7 SPEED TRANSMISSIONS
MODELS PS 140-7A
& PS 125-7B

TRANSMISSION TECHNOLOGIES Corporation

SERVICE MANUAL
Bulletin #2364

Technology in Motion®

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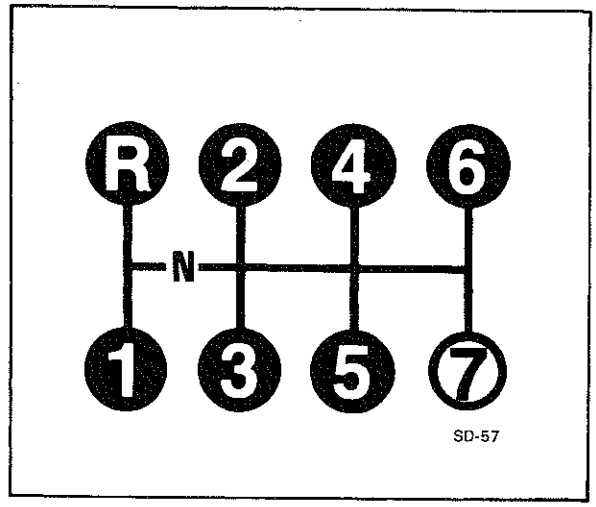
SPECIFICATIONS
Spicer Seven Speed
MODELS PS140-7A & PS125-7B

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

Speeds:	7 Forward, 1 Reverse
Torque Capacity:	PS140-7A 950-1400 lbs. ft. (1290-1900 Nm) PS125-7B 950-1250 lbs. ft. (1290-1700 Nm)
Length:	30.75" (781.05 mm)
Weight:	626 lbs. (284 kg)
End Yokes:	1710 6-4-7691 1760 6.3-4-1251 1810 6.5-4-3821
Flanges:	1710 6-1-5821
Clutch:	14" or 15½" (355.6 or 393.70 mm) 2-Plate
Clutch Housing:	S.A.E. Nos. 1 or 2 Nodal Mount Standard
Oil Capacity:	48 Pints (22.7 Liters) at 0° Installation
Drive Gear:	2" Standard
Power Take-Off:	6 Bold right and lower left. Countershaft P.T.O. provision, standard on the right side, optional on the left.

SHIFT PATTERN
PS140-7A & PS125-7B



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

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

Starting

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

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

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

Upshifting

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

Downshifting

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

***NOTE**—All RPM drops are based on the PS140-7A and PS125-7B transmission ratios and an engine governed speed of 1900-1950 RPM. These drops will vary with other transmission ratios or with engines of higher governed speeds.

OPERATION

Clutches

A clutch brake is required for use with this transmission. It is recommended that the torque limiting clutch brake be used instead of the three-piece type. Attention is called to the fact that Spicer 14" and 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 subassemblies which are incorporated here are for the mechanic's convenience and show the latest material. The parts are arranged in their correct order and may also be used as a reference for assembly or disassembly of this unit.

Power Flow

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

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

Spicer® Transmission Lubrication

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

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 *should not exceed* 5000 miles (8045 km), of over-the-road service. In off-highway use, the change should be made after 24 and before 100 hours of service have elapsed. There are many factors that influence the following oil change periods, and we have not specified a definite mileage interval.

In general, it is suggested that a drain and flush period be scheduled every 50,000 miles (80,450 km) for normal over-the-highway operations. Off-highway usually requires oil change every 1000 hours. The oil level in the transmission should be checked every 5000 miles (8045 km) on-highway, or every 40 hours in off-highway operation. When it is necessary to add oil, we recommend that types or brands of oil should not be mixed. The correct oil level in 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 because of excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy varnish and sludge deposits that plug up oil ports and build up on splines and bearings. Overflow of oil escapes onto clutch or parking brakes causing additional trouble.

NON-SYNCHRONIZED TRANSMISSION RECOMMENDED LUBRICANTS

The following lubricants are recommended, in order of preference.

TEMPERATURE	GRADE	TYPE
Above 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.

Front Bearing Retainer & Seal

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

Bearings

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

INSTALL SEAL DRY

WARNING

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

End Yokes and Flanges

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

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

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

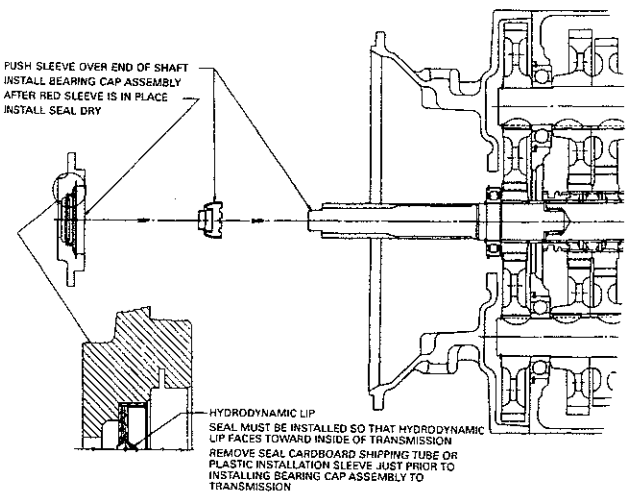
(b) If the bearing is *loose*, the shaft will keep moving inward until it is stopped by the internal parts such as pilot bearing thrust washers, etc.

Power Take-Off's

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

CAUTION

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

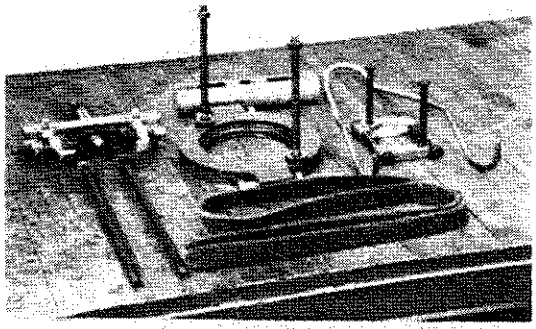


Tool Reference

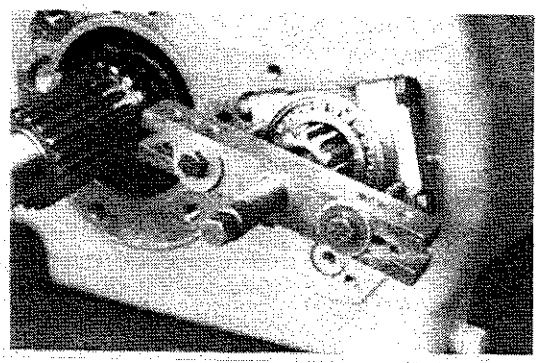
Tools

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

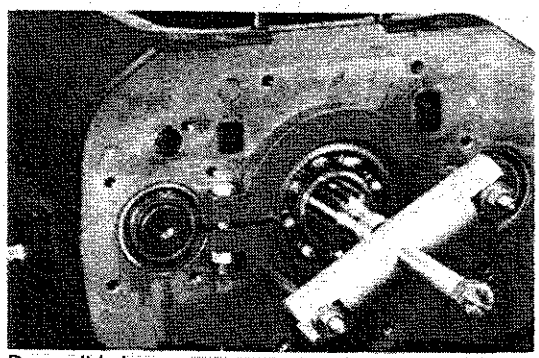
To reduce maintenance costs and vehicle downtime, we recommend using the special tools shown in this section.



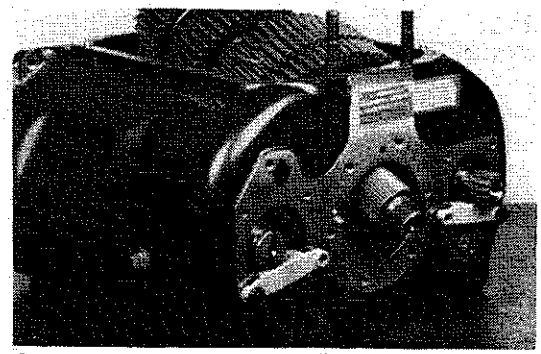
Suggested pullers and alignment tools.



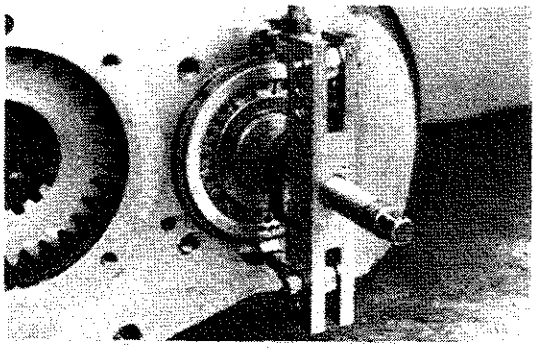
Countershaft rear bearing puller (Snap-on—CJ 950).



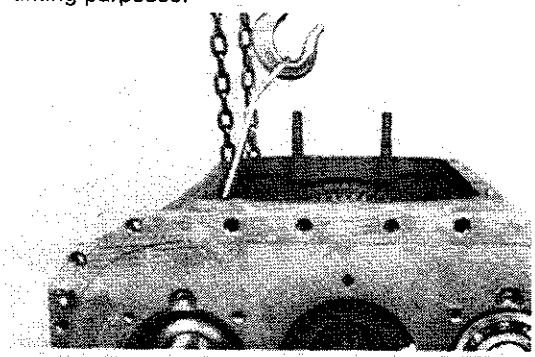
Reversible input and output bearing puller—(Kent-Moore J 24348). Used with end yoke remover (J 7804-01).



Countershaft alignment blocks for PS140-7A and PS125-7B (Kent-Moore J 28720). Provide maximum clearance for mainshaft assembly installation. Allow countershafts to be rotated for timing purposes.



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



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

Tools may be purchased through:

Kent-Moore
29784 Little Mack
Roseville, Michigan 48066-2298
Telephone: 1-800-328-6657

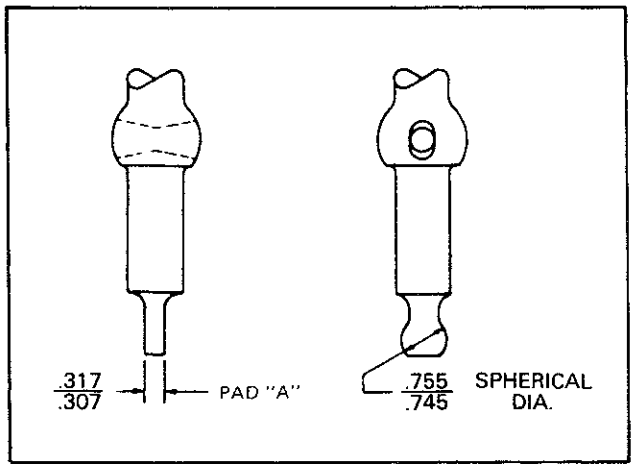
Shift Tower

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.

Inspection

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

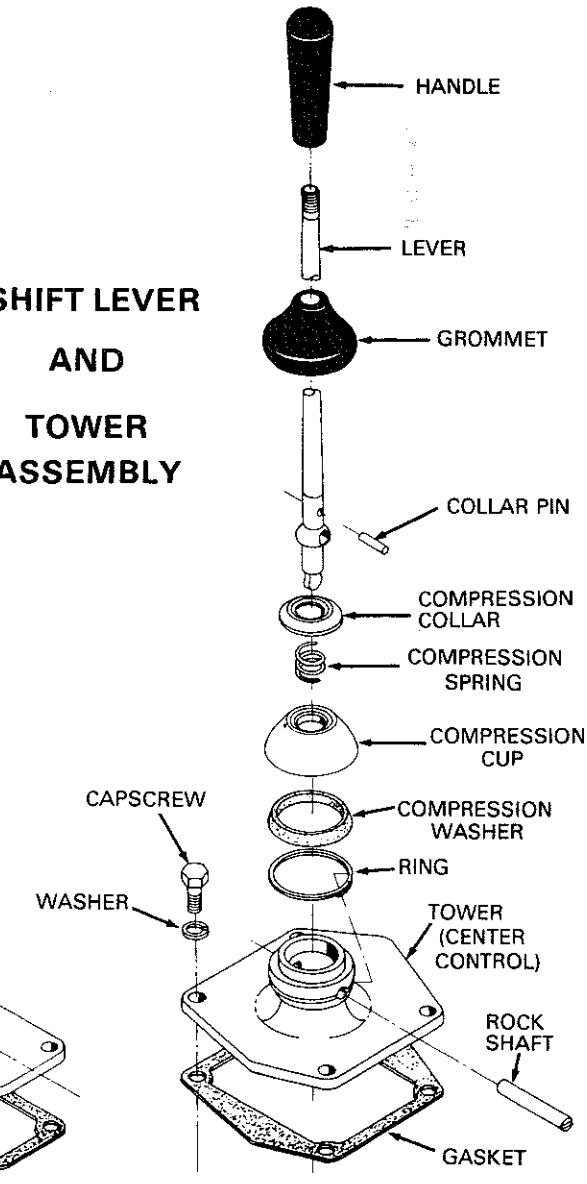


Check spring tension by comparing to a new part.

Reassembly

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

SHIFT LEVER AND TOWER ASSEMBLY



Remote Control Assembly

Disassembly

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

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

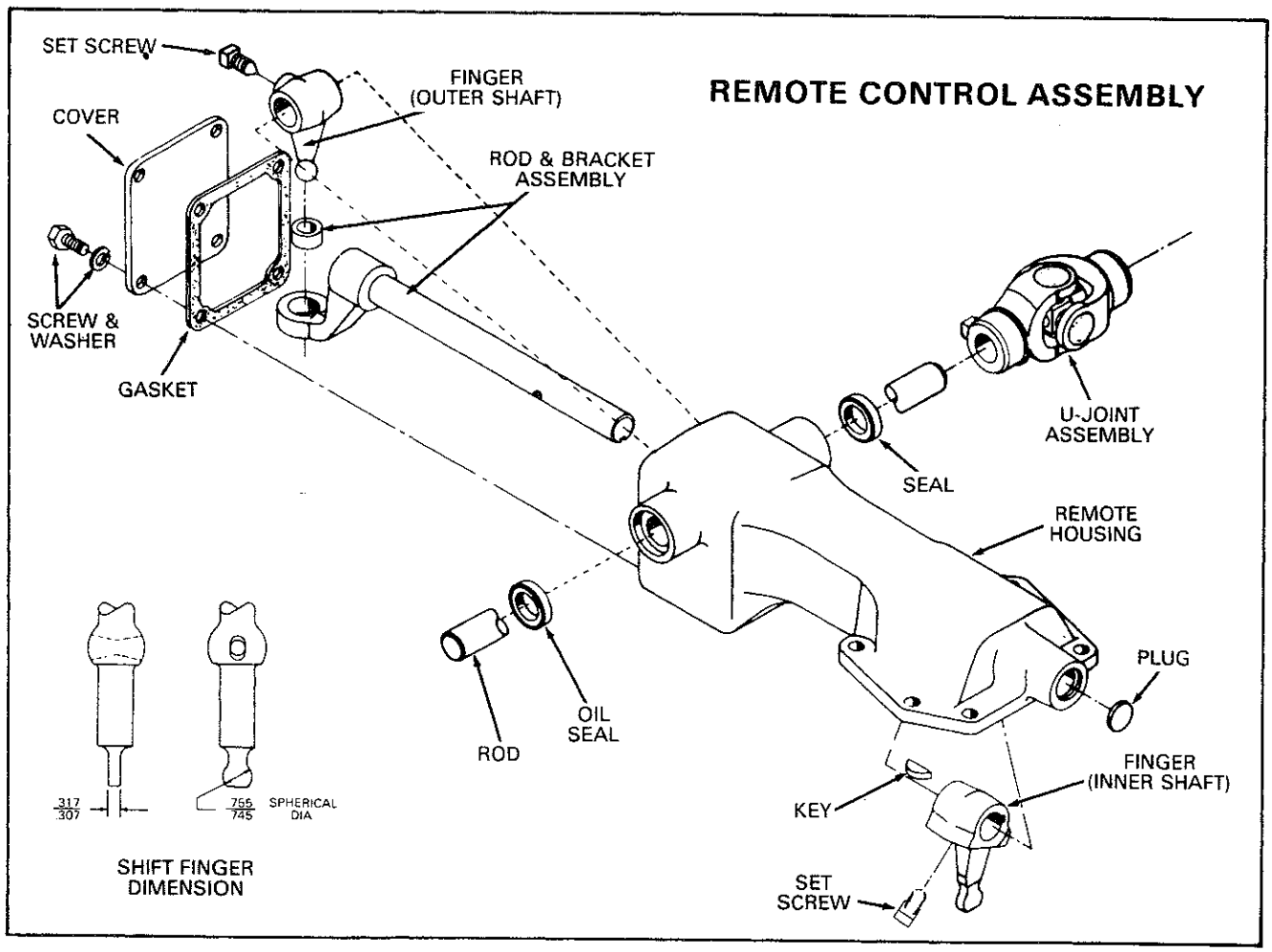
Inspection

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

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

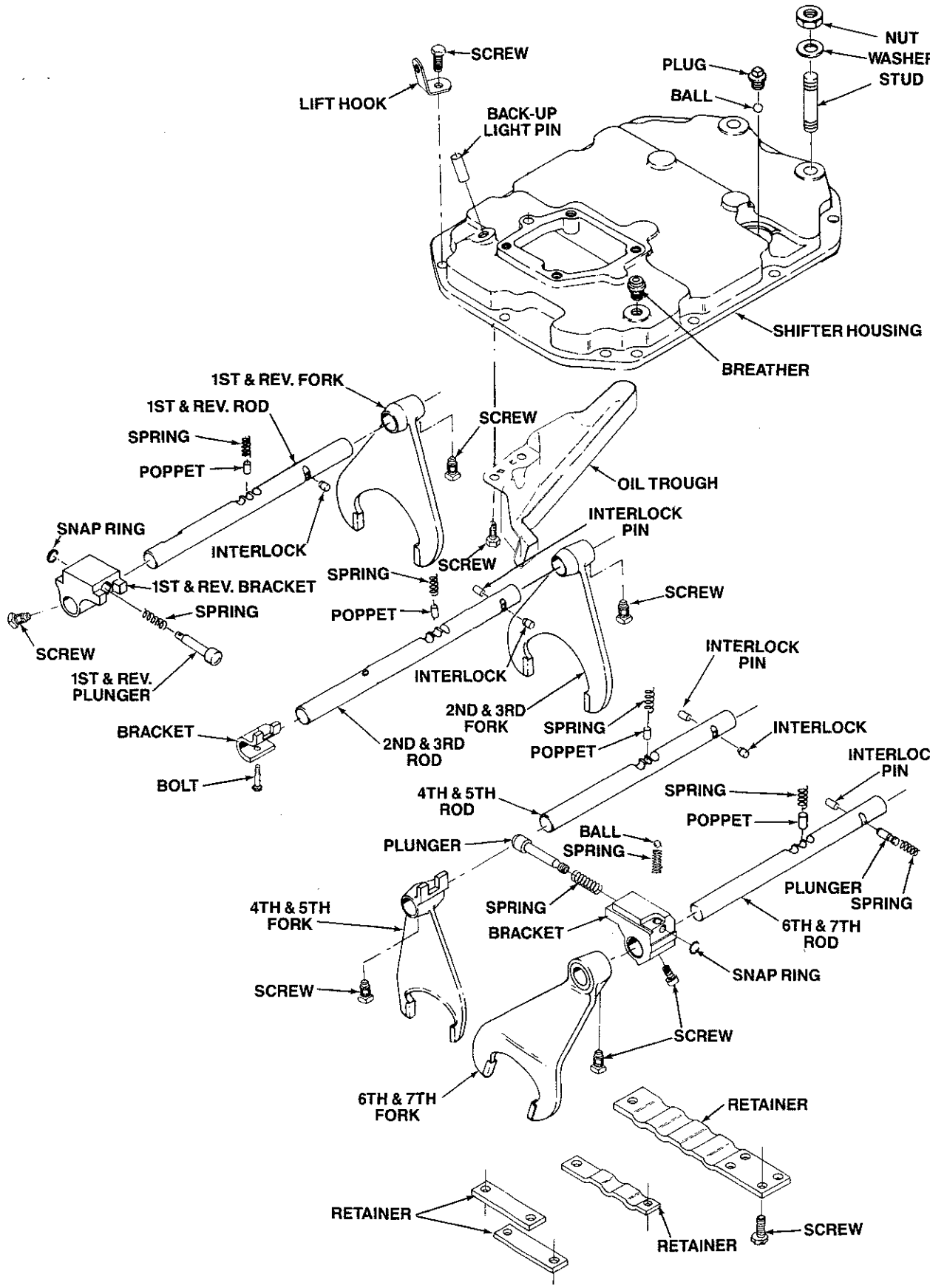
Assembly

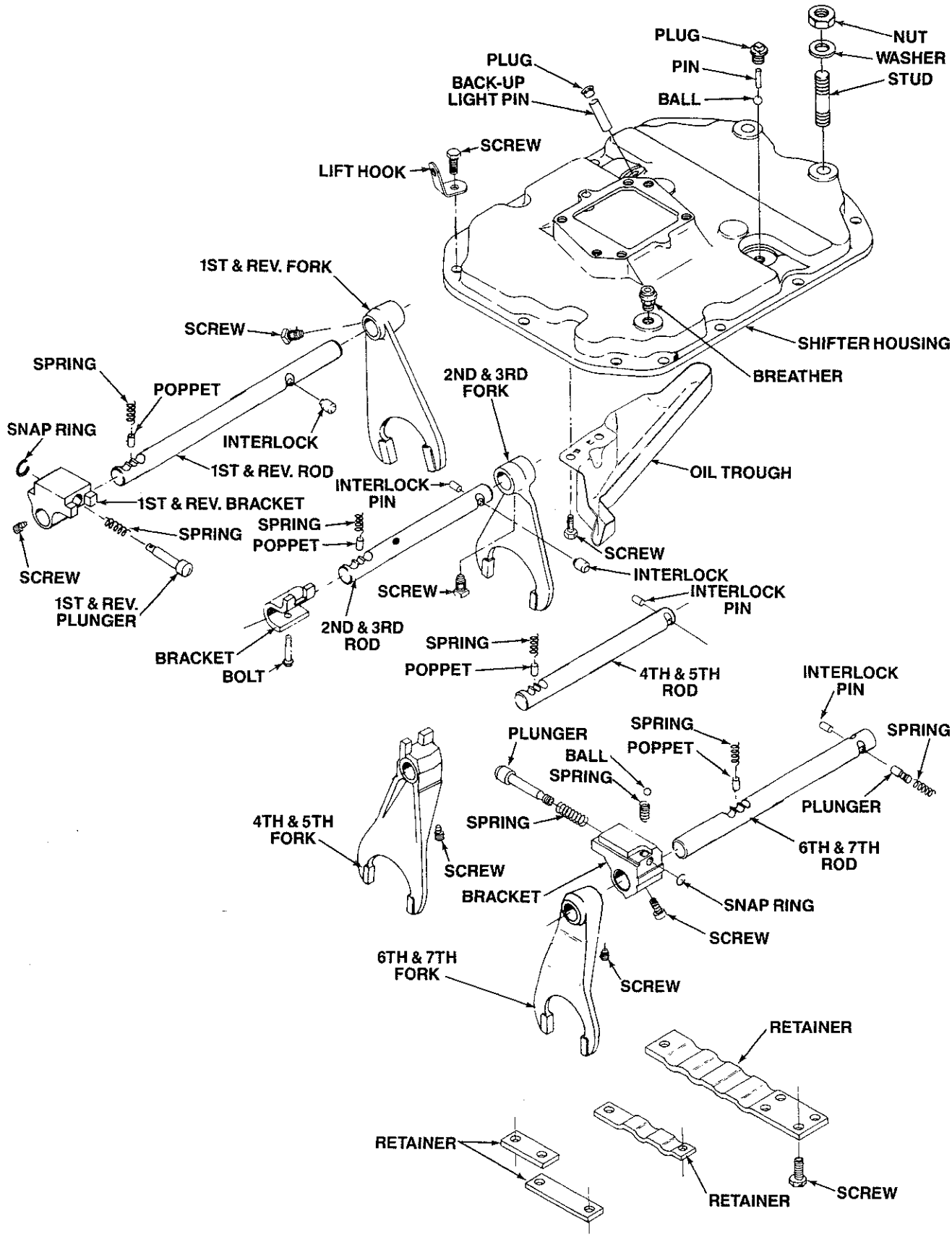
1. Install new key in rod and bracket assembly and install into remote housng, sliding shift finger (inner) on end of rod.
2. Line up setscrew hole and install setscrew, and torque to 40 to 50 lbs. ft.
3. Install joint shift rod and through cross holes and through outer finger, making sure finger is inserted into bracket.
4. Align setscrew hole and install same. Torque to 40 to 50 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 setscrew.



SHIFTER HOUSING FORWARD CONTROL

SECTION IV




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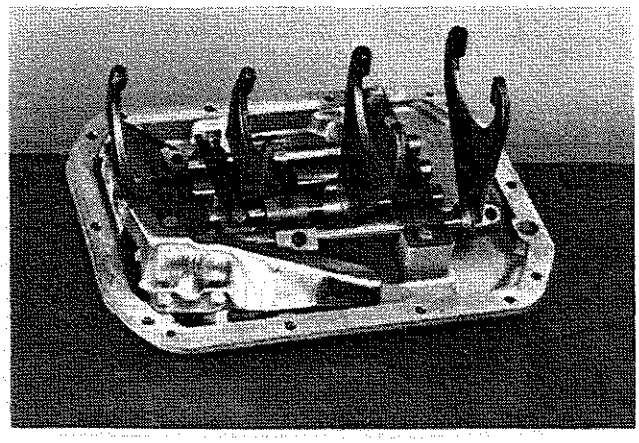
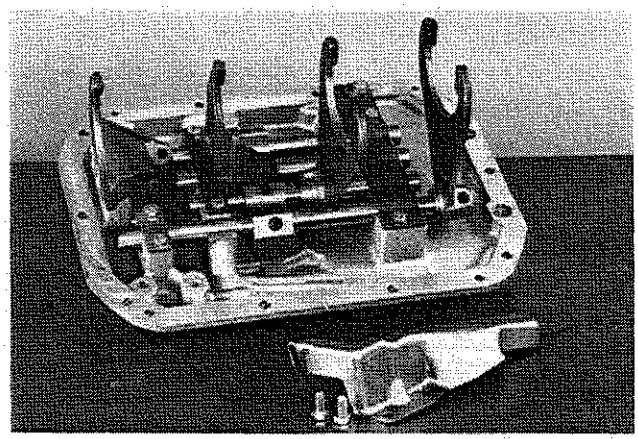
SHIFTER HOUSING DISASSEMBLY

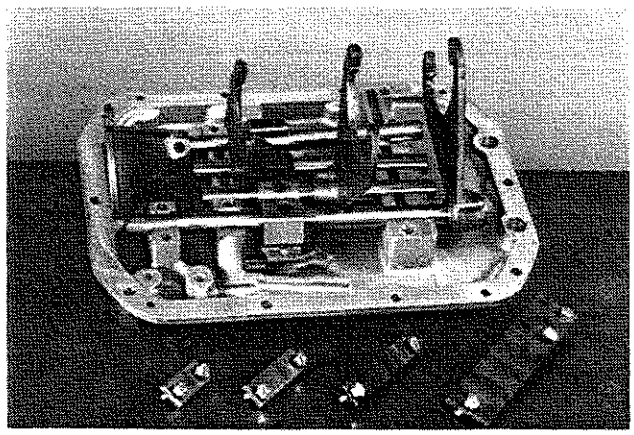
SECTION IV



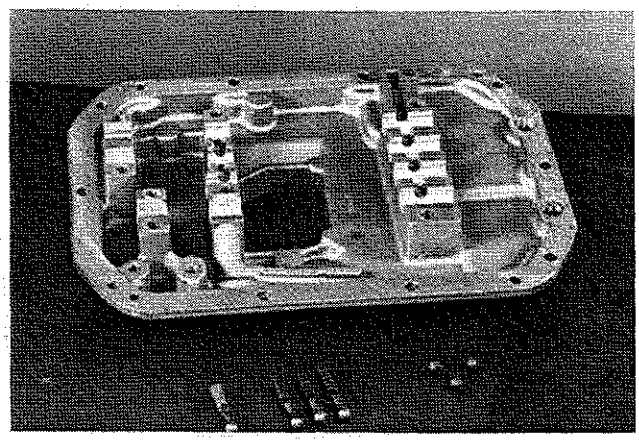
1. Disassembly of the cover begins by placing the cover on a bench with the forks up and in the neutral position.



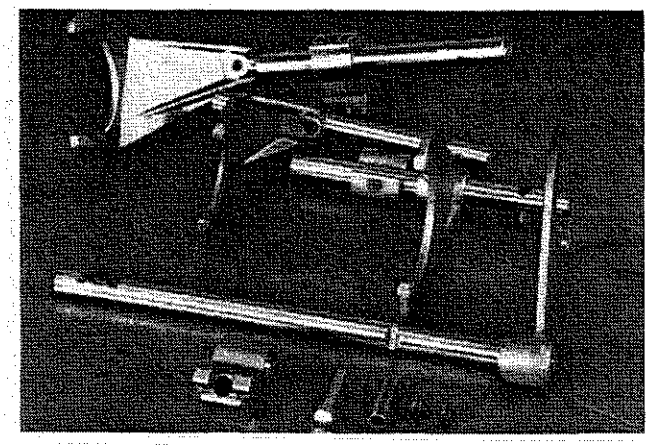
2. Remove the trough. It will make disassembling the rest of the cover easier.



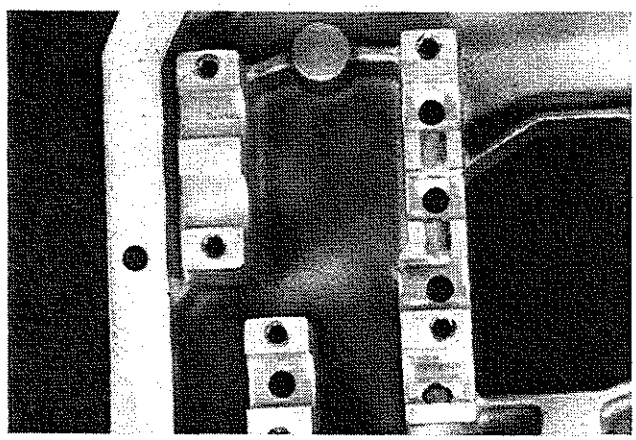
3. Loosen all fork and bracket setscrews, then remove the retainer straps.



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



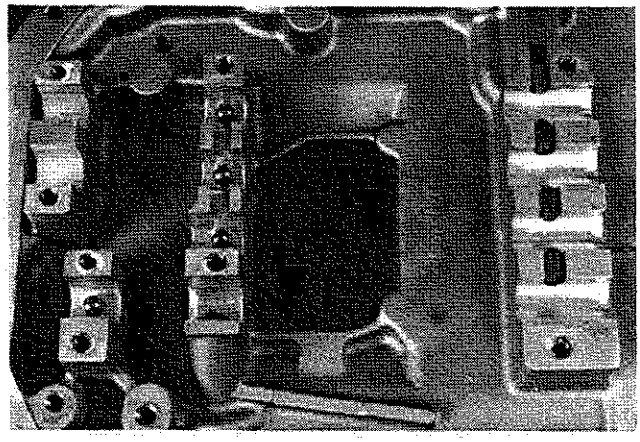
5. Next, disassemble the forks and brackets. Check all parts for wear or damage. Replace them if necessary.



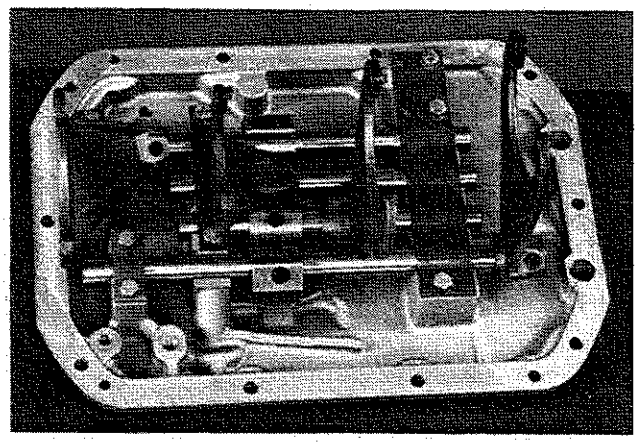
6. Check the poppet and detent holes for burrs or damage.

SHIFTER HOUSING REASSEMBLY

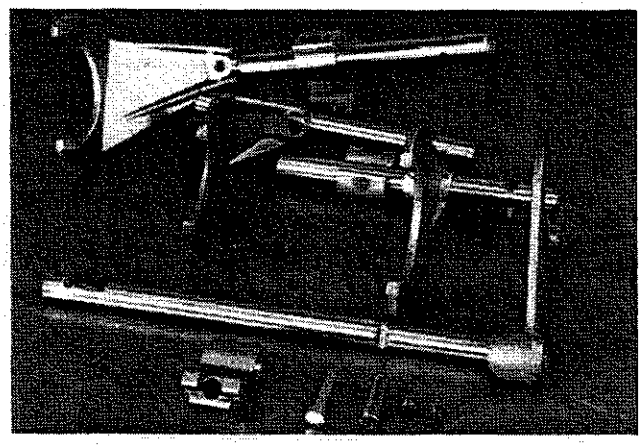
SECTION IV



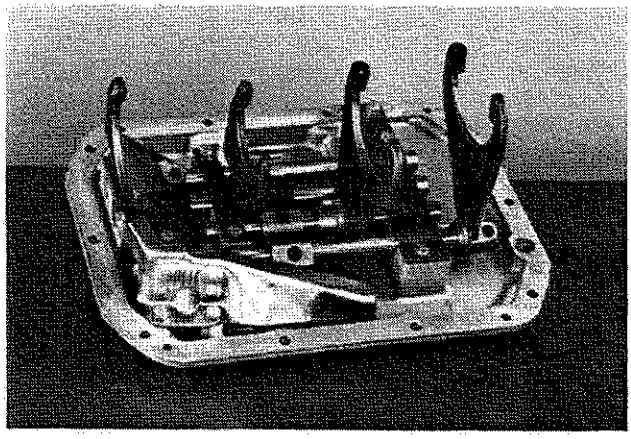
1. Lube all parts prior to reassembly. Clean the cover, then install the springs, poppets and interlocks.



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



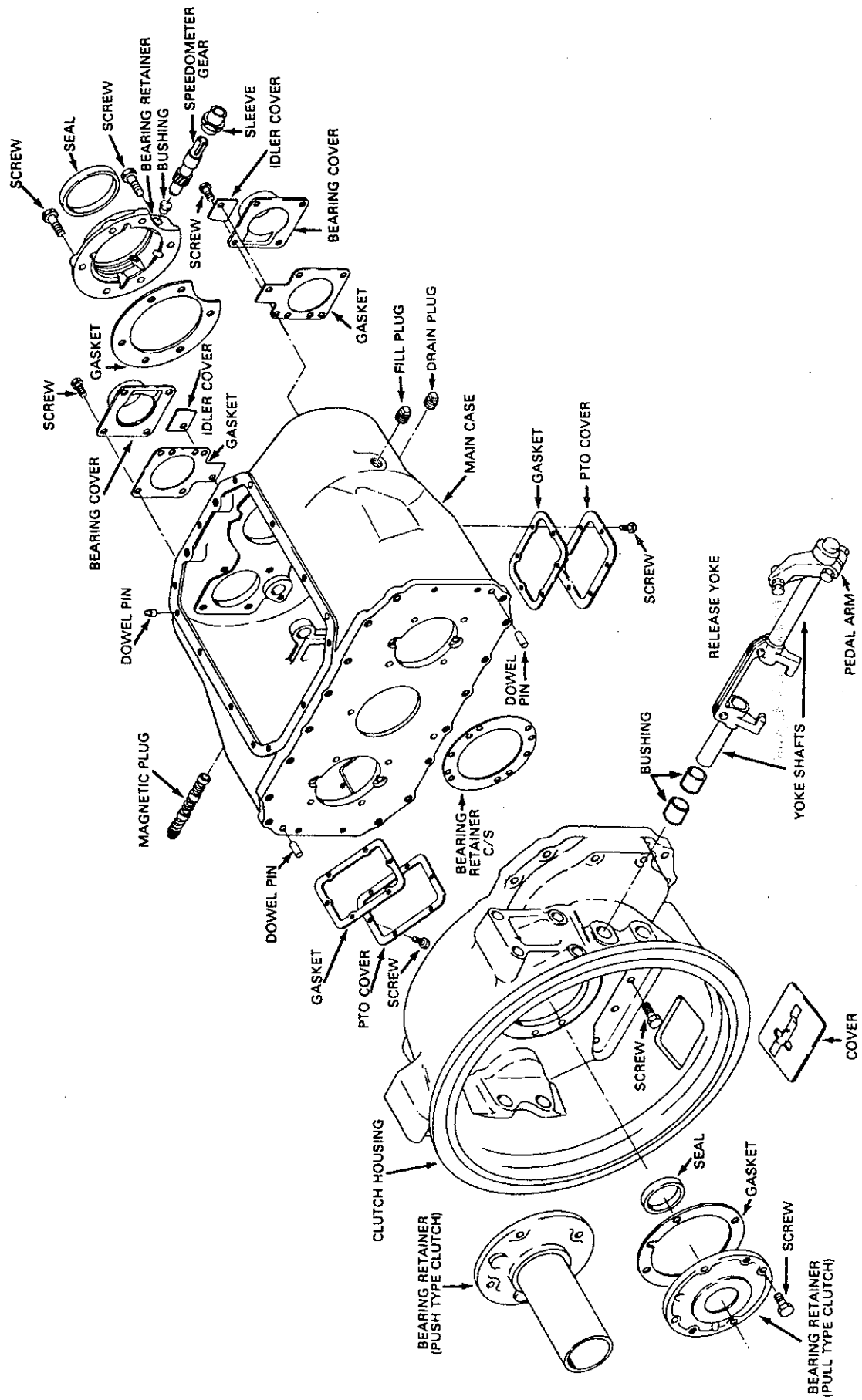
2. Reassemble the forks and brackets. Torque the allenhead setscrews to 26-32 ft. lbs. Torque the second-third bracket screws to 13-18 ft. lbs.

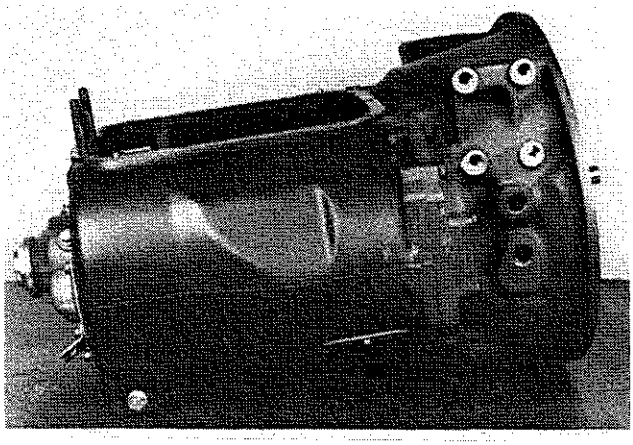


4. Next install the oil trough. Torque the bolts to 34-41 ft. lbs. Check the cover for correct functioning by shifting one fork into gear. If all interlocks were installed correctly, none of the other forks will shift into gear.

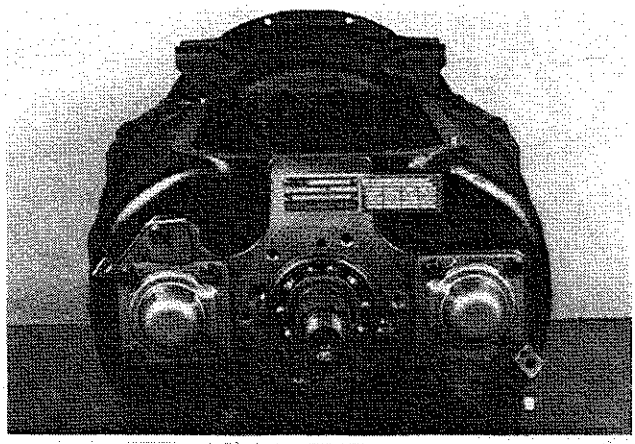
GEARS & CASE DISASSEMBLY

SECTION V

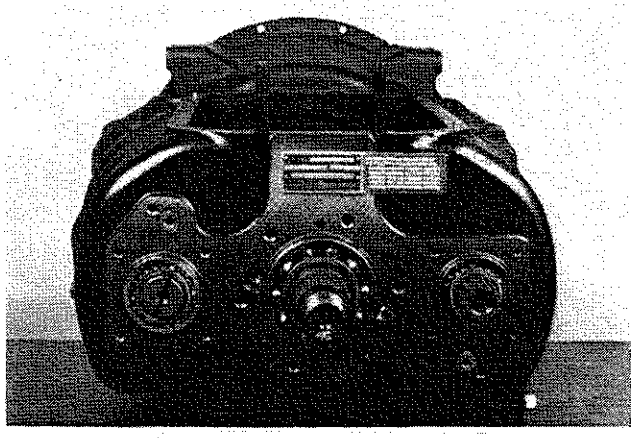




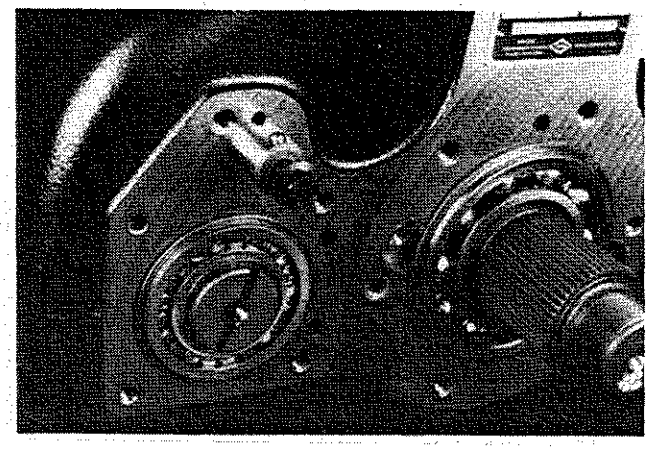
1. Remove the capscrews and shifter housing. **If the shifter housing is a forward control, shift the transmission into sixth gear.**



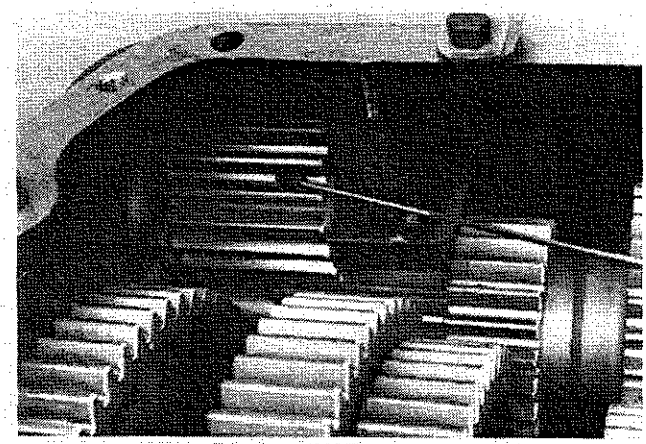
2. Remove the output bearing cap and gasket.



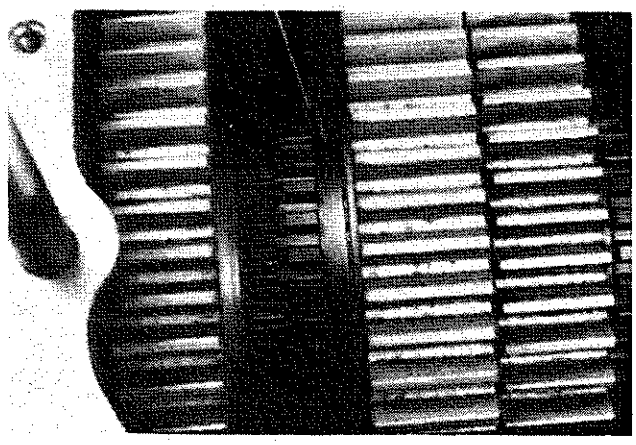
3. Remove the countershaft bearing retainers.



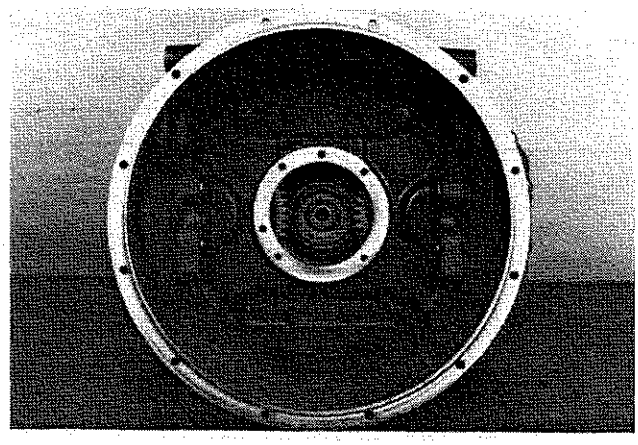
4. Insert a capscrew into the upper reverse idler shaft for removal. Don't lose the lockball in the shaft.



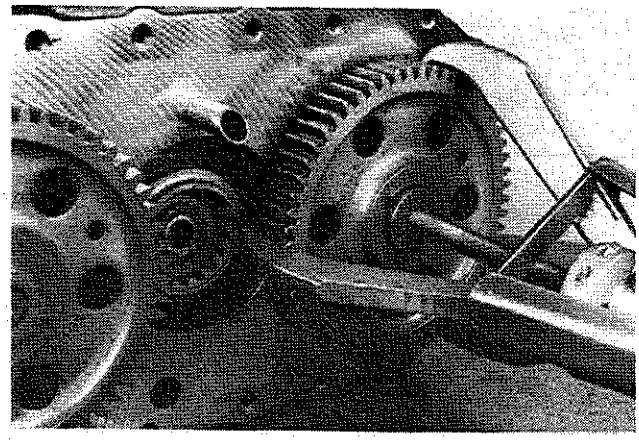
5. Roll the upper reverse idler gear toward the side of the case.



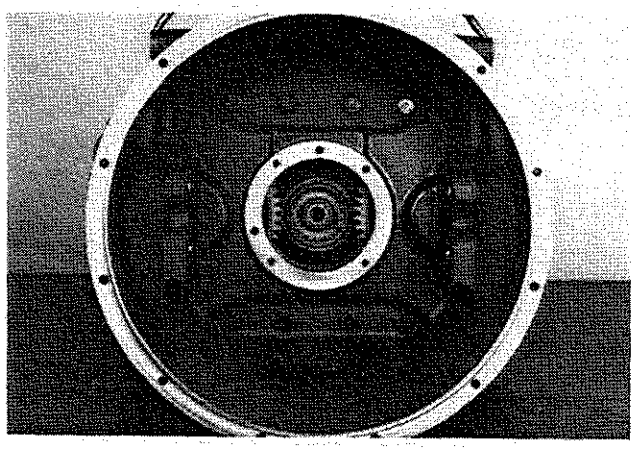
6. Engage the first-reverse collar into first gear.



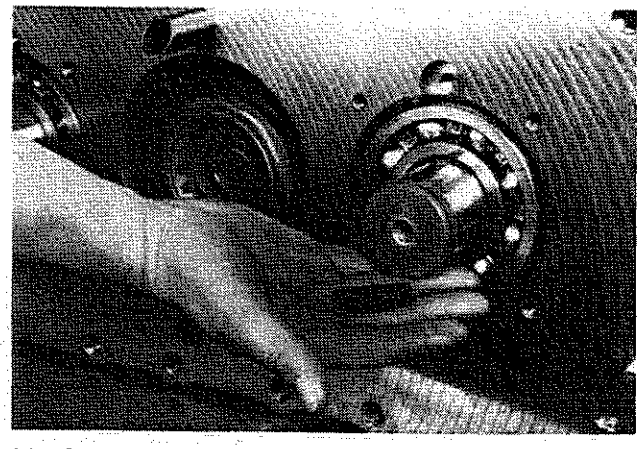
7. Remove the input bearing cap, gasket and input shaft.



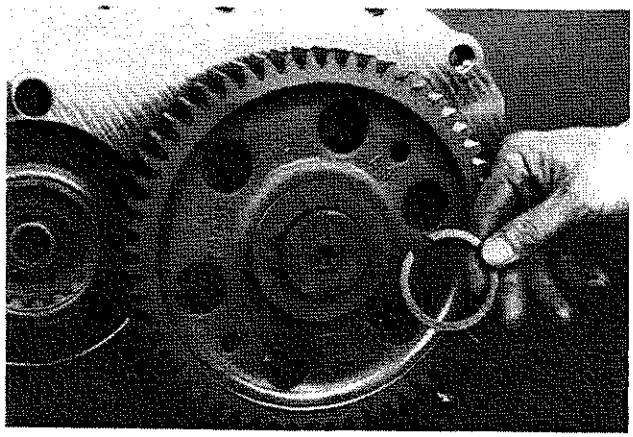
10. Remove the countershaft drive gears with the aid of a large puller.



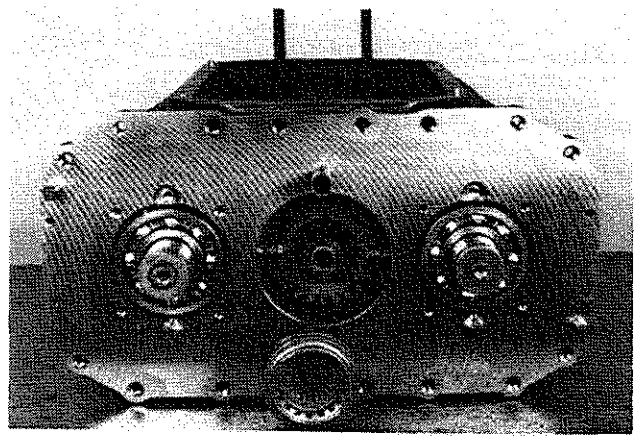
8. Next remove the clutch housing bolts and separate the housing from the case. Use of a chain hoist is recommended due to the weight of the housing.



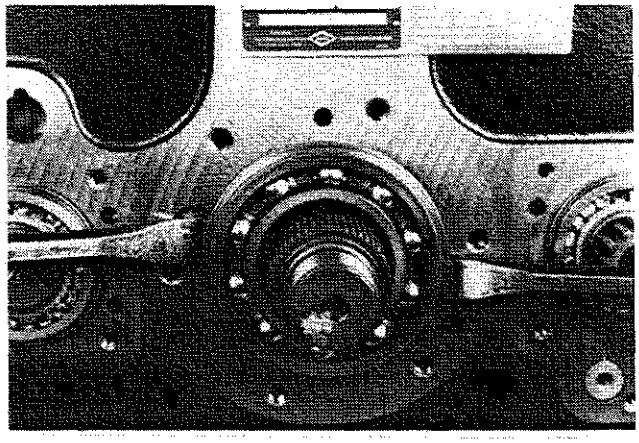
11. Continue by removing the countershaft driver gear countershaft keys.



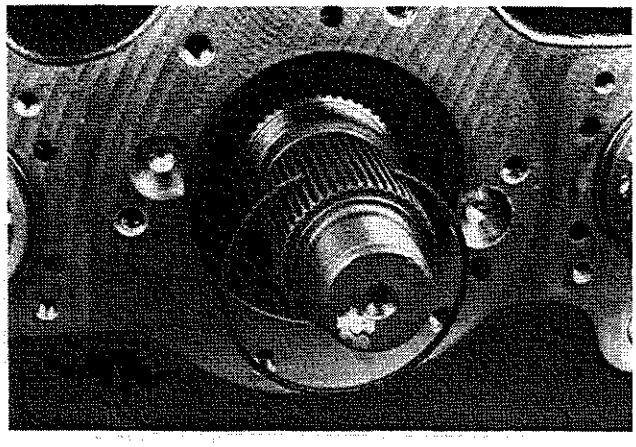
9. Remove the snap rings from the countershafts.



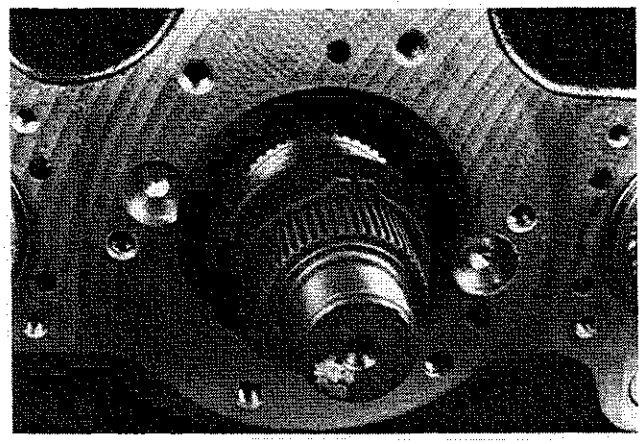
12. The sixth-seventh clutch collar may be removed from the mainshaft.



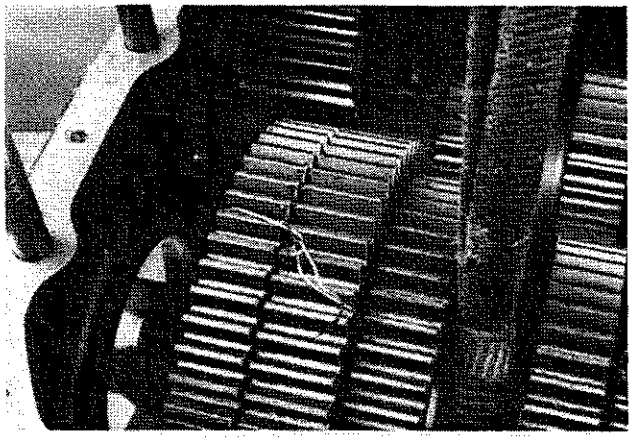
13. **Place a sling around the second-third mainshaft collar and use a hoist to provide support during bearing removal.** The milled slots also help make output bearing removal easier.



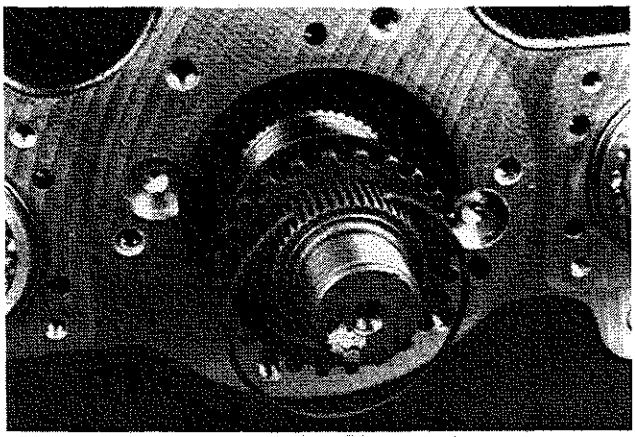
16. Remove the remaining gear bore snap ring.



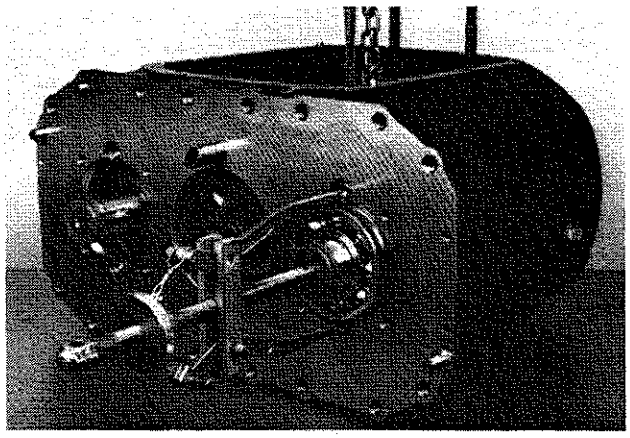
14. Remove the mainshaft snap ring and the internally splined thrust washer.



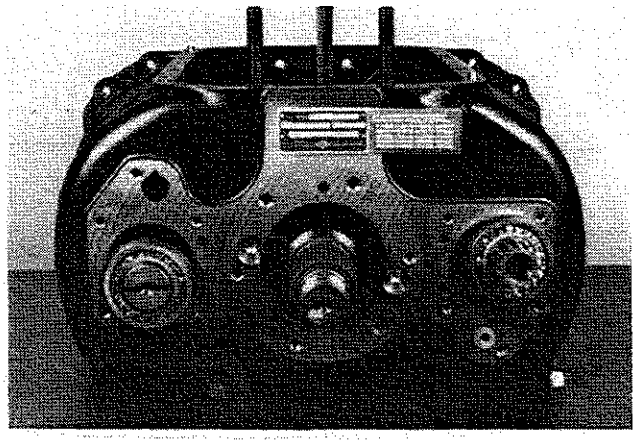
17. Butt first and reverse gears together. Secure them with lockwire to provide the necessary clearance for mainshaft removal.



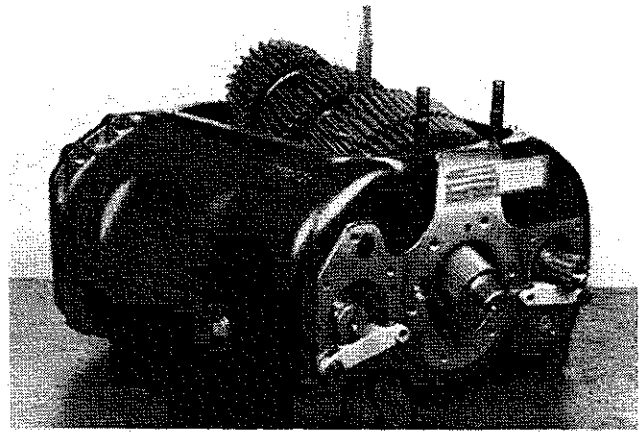
15. Next, remove the gear bore snap ring and both the externally and the internally splined thrust washers.



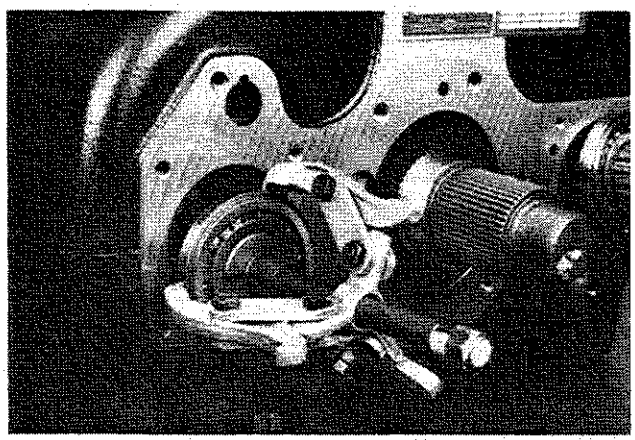
18. Use a puller to remove the countershaft front bearings.



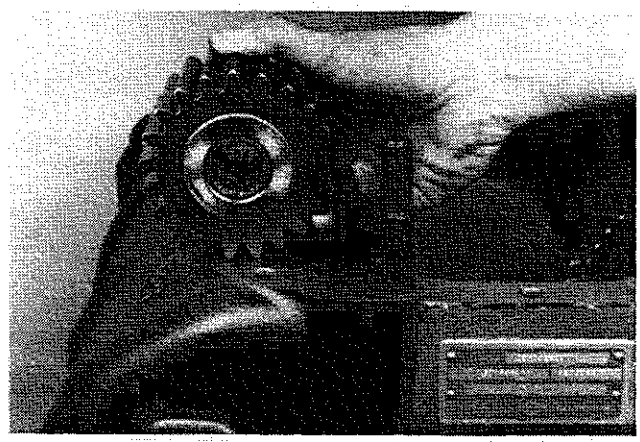
19. Move the countershafts to the rear as far as possible.



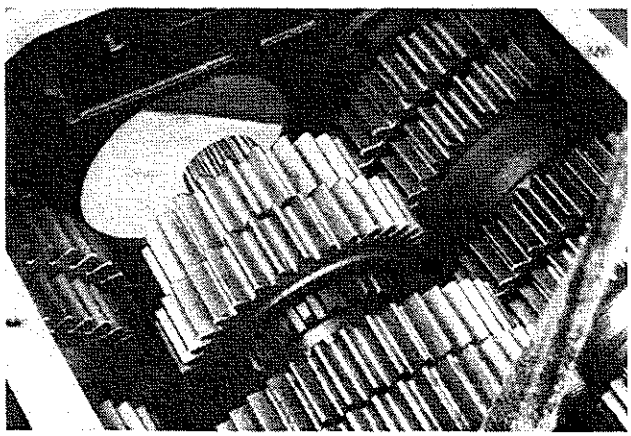
22. Lift the mainshaft assembly out of the case.



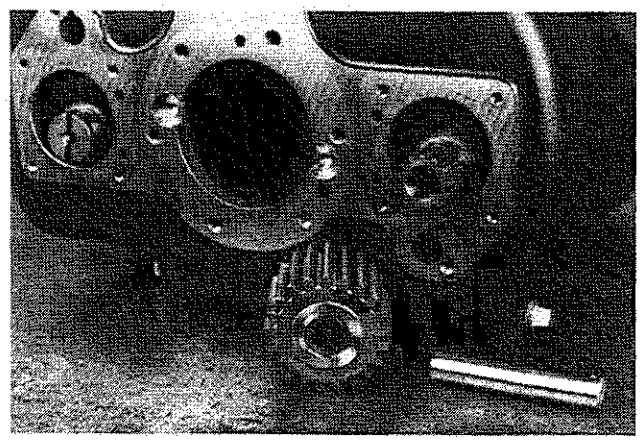
20. Install a puller for bearing removal.



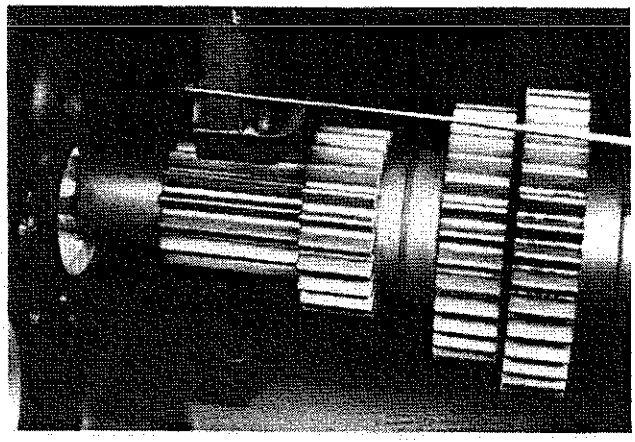
23. Remove the upper reverse idler gear.



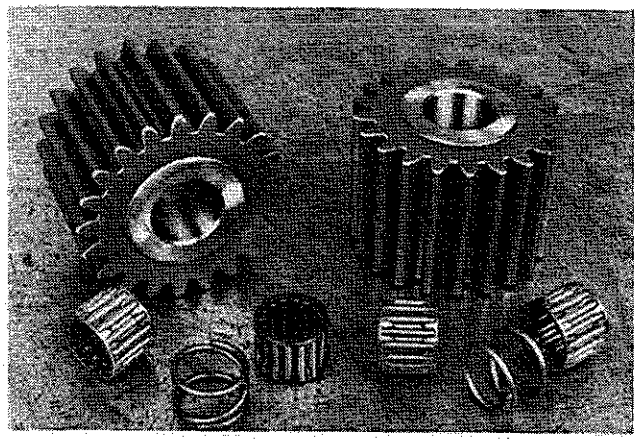
21. **To provide necessary clearance for mainshaft removal, move both countershafts forward and toward the side of the case.** Countershaft alignment blocks can also be used to help restrain the countershafts.



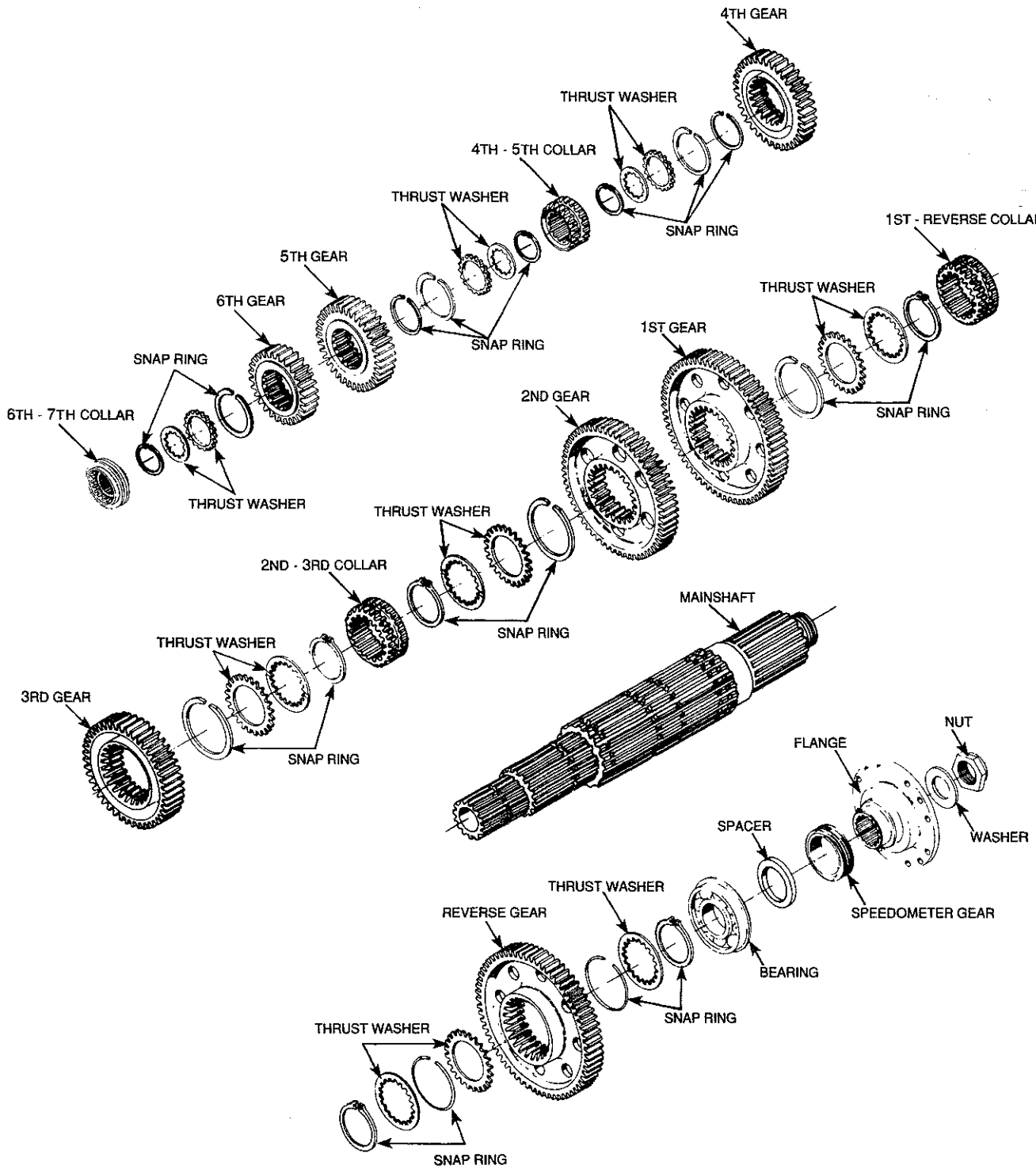
24. Remove the lower idler shaft and idler gear.

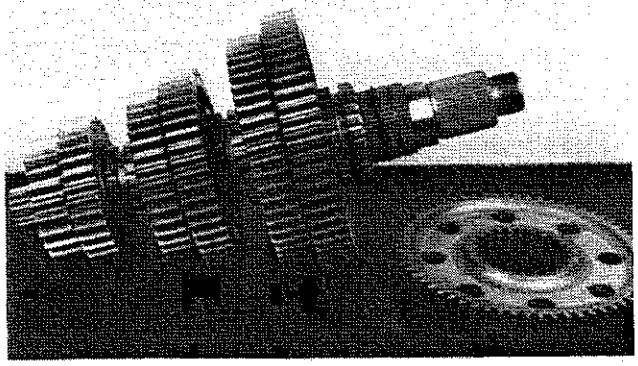


25. Because of this upper idler boss interference, it is easier to remove the right side countershaft first. Then remove the left side countershaft.

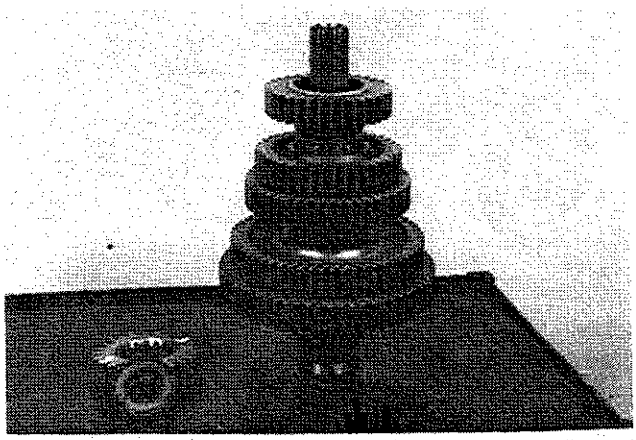


26. Check both idler gears and bearings for excessive wear.

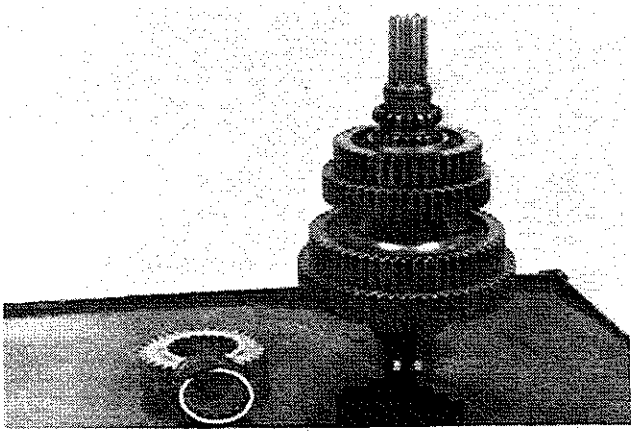

4TH GEAR
THRUST WASHER
4TH - 5TH COLLAR
THRUST WASHER
SNAP RING
1ST - REVERSE COLLAR
5TH GEAR
6TH GEAR
THRUST WASHER
1ST GEAR
SNAP RING
SNAP RING
SNAP RING
6TH - 7TH COLLAR
2ND GEAR
THRUST WASHER
THRUST WASHER
2ND - 3RD COLLAR
MAINSHAFT
SNAP RING
THRUST WASHER
3RD GEAR
NUT
FLANGE
SNAP RING
SPACER
WASHER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



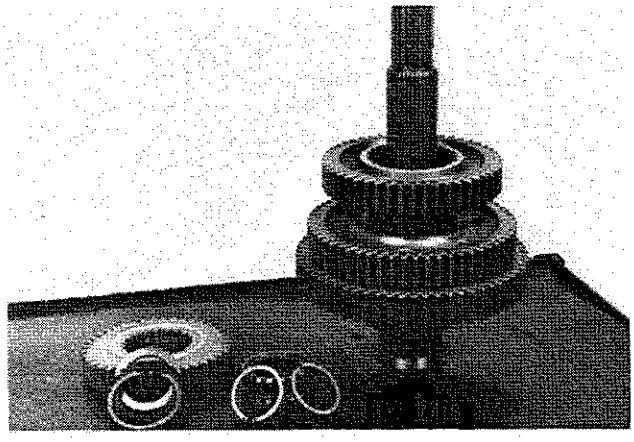
1. Begin disassembly of the mainshaft by cutting the lockwire and removing reverse gear.



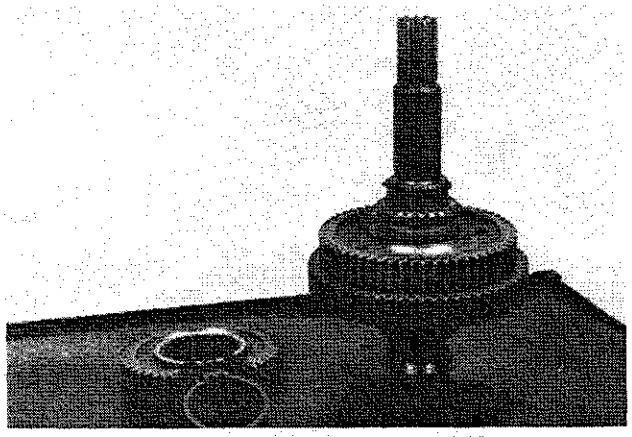
2. Remove the snap ring. Lift off sixth gear. Internally and externally splined thrust washers are in the gear. **The internal washer teeth face toward the shaft. The external washer teeth face away from the shaft.** A gear bore snap ring remains in the gear.



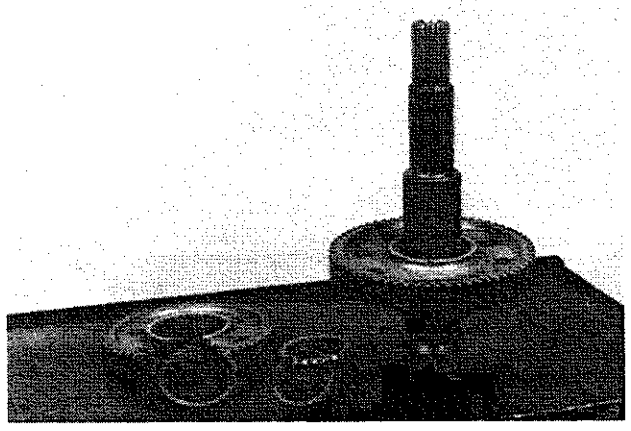
3. Remove fifth gear. There are two thrust washers and a snap ring inside the gear. **There is also a gear bore snap ring inside each gear except reverse gear. This snap ring need not be removed unless otherwise specified.**



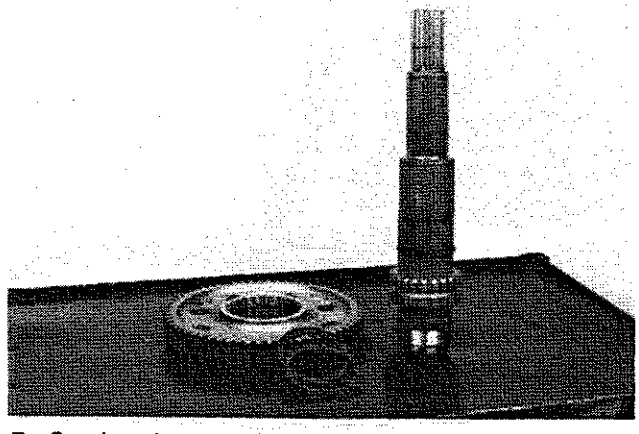
4. Remove the mainshaft snap ring. Lift fourth-fifth shift collar off the shaft. Remove the snap ring and fourth gear. Inside the gear are two thrust washers and a snap ring.



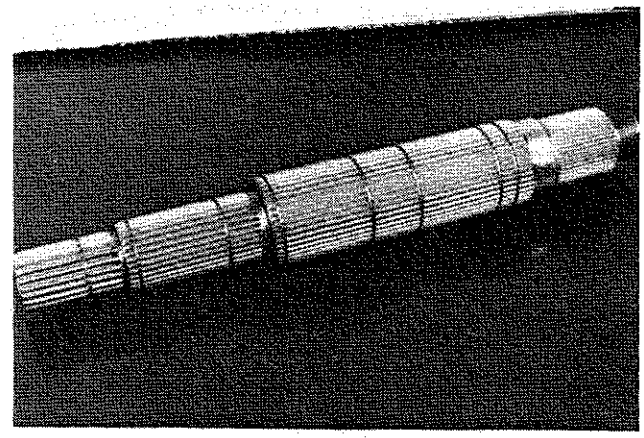
5. Continue by removing third gear. Two washers and a snap ring are inside it.



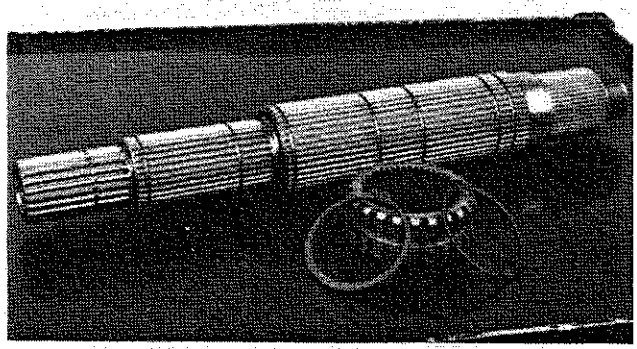
6. Remove the snap ring and second-third shift collar. Remove the next snap ring and lift second gear off the shaft. The gear contains two washers and a snap ring.



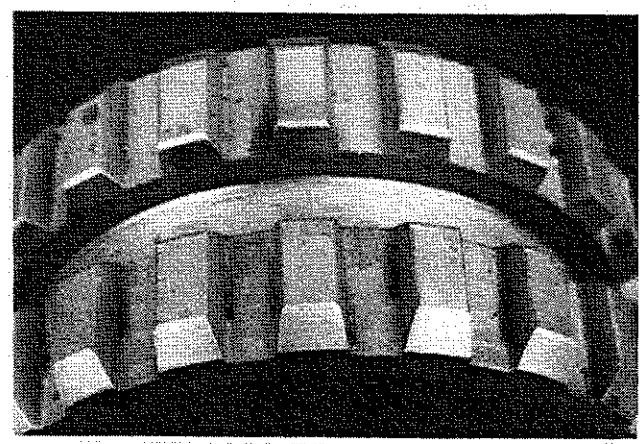
7. Continue by removing first gear. Again, there are two washers inside the gear. There is also a snap ring inside the gear, but there is no need to remove it.



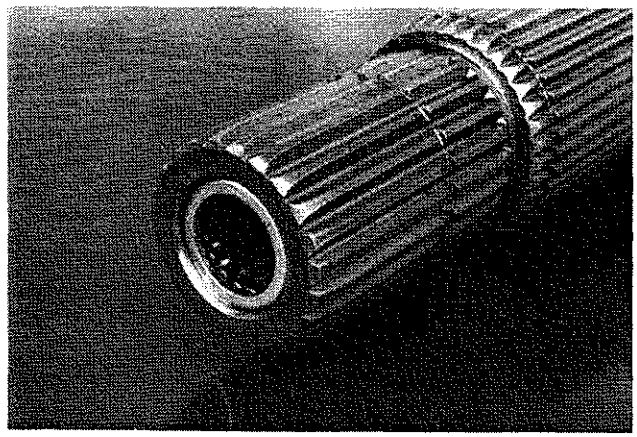
10. Notice that the mainshaft has rolled involute splines. They provide greater strength which means longer life.



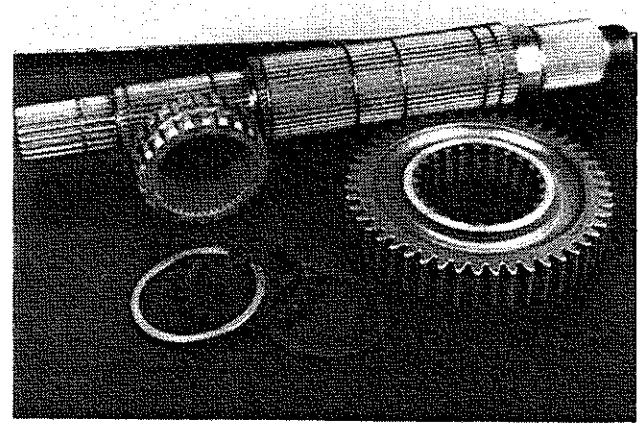
8. Remove the two snap rings and the first-reverse shift collar from the shaft.



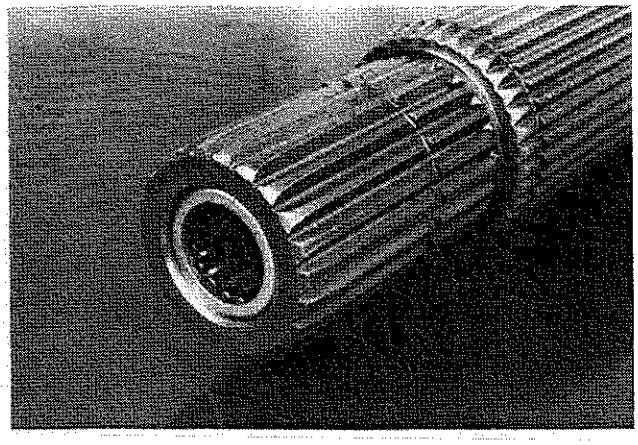
11. The fourth-fifth and sixth-seventh shift collars and gears have Taper-Lok™ gear locks. They are designed to draw gears into perfect alignment and eliminate gear jump-out.



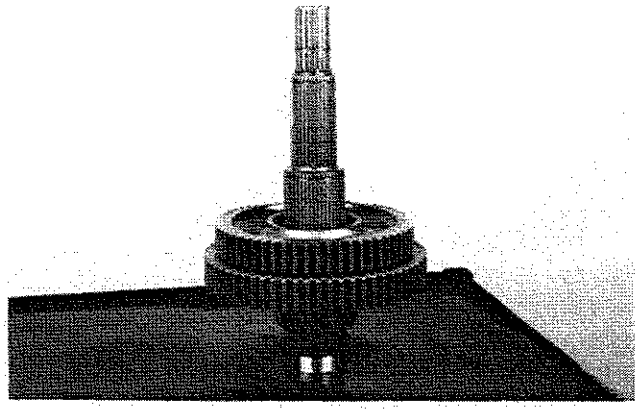
9. Remove the pocket bearing with an adequate puller.



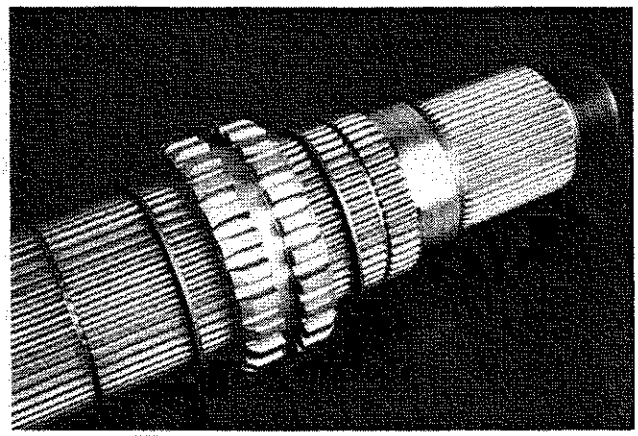
12. Clean all parts and inspect them for wear or damage. Replace them if necessary. **Remember: if a gear is damaged and is going to be replaced, also replace its mating countershaft gears.**



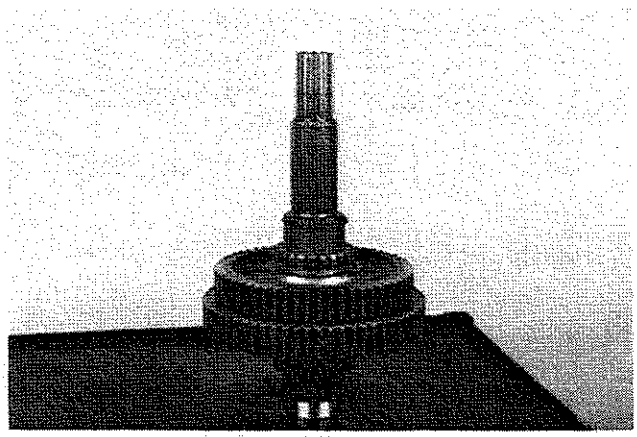
1. Install the pocket bearing to a depth of .070".



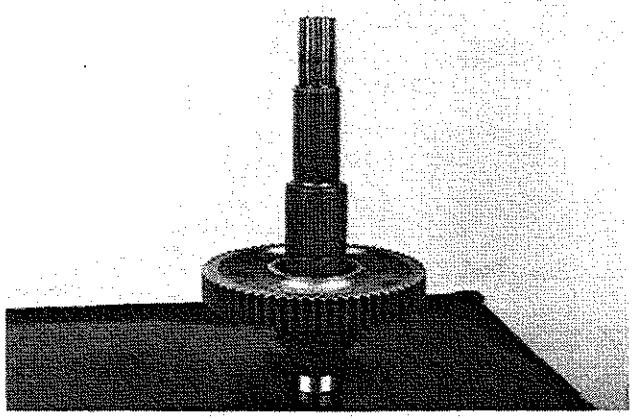
4. Place second gear on the shaft. Install the externally and internally splined thrust washers into the gear. Secure the assembly with a snap ring.



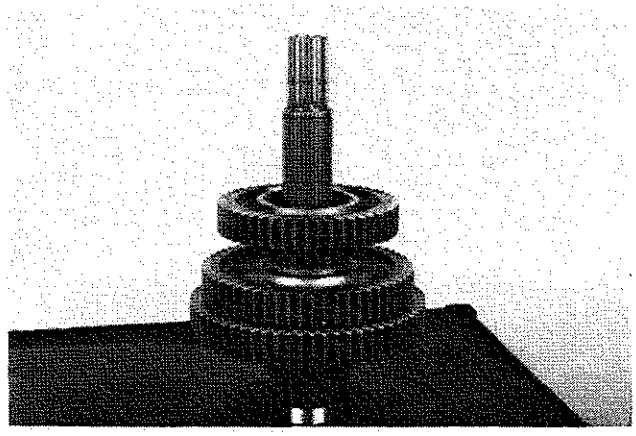
2. Lube all parts prior to reassembly. Install the first-reverse snap ring in the second groove from the bottom of the shaft. Slide the first-reverse collar into place and secure it with a snap ring.



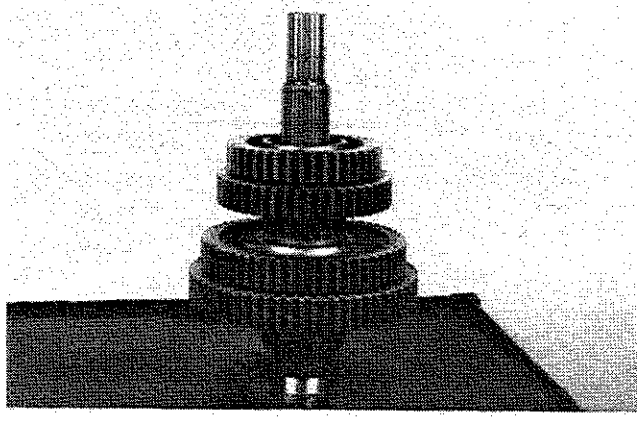
5. Install the second-third shift collar and snap ring.



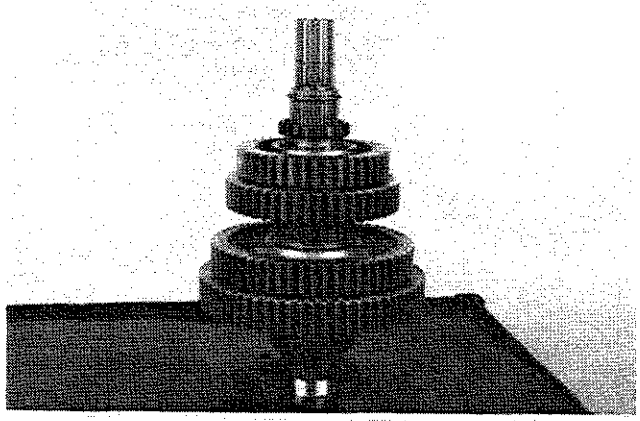
3. Place the internally and externally splined thrust washers on the shaft. The internally splined thrust washer should rest against the mainshaft snap ring.



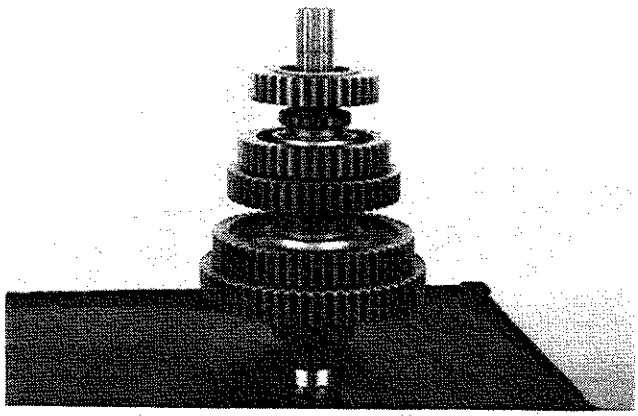
6. Place an internally splined washer and externally splined washer on the shaft. Install third gear.



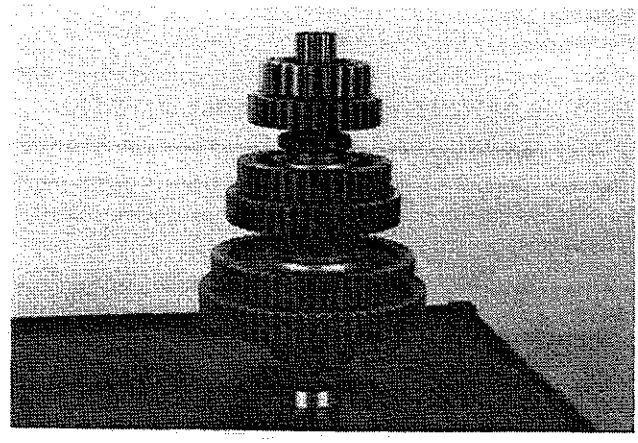
7. Place the externally splined thrust washer, snap ring and internally splined thrust washer in the gear. Slide fourth gear onto the shaft. Secure it with a snap ring.



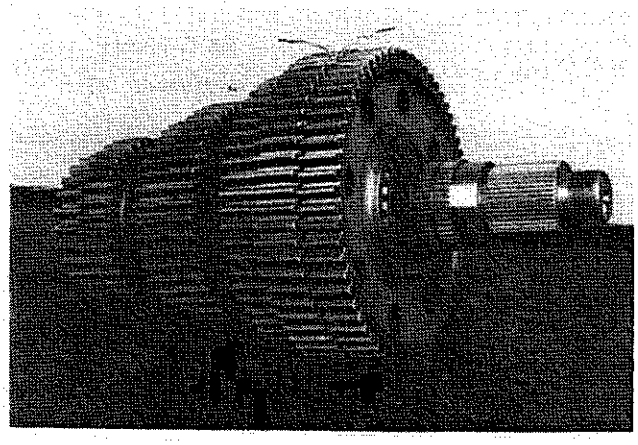
8. The fourth-fifth shift collar and snap ring are installed next.



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



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



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

INSPECTION PROCEDURES & TORQUE SPECIFICATIONS

SECTION VII

Inspection

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

These suggested inspection procedures should be followed:

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

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

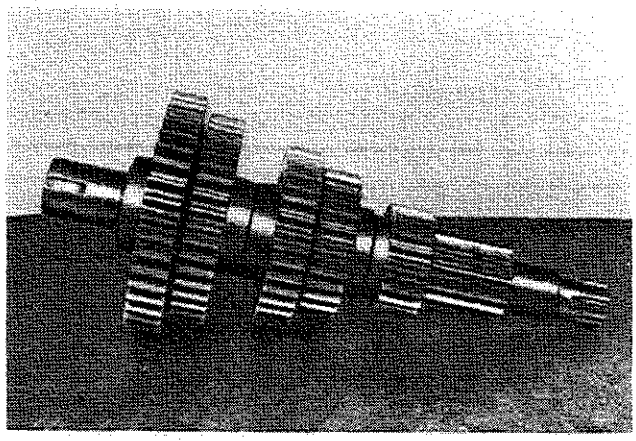
Thrust Washers: Check for flatness or excessive face wear (cracks, scoring, etc.)

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

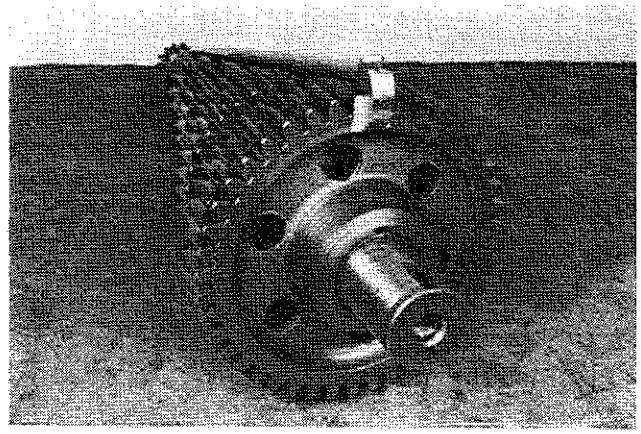
Mainshaft: Check spline gearlocks for sharp corners. Worn or ironed out gearlocks will produce gear jumping. Also, check for chipped splines at snap ring grooves.

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

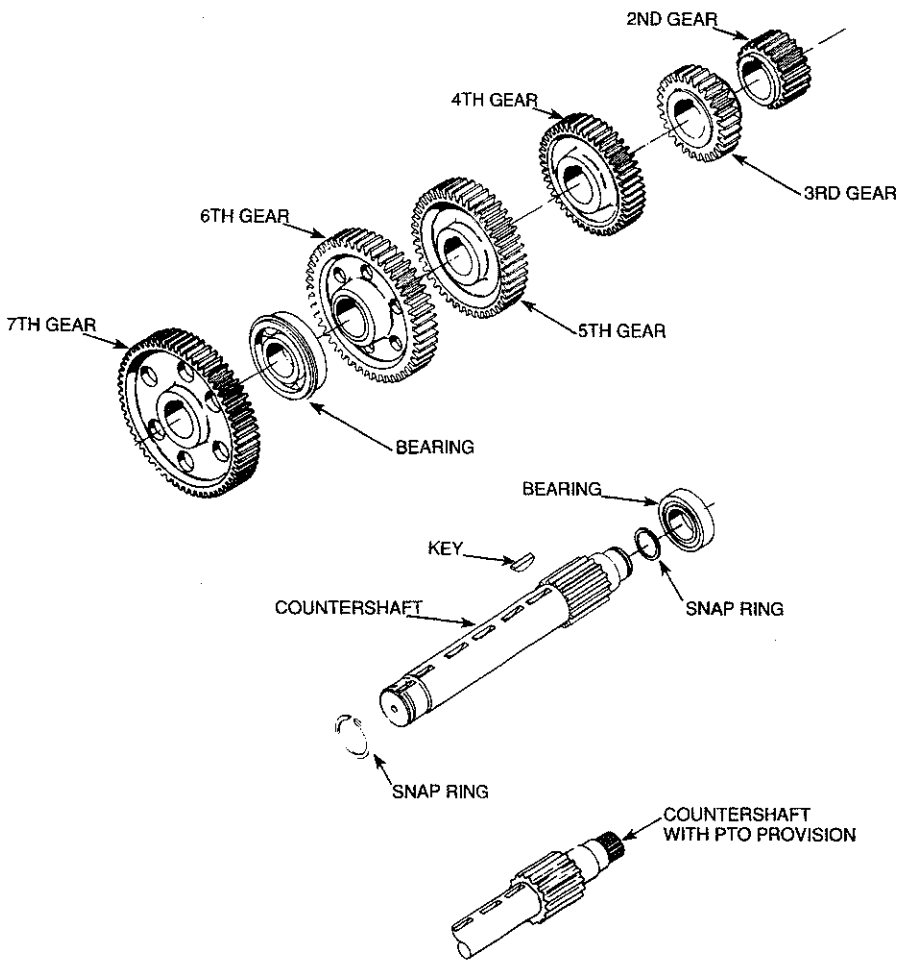
On all transmissions with .750-14 NPTF drain plugs, the drain plug torque should be 50-65 ft. lbs. The only exceptions are the ES42-5, ES52-5, CM40, CM49 and CM55 Models. The torque on these units should be 30-45 ft. lbs.



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

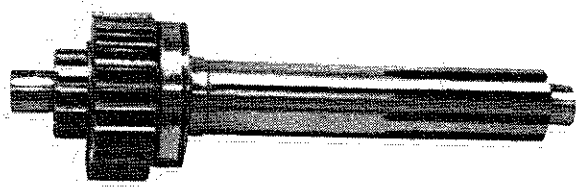


2. If you place a straight edge between these painted teeth, every gear on the countershaft will be in line. When you set the countershafts in time, these marks will be directly across from each other.

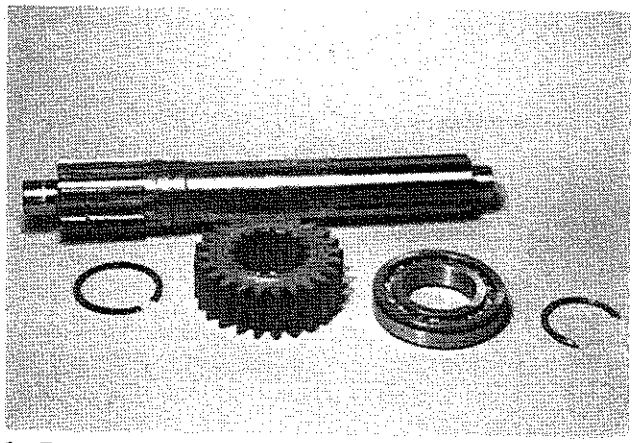


INPUT GEAR DISASSEMBLY & REASSEMBLY

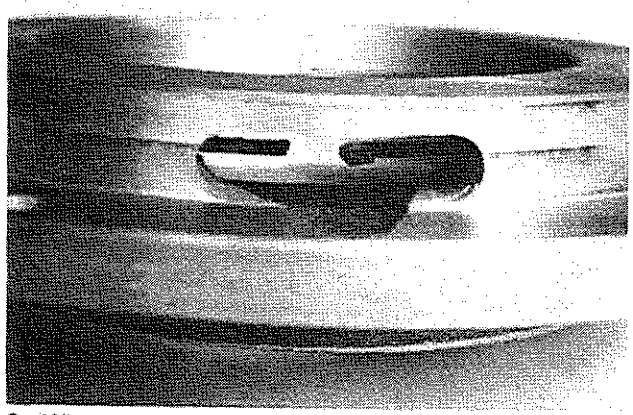
SECTION IX



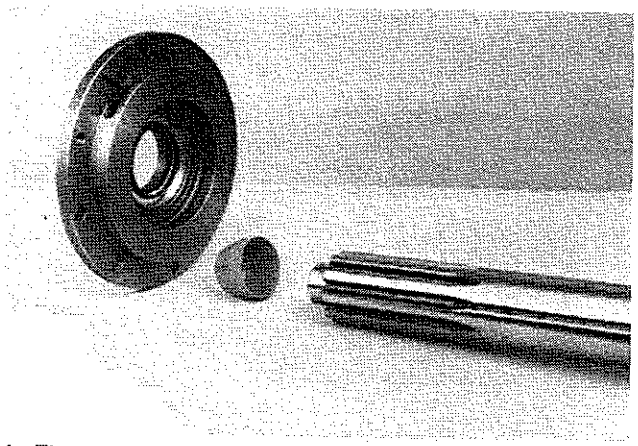
1. The input gear, shaft, and bearing are separate components secured with 2 snap rings.



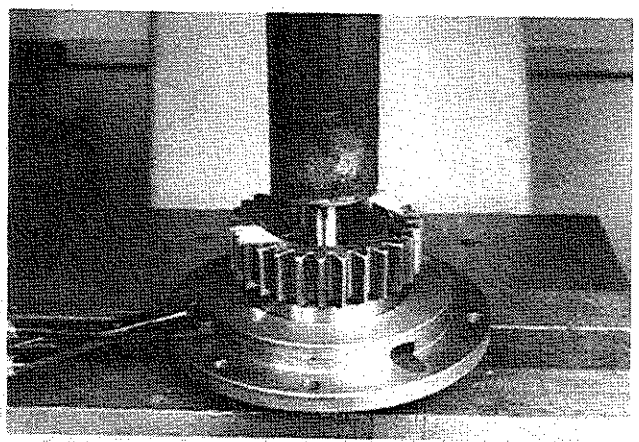
2. This view shows the input subassembly when disassembled.



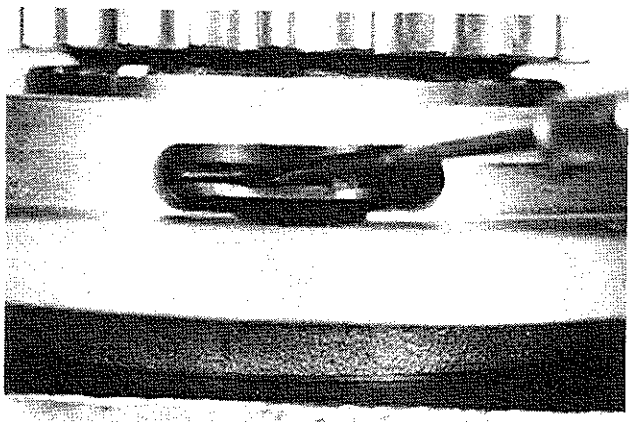
3. When reassembling, first install the snap ring into the input bearing cap.



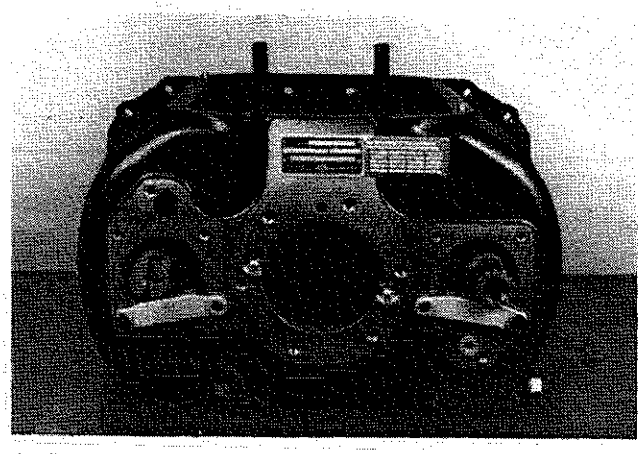
4. Then insert the input shaft through the bearing retainer. Use an installation sleeve to protect the seal. **Do not use grease on this seal. The shaft and seal must be oil free when mated to provide an effective seal.**



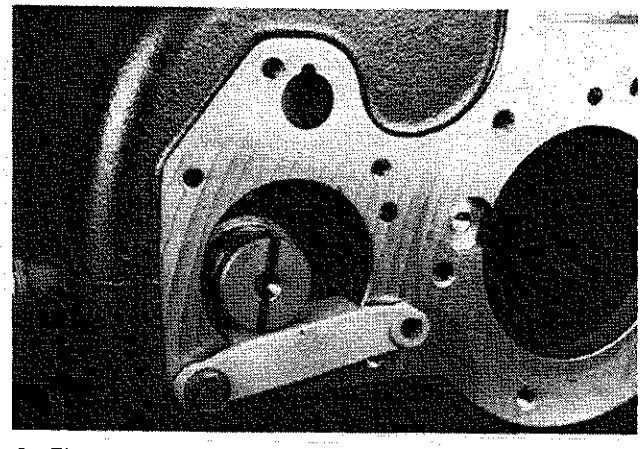
5. Expand the snap ring through the provided slot, while pressing the input shaft assembly into the bearing retainer. **CAUTION should be used during this procedure.** (This procedure is the same for all 7-speed, 2-piece input gears.



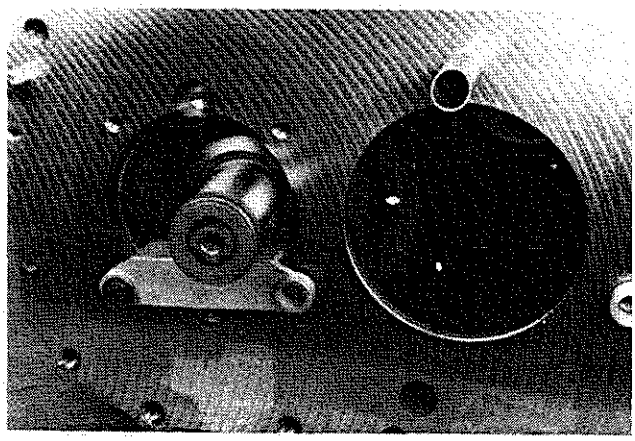
6. When snap ring grooves on the input shaft bearing and bearing retainer are in proper alignment, discontinue pressing and seat the snap ring in place. Inspect the assembly to assure the snap ring is properly seated and secured.



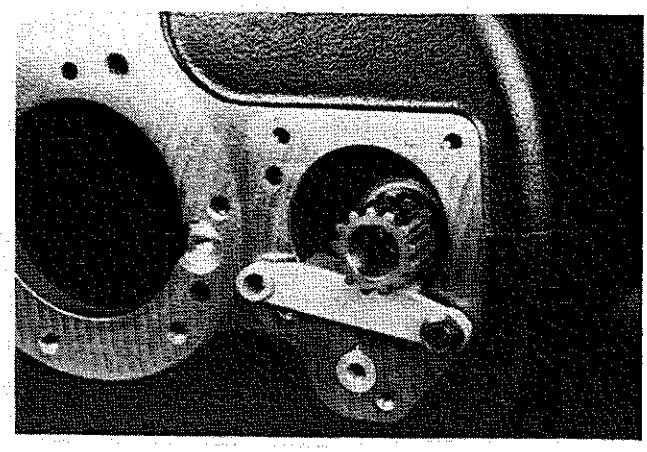
1. Reassembly of the unit begins by placing the lower reverse idler gear into the case. Then install the left side countershaft and the right side countershaft. Use of alignment blocks is recommended.



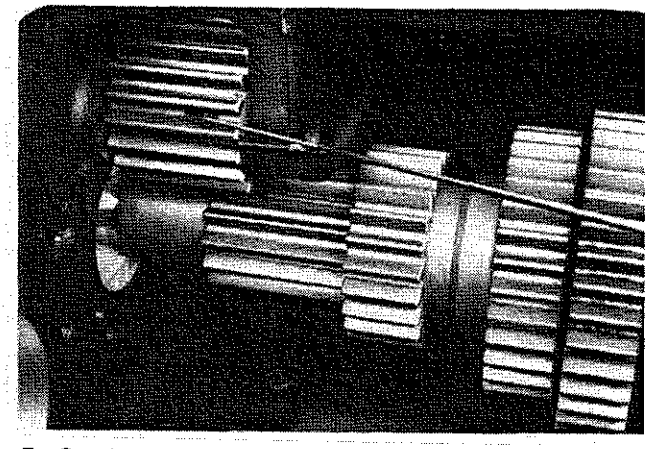
2. These blocks make timing the gears easier. They also help provide the necessary clearance for mainshaft installation.



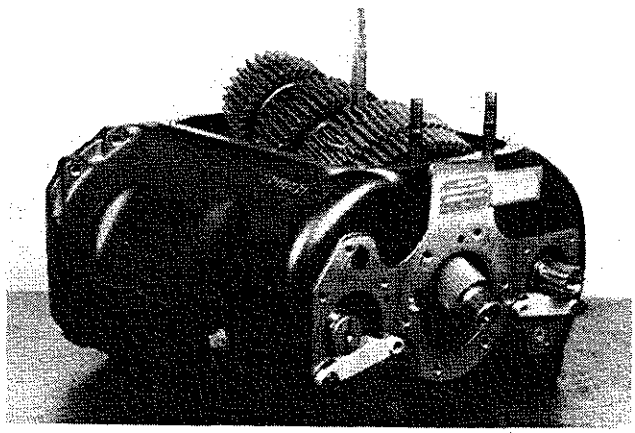
3. Align the countershaft timing marks toward the center of the case.



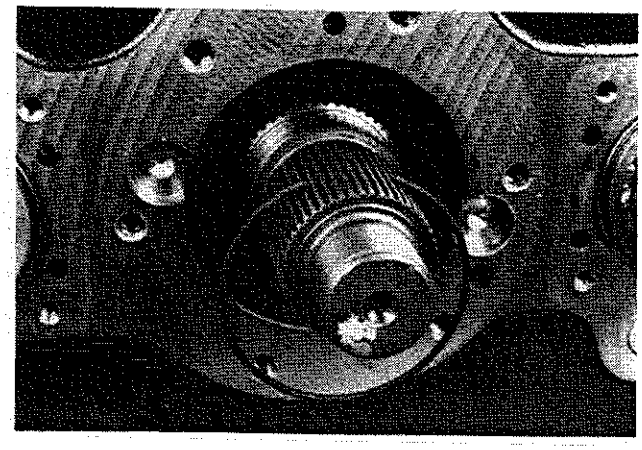
4. Insert the lower idler shaft with lockball.



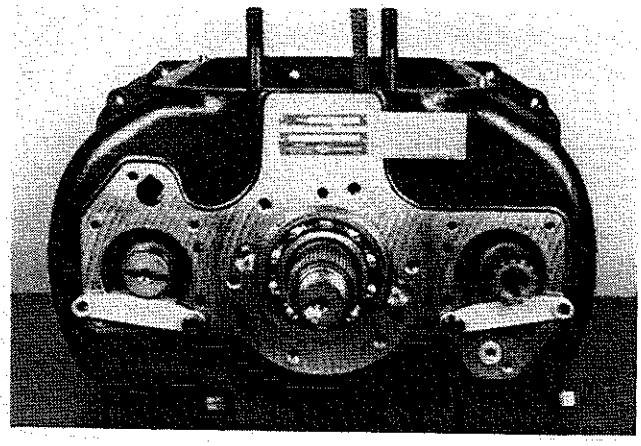
5. Set the upper reverse idler gear into the case, but don't install the idler shaft yet.



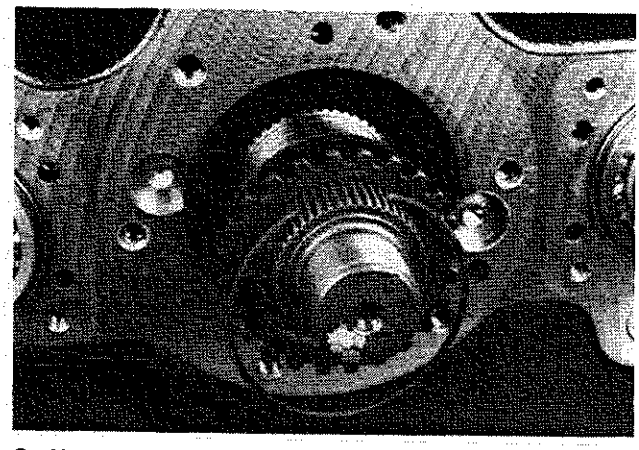
6. Lower the mainshaft assembly into the case.



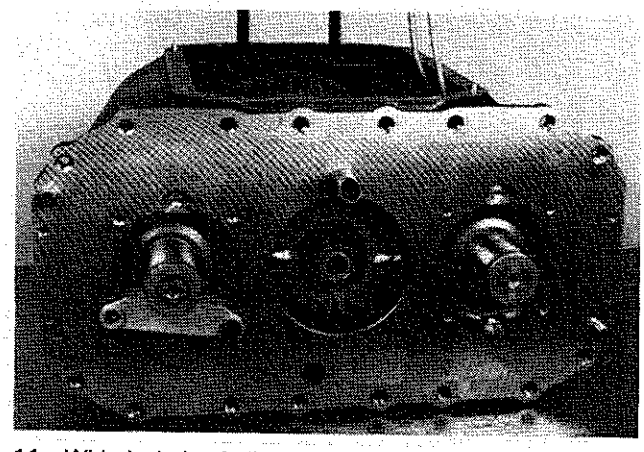
7. Cut the lockwire and slide the reverse gear rearward. Install the first gear bore snap ring.



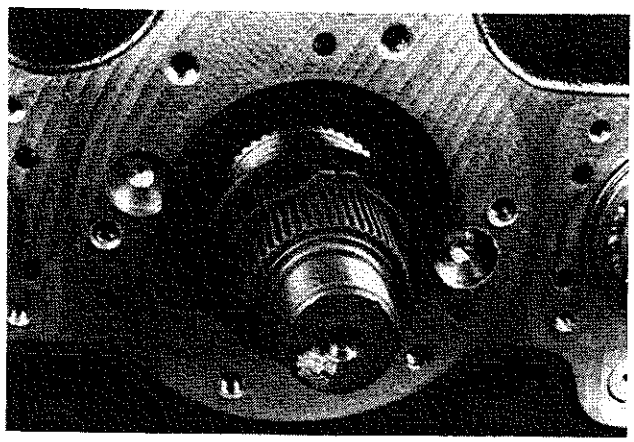
10. Slide the output bearing onto the shaft with a suitable driver. It is properly seated when the snap ring seats against the case.



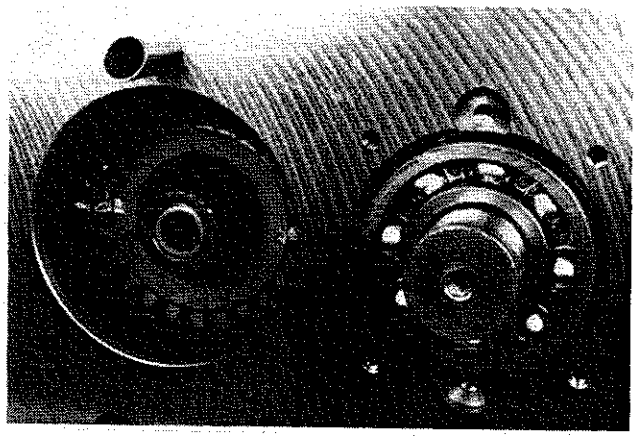
8. Next, install the internally and externally splined thrust washers. Secure them with the gear bore snap ring.



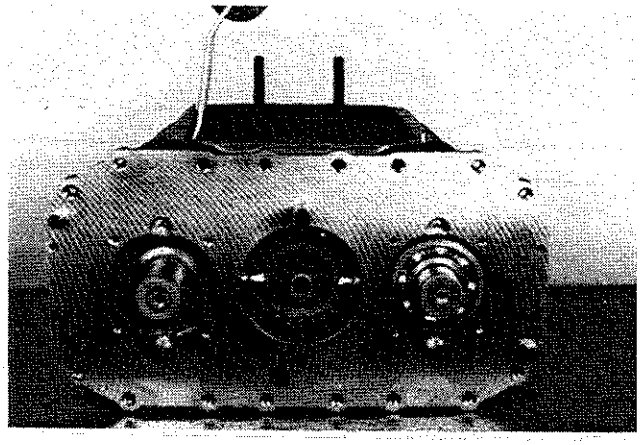
11. With the help of a lift hook, set the countershafts in time by matching the alignment marks.



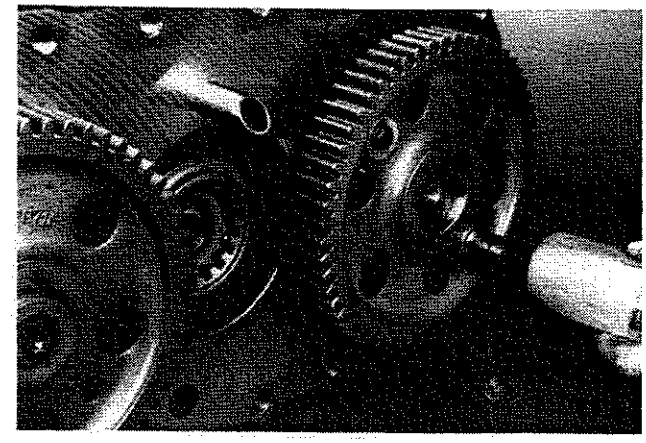
9. Install the internally splined thrust washer and secure it with the mainshaft snap ring.



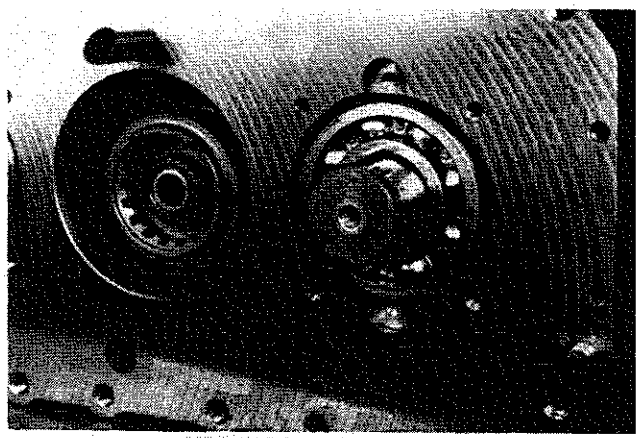
12. Install both the front and rear bearings on one of the countershafts.



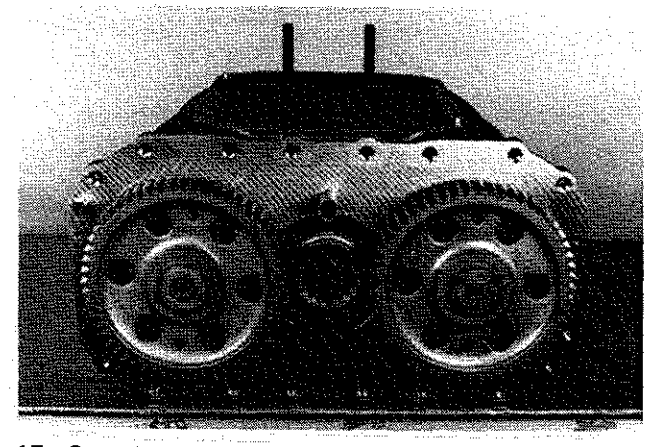
13. Repeat the procedure for the remaining countershaft.



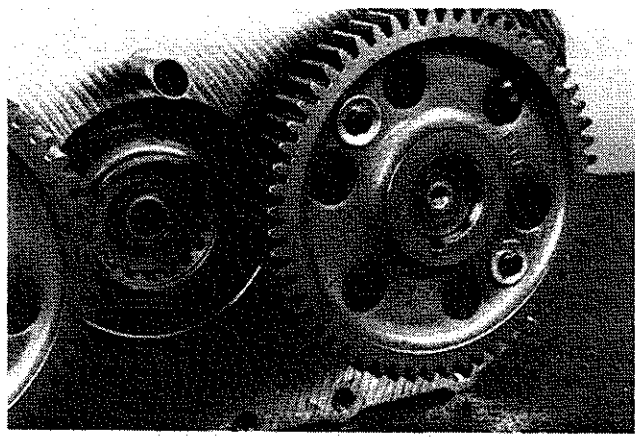
16. Using the alternating method, draw the gear onto the shaft, until it is seated behind the snap ring groove. Repeat this method for the other gear.



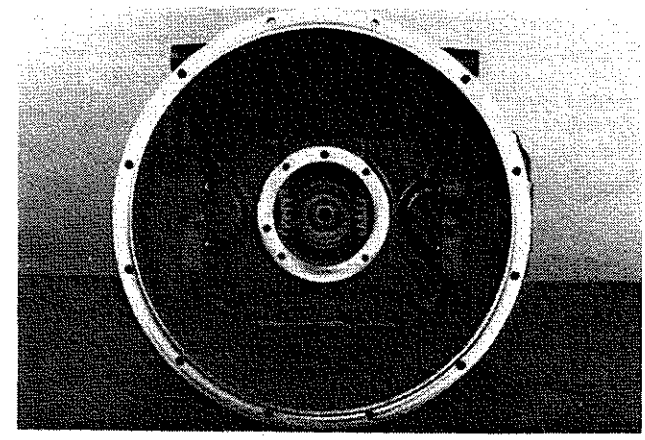
14. Next install the countershaft drive gear keys.



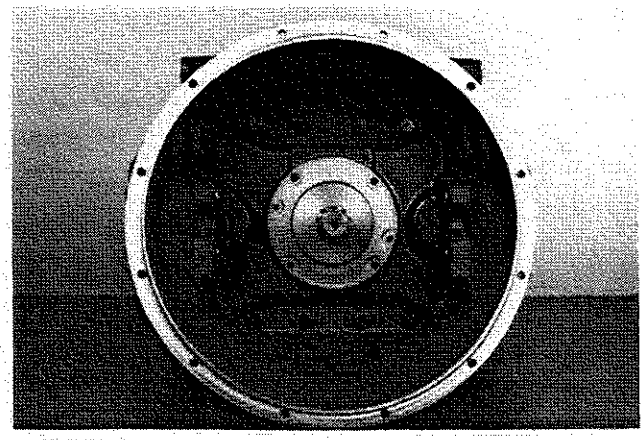
17. Once the gears are seated, install the snap rings and the sixth-seventh clutch collar.



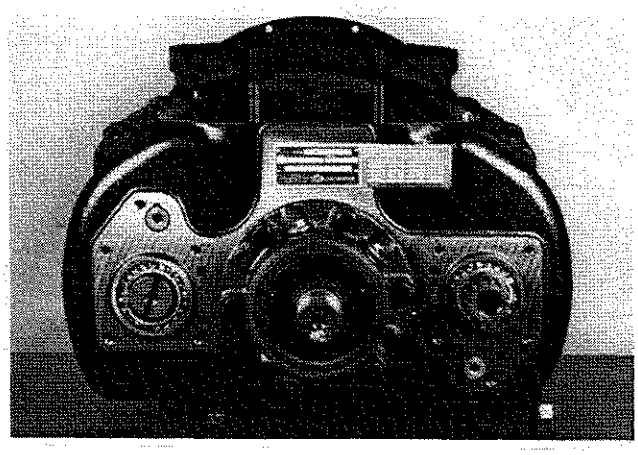
15. Slide the gear onto the shaft. Gather two of the 54103 (.375-16 x 3.00) grade eight bolts used for securing the clutch housing to the case. Place these in the two bolt holes in the gear, and thread them into the tapped installation holes provided in the case.



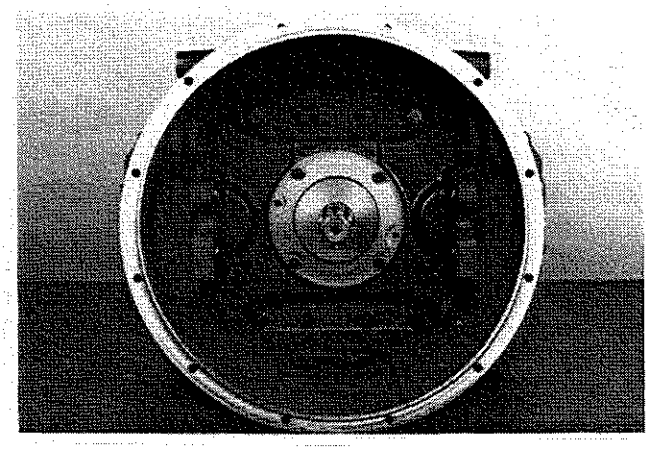
18. Apply a light coat of Loctite 515 to the clutch housing. Attach the housing to the case and secure it with capscrews. Torque them to 150-180 ft. lbs.



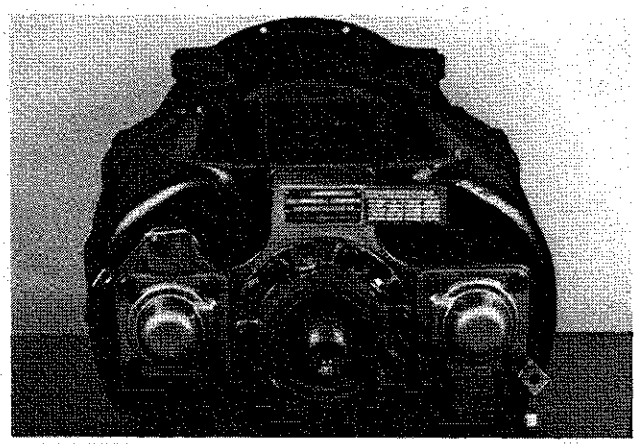
19. Pre-lube the pocket bearing with Moly #2 before installing the input shaft.



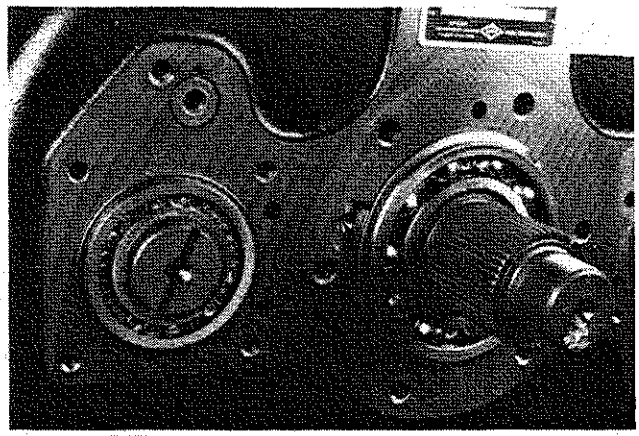
22. The output bearing cap and gasket may be assembled to the case. Torque the capscrews to 78-98 ft. lbs.



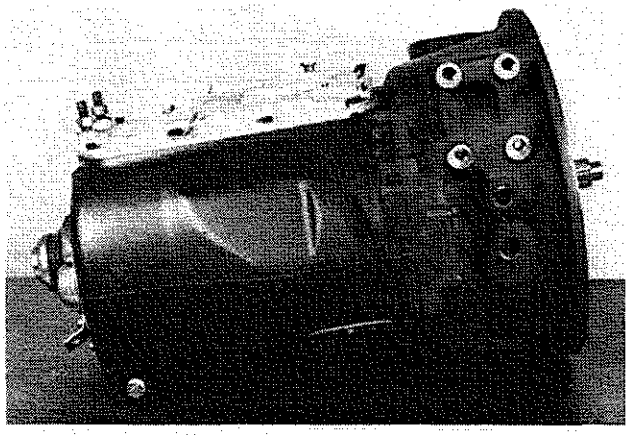
20. Place the input bearing cap and gasket over the input shaft. Be careful to align it with the clutch housing oil hole. Torque the capscrews to 34-41 ft. lbs.



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



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



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

Important Procedure

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

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

Check Functioning Prior to Disassembly

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

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

Inspect Thoroughly During Disassembly

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

Repair or Replace Worn Parts

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

Noisy Operation

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

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

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

(b) Defective vibration dampers.

(c) Crankshafts out of balance.

(d) Flywheels out of balance.

(e) Flywheel mounting bolts.

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

(g) Clutch assembly out of balance.

(h) Engine mounts loose or broken.

(i) Power take-off engaged.

(j) Universal joints worn out.

(k) Propeller shafts out of balance.

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

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

(n) Wheels out of balance.

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

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

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

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

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

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

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

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

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

Noise in Neutral

Possible Causes:

(a) Misalignment of transmission.

(b) Worn flywheel pilot bearing.

(c) Worn or scored countershaft bearings.

(d) Worn or rough reverse idler gear.

(e) Sprung or worn countershaft.

(f) Excessive backlash in gears.

(g) Worn mainshaft pilot bearing.

(h) Scuffed gear tooth contact surface.

(i) Insufficient lubrication.

(j) Use of incorrect grade of lubricant.

(k) Engine torsionals.

Noise in Gear

Possible Causes:

(a) Worn or rough mainshaft rear bearing.

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

(c) Noisy speedometer gears.

(d) Excessive end play of mainshaft gears.

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

Oil Leaks

Possible Causes:

(a) Oil level too high.

(b) Wrong lubricant in unit.

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

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

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

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

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

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

(i) Cracks or holes in castings.

(j) Drain plug loose.

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

(l) Speedometer adaptor or connections.

Walking or Jumping Out of Gear

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

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

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

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

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

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

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

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

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

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

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

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

(i) Worn taper on gear clutch teeth.

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

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

(a) Use of heavy shift lever extension.

(b) Shift rod poppet springs broken.

(c) Shift rod poppet notches worn.

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

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

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

(g) Thrust washers worn excessively or missing.

(h) Timing error on countershaft gears.

Hard Shifting

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

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

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

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

(d) Badly worn or bent shift rods.

(e) Improper adjustment on shifter linkage.

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

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

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

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

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

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

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

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

(n) Worn or elongated shift rod poppet holes.

(o) Timing error on countershaft gears.

Sticking in Gear

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

(b) Sliding clutch gears tight on splines.

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

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

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

Bearing Failures

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

(a) Worn out because of excess dirt.

(b) Fatigue of raceways or balls.

(c) Wrong type or grade of lubricant.

(d) Lack of lubricant.

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

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

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

(h) Improper assembly — brinelling bearing.

(i) Improper fit of shafts or bore.

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

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

Dirt

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

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

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

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

Fatigue

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

Corrosion

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

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

Shaft Fits

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

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

Removal of Bearings

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

Interchangeability

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

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

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

Clutch Troubleshooting

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

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

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

NOTE

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

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