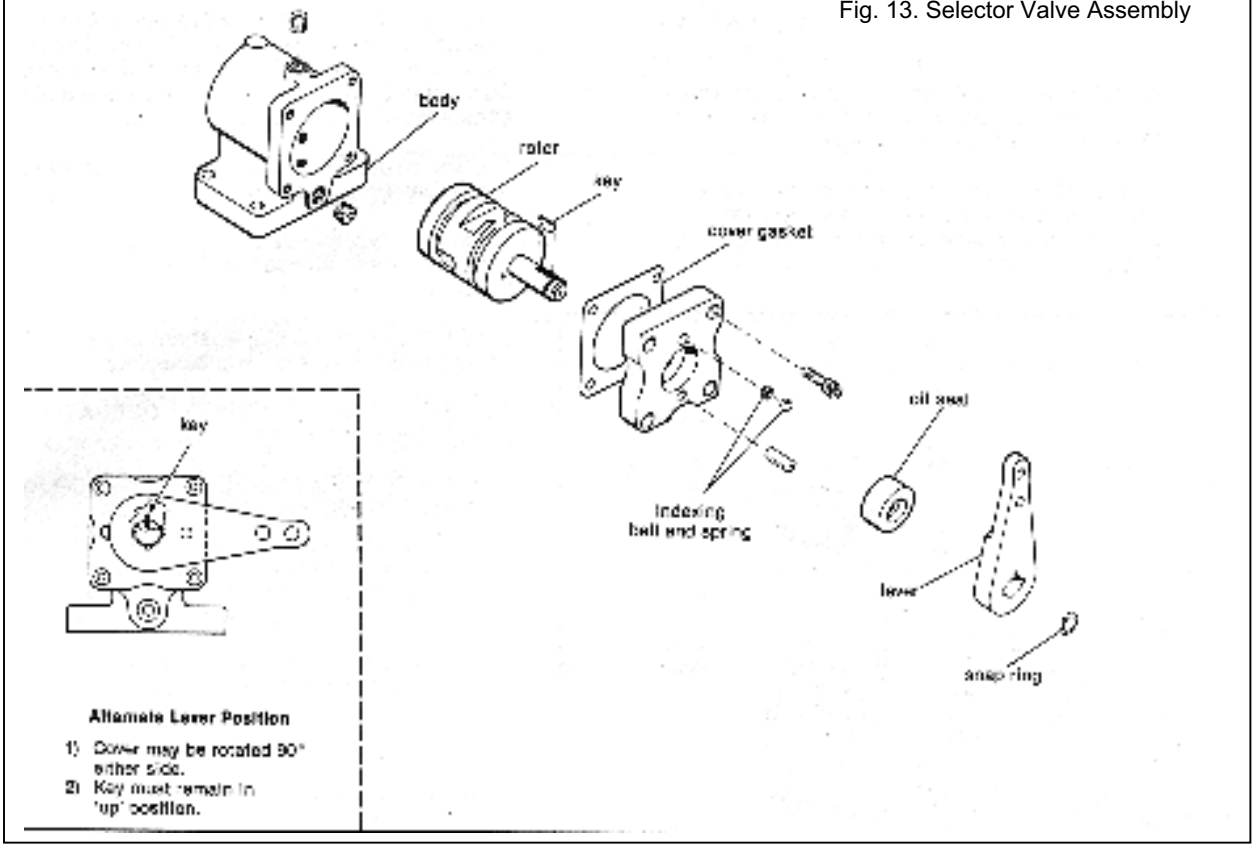
SECTION 6. REPAIR AND SUBASSEMBLIES

Fig. 13. Selector Valve Assembly



6.1 SELECTOR VALVE AND RELATED PARTS

A. REMOVAL

1.Disconnect hoses and disconnect control linkage from lever on selector valve.

2. Remove capscrews and lockwashers and lift off selector valve and baseplate being **very careful** to keep gaskets in proper configuration for replacement. (They may be fixed in position with wire, etc.).

B. DISSASEMBLY

1. Remove snap ring from rotor and note position of keyways on lever to rotor (Match mark if desired.) Remove lever from rotor being careful not to lose indexing ball and spring.

2. Remove key from rotor shaft.

3. (Note position of cover). Remove cover, cover gasket, and rotor from block. (Note relative position of keyway to rotor and lever, match mark if desired.)

C. CLEANING AND INSPECTION

1. Clean all parts thoroughly with solvent and clean all oil ports. Blow dry with compressed air.

2. Inspect rotor and valve body for scoring. Excessive scoring indicates replacement, as valves are not repairable.

3. Inspect oil seal in cover. If it is worn or shows evidence of leaking, replace it.

D. ASSEMBLY

NOTE:
On all fittings use Permatex ‘Super 300’ sealant, graphite paste, or equivalent. **Caution:** Do not use no.1 Permatex or Teflon tape.

1.If necessary install new seal in cover. Press seal in until it bottoms in bore (rubber face out). Apply lubricant to seal.

2. Insert rotor shaft through oil seal in cover.

3. Install lever with indexing ball and spring and make sure that keyway in rotor shaft remains upright.

4. Tap control lever into position with a soft hammer and secure with snap ring.

5.Position new cover gasket on pilot face of cover

6. Install rotor with cover into selector valve body. Secure cover with four capscrews. Tighten to 4 foot-pounds torque.

7. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on base plate and main housing. See fig. 14 below.

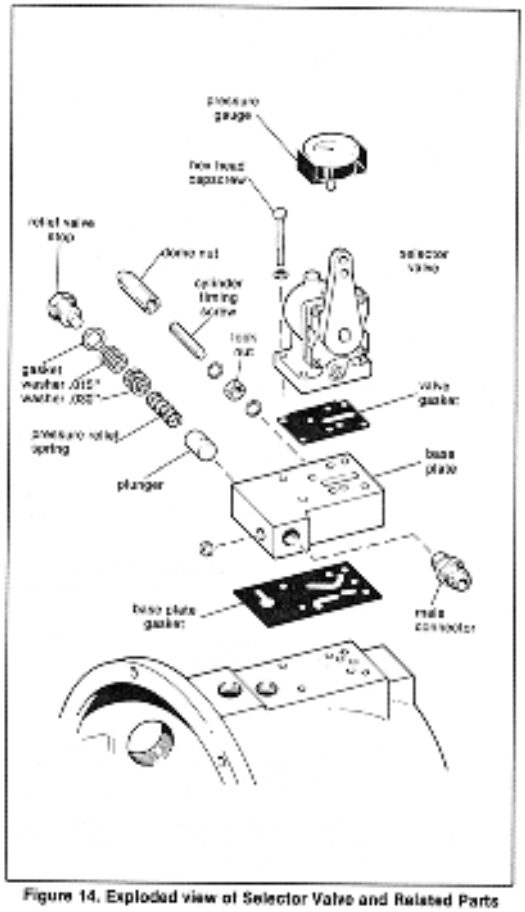


Figure 14. Exploded view of Selector Valve and Related Parts

E. PRESSURE RELIEF VALVE

1. Remove relief valve stop, gasket, washers, spring and plunger (see fig.14) NOTE: REMOVE RELIEF VALVE STOP CAREFULLY BECAUSE RELIEF SPRING IS UNDER TENSION.

2. Check relief valve plunger to see if it is free moving in base plate bore. If not inspect plunger for burrs, heat scores or distortions. Burrs may be removed with fine crocus cloth. Otherwise plunger should be replaced.

3. Clean all parts with cleaning solvent or diesel fuel. Blow dry with compressed air.

4. Generously lubricate relief plunger with oil or Vaseline. Check plunger for free movement in baseplate.

5.Install plunger spring, washers and gasket. Thread relief valve stop into baseplate

TO ESTABLISH CORRECT OPERATING PRESSURE SEE FIG.12.

NORMALLY THE CYLINDER TIMING SCREW ASSEMBLY NEED NOT BE REMOVED.

CAUTION

Avoid contact with rotating output
Coupling and always shut down engine
When doing even minor inspection or
Repair. Avoid contact with metal surfaces
As operating temperatures may exceed 200ºF

6.2 REMOVAL OF REVERSE GEAR

1. Remove drain plug at rear of housing and drain oil from sump.

2. Disconnect all plumbing and wiring and disconnect control linkage.

3. Remove oil breather and or inspection plugs.

4. Scribe alignment mark across outside diameter of flanges on output coupling (Or shaft and mating member) for exact refit. Disconnect coupling.

5. Remove or push back mating coupling to obtain maximum clearance between couplings. Note: Protect mating faces of couplings to insure proper refit and alignment.

6. Connect a suitable hoist and sling or lifting eye (Special tool no. 1-90020-0000) so it supports the weight of the transmission.

7.Remove capscrews and lockwashers holding reverse gear housing to oil pump housing.

8. Insert screwdriver through breather hole or side inspection hole to hold clutch assembly inside forward drum (see fig.15). Carefully move housing aft and away from oil dam.

CAUTION:
Clutch must be maintained in forward drum to prevent falling.

9. Remove clutch from forward driving drum (See figure 16)

10. Remove snap ring from groove on stub shaft and remove forward clutch driving drum.

Oil pump may be now removed (see page 22)

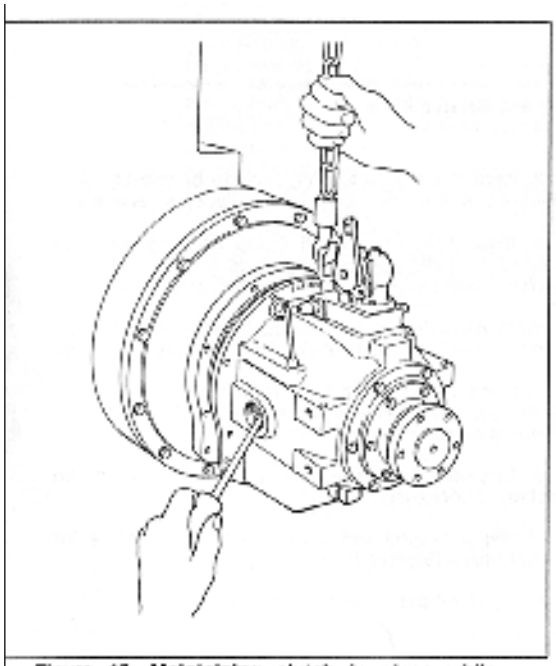


Figure 15. Maintaining clutch in place while removing transmission.

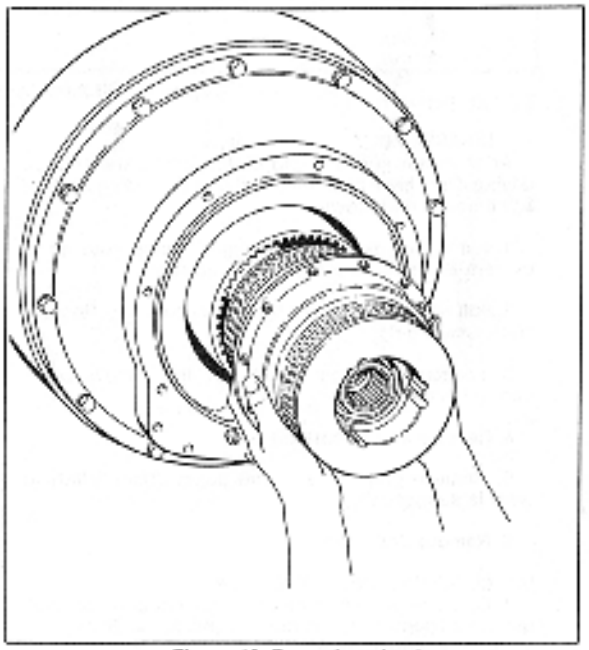


Figure 16. Removing clutch.

18

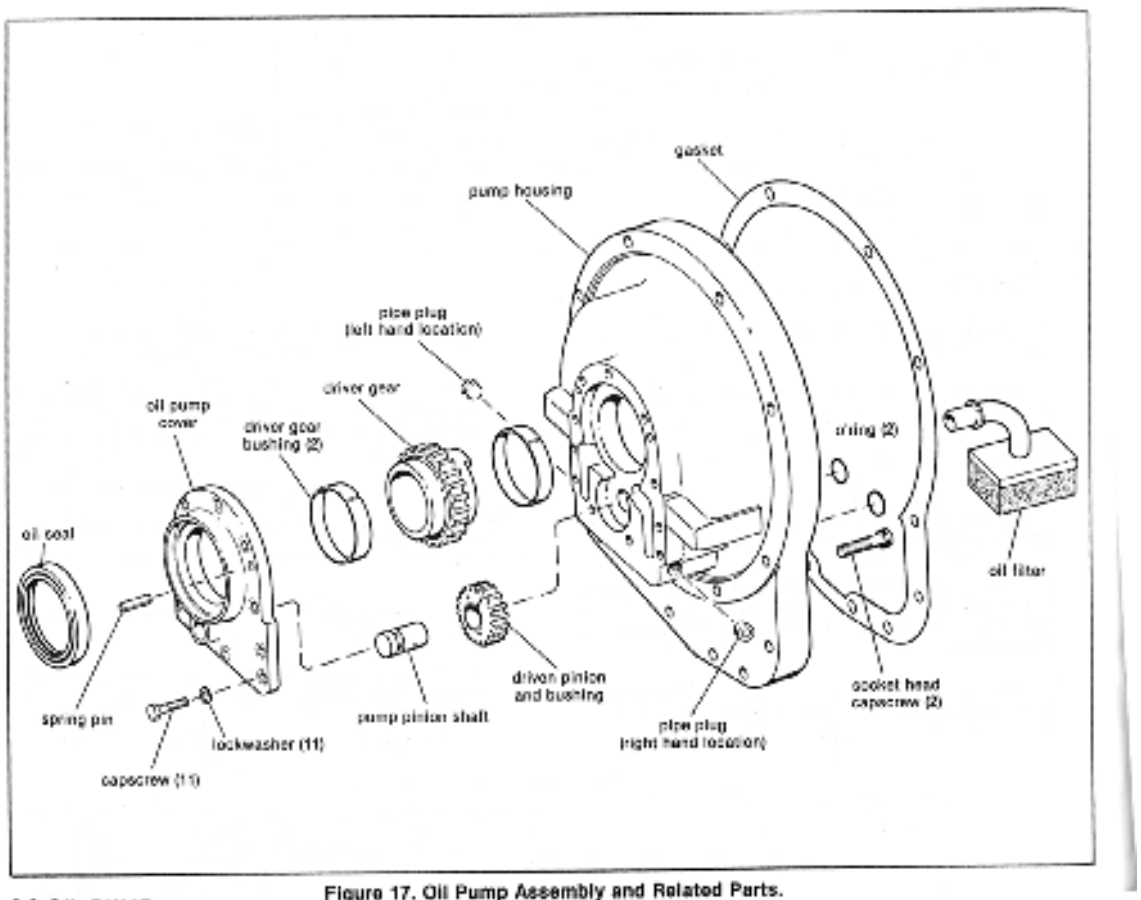


Figure 17. Oil Pump Assembly and Related Parts.

6.3 OIL PUMP

6.3 OIL PUMP

A. DISASSEMBLY

After reverse gear housing, clutch, and forward clutch driving drum have been removed (See preceding section 6.2) proceed as follows:

1. Remove capscrews securing oil pump housing to oil dam and remove pump from stub shaft

2. Pull oil filter assembly from pump housing. Remove and discard o-rings.

3. Loosen hex head capscrews and remove cover from oil pump.

4. Remove and discard oil seal

5. Remove pump, gears and pump pinion shaft (If wear is suspected).

6. Remove drain plug.

B. CLEANING AND INSPECTION

2. Inspect pump gears for damage or excess wear. See wear limits chart, p.23. Replace as necessary.

3. Inspect cover and oil pump housing for wear caused by gears. If grooving does not exceed .020” surfaces can be ground smooth (.020” Maximum cut).

4. Inspection driver gear bushings for wear, out of round condition or burrs. Replace them if they are damaged.

5.Inspect bushing in driven pinion. If it is worn or damaged, replace driven pinion and bushing assembly. Bushing comes installed and reamed to size.

6. Inspect driven shaft for damage or wear and replace if necessary.

7. Inspect cover and housing mating surfaces for smoothness. Replace if necessary.

8. Check oil passages for obstruction.

C. REASSEMBLY

1. Install new oil seal (metal face toward pump) in cover.

2. Install driver gear bushings in cover and housing. They should be reamed, if necessary, to 2.505”/2.506” I.D.

3. Lubricate bushings with light oil and install driver gear and driven pinion with bushing.

4. Install pinion shaft in cover.

5. Install cover with shaft over spring pins on pump housing. Secure cover with capscrews and lockwashers. Tighten to 9 lbs. Foot torque.

6. Replace drain plug

7. Install new o-rings in pump housing

Note: If pump is being installed at this time do not replace filter in pump bore until pump is secure.

6.4 TABLE: REPLACEMENT WEAR LIMITS

ITEM	NEW DIMENSIONS MINIMUM	NEW DIMENSIONS MAXIMUM	REPLACEMENT WEAR LIMIT
OUTPUT SHAFT			
O.D. at Forward Commutator	1.1215 in.	1.1225 in.	1.1205 in.
O.D. at Rear Commutator	1.9658	1.9663	1.9648
FORWARD COMMUTATOR BUSHING, I.D.	1.240	1.260	1.280
REAR COMMUTATOR BUSHING, I.D.	1.9695	1.9700	1.9720
CLUTCH DISC. THICKNESS			
Driving (external teeth)	.130	.140	.120
Driven, Thin (internal teeth)	.088	.100	.078
Driven, Thick (internal teeth)	.149	.155	.139
CLUTCH PACK THICKNESS-Clutch No. 1-00100-1300			
Forward Pack (Compressed)	1.526	1.675	1.490
Reverse Pack (Compressed)	1.090	1.195	.990
CLUTCH PACK THICKNESS-Clutch No. 1-00100-1104			
Forward Pack (Compressed)	1.151	1.255	1.050
Reverse Pack (Compressed)	.497	.535	.457
CLUTCH PACK THICKNESS-Clutch No. 1-00100-1103			
Forward Pack (Compressed)	1.151	1.255	1.050

ITEM	
OIL PUMP (Bushings p.22-23	If deep grooves are present or more than .006" clearance exists between O.D. of gears and I.D. of pump body.
SELECTOR VALVE	If deep grooves are present (.025" deep).
DRIVING DRUM SPLINES CLUTCH END FLANGE SPLINES	If grooves are present vertical to the spline.
ALL SPLINED PARTS	Replace if fit is not snug.

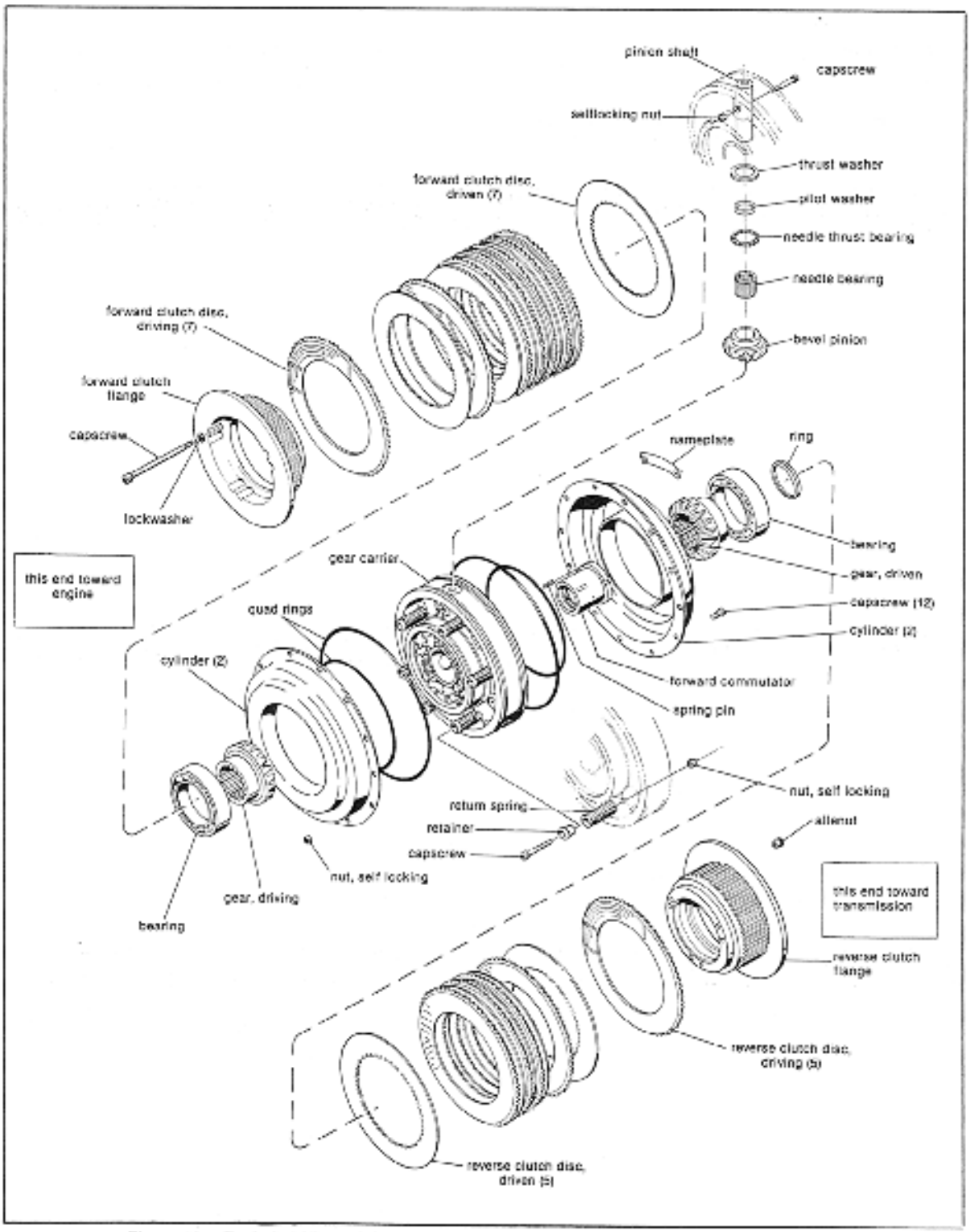


Figure 18. Exploded View of Standard Clutch Assembly No. 1-00100-1300. PTO clutches No. 1-00100-1103 and No. 1-00100-1104 are shown on pages 36 and 37 respectively.

6.5 CLUTCH

A) DISASSEMBLY

NOTE: FOR REMOVAL INSTRUCTIONS SEE PAGE 21.

1.move socket head capscrews, lockwashers, (and Allen nuts) securing both clutch flanges to bevel gear carrier.

2. Lift off clutch flanges and clutch discs.

3. Press and remove bearing and driving gear from both forward and reverse clutch flanges.

4. Removed locknuts, clutch identification tag and capscrews from outer perimeter of cylinders.

5. Separate and remove cylinders

6. Remove and discard quad rings from bevel gear carrier.

7.Remove capscrews and locknuts securing pinion shafts in bevel gear carrier and remove bevel pinion shaft with puller (see special tool no. 1-90008-0000, pinion shaft knockout puller).

B) CLEANING AND INSPECTION

1.Inspect bevel pinion for wear, chips, and breaks or out of round condition. If there is any damage, we recommend replacing all of them as a set.

2. Check all pinion bearings and washers for distortion or rough operation. If one bearing needs replacement we recommend replacing all of them as a set.

3. Clean all parts with a good grade cleaning solvent or diesel fuel. Blow dry with compressed air.

4. Inspect all oil passages in bevel gear carrier to see that they are free from obstruction.

5.Inspect bevel gear carrier for cracks, chips or worn mounting surfaces. Pay special attention to seal ring grooves. Discard carrier if damaged.

6. Inspect forward commutator bushing for chips, heat scores, scratches, distortion or wear (see wear limits p.23) Repair or replace as necessary.

7. Inspect all hardware and springs for wear or distortion. Repair or replace as necessary

8. Remove clutch discs from flanges and inspect discs for broken teeth, heat screws or wear (see wear limits, page 23). Replace as necessary.

9. Inspect driving gear, and driven gear, for wear, chips or cracks. If either one is damaged we recommend replacing both as a set.

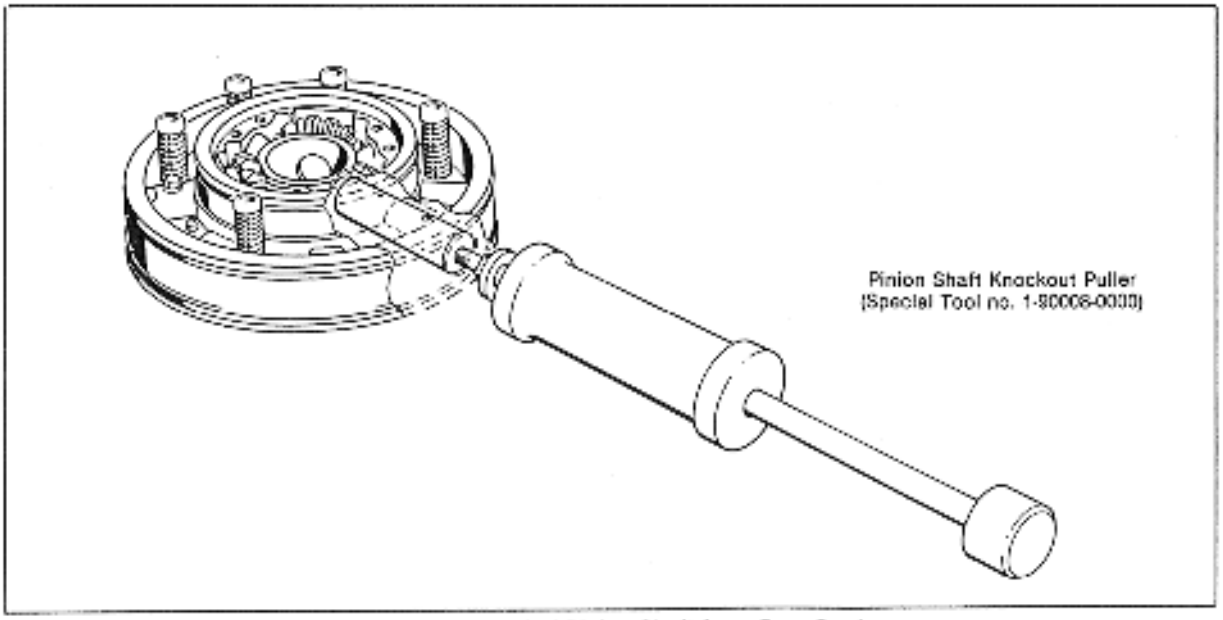


Figure 19. Removal of Pinion Shaft from Gear Carrier.

10. Check both clutch flange ball bearings for wear, distortion, or rough operation. Again we recommend replacement of both bearings if either one shows wear.

11. Inspect forward and reverse clutch end flanges for wear, cracks or distortion and make certain all oil passages are free from obstruction.

12. Inspect both clutch cylinders for cracks, distortions or scratches. Repair or replace as necessary.

C) ASSEMBLY

1. Installation of forward commutator:

a). Either the bushing should be frozen or the bevel gear carrier heated. This will allow ease of fit and will help prevent scoring of the gear carrier bore. An anti-seize compound should be used on the bushing also.

NOTE:
Bushing may be frozen with a solution of alcohol and water or dry ice. Gear carrier may be heated in hot oil or water (212°F, 100°C maximum)

b). Line up holes in flanged end of bushing with roll pins in bevel gear carrier. Press in new bushing on side of carrier stamped 'REV' until it seats in bore. The roll pins will lock the bushing in place and insure line up of oil holes in the bushing and bevel gear carrier.

2. Installation of pinion shafts:

a). To prevent damage to gear carrier and bearings, the carrier should again be heated to expand the bore diameter.

b). Apply lubricant on shaft and bores to ease fit.

c). (Gloves may be required since gear carrier is hot). Insert protective 3/8-24 cap screw in pinion shaft and tap shaft into carrier bore making sure holes are in line (see fig. 20)

Tap shaft about half way into bore so it protrudes just slightly into recess. Position thrust washer, pilot washer, and needle thrust bearing on protruding shaft. Insert needle bearing into pinion gear and slip gear (teeth toward center of carrier) into position over needle thrust bearing. Tap shaft the remaining distance until holes match up.

d). Repeat steps B and C for the 2 remaining shafts.

e). Secure shafts with capscrews and locknuts

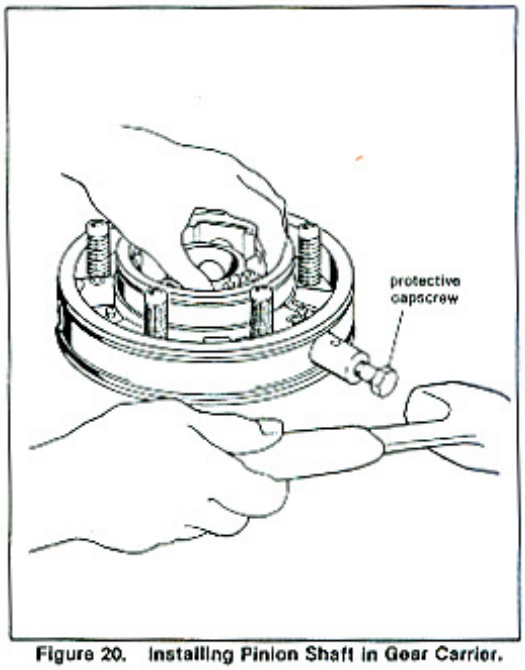


Figure 20. Installing Pinion Shaft in Gear Carrier.

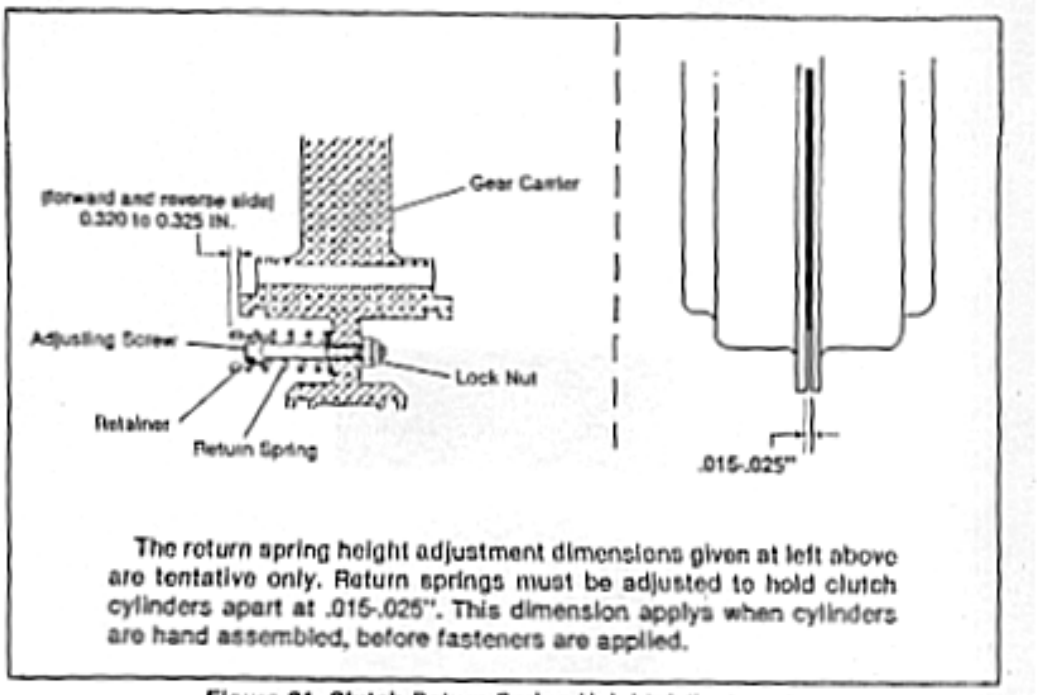


Figure 21. Clutch Return Spring Height Adjustment

3. Replacement of return springs and retainers (if necessary): insert return spring retainers into return springs and secure in gear carrier using capscrews. Tighten capscrews tentatively until top of spring retainer protrudes the specified distance from the face of the bevel gear carrier hub as shown in figure 21.

4. Without installing quad rings, place cylinders on bevel gear carrier by hand. (See fig.21) above. There must be a uniform gap between cylinders of .015 to .025". Check with a feeler gauge. If necessary, readjust return spring height and install locknuts.

5.Apply lube in seal ring grooves in bevel gear carrier and slip on four new quad rings avoiding twists in the rings.

6. ***To install cylinders:***

a). Apply a light coat of lubricant on inner walls of each clutch cylinder as well as quad rings.

b). With forward side of gear carrier up, press cylinder on by hand. (See figure 22)

c). Turn bevel gear carrier over (reverse side up) and press remaining cylinder on, checking to see that cap screw holes in both cylinders are aligned properly.

d). Insert capscrews and locknuts and tighten to 14 pounds-foot torque.

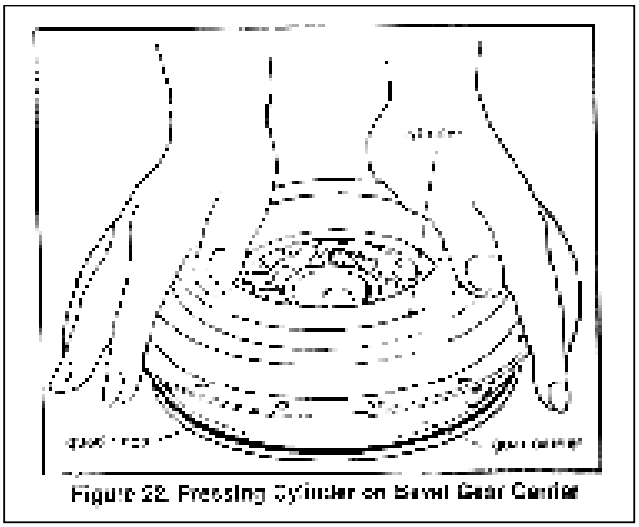


Figure 22. Pressing Cylinder on Bevel Gear Carrier

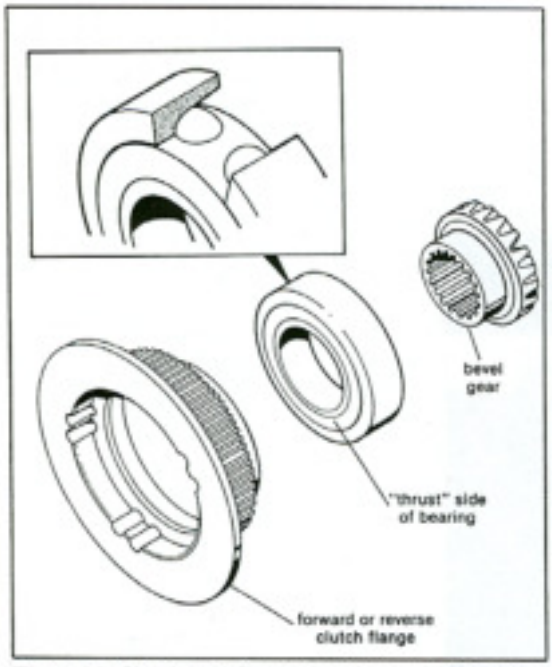


Figure 23. Clutch end flange, bearing and bevel gear. Bearing must be installed so that "thrust" side of bearing is toward clutch flange.

7.Press ball bearing into forward clutch flange. Make certain that thrust side of bearing goes toward clutch flange (see figure 23). Press bevel gear into ball bearing.

8. Likewise press the other ball bearing into reverse clutch flange (fig.23). Then press bevel gear into ball bearing. Check that ball bearings on both flanges are well seated.

9. Arrange the driving friction discs (external tooth) with the steel driven discs (internal tooth) against the forward and reverse clutch flanges. Refer to the appropriate illustration on section 7. Parts information.

10. Position reverse clutch flange and reverse clutch discs on reverse side of gear carrier (flange on commutator bushing is on reverse side). Position forward clutch flange with forward clutch discs and fasten both flanges to gear carrier. Tighten capscrews to 25 pounds-foot torque.

11. Check for free movement of gears in clutch assembly.

12. Test plug (special tool no. 1-90012-0000) can be used to check if cylinders hold pressure.

Clutch assembly is now ready for installation on stub shaft. See page 6 for clutch mounting instructions.

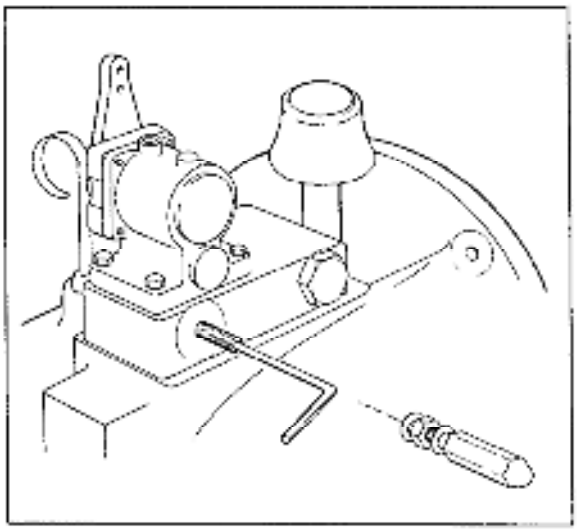


Figure 24. Clutch cylinder timing adjustment; To produce a faster shifting response, turn set screw COUNTER CLOCKWISE. To produce a slower response turn set screw CLOCKWISE.

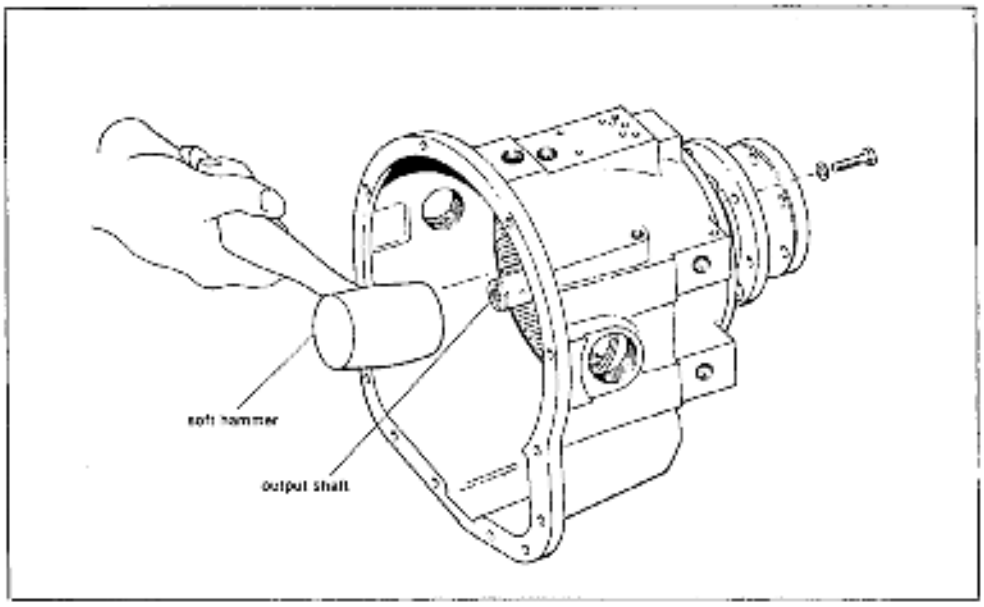


Figure 25. Removal of output shaft from housing.

6.6 OUTPUT SHAFT AND RELATED PARTS

A) DISASSEMBLY

1. Remove hex head capscrews (6) and lockwashers from bearing retainer. It is normally not necessary to remove rear cover.

2. From engine end of housing, (See fig. 25), tap output shaft with 'soft' hammer out of housing (bearing, bearing retainer oil seal, etc. Will come with shaft).
Discard bearing retainer gasket.

3. Remove snap ring (near ball bearing) from shaft and remove shaft spacer.

4. Press bearing retainer off of shaft (oil seal and ball bearing will come with retainer.)

5. If shaft has a flanged output end it is necessary to remove bearing locknut and lock washer in order to remove oil seal. Remove and discard oil seal.

6. In order to inspect commutator bushing thoroughly commutator must be removed from housing:

7. Rest housing with output end down:
   a) Remove roller bearing snap ring
   b) Pull roller bearing out of housing bore
   c) Press commutator bushing out of housing.

B) CLEANING AND INSPECTION

c). Rear commutator bushing: check wear on inner shell and check internal piston rings for cracks (see fig.26).

d). Output shaft roller bearing

Discard worn or damaged parts.

2. Check output flange mounting surface for nicks or burrs. File smooth with flat file.

3. Clean all parts with cleaning solvent or diesel fuel and flush oil ports in output shaft. Blow parts dry with compressed air.

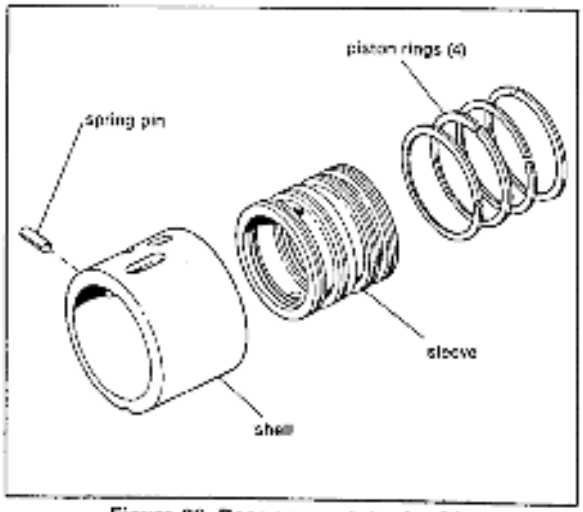


Figure 26. Rear commutator bushing.

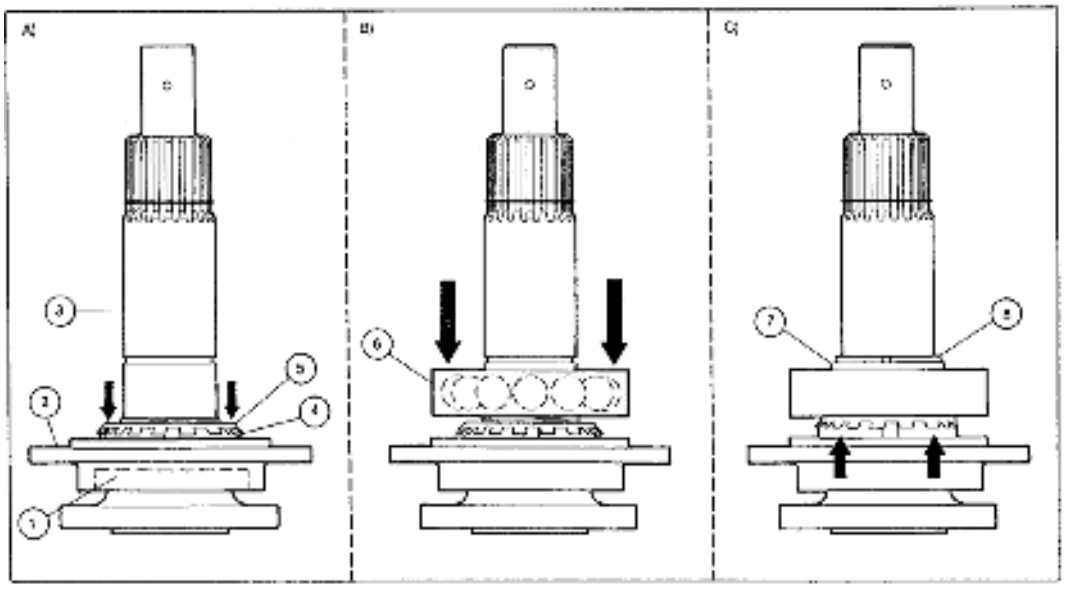


Figure 27. Assembly of Output Shaft Parts Prior to Installation in Housing.

C) RE-ASSEMBLY

1. See fig. 27A. Press in new oil seal (1) flush with rear surface of bearing retainer (2) (metal face of seal toward small end of shaft). Side bearing retainer onto output shaft (3) being careful not to damage oil seal.

Install bearing locknut (4) (with beveled side toward output end of shaft) and bearing lock washer (5) on output shaft. Thread locknut and lock washer up to shoulder on output shaft.

2. See fig.27B. Press ball bearing (6) on shaft down to shoulder of thread surface.

3. See fig.27C. Install spacer (7) and snap ring (8) onto output shaft.

4. Using spanner wrench tighten bearing locknut until bearing is snug against spacer and snap ring. Secure bearing locknut with lock washer.

5. To install rear commutator bushing: (see fig 28)

NOTE: To ease installation, housing may be heated and commutator cooled.

a) Place housing on press with engine mounting side face down.

b) Set guide (3/16" diameter rod bent to a right angle) as shown to insure line up of spring pin grooves in housing bore and commutator, see fig.28. Observe proper hole configuration as shown in illustration.

c) Apply lubricant to bushing and press lightly down to snap ring.

d) Punch spring pin into groove flush with housing surface.

Check to see that commutator sleeve floats inside commutator shell.

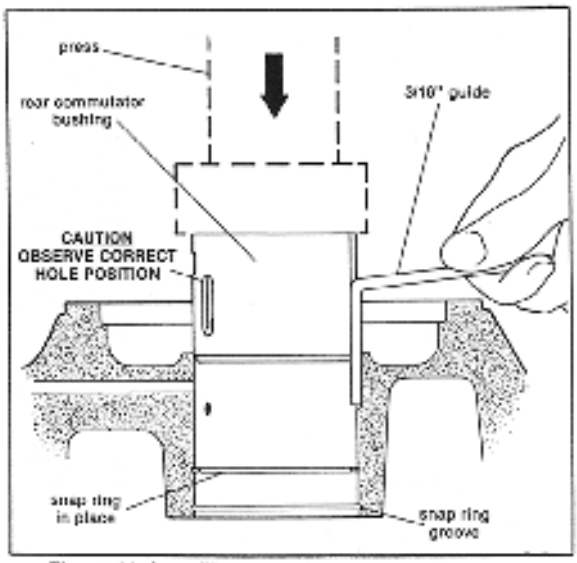


Figure 28. Installing Rear Commutator Bushing.

Tip housing to rest on output end:

6. Press output shaft roller bearing against snap right and install second snap ring.

Tip unit to rest on bell end:

7. Apply lubricant to rear cover and position new bearing retainer gasket. Make sure snap ring is in cover.

8. Install output shaft assembly including ball bearing and bearing retainer into housing (see fig.29). Secure bearing retainer to cover with capscrews and lockwashers (6).

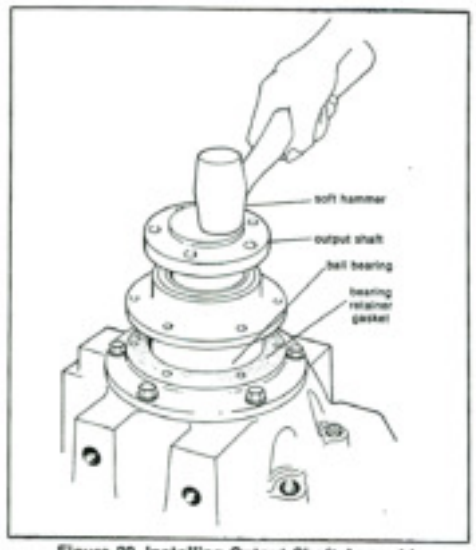


Figure 29. Installing Output Shaft Assembly.

6.7 HOUSING PARTS

1. (Refer to figure 30) Remove oil breather, oil pump discharge tube, and oil filter. Flush clean with solvent or diesel fuel. Blow dry with compressed air.

2. Inspect hoses for cracks and sponginess. Flush hoses and oil cooler with solvent and blow dry with compressed air.

3. Flush clean and inspect main housing.
a) Clean sump.

b) Check front bell end for nicks and burrs on mounting surfaces. Use a flat file for deburring.

4. If not done previously, remove selector valve base plate, being careful to keep gasket in proper configuration. Flush oil ports in housing. Baseplate should also be separated from valve and flushed clean. For proper reassembly see fig.14.

5. Inspect reverse clutch drum for grooves or (excess wear). Replace if necessary.

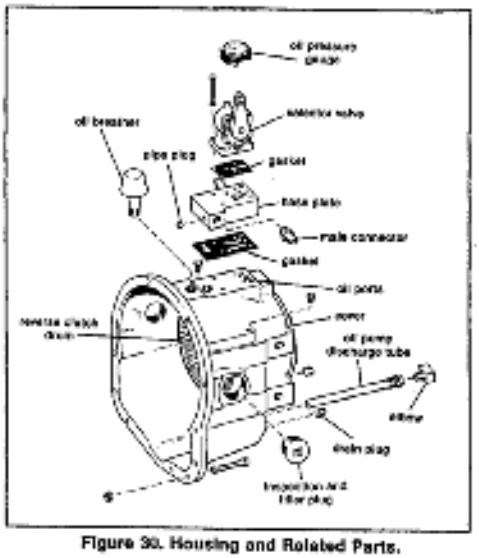


Figure 30. Housing and Related Parts.

6.8 ADAPTER GROUP AND RELATED PARTS

1. Inspect forward clutch driving drum splines and driving slots for damage or wear. Replace if necessary

2. Clean and inspect stub shaft splines for wear. Replace if necessary.

3. Inspect flywheel adapter and drive flange for distortion. Repair or replace as necessary.

4. Inspect oil dam mounting surfaces for nicks or burrs. Repair or replace as necessary.

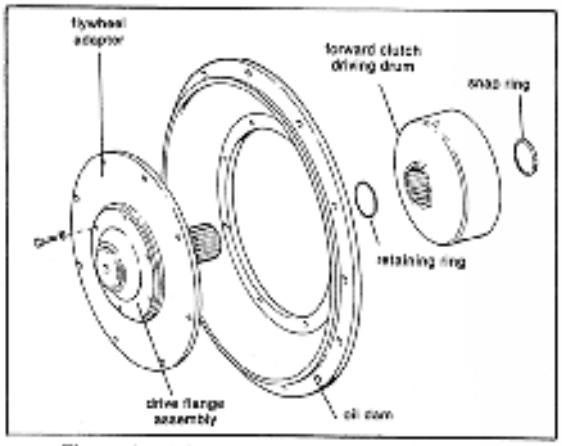


Figure 31. Adapter Group and Related Parts

Reassemble all parts and follow installation procedures described in section 3.

SECTION 7.
PARTS INFORMATION

7.1 PARTS ORDERING PROCEDURE

A. Contact your local dealer, distributor, or authorized service center.

B. Contact Capitol Gears, Inc. If the above cannot supply the part(s) you need. Write:

Customer Service
Capitol Gears, Inc.
349 North Hamline Ave.
St. Paul, MN 55104
USA

Cable address:
"Cap marine"
Tel: 645-9491
area code: 612
Telex: 28-7081

C. Always give complete part description as shown in the sample column below.

Necessary Info	sample
1. Model	5HD 200 E.R
2. Option code	2-20100-02011-30110
3. Serial #	10300-1279
4. Ratio	1 to 1
5. Eng.Mfg.No(if any)	
6. Part number	1-00230-4300
7. Description	Disc, clutch Driving
8. Figure number and item number	fig. 34, item 4
9. Quantity being ordered	12

NOTE:
Please do not use the terms "set" or "complete" when ordering parts but specify exactly each part required.

A list of distributors for capitol gear equipment may be obtained by writing to the customer service department at the address mentioned above.
Do no send any equipment to the factory without authorization from the customer service department.

Capitol Gears will route parts with customers' best interest in mind if routing is not specified when ordering.

Capitol Gears, inc. will provide its distributors, dealers and service centers with current changes and additions to service literature.

Contract your local Capitol representative for up to date service material.

Capitol Gasket and Seal kit no. 1-10172-0000 includes the necessary gaskets, seals, and o-rings for repairs on the 5HD 200 transmission (clutch quad rings must be purchased separately).

7.2 UNIT RECORD

"CAPITOL" Marine Gear model_____
serial no._____
installed in (Name of Vessel)_____
Installed by_____Date_____
Address_____
For use with (Engine & Model)_____
Type of Service _____
Purchased from (Dealer's name & Add.)_____
_____
Date Purchased_____