SECTION 6. REPAIR OF EXTERNAL SUBASSEMBLIES

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.

Capitol gasket and seal kit NO. 1-10195-0000 includes all necessary gaskets seals and o-rings for repairs on the HY 400 and HP 500 transmissions.

Gasket and seal kit No. 1-10196-0000 is designed for all torque converter (TC) models.

6.1 OIL PUMP

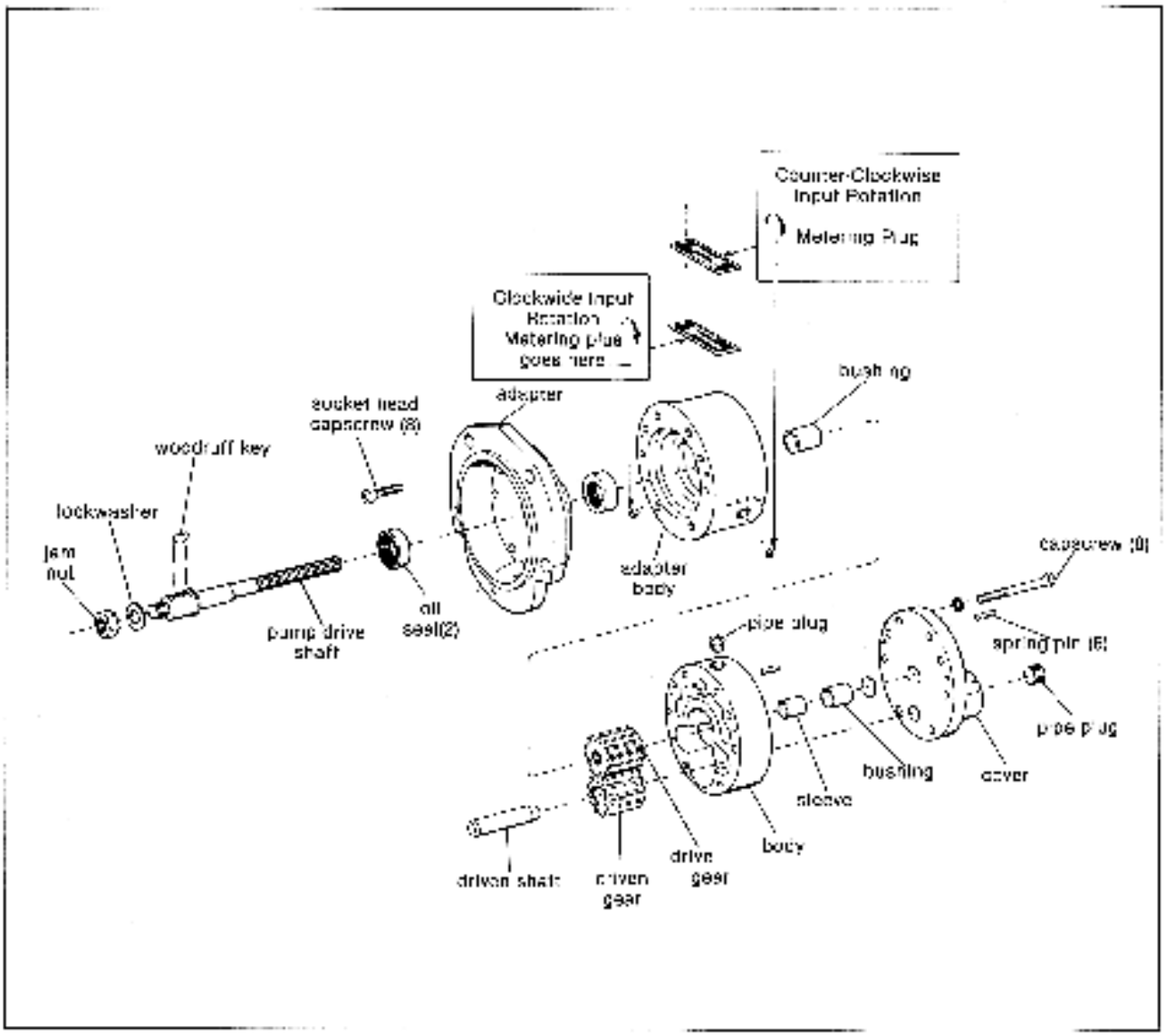


Fig. 18. Oil Pump; Single Direct Mount Style Shown.

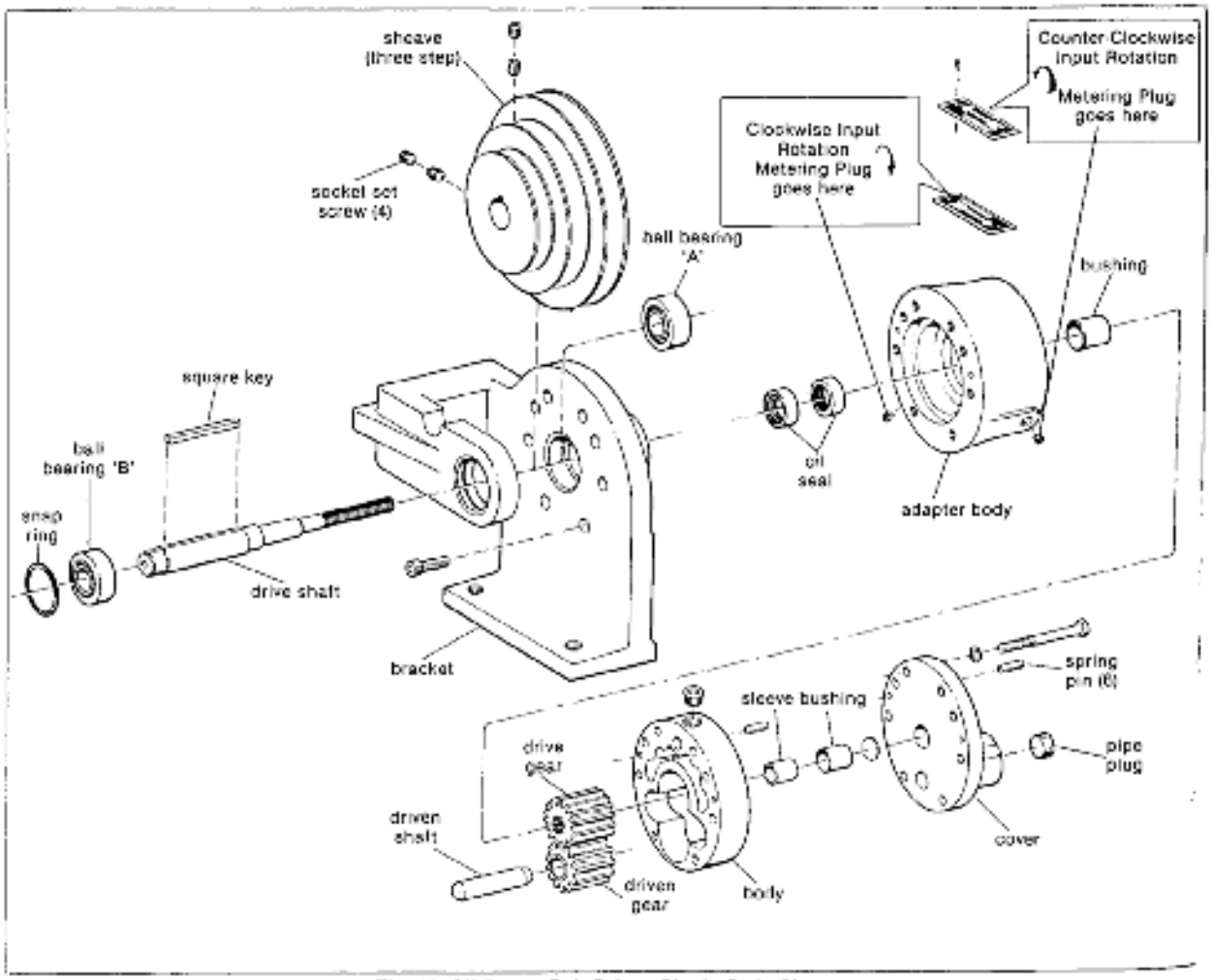


Fig. 19. Oil Pump; Belt Driven Single Style Shown

A. DISASSEMBLY

1. Disconnect hoses and remove mounting bolts securing pump

2. Remove capscrews in cover. Punch mark side of cover, body, and adapter body for reassembly. Separate parts with soft hammer.

3. Belt-driven pumps: remove socket set screws (4) then remove snap ring from bracket. From splined end tap pump shaft out of position With soft hammer.

Direct mounted pumps: Pull shaft through Adapter from keyed end.

4. Remove socket head capscrews (8). Remove and discard oil seals, remove pump gears, and remove driven shaft if wear is suspected. replace them. (New bushing should be reamed to .627/ .628 ID)

B. CLEANING AND INSPECTION

1. Remove all permatex and clean all parts with cleaning solvent or diesel fuel. Blow parts dry with compressed air.

2. Inspect gears and oil pump body for damage or excess wear. See wear limits chart, p. 22.

3. Inspect cover and adapter body for wear caused by gears. If grooving does not exceed .020” surfaces can be ground smooth (.002” maximum cut)

4. Inspect sleeve and bushing in cover for wear, out of round condition or burrs. If they are damaged or if flat discs are worn or loose,

5. Inspect bushing in adapter body. Replace if worn or damaged. New busying should be reamed to .502/ .503 ID after being pressed in bore.

6. Inspect bushings in driven gear. Replace if necessary and ream new bushings to .627/ .628 ID.

7. Inspect all mating surfaces for smoothness.

8. Check each oil passage and the metered plug for obstruction.

C. RE-ASSEMBLY

Belt-Driven Pumps:

1.Install new oil seals (Metal face inward) In bracket.

2. Install ball bearing 'A' (see fig. 19)

3. Install driven shaft in adapter body (7/16" into bore).

4. Apply very thin * coat of permatex 'super 300' or equivalent to mounting faces and following punch marks place adapter body with bushing installed on bracket. Secure with socket head capscrews (8).

5.Hold sheave and drive belt in position in bracket and with keyway aligned slide drive shaft and key into place, splined end first. Install socket set screws (4) in sheave.

6. Tall ball bearing 'B' (see fig. 10) into bracket and secure with snap ring.

7. Generously lubricate pump gears with Vaseline, lubriplate, or engine weight oil. Slide driving gear onto pump drive shaft and driven gear onto driven shaft (in adapter body).

8. Apply a very thin *coat of permatex 'super 300' sealant or equivalent to mating surfaces and slide body over gears and onto adapter body following punch marks

9. Apply thin * coat of sealant and install cover following punch marks. Loose insert hex head capscrews. Install spring pins (6) flush with cover. Torque capscrews (8) to 16 lbs-ft.

Direct engine mounted pumps:

1. Install new oil seals in adapter (Metal face inward)

2. Install driven shaft in adapter body (7/16" into adapter bore.)

3. Apply a very thin *coat of permatex 'super 300' sealant to mating surfaces and secure adapter body (bushing installed) to adapter following punch marks. Torque socket head capscrews to 16 lbs-ft.

4. Install shaft in adapter spline end first

5. Lubricate pump gears with Vaseline, lubriplate or equivalent. Slide driving gear onto driving shaft and driven gear (bushings installed) following punch marks.

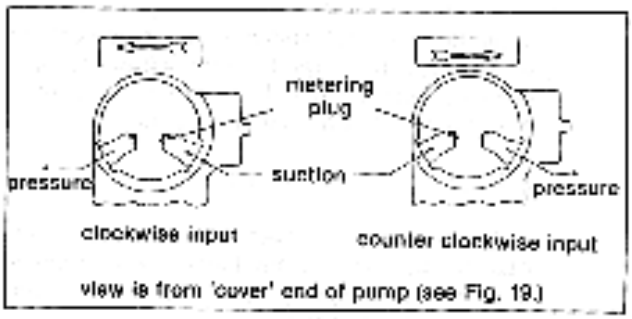
6. Apply thin coat * of 'super 300' permatex to mating surfaces and slide body over gears and onto adapter body, aligning punch marks.

7. Apply a thin coat * of sealant and install cover (bushing, disc and sleeve installed) following punch marks. Loose insert hex head capscrews. Install spring pins (6) flush with cover. Tighten capscrews to 16 lbs-ft torque.

***NOTE:**
Too much sealant can cause pump to malfunction and damage to reverse gear may result.

D. PUMP ROTATION

Input rotation to the pump must be the same as the rotation arrow on the pump itself indicates. If input rotation is changed the pump must change also. The metering plug must be moved to the opposite side and hoses must be reversed. The rotation arrow on the pump should be Changed also. (See page 9 for details)



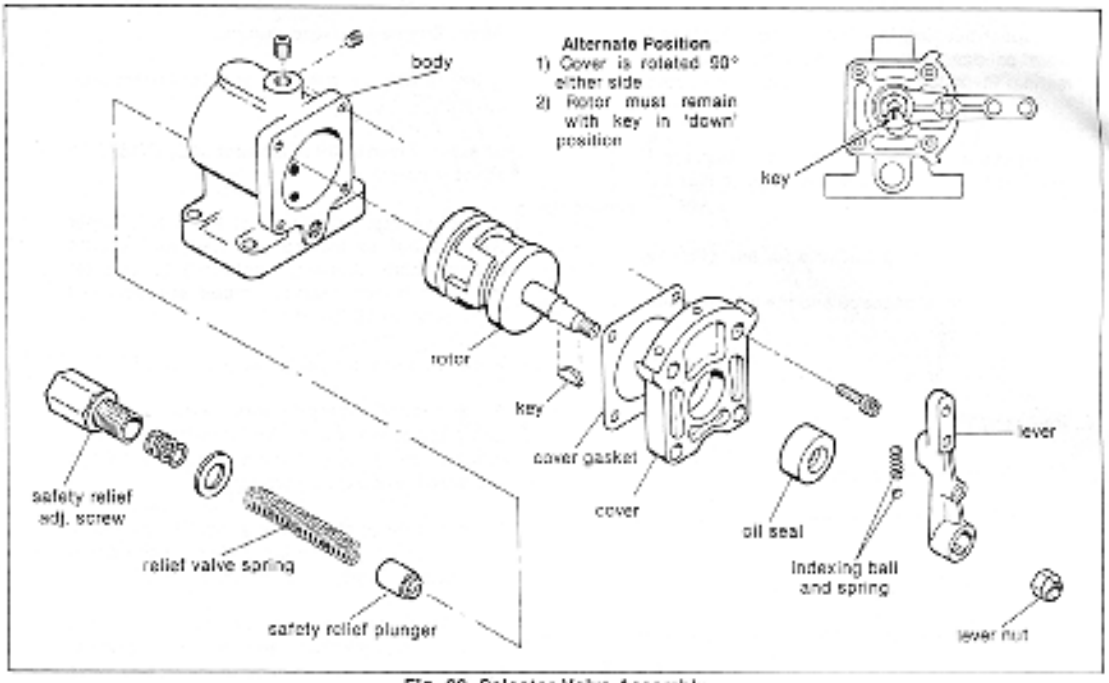


Fig. 20. Selector Valve Assembly

A. REMOVAL

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

2. Remove capscrews and lock washers and lift off selector valve and base plate being very careful to keep gaskets in proper configuration for replacement. (they may be fixed in position with wire, etc.)

B. DISASSEMBLY

1. Remove lock nut 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, Matchmark if desired.)

4.Remove safety relief adjustment screw, washers, spring and plunger. NOTE: SPRING IS UNDER TENSION.

C. CLEANING AND INSPECTION

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

2. Inspect rotor and valve block for scoring. Excessive scoring indicates replacement. 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. Set key in rotor shaft and install lever with Indexing ball and spring. Make sure that keyway in rotor shaft remains toward bottom of cover.

4. Tap control lever in position with a soft hammer and secure with lock nut.

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 pounds-foot torque.

7. Install safety relief adjustment parts in rear of valve body

8. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on main housing. See fig. 21

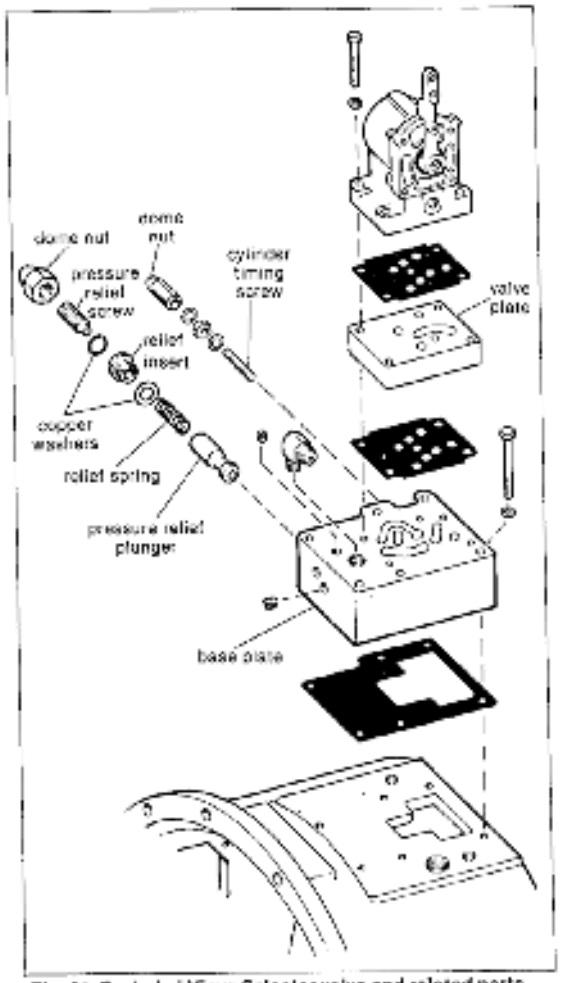


Fig. 21. Exploded View; Selector valve and related parts.

E. PRESSURE RELIEF PLUNGER

1. Remove dome nut, pressure relief screw, relief insert and accompanying washers. See fig. 21. **NOTE:** REMOVE RELIEF SCREW CAREFULLY BECAUSE RELIEF SPRING IS UNDER TENSION.

2. Check relief plunger to see if it is free moving. If not, inspect plunger for burrs, heat scores, Or distortions. Burrs may be removed with fine Crocus clothe. Otherwise plunger should be Replaced.

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

4. Generously lubricate relief plunger with oil or Vaseline. Insert plunger into baseplate. Check Plunger for free movement.

5. Apply washer and install relief insert. Thread pressure relief screw into insert.

6. Cap and lock pressure relief screw with dome nut and washer

REMINDER: Re-establish correct operating Pressure under normal operating speed and Temperature.

SECTION 7. REPAIR OF INTERNAL SUBASSEMBLIES

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.

7.1 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 inspection covers and remove oil filer if necessary.

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 member to obtain maximum clearance and remove pilot ring resting between couplings. NOTE: Protect mating faces of couplings And pilot ring to insure proper refit and Alignment.

6. Screw two ½”-20 eye bolts into lifting holes on top of housing and connect hoist so it supports the weight of the transmission.

7. Remove capscrews and lockwashers holding housing to oil dam

8. Insert screwdriver or similar object through inspection hole to hold clutch assembly inside forward drum. Slowly 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.

NOTE: See page 30 for adapter group repair.

Capitol Gasket and Seal Kit No. 1-10195-0000 includes all necessary gaskets, seals and o-rings for repairs on the HY 400 and HP 500 transmission.

Gasket and Seal kit No. 1-10196-0000 is designed for all torque converter (TC) models.

7.2 REPLACEMENT WEAR LIMITS

HY- 400

ITEM	NEW MINIMUM	DIMENSIONS MAXIMUM	REPLACEMENT WEAR LIMIT
OUTPUT SHAFT			
O.D At Forward Commutator	1.7450 in.	1.7455 in.	1.7440 in.
O.D At Rear Commutator	2.9970	2.9977	2.9960
O.D At Rear Bearing	3.1495	3.1500	3.1485
Forward Commutator Bushing I.D	1.7495	1.7505	1.7525
Rear Commutator Bushing I.D	2.999	3.000	3.015
CLUTCH DISC THICKNESS			
Driving (External teeth)	150	.160	.140
Driven, Thin (Internal Teeth)	.085	.095	.075
Driven, Thick (Internal Teeth)	.160	.175	.150
CLUTCH PACK THICKNESS Clutch No. 1-00100-6000			
Forward Pack (Compressed)	1.645	1.785	1.505
Reverse Pack (Compressed)	1.410	1.530	1.290
CLUTCH PACK THICKNESS Clutch No. 1-00100-4100			
Forward Pack (Compressed)	1.645	1.785	1.505
CLUTCH PACK THICKNESS Clutch No. 1-00100-4200			
Forward Pack (Compressed)	1.645	1.785	1.505
Brake (Compressed)	.470	.510	.440

HP-500

ITEM	NEW MINIMUM	DIMENSIONS MAXIMUM	REPLACEMENT WEAR LIMIT
OUTPUT SHAFT			
O.D At Forward Commutator	2.2450 in.	2.2455 in.	2.2440 in.
O.D At Rear Commutator	2.9970	2.9977	2.9960
O.D At Rear Bearing	3.1495	3.1500	3.1485
FORWARD COMMUTATOR BUSHING I.D	2.250	2.251	2.253
REAR COMMUTATOR BUSHING I.D	2.999	3.000	3.015
CLUTCH DISC THICKNESS			
Driving (External Teeth)	.184	.189	.174
Driven (Internal Teeth)	.085	.095	.075
CLUTCH PACK THICKNESS Clutch No. 1-00100-2419			
Forward Pack (Compressed)	2.152	2.272	1.992
Reverse Pack (Compressed)	1.883	1.946	1.743
CLUTCH PACK THICKNESS Clutch No. 1-00100-2420			
Forward Pack (Compressed)	2.690	2.840	2.490
Reverse Pack (Compressed)	2.421	2.556	2.241
CLUTCH PACK THICKNESS Clutch No. 1-00100-4300			

Forward Pack (Compressed)	2.690	2.840	2.490
Brake (Compressed)	.538	.568	.498

ITEM	REPLACEMENT WEAR LIMIT
OIL PUMP (BUSHINGS- See pages 17 and 18)	IF DEEP GROOVES ARE PRESENT, OR MORE THAN .006” CLEARANCE EXISTS BETWEEN PUMP GEARS AND 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.

7.3 CLUTCH AND GEAR CARRIER

A) DIASSEMBLY

1. Remove socket head capscrews, lock washers, (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 flange

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

5. Separate and remove cylinders

6. Remove and discard seal rings from bevel gear carrier. (Always replace with new seal rings to avoid internal leaks.)

7. Remove capscrews and locknuts securing pinion shafts in bevel gear carrier and remove bevel pinion shaft with puller.

B) CLEANING AND INSPECTION

1. Inspection bevel pinions for wear, chips, 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 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.22). Repair or replace as necessary.

7. Inspect all hardware and springs for wear or distortion (See wear limits p.22) Repair or replace as necessary.

8. Remove clutch discs from flanges and inspect discs for broken teeth, heat scores or wear (See wear limits, page 22). 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.

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 obstructions.

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

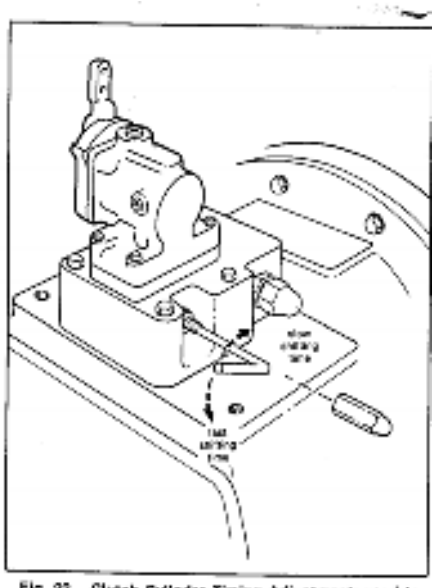


Fig. 22. Clutch Cylinder Timing Adjustment; used to regulate shifting time.

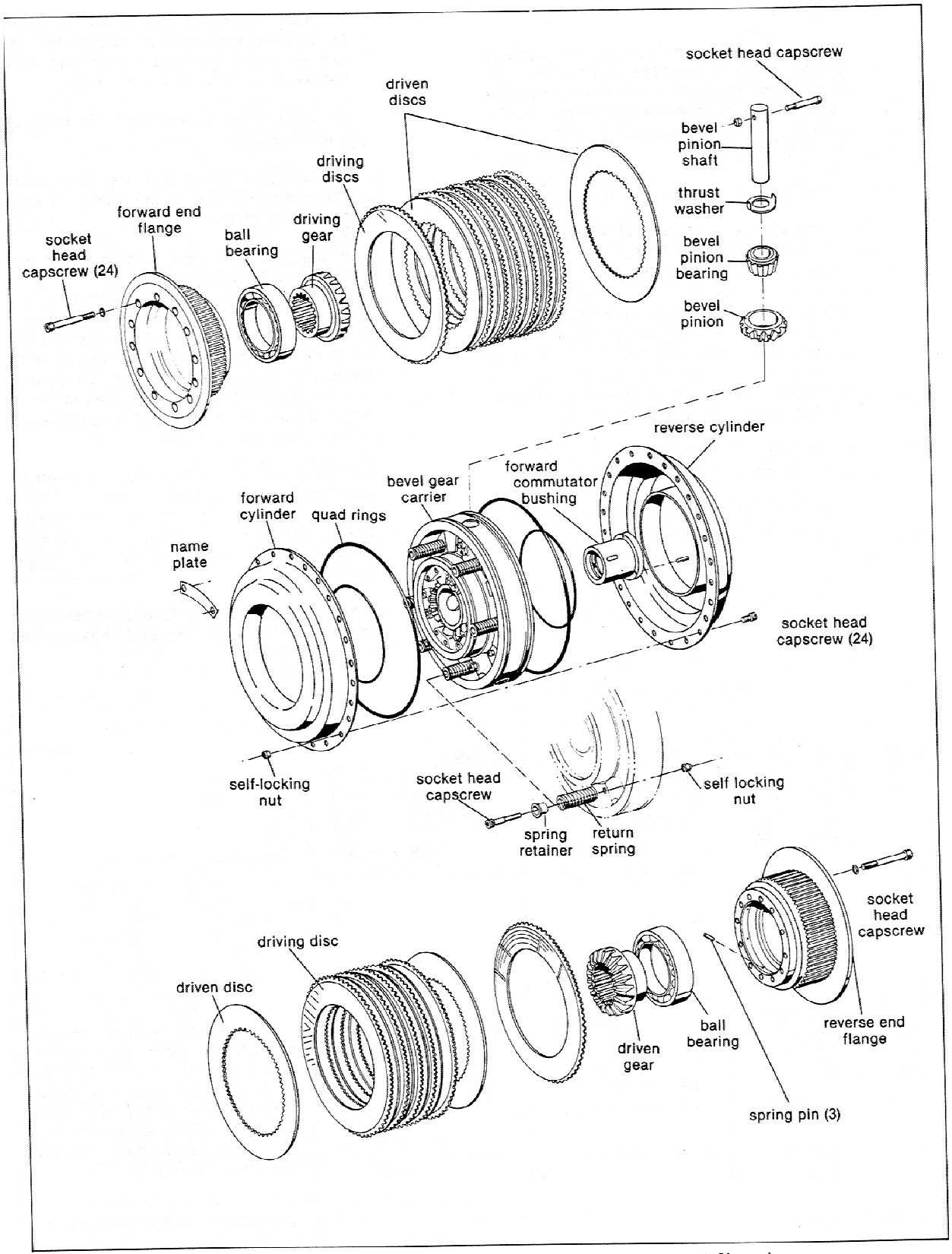


Fig. 23. Clutch and Gear Carrier (HY-400 Clutch No. 1-00100-6000 Shown)

1.In order to install a new commutator bushing 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 (275ºF, 135ºC maximum).

2.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.

3.Installation of pinion shafts:

A. Lay gear carrier flat on table

B. Apply lubricant on shafts and bores to Ease fit and prevent damage.

C. Insert protective capscrews in top of Pinion shaft and tap shaft into carrier bore Just enough to protrude slightly into inner recess; Make sure holes will match.

D. Insert thrust washer (HY 400 lonely) on protruding shaft

E. Place bevel pinion with bearing on shaft. Tap shaft into bearing until holes in shaft and carrier match.

F. Insert socket head cap screw and nut. Torque to 8 lbs-ft.

4. 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 24.

5. Without installing o-rings, place cylinders on bevel gear carrier by hand 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.

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

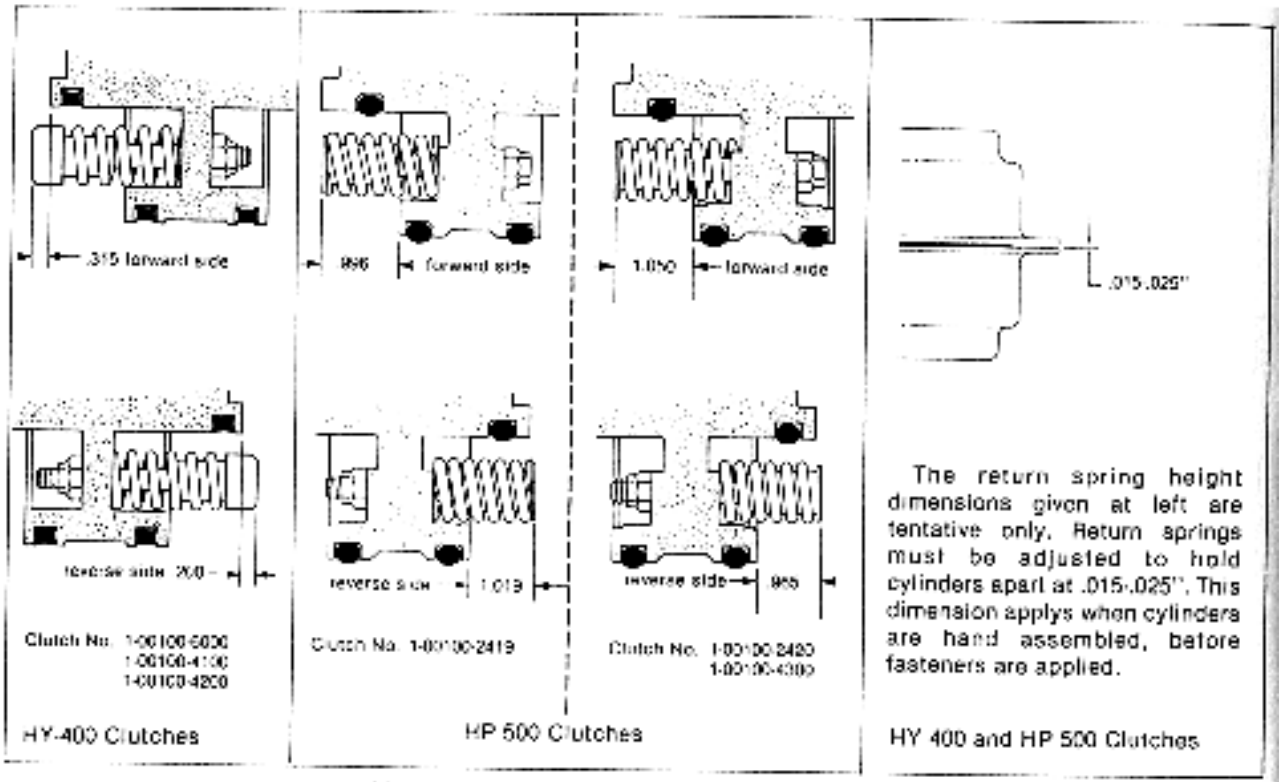


Fig. 24. Clutch Return Spring Height Adjustment

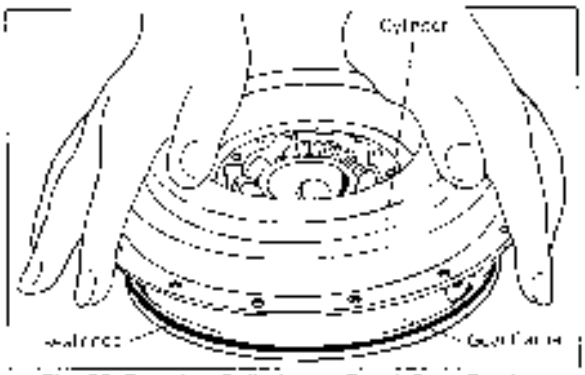


Fig. 25. Pressing Cylinder on Bevel Gear Carrier

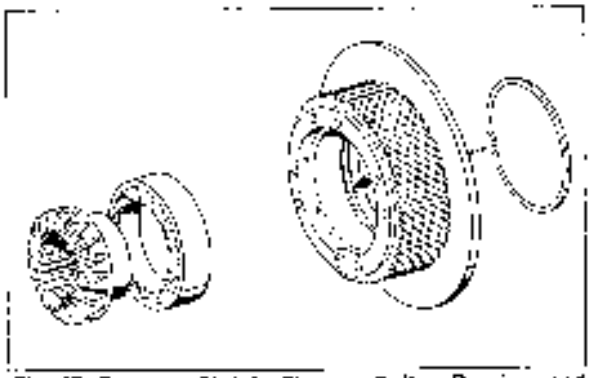


Fig. 27. Reverse Clutch Flange, Roller Bearing and Bevel Gear (snap ring in HP clutches only; location arrow applies only to clutch no. 1-00100-2419 and 1-00100-2420).

7.To install cylinders:

A. Apply a light coat of lubricant on inner walls of each clutch cylinder as well as seal rings/
B. With forward side of gear carrier up, press cylinder on by hand (see fig. 25)

CAUTION:
To prevent twisting or damaging of seal rings, take care to slip cylinders on evenly and straight down.

1.

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 lock nuts and tighten to 15 pounds-foot torque.

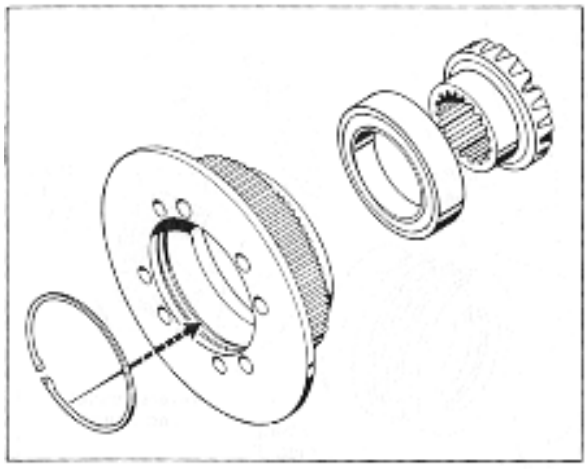


Fig. 26. Forward Clutch Flange, Roller Bearing and Bevel Gear (snap ring in HP clutches only; location arrow applies only to clutch no. 1-00100-2419 and 1-00100-2420).

8. Press ball bearing into forward clutch flange. Press bevel gear into ball bearing. See fig. 26. In "HP' 500 units be sure to replace snap ring in Innermost groove forward flange.

9. Likewise press the other ball bearing into reverse clutch flange. On HP 500 clutch be sure to install snap ring in outermost groove of reverse flange (see fig. 27). Then press bevel gear into ball bearing. Check that ball bearings on both flanges are well seated.

10. 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 pages 27 And 28.

11. 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 28 foot-pounds torque.

12.Check for free movement of gears in clutch assembly

clutch assembly is now ready for installation.

NOTE:
Clutch cylinder timing adjustment is illustrated on p. 23

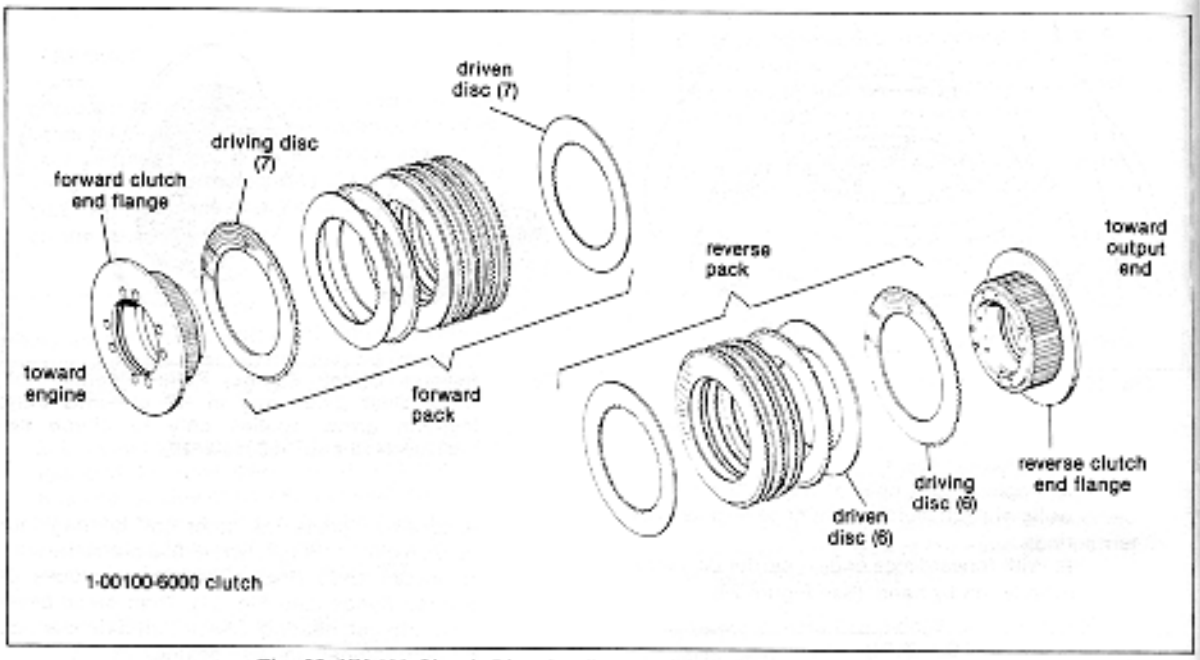


Fig. 28. HY-400 Clutch Disc Configuration (1-00100-6000 Clutch Only)

NOTE: Regarding HY-400 clutches 1-00100-4100 and 1-00100-4200 see parts information section, pages 45 and 47.

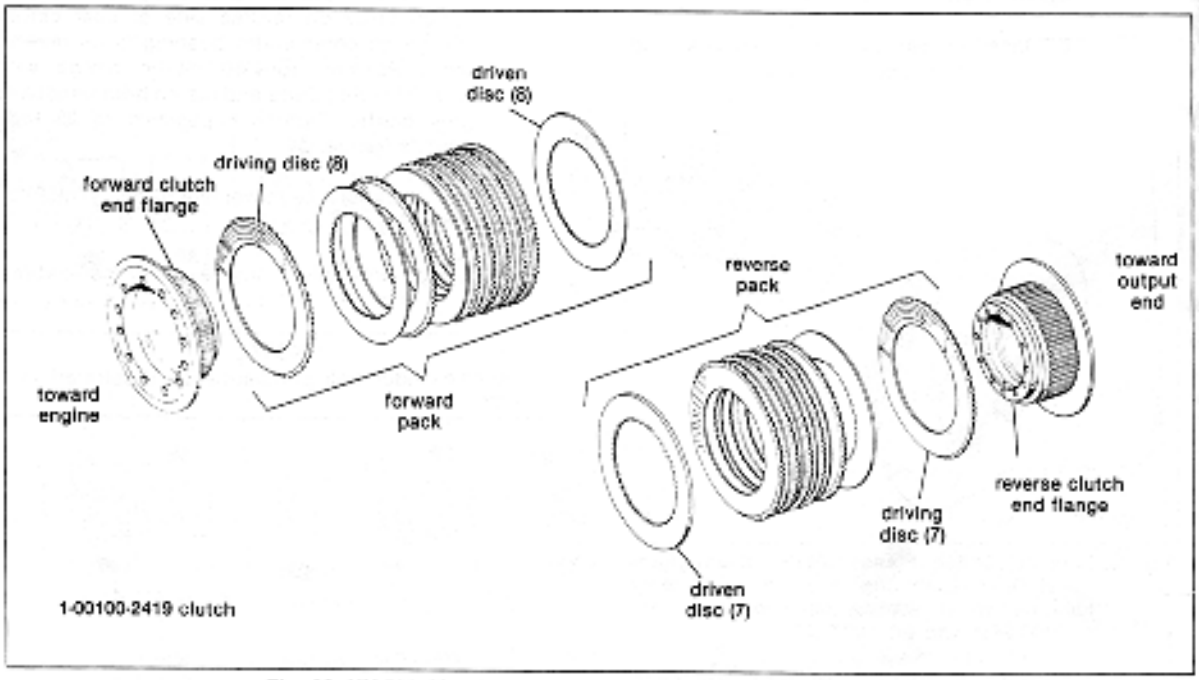


Fig. 29. HY-500 Clutch Disc Configuration (1-00100-2419 Clutch Only)

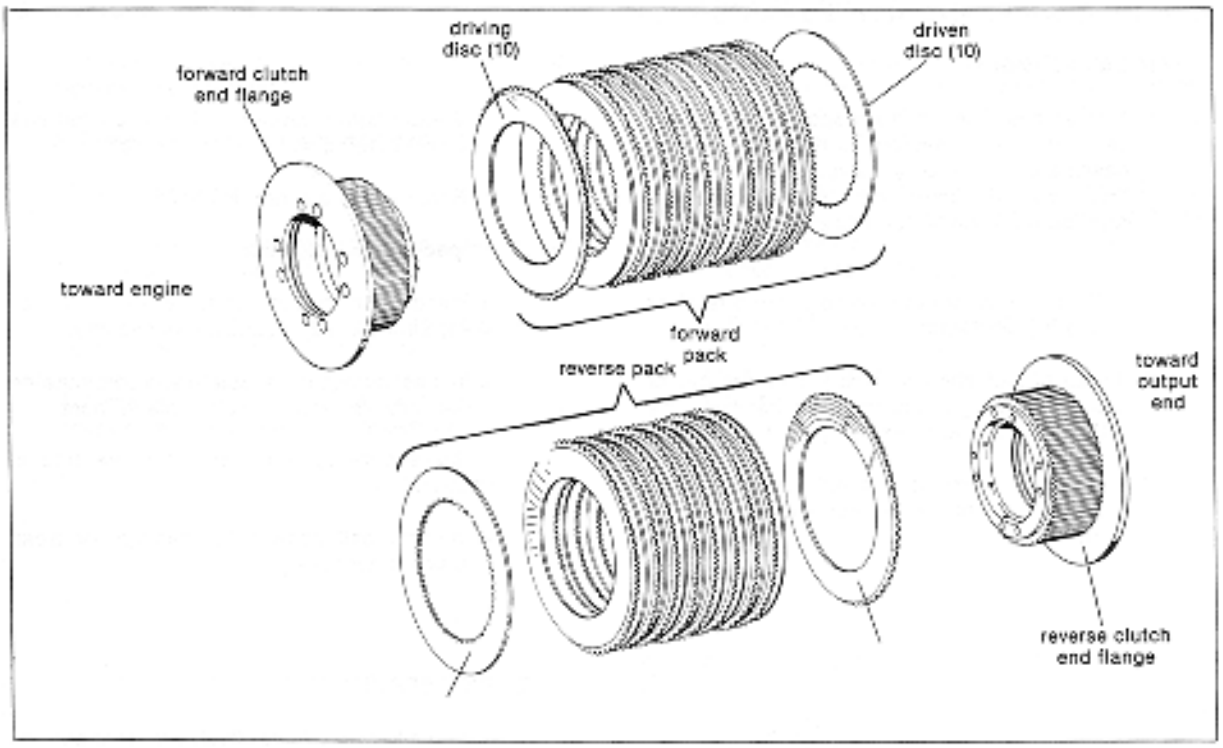


Fig. 30. HP 500 Clutch Disc Configuration (1-00100-2420 Clutch only)

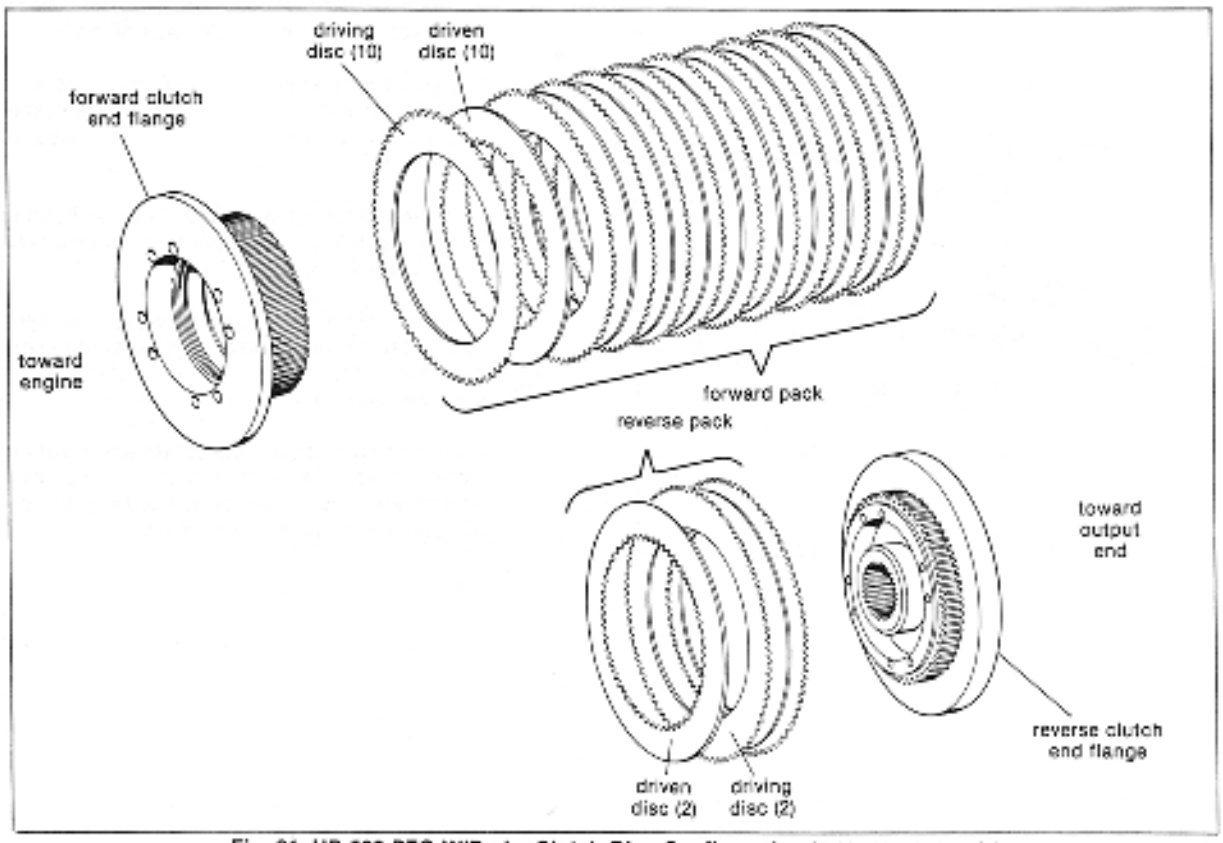


Fig. 31. HP 500 PTO W/Brake Clutch Disc Configuration (1-00100-4300 only)

7.4 OUT PUT SHAFT AND RELATED PARTS

A) DISSASSEMBLY

1. Remove hex head capscrews holding selector valve base plate with selector valve. Lift commutator tubes out of commutator and remove anti-rotation stud. Slide commutator off of output shaft.

2.Remove capscrews holding bearing retainer to bearing container.

3.Tap output shaft with soft hammer out of housing (bearing and bearing retainer will come with shaft.) Discard retainer gasket.

4.Remove bearing locknut with spanner wrench and remove lock washer. See fig. 32 below.

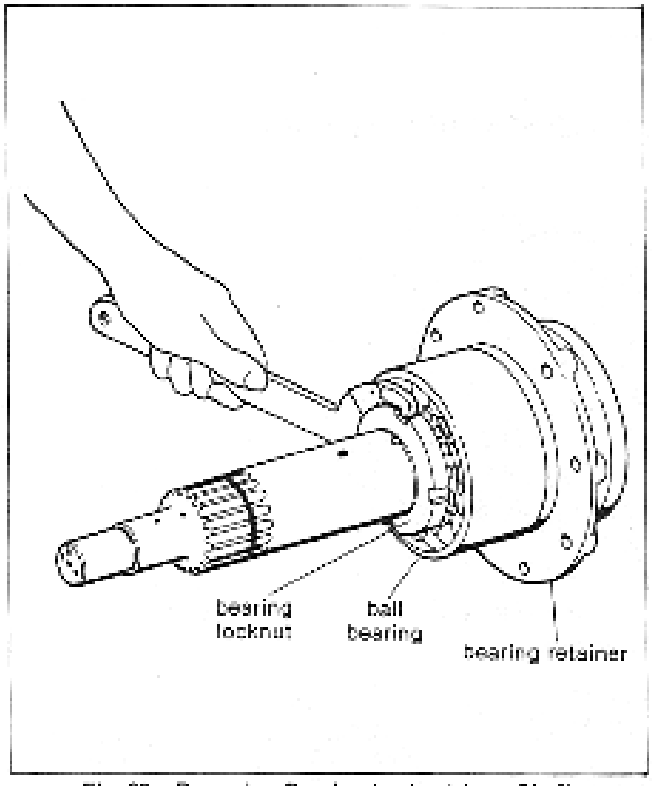


Fig. 32. Removing Bearing Locknut from Shaft.

5. Press bearing retainer off of shaft (Oil seal and ball bearing will come with shaft).

6. Remove and discard oil seal

B) INSPECTION AND CLEANING

1. Inspect commutator for damage or wear (See wear limits p.22) Replace if necessary.

2.Inspect O-rings in base plate and commutator. If they are no longer pliable replace them

3. Make sure commutator tubes are free of obstruction.

4.Inspect ball bearing for damage or wear. Replace if necessary

C) REASSEMBLY

1. Press in new oil seal flush with rear surface of bearing retainer.

2. Slide bearing retainer onto output shaft being very careful not to damage oil seal.

3. Press ball bearing onto shaft so it seats on shoulder of shaft. Install bearing lockwasher and tighten bearing locknut. Bend tangs of lockwasher.

4.Install new gasket and secure bearing retainer to bearing container with capscrews and lockwashers.

5. Install new o-rings in commutator and slide commutator in place on shaft so that stud hole is on starboard side. Install commutator tubes and anti-rotation stud.

6. Install new o-ring in baseplate and carefully install baseplate and selector valve over commutator tubes and onto housing. Secure with capscrews and lockwashers.

7.5 HOUSING PARTS

1.Clean oil breather and suction screen and replace filter element.

2. Flush clean and inspect main housing
   a. Clean sump
   b. Check front bell end for nicks and burrs. Use a flat file for deburring

3.Inspect reverse clutch drum for grooves or excess wear. Replace if necessary.

4.Inspect surfaces of output flange and mating coupling and file smooth if necessary.

7.6 ADAPTER GROUP

1. Clean and inspect stub shaft (mounted on engine flywheel) and forward clutch driving drum. Inspect spline on stub shaft for chips or wear. Replace as necessary.

2. Remove oil dam and inspect labyrinth oil seal on inside diameter. Repair or replace as necessary (wear or damage to seal indicates misalignment- check further!) (See fig. 33).

3. While oil dam is removed inspect flywheel adapter and drive flange for distortion or rough mounting surfaces. Repair or replace as necessary.

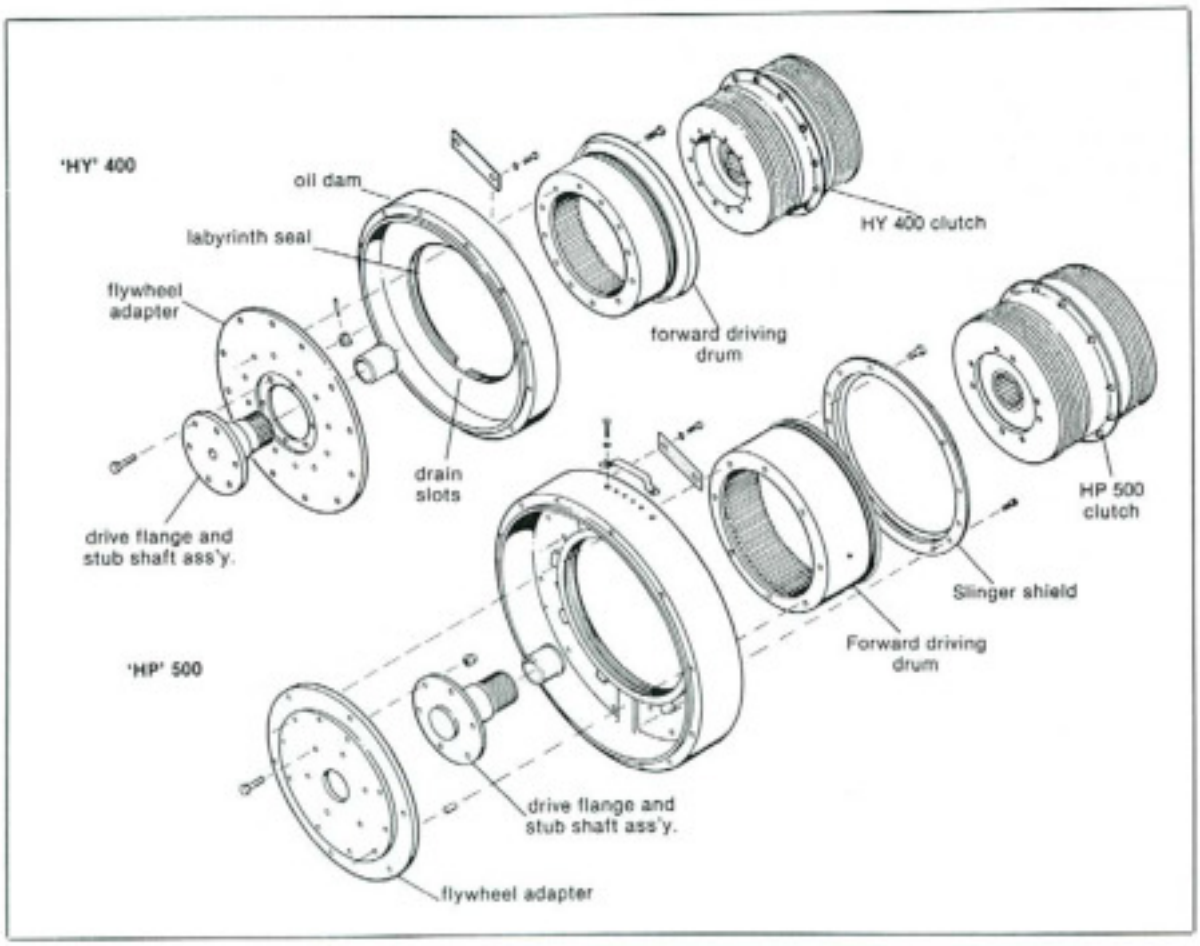


Fig. 33. Adapter Group and Clutch