassembly of Shift Bar Housing



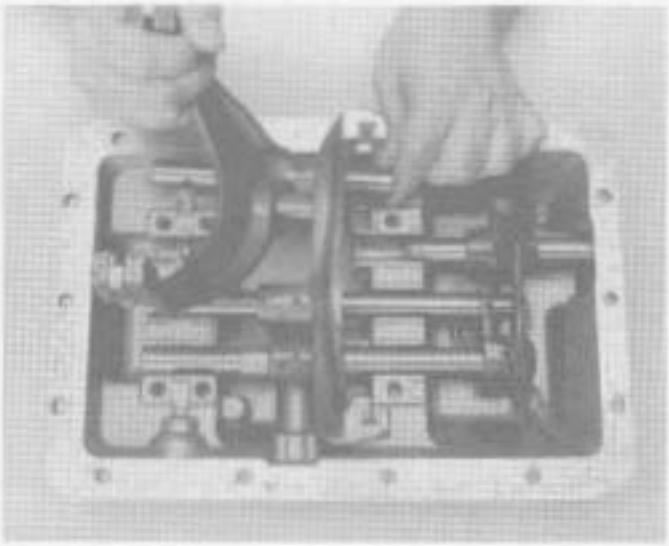
1. Shift the transmission into neutral position, remove the capscrews, and lift the shift bar housing and gasket from the case (inset).



3. Remove the rest of the capscrews and the two retainers.



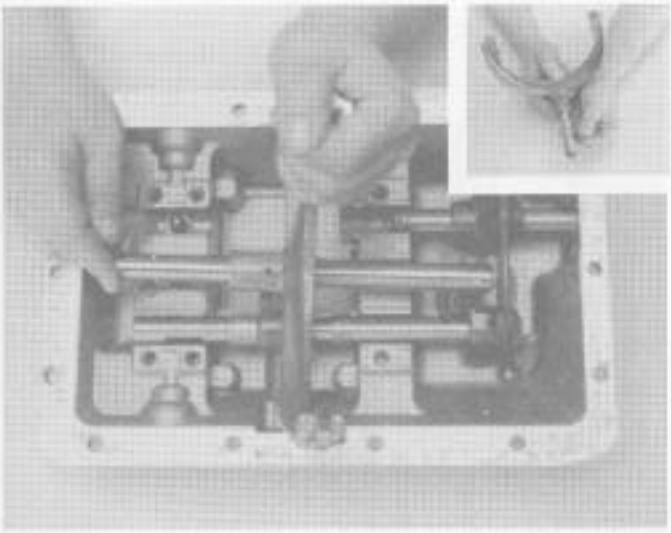
2. Lay the shift bar housing on the work bench. Remove two capscrews as shown and shift 4th-5th yoke assembly into 4th speed position with a screwdriver.



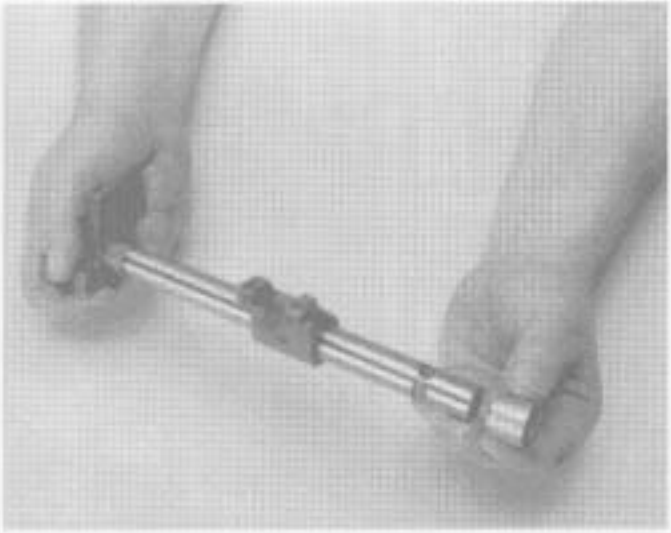
4. Remove the 4th-5th yoke assembly.

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

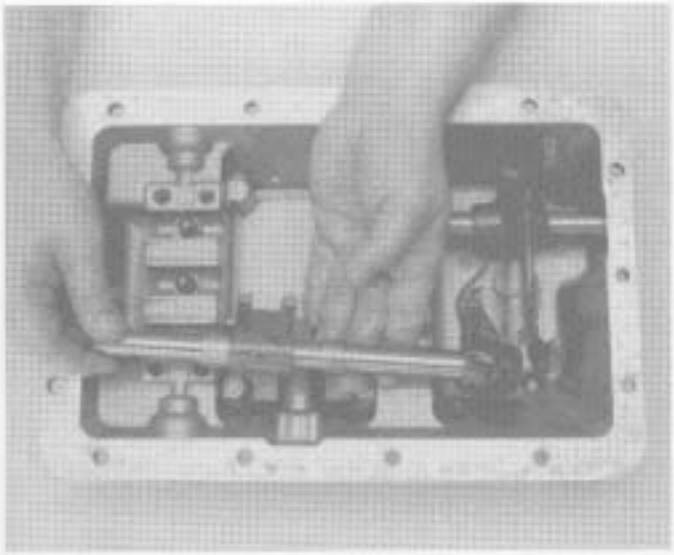
Shift Bar Housing Disassembly (cont.)



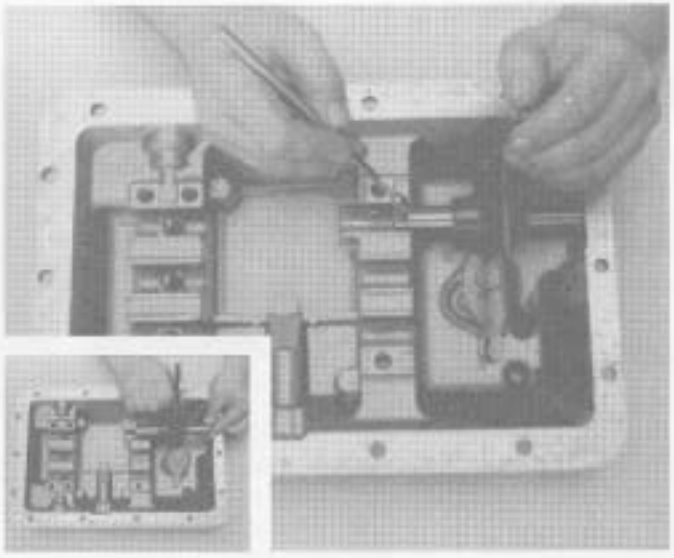
5. Remove 2nd-3rd yoke assembly and interlock pin (inset).



7. If necessary, remove the front spacer from 1st-reverse shift bar.



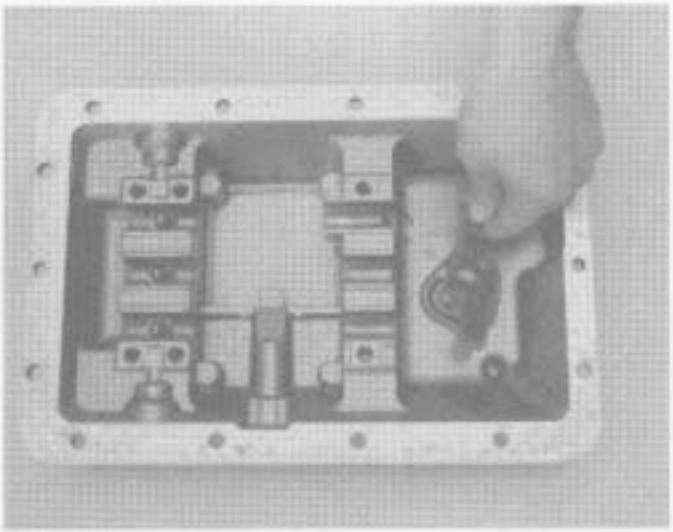
6. Remove 1st-reverse bar assembly. If necessary remove the front spacer from 1st-reverse shift bar (inset).



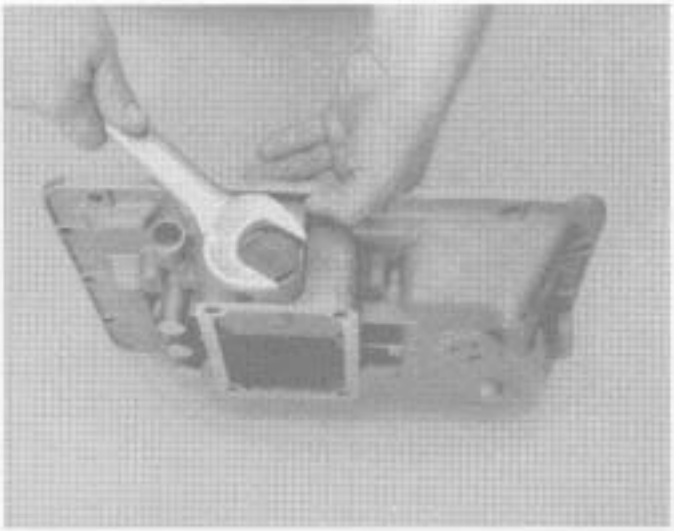
8. Remove the 1st-reverse lock pin from the 1st-reverse shift yoke assembly. Remove the 1st-reverse shift yoke (inset).

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

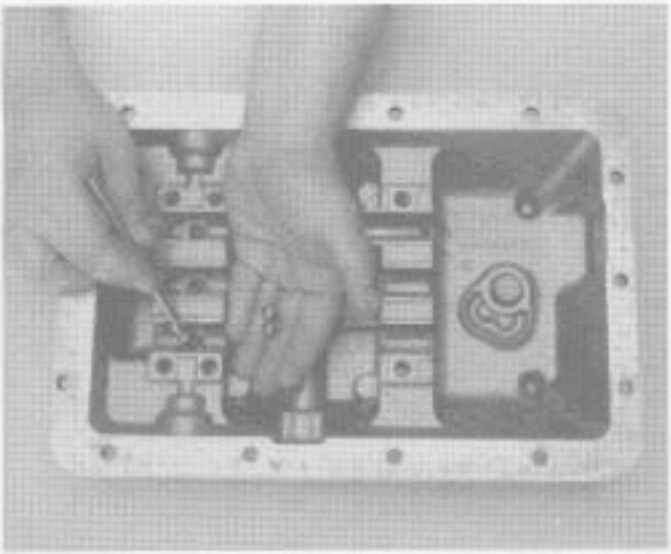
Shift Bar Housing Disassembly (cont.)



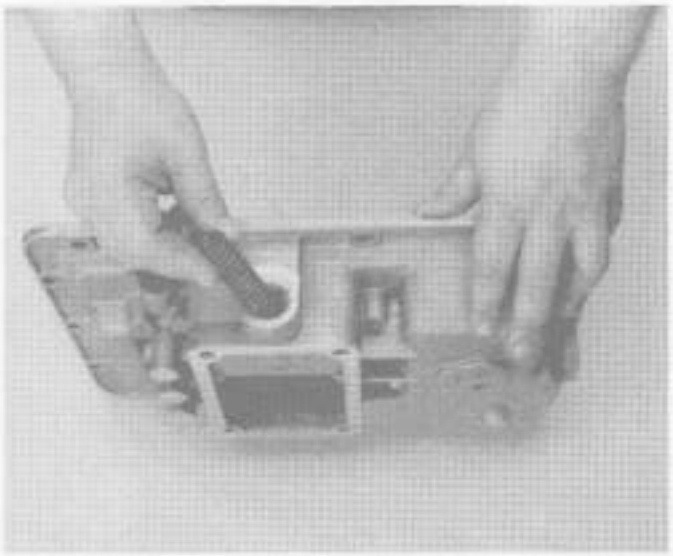
9. Remove the 1st-reverse actuator.



11. Remove the reverse plunger retaining plug and gasket from the shift bar housing.



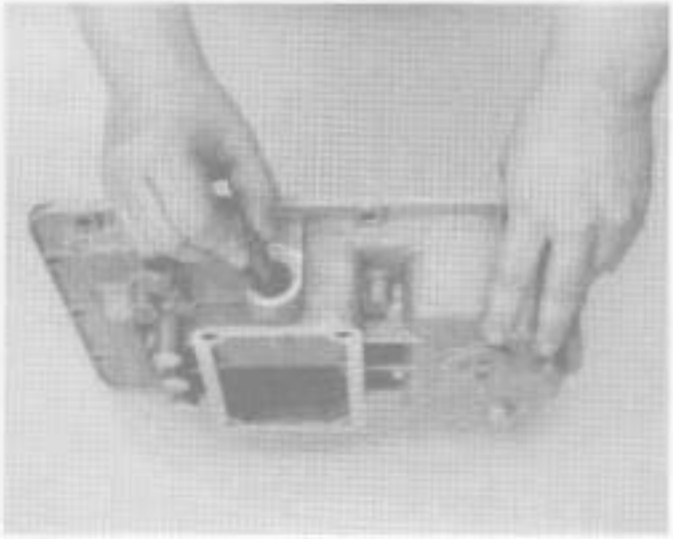
10. Remove the four interlock balls, the three detent balls, the three back up light switch balls, and the three springs from the shift bar housing.



12. Remove the reverse plunger spring.

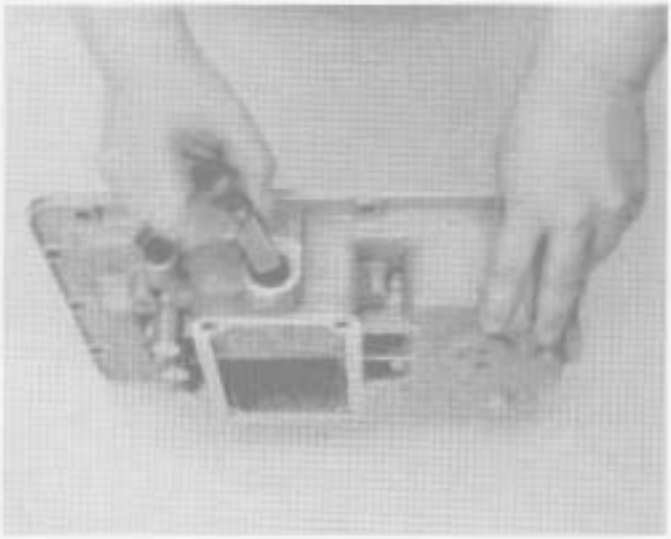
DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

Shift Bar Housing Disassembly (cont.)



13. Remove the reverse plunger stop.

15. If the yoke pads are to be replaced, remove worn pad from shift yoke, install new pad and bend tabs over top and bottom of yoke.

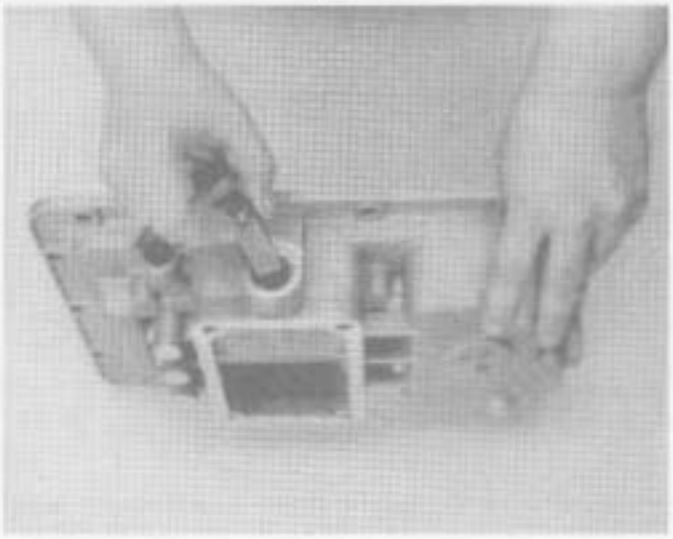


14. Remove the reverse plunger.

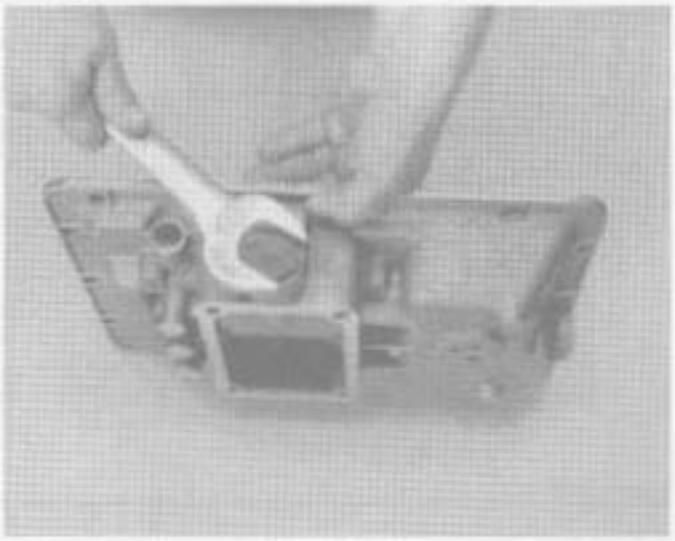
16. If necessary, shift blocks and shift yokes can be removed by driving lockpin from shift bar with a punch and hammer as shown.

DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

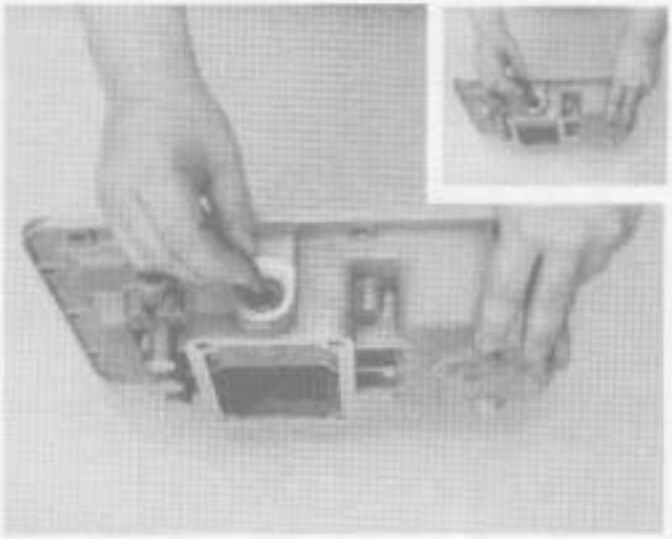
D. Reassembly of Shift Bar Housing



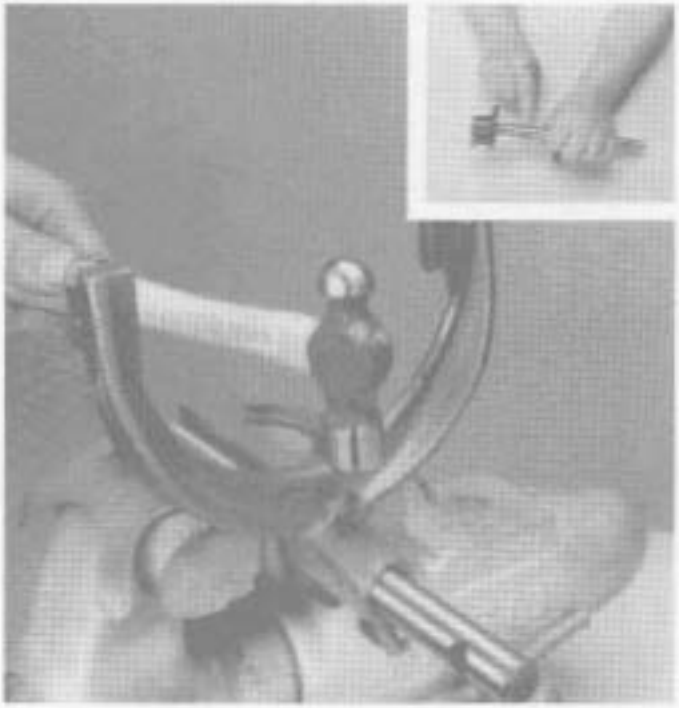
1. Place the shift bar housing on its side as shown and install the reverse plunger.



3. Install the reverse plunger gasket and plug. Tighten the reverse plunger plug to the recommended torque.



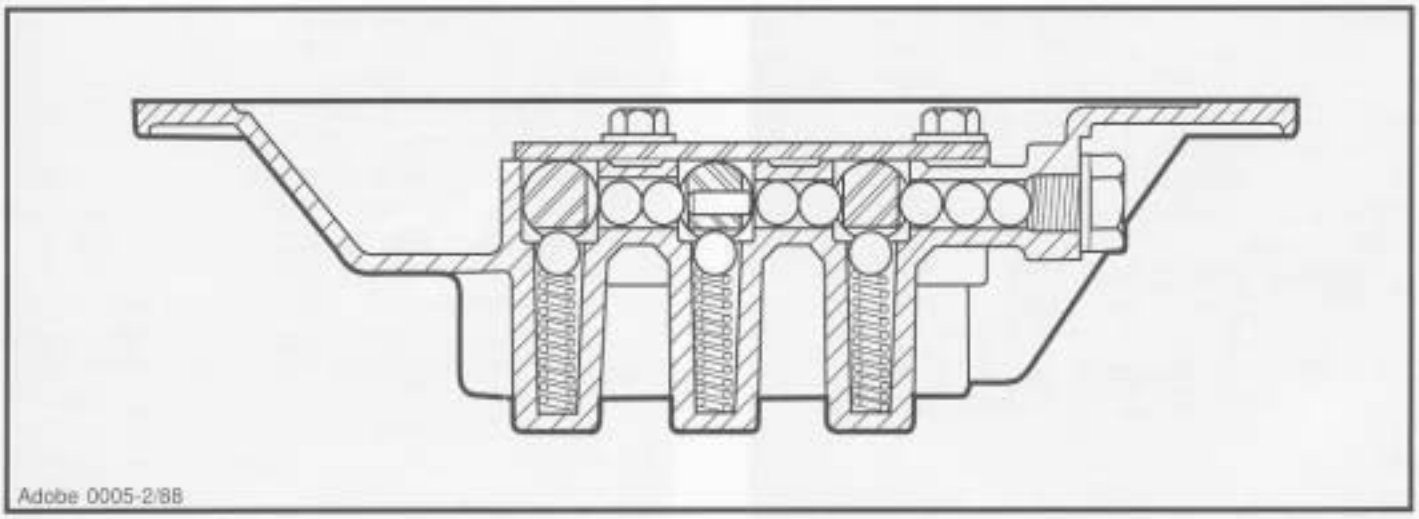
2. Install the reverse plunger spring (inset), and the reverse plunger stop.



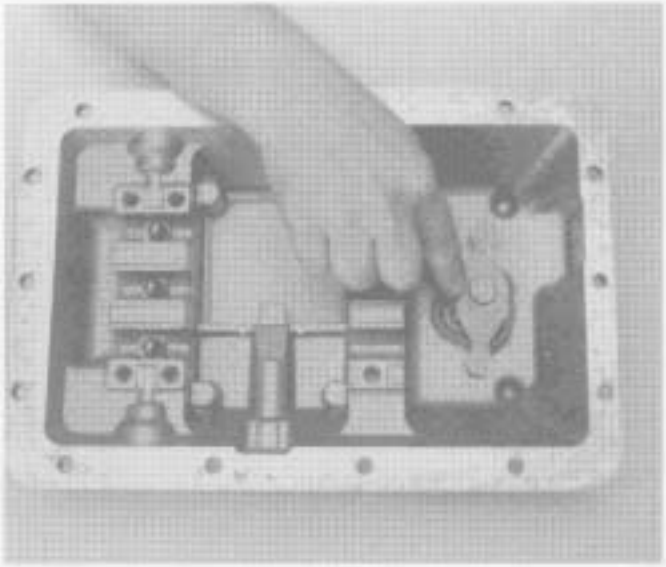
4. If shift blocks or shift yokes were removed, align shift yoke or block with alignment hole in the shift bar and insert lock pin.
NOTE: If previously removed install two spacers on 1st-reverse shift bar before installing both shift blocks (inset).

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

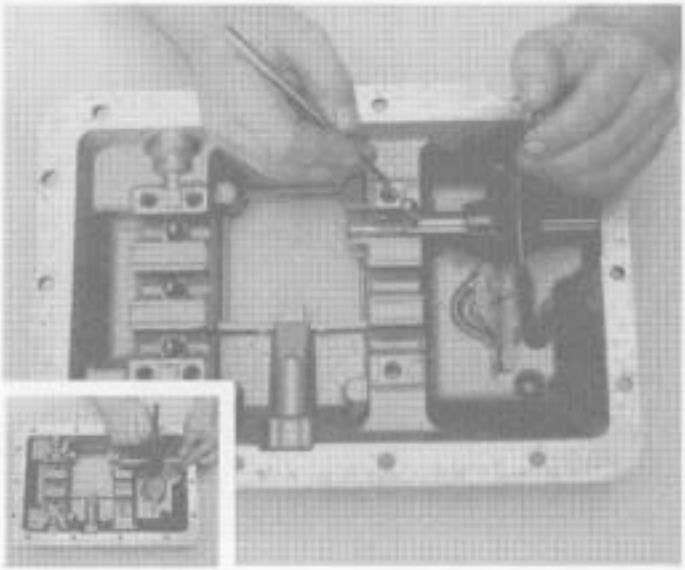
Shift Bar Housing Assembly (cont.)



5. Install interlock balls, detent balls and springs in the following sequence; position (3) balls in the reverse light switch bore and install 1st-reverse detent spring and ball. Position (2) balls in adjacent cross bore and install 2nd-3rd detent spring and ball. Position (2) balls in adjacent cross bore and install 4th-5th detent spring and ball. **NOTE:** Balls and springs can be used interchangeably.



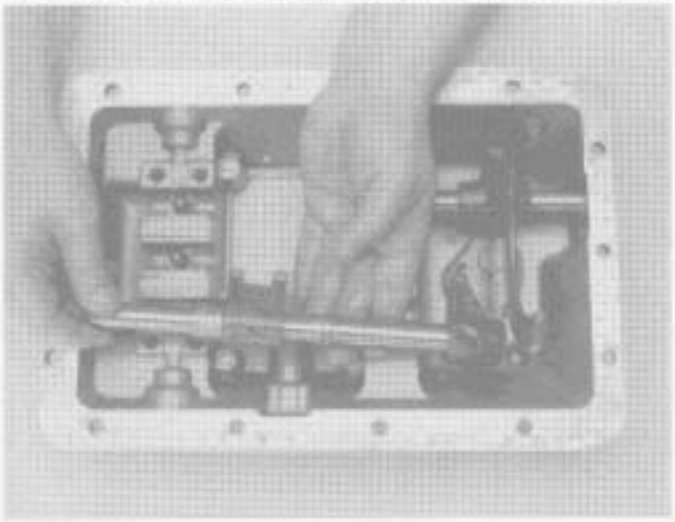
6. Seat the 1st-reverse actuator in the shift bar housing, over the actuator pivot pin, as shown.



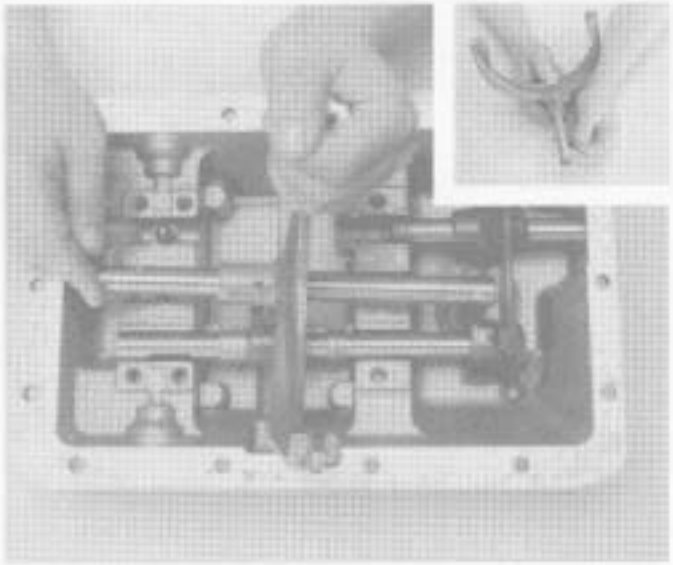
7. Position 1st-reverse yoke assembly in the shift bar housing (inset). Install the 1st-reverse lock pin in the yoke assembly.

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

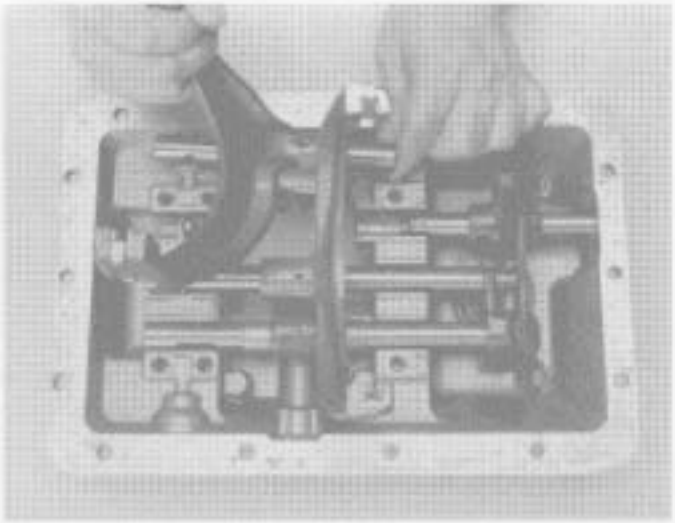
Shift Bar Housing Assembly (cont.)



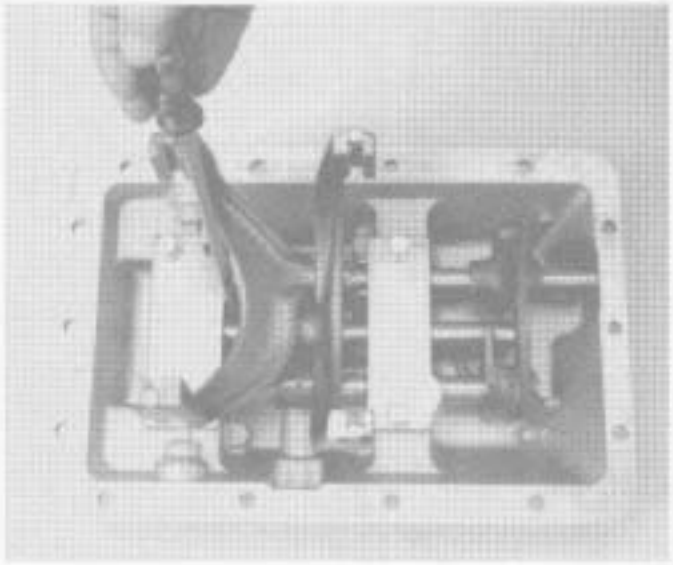
8. Position 1st-reverse bar assembly in the housing assembly as shown.
NOTE: Position spacers as shown.



9. Install the 2nd-3rd yoke assembly interlock pin (inset). Position the 2nd-3rd yoke assembly in the housing assembly as shown.

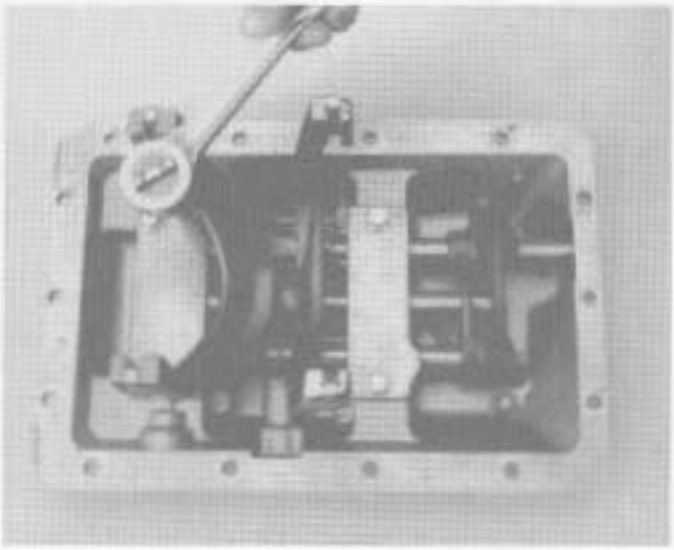


10. Position the 4th-5th yoke assembly in the housing assembly as shown.



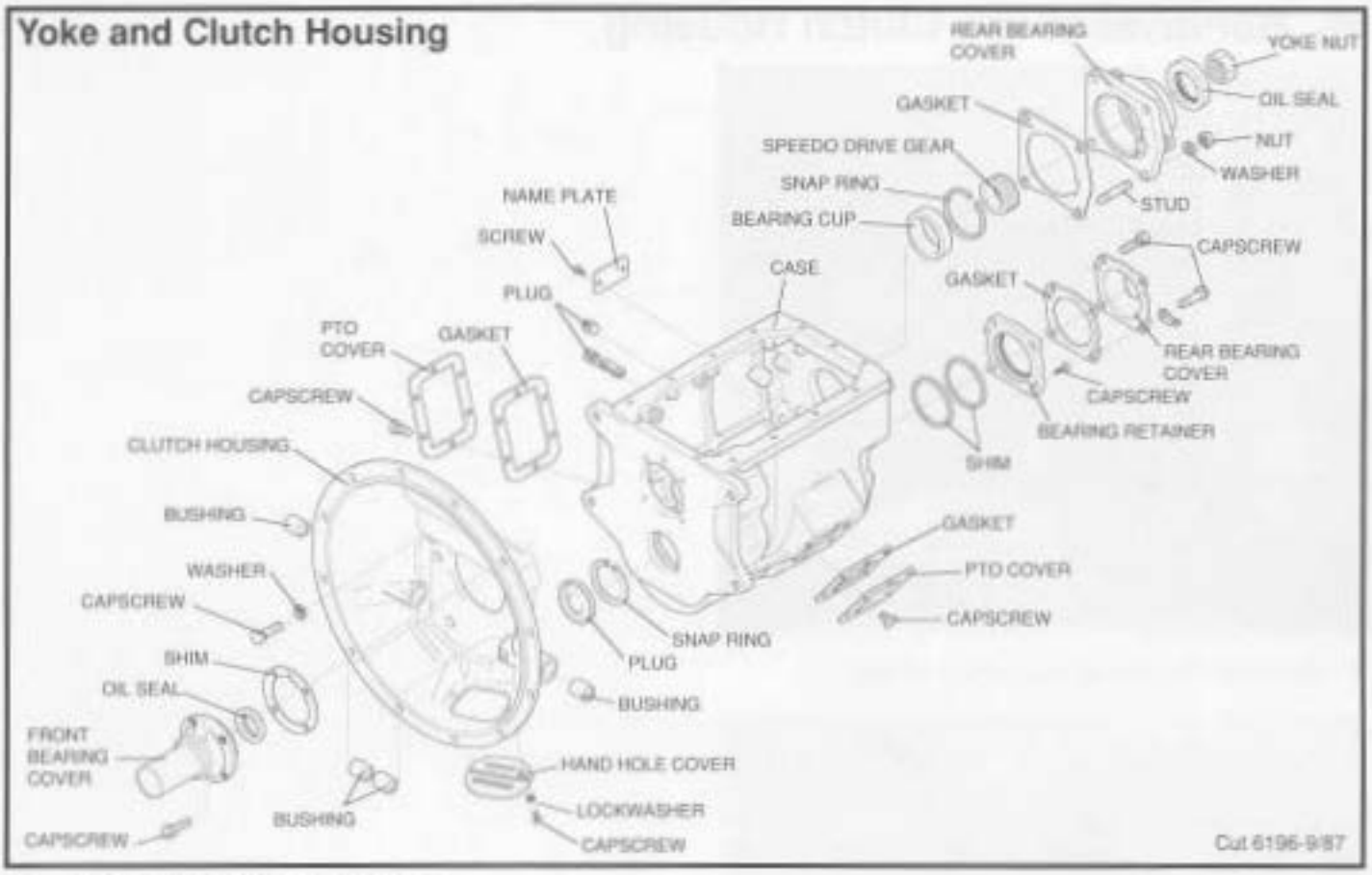
11. Place the shift yokes in neutral and install the two retainers and the four capscrews as shown. Tighten the capscrews to the recommended torque. Shift 4th-5th yoke assembly into 4th speed position.

Shift Bar Housing Assembly (cont.)

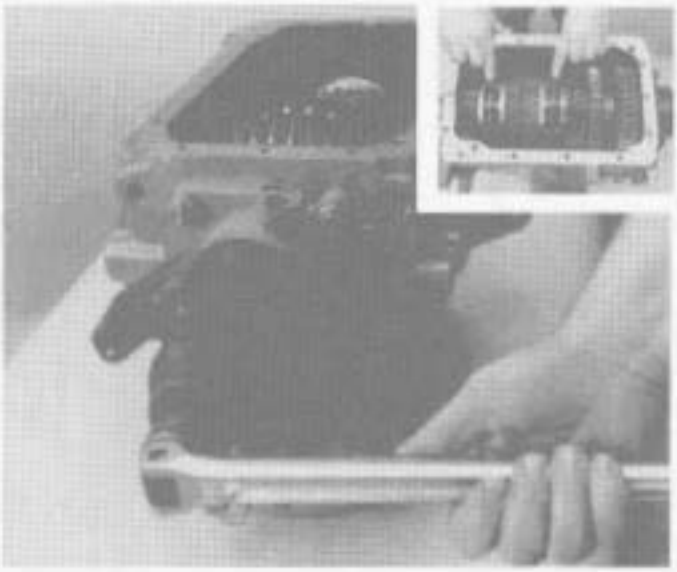


12. Install the remaining two capscrews and tighten capscrews to recommended torque.

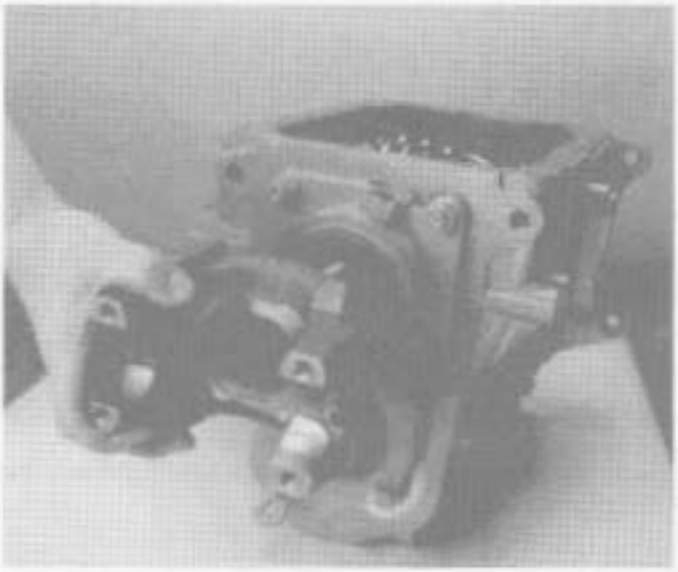
REMOVAL - YOKE AND CLUTCH HOUSING



A. Removal of Yoke



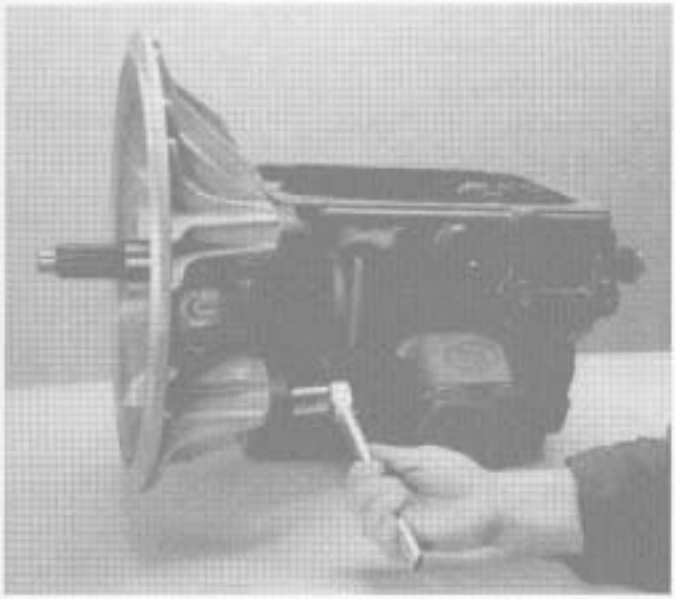
1. Lock the transmission by engaging two mainshaft gears as shown (inset). Use a large breaker bar to turn the retaining nut from the output shaft.



2. Remove the yoke from the output shaft.

REMOVAL - YOKE AND CLUTCH HOUSING

B. Removal of the Clutch Housing

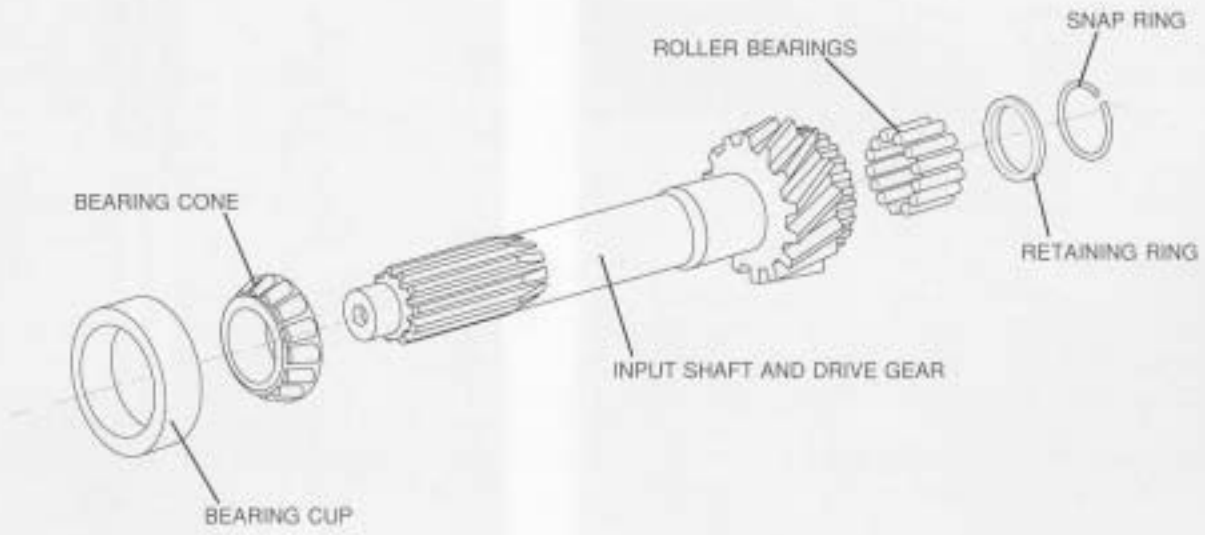


1. Remove the four retaining bolts as shown.

2. Jar clutch housing with a rubber mallet and pull from the transmission case.

DISASSEMBLY - TRANSMISSION

Input Shaft Assembly



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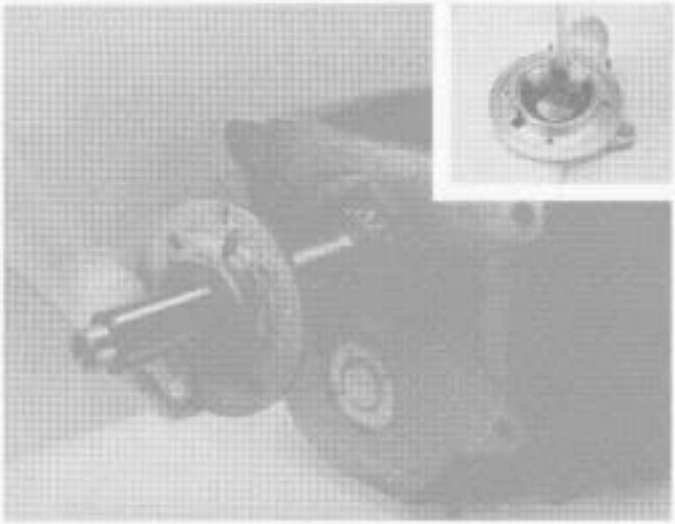
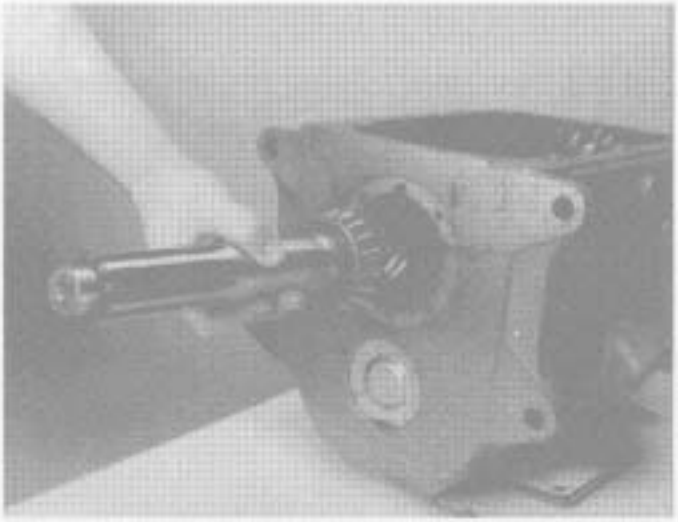
A. Removal & Disassembly of Input Shaft Assembly



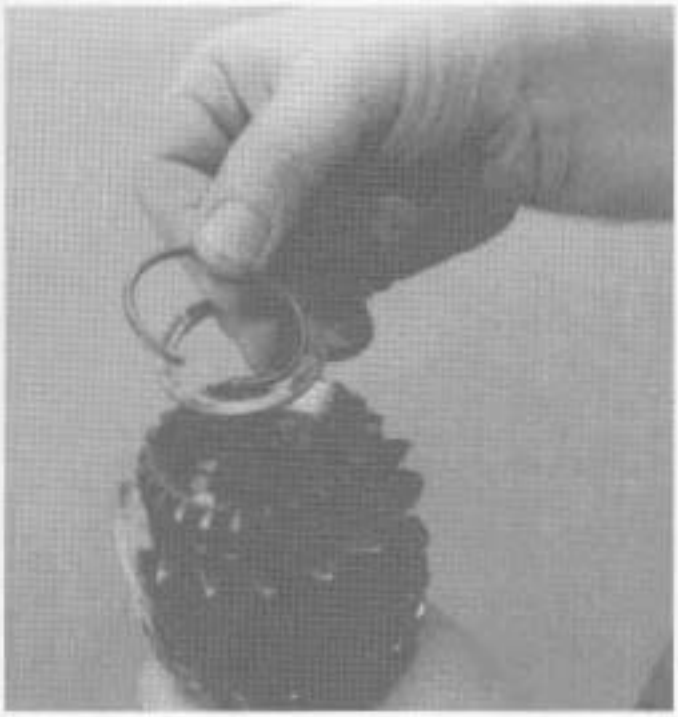
1. Remove the four capscrews from the front bearing cover and remove the cover and shims. The front bearing cover shims can come off with the front bearing cover. If necessary, remove the oil seal from the cover (inset).



2. Remove the input shaft assembly from the transmission.

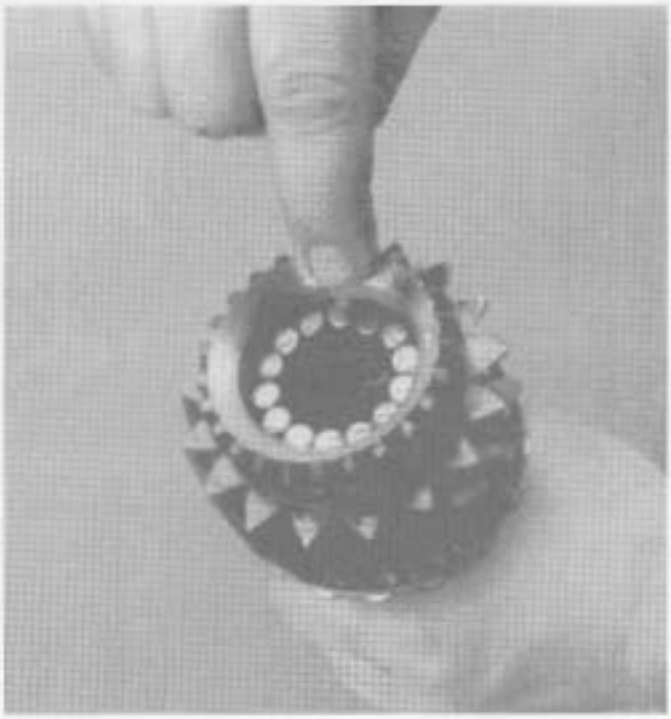
DISASSEMBLY - TRANSMISSION

Input Shaft Disassembly (cont.)



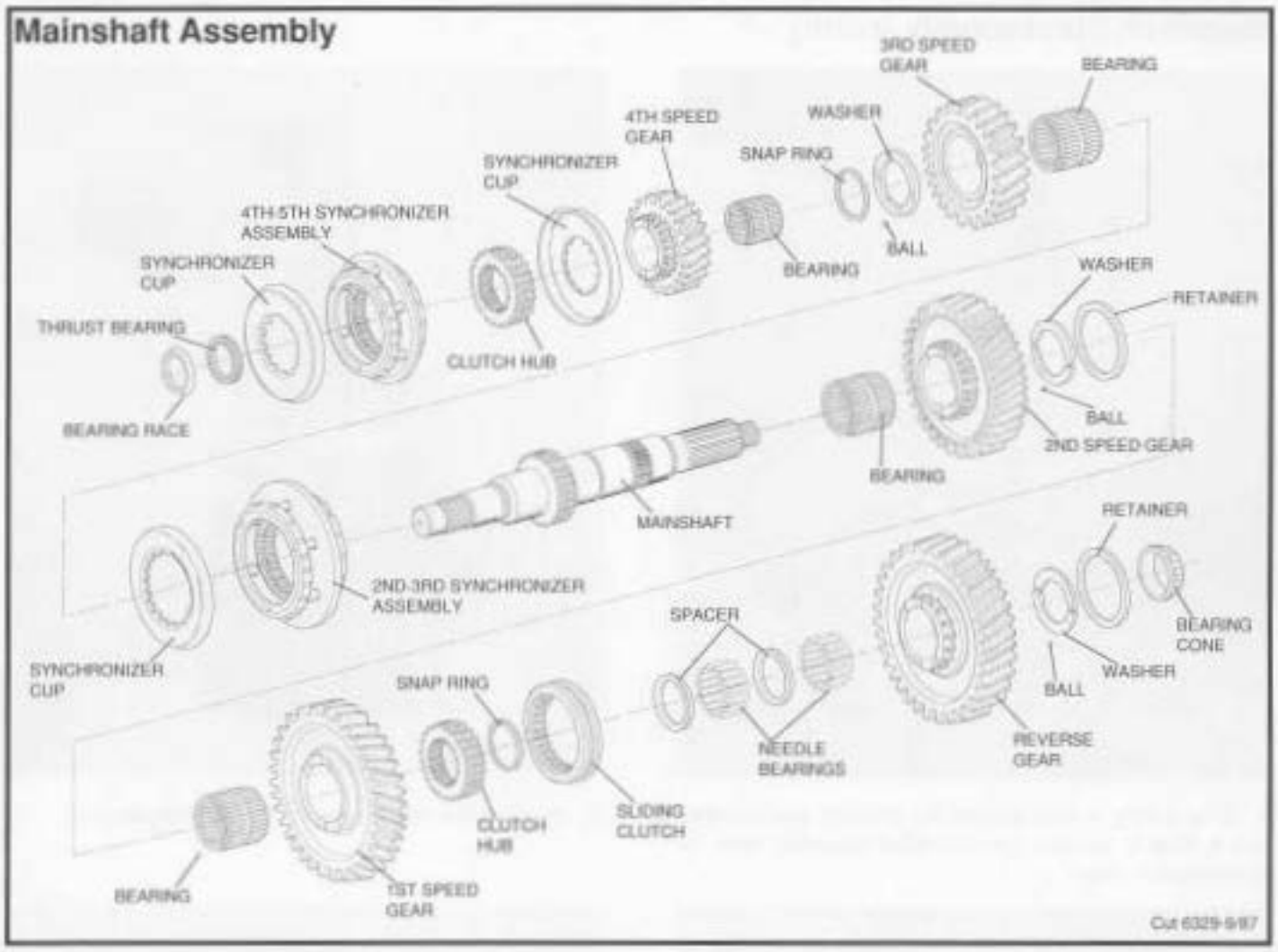
3. If necessary, remove the retention snap ring and the bearing retention ring.

5. Use a chisel to remove the bearing cage and rollers. Install bearing puller and remove the bearing race from the input shaft.

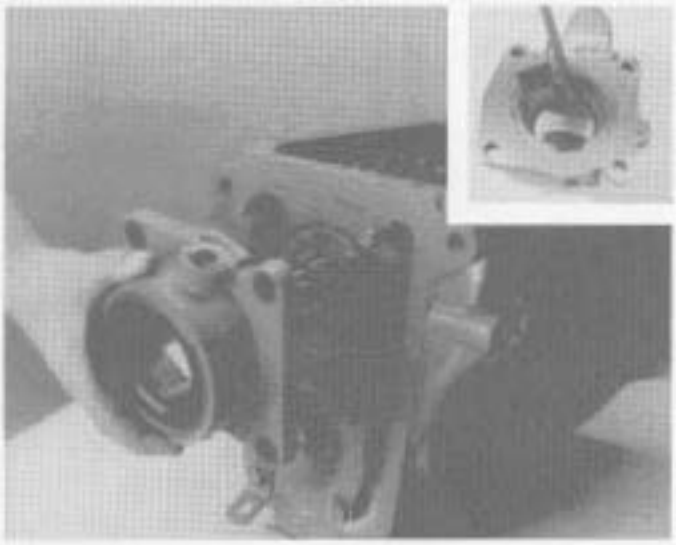


4. If necessary, remove the 14 roller bearings from the main drive gear bearing pocket.

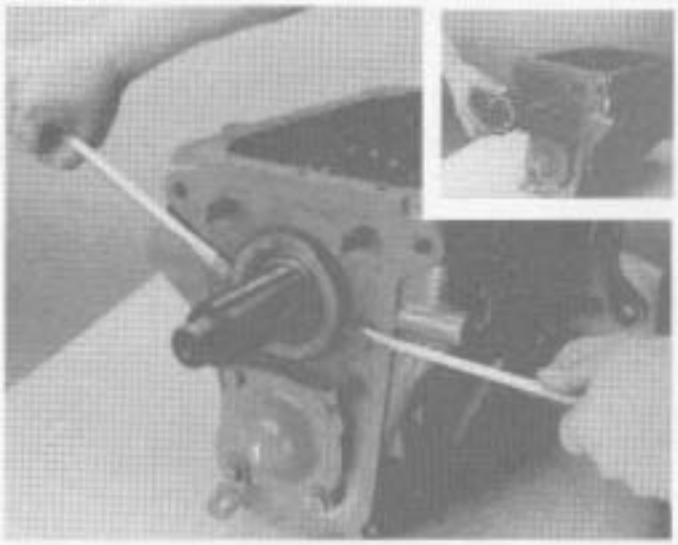
DISASSEMBLY - TRANSMISSION



B. Removal and Disassembly of Mainshaft



1. Remove the four retaining nuts and lockwashers and remove the rear bearing cover. If necessary, remove the oil seal from the bearing cover.



2. Remove speedometer drive gear (inset). Tap on the front of the main shaft to move the mainshaft rearward and remove the rear bearing cup and spacer.

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DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)

3. Wrap a sling or rope around the 2nd-3rd synchronizer. Use a hoist to remove the mainshaft assembly from the transmission case.

5. Remove the thrust bearing and bearing race.

4. Install the mainshaft assembly in a vise equipped with soft jaws or wood, shaft front facing up. Remove the 4th-5th speed synchronizer and cups.

6. Remove 4th-5th speed clutch hub.

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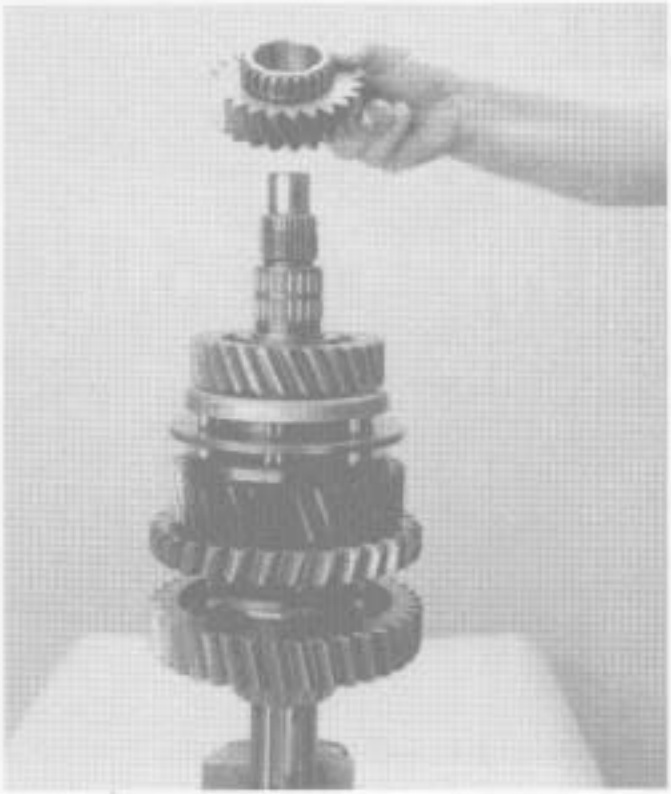
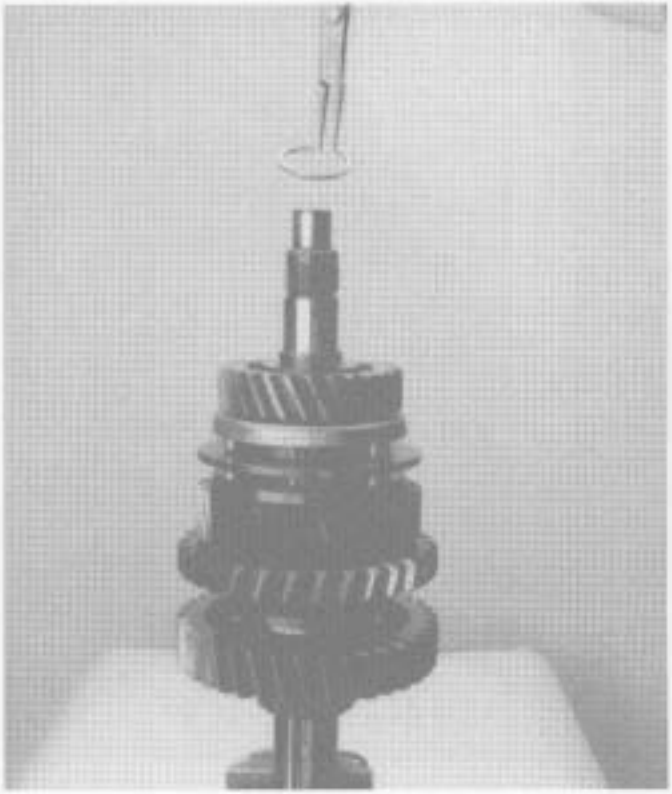
DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)



7. Remove the 4th speed gear.



9. Remove 3rd speed gear retaining snap ring.

8. Remove 4th gear bearing.

10. Remove 3rd speed gear thrust washer. Remove the locating ball.

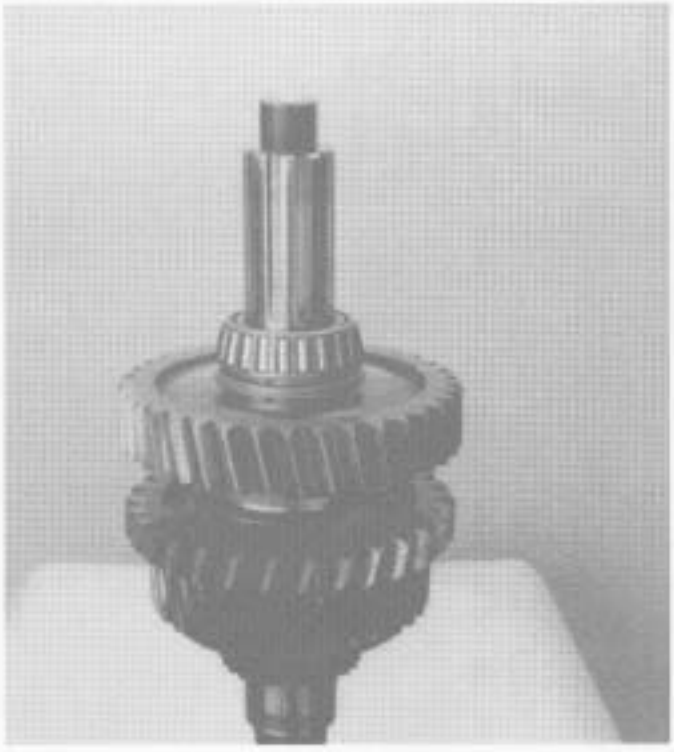
DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)

11. Remove the 3rd speed gear.

13. Remove the 3rd gear synchronizer cup and synchronizer assembly.

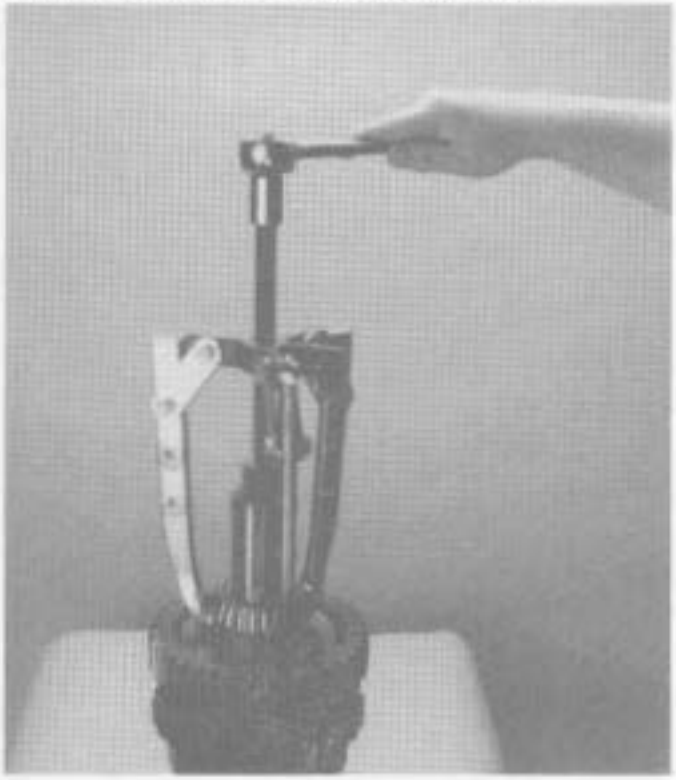
12. Remove the 3rd gear bearing.



14. Reposition mainshaft in the vise so rear bearing is up.

DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)



15. Using a gear puller, remove the mainshaft rear bearing as shown.

17. Remove the 1st gear split washer.

16. Remove the 1st gear split washer retaining ring.

18. Remove the 1st gear. Use caution so not to lose bearing rollers under the 1st gear (inset).

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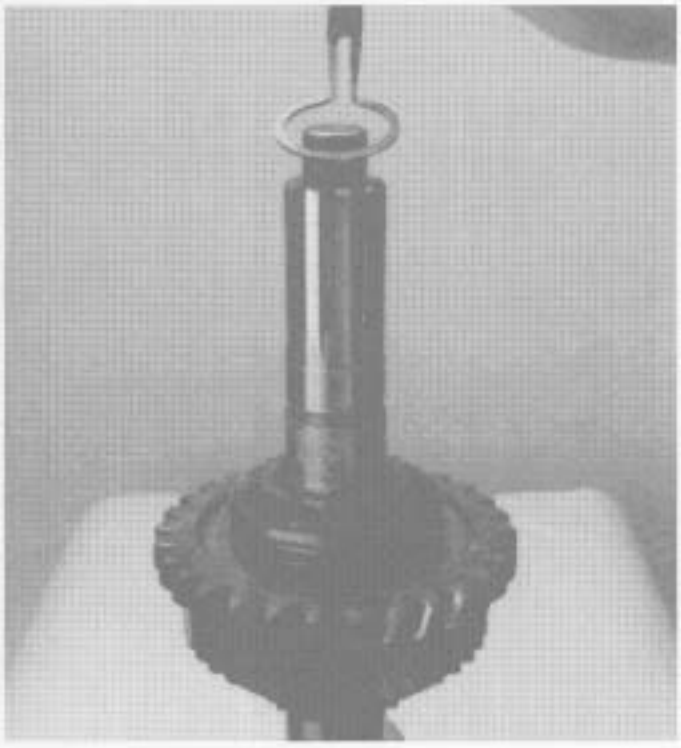
DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)

19. Remove the bearing rollers and spacers.

21. Remove the 1st-reverse sliding clutch.



20. Remove 1st-reverse shift hub snap ring.

22. Remove the shift hub.

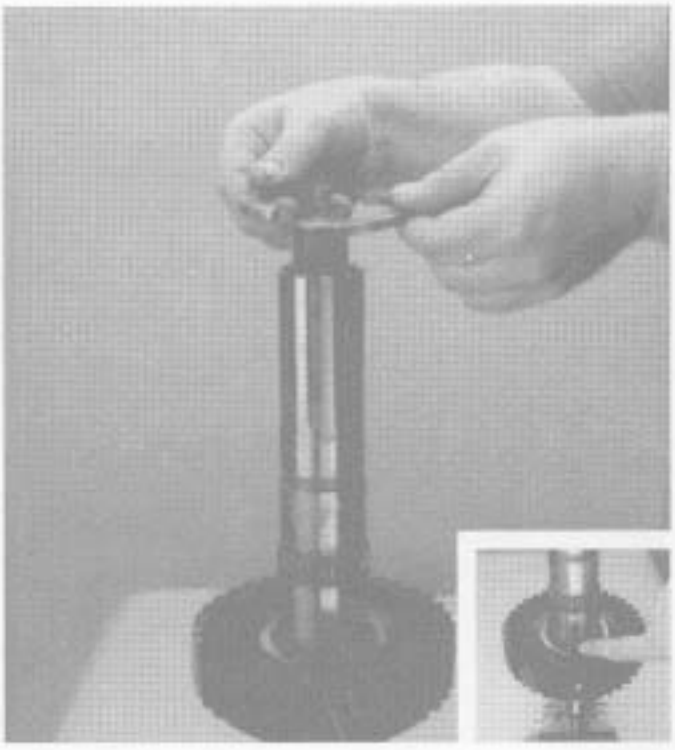
DISASSEMBLY - TRANSMISSION

Mainshaft Disassembly (cont.)

23. Remove the reverse gear.

25. Remove 2nd gear split washer retainer ring.

24. Remove the reverse gear bearing.



26. Remove the 2nd gear split washer and locating ball (inset).

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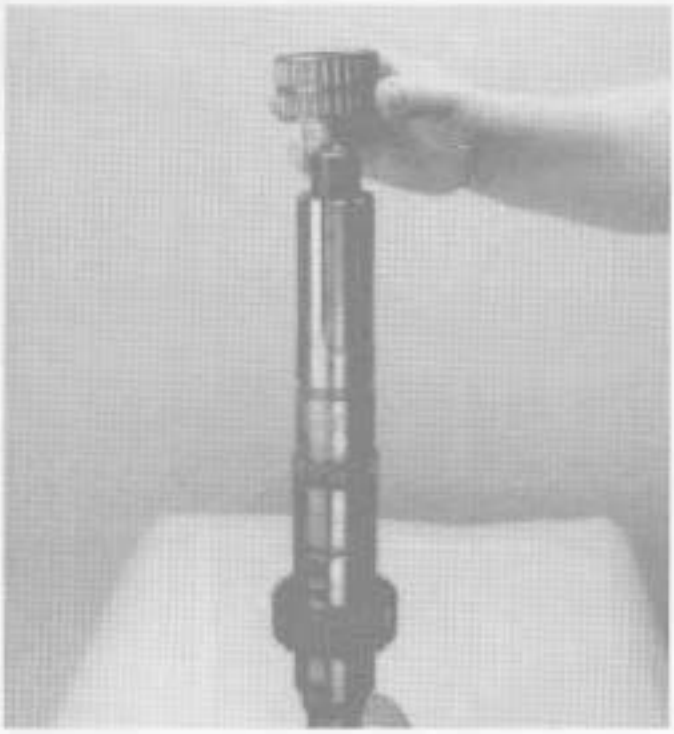
DISASSEMBLY - TRANSMISSION

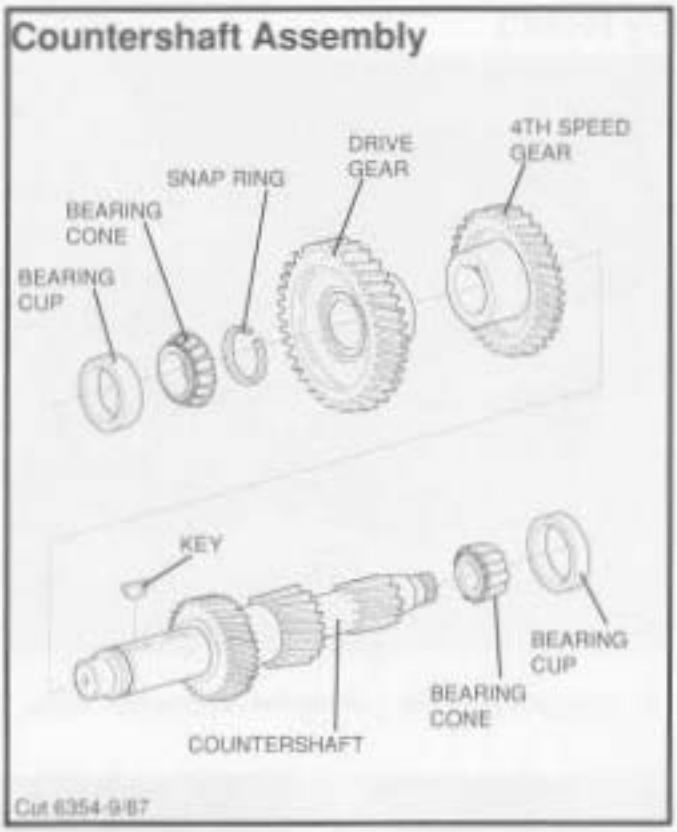
Mainshaft Disassembly (cont.)

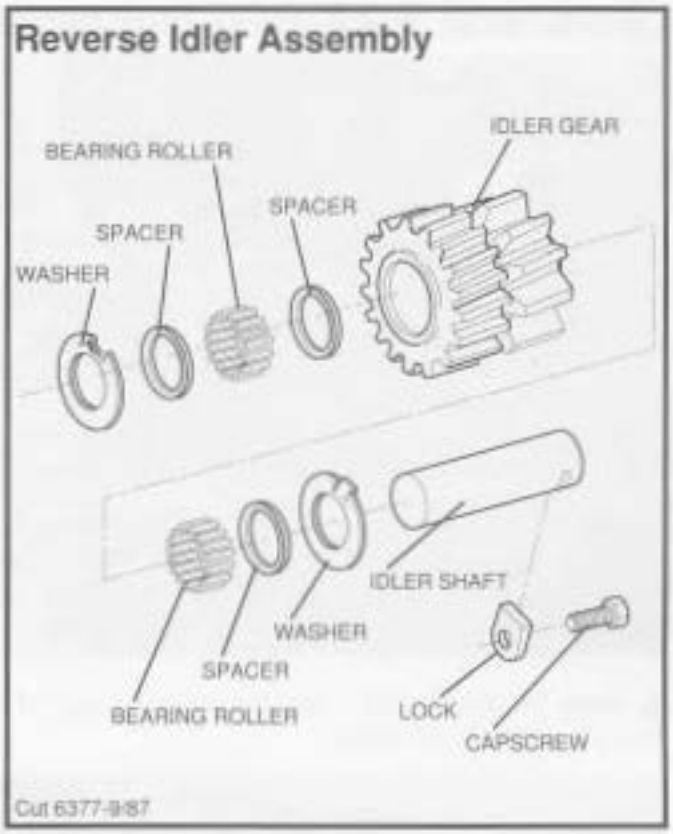
27. Remove 2nd speed gear.



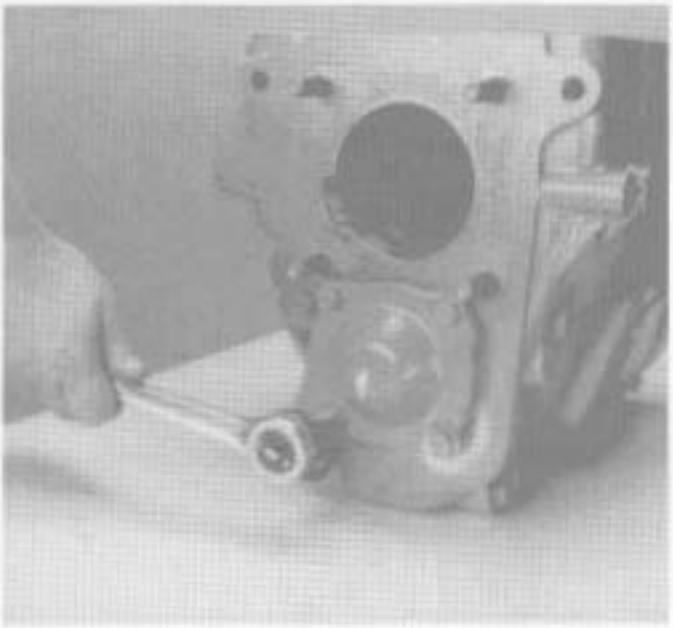
28. Remove 2nd gear bearing.

DISASSEMBLY - TRANSMISSION

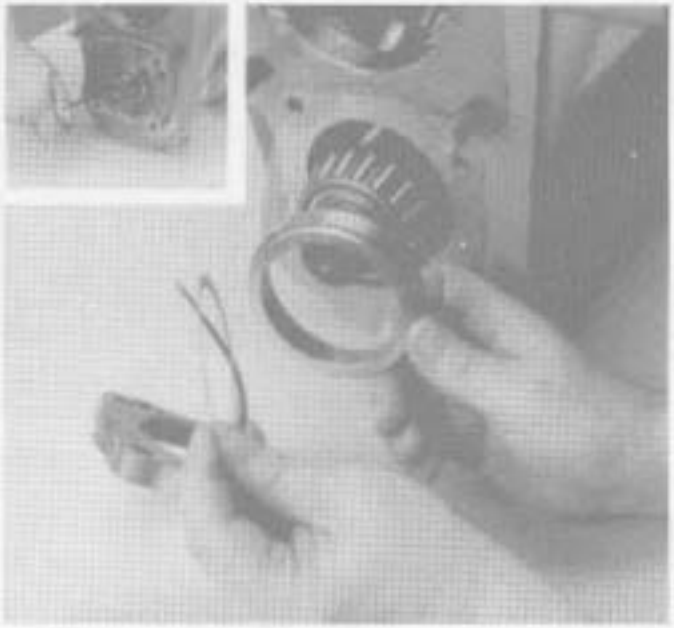




C. Removal and Disassembly of Countershaft and Reverse Idler



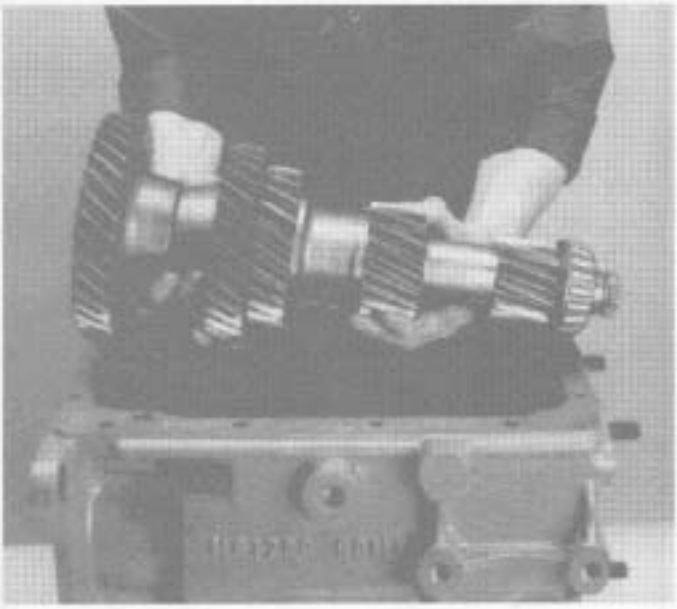
1. Remove the four capscrews and the countershaft rear bearing cover and gasket.



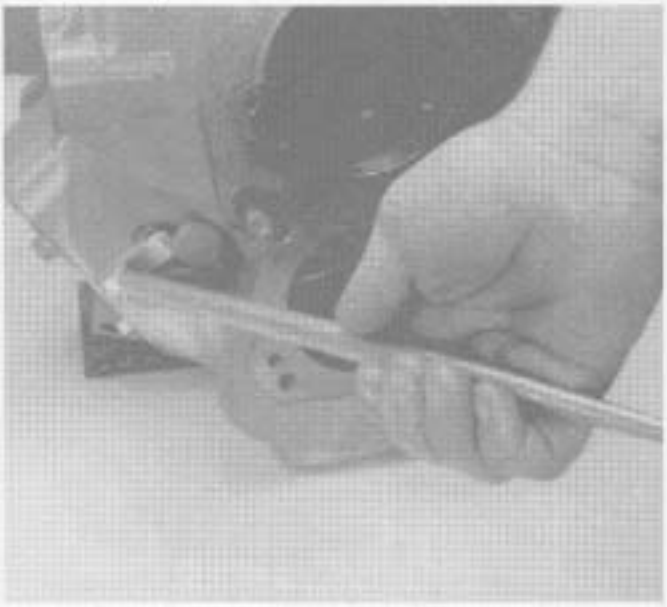
2. Remove the two set screws (inset). Remove the bearing retainer, outer race, and shims.
NOTE: Countershaft may slide to the rear and out of the bearing bore.

DISASSEMBLY - TRANSMISSION

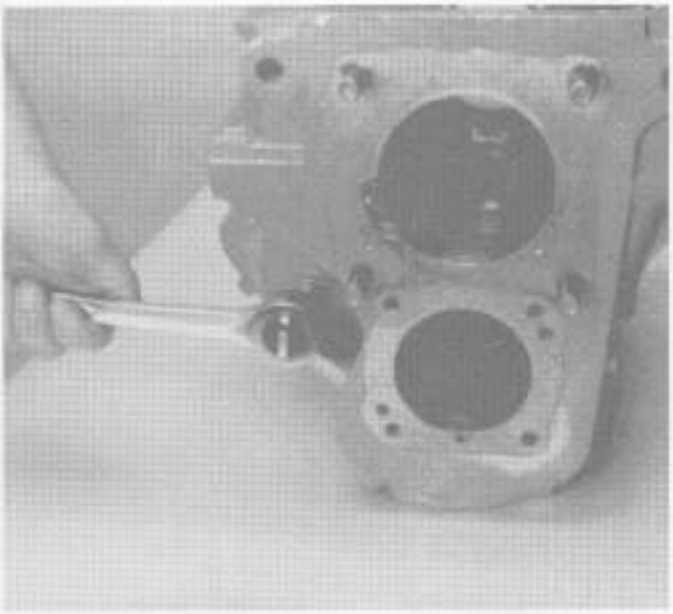
Countershaft and Reverse Idler Disassembly (cont.)



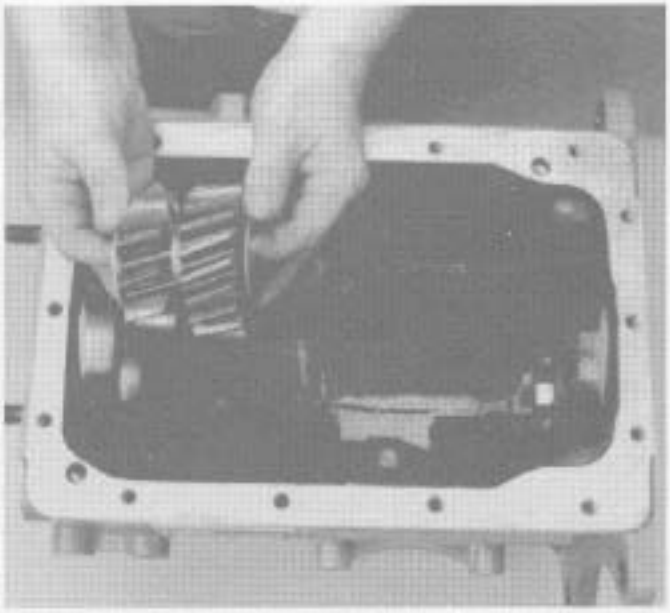
3. Move the countershaft assembly to the rear and lift it from the transmission case.



5. Using a wedge bar, remove the reverse idler shaft.



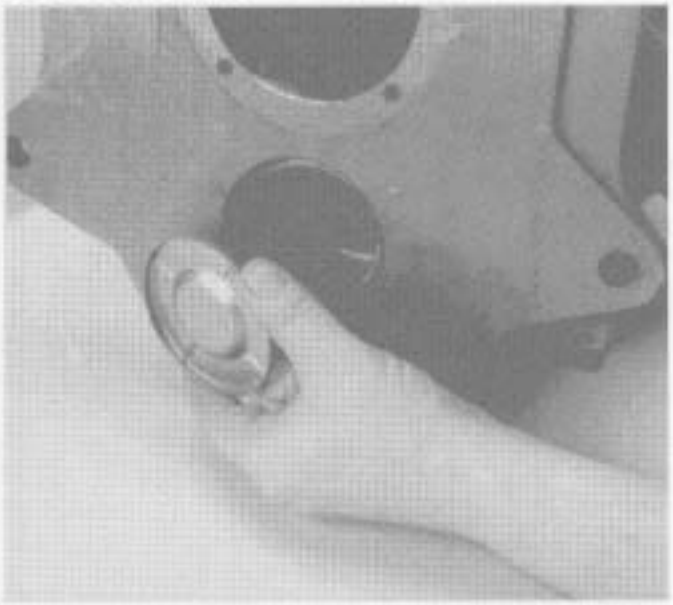
4. Remove the reverse idler retaining capscrew and the retainer.



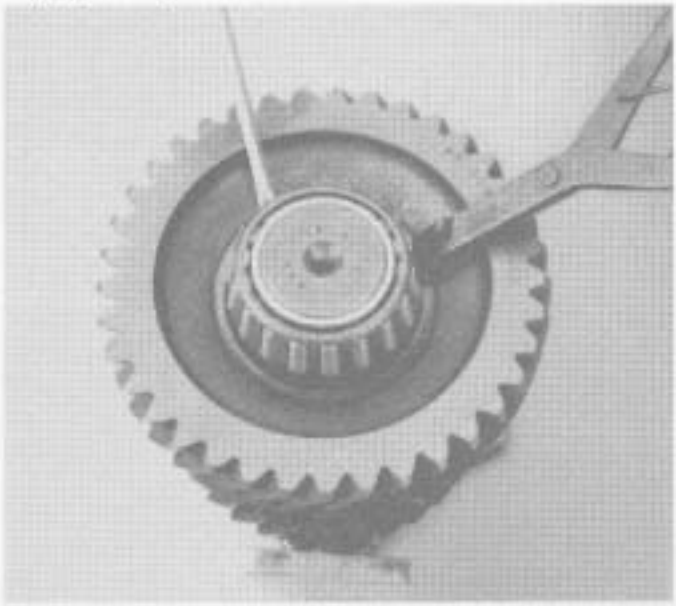
6. Remove the reverse idler bearings, spacer, and thrust washers.

DISASSEMBLY - TRANSMISSION

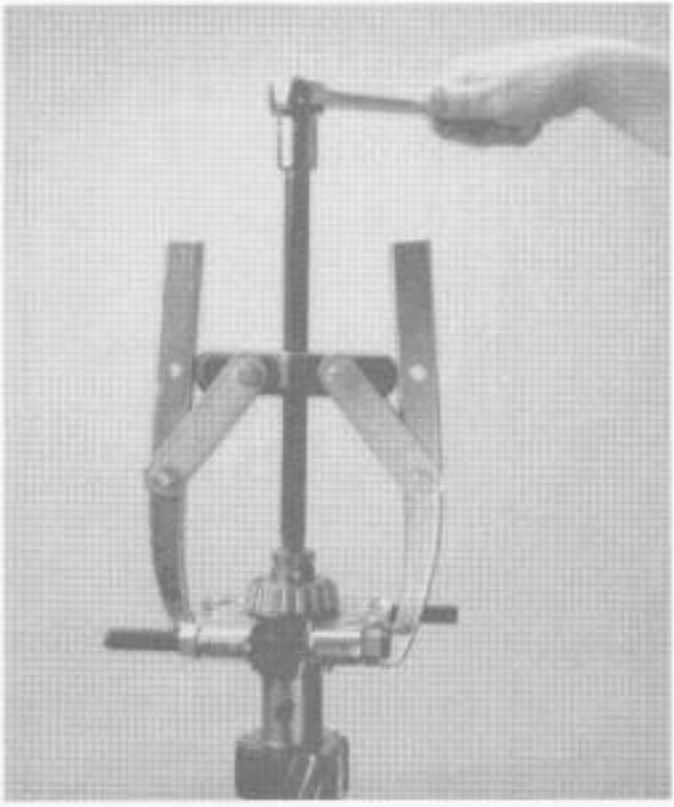
Countershaft and Reverse Idler Disassembly (cont.)



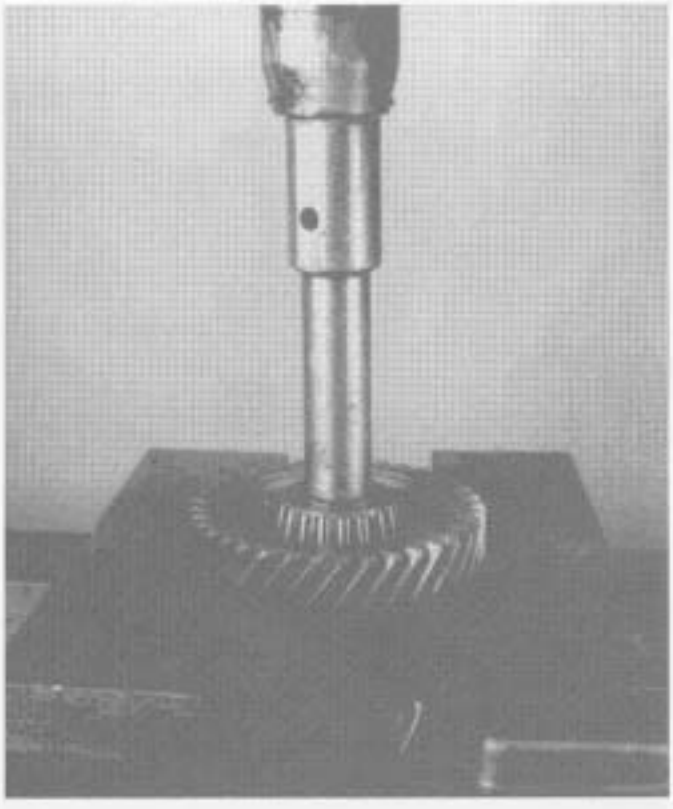
7. If the countershaft front bearing race is to be replaced, drive the bore plug through the front of the transmissison and drive the race to the rear toward the case's inside.



9. Use a screwdriver and snap ring pilers to move the snap ring out of snap ring groove and against the bearing back.



8. Position gear puller and clamp behind the rear countershaft bearing and remove the bearing.



10. Use the countershaft drive gear rear face as a base, then press the drive gear, snap ring, and bearing from the countershaft.

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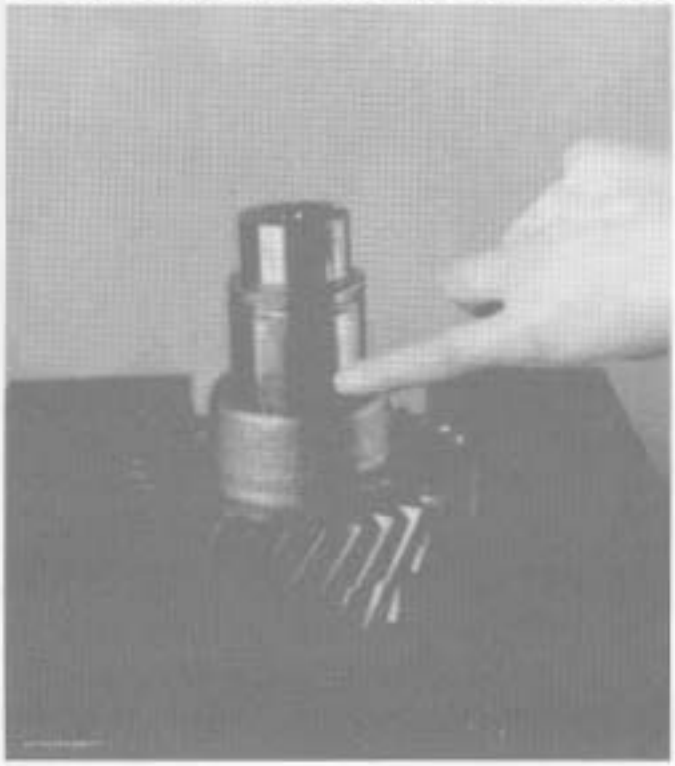
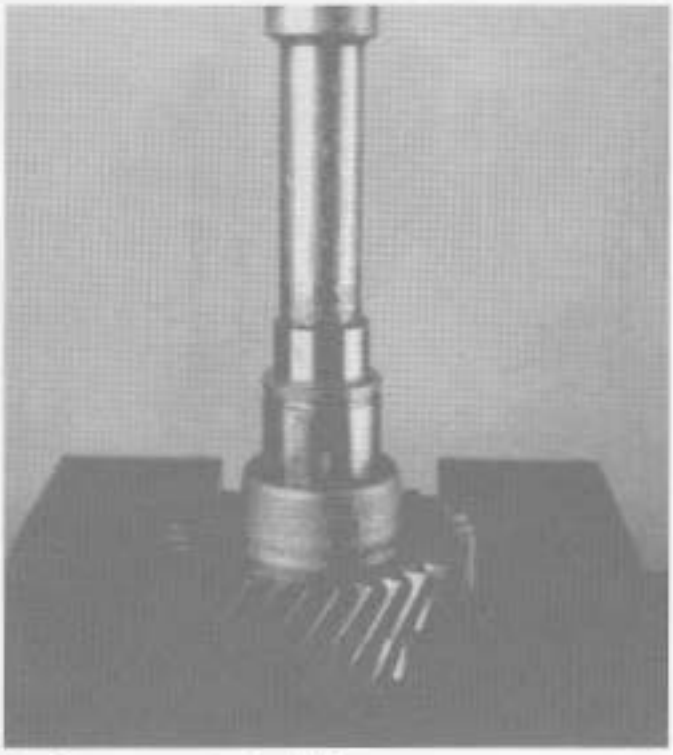
DISASSEMBLY - TRANSMISSION

Countershaft and Reverse Idler Disassembly (cont.)



11. Remove the 5th gear key from the countershaft.

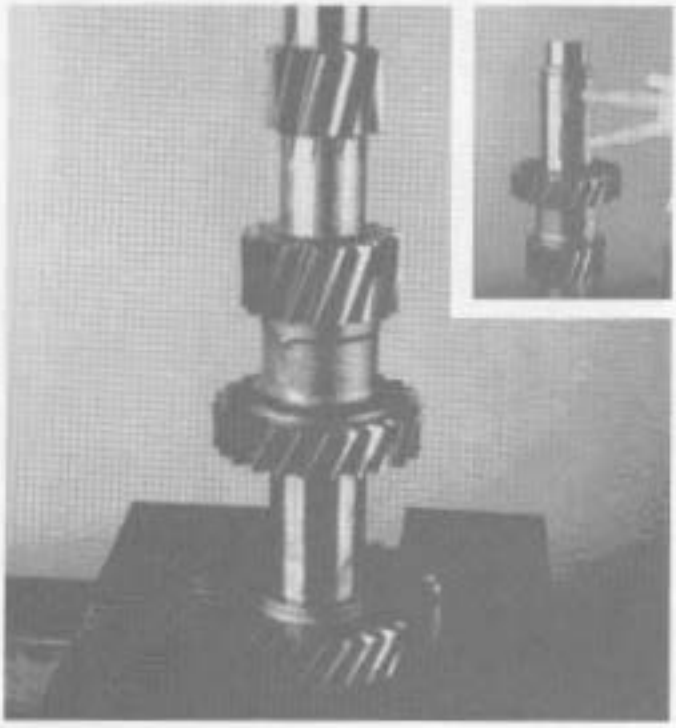
13. Remove 4th gear key from the countershaft



12. Remove countershaft 4th gear.

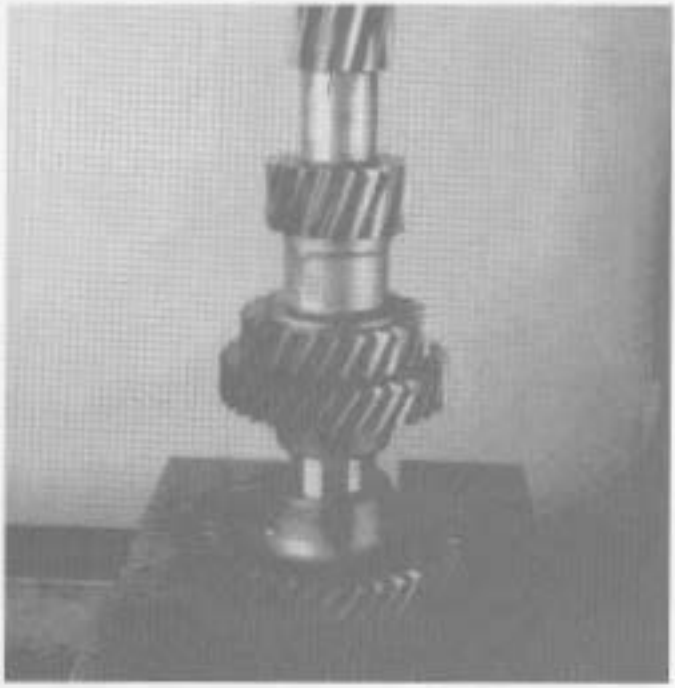
REASSEMBLY - TRANSMISSION

A. Reassembly and Installation of Countershaft and Reverse Idler



1. Install 4th and 5th speed gear keys in the countershaft keyways (inset). Align 4th speed countershaft gear keyway to shaft key. Press 4th gear on the countershaft, long hub to shaft front.

3. Install snap ring in the countershaft front snap ring groove.



2. Press 5th speed countershaft gear on, long hub to shaft rear.

4. Heat and install the front countershaft bearing.
CAUTION: Do not heat the bearing above 275°F (136°C). If possible, use a heat lamp as the source.

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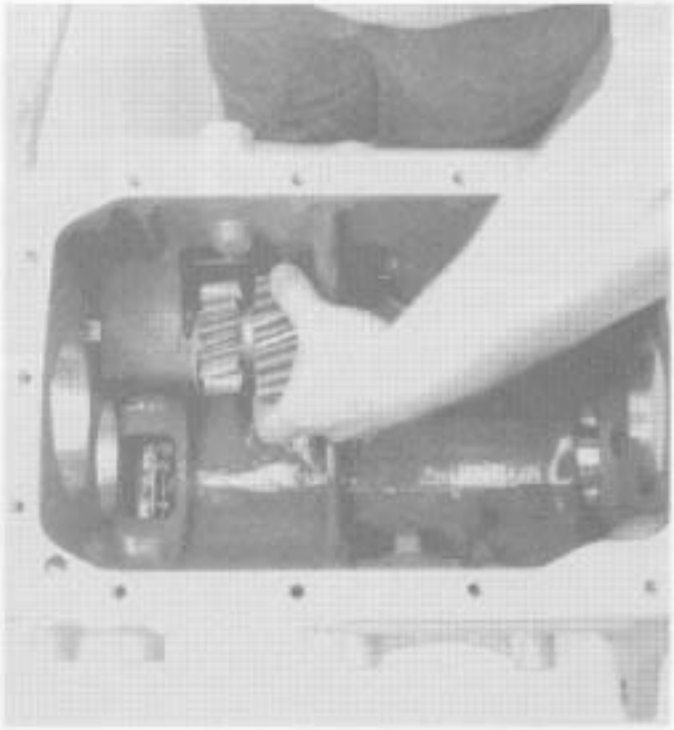
REASSEMBLY - TRANSMISSION

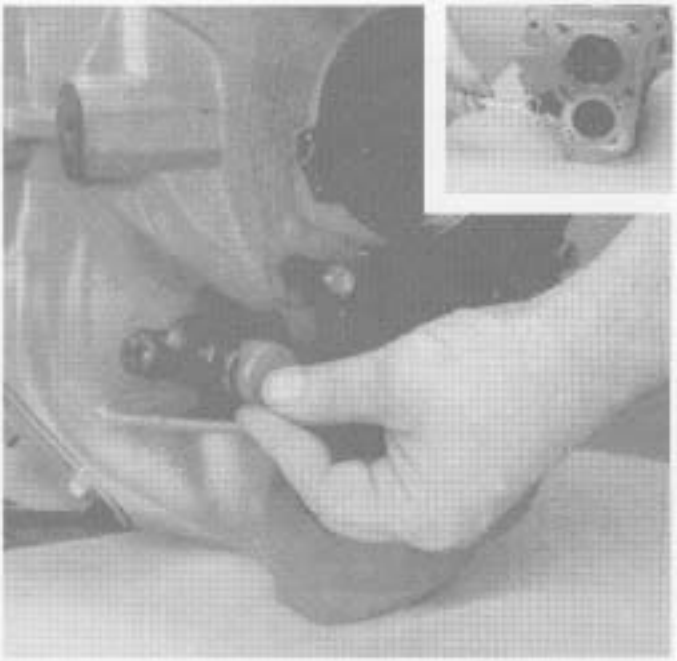
Reassembly Countershaft and Reverse Idler (cont.)

5. Heat and install the rear countershaft bearing. CAUTION: Do not heat the bearing above 275°F (136°C). If possible, use a heat lamp as the source.



7. Use grease on the two reverse idler thrust washers to hold in place. Install reverse idler gear with tangs of washers in housing groove, with the small reverse idler gear to the rear.

6. If previously removed, install the snap ring, countershaft front bearing race (from inside of case) and front case bore plug. Coat the outer diameter of bore plug with Loctite #510 before installing.



8. Insert the reverse idler shaft through the case and idler gear needle bearings. Install the reverse idler retainer and capscrew (inset). Make sure the idler shaft locking groove lines up with the capscrew hole. Tighten the capscrew to the recommended torque.

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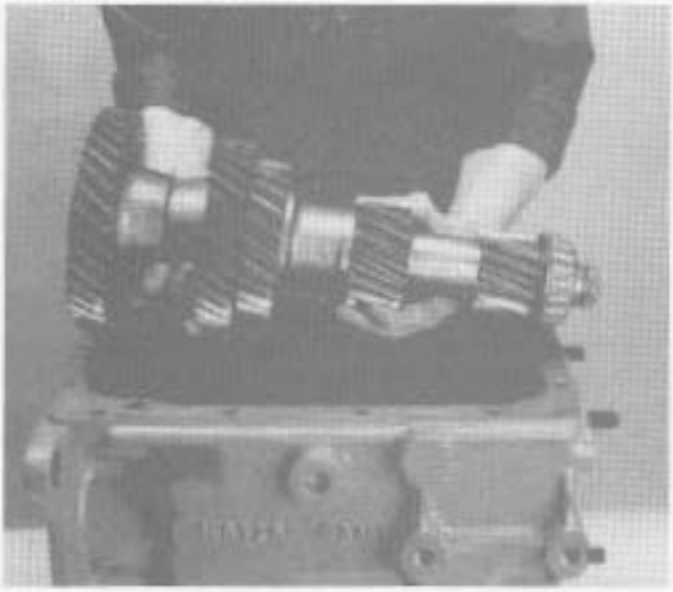
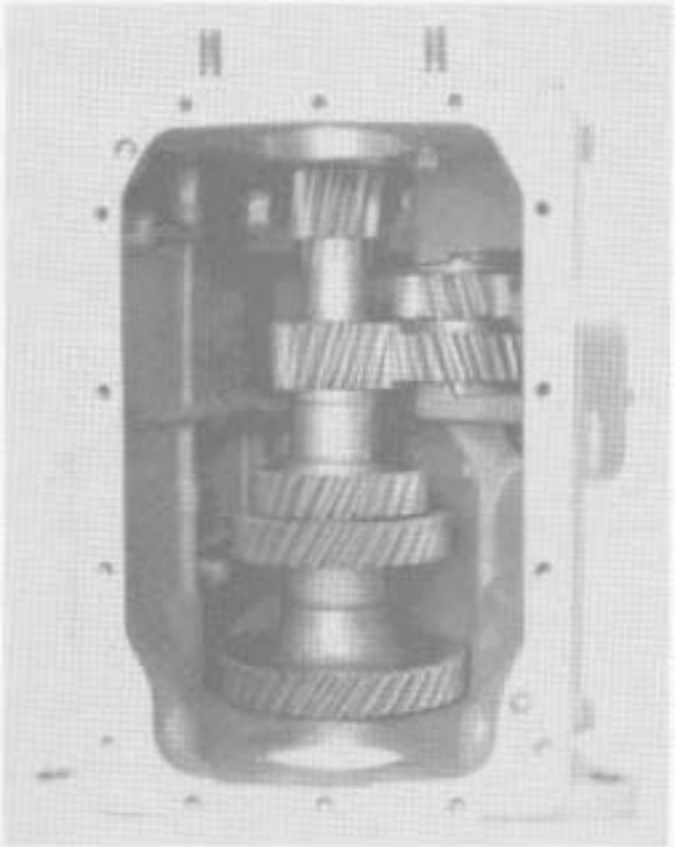
REASSEMBLY - TRANSMISSION

Reassembly Countershaft and Reverse Idler (cont.)



9. Carefully lower the countershaft into the transmission case.

11. Install the countershaft rear bearing race into the transmission case as shown.



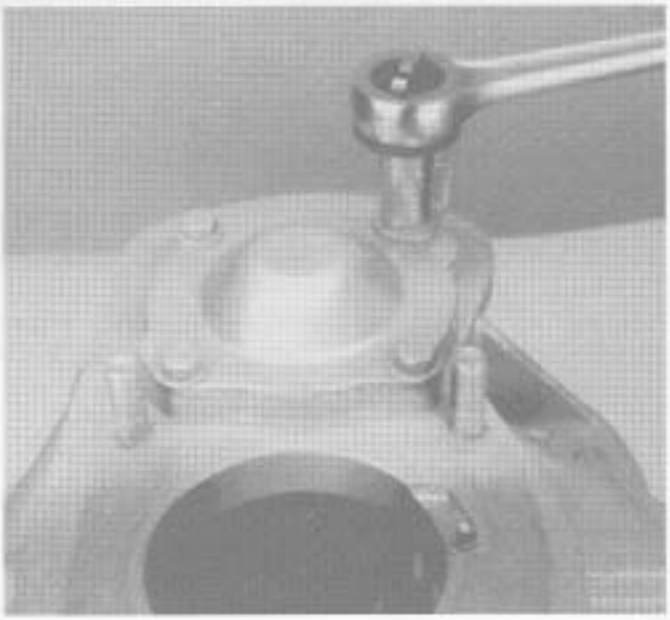
10. Position the transmission case on end as shown. Position the countershaft assembly into the front bearing race.

12. Temporarily install new shims into the bearing retainer (inset). Install the retainer and tighten the set screws to the recommended torque.

REASSEMBLY - TRANSMISSION

Reassembly Countershaft and Reverse Idler (cont.)

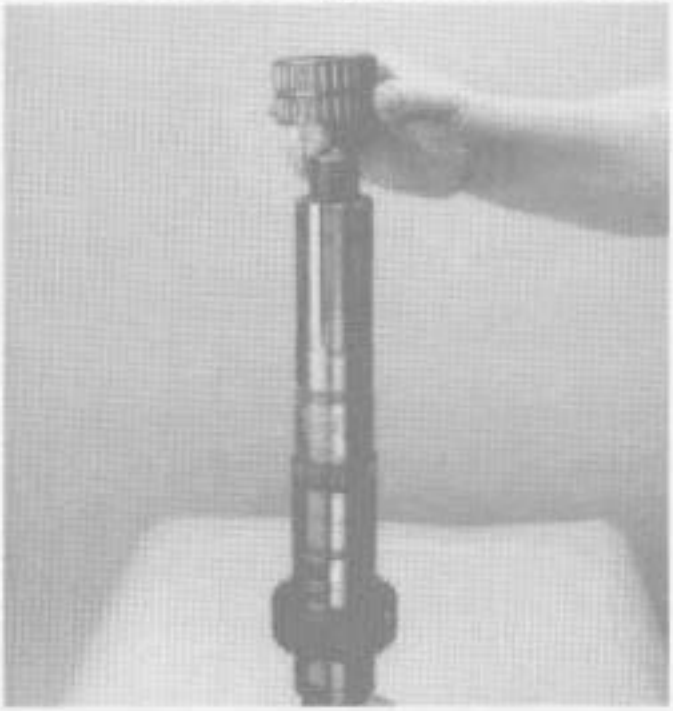
13. Rotate the countershaft to seat the bearings and races. Position the dial indicator as shown, lift the countershaft with a screwdriver to measure the end play. End play must be set at .002-.008 (0.05-0.20 mm). Add shims for more end play and remove shims for less end play.
NOTE: Once end play is correct remove the retainer and apply a light coat of Loctite #510 to each side of the shims and the retainer face.
Coat set screw threads with Loctite #262 and tighten to the recommended torque.



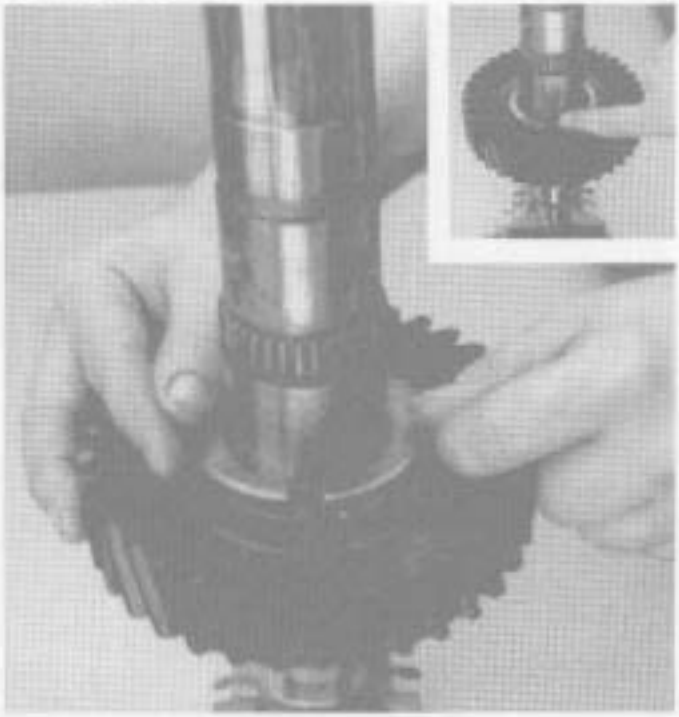
14. Install the countershaft rear bearing cover and gasket. Coat capscrew threads with Loctite #262 and tighten to the recommended torque.

REASSEMBLY - TRANSMISSION

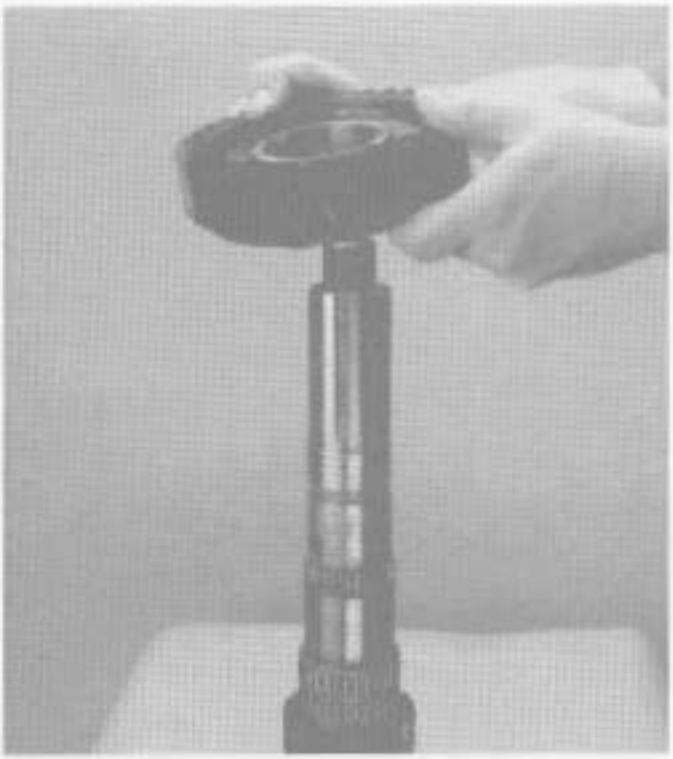
B. Reassembly and Installation of Mainshaft



1. Install the mainshaft in a vise equipped with wood or brass jaws, mainshaft rear facing up. Lubricate and install mainshaft 2nd speed gear bearing.



3. Install locating ball (inset) and 2nd gear split washer so the split rings join at the locating ball.



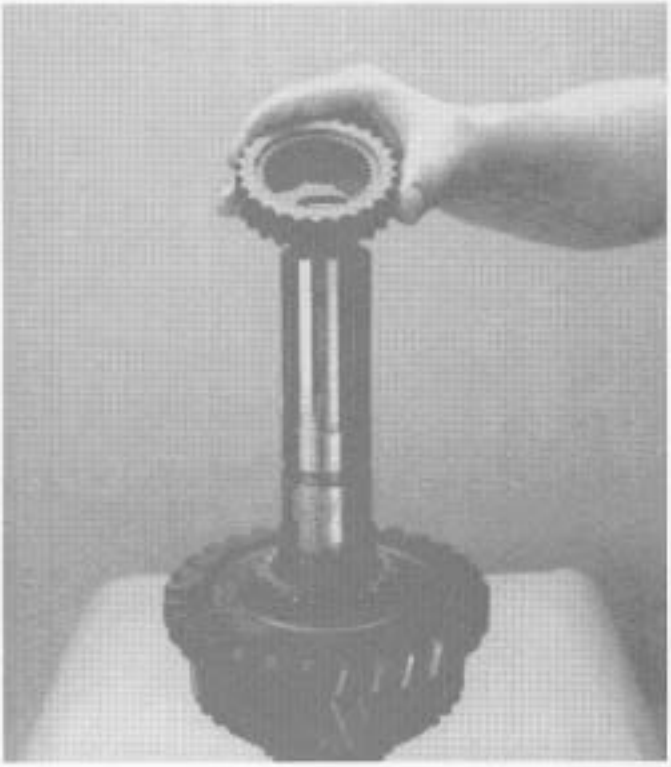
2. Install mainshaft 2nd gear.

4. Install 2nd gear split washer retainer ring.

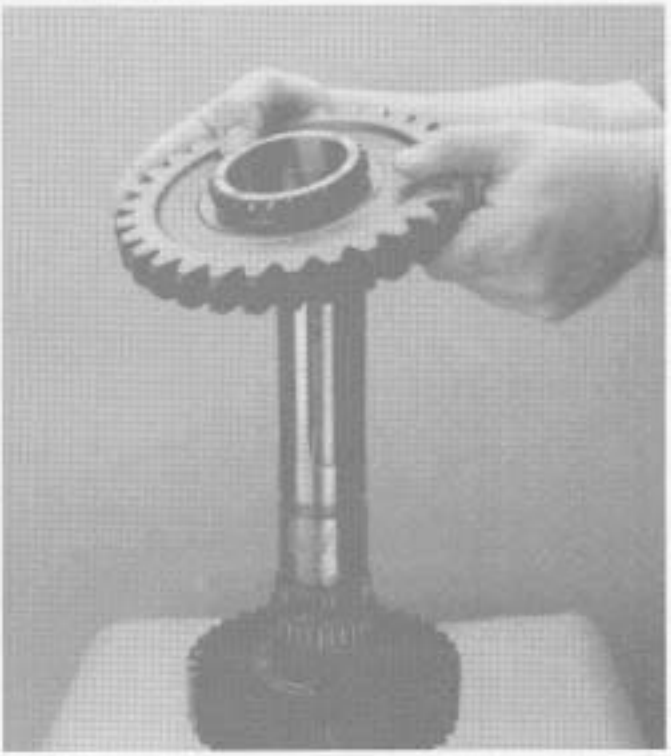
REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

5. Install mainshaft reverse gear bearing.



7. Install mainshaft 1st-reverse speed clutch hub.



6. Install mainshaft reverse gear.

8. Install 1st-reverse gear sliding clutch.

REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

9. Install the mainshaft 1st-reverse clutch hub snap ring.

11. Install mainshaft 1st gear over the two rows of needle bearings, with clutching teeth down. Be careful not to catch the needle roller bearings.

10. Coat the mainshaft 1st gear position with a high quality grease. Lay a row of needle bearings around the mainshaft, 44 needle bearins. Place a spacer ring over the top of the bearings. Lay a second row of 44 needle bearings around the mainshaft on top of the spacer ring. Install a spacer ring over the top of the second row of needle bearings.

12. Install a locating ball on the mainshaft. Install 1st speed gear split washer, so the split rings join at the locating ball.

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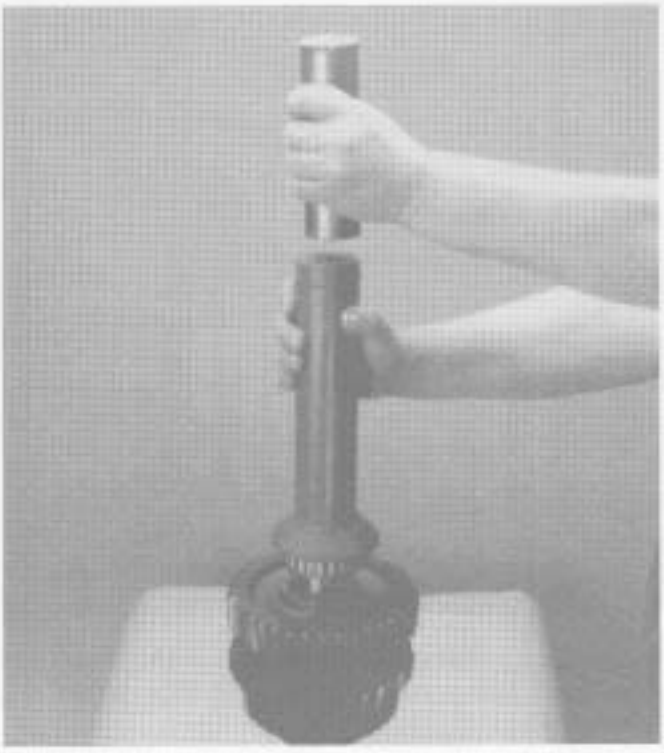
REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

13. Install the split washer retainer ring over the split rings.

15. Reposition mainshaft in vise so front is up. Install the mainshaft 3rd speed gear synchronizer assembly.



14. Using a bearing driver, install mainshaft rear bearing as shown.

16. Install the mainshaft 3rd speed gear synchronizer cup as shown.

REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

17. Install mainshaft 3rd speed gear bearing.

19. Install locating ball and 3rd speed gear thrust washer.

18. Install mainshaft 3rd speed gear, clutching teeth facing down.

20. Install mainshaft 3rd speed gear retaining snap ring in the snap ring groove.

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REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

21. Install mainshaft 4th gear bearing.

23. Install mainshaft 4th-5th speed clutch hub, machined surface facing up.

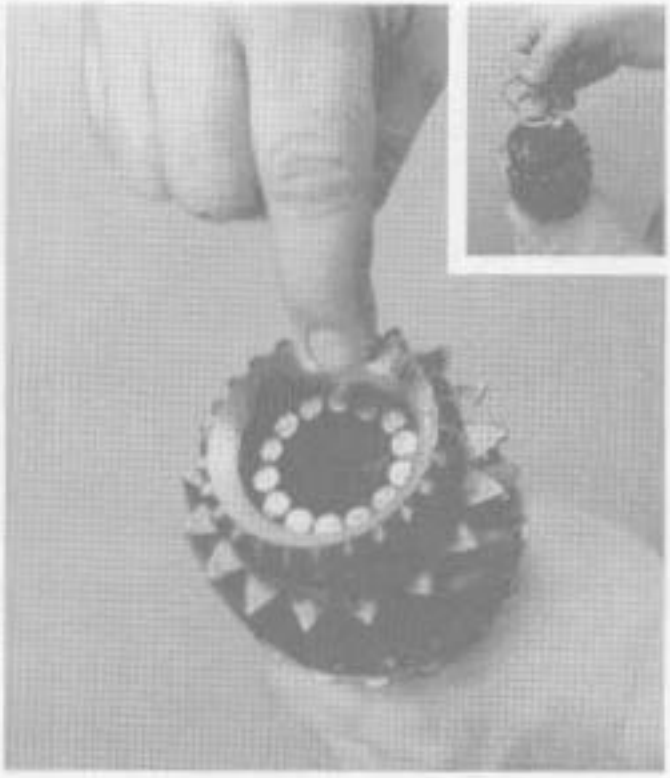
22. Install mainshaft 4th speed gear, clutching teeth facing up.

24. Install thrust bearing and bearing race on the mainshaft 4th-5th clutch hub.

REASSEMBLY - TRANSMISSION

Reassembly of Mainshaft (cont.)

25. Install 4th-5th speed synchronizer and cups over the mainshaft 4th-5th clutch hub.



27. If previously removed, install 14 roller bearings in the main drive gear bearing pocket. Install the retention snap ring and retention ring (inset), lubricate the bearings with a high quality grease.

26. Remove the mainshaft from the vice and wrap a sling or rope around 2nd-3rd synchronizer. Use a hoist to install the mainshaft assembly in transmission case.

28. Heat the input shaft bearing and install the bearing on the input shaft.
CAUTION: Do not heat bearing above 275°F (136°C). If possible use a heat lamp as the source.

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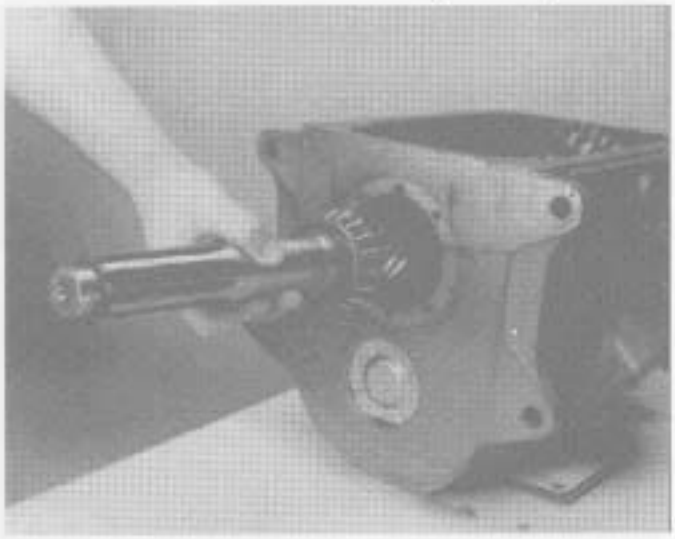
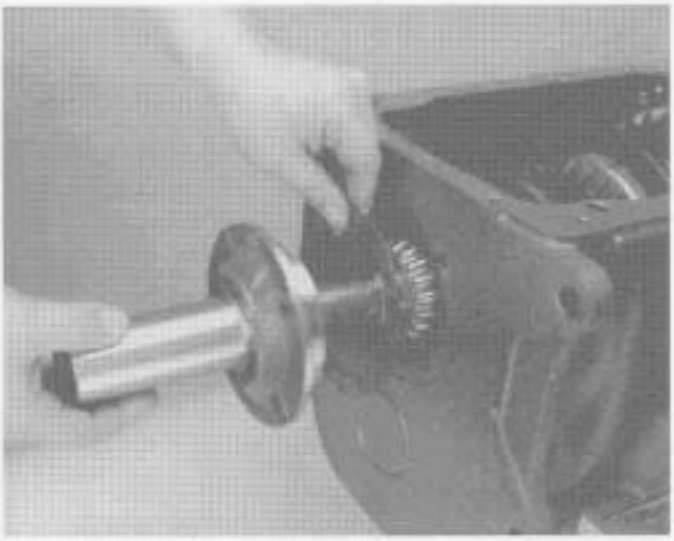
REASSEMBLY - TRANSMISSION

Installation of Mainshaft (cont.)

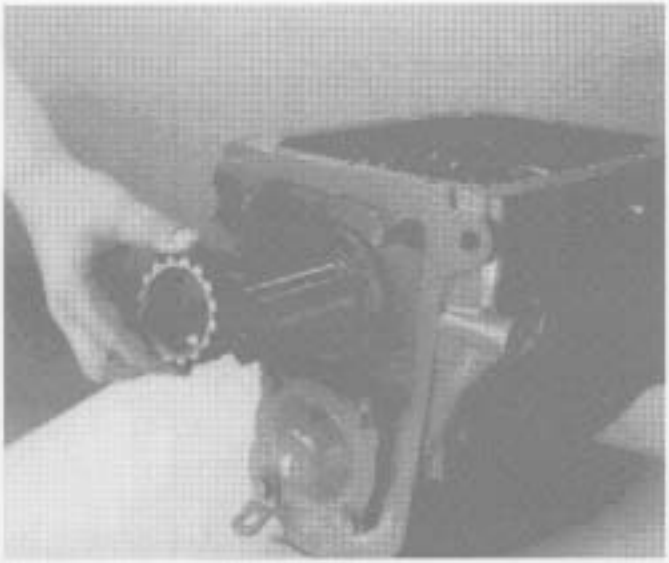


29. Install the input shaft by aligning clutching teeth on drive gear with teeth in mainshaft 5th speed synchronizer cup.

30. Coat the outer diameter of the input shaft bearing cover oil seal with Loctite #510. Install the oil seal on the front bearing cover with a bearing driver as shown. Install the input bearing race in the front bearing cover with the proper bearing driver.



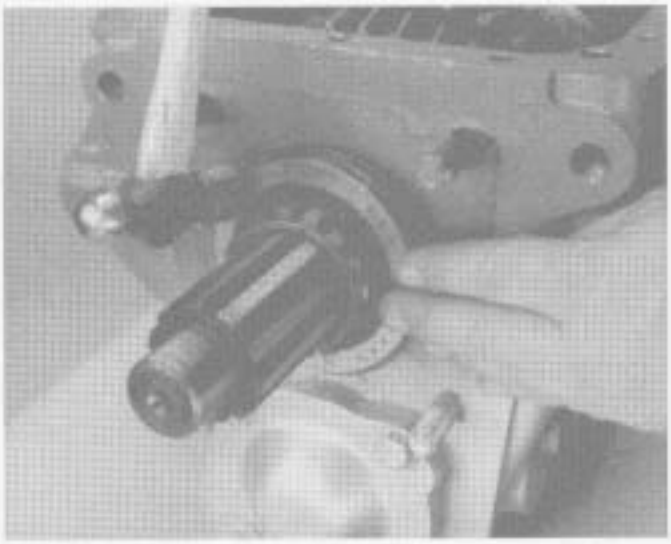
31. Install input shaft bearing cover, gasket, and cap-screws. The front bearing cover lubrication oil groove must be at the top. Apply Loctite #262 to threads of capscsrews and tighten to recommended torque.
NOTE: Bearing cover is marked for proper installation.



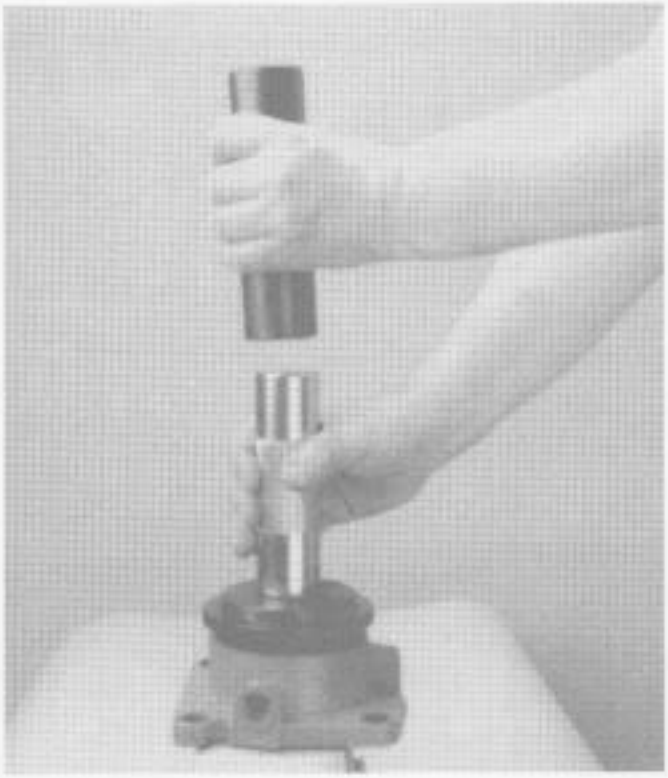
32. Install the speedometer drive gear or rotor on the output shaft.

REASSEMBLY - TRANSMISSION

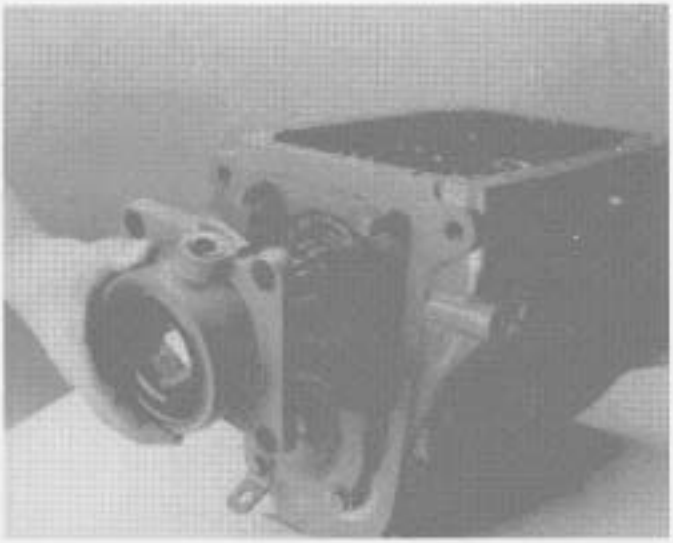
Installation of Mainshaft (cont.)



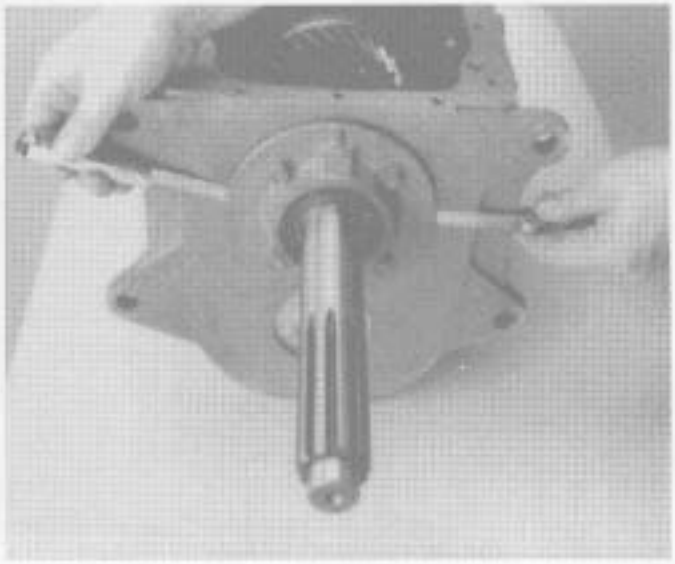
33. Install the main shaft rear outer bearing race in the output shaft bearing bore.



34. If a new oil seal is required, install using a flanged driver. Coat the oil seal outer diameter with Loctite #510.



35. Coat both sides of a new rear bearing cover gasket with Loctite #510, and position the gasket on the rear bearing cover. Install the rear bearing cover, position the lubrication oil groove with case hole.
NOTE: Rear bearing cover is marked for proper installation.



36. Tighten the front bearing cover capscrews to 30 in.-lbs. of torque. Using two feeler gages at the capscrew locations, record the gap between the front bearing cover and the transmission case. Average the two recorded measurements and add 0.016. This total gives you a shim pack thickness to start the end play measurement. Combine the shims to equal the total shim pack measurement from the above procedure. Remove the front bearing cover and install the shim pack. Replace the front bearing cover and four retaining capscrews, tighten capscrews to recommended torque.

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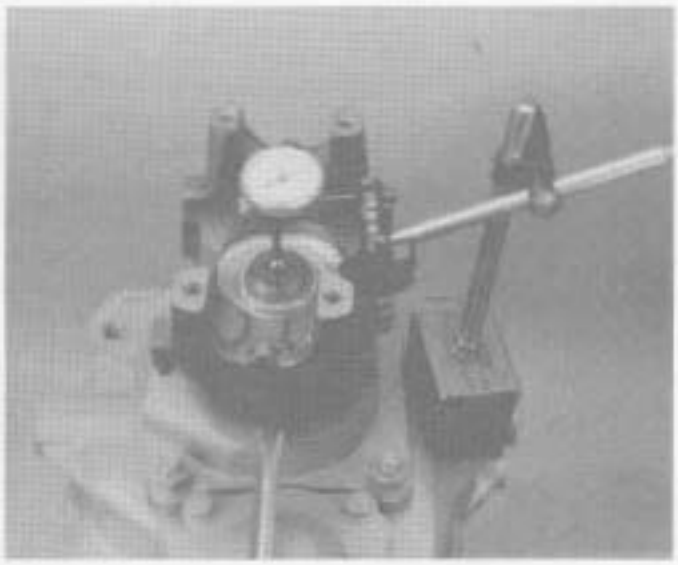
REASSEMBLY - TRANSMISSION

Installation of Mainshaft (cont.)

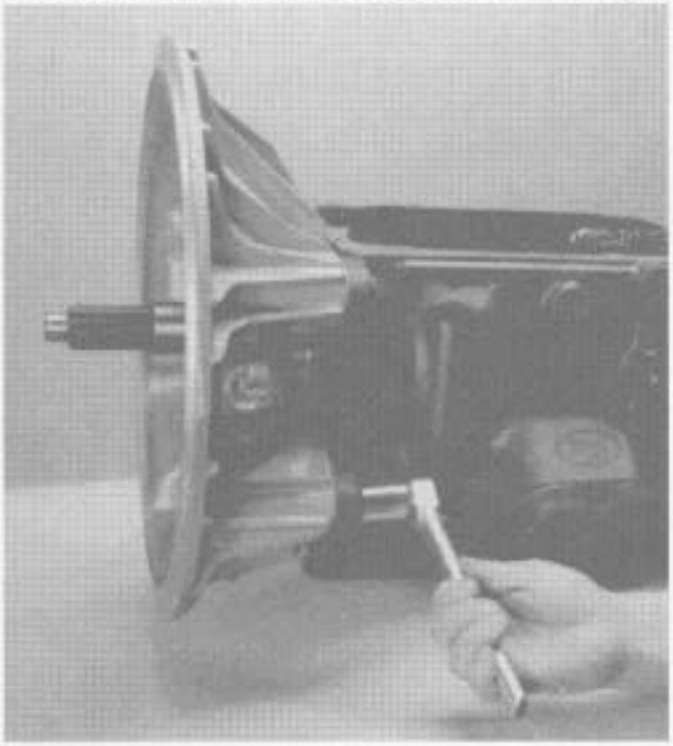
37. Place transmission in a vertical position as shown. Install yoke and nut. Tighten the yoke nut to recommended torque. Rotate the input shaft six times in each direction to seat the bearings and races.



38. Position a dial indicator as shown on the output shaft. Pry on the output flange and read the dial indicator to get the mainshaft end play. End play must be between .008-.012 (0.20-0.30 mm). Add shims to the front bearing cover for more end play or remove shims for less end play. After the correct end play is set remove the front bearing cover and shims. Coat both sides of the shims with a light coat of Loctite #510. Install the shims and the front bearing cover on the transmission case. Coat the front bearing cover capscrews with Loctite #262, install in the front bearing cover, and tighten to the recommended torque.

INSTALLATION - CLUTCH HOUSING

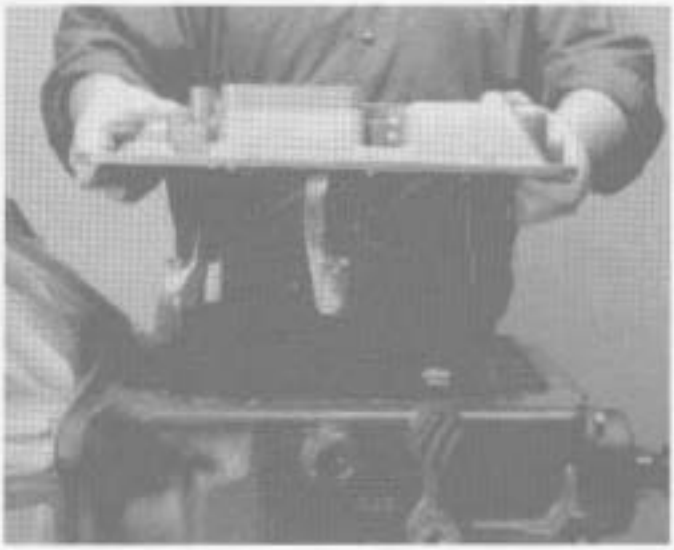
A. Installation of Clutch Housing



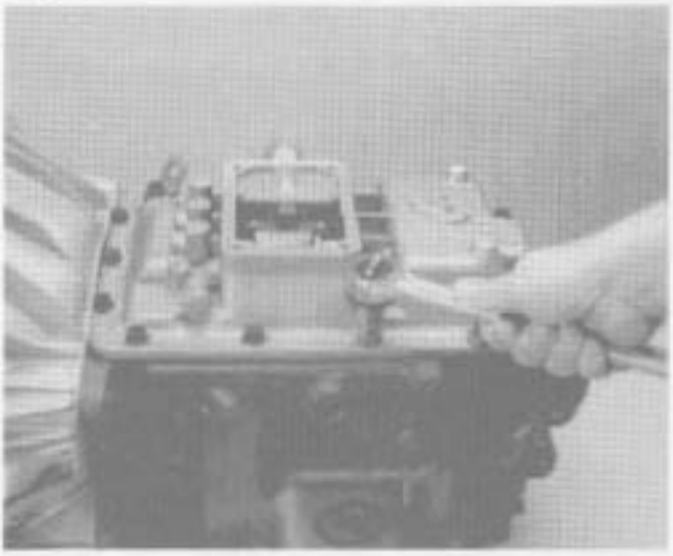
1. Position the transmission as shown. Place the clutch housing on the transmission case. Install the four retaining bolts and tighten to the recommended torque.

INSTALLATION - SHIFTING CONTROLS

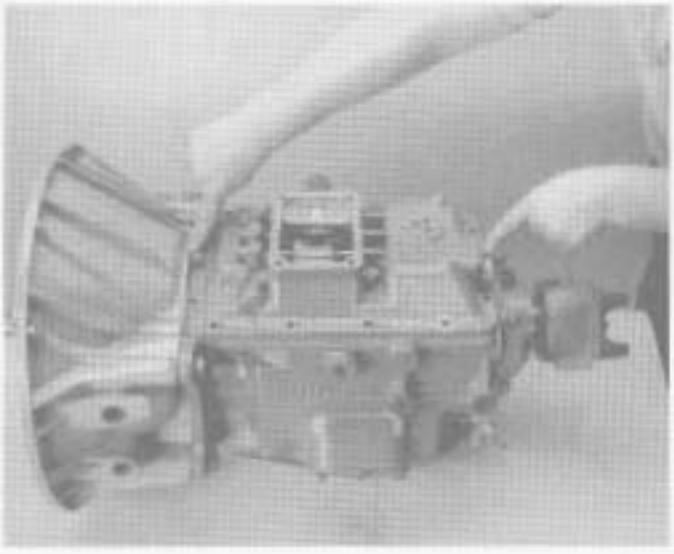
A. Installation of Shift Bar Housing and Gear Shift Lever



1. Place the transmission in neutral and install the gasket. Place the shift bar housing in neutral and install on case, make sure the shift yokes align with corresponding synchronizers and sliding clutch.



3. Install the remaining capscrews and tighten to the recommended torque.

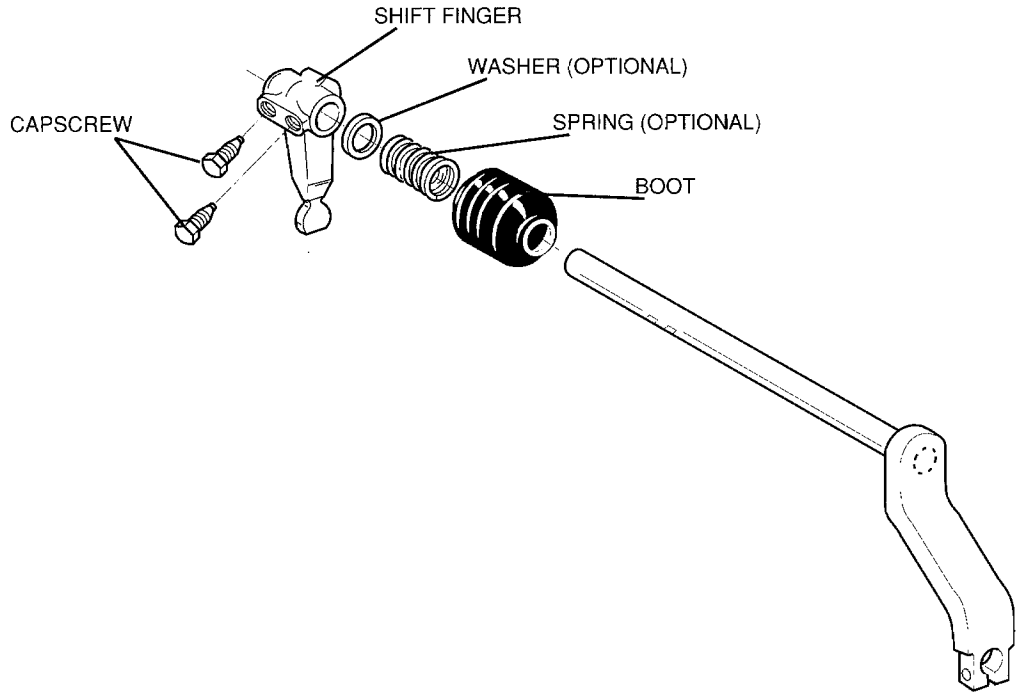


2. Apply Loctite #262 to threads of capscrews. Install two capscrews into shift bar housing alignment holes and tighten to the recommended torque.

4. Coat the retaining capscrews threads withLoctite #262 and install. Tighten the capscrews to the recommended torque.

OPTIONS

REMOTE SHIFT ARM



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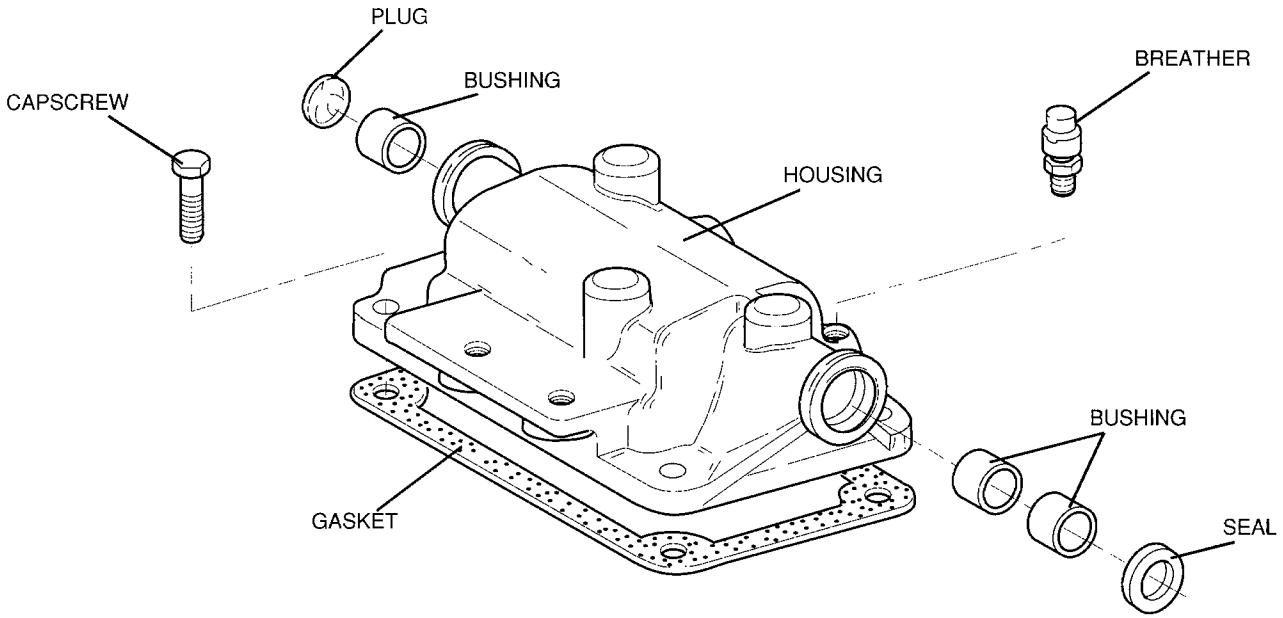
REMOTE CONTROL HOUSING ASSEMBLY



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