

# THREE-SPEED MANUAL TRANSMISSION

## "A" SERIES

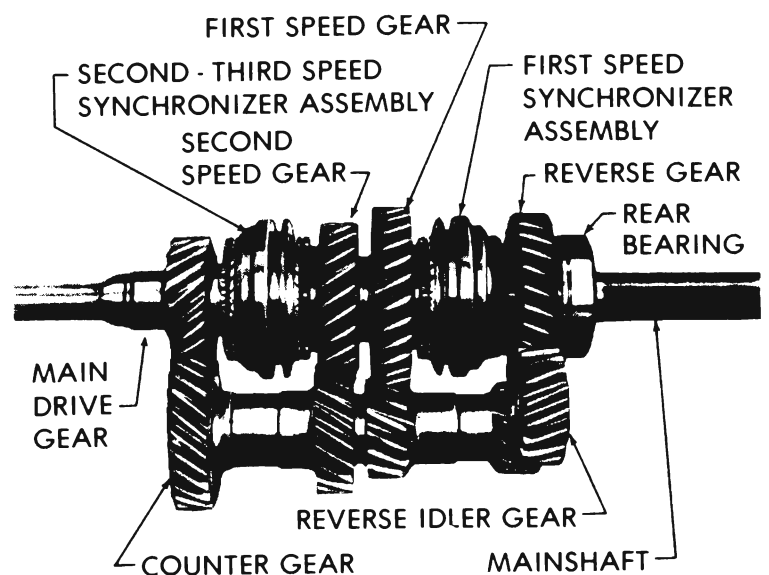
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## DESCRIPTION AND OPERATION

### DESCRIPTION OF THE 3-SPEED MANUAL TRANSMISSION

The "A" Series cars have as standard equipment a three-speed manually operated transmission with all forward gears synchronized. All forward speed changes are accomplished with synchronizer sleeves. See Figure 7B-1. The synchronizers permit quicker shifts, greatly reduce gear clash, and permit down shifting from third to second between 40-20 MPH and from second to first below 20 MPH. Power flow in all gears is shown in Figure 7B-36.



7B-1

Figure 7B-1-Gear Synchronizers

**TROUBLE DIAGNOSIS****TROUBLE DIAGNOSIS**

Complaint	Probable Cause
Noisy in Forward Speeds	<ol style="list-style-type: none"> <li>1. Low lubricant level.</li> <li>2. Incorrect lubricant.</li> <li>3. Transmission misaligned or loose.</li> <li>4. Main drive gear bearing worn or damaged.</li> <li>5. Counter gear or needle roller bearings worn or damaged.</li> <li>6. Main drive gear worn or damaged.</li> <li>7. Blocking rings worn or damaged.</li> </ol>
Noisy in "Reverse"	<ol style="list-style-type: none"> <li>1. Reverse idler gear or shaft, worn or damaged.</li> <li>2. Reverse gear worn or broken.</li> </ol>
Hard Shifting	<ol style="list-style-type: none"> <li>1. Clutch improperly adjusted.</li> <li>2. Shift linkage out of adjustment.</li> <li>3. Bent, damaged or loose shift linkage.</li> <li>4. Shift levers, shafts or forks worn.</li> <li>5. Incorrect lubricant.</li> <li>6. Blocking rings worn or broken.</li> </ol>
Jumping Out of Gear	<ol style="list-style-type: none"> <li>1. Shaft linkage out of adjustment, worn or loose.</li> <li>2. Partial engagement of gear.</li> <li>3. Transmission misaligned or loose.</li> <li>4. Bent or worn shift fork, lever and/or shaft.</li> <li>5. Worn pilot bearing.</li> <li>6. End play in main drive gear (bearing retainer loose or broken, loose or worn bearings on main drive gear and output shafts).</li> <li>7. Detent cam spring weak.</li> <li>8. Detent cam notches worn.</li> <li>9. Worn clutch teeth on main drive gear and/or worn clutch teeth on synchronizer sleeve.</li> <li>10. Worn or broken blocking ring.</li> <li>11. Bent output shaft.</li> </ol>
Sticking in Gear	<ol style="list-style-type: none"> <li>1. Clutch not releasing fully.</li> <li>2. Low lubricant level.</li> <li>3. Incorrect lubrication.</li> <li>4. Corroded transmission levers (shaft).</li> <li>5. Tight main drive gear pilot bearing.</li> <li>6. Frozen synchronizing blocking ring on main drive gear cone.</li> <li>7. Burred or battered teeth on synchronizer sleeve and/or main drive gear.</li> </ol>
Forward Gears Clash	<ol style="list-style-type: none"> <li>1. Clutch not releasing fully.</li> <li>2. Weak or broken springs in the synchronizer assembly.</li> <li>3. Worn blocking rings and/or cone surfaces.</li> <li>4. Broken blocking rings.</li> <li>5. Excessive rock of synchronizer assembly on mainshaft.</li> </ol>

Complaint	Probable Cause
Gears Spinning When Shifting Into Gear From "Neutral"	<ol style="list-style-type: none"> <li>1. Clutch not fully releasing.</li> <li>2. Binding main drive gear pilot bearing.</li> <li>3. Synchronizers not functioning.</li> </ol>
Reverse Gear Clash	<ol style="list-style-type: none"> <li>1. Allow approximately 3/4 seconds after the clutch pedal has been depressed before shifting into reverse gear.</li> <li>2. If gear clash continues after allowing proper time for the clutch plate to stop, check the clutch adjustment to make sure that it is within specifications.</li> <li>3. Make sure that the engine idle speed is set to specifications.</li> <li>4. Gear clash can also be caused by the following:                      Dragging clutch driven plate.                      Distorted clutch driven plate.                      Tight or frozen main drive gear bearing.</li> </ol>
Scored or Broken Gear Teeth	<ol style="list-style-type: none"> <li>1. Insufficient lubricant.</li> <li>2. Failure of the car operator to fully engage the gears on every shift before engaging the clutch and applying engine power.</li> </ol>

## REMOVAL AND INSTALLATION

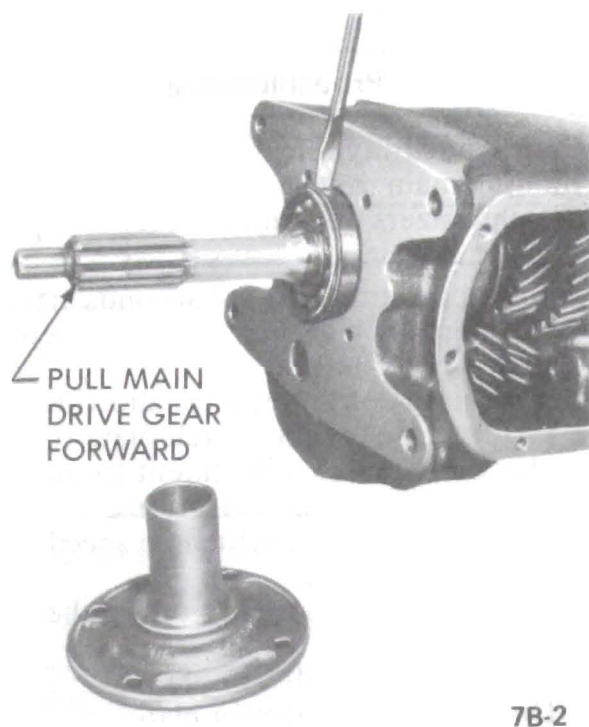
### REMOVAL AND INSTALLATION OF TRANSMISSION

#### Removal

1. Disconnect speedometer cable and remove driven gear and sleeve assembly.
2. Disconnect shift controls from transmission.
3. Remove propeller shaft.
4. Support rear of engine and remove transmission support.
5. Remove the two (2) top transmission to flywheel housing bolts and insert guide pins.
6. Remove the two (2) lower transmission to flywheel housing attaching bolts.
7. Slide transmission straight back on guide pins until the main drive gear is free of splines in the clutch driven plate. If guide pins are not used, damage to the clutch driven plate can result.
8. Remove transmission.

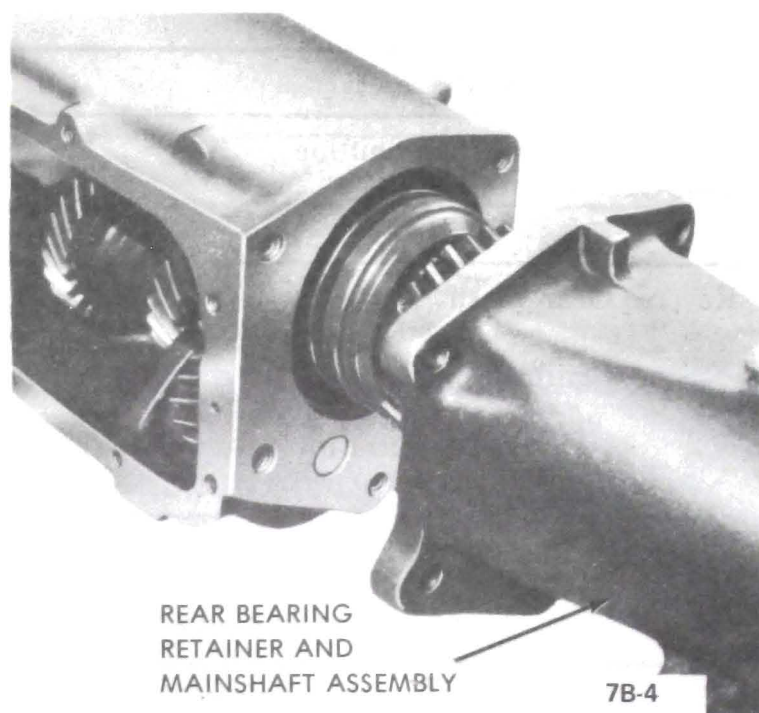
### INSTALLATION

1. Install guide pin in upper and lower right transmission to flywheel housing bolt holes for alignment and place transmission on guide pins. Place transmission in third gear and rotate transmission mainshaft as necessary to start main drive gear into clutch driven plate. Slide transmission forward. If guide pins are not used, damage to the clutch driven plate can result.
2. Install two (2) lower transmission mounting bolts. Remove guide pin and install two upper bolts. Torque bolts to 45-60 lb. ft.
3. Install transmission support.
4. Install propeller shaft.
5. Install speedometer driven gear and connector speedometer cable.
6. Connect linkage and adjust as described in Linkage Section.



7B-2

Figure 7B-2 Removing Front Main Bearing



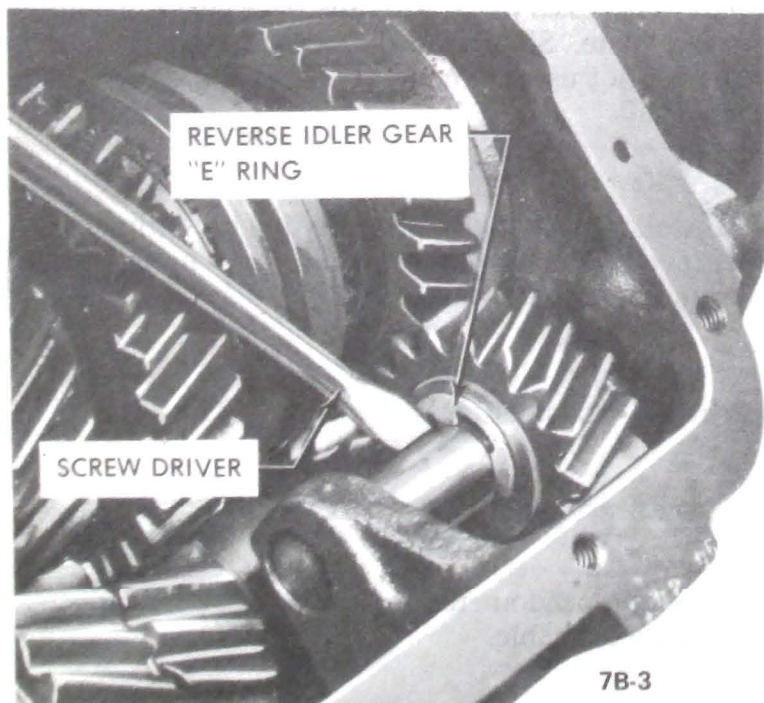
7B-4

Figure 7B-4 Removing Mainshaft Assembly

## OVERHAUL AND MAJOR SERVICE

### DISASSEMBLY OF TRANSMISSION

1. Drain lubricant.
2. Remove side cover attaching bolts. Remove side cover assembly and gasket.
3. Remove front main bearing retainer and gasket.
4. Remove front main bearing to main drive gear snap ring.



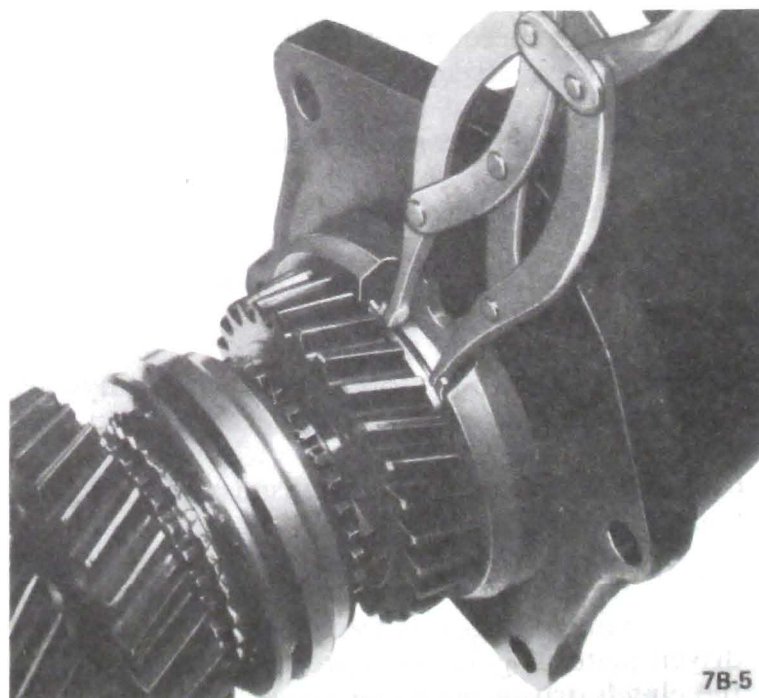
7B-3

Figure 7B-3 Removing Reverse Idler "E" Ring

5. Remove front main bearing by pulling main drive gear out of case as far as possible. See Figure 7B-2. Remove front bearing.

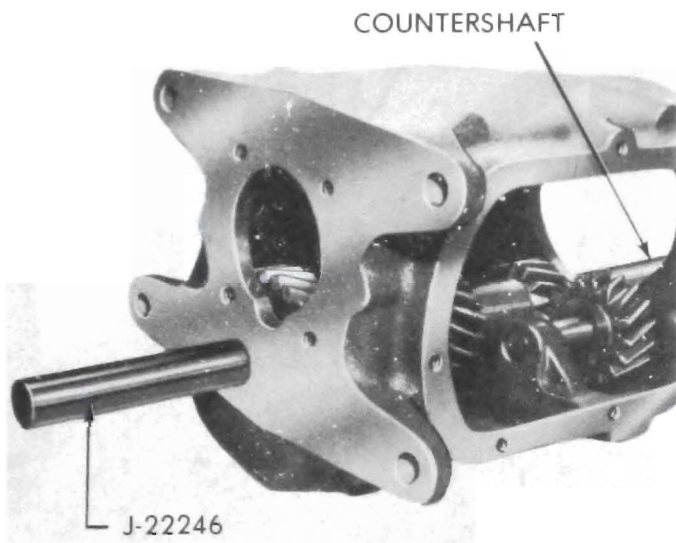
The front bearing is a slip fit on main drive gear. It may be necessary to aid removal with a screwdriver.

6. Remove reverse idler shaft to gear "E" ring. See Figure 7B-3.
7. Remove rear bearing retainer to case attaching bolts.
8. From rear of case, remove rear bearing retainer and mainshaft assembly. See Figure 7B-4.



7B-5

Figure 7B-5 Removing Rear Bearing Retainer



7B-6

Figure 7B-6 Removing Countershaft

9. Remove main drive gear, 14 needle bearings, and third speed blocking ring from mainshaft assembly.

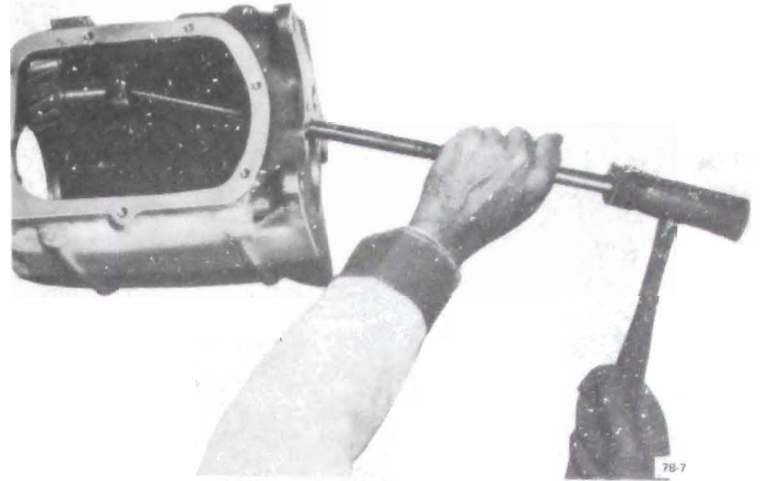
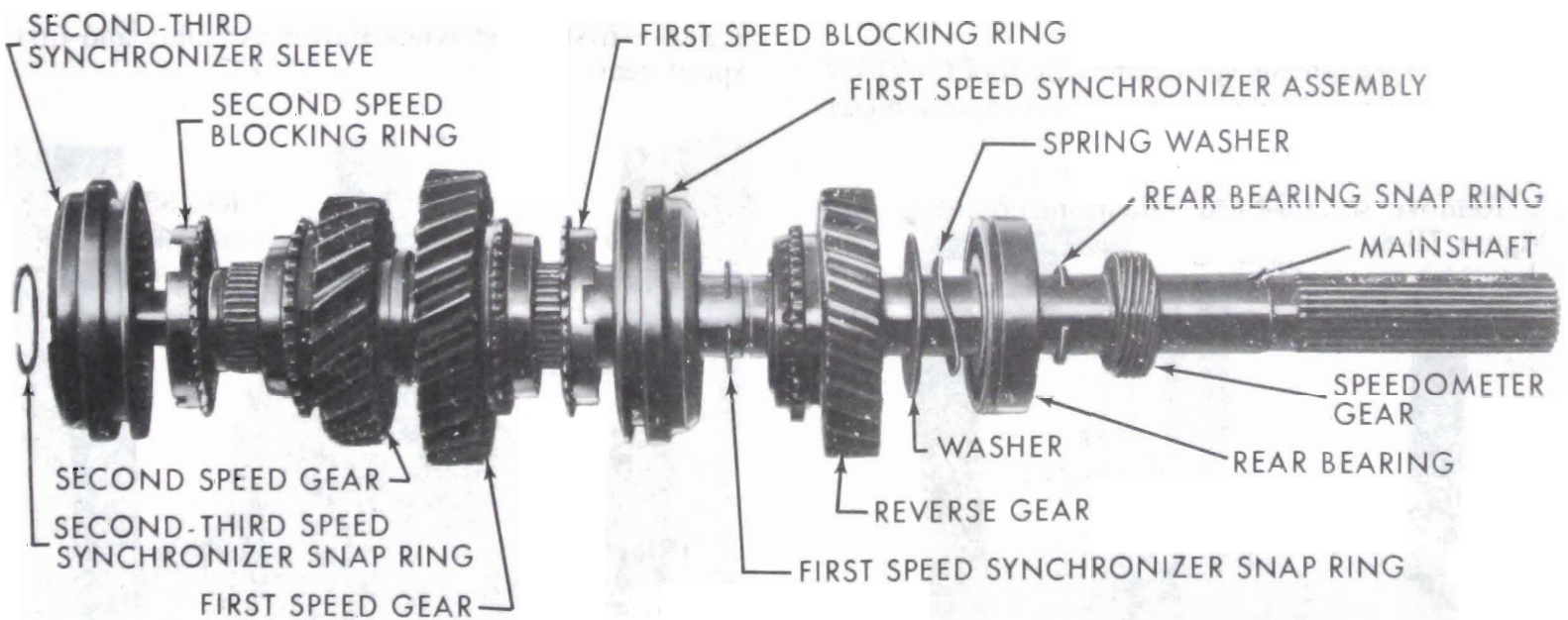


Figure 7B-7 - Removing Reverse Idler Shaft

10. Using snap ring pliers, expand snap ring at rear of bearing retainer which retains the rear bearing to the retainer. See Figure 7B-5. Remove rear bearing retainer.

11. Using Countershaft Alignment Tool J-22246, remove counter gear shaft and its woodruff key



7B-8

Figure 7B-8 - Exploded View of Mainshaft

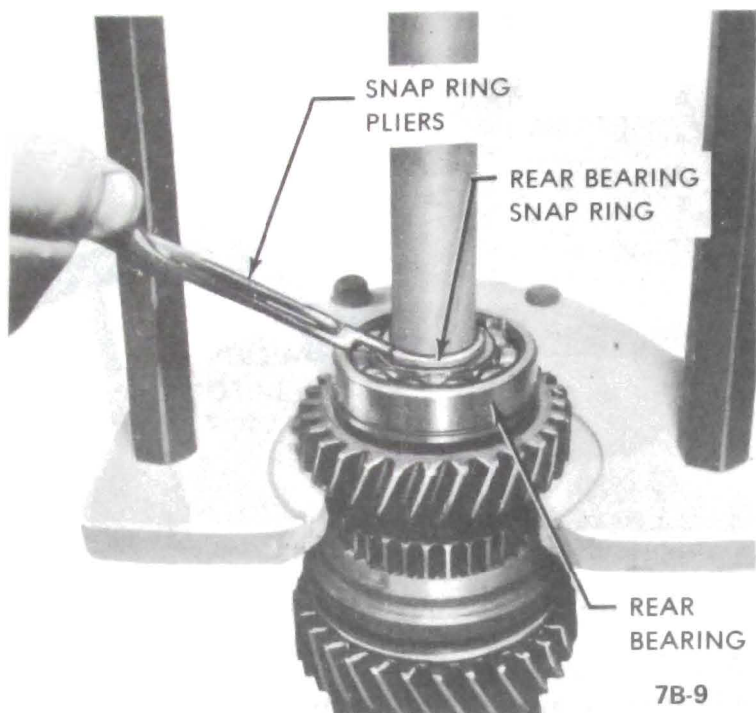


Figure 7B-9 - Removing Rear Bearing Snap Ring

through rear of case. See Figure 7B-6. Remove two (2) tanged bronze thrust washers.

12. Use a long brass drift and drive reverse idler shaft and woodruff key through rear of case. See Figure 7B-7.

13. Remove reverse idler gear tanged steel thrust washer.

## MAINSHAFT ASSEMBLY

### Disassembly

1. Install speedometer gear removing tool (J- 21427 and J-9578) on output shaft and remove speedometer gear.

2. Remove second-third synchronizer sleeve. See Figure 7B-8.

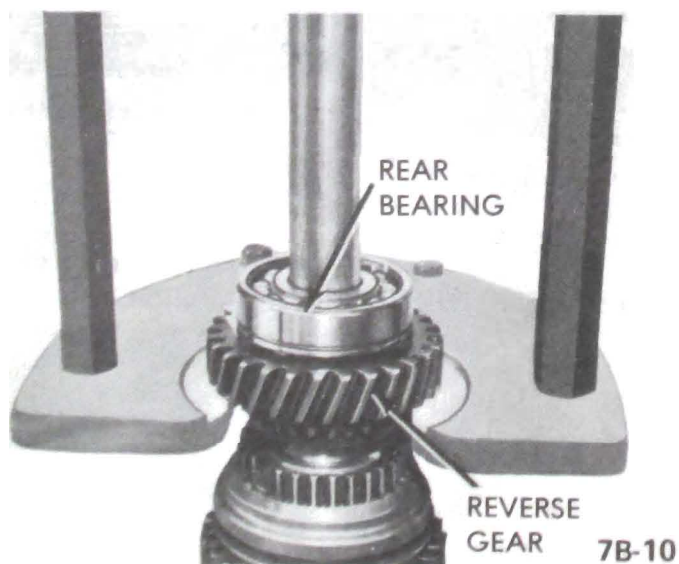


Figure 7B-10 - Removing Rear Bearing

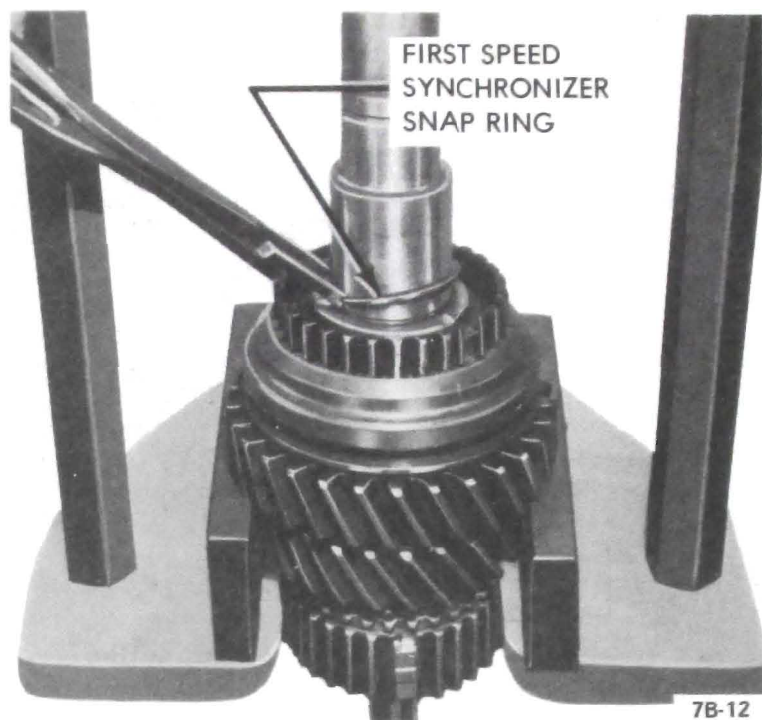


Figure 7B-12 - Removing First Speed Synchronizer Snap Ring

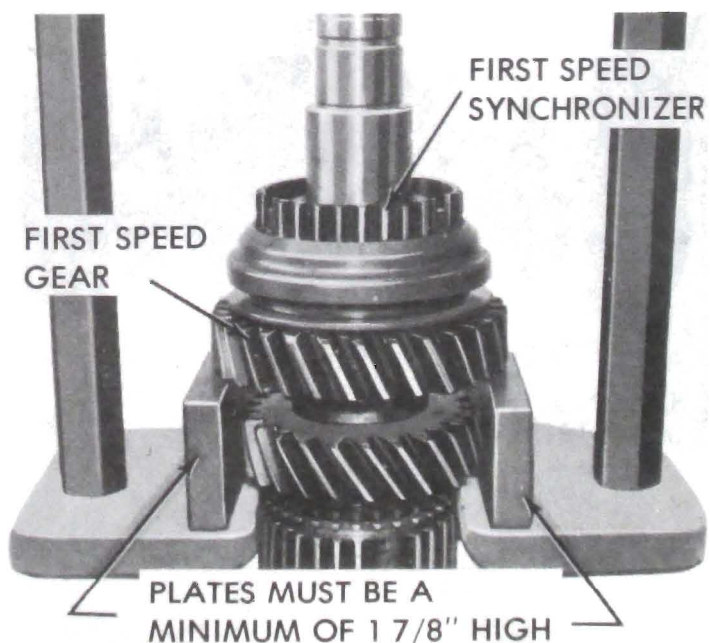
3. Remove rear bearing snap ring. See Figure 7B-9.

4. Using ram press or arbor press, remove rear bearing spring washer, thrust washer, and reverse gear. See Figure 7B-10.

5. Remove first speed synchronizer snap ring. See Figure 7B-12.

6. Support first speed gear on press plate using two (2) pieces of stock 6x1-7/8x1/4. See Figure 7B-13.

Remove first speed synchronizer assembly and first speed gear.



7B-13

Figure 7B-13 - Removing First Speed Synchronizer Assembly

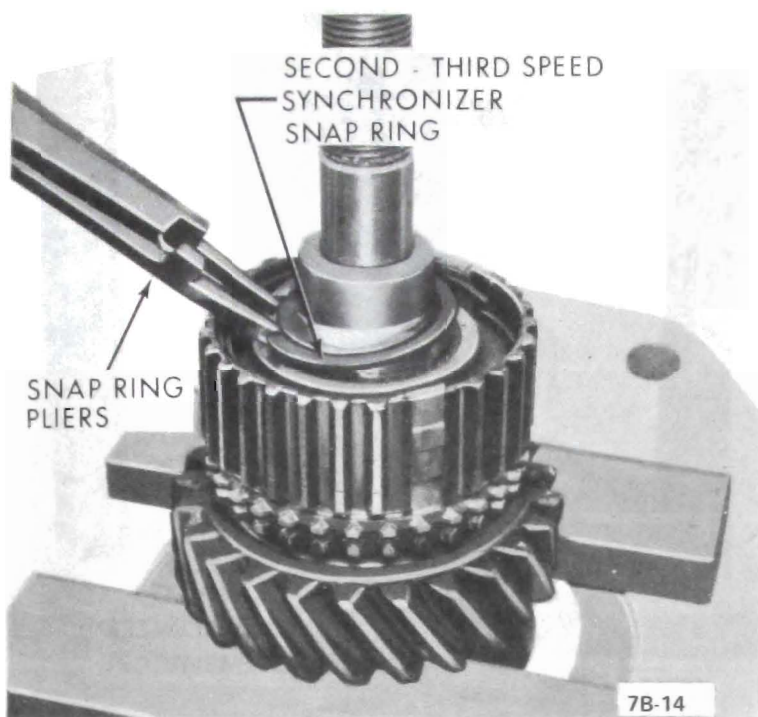


Figure 7B-14 - Removing Second-Third Speed Synchronizer Snap Ring

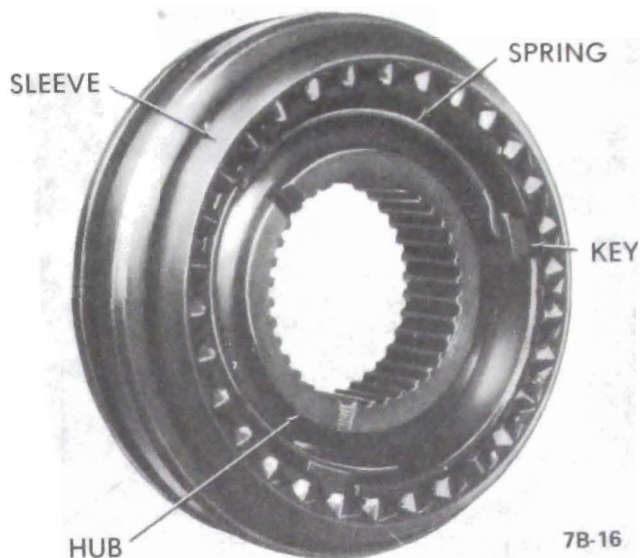


Figure 7B-16 - Synchronizer Assembly

7. Remove second-third speed synchronizer assembly snap ring. See Figure 7B-14.

8. Support second speed gear on press plate using two (2) pieces of stock 6x1-7/8x1/4. See Figure 7B-15. Remove second-third speed synchronizer assembly and second speed gear.

**Inspection**

1. Check synchronizer hubs, sliding keys and springs and, if necessary, replace as follows:

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled. The keys and springs must be replaced if worn or broken.

- a. Mark hub and sleeve with paint so they can be reassembled in the same position.
- b. Remove sliding sleeve from synchronizer hub. Remove keys and springs from the hub. See Figure 7B-16.
- c. Place the three (3) keys and two springs in position

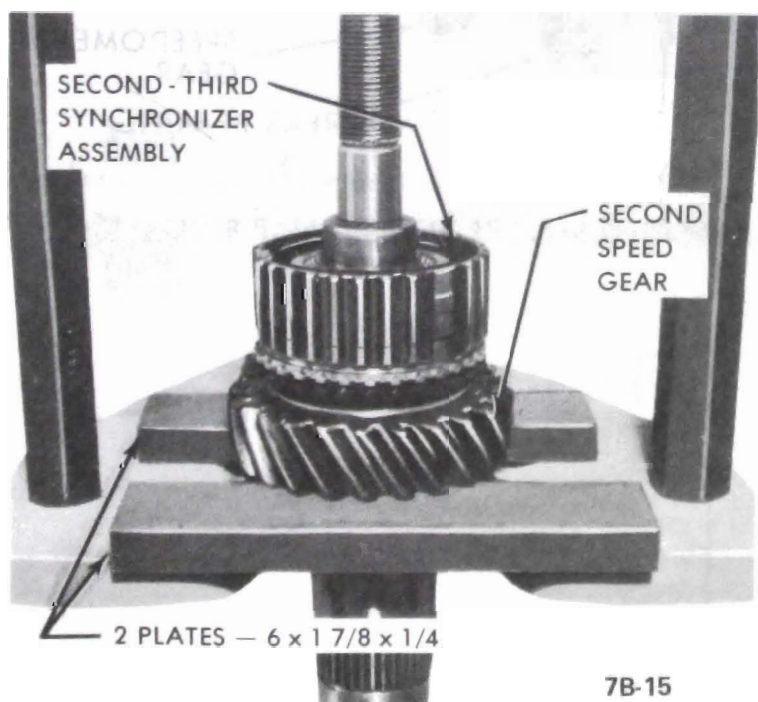


Figure 7B-15 - Removing Second-Third Speed Synchronizer Assembly

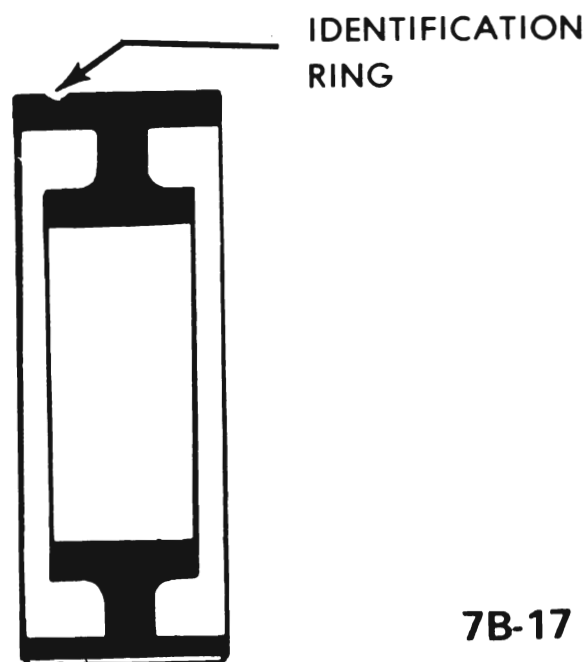


Figure 7B-17 - Identification Ring

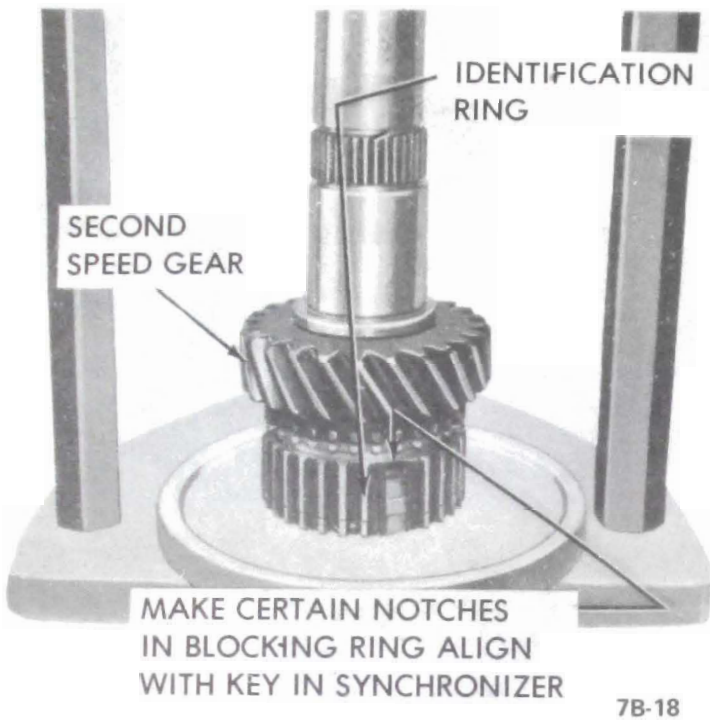


Figure 7B-18 - Installing Second Speed Gear

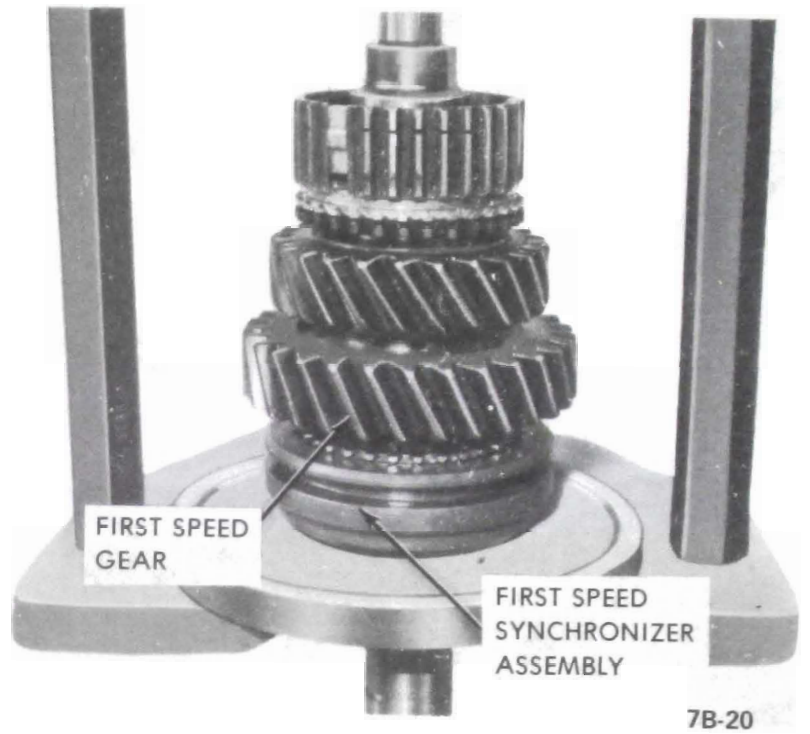


Figure 7B-20 - Installing First Speed Gear

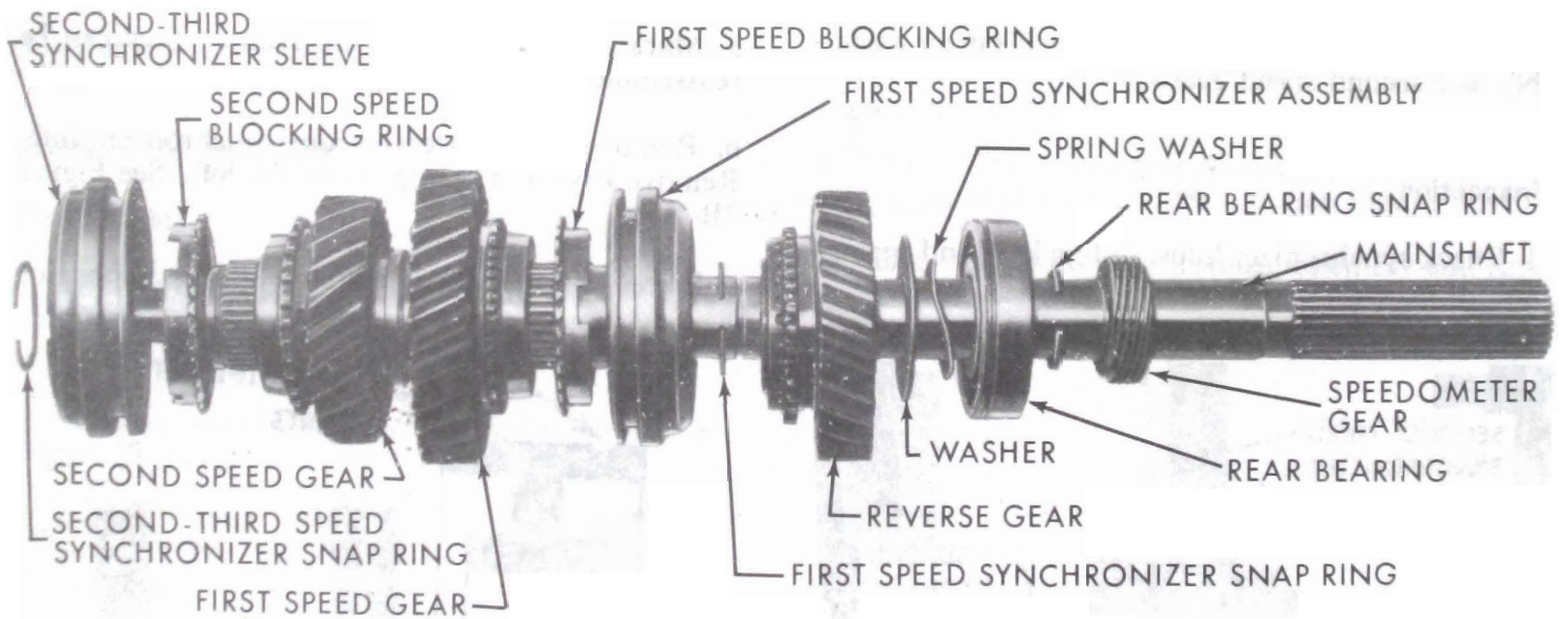


Figure 7B-19 - Exploded View of Mainshaft



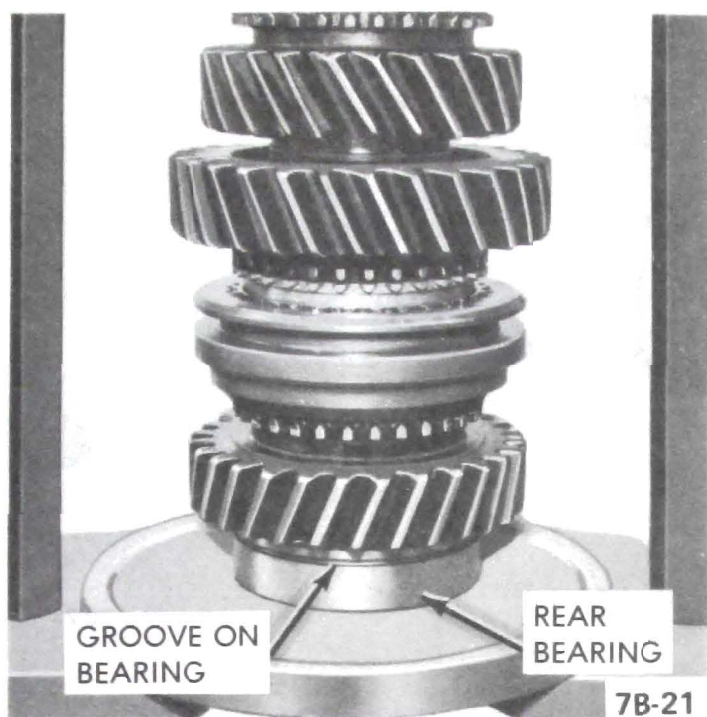


Figure 7B-21 - Installing Rear Bearing

(one on each side of hub) so all three (3) keys are engaged by both springs. See Figure 7B-16.

The tanged end of each synchronizer spring should be installed in different key cavities on either side of hub. Slide the sleeve onto the hub aligning the marks made before disassembly. An identification ring around the outside of the synchronizer hub splines identifies the end that must be opposite fork slot in sleeve. See Figure 7B-17.

2. Wash front and rear bearing thoroughly in a cleaning solvent. Blow out bearing with compressed air.

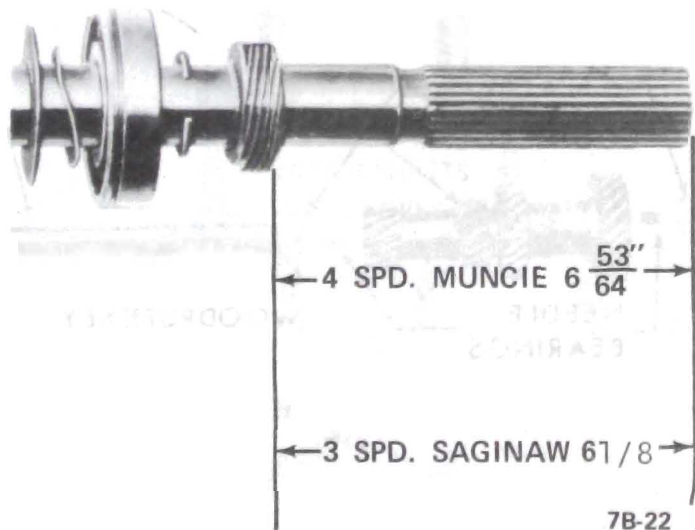


Figure 7B-22 - Installing Speedometer Drive Gear

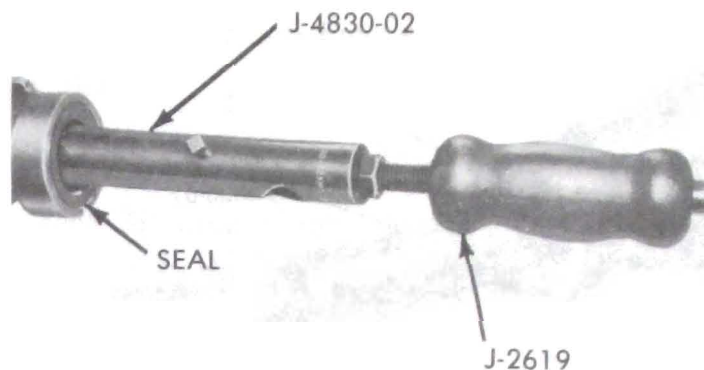


Figure 7B-23 - Removing Rear Bearing Retainer Oil Seal

Do not allow the bearings to spin; turn them slowly by hand. Spinning bearings will damage the race and balls.

Make certain bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

3. Check for cracks in blocking rings.

### Assembly

1. Install second speed gear blocking ring on mainshaft. Using ram press or arbor press and Press Plate J-8609, press second-third speed synchronizer assembly (with identification ring toward front of transmission) onto mainshaft. See Figure 7B-18. Install retaining snap ring.

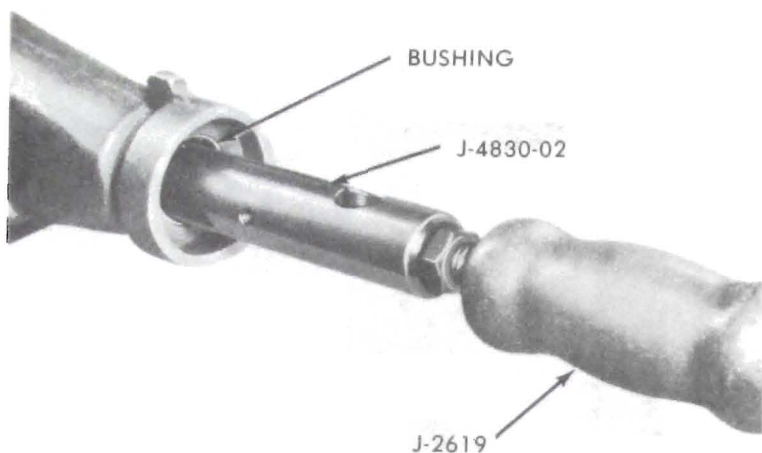
Make certain notches in blocking ring align with keys in synchronizer assembly.

2. Install first speed gear and synchronizer on mainshaft. See Figure 7B-20. Using ram press and Press Plate J-8609, press first speed synchronizer assembly (with identification ring toward rear of transmission) onto mainshaft. Install retaining snap ring. Make certain notches in blocking ring align with keys in first speed synchronizer assembly.

3. Install reverse gear, thrust washer, spring washer, and rear bearing. See Figure 7B-19.

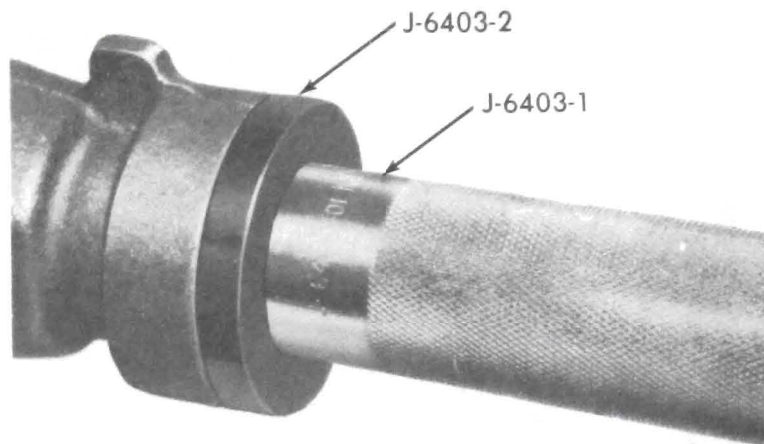
Groove on bearing must be toward reverse gear. Using ram press or arbor press, press rear bearing into position. See Figure 7B-21. Install retaining snap ring.

4. Install speedometer drive gear. Press to 6- 1/8". See Figure 7B-22.



7B-24

Figure 7B-24 - Removing Rear Bearing Retainer Bushing



7B-26

Figure 7B-26 - Installing Rear Bearing Retainer Oil Seal

5. Install second-third synchronizer sleeve. See Figure 7B-65.

**REAR BEARING RETAINER SEAL AND BUSHING**

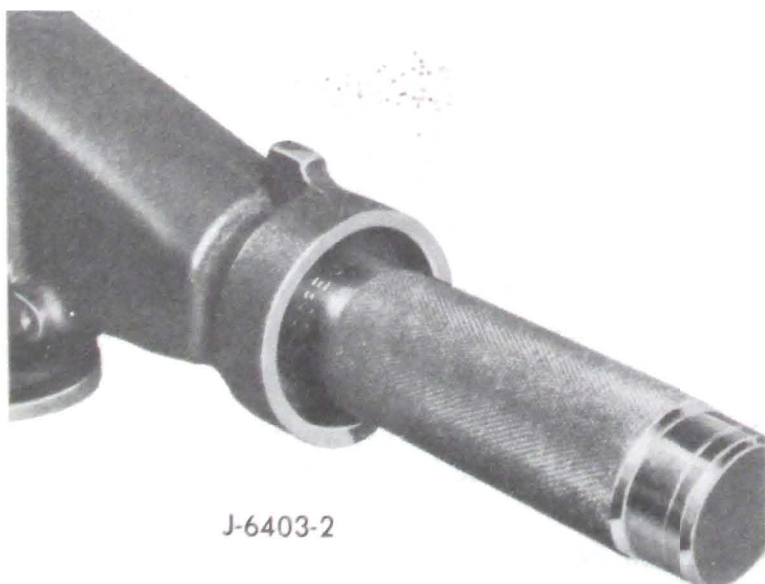
**Removal**

1. Using J-2619 Slide Hammer and J-4830-02 Puller, remove rear bearing retainer oil seal. See Figure 7B-23.
2. Using J-2619 Slide Hammer and J-4830-02 Puller, remove rear bearing retainer bushing. See Figure 7B-24.

**Installation**

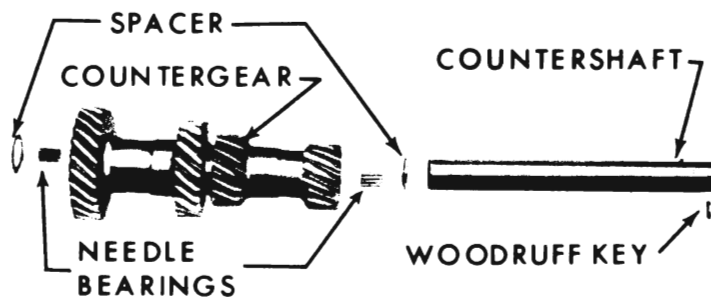
1. Install rear bearing retainer bushing, using Tool J-6403-1. See Figure 7B-25.
2. Install rear bearing retainer oil seal as follows:
  - a. Install J-6403-2 onto J-6403-1. Flat side of J-6403-2 must be toward rear of J-6403-1. See Figure 7B-26.

Install oil seal.



7B-25

Figure 7B-25 - Installing Rear Bearing Retainer Bushing



7B-27

Figure 7B-27 - Exploded View of Countergear

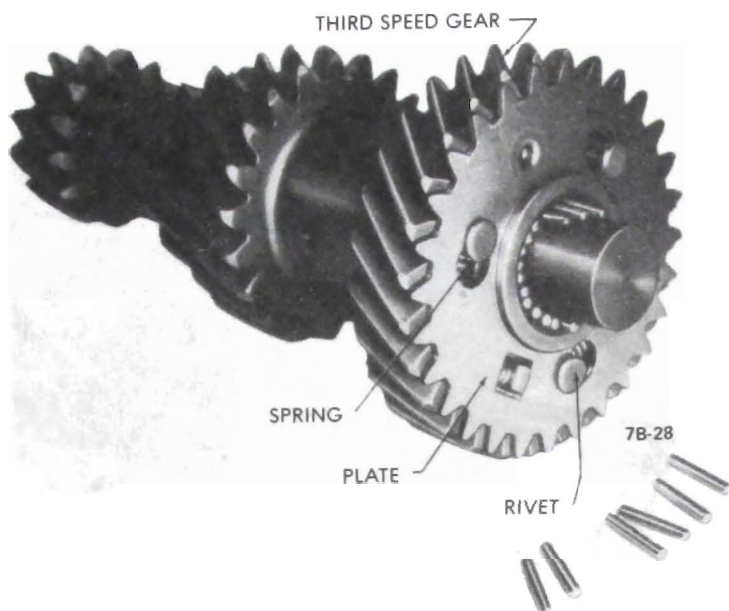


Figure 7B-28 - Anti-Rattle Gear

### COUNTERGEAR ASSEMBLY

#### Disassembly

1. Remove Countershaft Alignment Tool J-22246.

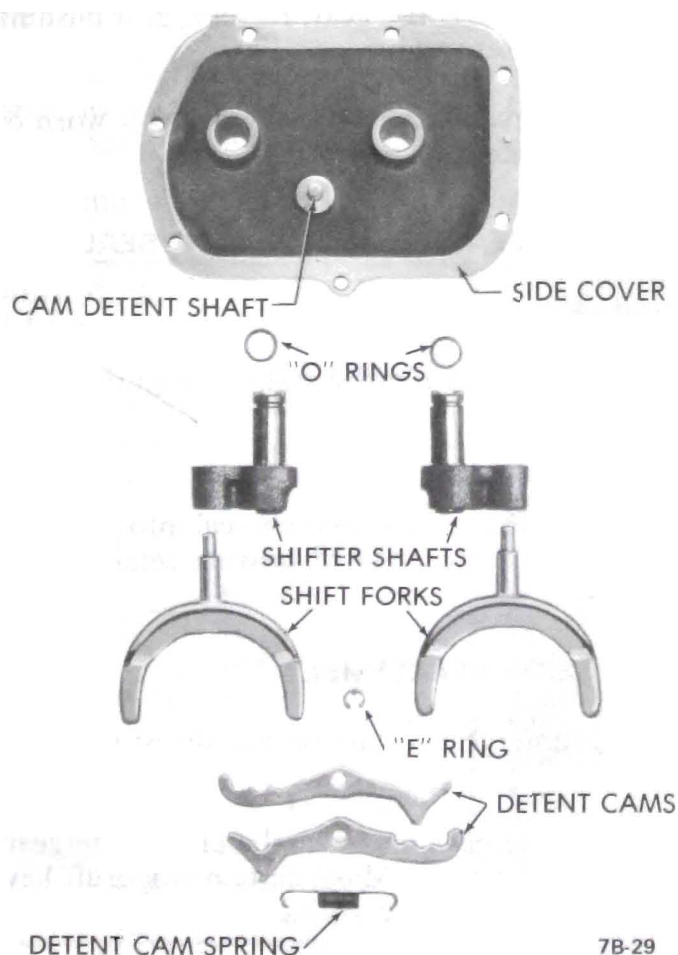


Figure 7B-29 - Exploded View of Side Cover

2. From each end of countershaft, remove spacer and 27 needle bearings. See Figure 7B-27.

#### Inspection

1. Check for broken needle bearings.
2. Check for broken anti-rattle gear springs. The anti-rattle gear is riveted to the countergear and is not serviced separately. See Figure 7B-28.

#### Assembly

1. Install Countershaft Alignment Tool J-22246.
2. From each end of countergear, install 27 needle bearings and spacer. Use heavy grease to retain needle rollers. See Figure 7B-27.

### SIDE COVER ASSEMBLY

#### Disassembly (See Figure 7B-29)

1. Remove detent cam spring.
2. Remove shifter forks.
3. Remove shifter shafts.
4. Remove detent cam retainer.
5. Remove detent cams.
6. Inspect shifter shaft "O" rings and replace if necessary.

#### Assembly (See Figure 7B-29)

1. Install shifter shaft "O" rings, if removed.
2. Install detent cams.
3. Install detent cam retainer.
4. Install shifter shafts.
5. Install shifter forks.
6. Install detent cam spring.

Detent cams, shifter shafts and forks are interchangeable.

### CLEANING AND INSPECTION OF TRANSMISSION PARTS

#### Transmission Case

1. Wash the transmission case thoroughly inside and outside with a suitable cleaning solvent; then inspect case for cracks.



7B-30

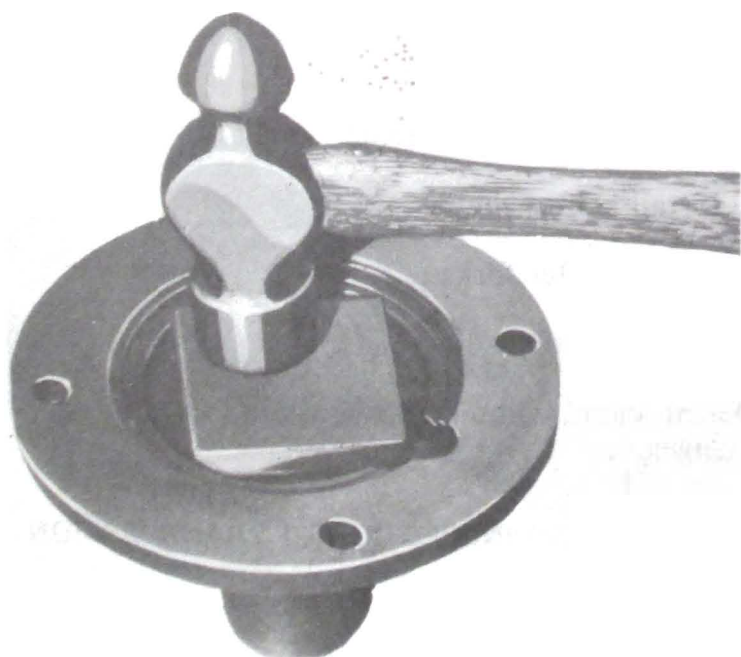
Figure 7B-30 - Removing Front Bearing Retainer Seal

2. Check front and rear faces for burrs, and if present, remove with a fine mill file.

3. Check and clean magnet in bottom of transmission case.

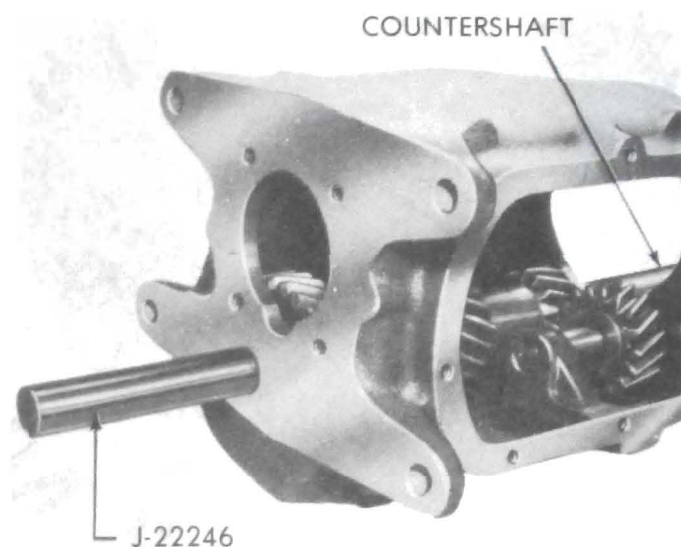
### Needle Bearings

All main drive gear and countergear needle bearings should be inspected closely and replaced if they show wear.



7B-31

Figure 7B-31 - Installing Front Bearing Retainer Seal



7B-32

Figure 7B-32 - Installing Countergear Shaft

### Transmission Gears

1. Inspect all gears for excessive wear, chips or cracks.

2. Inspect reverse gear bushing and if worn or damaged, replace the entire gear. Reverse gear bushing is not serviced separately.

3. Inspect reverse idler gear bushing and if worn or damaged, replace the entire gear.

### FRONT MAIN BEARING RETAINER OIL SEAL

#### Removal

1. Using screwdriver remove seal. See Figure 7B-30.

#### Installation

1. Using a suitable tool, drive new seal into position. Lip of seal must face rear of bearing retainer. See Figure 7B-31.

### TRANSMISSION REASSEMBLY

1. Install countergear to case bronze thrust washers.

2. Install countergear into case. Install countergear shaft from rear of case. Make certain woodruff key is in position. See Figure 7B-32.

3. Install reverse idler gear tanged steel thrust washer. Install reverse idler gear, shaft and woodruff

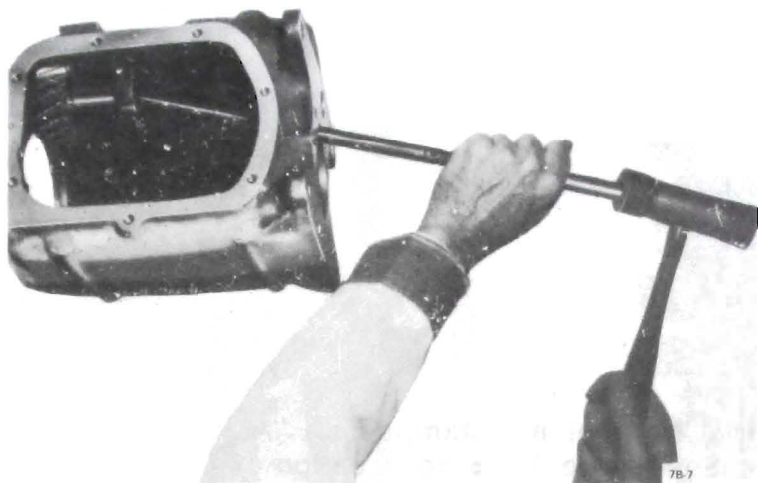


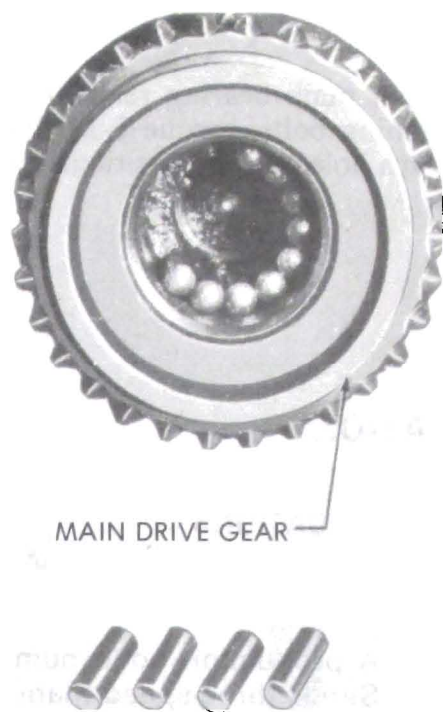
Figure 7B-33 - Installing Rear Bearing Retainer

key. Reverse idler gear snap ring will be installed after installation of mainshaft.

4. Install the rear bearing retainer. Spread snap ring in the retainer to allow the snap ring to drop around rear bearing. See Figure 7B-33. Press on end of mainshaft until the snap ring engages groove in rear bearing.

5. Install fourteen (14) needle bearings in main drive gear, using heavy grease to hold the bearings in place. See Figure 7B-34.

6. Assemble third speed blocking ring on main drive gear.



7B-32

Figure 7B-34 - Installing Needle Roller Bearings

7. Pilot main drive gear and third speed blocking ring over front of mainshaft. Make certain notches in blocking ring align with keys in second-third synchronizer assembly.

8. Using heavy grease, install rear bearing retainer to case gasket.

9. Install rear bearing retainer and mainshaft assembly into case. Install bearing retainer to case bolts. Torque 35-55 lb.ft.

10. Install front main bearing onto main drive gear. Outer snap ring groove must be toward front of gear.

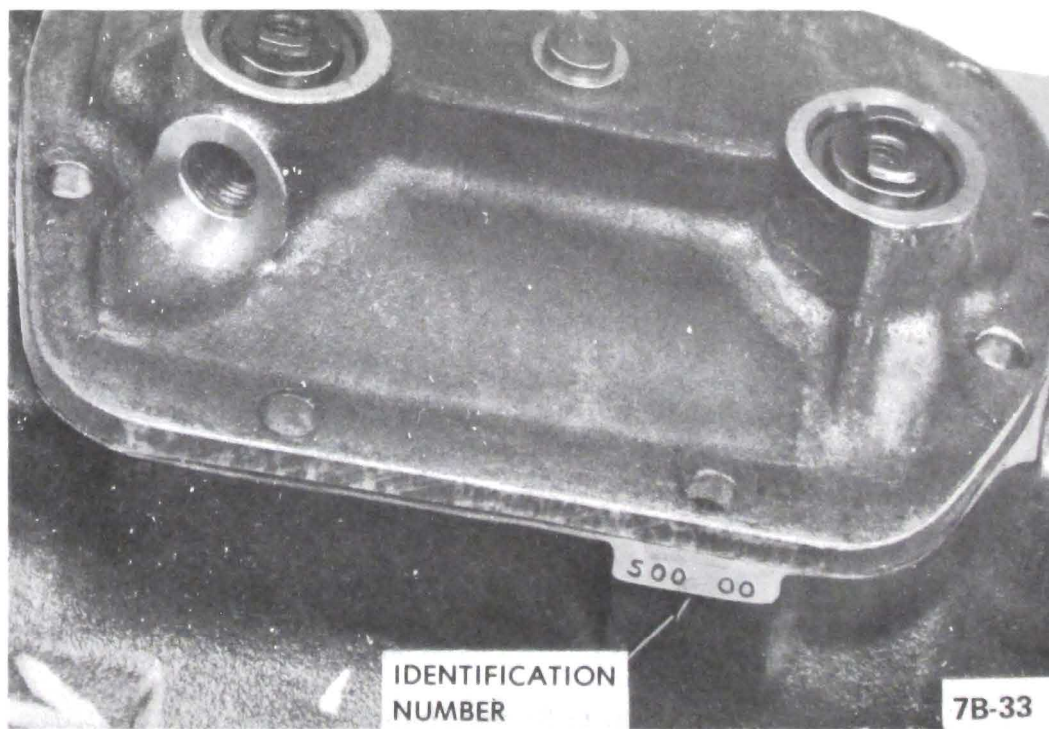
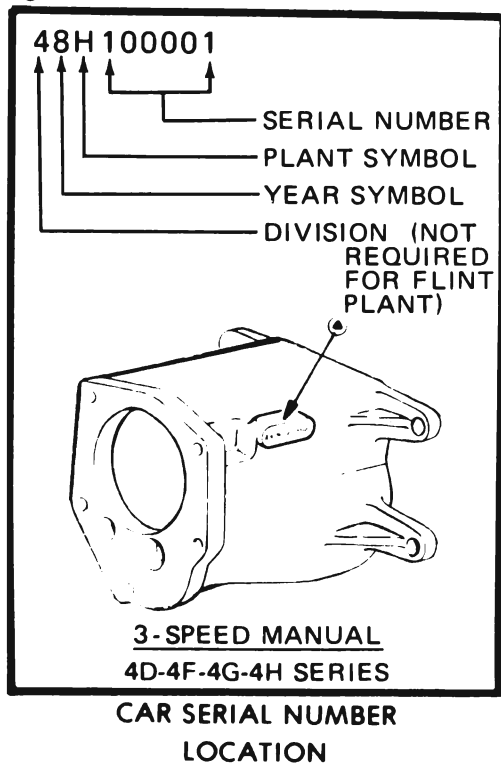


Figure 7B-35 Transmission Identification Number Location

11. Install retaining snap ring.

12. Install front main bearing retainer, gasket and four (4) attaching bolts, torque 8-12 lb.ft. The retainer oil return hole must be positioned toward bottom of case.

13. Install reverse idle gear "E" ring.

14. Install new side cover gasket. Place transmission in neutral and install side cover. Install attaching bolts and tighten evenly to avoid side cover distortion. Torque 8-12 lb.ft.

## SPECIFICATIONS

### GENERAL SPECIFICATIONS

#### Transmission Identification

A production code number and Car Serial Number are stamped on "A" Series three-speed manual transmissions. See Figure 7B-35 for location of these numbers.

These numbers should always be furnished on all product reports, AFA forms, and all correspondence with the factory concerning a particular transmission.

#### B. General Specifications

Type .....	All Forward Gears Synchronized
Mounting .....	Unit With Engine
Lubricant	
Type .....	SAE 80 or 90 Multi-Purpose
Capacity .....	3 1/2 Pints
Synchronization .....	1st, 2nd and 3rd
Gear Ratios .....	V-8
1st .....	2.54:1
2nd .....	1.50:1
3rd .....	1.00:1
Reverse .....	2.63:1
Gear Shifting .....	On Steering Column
Speedometer Drive Gear .....	Nylon

#### Bolt Tightening Specifications

Use a reliable wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Location	Thread Size	Torque Lbs.Ft.
Front Main Bearing Retainer .....	5/16-18 x 3/4	12-18
Side Cover to Case .....	5/16-18 x 3/4	12-18
Rear Main Bearing Retainer .....	7/16-14 x 1-1/8	35-55
Shift Lever to Shifter Shaft Bolts .....	3/8-16 x 1	20-30
Lubrication Filler Plug .....	1/2-14	10-15
Transmission Case to Flywheel Housing .....	7/16-14 x 1-1/4	45-60

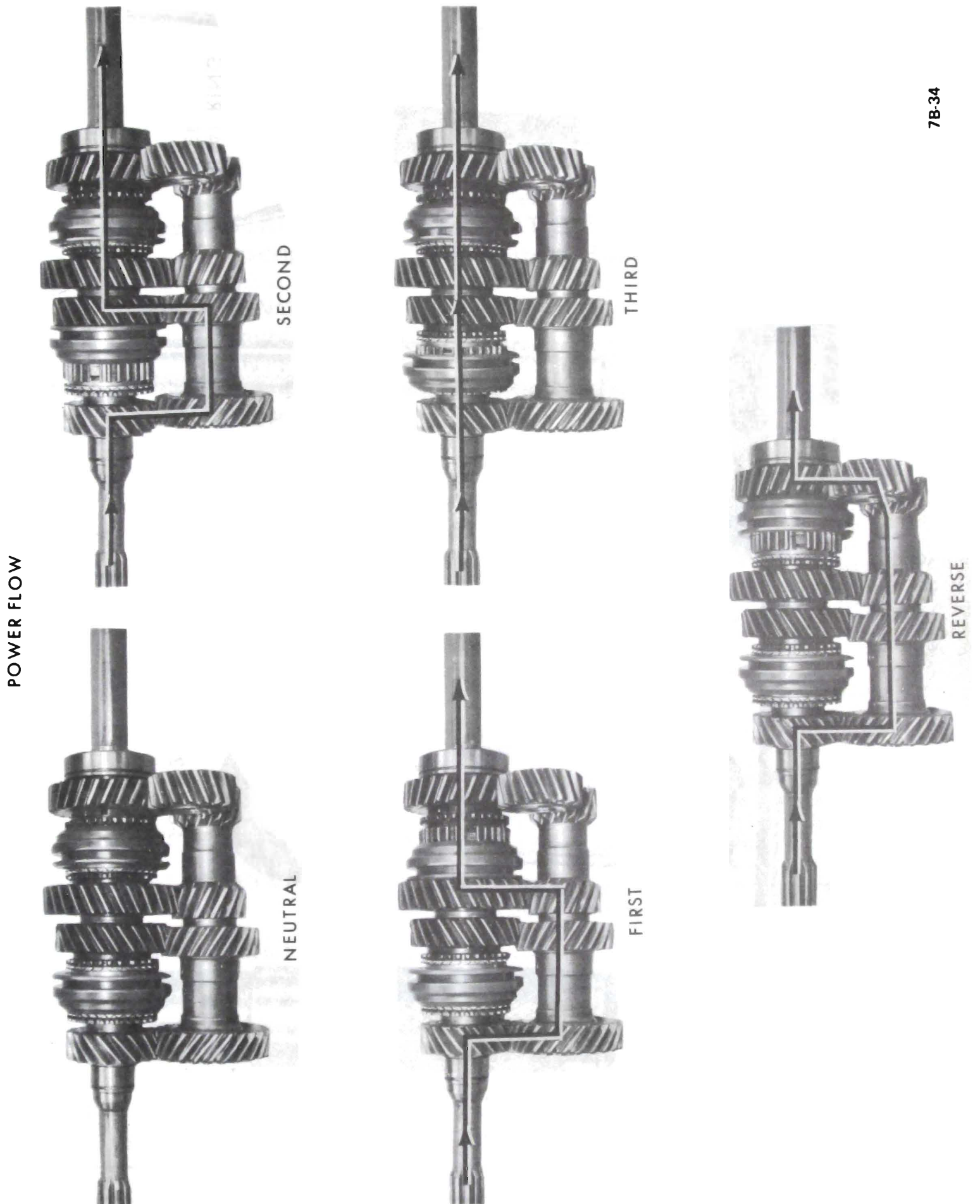


Figure 7B-36 Power Flow

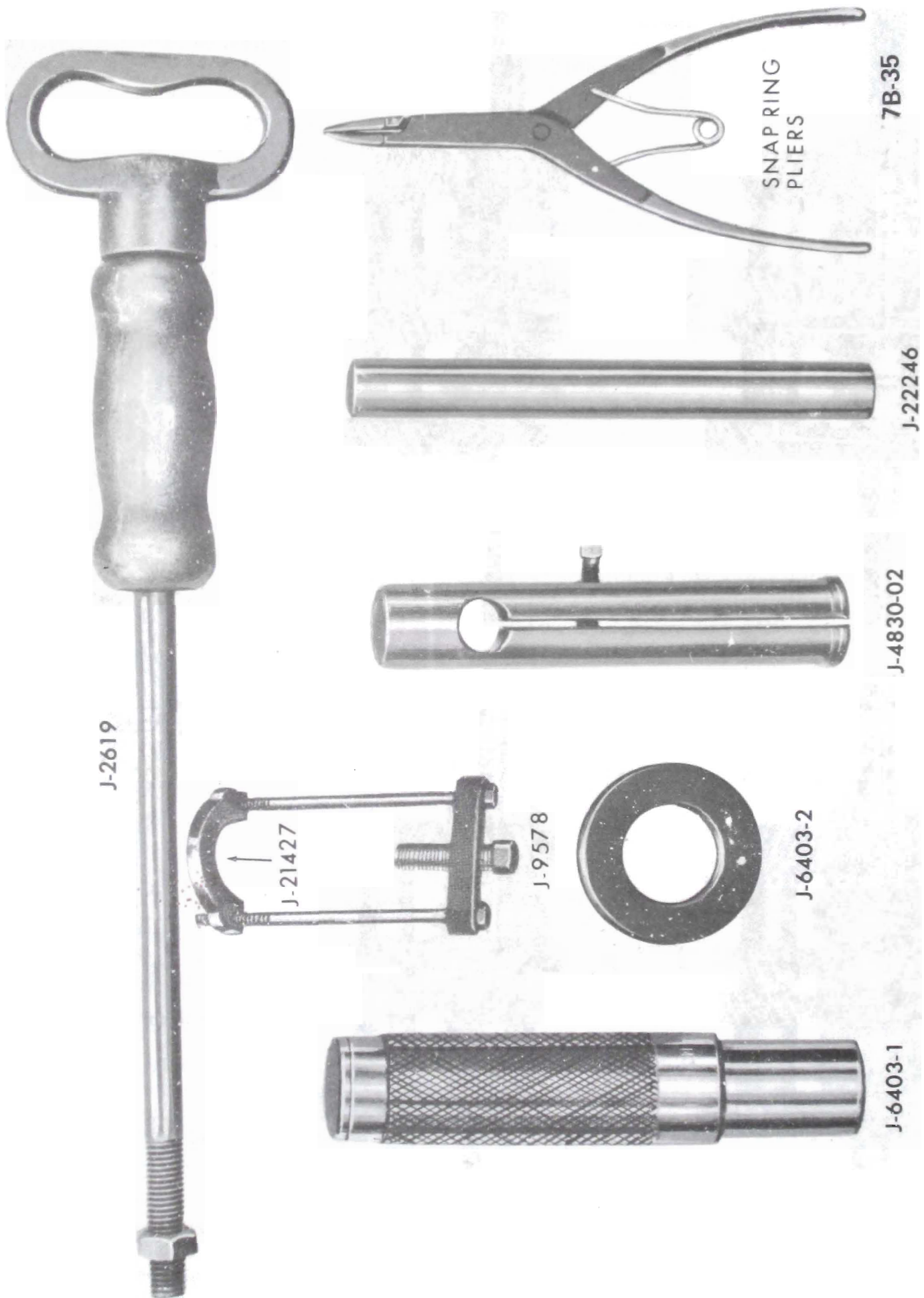


Figure 7B-37 Tool Picture



# FOUR-SPEED MANUAL TRANSMISSION

## "A" SERIES

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### DESCRIPTION AND OPERATION

#### DESCRIPTION AND OPERATION OF THE G.S.

#### AND G.S. STAGE 1 4-SPEED MANUAL TRANSMISSION

The G.S. will have as optional equipment a four-speed manually-operated transmission. All four forward gears are provided with synchronizing assem-

blies, see Figure 7B-61, which can be engaged while the car is in motion. Closely spaced gear ratios provide excellent ratio matching with minimum loss of engine speed at shift points.

Reverse gear is not synchronized; therefore, vehicle must be brought to a complete stop before engaging reverse gear.

Power flow in all gears is shown in Figure 7B-62.

### TROUBLE DIAGNOSIS

#### FOUR-SPEED MANUAL TRANSMISSION

#### TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Shifts Hard	1. Clutch not releasing engine or slow to release.	1. Adjust or repair clutch.

Condition	Possible Cause	Correction
	2. Shift linkage binding.	2. Free-up and adjust as required.
Shifts Hard on Downshift	1. Downshifting at too high an engine speed.	1. Shifting into low gear above 45 mph and second above 65 mph causes extra work for synchronizing assemblies and will require extra time. There is also danger of over-speeding the engine if low or second is used at high car speeds.
Disengages From Gear	1. Dirt between transmission case and clutch housing.	1. Clean mating surfaces.
	2. Does not fully engage.	2. Check linkage for interference. Adjust. See Section 73, or replace damaged shift linkage.
	3. Clutching teeth worn or defective and/or clutch hub spline worn.	3. Replace gear, clutch sleeve and clutch hub.
Noisy	1. Gears worn, scored or broken.	1. Replace gears.
	2. Bearing dirty, worn.	2. Flush transmission with kerosene. If noise is still present, replace bearings and examine gears as above.
	3. Interference of clutch sleeve with countergear.	3. Replace worn shift forks, countergear and idler gear thrust washers to restore gears and clutch sleeve to proper location. Examine thrust faces on these gears for wear. Replace if worn excessively.
Leaks Lubricant	1. Excessive amount of lubricant in transmission.	1. Drain to correct level.
	2. Loose or broken main drive gear bearing retainer.	2. Tighten or replace retainer.
	3. Front main bearing retainer gasket damaged.	3. Replace gasket.

Condition	Possible Cause	Correction
	4. Cover loose or gasket damaged.	4. Tighten cover or replace gasket.
	5. Operating shaft seal leaks.	5. Replace operating shaft seal.
	6. Countershaft loose in case.	6. Replace case.
	7. Lack of sealant on bolts.	7. Coat bolts with sealant.
	8. Worn extension oil seal.	8. Replace seal.
Excessive Backlash In All Reduction Gears	1. Worn countergear bearings.	1. Replace countergear bearings and shaft.
	2. Excessive end play in countergear.	2. Replace countergear thrust washers.
Noisy In All Reduction Gears	1. Insufficient lubricant.	1. Fill to correct level.
	2. Worn or damaged main drive gear or countergear.	2. Replace faulty or damaged gears.
Noisy In All Gears	1. Insufficient lubricant.	1. Fill to correct level.
	2. Worn countergear bearings.	2. Replace countergear bearings and shaft.
	3. Worn or damaged main drive gear and countershaft drive gear.	3. Replace worn or damaged gears.
	4. Damaged main drive gear or mainshaft ball bearings.	4. Replace damaged bearings.
	5. Damaged speedometer gears.	5. Replace damaged gears.
Noisy in High Gear	1. Damaged front main bearing.	1. Replace damaged bearing.
	2. Damaged rear bearing.	2. Replace damaged bearing.
	3. Damaged speedometer gears.	3. Replace speedometer gears.

Condition	Possible Cause	Correction
Noisy In "Neutral" With Engine Running	1. Damaged front main bearing.	1. Replace damaged bearing.
	2. Damaged mainshaft pilot bearing.	2. Replace damaged bearing.

## REMOVAL AND INSTALLATION

### REMOVAL AND INSTALLATION OF TRANSMISSION

#### Removal

1. Disconnect speedometer cable and remove driven gear.
2. Disconnect shift controls from transmission.
3. Remove propeller shaft.
4. Support rear of engine and remove transmission support.
5. Remove the two (2) top transmission to flywheel housing bolts and insert guide pins.
6. Remove two (2) lower transmission to flywheel housing attaching bolts.
7. Slide transmission straight back on guide pins until main drive gear is free of splines in clutch driven plate. If guide pins are not used damage to the clutch driven plate can result.
8. Remove transmission.

#### Installation

1. Install guide pin in upper and lower right transmission to flywheel housing bolt holes for alignment and place transmission on guide pins. Place transmission in third gear and rotate transmission mainshaft as necessary to start main drive gear into clutch driven plate. If guide pins are not used, damage to clutch driven plate can result.
2. Install two (2) lower transmission mounting bolts. Remove guide pin and install two (2) upper bolts. Torque bolts to 45 to 60 lb.ft.
3. Install transmission support.

4. Install propeller shaft.

5. Install speedometer driven gear, and connect speedometer cable.

6. Connect linkage and adjust as described in Group 73.

## OVERHAUL AND MAJOR SERVICE

### DISASSEMBLY OF TRANSMISSION

1. Remove side cover attaching bolts. Remove side cover assembly and gasket. Drain lubricant.
2. Remove two (2) bolt lock strips from main bearing retainer. Remove front main bearing retainer and gasket.
3. Remove main drive gear retaining nut. See Figure 7B-40 using Tool J-933.

Retaining nut has lefthand threads. Aid removal of retaining nut by locking up transmission. This can best be accomplished by placing transmission in two gears at once.

4. With transmission gears in neutral, drive lock pin from bottom side of reverse shifter lever boss and pull shaft out about 1/8". This disengages the reverse shift fork from reverse gear. See Figure 7B-41.

5. Remove six bolts attaching case extension to rear bearing retainer. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.

6. Remove rear section of reverse idler gear, shaft and tanged thrust washer.

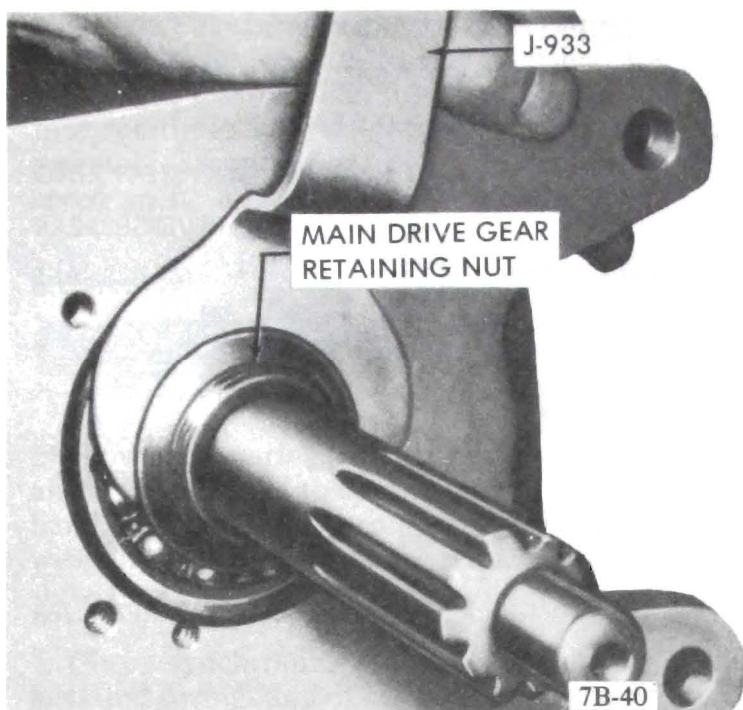


Figure 7B-40 - Removing Main Drive Gear Retaining Nut

7. Install speedometer gear, removing Tool J-21427 and J-9578 on output shaft and remove speedometer gear.

8. Remove reverse gear.

9. Slide third-fourth synchronizer sleeve to fourth speed position (forward).

10. Carefully remove rear bearing retainer and entire mainshaft assembly from case by tapping bearing retainer with a soft hammer.

11. Unload 17 needle roller bearings and cage from main drive gear and remove fourth speed blocking

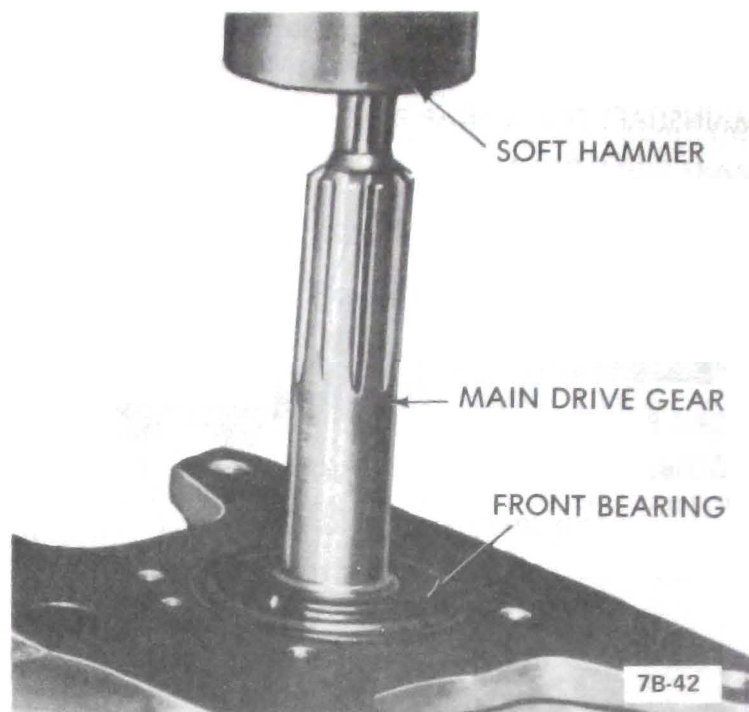


Figure 7B-42 - Removing Main Drive Gear

ring.

12. Lift the front reverse idler gear and thrust washer from case.

13. With soft hammer, tap main drive gear down from front bearing as shown in Figure 7B-42.

14. From inside case, tap out front bearing and snap ring.

15. From front of case, tap out countershaft, using countershaft alignment tool J-22246 as shown in Figure 7B-43. Remove the countergear and both tanged washers.

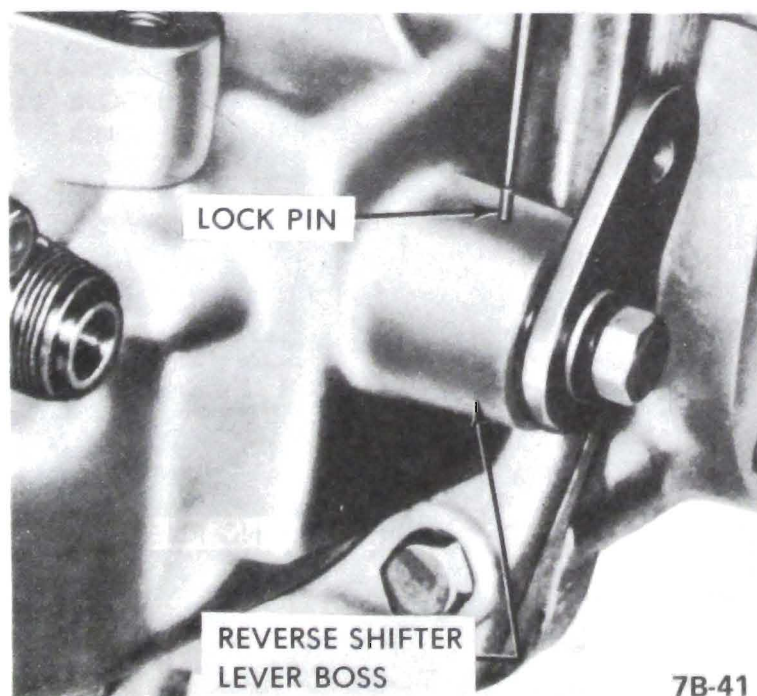


Figure 7B-41 - Removing Shifter Shaft Lock Pin

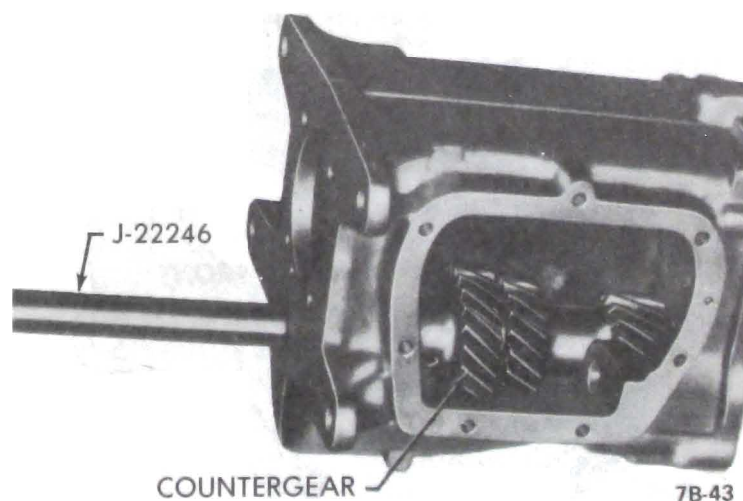
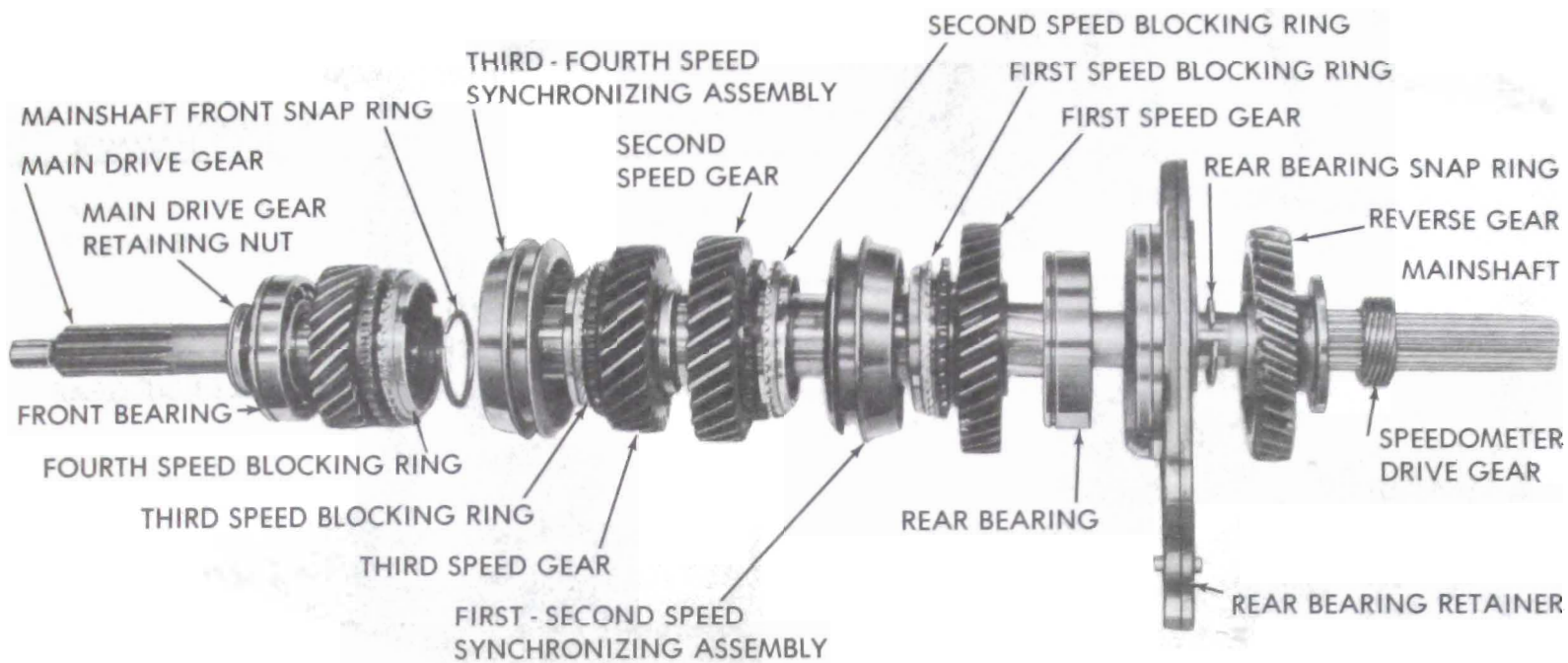


Figure 7B-43 - Removing Countergear With Tool J-22246



7B-45

Figure 7B-45 - Exploded View of Main Shaft Assembly

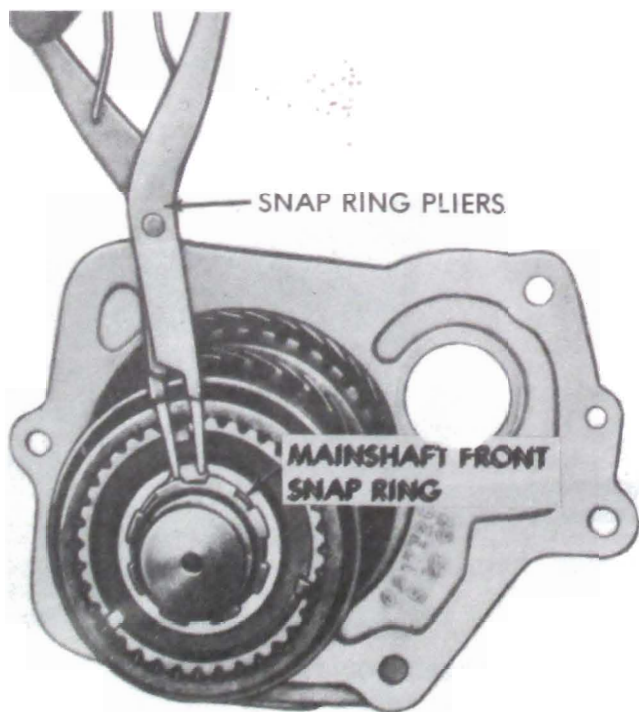
**MAINSHAFT ASSEMBLY**

**Disassembly - Refer to Figure 7B-45**

1. Remove mainshaft front snap ring. See Figure 7B-46 and remove third-fourth speed synchronizing assembly by holding synchronizing assembly and tapping front of mainshaft with a plastic hammer. Remove third speed gear and blocking ring from

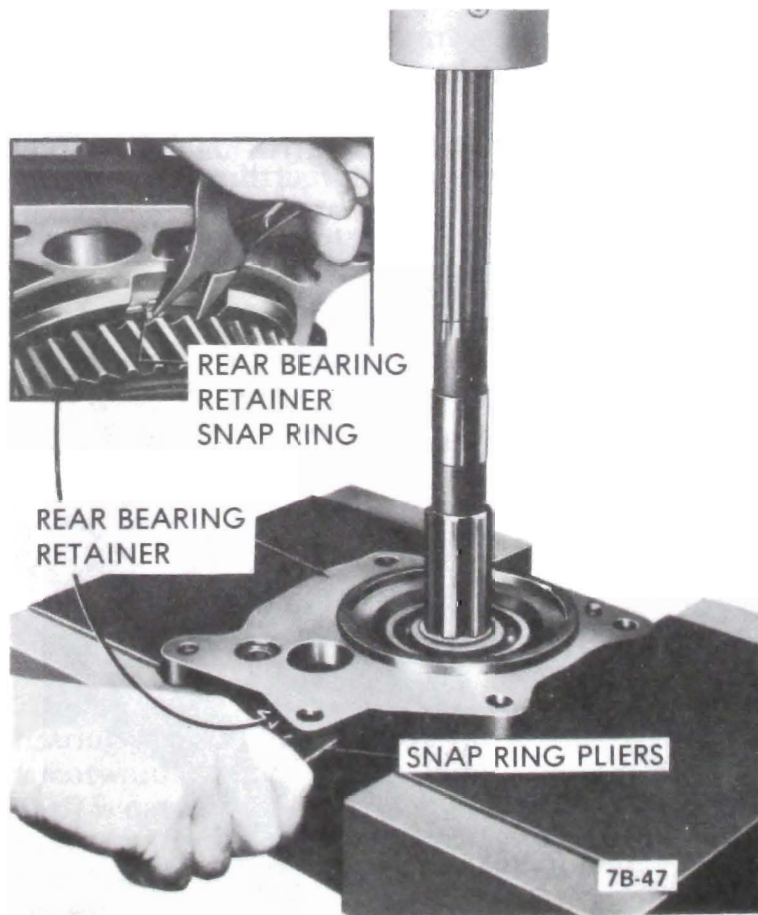
front of mainshaft.

2. Spread rear bearing retainer snap ring and press mainshaft out of retainer. See Figure 7B-47.



7B-46

Figure 7B-46 - Removing Main Shaft Front Snap Ring



7B-47

Figure 7B-47 - Removing Rear Bearing From Retainer

3. Remove rear bearing snap ring. Support second speed gear and press on rear of mainshaft to remove shaft from rear bearing, first speed gear and sleeve, first speed blocking ring, first-second synchronizer assembly, second speed blocking ring, and second speed gear.

**Inspection**

1. Wash the front and rear bearings thoroughly in a suitable cleaning solvent.
2. Blow out bearings with compressed air. Do not allow the bearings to spin, but turn them slowly by hand. Make certain bearings are clean, then lubricate with light engine oil and check for roughness by slowly turning the race by hand.
3. Check synchronizer hubs, sliding sleeves, sliding keys and springs and, if necessary, replace as follows:

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled. The keys and springs may be replaced if worn or broken.

- a. Mark hub and sleeve so they can be reassembled in the same position.

The sleeve with the chamfered edge opposite fork slot identifies the third-fourth synchronizer sleeve.

- b. Remove sliding sleeve from synchronizer hub.
- c. Place three (3) keys and two springs in position

(one on each side of hub) so all three (3) keys are engaged by both springs. Synchronizer springs should be installed so tanged end of each spring falls into the same key in the hub. Slide the sleeve onto the hub aligning the marks made at disassembly.

**Assembly - Refer to Figure 7B-45**

1. From rear of mainshaft, assemble second speed gear (with hub of gear toward rear of shaft).
2. Install first-second speed synchronizer assembly onto mainshaft (sliding sleeve taper toward the rear, fork slot toward front), together with a blocking ring on either side so their keyways line up with the clutch keys. See Figure 7B-48.
3. Press first gear sleeve onto mainshaft.
4. Install first speed gear (with hub toward front). Press on rear bearing with the snap ring groove toward front of transmission.
5. Choose the correct selective fit snap ring (.087", .090", .093", or .096") and install it in the groove in mainshaft behind the rear bearing. With proper ring, maximum distance between snap ring and rear face of bearing must be from zero to .005". Always use the new snap rings when reassembling transmission and do not expand the snap ring further than is necessary for assembly.
6. Install third speed gear (hub to front of transmission) and third speed gear blocking ring (notches to front of transmission).

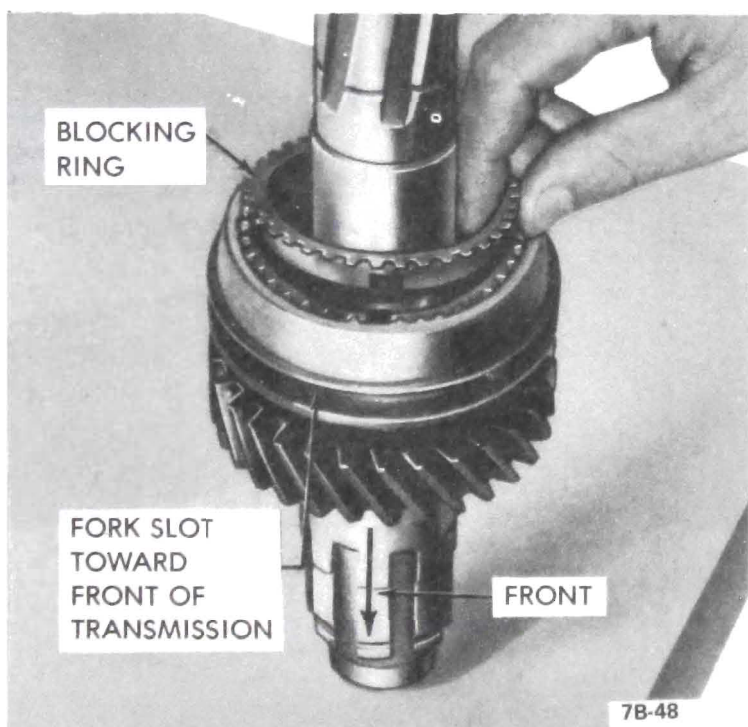


Figure 7B-48 - Installing Blocking Ring

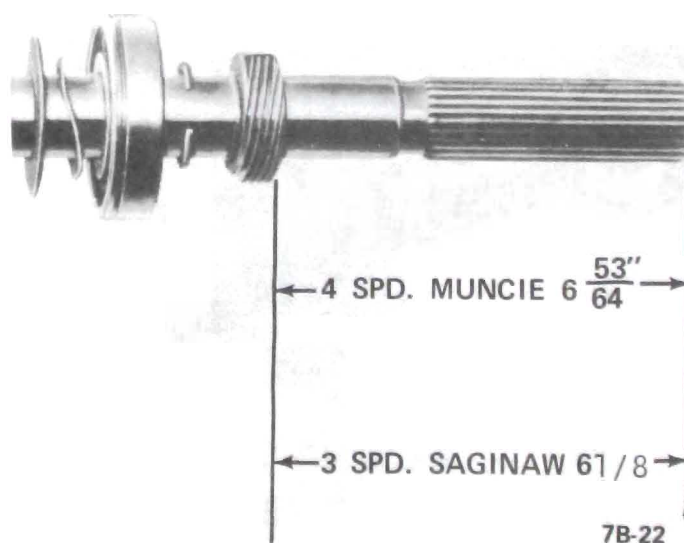
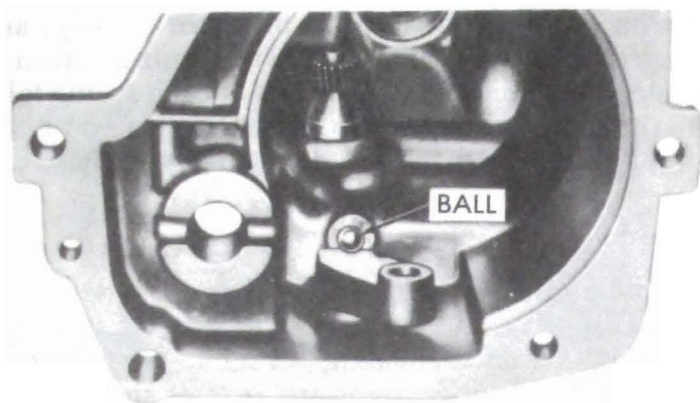
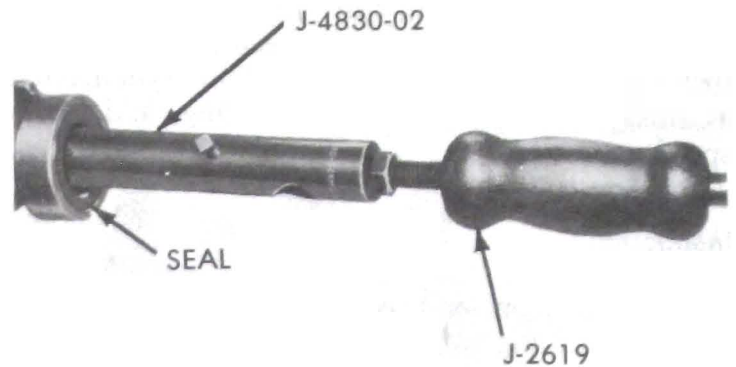


Figure 7B-50 - Installing Speedometer Drive Gear



7B-50

Figure 7B-51 - Installing Reverse Shifter Shaft



7B-23

Figure 7B-53 - Removing Case Extension Oil Seal

7. Install third-fourth speed gear synchronizing assembly with fork slot toward the rear of transmission making certain keys in hub correspond to notches in third speed gear blocking ring. Make certain sleeve with chamfered edge opposite fork groove is used for the third-fourth synchronizing assembly.

8. Install snap ring in groove in mainshaft in front of third-fourth speed synchronizing assembly, with ends of snap ring seated behind spline teeth.

9. Install rear bearing retainer. Spread snap ring in rear bearing retainer to allow snap ring to drop around rear bearing. Press on end of mainshaft until snap ring engages groove in rear bearing.

10. Install reverse gear, sleeve taper to rear.

11. Install speedometer drive gear. Press to 6-53/64". See Figure 7B-50.

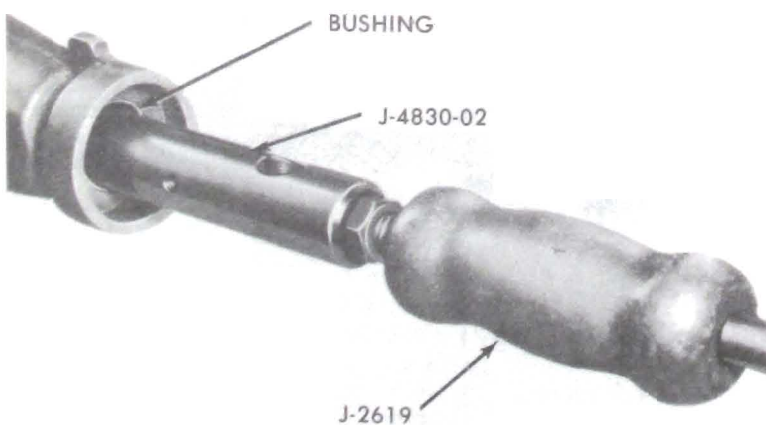
### REVERSE SHIFTER SHAFT AND SEAL - REMOVE AND REPLACE

1. With case extension removed from transmission the reverse shift shaft lock pin will already be removed.

2. Remove shift fork.

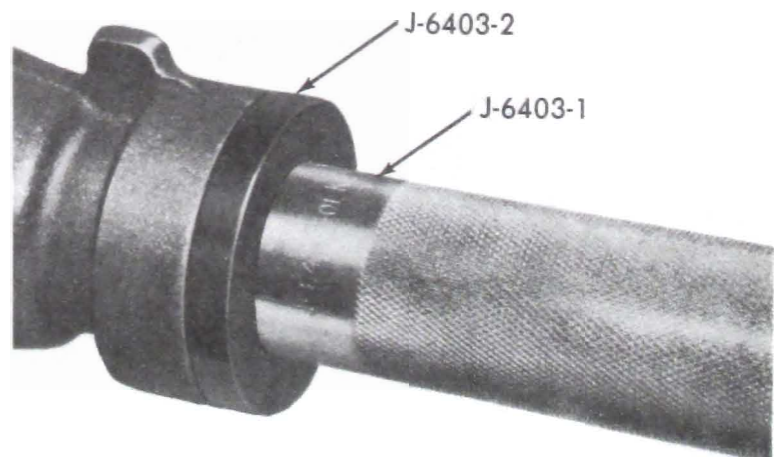
3. Carefully drive shift shaft into case extension allowing ball detent to drop into case. Remove shaft and ball detent spring.

4. Place ball detent spring into detent spring hole and from inside of extension, install shifter shaft fully into its opening until the detent plate is butted against inside of extension housing.



7B-24

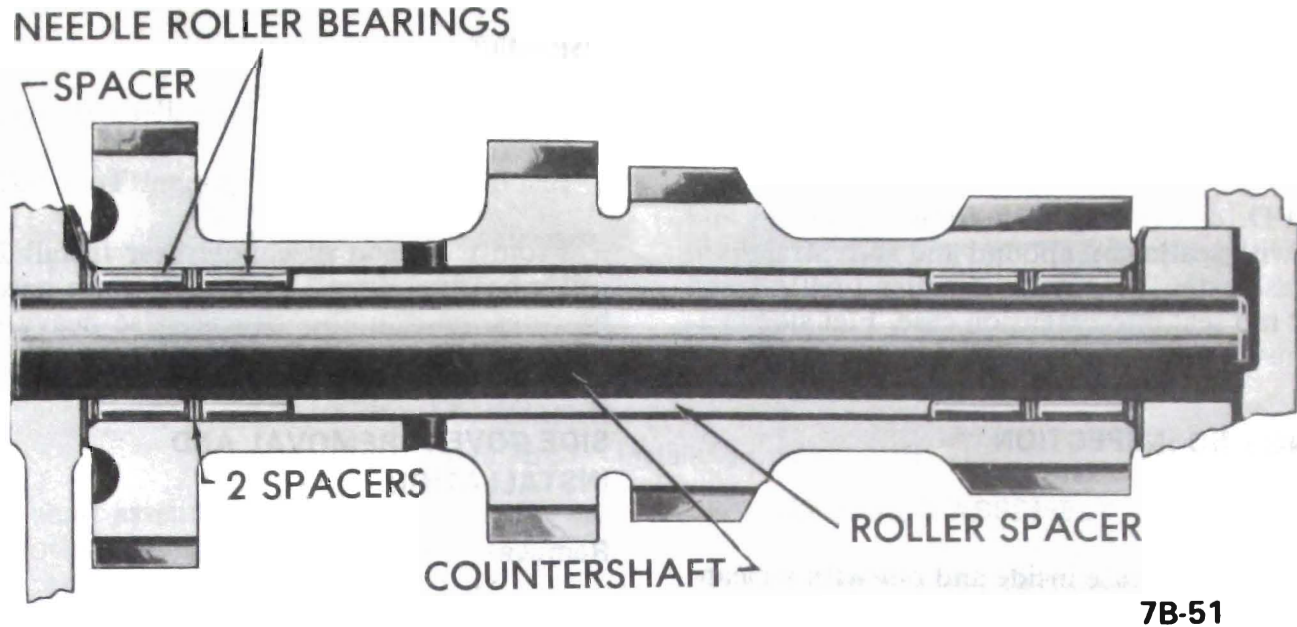
Figure 7B-52 - Removing Case Extension Bushing



7B-26

Figure 7B-54 - Installing Extension Oil Seal





7B-51

Figure 7B-55 - Exploded View of Countergear

5. Place detent ball on spring, while holding ball down with a suitable tool, push the shift shaft into place and turn until the ball drops into place in detent on shaft detent plate. See Figure 7B-50.

6. Install shift fork.

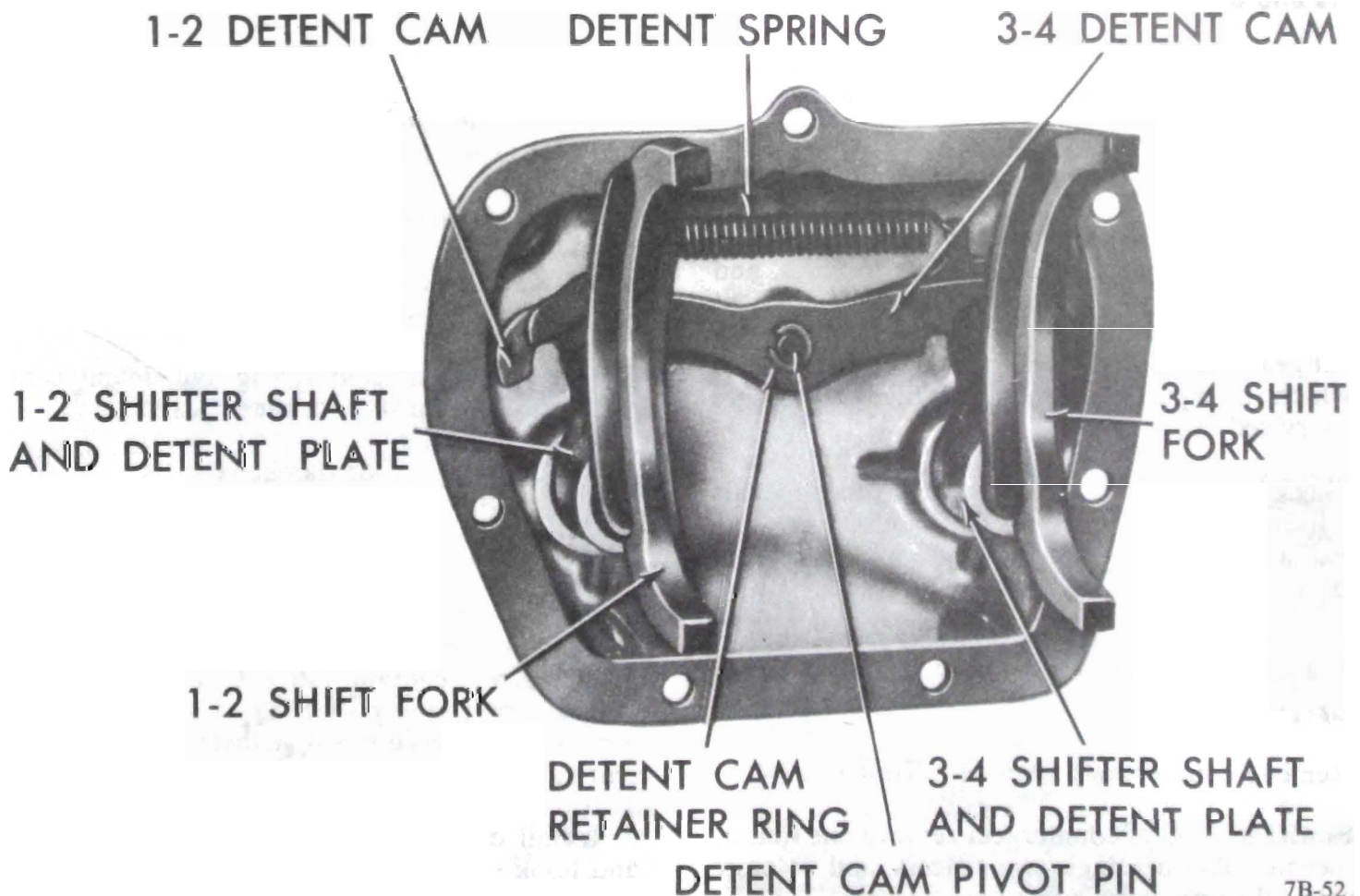
Do not drive shifter shaft lock pin into place until case extension has been installed on transmission case.

**TRANSMISSION CASE EXTENSION BUSHING AND OIL SEAL - REMOVAL AND REPLACEMENT**

**Removal**

1. Using J-2619 slide hammer and J-4830-02 puller, remove case extension oil seal. See Figure 7B-55.

remove case extension bushing. See Figure 7B-56.



7B-52

Figure 7B-56 - Side Cover Assembly

**Replacement**

1. Drive new bushing in from rear of case extension with J-6403-1.
2. Coat I.D. of bushing with transmission oil and new seal with sealing compound and start straight in bore of case extension. Using installer J-6403-1 and J-6403-2 tap seal into extension case. Flat side of J-6403-2 must be toward rear of J-6403-1. See Figure 7B-57.

**CLEANING AND INSPECTION****Transmission Case**

Wash transmission case inside and out with a cleaning solvent and inspect for cracks. Make certain magnet in bottom of case is clean. Inspect front face which fits against clutch housing for burrs and if any are present, dress off with a fine cut mill file.

**Needle Roller Bearing and Spacers**

All main drive gear and countergear needle roller bearings should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

**Gears and Bushing**

Inspect all gears and first speed gear bushing and, if necessary, replace all that are worn or damaged.

**Reverse Idler**

1. The bushings used in the idler gears are pressed into gear, then peened into holes in the bores, and then bored in place. This insures positive alignment of bushings and their shafts; as well as proper meshing of gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.
2. Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing or use a micrometer. The proper clearance is from .003" to .005".

**COUNTERGEAR ASSEMBLY (SEE FIGURE 7B-58).****Disassembly**

1. Remove countershaft alignment Tool J-22246.
2. From each end of countergear remove one spacer, 28 needle roller bearings, two spacers, and 28 more needle roller bearings.
3. Remove roller spacer.

**Inspection**

1. Check for broken needle roller bearings.
2. Install countershaft alignment Tool J-22246.
3. From each end of countergear install 28 needle roller bearings, two spacers, 28 more needle roller bearings, and another spacer. Use heavy grease to retain needle roller bearings.

**SIDE COVER - REMOVAL AND INSTALLATION****Removal**

It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission side cover assembly, but the side cover assembly itself must be removed from transmission case. See Figure 7B-56.

1. Loosen side cover bolts to allow transmission to drain.
2. Disconnect shift controls from transmission.
3. Remove transmission side cover assembly from transmission case.

**Disassembly**

1. Remove the outer shift lever nuts and lock washers and pull levers from shafts.
2. Remove both shift forks from shifter shaft assemblies. Remove both shifter shaft assemblies from cover. If replacement is required remove shifter shaft ring seals.
3. Remove detent cam spring and detent cam retainer ring. Remove both detent cams.
4. Inspect and replace damaged parts.

**Reassembly**

1. With detent spring tang projecting up over the second-third shifter shaft cover opening install first-reverse detent cam onto detent cam pivot pin. With detent spring tang projecting up over the first-reverse shifter shaft cover hole install second-third detent cam.
2. Install detent cam retaining ring to pivot shaft, and hook spring into detent cam notches.
3. Install both shifter shaft assemblies in cover being careful not to damage seals. Install both shift forks

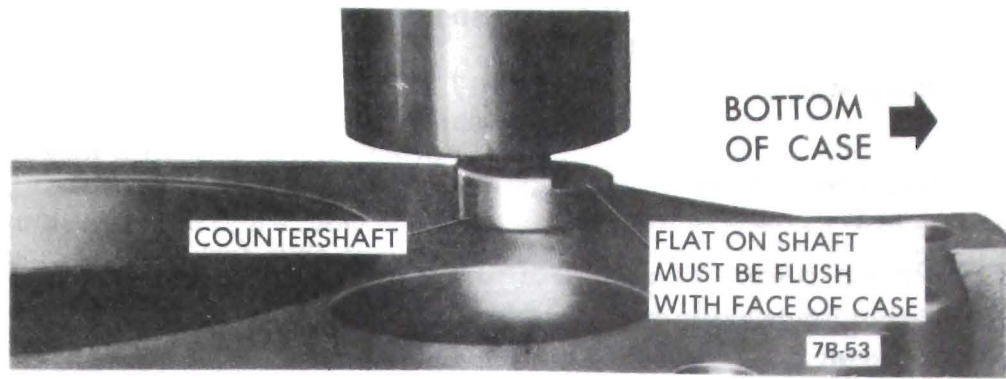


Figure 7B-57 - Installing Countershaft

to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.

4. Install outer shifter levers, flat washers, lock washers and bolts.

#### Installation

1. Shift shifter levers into neutral detent (center) position. Position cover gasket on case.

2. Carefully position side cover into place making certain shift forks are aligned with their respective mainshaft sliding sleeves.

3. Install cover attaching bolts and tighten evenly to 14-22 lb.ft.

4. Remove filler plug at side of transmission and add 3 pints of SAE 80 Multi-Purpose Gear Lubricant. Lubricant level should be approximately level with bottom of filler plug hole. Install plug. Torque to 25-35 lb.ft.

#### TRANSMISSION ASSEMBLY

1. Rest transmission case on its side with side cover opening toward assembler. Install countergear tanged thrust washers in place, retaining them with heavy grease, making certain tangs are resting in notches in case.

2. Place countergear in bottom of transmission case, making certain that tanged thrust washers are not moved out of position.

3. Lubricate and insert countershaft in rear of case. Turn countershaft so flat on end of shaft is horizontal and facing bottom of case. The flat on shaft must be horizontal and toward bottom of transmission to mate with rear bearing retainer when installed.

4. Align countergear with shaft in rear and hole in front of case. Press countershaft into case (pushing alignment tool out front of case) until flat on shaft is flush with rear of case. Make certain thrust washers remain in position. See Figure 7B-57.

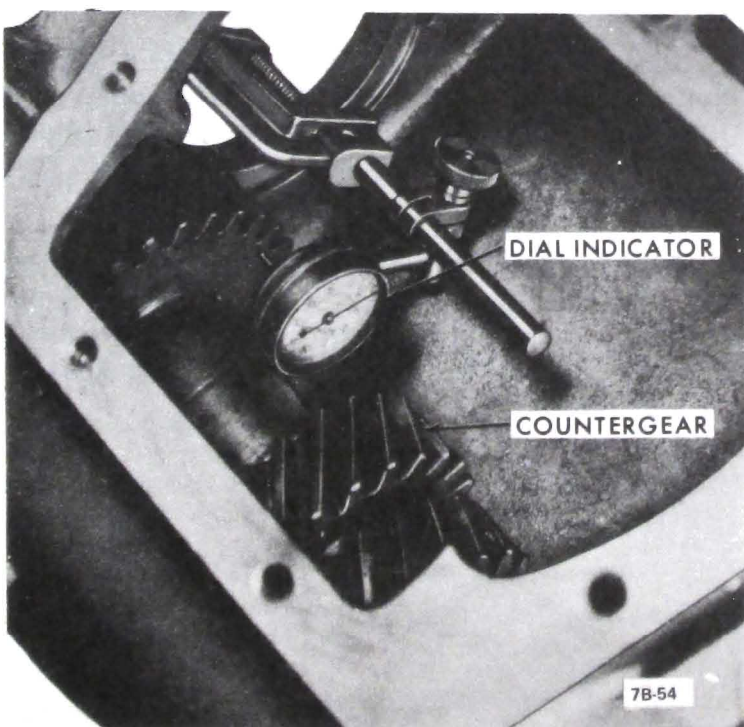


Figure 7B-58 - Checking Countergear Alignment

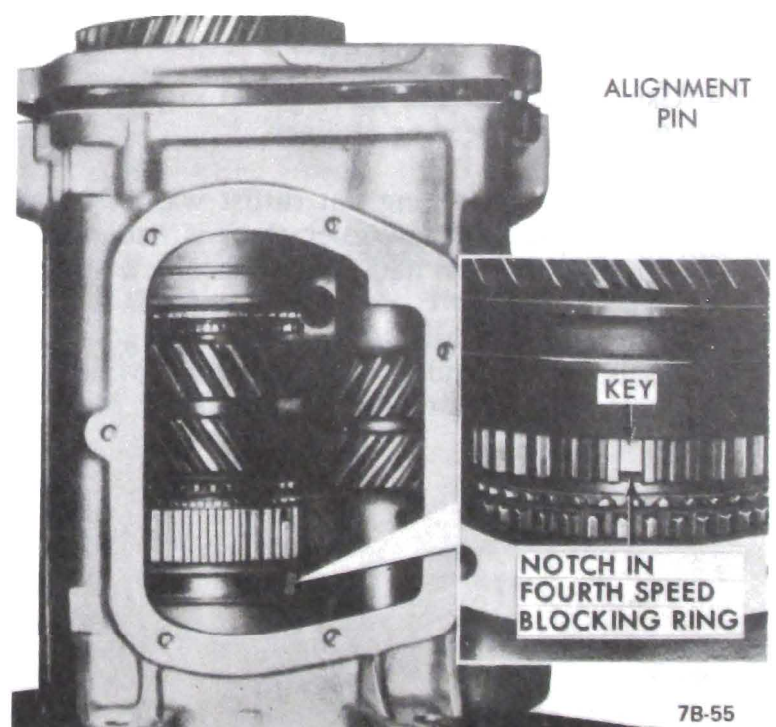


Figure 7B-59 - Installing Mainshaft Assembly

5. Attach a dial indicator as shown in Figure 7B-61 and check end play of countergear. If end play is greater than .025" new thrust washers must be installed.

6. Install case and seventeen needle roller bearings into main drive gear, using heavy grease to hold the bearings and cage in place.

7. Install main drive gear through side cover opening and into position in transmission front bore.

8. Place gasket in position on front face of rear bearing retainer.

9. Install fourth speed blocking ring on main drive gear with notches toward rear of transmission.

10. Position reverse idler gear thrust washer (tanged) on machined face of ear cast in case for reverse idler shaft and hold with heavy grease. Position front reverse idler gear next to thrust washer, with hub facing toward rear of case.

Before attempting installation of mainshaft assembly into case, slide third-fourth synchronizing sleeve forward into fourth speed position.

11. Lower mainshaft assembly into case making certain notches on fourth speed blocking ring correspond to keys in synchronizing assembly. See Figure 7B-59.

12. With guide pin in rear bearing retainer aligned with hole in rear of case, tap rear bearing retainer into position with a soft hammer.

13. From rear of case, insert rear reverse idler gear, engaging splines with portion of front gear inside case.

14. Using heavy grease, place gasket in position on rear face of rear bearing retainer.

15. Install the remaining flat thrust washer on reverse idler shaft. If new idler shaft is being used, drive out the roll pin and press it into new shaft.

16. Install reverse idler shaft, roll pin, and thrust washer into gears and front boss of case. Make certain to pick up front tanged thrust washer. Roll pin

should be in a vertical position.

17. Position reverse gear at rear of spline, pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork forward in extension (reverse detent position). Start the extension onto transmission case, while slowly pushing in on shifter shaft to engage shift fork with reverse gear shift collar. Then pilot reverse idler gear shaft into extension housing permitting extension to slide onto transmission case.

18. Install six extension and retainer-to-case attaching bolts. Torque upper 3 bolts to 15-24 lb.ft.; lower 3 bolts to 25-35 lb.ft.

19. Push or pull reverse shifter shaft to line up groove in shaft with holes in the boss and drive in lock pin. Install shifter lever.

20. Press bearing onto main drive gear (snap ring groove to front) and into case until several main drive gear retaining nut threads are exposed.

21. Lock transmission up by shifting into two gears. Install main drive gear retaining nut on main drive gear shaft and draw up tight, using Tool J-933. Make certain bearing seats fully against shoulder on gear. Torque retaining nut to 40 lb.ft. and lock in place by staking securely into main drive gear shaft hole with a center punch. Care must be used to avoid damaging threads on shaft.

22. Install main drive gear bearing retainer, gasket and four attaching bolts with locking strips, using a suitable sealer on bolts. The retainer oil return hole must be positioned toward bottom of transmission case. Torque to 18-24 lb.ft.

23. Shift third-fourth sliding sleeve into neutral position and first-second sliding sleeve into second gear (forward) position. Shift side cover third-fourth shifter lever into neutral detent and first-second shifter lever into second gear detent position.

24. Install side cover gasket and carefully position side cover into place. There is a dowel pin in cover to assure proper alignment with case. Install attaching bolts and tighten evenly to avoid side cover distortion. Torque to 14-22 lb.ft.

## DIVISION VI SPECIFICATIONS

### 72-24 GENERAL SPECIFICATIONS

#### a. Transmission Identification

A production code number and Car Serial Number are stamped on all G.S. and G.S. Stage 1 four-speed manual transmissions. These numbers should always be furnished on all AFA Forms, and all correspondence with the factory concerning a particular transmission.

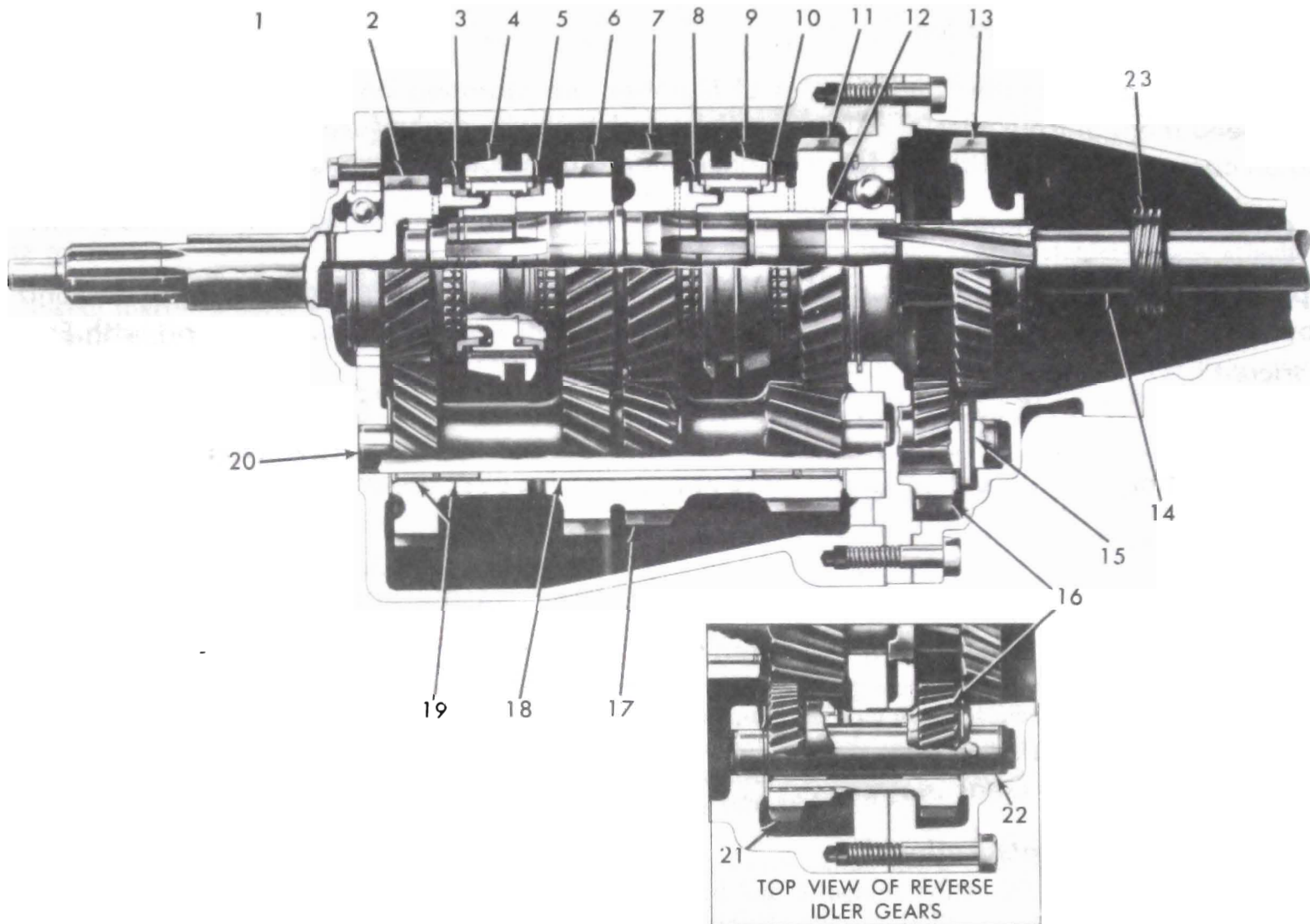
#### b. General Specifications

Type .....	All Forward Gears Synchronized
Mounting .....	Unit with Engine
Lubricant	
Type .....	SAE 80 or 90 Multi-Purpose
Capacity .....	3 Pints
Synchronization .....	1st, 2nd, 3rd and 4th
Gear Ratios	
1st .....	2.20 to 1
2nd .....	1.64 to 1
3rd .....	1.28 to 1
4th .....	1.00 to 1
Reverse .....	2.27 to 1
Gear Shifting .....	On Floor
Speedometer Drive Gear .....	Nylon

#### c. Bolt Tightening Specifications

Location	Thread Size	Torque Lbs. Ft.
Front Main Bearing Retainer .....	3/8 - 16 x 7/8	18 - 24
Side Cover to Case .....	3/8 - 16 x 7/8	14 - 22
Case Extension Top Three .....	3/8 - 16 x 1 3/4	15 - 24
Case Extension Bottom Three .....	7/16 - 14 x 2 1/2	25 - 35
Lubrication Filler Plug .....		25 - 35
Transmission Case to Flywheel Housing .....		45 - 60

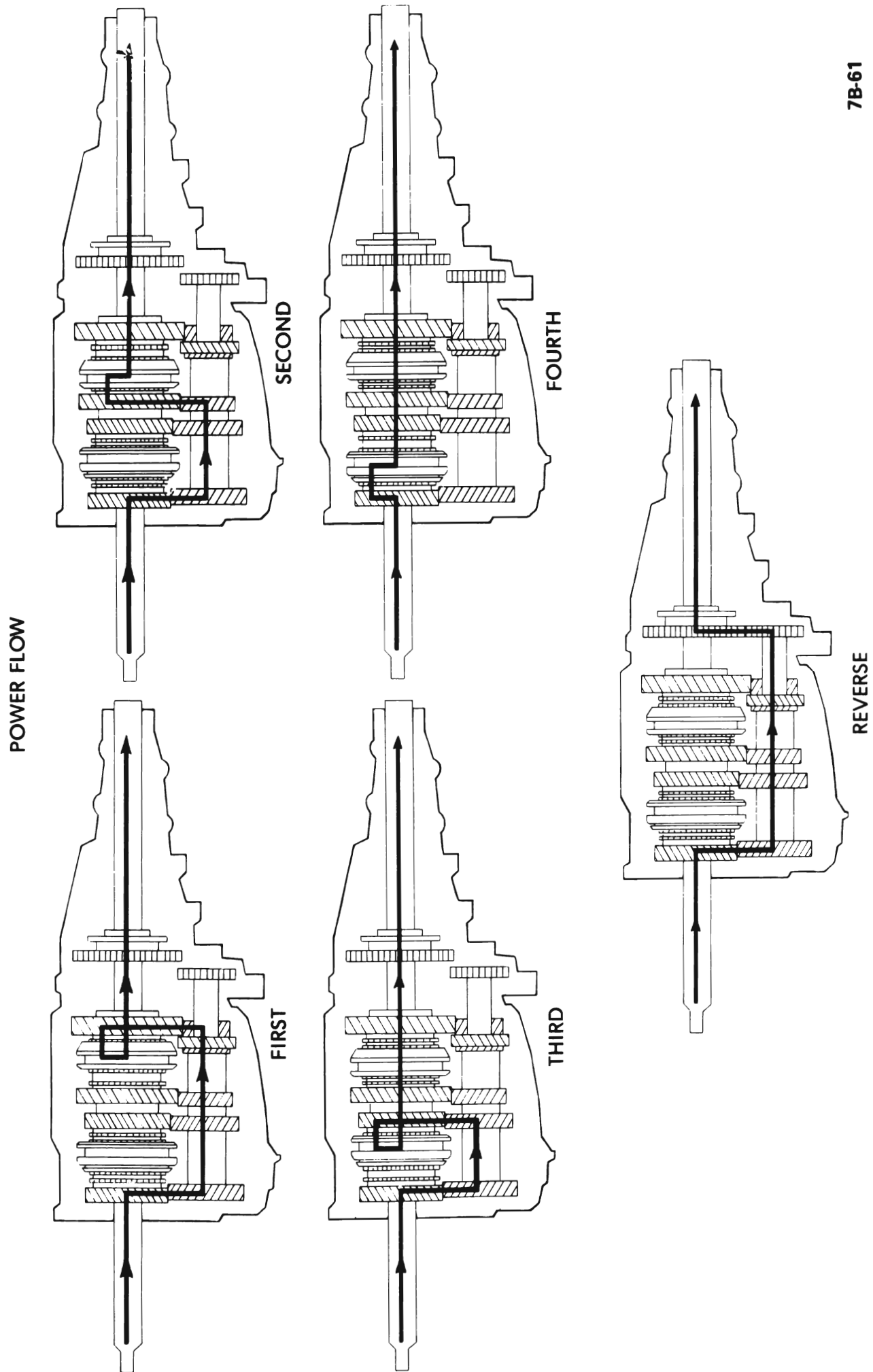
Use a reliable wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for **clean and lightly lubricated threads only**; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.



FOUR—SPEED TRANSMISSION CROSS SECTION

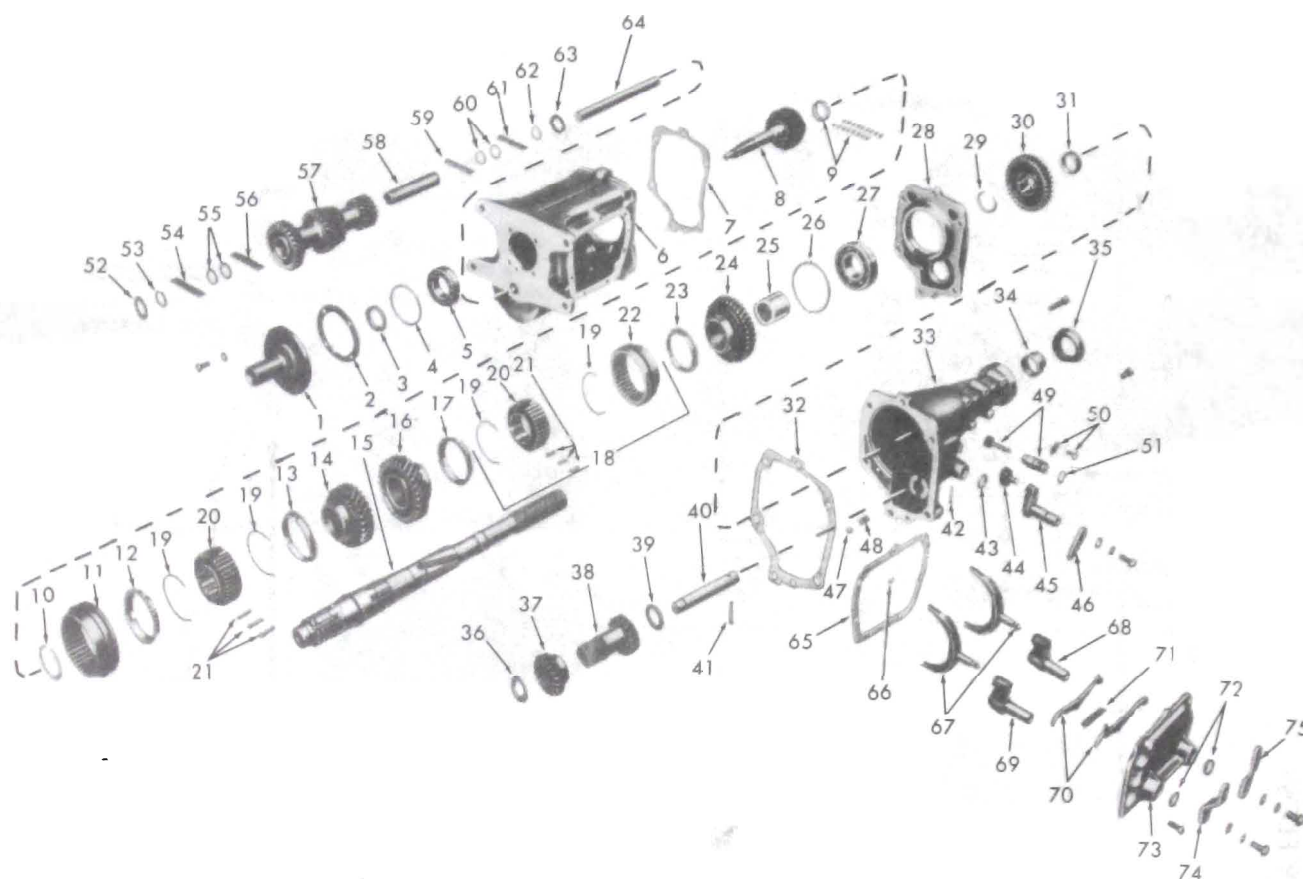
- |  |  |  |
|--|--|--|
| 1. BEARING RETAINER                              | 9. FIRST AND SECOND SPEED SYNCHRONIZING ASSEMBLY | 17. COUNTERGEAR                        |
| 2. MAIN DRIVE GEAR                               | 10. FIRST SPEED BLOCKING RING                    | 18. COUNTERSHAFT BEARING ROLLER SPACE  |
| 3. FOURTH SPEED BLOCKING RING                    | 11. FIRST SPEED GEAR                             | 19. COUNTERSHAFT NEEDLE ROLLER BEARING |
| 4. THIRD AND FOURTH SPEED SYNCHRONIZING ASSEMBLY | 12. FIRST SPEED GEAR SLEEVE                      | 20. COUNTERSHAFT                       |
| 5. THIRD SPEED BLOCKING RING                     | 13. REVERSE GEAR                                 | 21. REVERSE IDLER GEAR (FRONT)         |
| 6. THIRD SPEED GEAR                              | 14. MAIN SHAFT                                   | 22. REVERSE IDLER SHAFT                |
| 7. SECOND SPEED GEAR                             | 15. REVERSE IDLER SHAFT ROLL PIN                 | 23. SPEEDO DRIVE GEAR                  |
| 8. SECOND SPEED BLOCKING RING                    | 16. REVERSE IDLER GEAR (REAR)                    |  |

Figure 7B-61 Cross Section of 4-Speed Manual Transmission



7B-61

Figure 7B-62 Power Flow

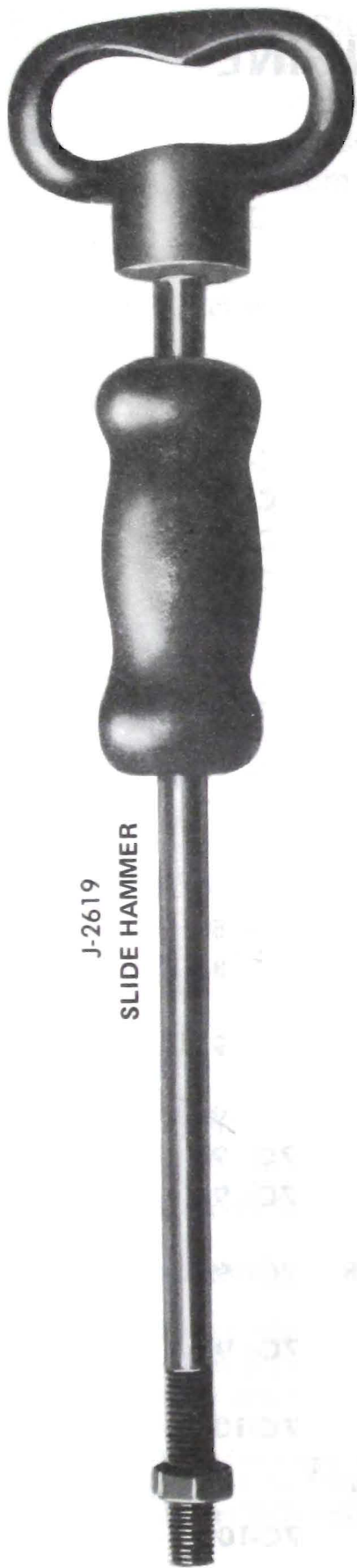


Four-Speed Transmission-Exploded View

- |   |  |  |  |
|---|--|--|--|
| 1. Bearing Retainer                               | 19. Clutch Key Spring                                | 40. Reverse Idler Shaft                      | 58. Countergear Roller Spacer                                |
| 2. Gasket   | 20. Clutch Hub                                       | 41. Reverse Idler Shaft Roll Pin             | 59. Bearing Rollers (28)                                     |
| 3. Bearing Retaining Nut                          | 21. Clutch Keys                                      | 42. Reverse Shifter Shaft Lock Pin           | 60. Spacer   |
| 4. Bearing Snap Ring                              | 22. First and Second Speed Sliding Sleeve            | 43. Reverse Shifter Shaft Lip Seal           | 61. Bearing Rollers (28)                                     |
| 5. Front Main Bearing                             | 23. First Speed Gear Blocking Ring                   | 44. Reverse Shift Fork                       | 62. Spacer   |
| 6. Transmission Case                              | 24. First Speed Gear                                 | 45. Reverse Shifter Shaft and Detent Plate   | 63. Tanged Washer  |
| 7. Rear Bearing Retainer Gasket                   | 25. First Gear Sleeve                                | 46. Reverse Shifter Lever                    | 64. Countershaft   |
| 8. Main Drive Gear                                | 26. Rear Bearing Snap Ring                           | 47. Reverse Shifter Shaft Detent Ball        | 65. Gasket   |
| 9. Bearing Rollers (17) and Cage                  | 27. Rear Bearing                                     | 48. Reverse Shifter Shaft Ball Detent Spring | 66. Detent Cams Retainer Ring                                |
| 10. Snap Ring                                     | 28. Rear Bearing Retainer                            | 49. Speedometer Driven Gear and Fitting      | 67. Forward Speed Shift Forks                                |
| 11. Third and Fourth Speed Sliding Sleeve         | 29. Selective Fit Snap Ring                          | 50. Retainer and Bolt                        | 68. First - Second Speed Gear Shifter Shaft and Detent Plate |
| 12. Fourth Speed Gear Blocking Ring               | 30. Reverse Gear                                     | 51. "O" Ring Seal                            | 69. Third - Fourth Speed Gear Shifter Shaft and Detent Plate |
| 13. Third Speed Blocking Ring                     | 31. Speedometer Drive Gear                           | 52. Tanged Washer                            | 70. Detent Cams  |
| 14. Third Speed Gear                              | 32. Rear Bearing Retainer to Case Extension - Gasket | 53. Spacer                                   | 71. Detent Cam Spring  |
| 15. Main Shaft                                    | 33. Case Extension                                   | 54. Bearing Rollers (28)                     | 72. "O" Ring Seals   |
| 16. Second Speed Gear                             | 34. Extension Bushing                                | 55. Spacer                                   | 73. Transmission Side Cover                                  |
| 17. Second Speed Gear Blocking Ring               | 35. Rear Oil Seal                                    | 56. Bearing Rollers (28)                     | 74. Third - Fourth Speed Shifter Lever                       |
| 18. First and Second Speed Synchronizing Assembly | 36. Reverse Idler Front Thrust Washer (Tanged)       | 57. Countergear                              | 75. First - Second Speed Shifter Lever                       |
|   | 37. Reverse Idler Gear (Front)                       |  |  |
|   | 38. Reverse Idler Gear (Rear)                        |  |  |
|   | 39. Flat Thrust Washer                               |  |  |

Figure 7B-63 Exploded View of Transmission





J-2619

SLIDE HAMMER

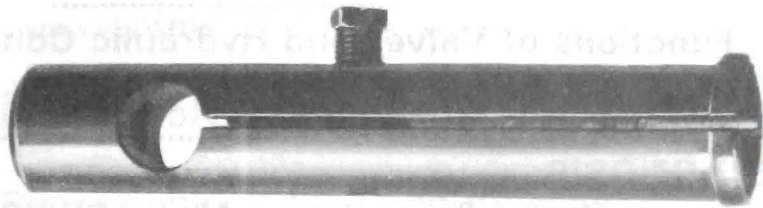


J-6403-1

BUSHING INSTALLER

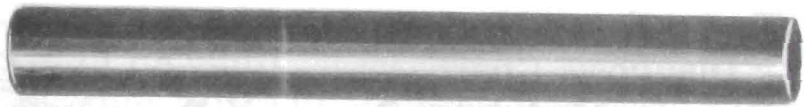
OIL SEAL  
INSTALLER

J-6403-2



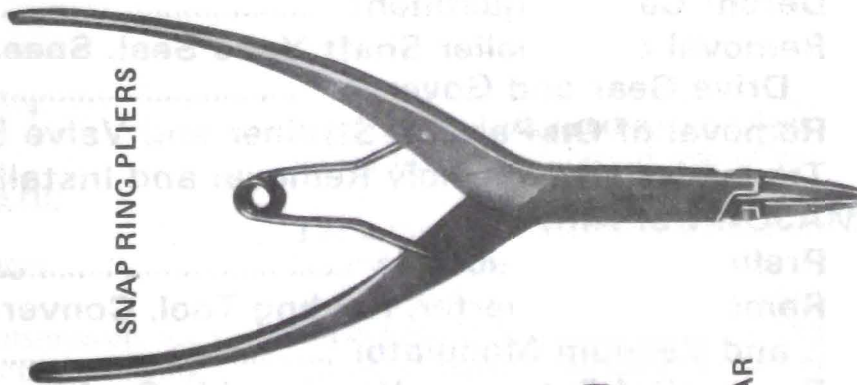
J-4830-02

BUSHING AND OIL  
SEAL REMOVER

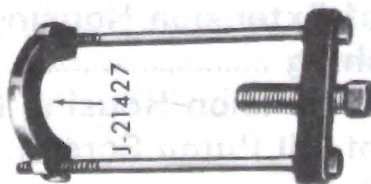


J-22246

COUNTERSHAFT GEAR  
ALIGNMENT TOOL



SNAP RING PLIERS



J-21427

J-9578

SPEEDO-GEAR  
REMOVER

Figure 7B-64 Tool Picture