

**PRO-SHIFT 5+2
TRANSMISSION
SERVICE MANUAL**



Bulletin No. 2361-1

Revised August 2000



TABLE OF CONTENTS

	PAGES
SECTION I — GENERAL INFORMATION	
SPECIFICATIONS & SHIFT PATTERN	2
SHIFT INSTRUCTIONS	3
SECTION II — MAINTENANCE	
LUBRICATION & TOWING	4
DISASSEMBLY PRECAUTIONS	5
FILTER REGULATOR	6
PIPING DIAGRAM	7
SECTION III — CONTROLS	
SHIFT TOWER	8
REMOTE CONTROL	9
SECTION IV — SHIFTER HOUSING	
FORWARD CONTROL—EXPLODED DRAWING	10
CENTER CONTROL—EXPLODED DRAWING	11
SHIFTER HOUSING DISASSEMBLY	12
SHIFTER HOUSING REASSEMBLY	13-14
SECTION V	
REAR CASE SUBASSEMBLY—EXPLODED DRAWING	15
REAR CASE GEARS—EXPLODED DRAWING	16
REAR CASE DISASSEMBLY	17-18
SECTION VI	
FRONT CASE SUBASSEMBLY—EXPLODED DRAWING	19
FRONT CASE DISASSEMBLY	20-23
SECTION VII	
GEARS AND RELATED PARTS—EXPLODED DRAWING	24
MAINSHAFT DISASSEMBLY & REASSEMBLY	25-27
INSPECTION PROCEDURE & TORQUE SPECIFICATIONS	28
SECTION VIII	
COUNTERSHAFT DISASSEMBLY & REASSEMBLY	29
INPUT GEAR DISASSEMBLY & REASSEMBLY	30
SECTION IX	
FRONT CASE REASSEMBLY	31-33
REAR CASE REASSEMBLY	34-35
SECTION X	
TROUBLESHOOTING	36-40

SPECIFICATIONS

Models PS105-7LL, 9505-2A, PS130-6L and 9505-2B

GCW RangeUp to 80,000 lbs.

HP RangeUp to 300 HP

RPM RangeUp to 2200 RPM

Engine TypesHigh torque rise, 10 Liter

Speeds

PS105-7LL, 9505-2A ... 7 forward, 2 reverse

PS130-6L, 9505-2B ... 6 forward, 2 reverse

Torque Capacity

PS105-7LL, 9505-2A ... Up to 950 lbs. ft. (1290 nm)

PS130-6L, 9505-2B ... Up to 1300 lbs. ft. (1765 nm)

Length*34.813" (884.25 mm)

Weight**683 lbs. (309.8 kg)

Clutch HousingSAE Nos. 1 or 2—both available with nodal mount

Clutch14" or 15½" (356.6 or 393.7 mm)—2 plate

Yoke or Flange1710, 1760, 1810 series

Drive Gear2" standard

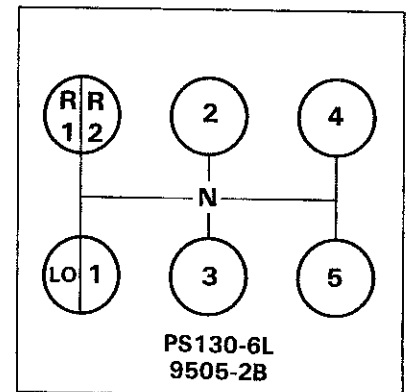
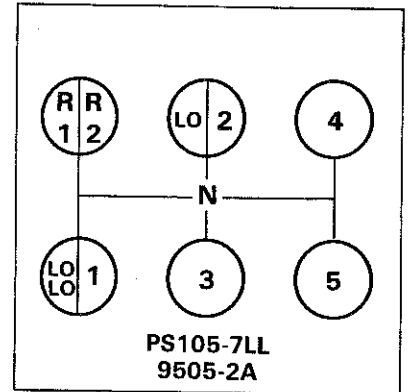
Oil Capacity30 pints (14.2 litres) at 0° installation

Power Take OffStandard 6 bolt right side and 8 bolt bottom left. Countershaft PTO provision standard on right and optional on left or on both countershafts.

*From bell housing to end of splines on output shaft.


**Iron case, aluminum bell, aluminum center control shifter housing. Add 40 lbs. (18 kg) for iron clutch housing. Add 22 lbs. (10 kg) for iron forward control shifter housing.

Shift Patterns




Gear Ratios

PS105-7LL, 9505-2A		PS130-6L, 9505-2B		
% Step	Ratio	Gear	Ratio	% Step
	24.36	LOLO		
75	13.90	LO	14.49	70
63	8.53	1	8.53	75
75	4.87	2	4.87	69
69	2.87	3	2.87	72
72	1.67	4	1.67	67
67	1.00	5	1.00	
	24.36	R	14.49	
	8.53	R	8.53	



How to Shift Spicer Models PS105-7LL, 9505-2A, PS130-6L and 9505-2B

The simple shift pattern makes these units favorites with drivers. They shift like 5-speeds on-highway, and have the added versatility of two low gears for special applications.

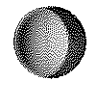


This air system uses less air and fewer parts, but delivers increased reliability. Here's how these transmissions are designed to work for you in the driver's seat.

Starting

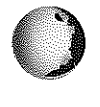
With the engine idling, depress the clutch and move stick into first gear. Gradually release the clutch and accelerate the engine to governed speed (2100-2200 RPM).

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



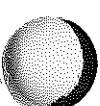
NOTE—*The clutch brake on this transmission is actuated by depressing the clutch pedal all the way to the floor. For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.*

Upshifting



Once governed engine speed has been attained, to shift into second gear, depress the clutch and move the stick to neutral. Engage the clutch and allow RPM to drop approximately 900. (RPM drop may vary with engines of different governed speeds)*, depress the clutch and move the stick into second gear. Re-engage the clutch and accelerate to governed speed. Continue up-shifting through fifth gear in this manner.

Downshifting



When down-shifting from fifth gear, allow RPM to drop approximately 900*, depress clutch pedal and move stick to neutral. Engage the clutch, accelerate to governed speed, depress the clutch and move the stick into fourth gear, then reengage the clutch. Continue down-shifting through first gear in this manner.

***NOTE**—All RPM drops are based on the 5-Speed transmission ratios and an engine governed speed of 2100-2200 RPM. These drops will vary with other transmission ratios or with engines of higher governed speeds.

OPERATION

Clutches

A clutch brake is required for use with this transmission. It is recommended that the torque limiting clutch brake be used instead of the three-piece type. Attention is called to the fact that Spicer 14" and 15½" 2-plate clutch service manuals (Bulletins 1308 and 1309) are available for the asking, and contain complete information on all Spicer Heavy Duty Clutches.

Replacement Parts

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

No special precautions are necessary during removal or installation of the bell housing. The bell housing is piloted on the input drive shaft bearing cap and the large flat case mounting face insures correct alignment of bores, face and pilot with bell housing.

Power Flow

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

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

Spicer® Transmission Lubrication

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

Recommended Lubricants

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

DO NOT USE EXTREME PRESSURE ADDITIVES, such as found in multi-purpose or rear axle type lubricants. These additives are not required in Spicer transmissions, and may in some cases create transmission problems. Multi-purpose oils, as a group, have relatively poor oxidation stability, a high rate of sludge formation and a greater tendency to react on or corrode the steel and bronze parts.

Oil Changes

We recommend an initial oil change and flush after the transmission is placed in *actual* service. This change should be made any time following 3000 miles (4827 km), but *never exceed 5000 miles (8045 km)*, of over-the-road service. In off-highway use, the change should be made after 24 and before 100 hours of service have elapsed. There are many factors that influence the following oil change periods and we have not specified a definite mileage interval.

In general, it is suggested that a drain and flush period be scheduled every 50,000 miles (80,450 km) for normal over-the-highway operations. Off-highway usually requires oil change every 1000 hours. The oil level in the transmission should be checked every 5,000 miles (8,045 km) on-highway, or every 40 hours in off-highway operation. When it is necessary to add oil we recommend that types or brands of oil should not be mixed. The correct oil level in *all* Spicer transmissions is established by the filler plug opening.

Refill

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

Overfilling

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

Towing

Do not tow vehicles equipped with Spicer transmissions without first pulling the axles or disconnecting the drive shaft. Lubrication of the internal gear train is inadequate when the vehicle is towed.

The following lubricants are recommended, in order of preference.

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

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

General Precautions for Disassembly

IMPORTANT

Read this section before starting the detailed disassembly procedure.

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

Rebuild Facilities

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

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

Cleanliness

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

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

Bearings

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

End Yokes & Flanges

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

Serious damage can be done internally to bearings, thrust faces and washers, pilot bearings, etc., by hammering on external parts.

In most designs when the yoke/flange locknuts are tightened and secure, the internal bearings and gears are in proper location. When the yoke/flange is driven on the shaft, two conditions can exist.

- (a) If the bearing fit is *tight* on the shaft, then usually the bearings will brinell as they must absorb the pounding forces.
- (b) If the bearing is *loose*, the shaft will keep moving inward until it is stopped by the internal parts such as pilot bearing thrust washers, etc.

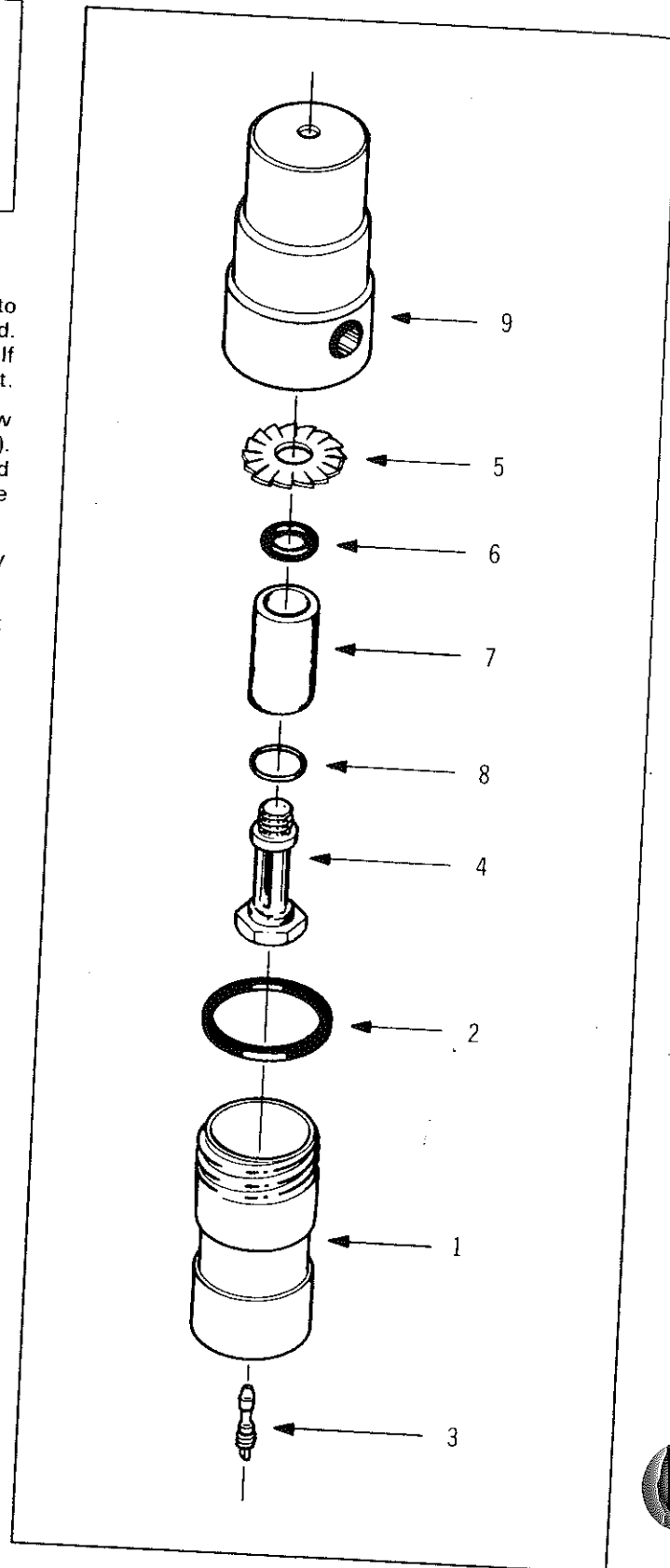
Disassembly and Reassembly of Filter-Regulator

NOTE

These units use a filter-regulator preset at 35-40 P.S.I. Maximum setting 60 P.S.I. Use only petroleum base solvent to clean parts. Blow air through filter (inside to outside) to dislodge surface contaminants. (Do not disassemble regulator section (9), as it is not field repairable.

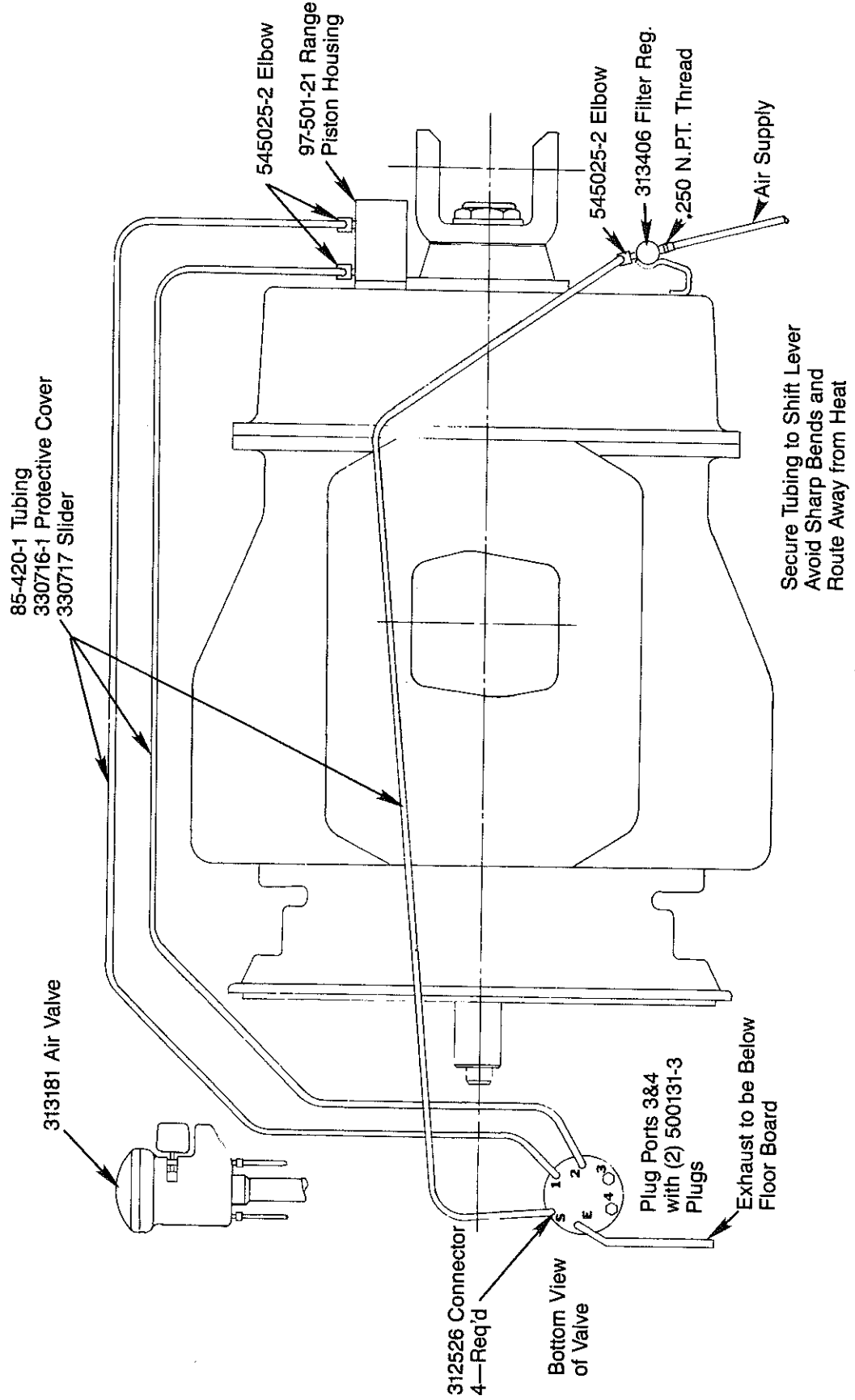
MAINTENANCE

1. Clean or replace filter element (7) every six months to one year to whenever slow shifting is encountered. Element should be replaced after three cleanings. If regulator malfunction is indicated, replace entire unit.
2. To service filter section, shut off air pressure. Unscrew bowl (1) and remove O-Ring (2). Unscrew stud (4). Remove louver (5), upper gasket (6), element (7), and lower gasket (8) from stud. Do not disassemble regulator section (9).
3. After cleaning, inspect parts carefully; replace any damaged parts.
4. Reassemble by installing element (7) on stud (4) so that large end of internal taper (thinnest wall section) is toward hex on stud. Torque stud to 5-10 lbs. inch.
5. Apply a wipe coat of Dow Corning DC7 Silicone Grease (or equivalent) to O-Ring (2) seating surfaces on regulator (9) and bowl (1). Apply a light, even coat of Molykote "G" (or equivalent) to bowl threads. Torque bowl to 5-10 lbs. inch. If drain valve (3) was removed, reinstall and torque to 10-15 lbs. inch.



MAINTENANCE PIPING DIAGRAM

SECTION II



Included With Kit
313595X 9505

Shift Tower

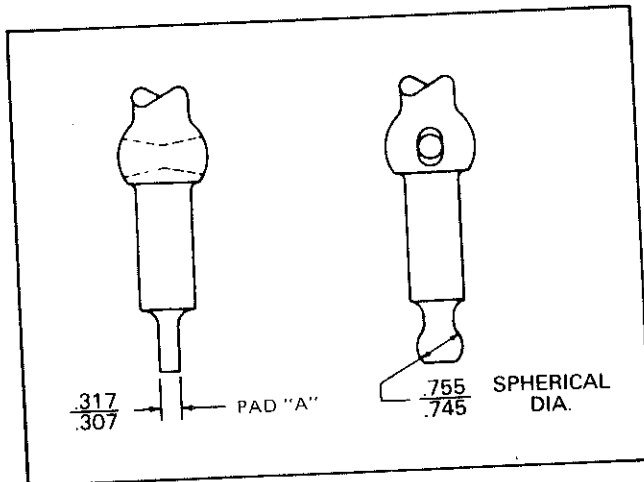
Disassembly

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

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

Inspection

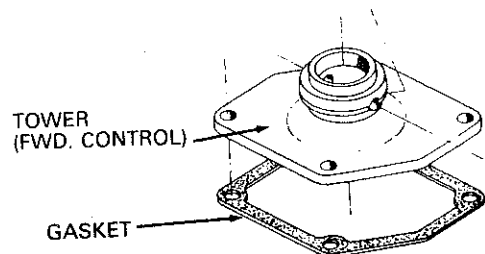
Wash all parts thoroughly and inspect for excessive wear at cross hole in lever and rock shaft. Inspect finger end of lever for excessive wear.



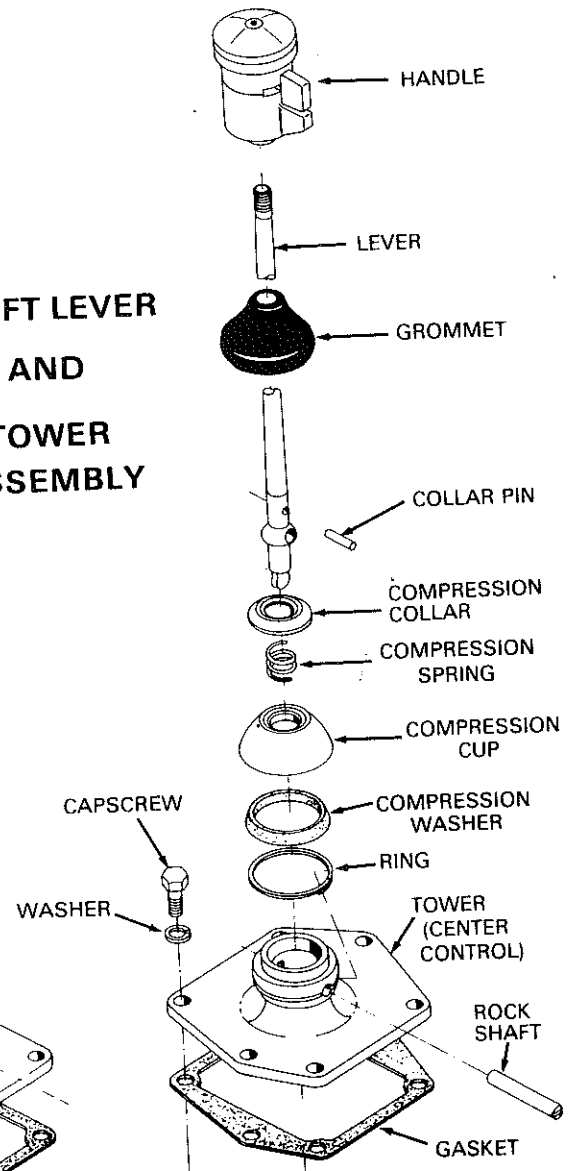
Check spring tension by comparing to a new part.

Reassembly

1. Position shift lever dome on edge in vise.
2. Hold shift lever so that cross hole in lever aligns with rock shaft cross holes in dome.
3. Insert rock shaft through hole in dome and cross hole of shift lever.



SHIFT LEVER AND TOWER ASSEMBLY



Remote Control Assembly

Disassembly

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

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

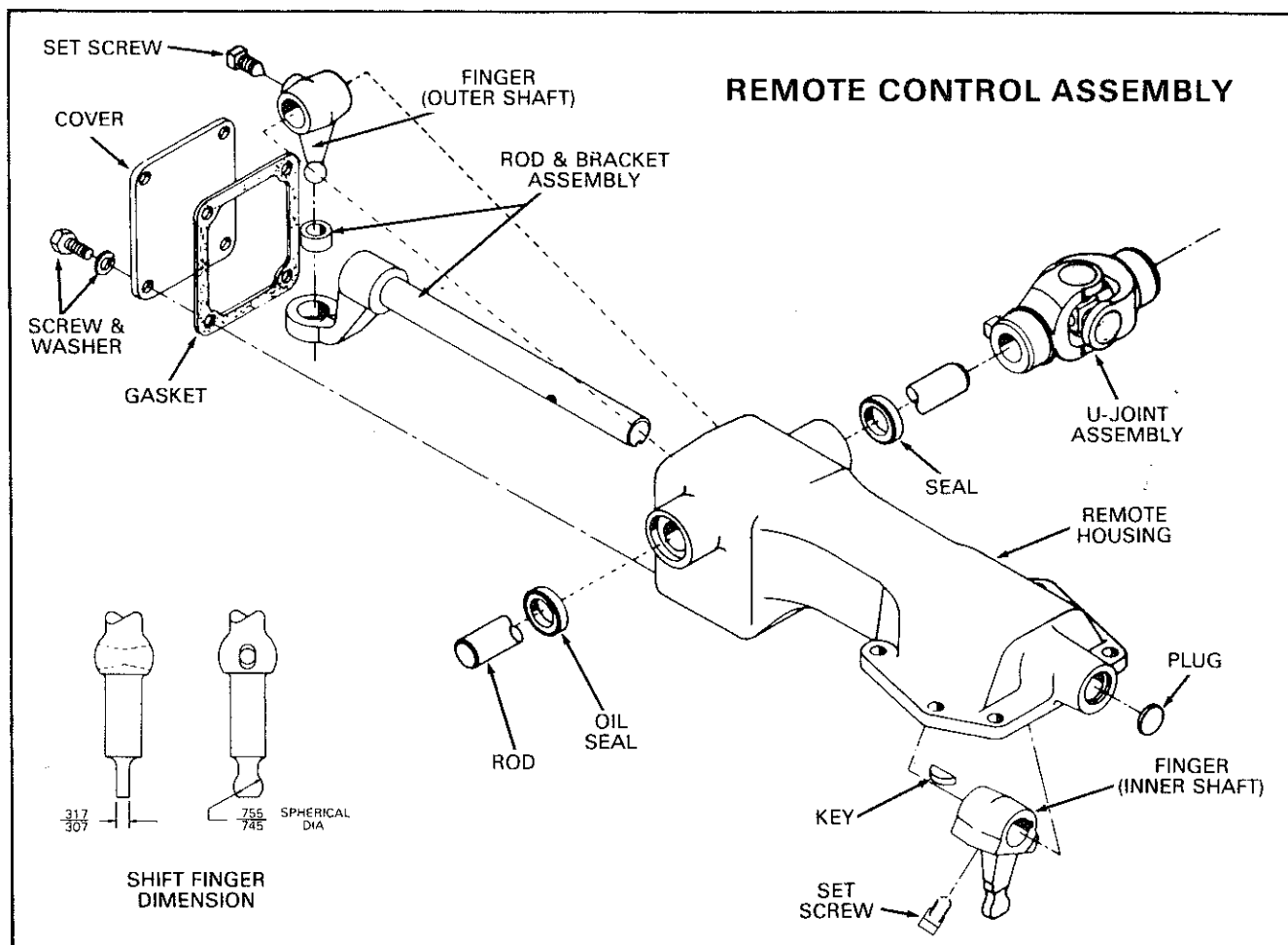
Inspection

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

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

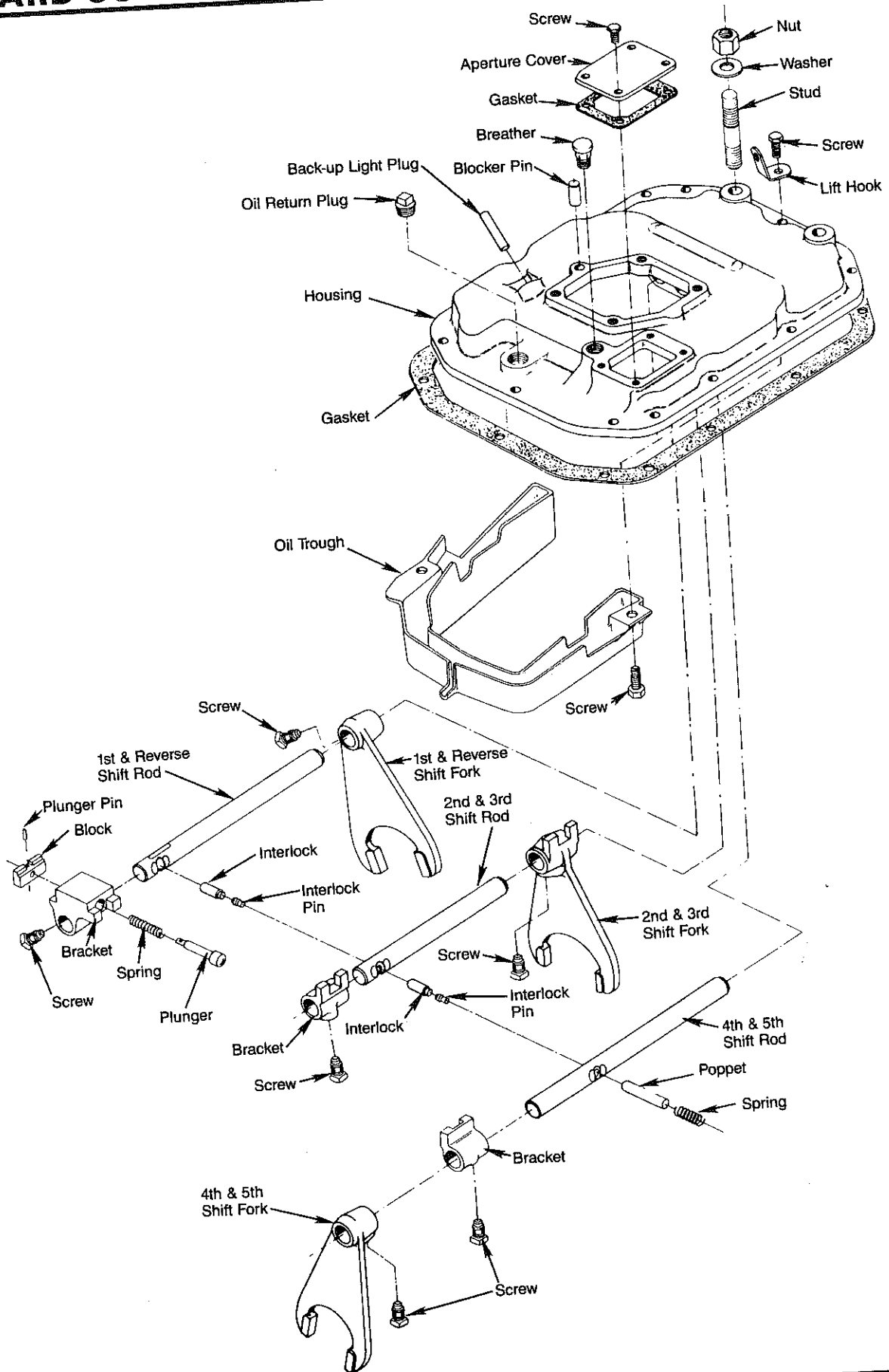
Assembly

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



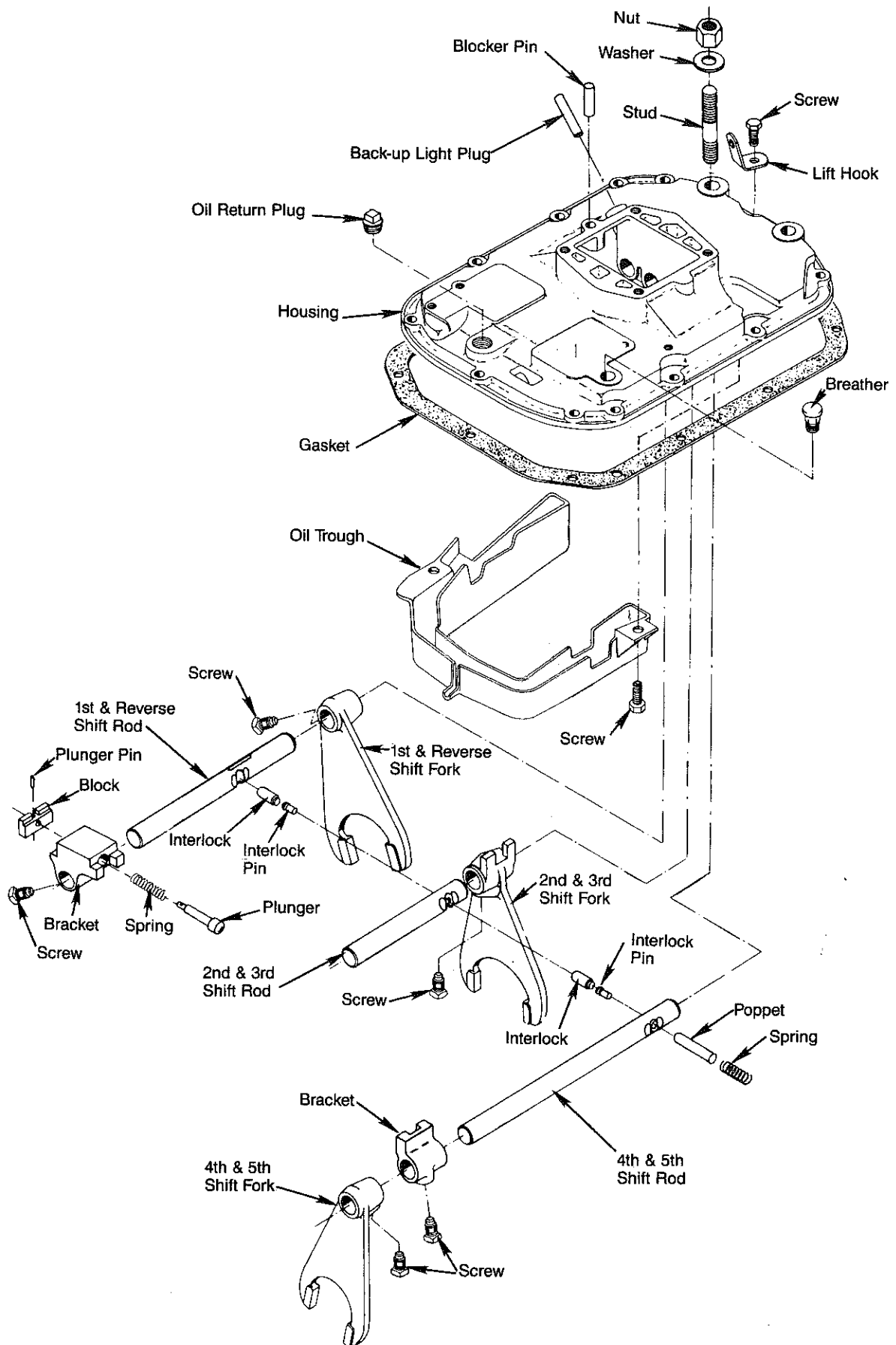
SHIFTER HOUSING FORWARD CONTROL

SECTION IV



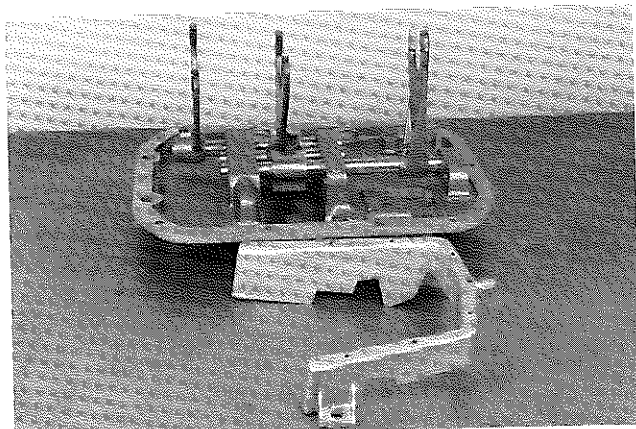
SHIFTER HOUSING CENTER CONTROL

SECTION IV

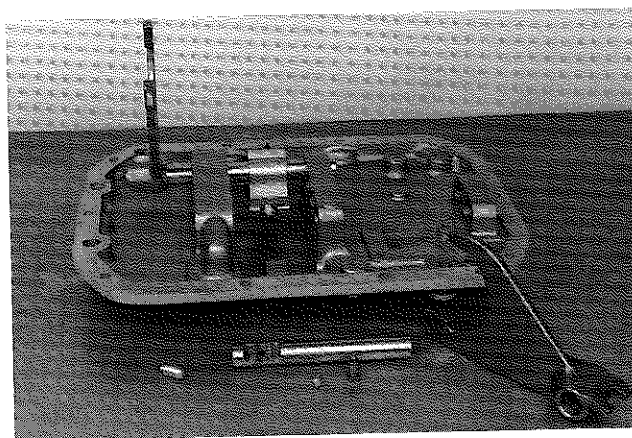


SHIFTER HOUSING DISASSEMBLY

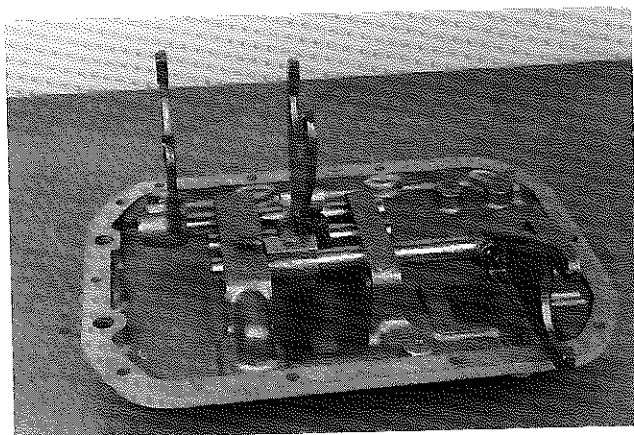
SECTION IV



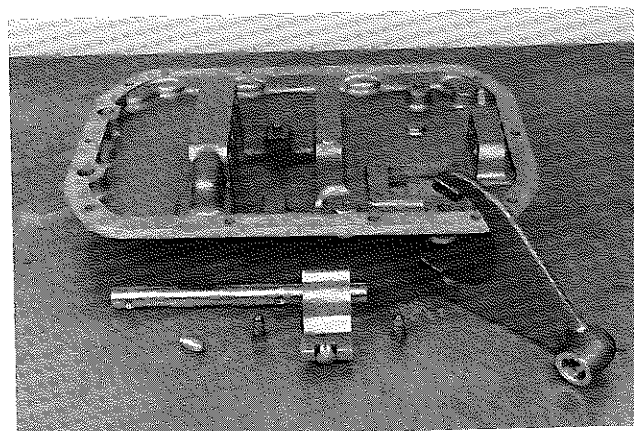
1. Place the positive-stop shift cover on the bench with the forks in the neutral position. Remove the oil trough.



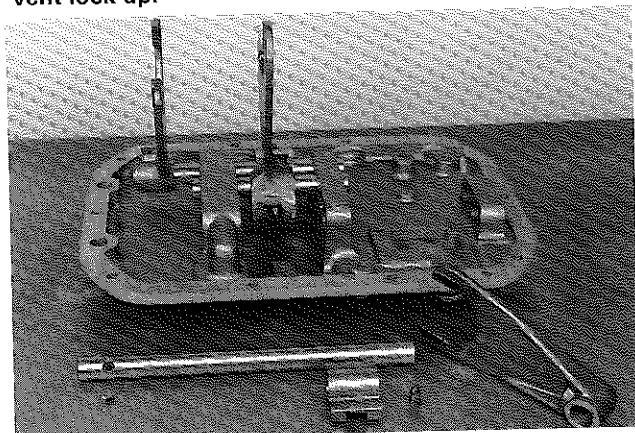
4. Remove the 2nd-3rd fork set screw, fork and rod from the cover. Recover the interlock pin and poppet. Also remove the interlock from the rear boss.



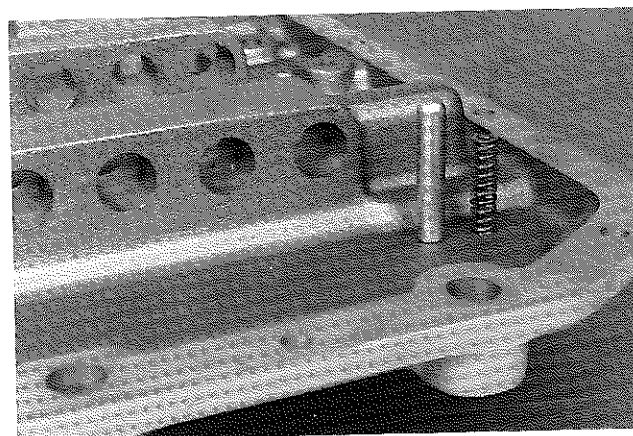
2. Remove the 4th-5th bracket set screw. Now rotate the fork and rod 90°. **Note: In order to prevent shift bracket spring damage, the interlock pin must remain in a vertical position while removing the rod. This will also prevent lock up.**



5. Next remove the 1st-reverse fork, bracket and interlock.



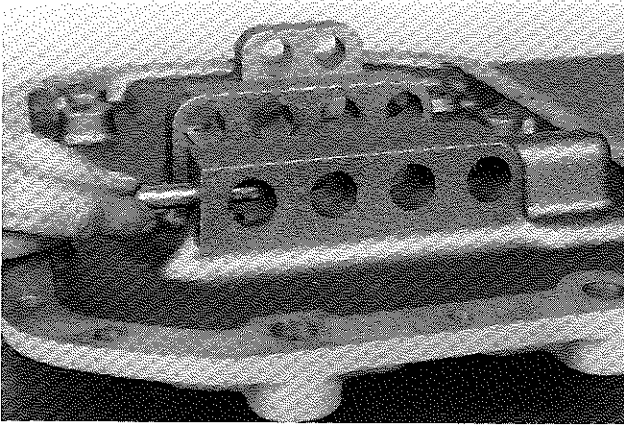
3. Continue by removing the 4th-5th fork set screw, and remove the rod, fork and bracket. Don't lose the interlock poppet and pin.



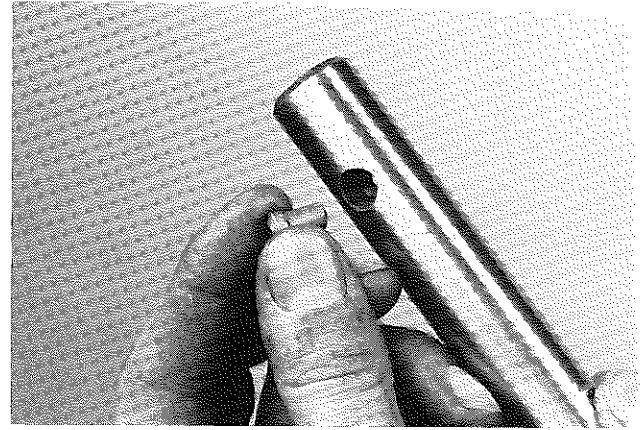
6. Complete disassembly by removing the spring and plunger from the boss. Check shifter housing and components for signs of wear.

SHIFTER HOUSING REASSEMBLY

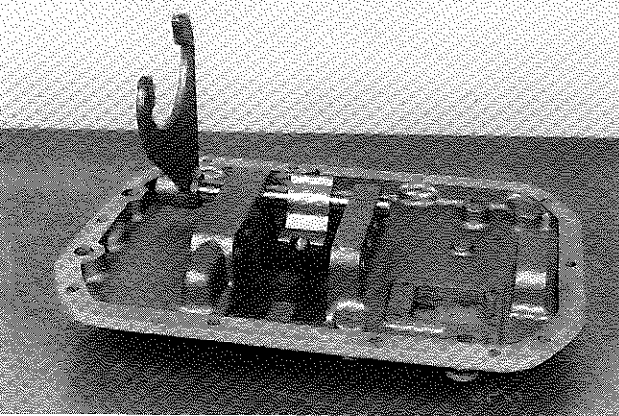
SECTION IV



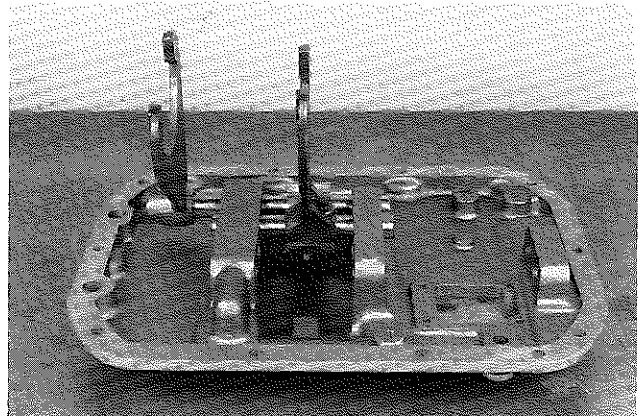
1. Begin reassembly by inserting the interlock spring and plunger into the cover.



4. Insert the interlock pin into the 2nd-3rd shift rod.



2. Install the 1st-reverse rod, shift bracket and fork. Torque the set screws to 26-32 lbs. ft.



5. Install the 2nd-3rd shift rod and fork, and tighten the set screw. Be sure to check each shift rod for free movement while reassembling. Install the next interlock with the round end facing the 2nd-3rd shift rod.



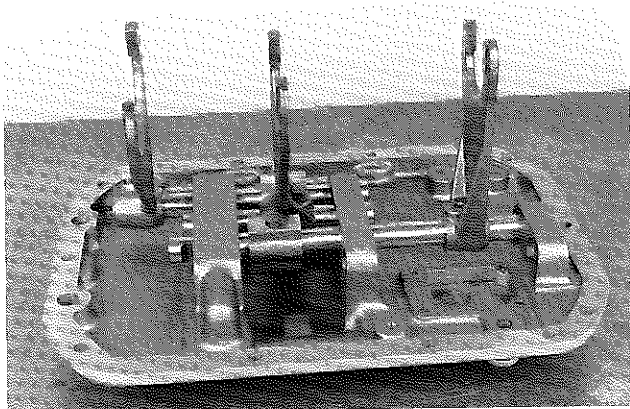
3. Install the interlock poppet into the cover, with the round end facing the 1st-reverse rod. **Caution: Make sure all interlocks are installed properly. They prevent the transmission from being shifted into two gears at the same time.**



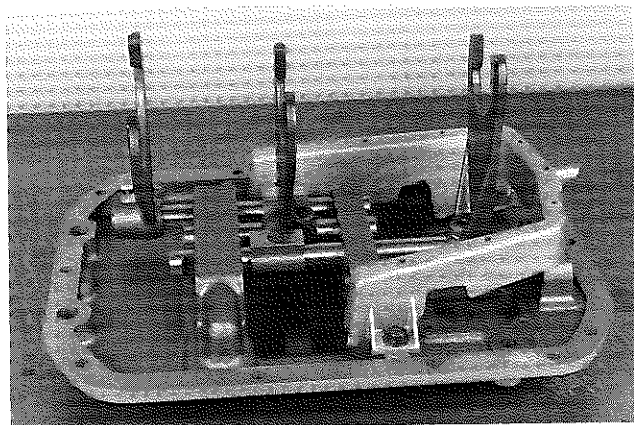
6. Next, place a wedge into the 4th-5th rod boss. This will keep the plunger and spring in position and will make 4th-5th rod installation easier. (Left - Kent Moore tool J 7806K; Right - hand made from an old shift rod.)

SHIFTER HOUSING REASSEMBLY

SECTION IV



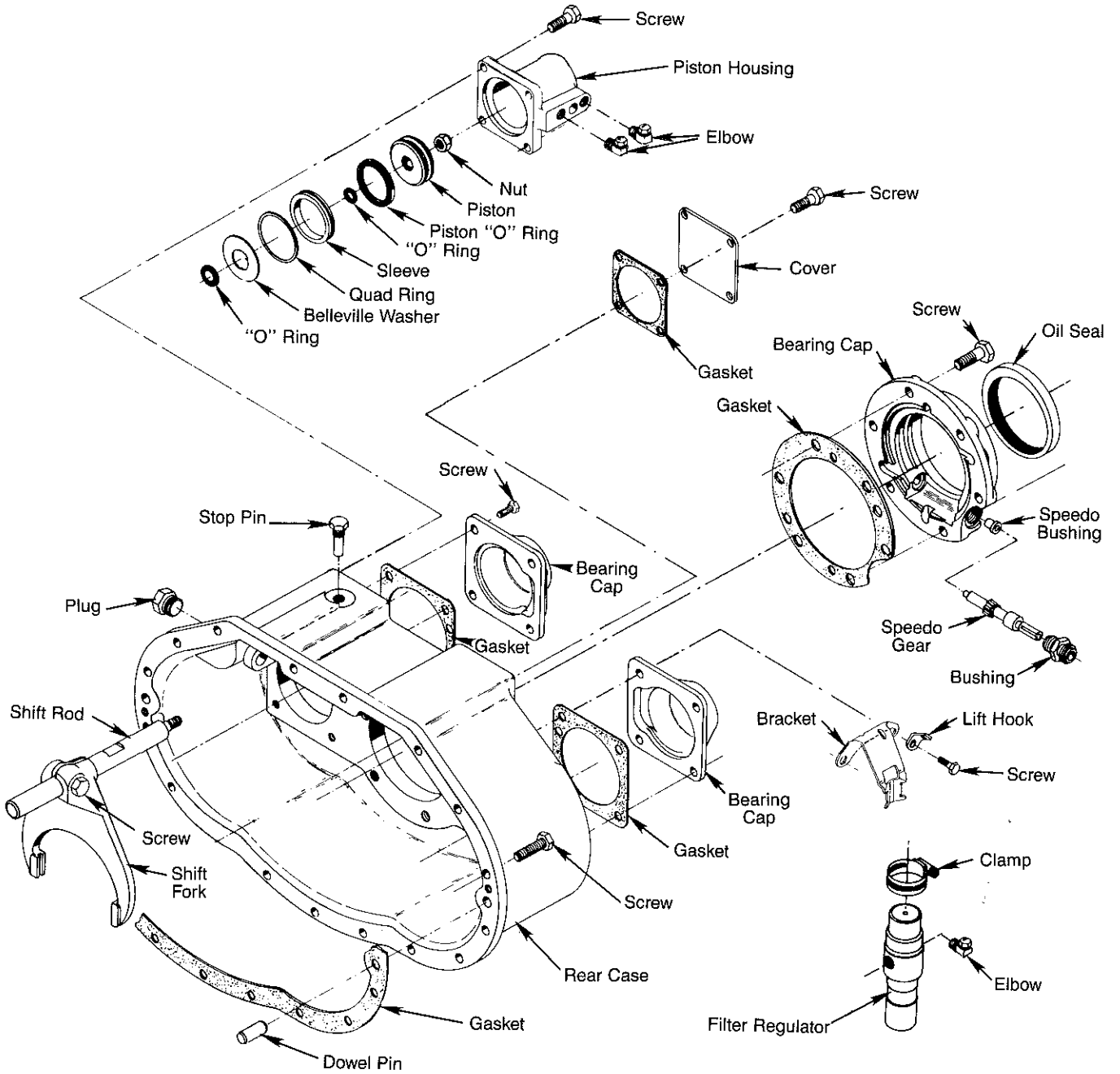
7. Place the 4th-5th rod behind the wedge and tap it into place with a rubber mallet. The interlock hole should face upward to prevent damage to the shift bracket plunger spring. Install the fork and bracket. **Caution: the shift bracket bolt has fine threads, so limit the torque to 13-18 lbs. ft.**

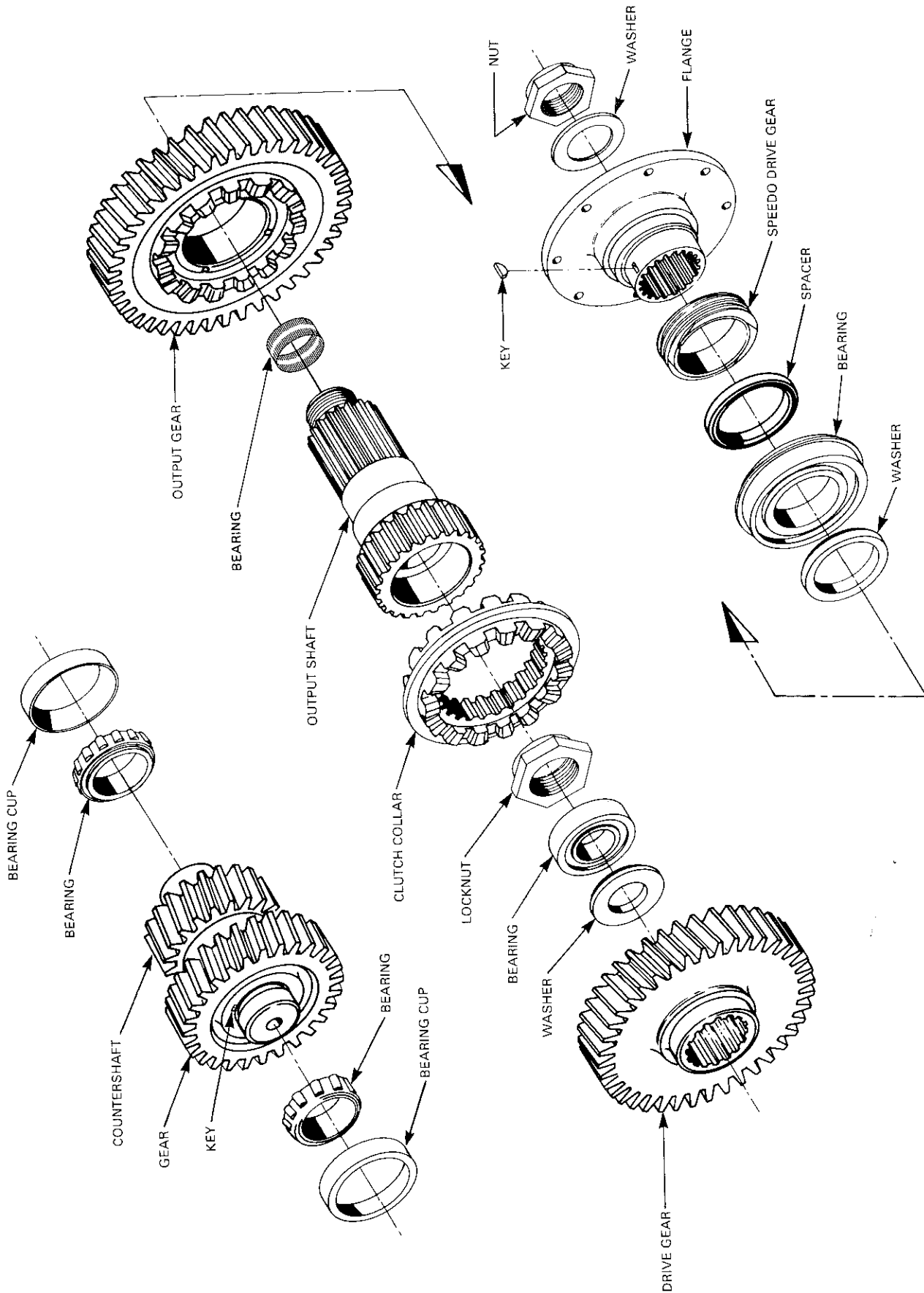


8. Install the oil trough. When shifter housing reassembly is complete, check to make sure the interlocks are functioning properly. Shift one fork into gear; if all interlocks are installed correctly, none of the other forks will shift.

REAR CASE SUBASSEMBLY

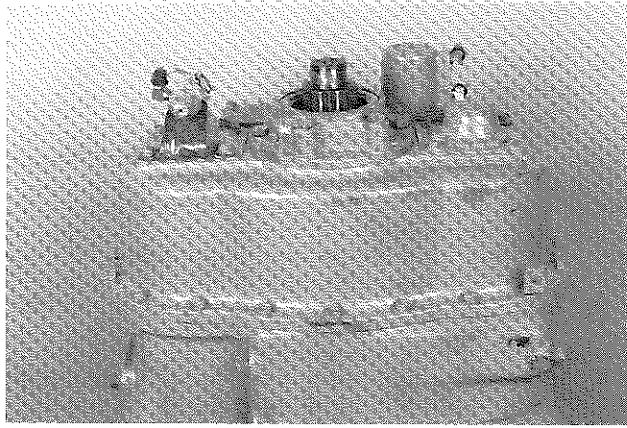
SECTION V



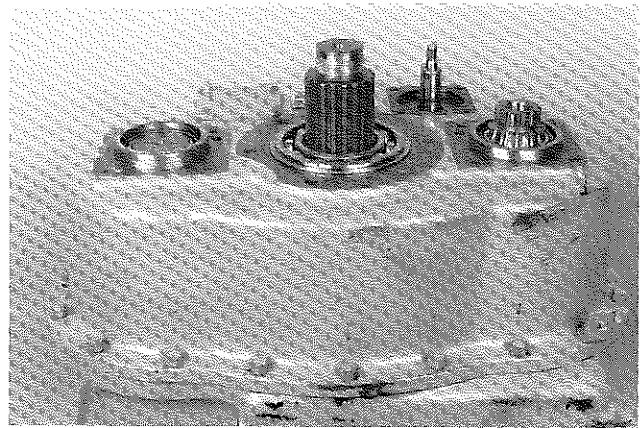


REAR CASE DISASSEMBLY

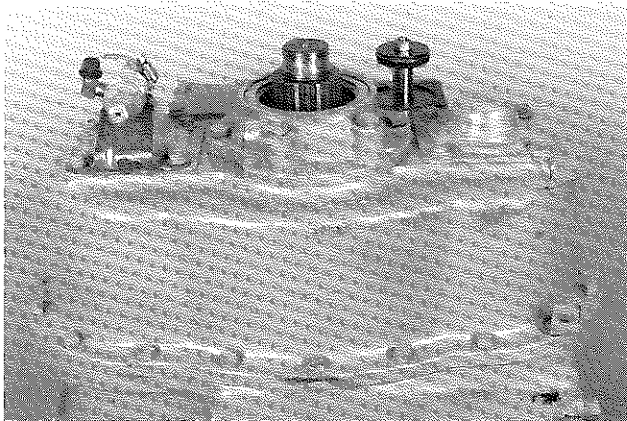
SECTION V



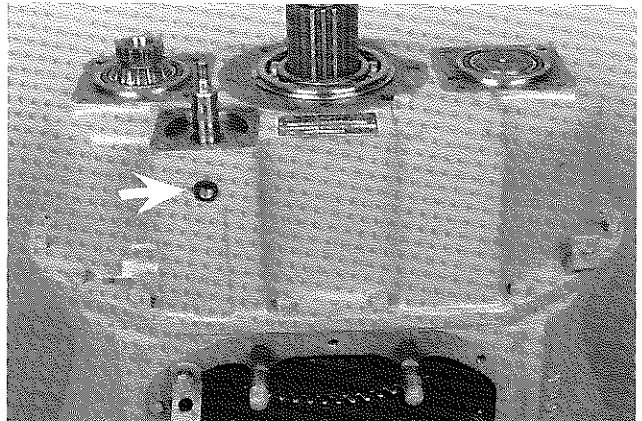
1. To begin disassembly, place the transmission in an upright position.



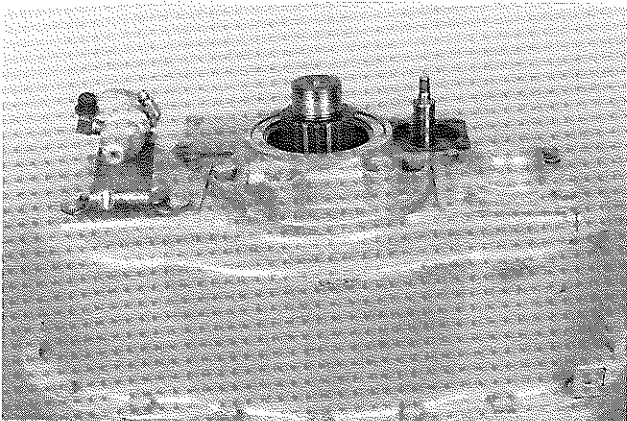
4. The pressure regulator, countershaft bearing caps, output bearing cap and gaskets may be removed.



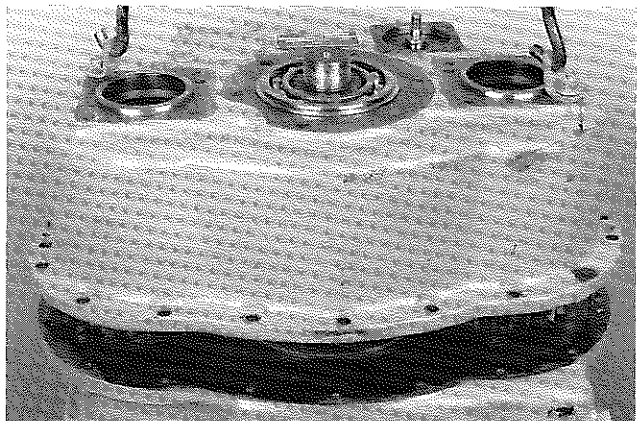
2. Remove the piston housing.



5. Remove the shift fork stop pin before lifting the auxiliary case.



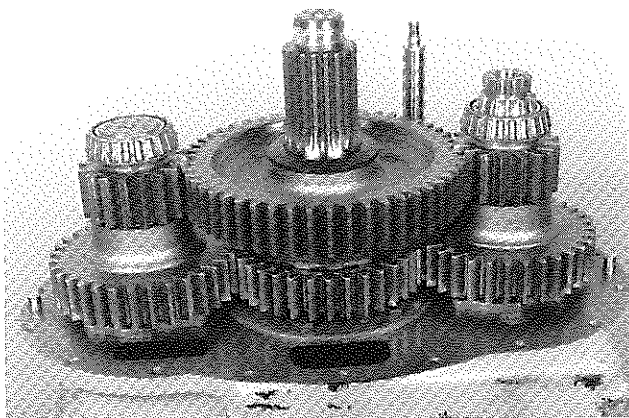
3. Remove the remaining piston parts.



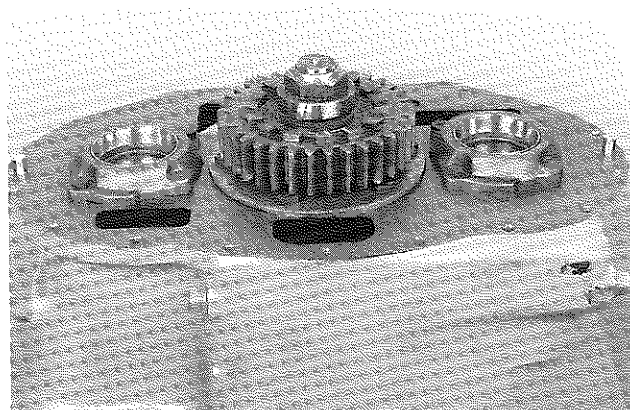
6. Use a chain hoist when lifting case. Tap on the end of the output shaft while the case is being removed. Remove the housing gasket.

REAR CASE DISASSEMBLY

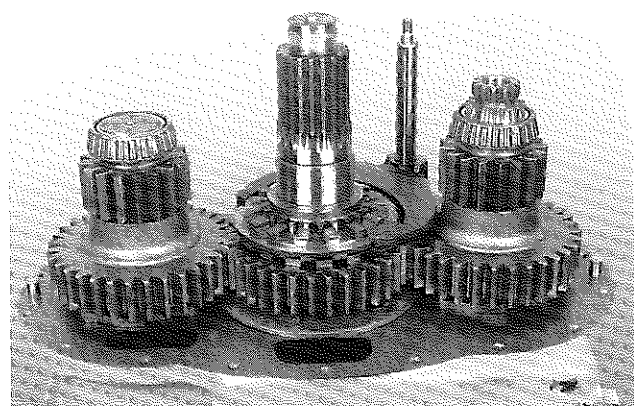
SECTION V



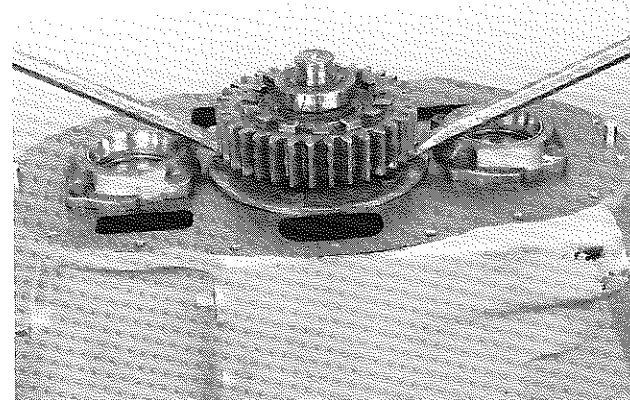
7. This will loosen the bearing from the shaft, while allowing it to remain on the main section.



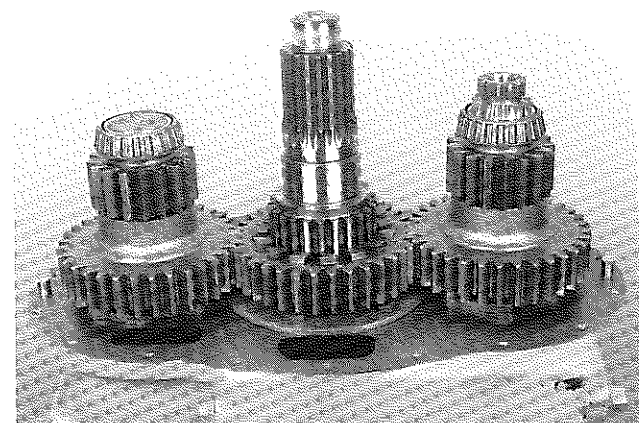
10. Remove the output shaft and countershafts.



8. Remove the washer, low speed gear and caged needle bearing.



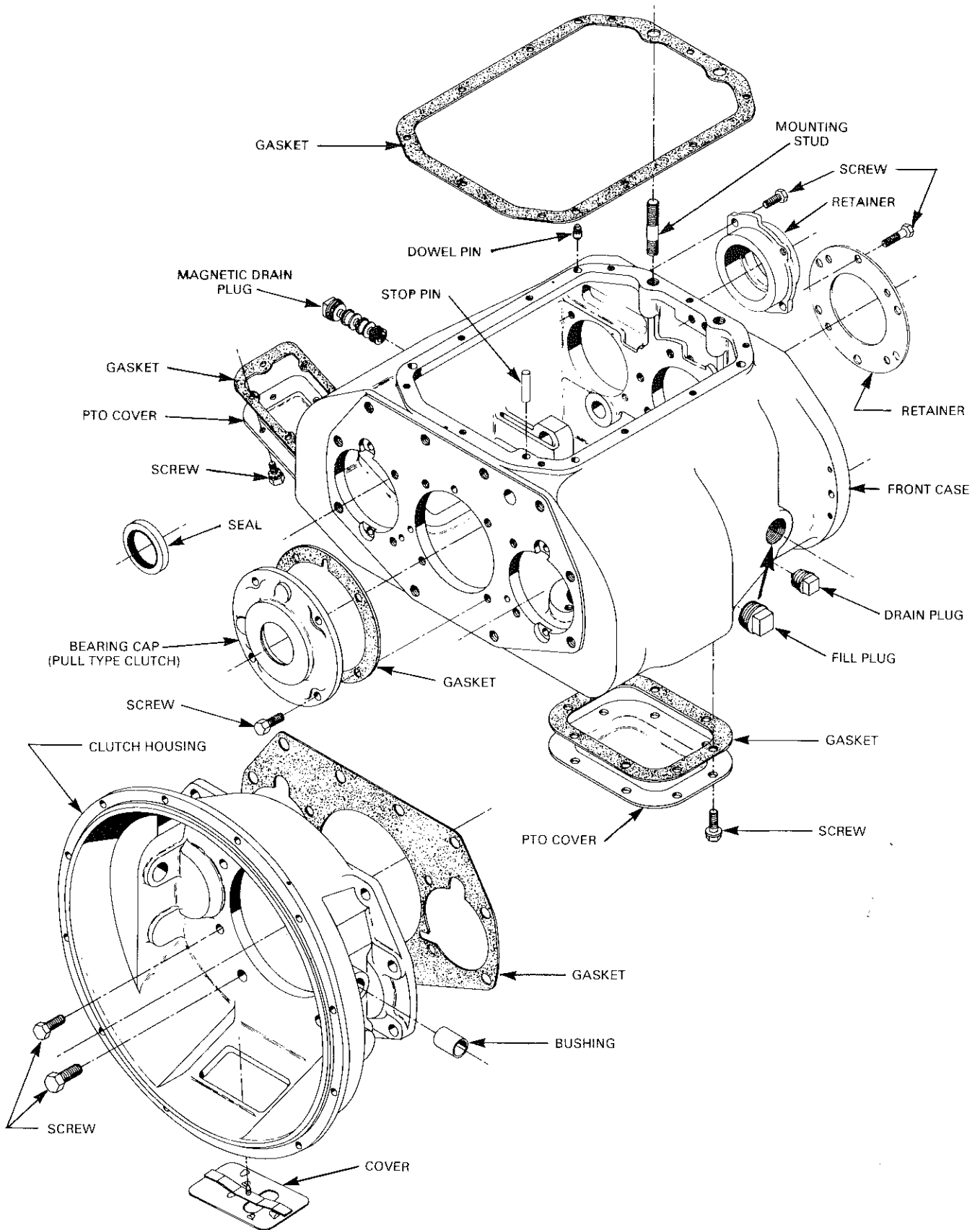
11. After removing the mainshaft nut, lift the gear, washer and the bearing from the mainshaft.



9. Remove the fork and rod assembly and the curvic clutch collar.

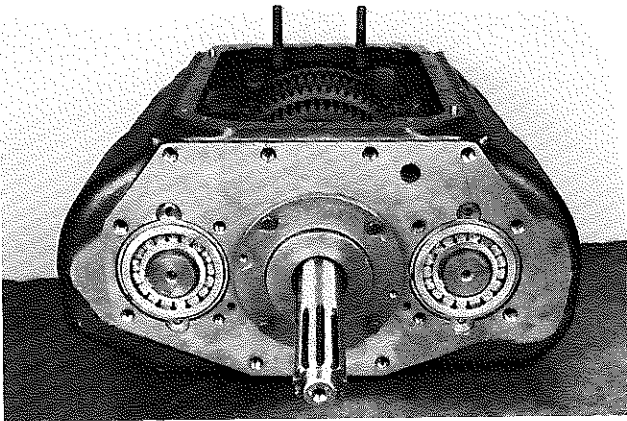
FRONT CASE SUBASSEMBLY

SECTION VI

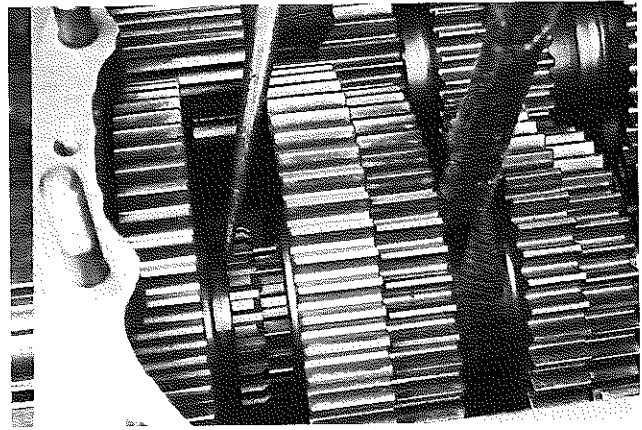


FRONT CASE DISASSEMBLY

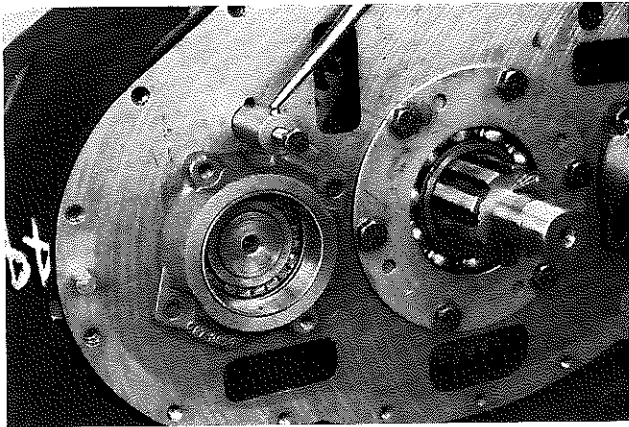
SECTION VI



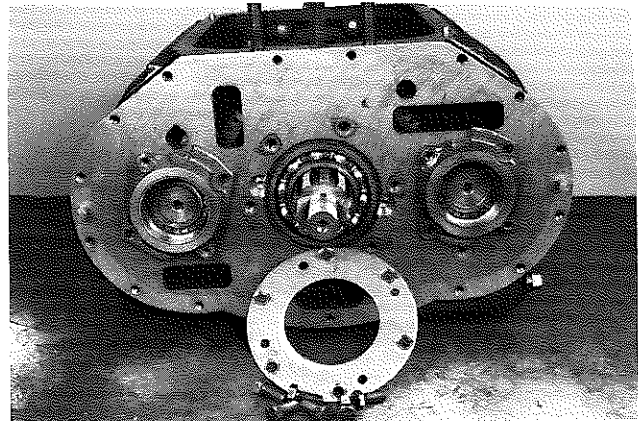
1. Now, place the transmission on a bench and remove the clutch housing.



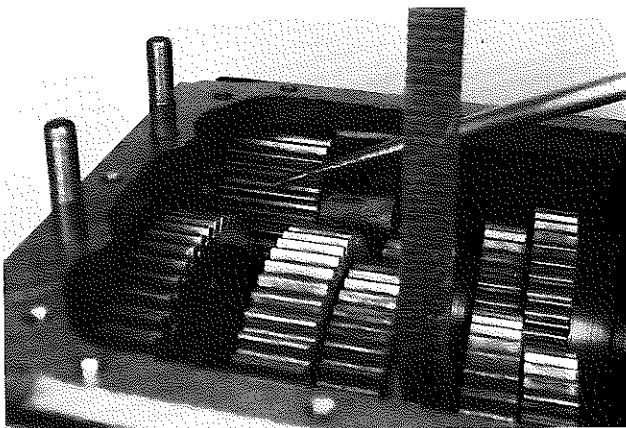
4. Engage the 1st-2nd-Reverse collar into reverse gear.



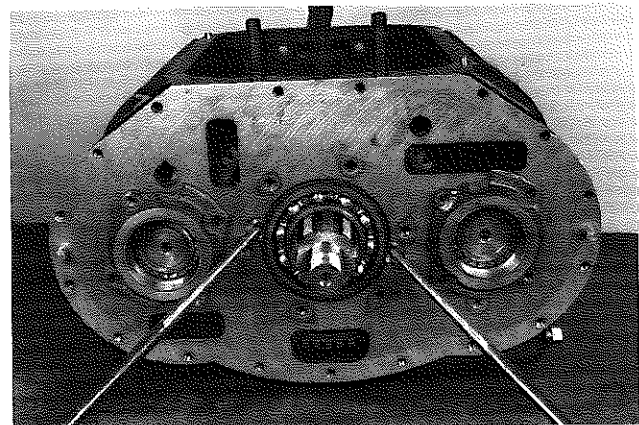
2. Insert a cap screw into the upper reverse idler shaft for removal. Do not lose the lockball which prevents the shaft from turning.



5. Remove the bearing retainer.



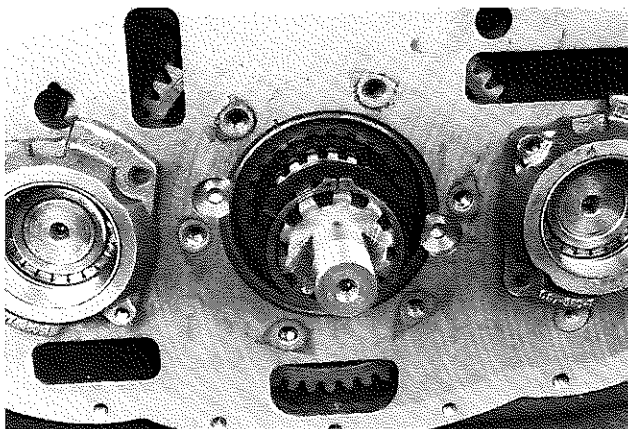
3. Roll the upper reverse idler gear toward the side of the case.



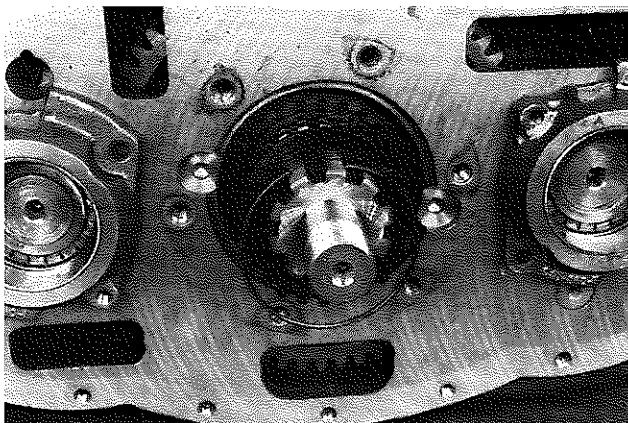
6. These milled slots facilitate bearing removal.

FRONT CASE DISASSEMBLY

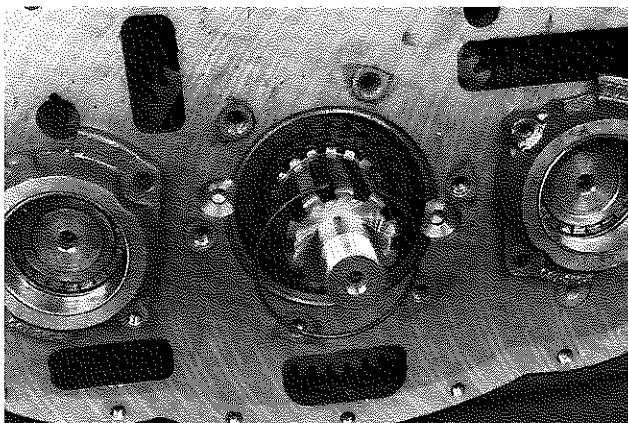
SECTION VI



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



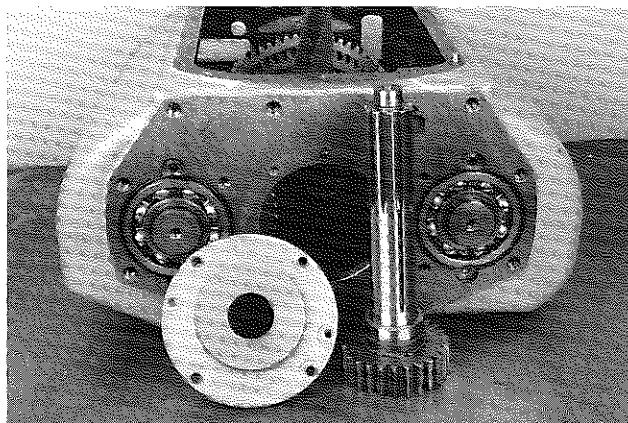
8. Next, remove the gear bore snap ring and both the externally and the internally splined thrust washers.



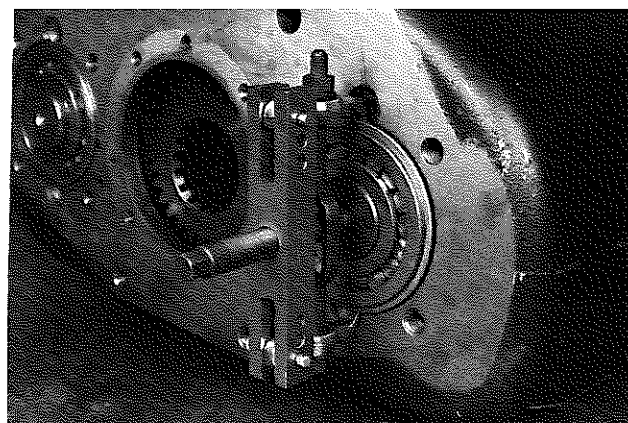
9. Finally, remove the remaining gear bore snap ring.



10. Now, butt 1st-2nd and reverse gears together. Secure with lockwire to provide the necessary clearance for the removal of the mainshaft assembly.



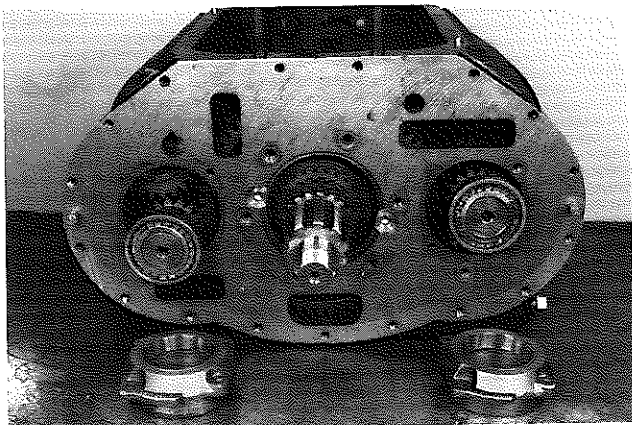
11. Remove the input bearing cap and shaft.



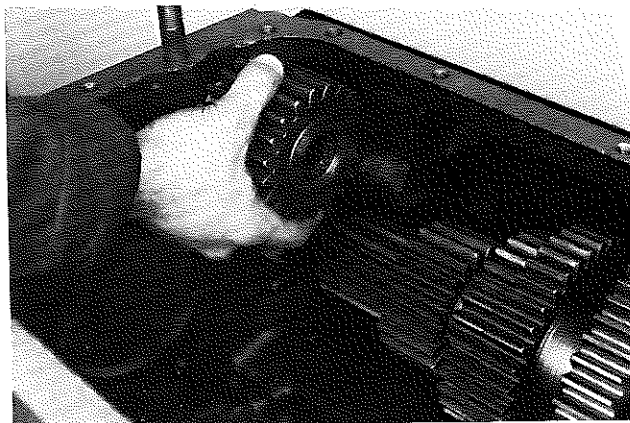
12. To remove the countershaft front bearing, tap the shaft forward so a puller can be installed behind the bearing snap ring.

FRONT CASE DISASSEMBLY

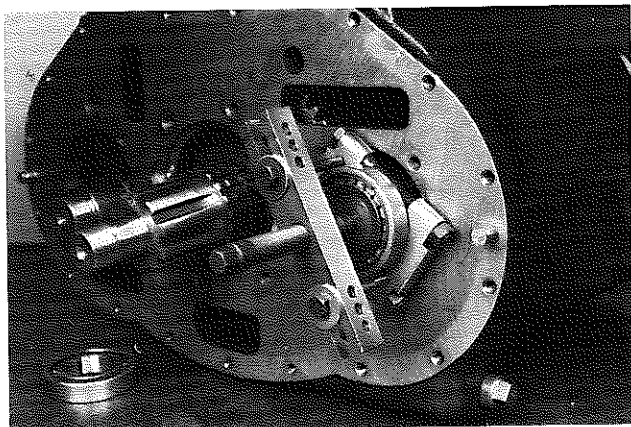
SECTION VI



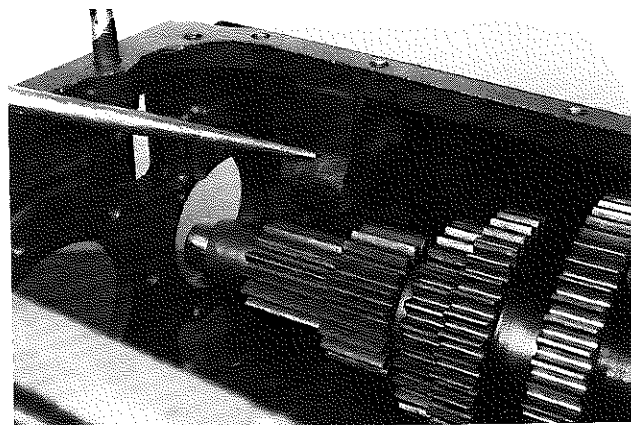
13. After removing the bearing retainers, move the countershafts to the rear, as far as possible.



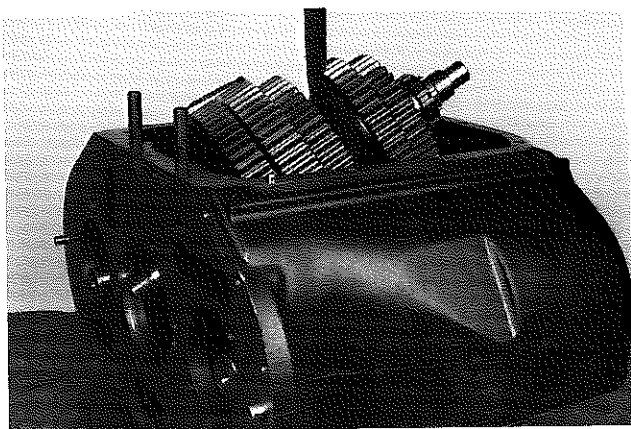
16. Remove the upper reverse idler gear.



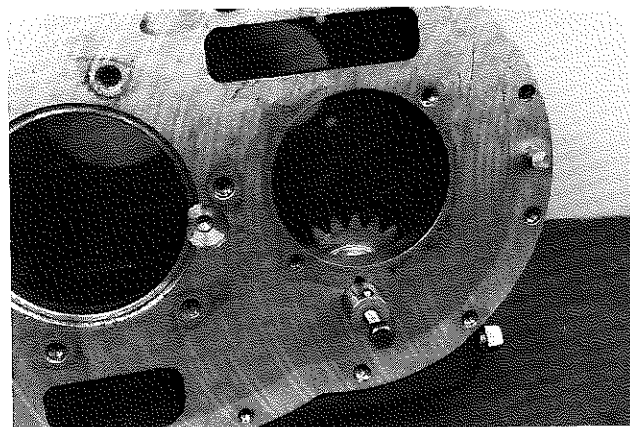
14. Install a puller for bearing removal.



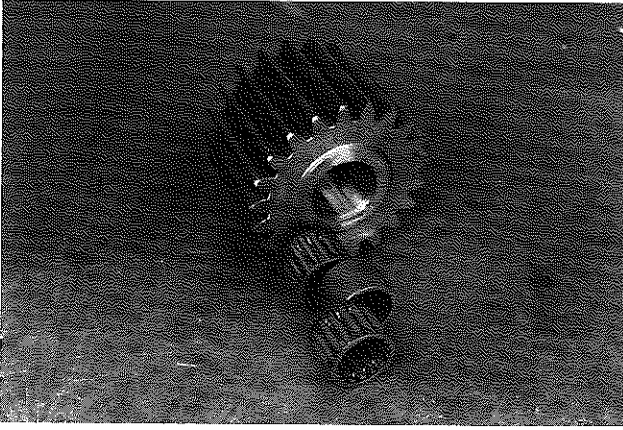
17. Due to this upper idler boss interference, remove the right side countershaft first, then the left side.



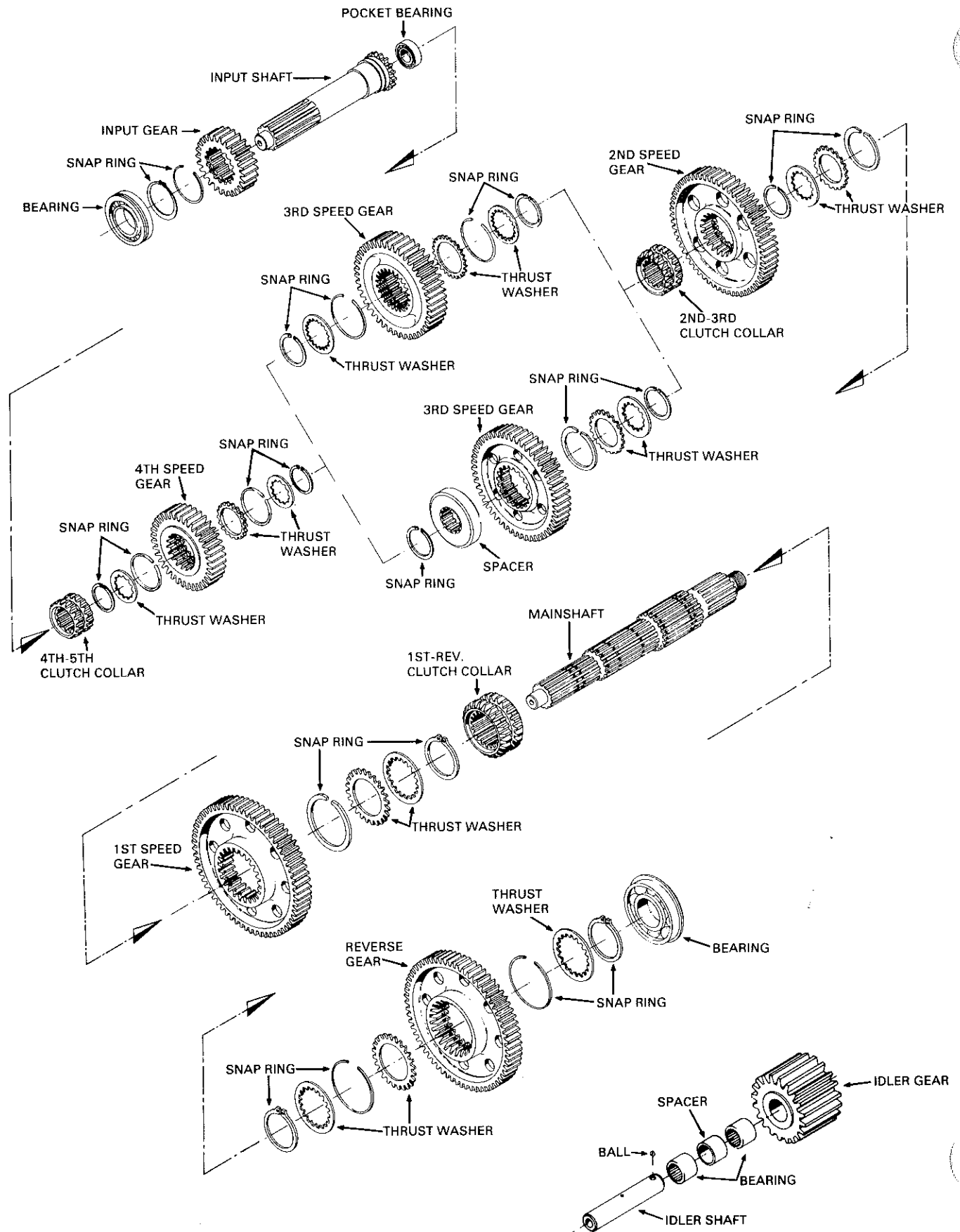
15. To provide the necessary clearance for mainshaft removal, move both countershafts forward and toward the side of the case. Then lift the mainshaft assembly out of the case.

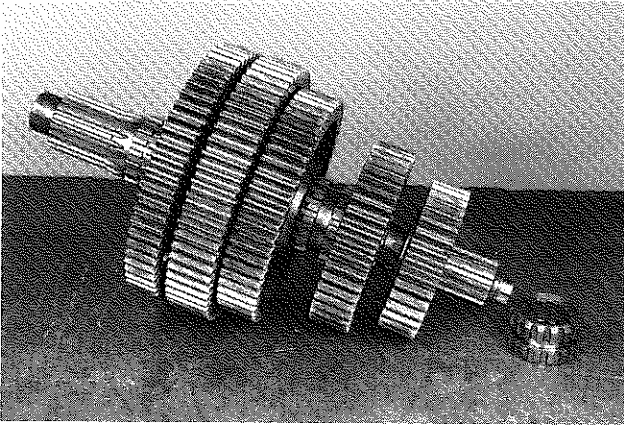


18. Remove the lower reverse idler shaft with lockball.

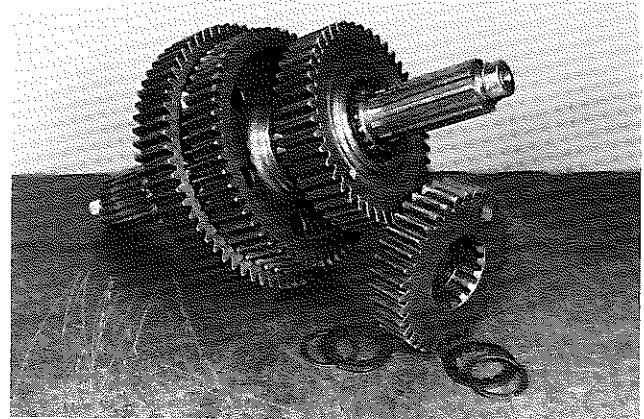


19. Remove the lower reverse idler gear from the case. Check both idler gears and bearings for wear.

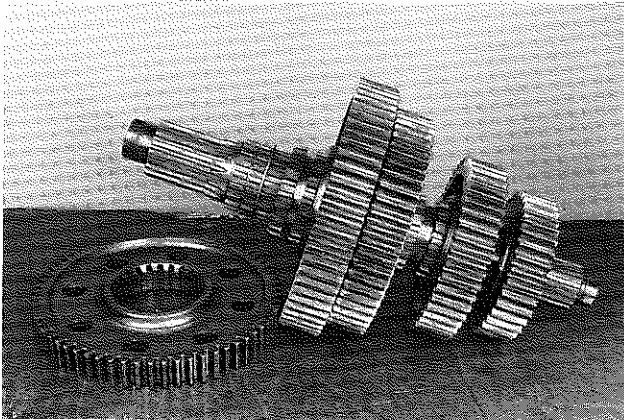




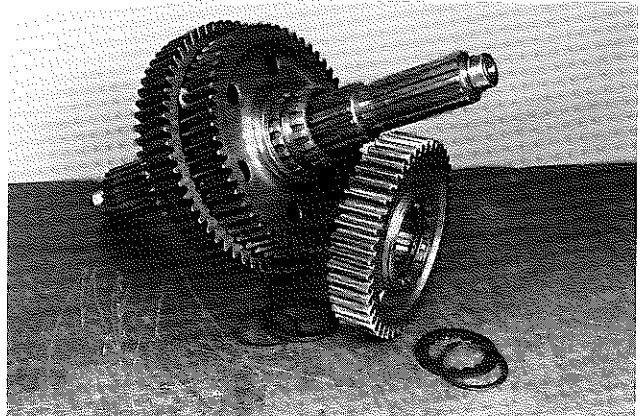
1. Begin the mainshaft disassembly by removing the clutch collar.



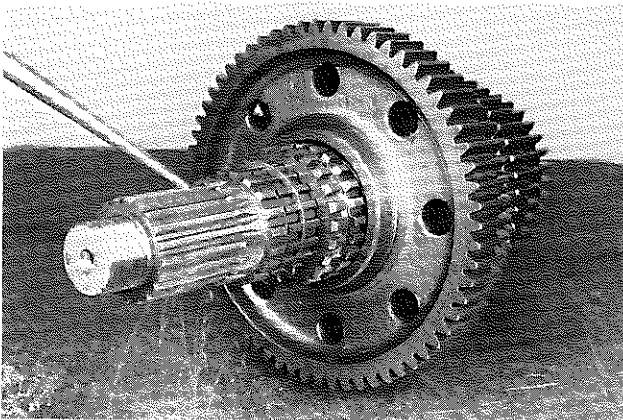
4. Remove the snap ring and 4th speed gear.



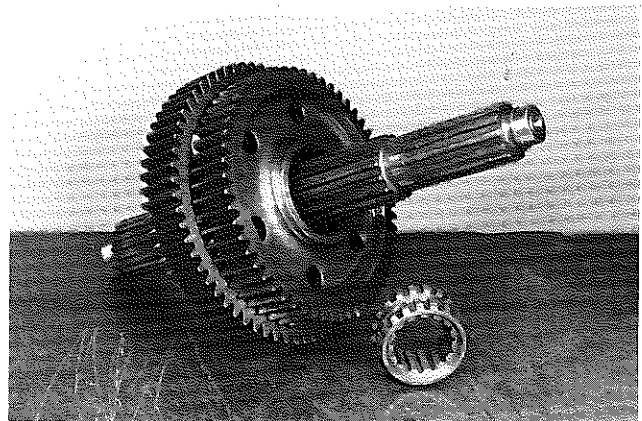
2. Cut the lockwire and remove the reverse gear.



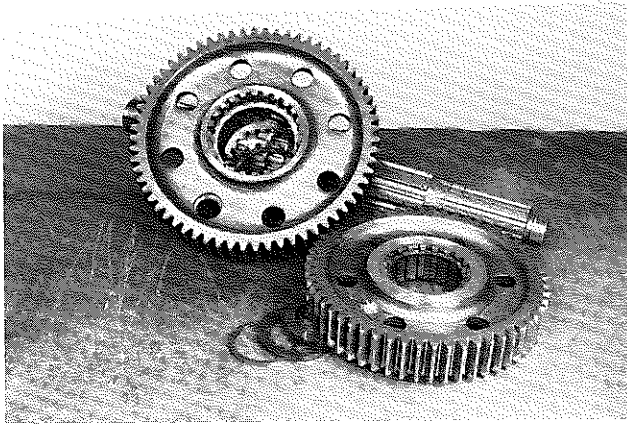
5. Remove another snap ring and the 3rd speed gear.



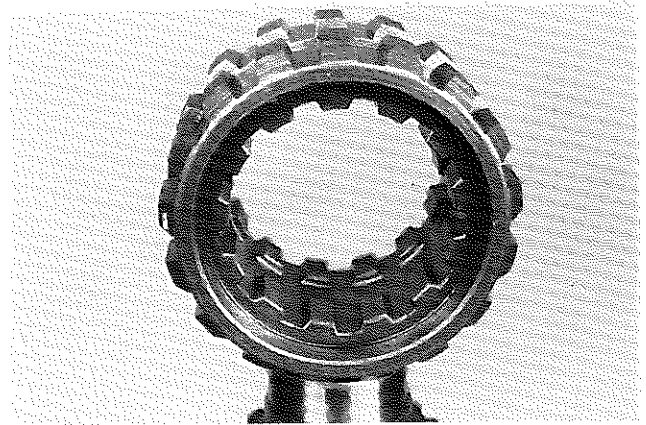
3. This diameter of the mainshaft has been enlarged, thus increasing the torque capacity.



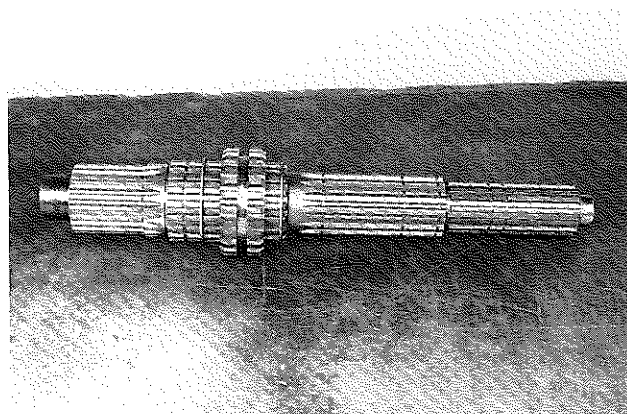
6. Slide the 2nd-3rd speed clutch collar off the mainshaft.



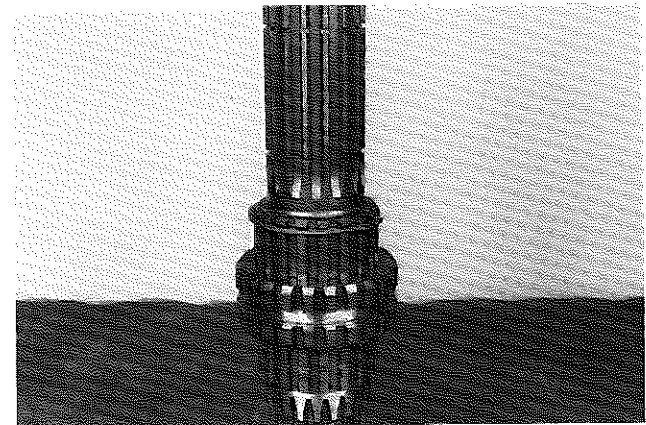
7. Another snap ring secures both the 2nd speed and the 1st speed gears to the mainshaft.



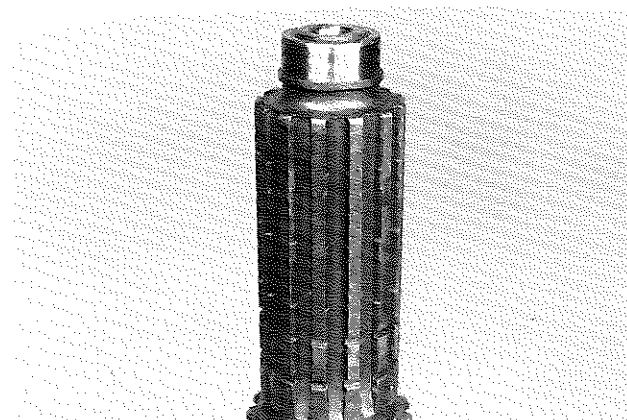
10. While the clutch collar has a relieved area on the internal diameter that provides sharp corners, when "in gear" these edges lock together to keep the transmission in the selected gear.



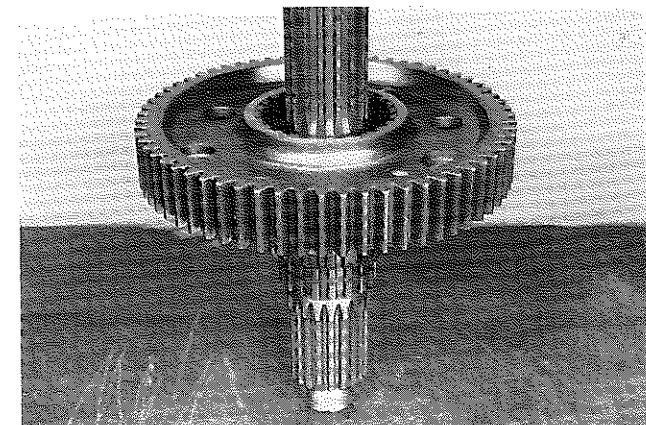
8. All that remains on the mainshaft are two snap rings and the 1st-reverse clutch collar.



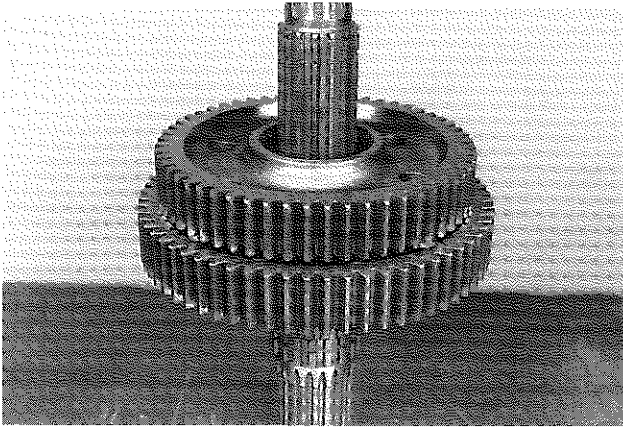
11. Install the 1st-reverse clutch collar between the mainshaft snap rings.



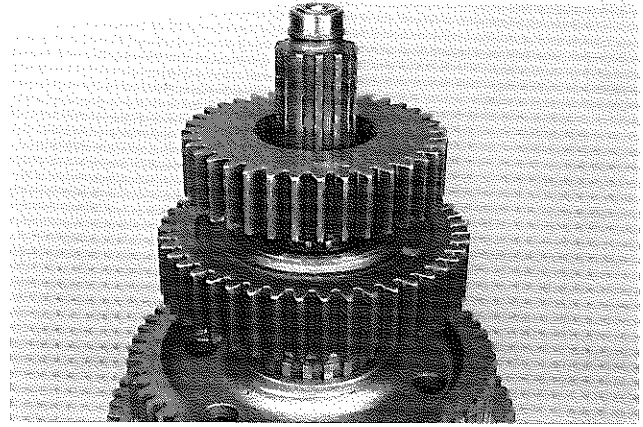
9. Spicer utilizes "gear locks" to maintain clutch collar engagement. The mainshaft splines have machined grooves.



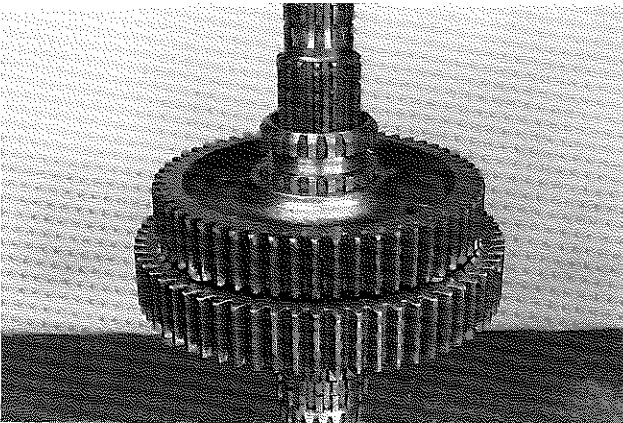
12. Next the 1st speed gear, complete with thrust washers, is placed on the mainshaft.



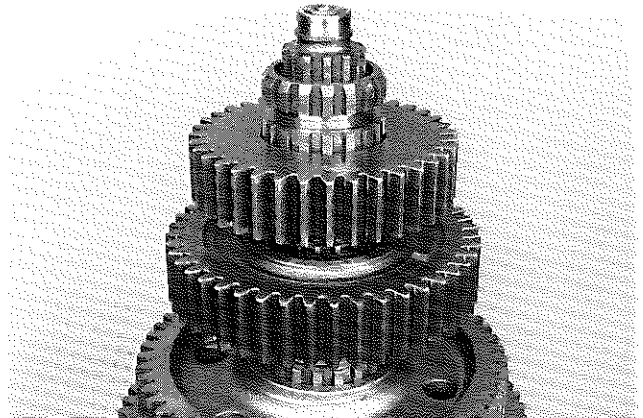
13. Place the 2nd speed gear on the mainshaft and secure with a mainshaft snap ring.



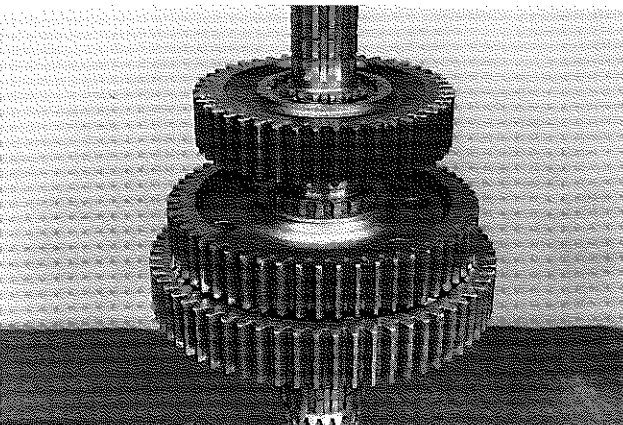
16. Install the 4th speed gear.



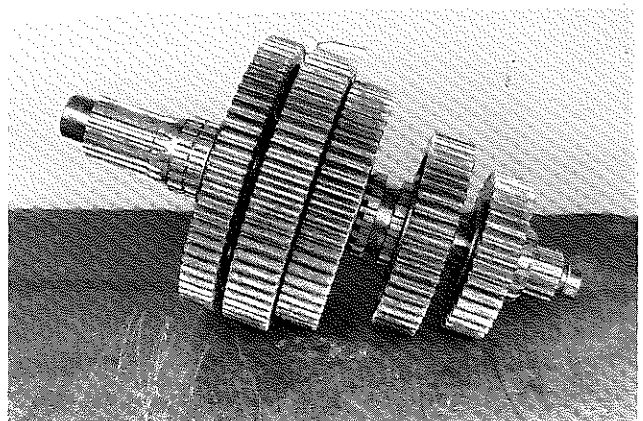
14. Slide the 2nd-3rd speed clutch collar onto the mainshaft.



17. Then place the 4th-5th speed collar onto the mainshaft.



15. Third speed gear is secured to the mainshaft by a snap ring on each side of this gear.



18. Install the reverse gear and butt it against the 1st speed gear. Secure with lockwire.

Inspection

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

These suggested inspection procedures should be followed:

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

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

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

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

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

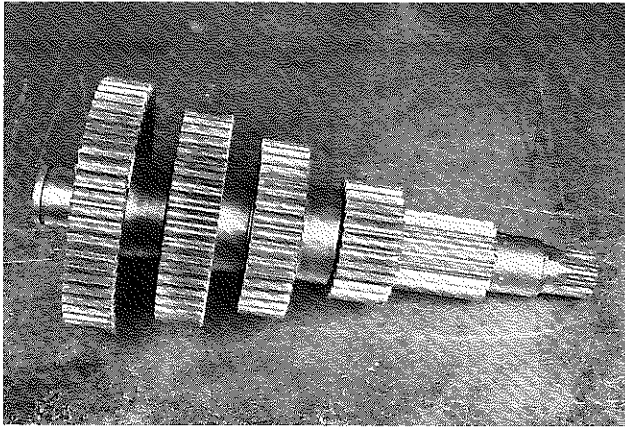
TORQUE SPECIFICATIONS FOR NUTS AND CAPSCREWS

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

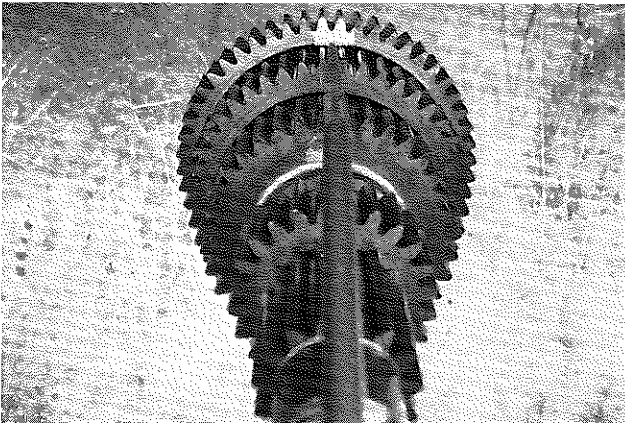
On all transmissions with .750-14 NPTF drain plugs, the drain plug torque should be 50-65 ft. lbs. The only exceptions are the ES42-5, ES52-5, CM40, CM49 and CM55 Models. The torque on these units should be 30-45 ft. lbs.

COUNTERSHAFT DISASSEMBLY & REASSEMBLY

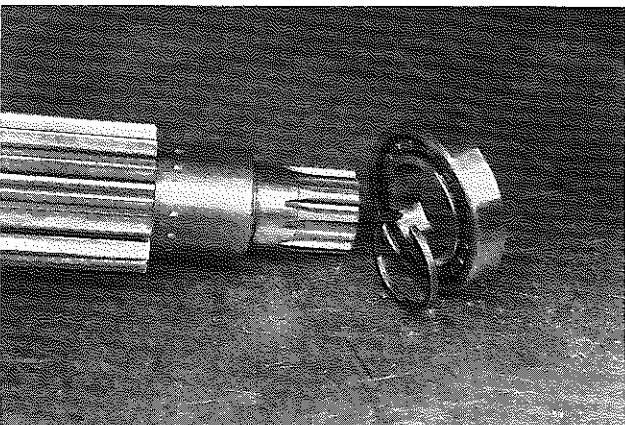
SECTION VIII



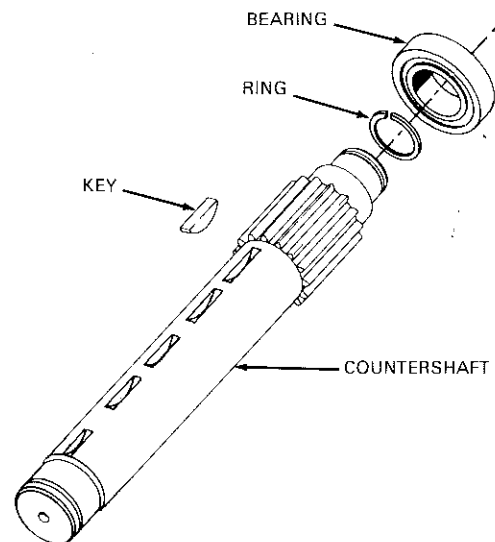
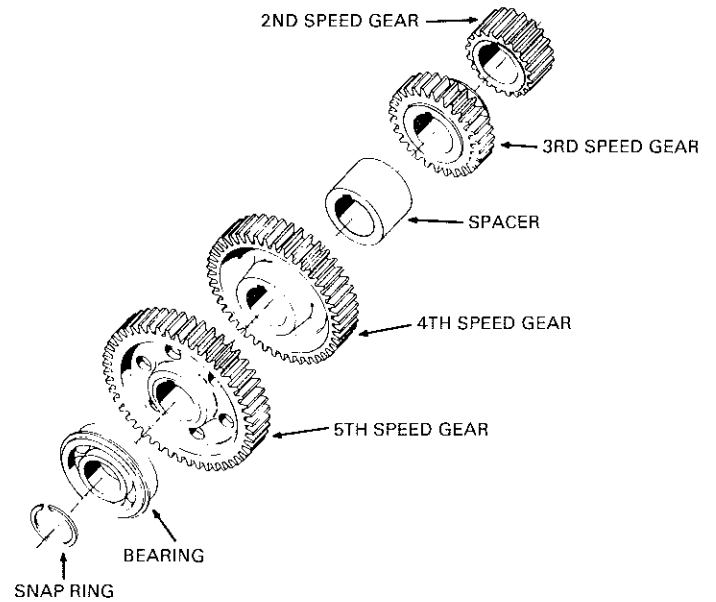
1. This view shows the hub direction of the gears. The first-reverse gear is an integral part of the shaft, while the remaining gears are secured with individual Woodruff keys under each gear.

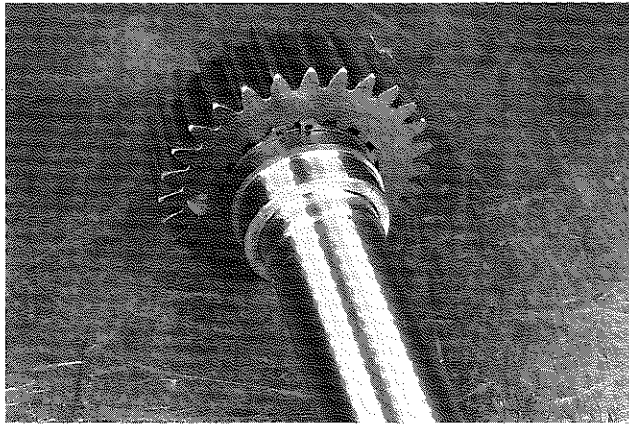


2. If you place a straight edge between these painted teeth, every gear on the countershaft will be in line. When you set these shafts in time, these marks will be directly across from each other.

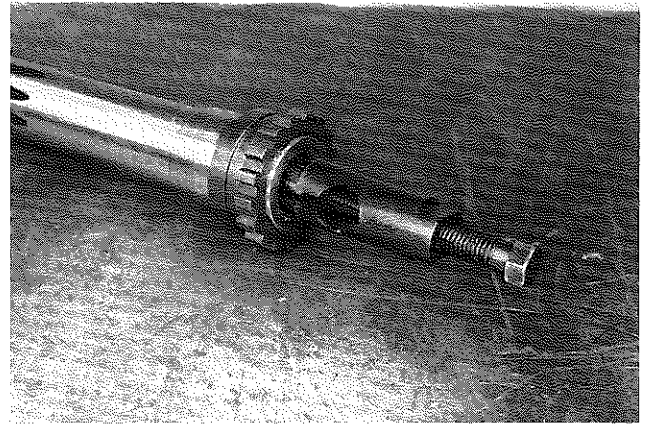


3. The countershaft rear bearing requires a spacer ring for proper location.

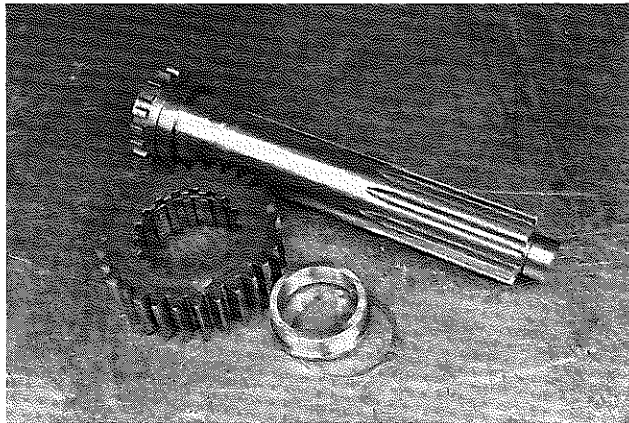




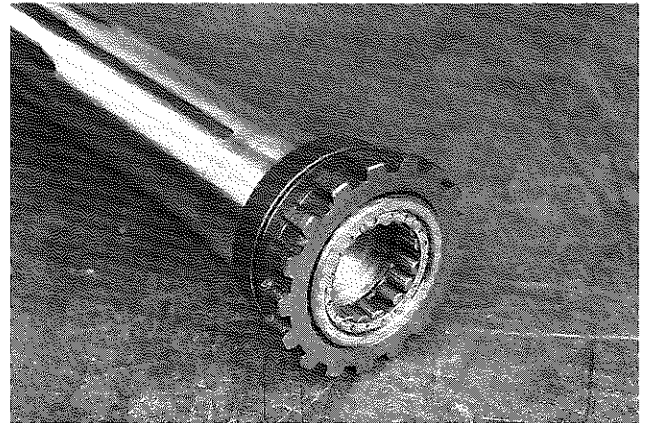
1. The input gear and shaft are separate components secured with a snap ring.



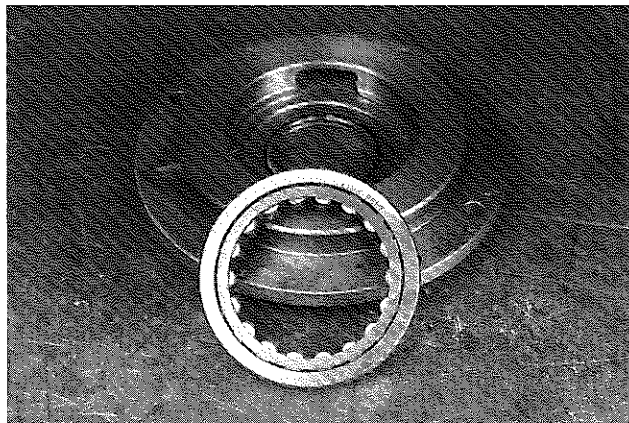
4. Remove the pocket bearing. Kent-Moore puller J-29128 is recommended.



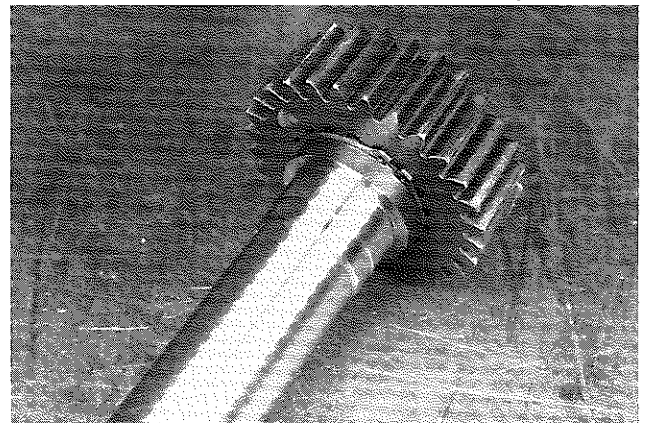
2. This view shows the input sub-assembly when disassembled.



5. This new style pocket bearing is reversible.



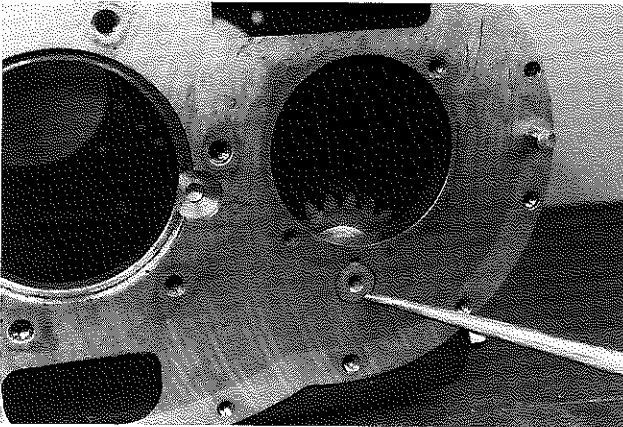
3. The input bearing is a press fit into the input bearing cap.



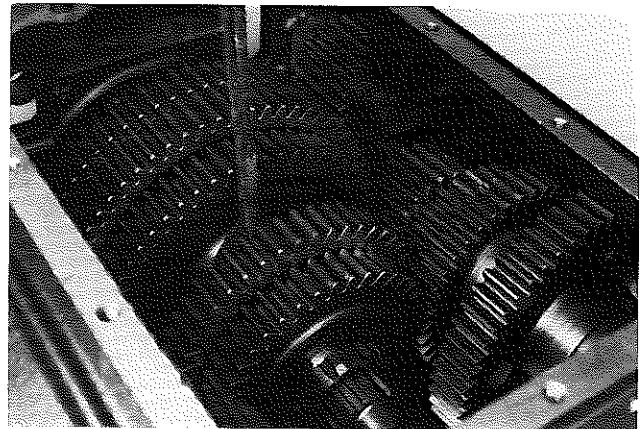
6. The snap ring in the input shaft secures the gear in its proper location.

FRONT CASE REASSEMBLY

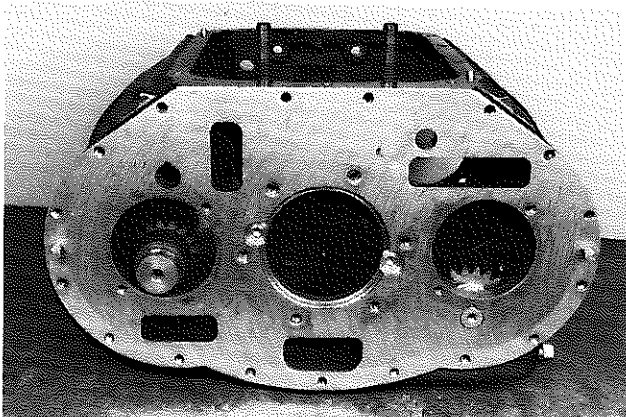
SECTION IX



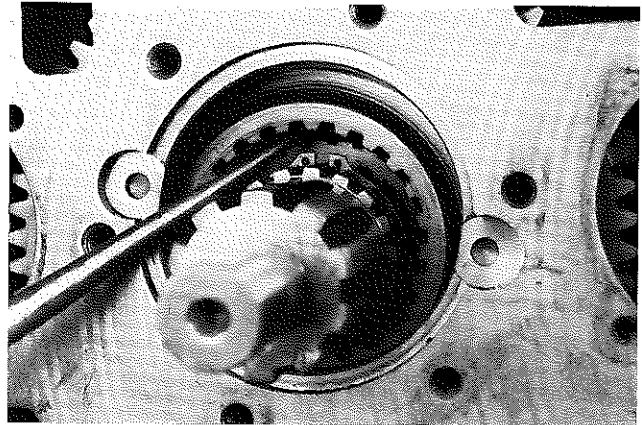
1. Reassembly of the transmission begins by placing the lower reverse idler gear into the case. Install the idler shaft with lockball.



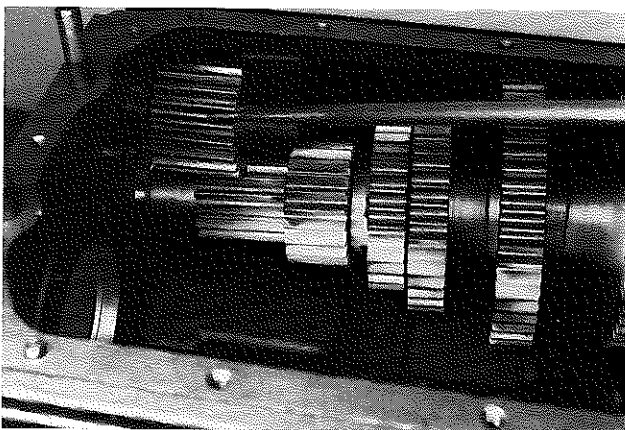
4. Lower the mainshaft assembly into the case, keeping the lockwire on top.



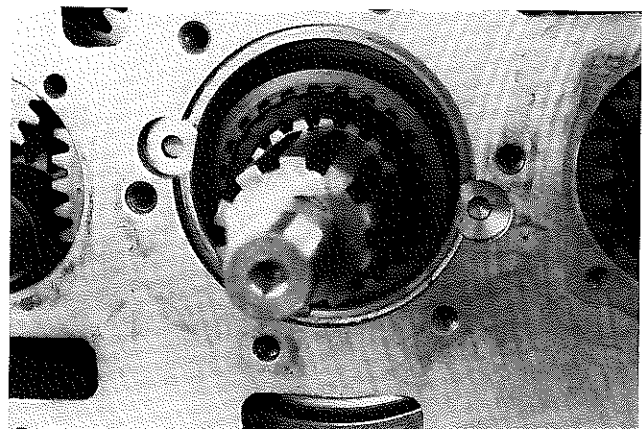
2. Install the left side countershaft first, then the right side. Align the timing marks toward the center of the case.



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



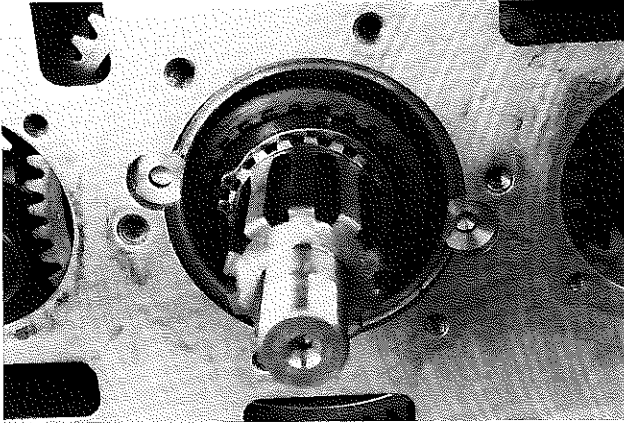
3. Install the upper reverse idler gear, but not the shaft at this time. Placing a screwdriver in the idler shaft hole will help keep the gear out of the way.



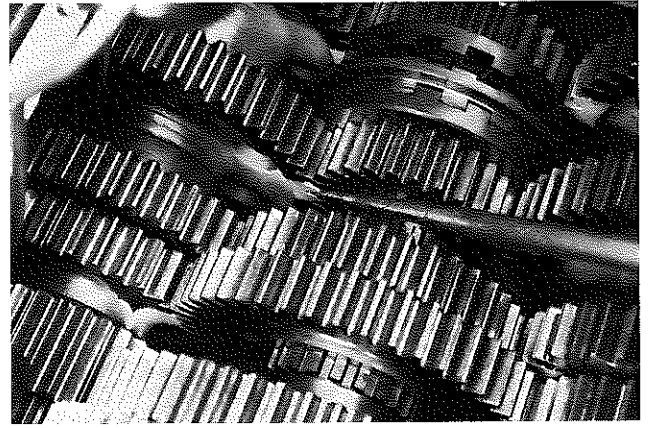
6. Next, place both the internally and the externally splined thrust washers into the bore and secure with the remaining gear bore snap ring.

FRONT CASE REASSEMBLY

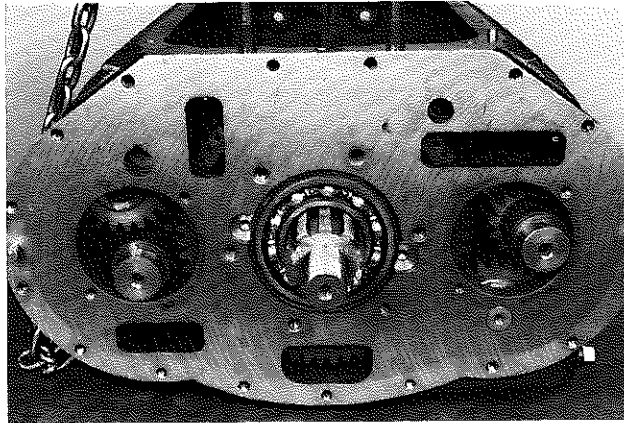
SECTION IX



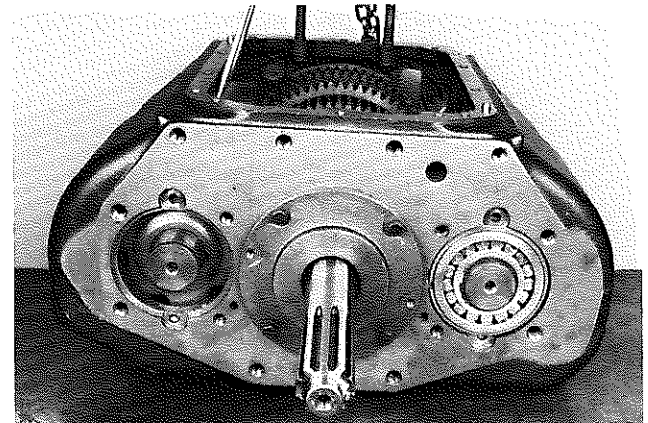
7. Finally, install the internally splined thrust washer and secure with the mainshaft snap ring.



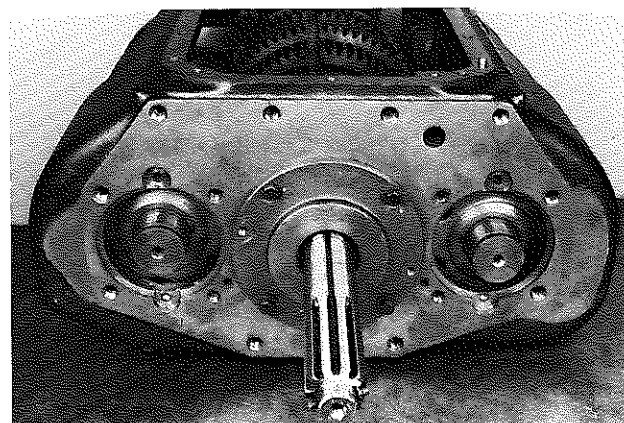
10. With the aid of a countershaft lift hook, set the countershaft in time. This is accomplished by matching the paint marks.



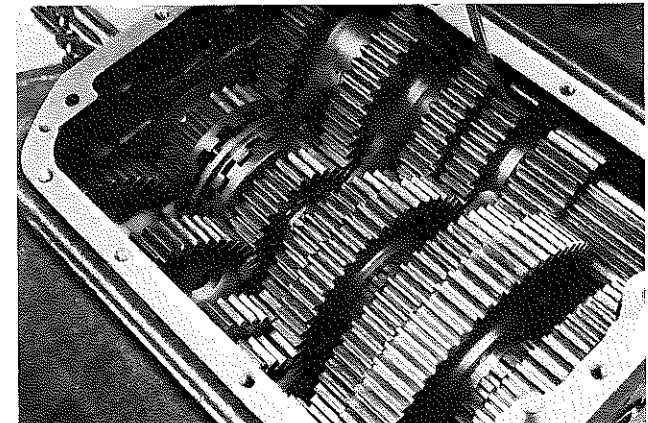
8. Slide the output bearing onto the shaft and with a suitable driver, install until the snap ring seats against the case.



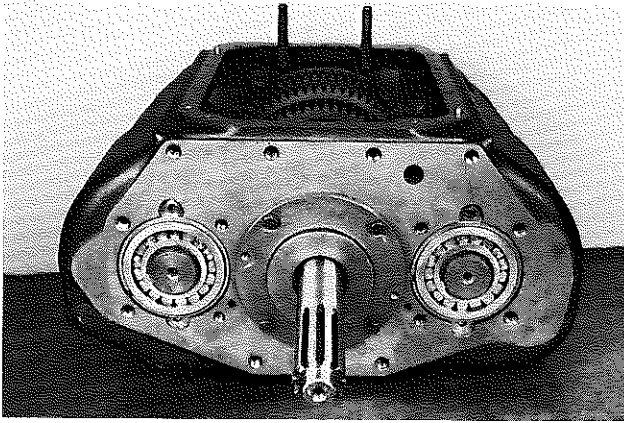
11. Install both the front and the rear bearings.



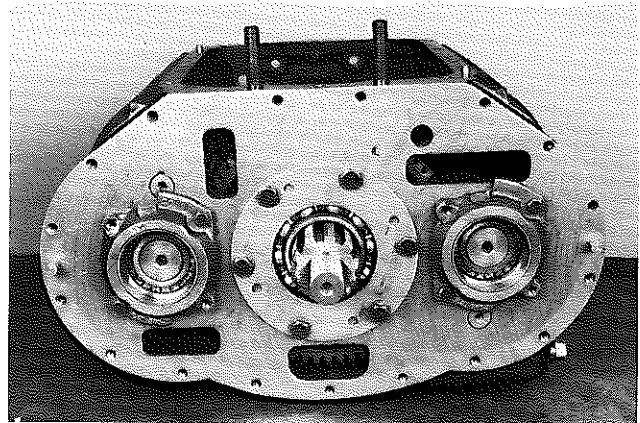
9. Install the drivegear. Align the oil holes and secure with capscrews. Torque 34-41 lbs. ft.



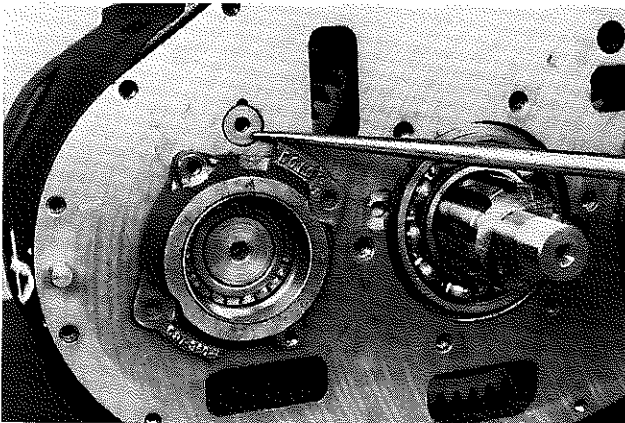
12. Repeat this procedure for the remaining countershaft.



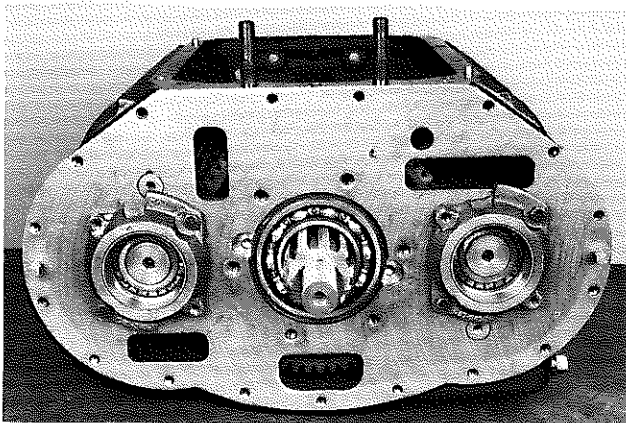
13. The input shaft may now be rotated to check for correct timing. If the shaft turns freely, the unit is in time. If it locks up, check the timing marks for proper alignment.



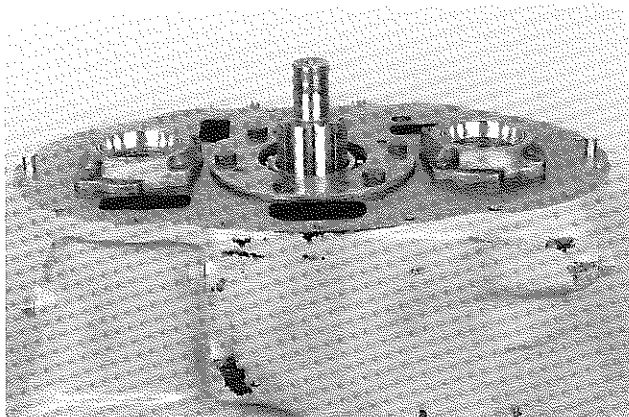
16. Assemble the output bearing retainer to the case. Complete reassembly by installing the clutch housing.



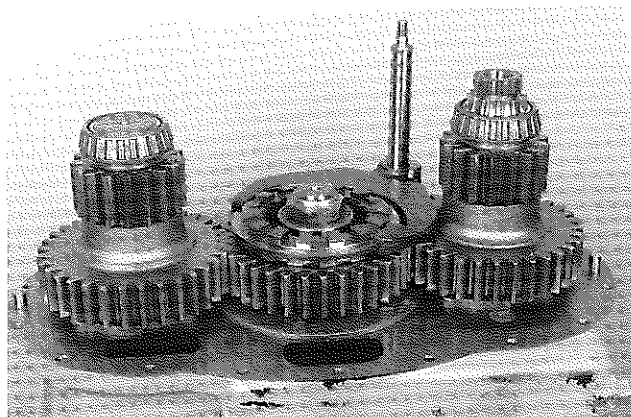
14. Install the upper reverse idler shaft complete with lockball. It is necessary to lift up on the mainshaft reverse gear to obtain proper alignment.



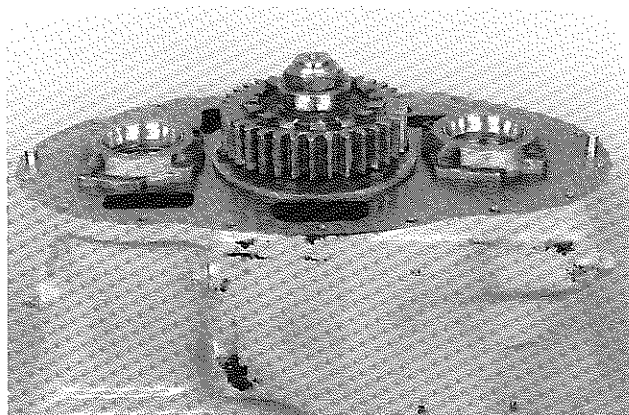
15. Secure the countershaft rear bearing retainers with capscrews. Torque 34-41 lbs. ft.



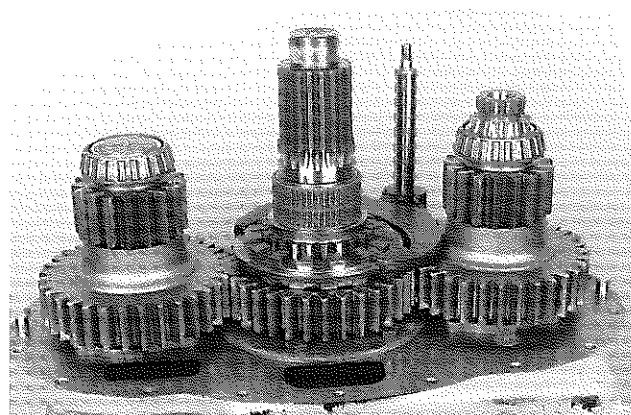
1. Stand the transmission upright.



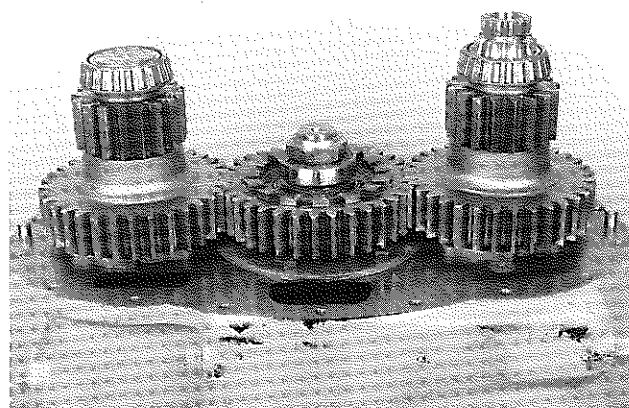
4. Assemble the shift fork and rod assembly complete with the curvic clutch collar.



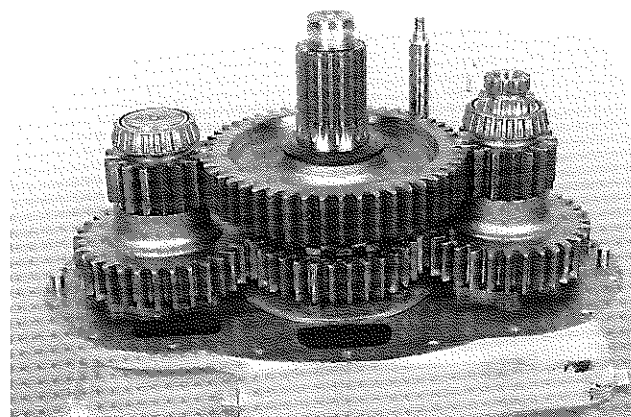
2. Install the drive gear. Assemble the washer and bearing, and secure them with the nut. Torque to 550-600 lbs. ft.



5. Place the output shaft through the clutch collar splines. Install the caged needle bearing.



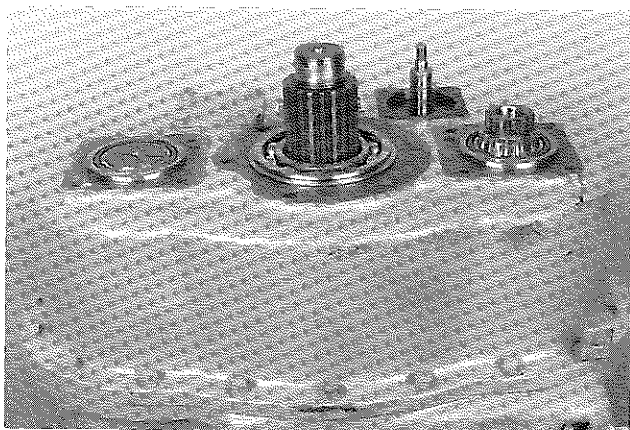
3. Set the countershafts in time with the drive gear by matching the timing marks.



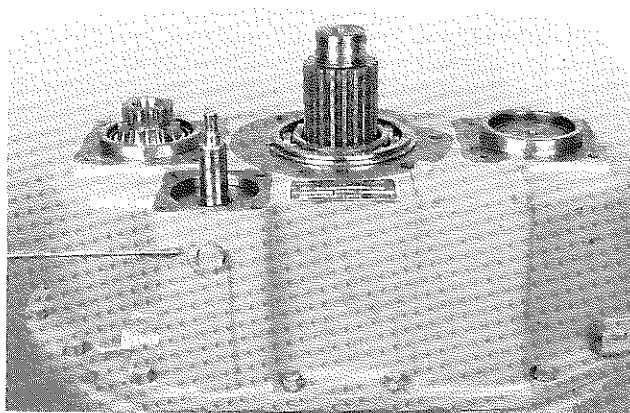
6. Place the low gear and washer onto the output shaft.

REAR CASE REASSEMBLY

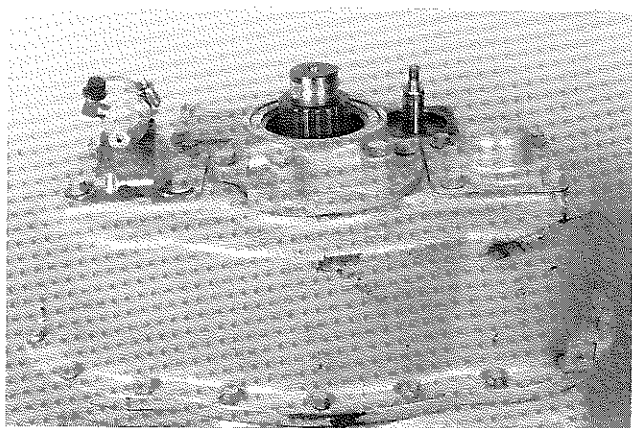
SECTION IX



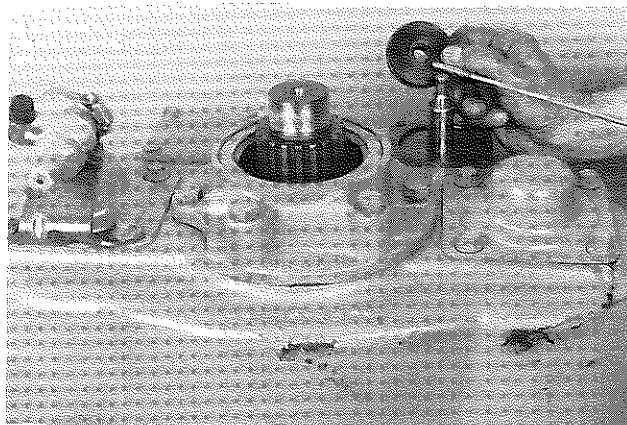
7. Set the auxiliary section case and gasket onto the unit, and secure it with capscrews. Torque to 34-41 lbs. ft. The output bearing can also be installed now.



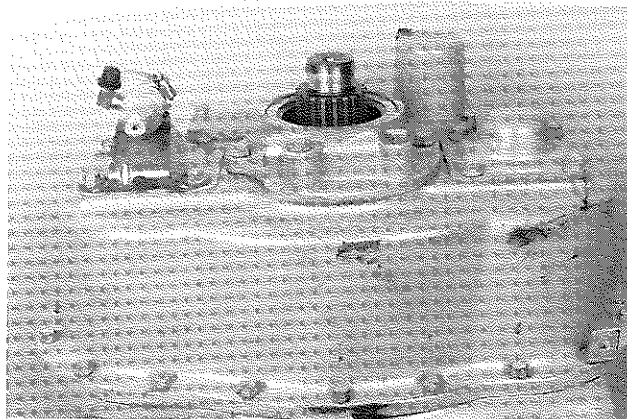
8. Be sure to reinstall the shift fork stop pin.



9. Install the output bearing cap and gasket, the counter-shaft bearing caps, and the pressure regulator.



10. Assemble the gasket and adaptor plate with the "O" ring facing the transmission. Then place the piston on the shift rod and secure it with the locknut.



11. Seat the piston housing firmly against the case and secure it with capscrews. Complete the reassembly by installing the shifter housing. Torque to 25-32 lbs. ft.

Important Procedure

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

Road test whenever possible. Mechanics usually get second or third hand reports of trouble experienced with the unit. These reports do not always accurately describe the actual conditions. Sometimes symptoms seem to indicate trouble in the transmission, while actually the problem is with the axle, driveshaft, universal joints, engine or clutch. This is especially true of noise complaints. Therefore, before removing the transmission or related components to locate trouble, road test to check the possibility of trouble in other closely associated units. Road testing is most effective when the mechanic himself drives the vehicle. However, riding with the driver can be very informative.

Check Functioning Prior to Disassembly

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

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

Inspect Thoroughly During Disassembly

It is poor practice to disassemble a unit or the complete transmission as quickly as possible without examining the parts. The mechanic may completely disassemble a unit and fail to find the cause of the trouble, unless he examines the parts. After the transmission is disassembled, check the lubricant for foreign particles. This is a source of trouble often overlooked during the disassembly.

Repair or Replace Worn Parts

Many times the parts or critical adjustments causing the trouble are not replaced or corrected because the mechanic only inspects and replaces parts that have failed completely. *All* pieces should be accurately examined because broken parts are often just the result—not the cause—of the problem. All parts that are broken or worn and no longer meet specifications should be replaced.

Also, parts that are worn to the extent that they do not have a long service life remaining should be replaced. Replacing these parts now will avoid another teardown on the unit in the near future. Also at this time, make the recommended changes or modifications to bring the transmission up to date and increase the service life of the unit.

CAUTION: If the backup lights do not function, check the following:

1. Continuity of switch with ball fully depressed
2. Electrical plug connection
3. Wiring

Noisy Operation

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

In numerous instances drivers have insisted noise was coming from the transmission, investigations revealed it was caused by one of the following conditions:

- (a) Fan out of balance or blades were bent.
- (b) Defective vibration dampers.
- (c) Crankshaft out of balance.
- (d) Flywheel out of balance.
- (e) Loose flywheel mounting bolts.
- (f) Rough engine idle producing rattle in gear train.
- (g) Clutch assembly out of balance.
- (h) Loose or broken engine mounts.
- (i) Power take-off was engaged.
- (j) Worn universal joints.
- (k) Driveshaft out of balance.
- (l) Universal joint angles out of plane or at excessive angles.
- (m) Center bearings in driveline dry, not mounted properly.
- (n) Wheels out of balance.
- (o) Tire treads humming or vibrating at certain speeds.
- (p) Air leaks on suction side of induction system, especially with turbo-chargers.

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

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

A lack of lubricant or use of improper lubricant can also result in growling and grinding noises. This is because there is insufficient lubricant to cool and cover the gears, which allows metal-to-metal contact.

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

- (c) *Gear whine.* This is usually caused by lack of backlash between mating gears. Improper PTO shimming is the big offender here.

- (d) *Vibration.* Today's improved highways mean entire power trains are cruising at higher RPMs. These higher speeds mean damage caused by driveline vibration is more obvious than in the past.

When the maximum RPM of a shaft is reached, it begins to bow. A resonant hum can be heard, and a vibration will be set up. This type vibration can cause gear seizures, broken synchronizer pins, bearing failures, brinelling and corrosion.

During acceleration and deceleration, the shaft may pass through half-critical vibration (half the maximum RPM of the shaft). A whine or boom may be heard at this point.

- (e) *Metallic rattles.* These noises within the transmission usually result from a variety of conditions. Engine torsional vibrations are transmitted to the transmission through the clutch. In heavy duty equipment, clutch discs with vibration dampers are not used, so a rattle—particularly in neutral—is common with diesel equipment.

In general, engine speeds should be 600 RPM or above to eliminate objectionable rattles and vibration during the idle. A defective or faulty injector would cause a rough or lower idle speed, and possibly a rattle in the transmission. A rattle can also be caused by excessive backlash between the PTO input gear and the transmission output gear.

Noise in Neutral

Possible Causes:

- (a) Misalignment of transmission.
- (b) Worn flywheel pilot bearing.
- (c) Worn or scored countershaft bearings.
- (d) Worn or rough reverse idler gear.
- (e) Sprung or worn countershaft.
- (f) Excessive backlash in gears.
- (g) Worn mainshaft pilot bearing.
- (h) Scuffed gear tooth contact surface.
- (i) Insufficient lubrication.
- (j) Use of incorrect grade of lubricant.

Noise in Gear

Possible Causes:

- (a) Worn or rough mainshaft rear bearing.
- (b) Rough, chipped, or tapered sliding gear teeth.
- (c) Noisy speedometer gears.
- (d) Excessive end play of countershaft gears.
- (e) Refer to conditions listed under *Noise in Neutral*.

Oil Leaks

Possible Causes:

- (a) Oil level too high.
- (b) Wrong lubricant in unit.
- (c) Non-shielded bearing used as front or rear bearing cap where applicable.
- (d) Seals defective, wrong type or omitted from bearing cap.
- (e) Transmission breather omitted or plugged internally.
- (f) Capscrews loose, omitted or missing from remote control, shifter housing, bearing caps, PTO or covers.
- (g) Oil drain-back openings in bearing caps or case plugged with varnish, dirt, or gasket material.
- (h) Gaskets shifted or squeezed out of position, broken gaskets with pieces still under bearing cap, clutch housing, PTO and covers.
- (i) Cracks or holes in castings.
- (j) Loose drain plug.
- (k) Oil leakage from engine.
- (l) Loose speedometer adaptor or connections.

Walking or Jumping Out of Gear

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

- (a) External interference, such as the floorboard opening, preventing full engagement, *or*
- (b) An internal malfunction, such as worn clutching teeth, allowing the transmission to shift out of position.

If a remote control is being used, make sure it is functioning properly before the transmission is blamed for the problem. Note whether the unit walks out of gear under drive while pulling a load, or on a coast load. Also, notice whether the gear hop occurs on smooth roads or only on rough roads. Items that would prevent full engagement of gears are:

- (a) Improperly positioned forward remote control which limits full travel forward and backward from the remote neutral position.
- (b) Improper length shift rods or linkage that limits travel of forward remote from neutral position.
- (c) Loose bell cranks, sloppy ball and socket joints.
- (d) Shift rods, cables, etc., too spongy or flexible, or not secured properly at both ends.
- (e) Worn or loose engine mounts if forward unit is mounted to frame.
- (f) Forward remote mount too flimsy, or loose on the frame.
- (g) Set screws loose at remote control joints, on shift forks inside remote or even inside transmission unit.
- (h) Shift fork pad clips or groove in sliding gear or collar worn excessively.
- (i) Worn taper on gear clutch teeth.
- (j) Transmission and engine out of alignment either vertically or horizontally.

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

- (a) Use of heavy shift lever extensions.
- (b) Broken shift rod poppet springs.
- (c) Worn shift rod poppet notches.
- (d) Bent or sprung shift rods.
- (e) Shift fork pad clips broken or missing.
- (f) Excessive end-play in drive gear, mainshaft or countershaft, caused by worn bearings or retainers.
- (g) Worn or missing thrust washers.



Hard Shifting

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

- (a) No lubricant in remote control unit. (Note: The forward remote is isolated and is often overlooked. Many remote controls used on transmissions and auxiliaries require separate lubrication.)
- (b) No lubricant in, or grease fittings on, u-joints or swivels of remote controls.
- (c) Lack of lubricant or wrong lubricant used, causing buildup of sticky varnish and sludge deposits on splines of shaft and gears.
- (d) Badly worn or bent shift rods.
- (e) Improper adjustment on shifter linkage.
- (f) Sliding clutch gears tight on splines of shaft.
- (g) Clutch teeth burred over, chipped or badly mutilated because of improper shifting.
- (h) Binding or interference of shift lever with other objects or rods inside the cab or near the remote control island.
- (i) Driver not familiar with proper shifting procedure for the transmission, or with 2-speed axle or auxiliary.
- (j) Clutch or drive gear pilot bearing seized, rough, or dragging.
- (k) Clutch brake engaging too soon when clutch pedal is depressed.
- (l) Wrong lubricant, especially if extreme pressure type lubricant is added.
- (m) Free running gears seized or galled on either the thrust face or diameters.



Sticking in Gear

- (a) Clutch not releasing. Also check remote units such as hydraulic or air assist. **Note:** On some units employing a full air control for clutch release, air pressure of approximately 60 lbs. or more must be secured before the clutch can be released. **Do not leave these vehicles parked in gear.**
- (b) Sliding clutch gears tight on splines.
- (c) Chips wedged between or under splines of shaft and gear.
- (d) Improper adjustment, excessive wear or lost motion in shifter linkage.
- (e) Clutch brake set too high on clutch pedal, locking gears behind hopping guards.

Bearing Failures

The service life of most transmissions, main and auxiliary, is governed by the life of the bearings. The majority of bearing failures can be attributed to vibration and dirt. Some other prominent reasons for unit bearing failures are:

- (a) Fatigue of raceways or balls.
- (b) Wrong type or grade of lubricant.
- (c) Lack of lubricant.
- (d) Broken retainers, brinelled races and fretting caused by vibration.
- (e) Bearings set up too tight or too loose.
- (f) Improper installation resulting in brinelled bearings.
- (g) Improper fit of shafts or bore.
- (h) Acid etching due to water in lube.
- (i) Vehicle overload or too large an engine for the transmission resulting in overload.

Dirt

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

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

Softer material, such as dirt or dust, usually forms abrasive paste or lapping compounds within the bearings. The pressure between the balls and raceways makes a perfect pulverizer: The rolling motion tends to entrap and hold the abrasives. As the balls and raceways wear, the bearings become noisy. The lapping action tends to increase rapidly as the fine steel from the balls and rollway adds to the lapping material.

Hard, coarse material, such as metal chips, may enter the bearings during assembly from tools such as hammers, drifts, and power chisels. It may also be manufactured within the unit during service from raking teeth. These chips produce small indentations in balls and races. When these hard particles jam between the balls and races, it may cause the inner race to turn on the shaft, or the outer race to turn in the housing.

Fatigue

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

Corrosion

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

Shaft Fits

Bearing fits on rotating shafts are usually specified as tight. Excessive looseness—even .001"—under a load, produces a creeping or slipping of the inner race on the rotating shaft. The result is that surface metal of the shafts scrub or wear off. The force causing the inner race to rotate disappears when the bearing fits properly.

Installation and Removal of Bearings

Improper installation or removal of bearings, especially hammering the bearing on the shaft with off-center blows, can result in brinelling. Since such damage is seldom visible, it does not become known until after failure or complete disassembly. The correct drivers (preferably under an arbor press) and pullers should be used.

Removing bearings is more difficult than installing them. In most cases, it is necessary to remove the bearing by pulling on the outer race, which can damage the balls or races. Therefore, it is a good idea to replace bearings during an overhaul, to prevent problems. However, if a bearing is not going to be replaced, avoid removal during low mileage rebuilds.

Interchangeability

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

Numbers and symbols stamped on inner and outer races of bearings designate size and type. Note that the numbering systems of different bearing manufacturers have not been standardized. Consult interchangeable tables and use the proper bearings for replacement parts.

Clutch Troubleshooting

Faulty clutch operation interferes with proper shifting of gears in any transmission. For complete information on Spicer clutches, refer to bulletins 1302 and 1308. If a clutch other than a Spicer is used with this transmission, refer to the manufacturer's service manual for correct adjustment and maintenance. The two following paragraphs describe the most common problems encountered with Spicer clutches.

- (a) If the clutch slips or does not engage properly, first check the internal clutch adjustment. If adjustment does not remedy the situation, check for weak pressure springs, lack of free pedal, and worn or oily clutch facings and binding release mechanism.
- (b) If the clutch drags or does not release properly, check the internal clutch adjustment. Some other causes for clutch drag are: an intermediate plate sticking on drive pins or drive lugs; the pressure plate not retracting; a distorted or warped driven disc; worn splines on the main drive gear of the transmission; a damaged clutch release bearing; or the bushing in the release sleeve may be dragging on the transmission drive gear.



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