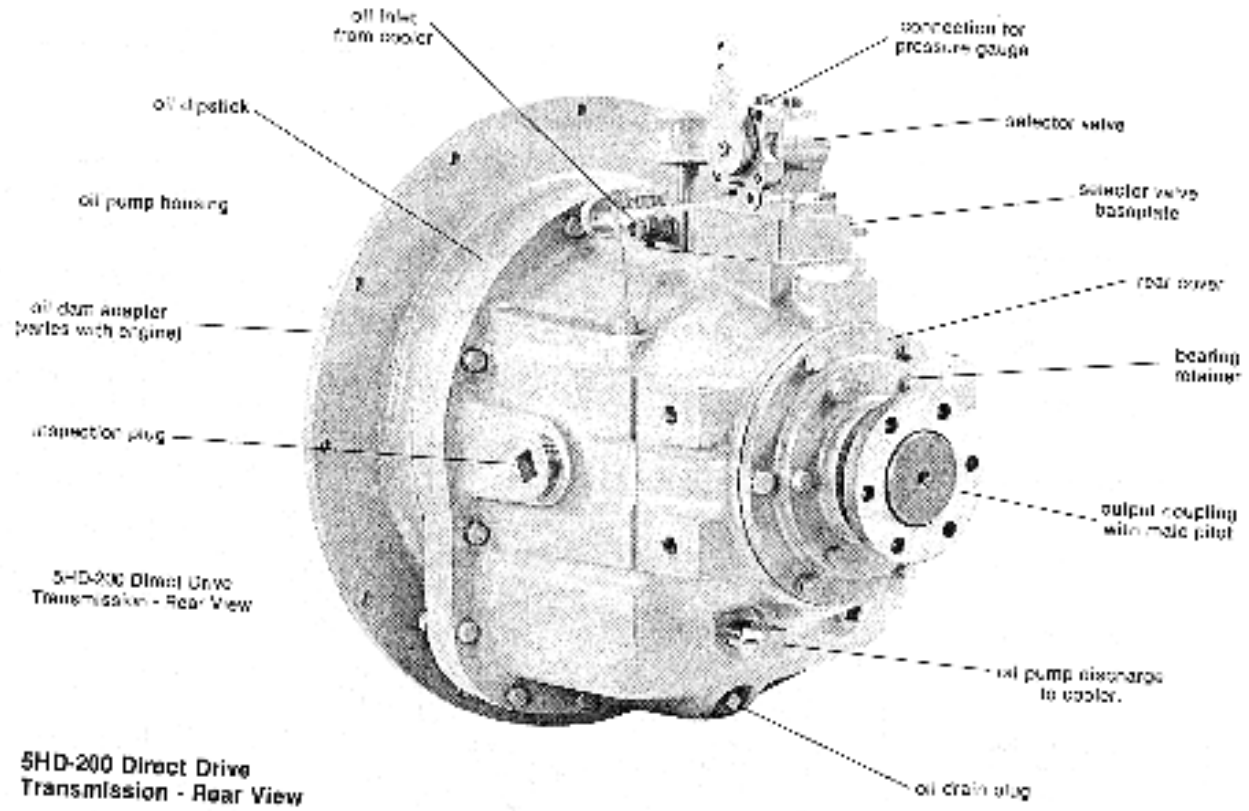
SERVICE MANUAL

5HD 200

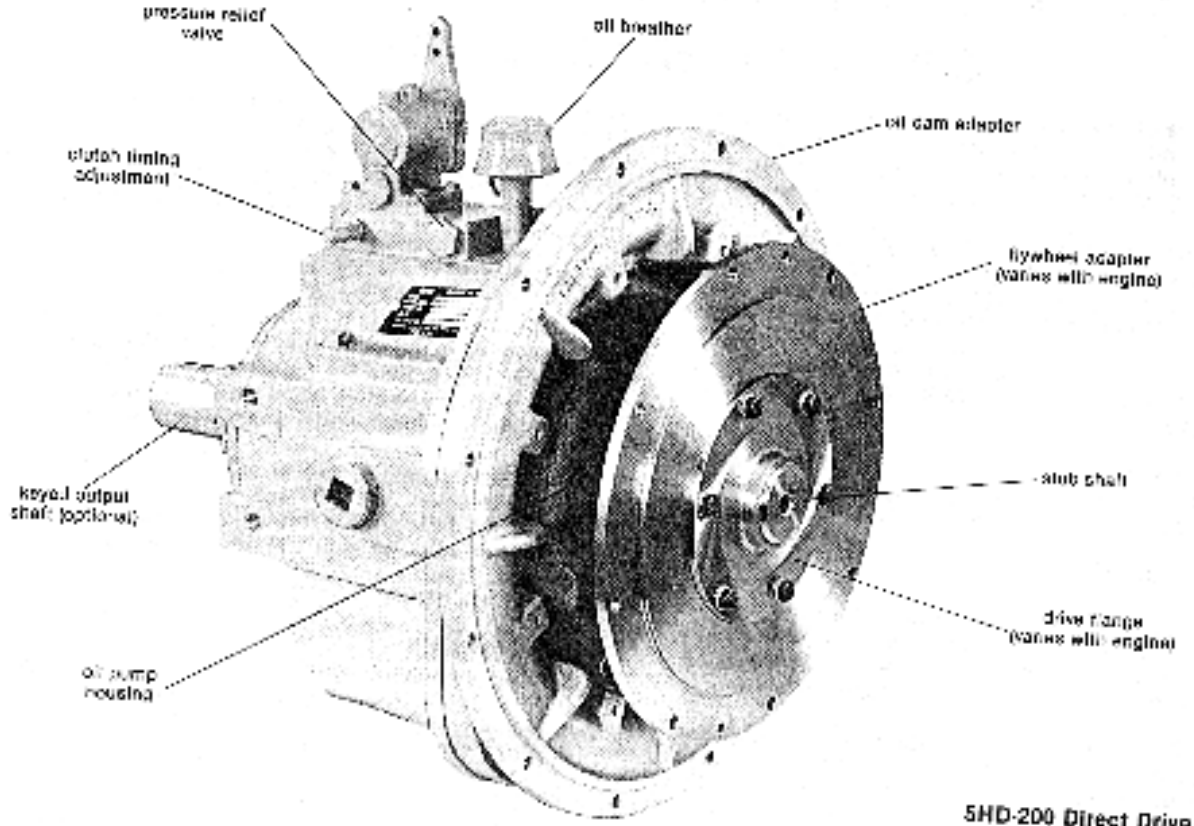
Direct drive reverse

Transmission

TABLE OF CONTENTS



5HD-200 Direct Drive Transmission - Rear View



5HD-200 Direct Drive Transmission - Front View

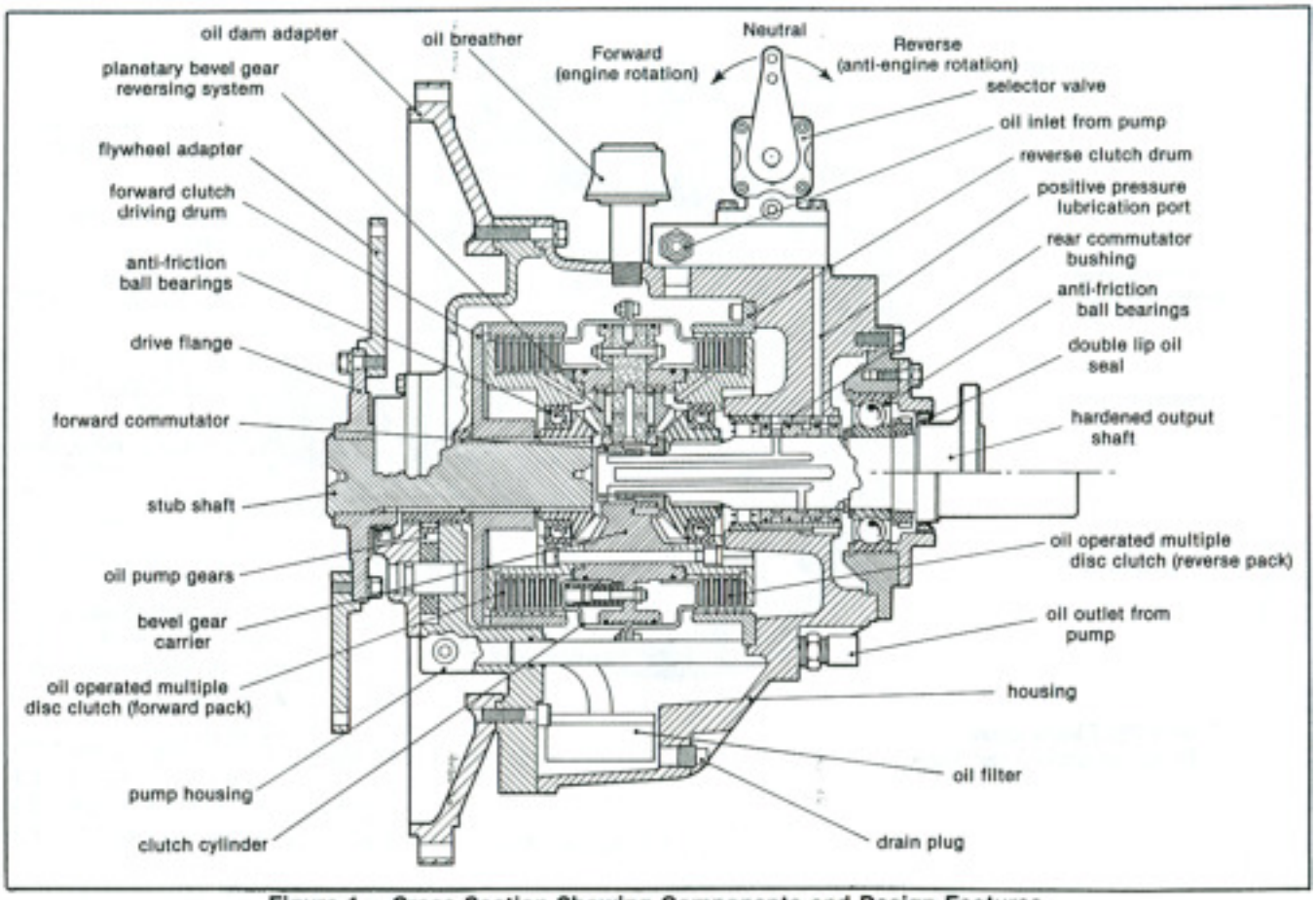


Figure 1. Cross Section Showing Components and Design Features

SECTION 1. INTRODUCTION

The purpose of this manual is to provide assistance to operations and maintenance personnel to reduce downtime and obtain consistent performance from the Capitol 5HD-200 Direct Drive Reverse Transmission.

This service manual contains thorough installation and operation procedures, steps for proper maintenance and repair, a trouble shooting guide for assessing difficulties promptly, an illustrated parts information section, and engineering drawings for fabricating special tools. It should be made readily available to all those responsible for the operation or servicing of the reverse gear.

Performance characteristics and other details may be obtained from the engineering department of Capitol Gears, inc., St. Paul, Minnesota, U.S.A.

1.1 DESCRIPTION

The 5HD 200 direct drive reverse transmission is operated hydraulically; the clutch is activated by high-pressure oil and the gears, bearings and clutch discs are lubricated and cooled by low-pressure oil.

The direct drive transmission is direct engine mounted by means of a flywheel adapter and an oil dam adapter and includes four major subassemblies: clutch pack, oil pump, selector valve and shaft. The clutch pack consists of: reciprocating cylinders, clutch discs and a Planetary bevel gear reversing system; the oil pump supplies oil pressure for clutch engagement and lubrication and provides a barrier against contamination from engine oil. The selector valve is used to obtain forward, neutral or reverse, and the one-piece output shaft may be keyed or flanged depending on application.

1.2 OUTPUT ROTATION

The Capitol reverse gear in forward mode provides output rotation in the same direction as engine rotation. The transmission may be supplied for a right hand engine (Clockwise rotation when viewed from the front) or a left hand engine
(Counter clockwise rotation.)

For marine application, a twin screw arrangement is possible provided the engines rotate in opposite direction, or if final drive is through vee drives, with one containing an idler for opposite rotation output.

1.3 ACCESSORIES

OIL COOLER
Various Capacity coolers are available depending on engine horsepower and are purchased optionally. However oil cooler must be used with a capitol drive unit.

COUPLING KIT
A prop shaft coupling kit, including mounting bolts, is available to meet most requirements.

SECTION 2. PRINCIPLES OF OPERATION

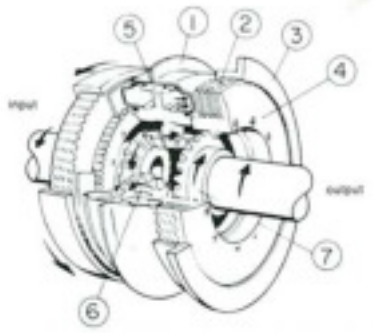
2.1 POWER FLOW

The flywheel adapter, which is directly fastened to the engine flywheel, rotates the drive flange, stub shaft, forward driving drum and forward clutch discs always at engine speed. When the forward clutch is activated the whole clutch pack rotates in engine direction. This causes the output shaft to rotate in engine direction also. A direct drive transmission, not having reduction gears provides output rotation at engine speed.

When the reverse clutch is activated, the clutch pack is held stationary to the housing. Power is transferred through the bevel

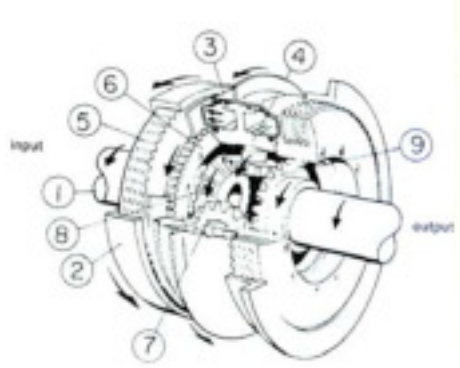
2.2 CLUTCH

The clutch assembly is a multiple disc type clutch activated by a hydraulic mechanism. This mechanism is formed by a carrier to the bevel gears and by two cylinders bolted together which act as the clutch pistons. The movement of the cylinders is regulated by the selector valve, which directs pressurized oil to the proper cylinder depending on the mode selected. The bevel gears inside the carrier transmit power flow to the pinion.



REVERSE MODE

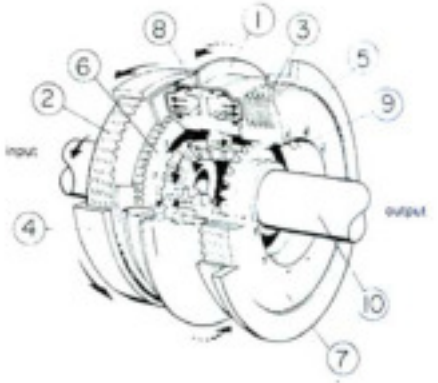
Reverse is achieved when cylinder (1) is pressurized and slides against reverse clutch discs (2) clamping them together. Half of the discs are splined to the stationary reverse drum (3) and half are splined to end flange (4) bolted to gear carrier (5). Rotating gear carrier then stops. The bevel gears (6) now rotate on their shafts causing driven gear (7) to turn in anti-engine direction producing reverse output.



FORWARD MODE

At all times, stub shaft (1), forward driving drum (2) and driving gear (8) are turning in engine rotation direction at engine speed.

Forward is achieved when selector valve is shifted to allow oil to pressurize forward half of cylinder (3). Cylinder then slides on bevel gear carrier (4) clamping clutch discs (5) together. Half of discs are splined to forward driving drum and half are splined to end flange (6). Because end flange is bolted to gear carrier and discs are now locked together, gear carrier with bevel gears (7) now rotates at engine speed along with driving gear. Rotating bevel gears cause driven gear (9) to turn with them and this causes rotation of output shaft in forward rotation.



NEUTRAL MODE

Both halves of clutch cylinder (1) are filled with pressurized oil. Cylinder cannot press against either forward (2) or reverse clutch discs (3). Discs splined to driving drum (4) and reverse drum (5) remain separate from discs splined to end flanges (6) & (7). Consequently no direct torque is applied to gear carrier (8) or driven gear and output shaft (9) & (10). Bevel gears may revolve on their own shafts and gear carrier orbits at half engine speed.

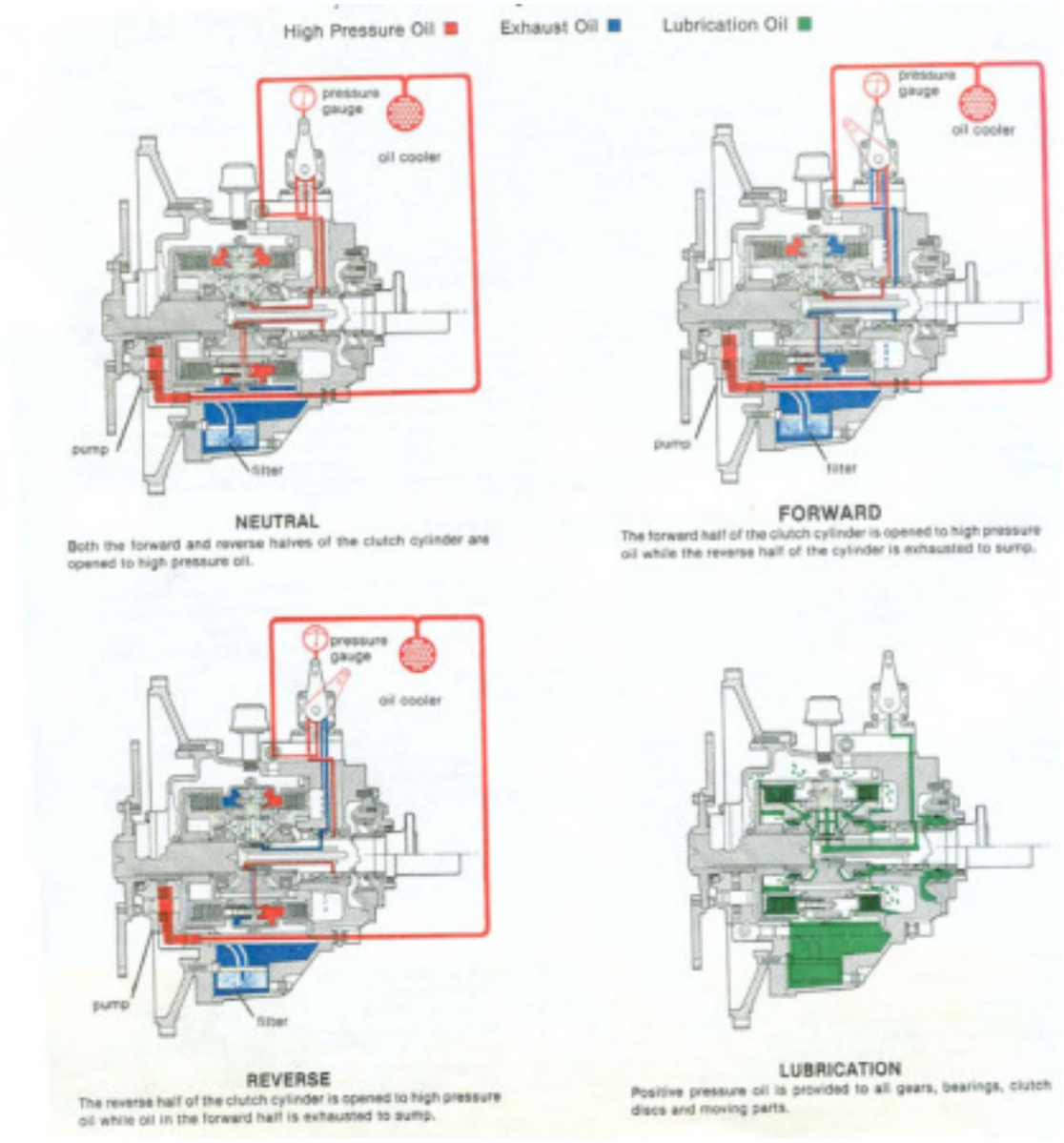
2.3 HYDRAULIC SYSTEM

Pressurized oil is provided by an internal gear type oil pump which is engine driven. From the pump oil flows through a filter and cooler before reaching the selector valve. Forward, neutral and reverse are obtained by means of the selector valve, which directs high-pressure oil through internal passages to the clutch. Low-pressure oil is channeled to cool bearings, gears and clutch discs.

In neutral, the ports to both forward and reverse sides of the clutch cylinder are opened and the balanced pressure that results keeps the cylinder from activating either forward or reverse discs. Oil is distributed through the lubrication system.

When the selector valve is shifted to either forward or reverse mode, high-pressure oil is allowed to flow only to one half of the clutch cylinder to engage the selected pack. Oil in the other half of the cylinder is exhausted to sump. Again low-pressure oil is distributed through the lubrication system.

The pump housing completely separates the transmission lubrication system from the engine lubrication system.



SECTION 3. INSTALLATION AND OPERATION

3.1 PRELIMINARY INSPECTION

Check parts for shortage and any damage that may have occurred (the parts information section may be used as reference). Report immediately any shortage
Or damage to your local distributor, transfer agent or Capitol Gears.

3.2 INSTALLATION PREPARATION

An installation plan drawing has been provided in the rear of this manual.

Average weight of the 5HD 200 is 170 lbs dry.

SPECIAL TOOLS REQUIRED

1. Chain hoist or equivalent
2. Lifting eye (Special tool No. 1-90020-0000)
3. Straight edge
4. Feeler Gauge
5. Thousandths Dial indicator

To insure proper alignment of driving members it is recommended that engine flywheel housing, flywheel, oil dam and stub shaft be dial indicated to insure trueness.

1. (Fig.2A) Dial indicate the bolt face of the engine flywheel-housing flange. Rotate engine flywheel. Record reading. Face deviation must not exceed a total indicator reading of .007 inch.

2. (Fig.2B) Mount indicator with stern riding on flywheel housing bore as shown. Rotate flywheel and record reading. The bore eccentricity must not exceed a total indicator reading of .007 inch.

Record reading. Pilot bore eccentricity must not exceed a total indicator reading of .007 inch.

The sum total of all readings in steps 1 through 4 must not exceed .007".

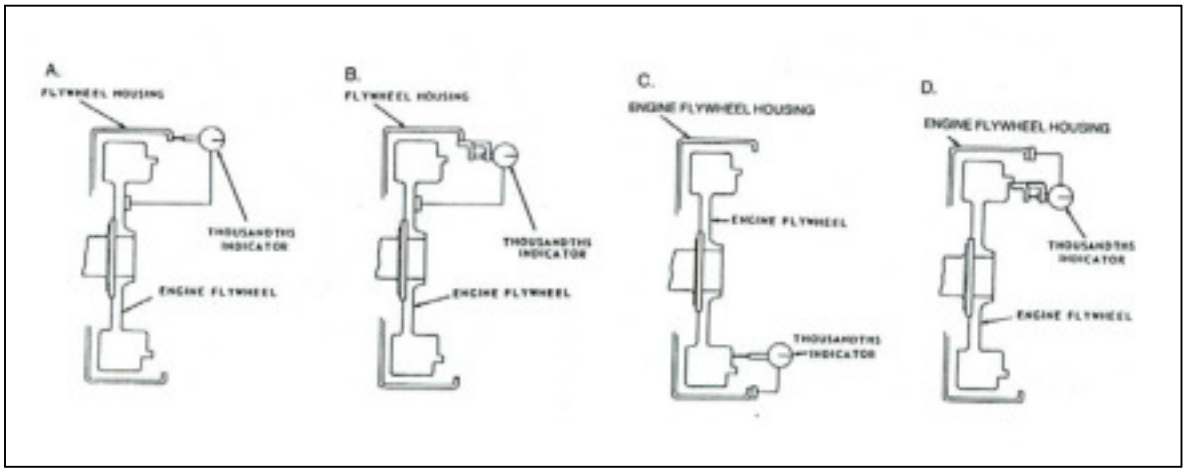
NOTE:
Keep all mating surfaces clean. Use cleaning solvent or diesel fuel.

1.Remove bolts from flange of reverse gear housing and remove oil dam and pump housing.

2. Separate the forward clutch-driving drum from the stub shaft. Allow drive flange assembly (Stub shaft, drive flange and flywheel adapter) to remain together.

3. Remove all burrs and thoroughly clean the engine flywheel and flywheel adapter mating surfaces; Secure drive flange assembly to engine flywheel.

4. Secure oil dam to engine flywheel housing with capscrews and lockwashers.



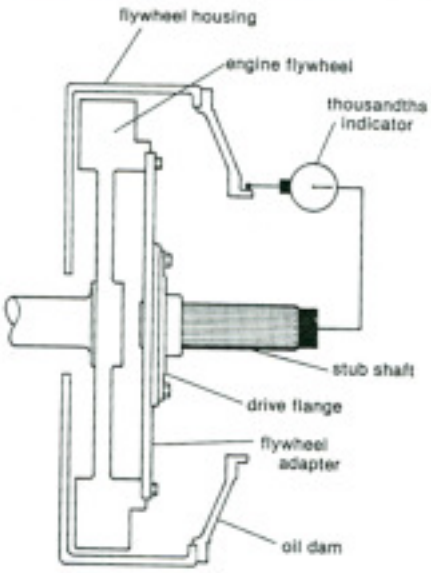


Figure 3. Dial Indicating Oil Dam Pilot O.D.

5. Dial indicate oil dam pilot O.D as shown in figure 3. Record reading. Total indicator reading must not exceed .007 inch.

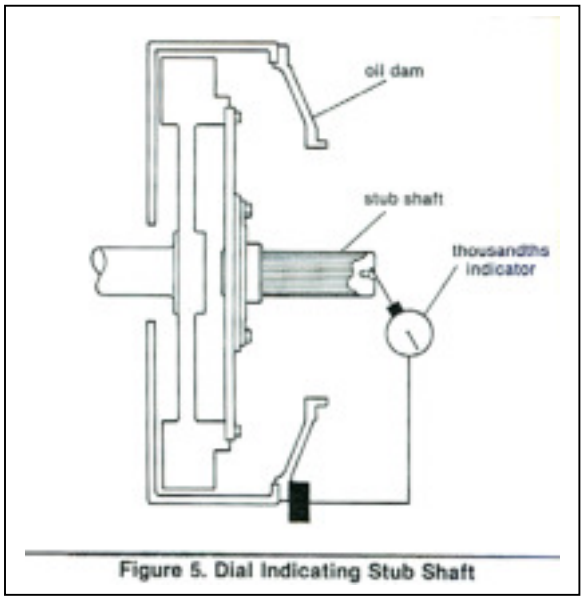


Figure 5. Dial Indicating Stub Shaft

7. Dial indicate stub shaft as shown in figure 5. Record reading. Total indicator reading must not exceed .007 inch.

The sum total of readings in steps 5,6 and 7 must not exceed .007 inch.

8. Install oil pump housing onto stub shaft being careful not to damage oil seal. Secure pump housing to oil dam with 2 socket head capscrews (at bottom of housing). Refer to figure 7.

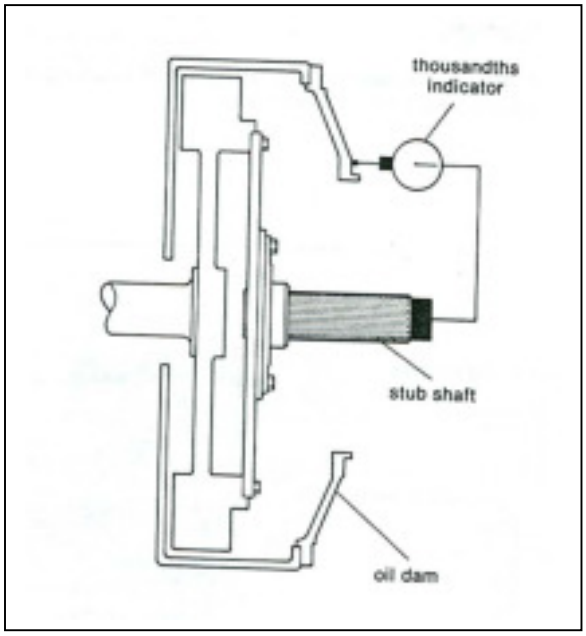


Figure 6. Securing Forward Clutch Driving Drum with Snap Ring.

9. Secure forward clutch driving drum on stub shaft. Make certain that dogs on pump drive gear enter slots in driving drum. Install snap ring in groove on stub shaft and make sure ring seats in groove (see figure 6).

10. Place clutch assembly on splines of stub shaft. Be sure flange marked “FORWARD” is toward engine flywheel. Note: The forward pack contains the greater number of clutch discs and it must go toward the engine flywheel. Otherwise severe damage may result

11. Install oil filter in pump. Filter must go in central hole directly below the bore. See figure 7.

12. Locate gasket on pump housing, using a small amount of grease to hold it in place. Remove oil breather from top of reverse gear housing.

3.3 INSTALLATION OF REVERSE GEAR

1. Using a suitable hoist and sling (or lifting eye, special tool no. 1-90020-0000) lift reverse gear in position behind engine (see fig.7). Ease unit forward over clutch assembly gently twisting reverse gear so that discs enter reverse drum properly without damaging teeth (Note: avoid damage to oil filter assembly).

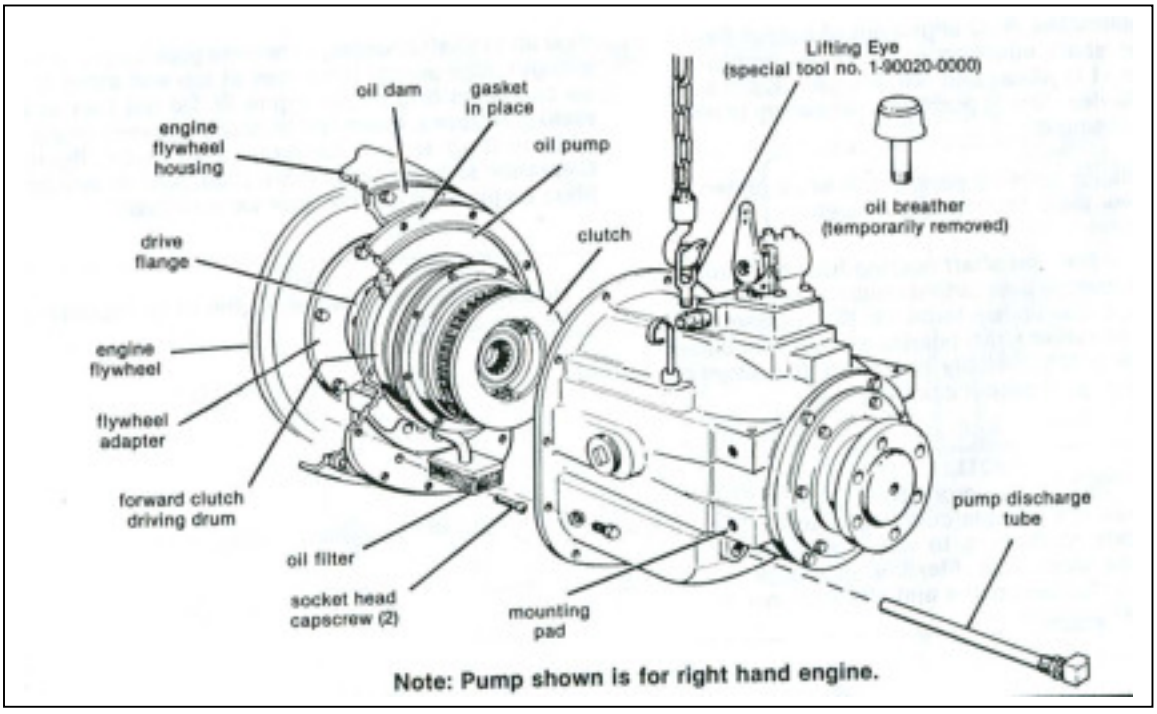
2. Secure transmission housing to oil pump housing and oil dam with capscrews and lockwashers. Tighten to 28 pounds- foot torque.

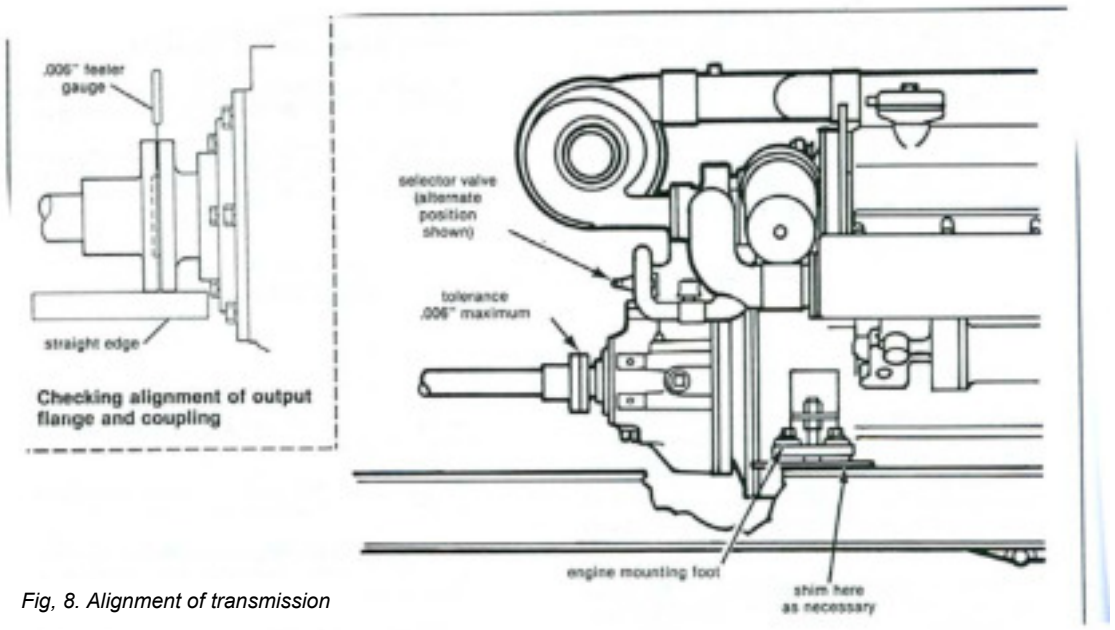
3. Check clutch end float. Insert screwdriver through oil breather hole or side inspection Hole and pry clutch fore and aft. End float should be 1/16 to 3/32”.

4. Turn output shaft over for several revolutions to check for free movement of transmission.

5. Remove plastic plug in bottom rear of housing and install pump discharge tube through gear housing into hole in pump housing (see fig. 7)

6. Connect hoses from discharge tube to oil cooler and from cooler to selector valve base plate (see installation drawing at rear of book and water piping instructions on page 8)





Fig, 8. Alignment of transmission

3.4 ALIGNMENT

In marine application, final alignment of output flange and propeller shaft coupling must be accomplished when the vessel is afloat and not in drydock, because most hulls will flex. This is positively necessary to meet warranty requirements.

Mounting pads on housing permit unit to be bolted to bed rails, power plant fame, keelsons, etc.

The distance of the first shaft bearing from the mating surface of the reverse gear output coupling is extremely important. To avoid undue force on the reverse gear bearings, the propeller shaft bearing should be located at least twelve and preferably twenty shaft diameters from the reverse gear output coupling.

NOTE:
The same alignment procedures should be followed even if a flexible coupling is used. The most accurate method is to use a non-flexible spacer of the same size. Flexible couplings are used only to dampen noise and vibration not to correct misalignment.

Now alignment shaft coupling to reverse gear coupling. Lay a straight edge across the edges at top and sides to line up couplings (See insert, figure 8). Do not burr or mar mating surfaces. Insert feeler gauge between couplings and run it all around the flange (See insert, figure 8). Clearance should not be more than .006” at any point. Shim engine and reverse gear as necessary.

NOTE:
Under no condition is the engine to be supported by gear housing.

3.5 WATER PIPING

To assure proper cooling of Capitol's reverse gear units, connect the cooling system as indicated on one of the three diagrams shown. It is extremely important that the marine gear oil be cooled properly: the oil cooler must receive an ample supply of cold water.

The connections shown on the following diagrams are recommendations for optimum performance.

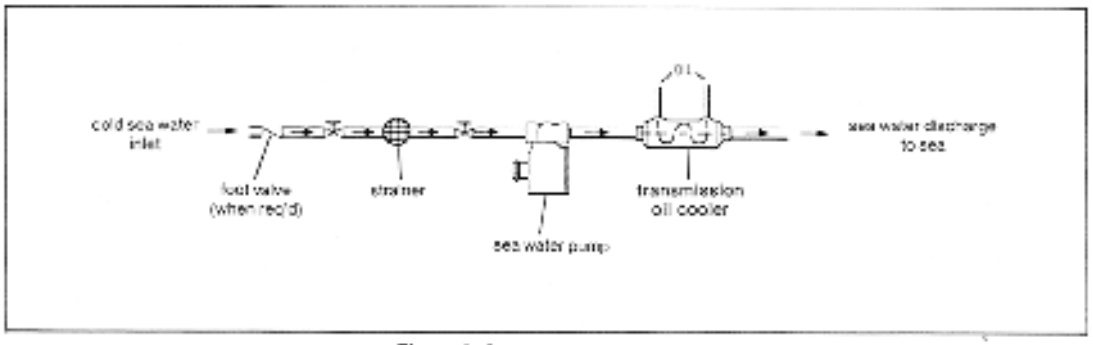


Figure 9. Separate pump system

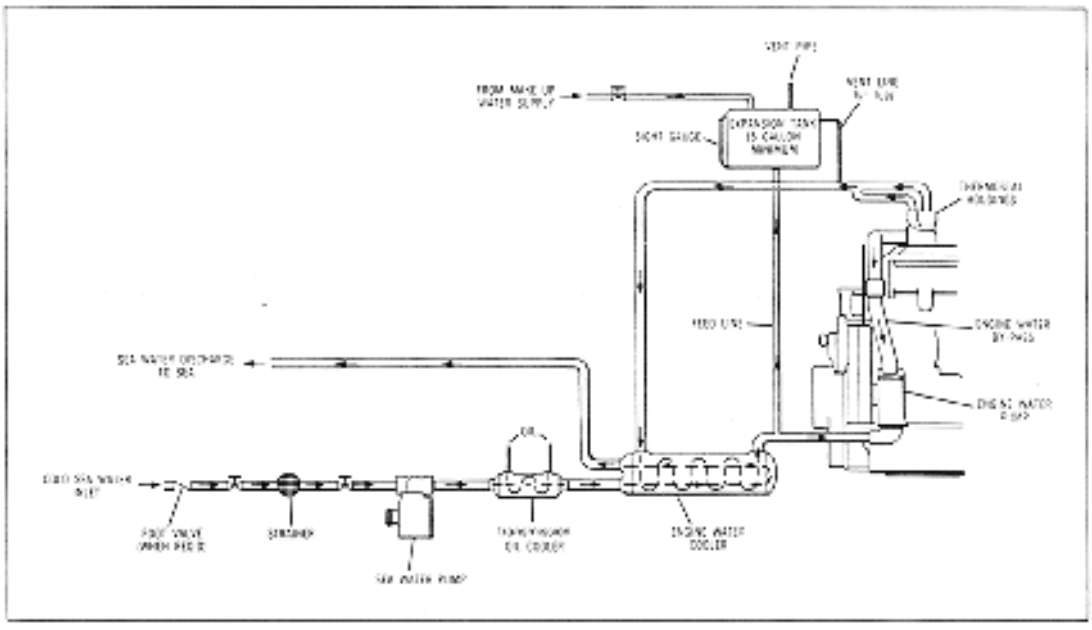


Figure 10. Heat exchange system

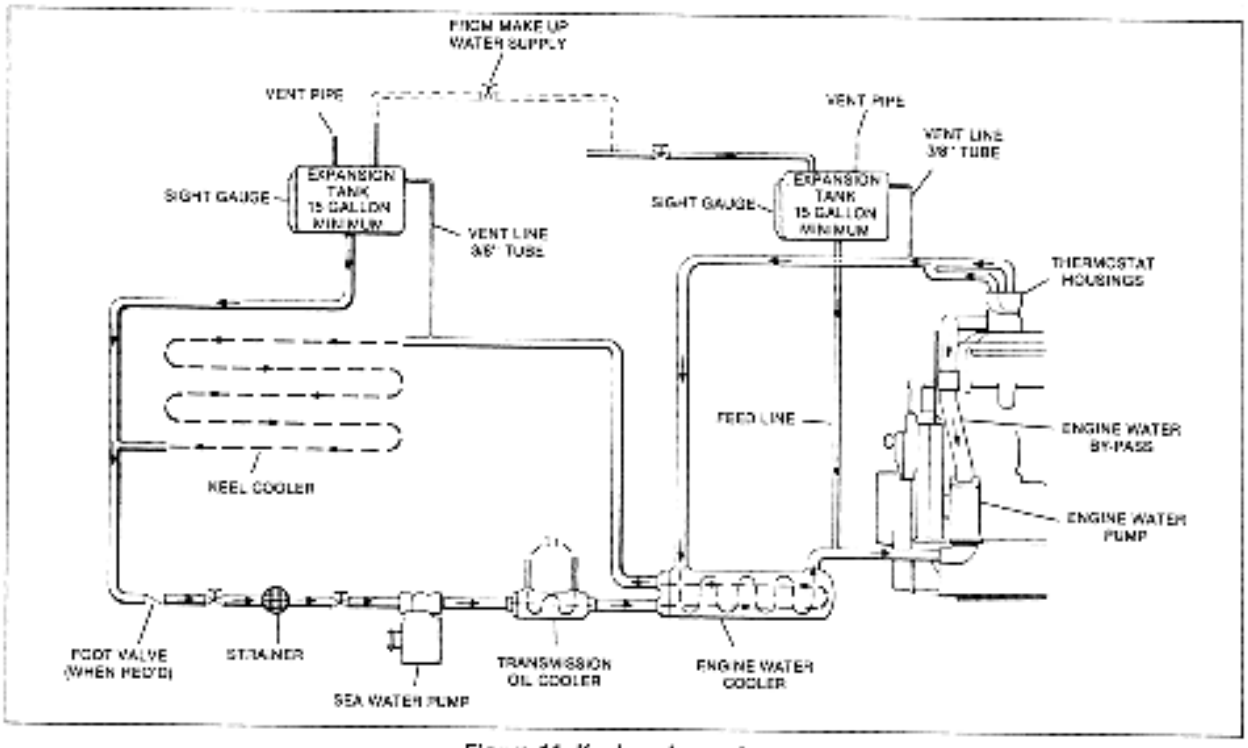
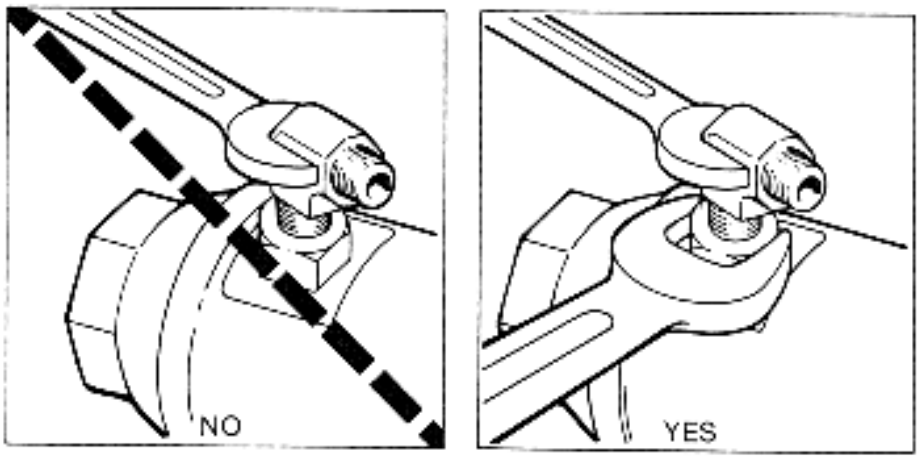


Figure 11. Keel cooler system



CAUTION: ALWAYS USE BACKUP WRENCH ON COOLER FITTINGS

3.7 START UP PROCEDURE

1.Remove oil breather or inspection plug and add recommended oil unit level is up to full mark on dipstick (See lube chart, p.14). Replace but do not secure.

2.Install pressure gauge of 300-pound capacity directly on top of gear or bulkhead. Connect gauge to control valve with ¼" steel tubing or hydraulic hose. (Note: Electric type oil pressure gauges are not recommended.)

Reverse gear is now ready for start up:

3.Engage starter for approximately 30 seconds. (DO NOT START ENGINE). This activates pressure pump which pre-lubricates reverse gear, preventing premature wear before load is applied.

4.Start engine and check all connections for leaks.

5.Oil pressure is adjusted at factory or testing purposes only and it may be necessary to readjust pressure to the correct level (200-210 PSI). This should be set for normal operating speed and temperature (See fig.12 below).

NOTE:
Normally, unit pressure at idle start-up will be 180 PSI, but final adjustment must be made as noted above.

6. After unit has been operated a few minutes, stop engine, check oil level and add sufficient oil to bring level to full mark on dipstick. (See lube chart for capacities). Replace oil breather or inspection plug.

7. Shift several times in insure that all cylinders, hoses and cooler are full of oil.

8. Install selector valve cables and shift to insure valve lever goes into full detent in all 3 positions: forward, neutral and reverse.

NOTE:
We strongly recommend installing an interlock control system, which prevents shifting at other than engine idle speed and greatly prolongs life of the gear.

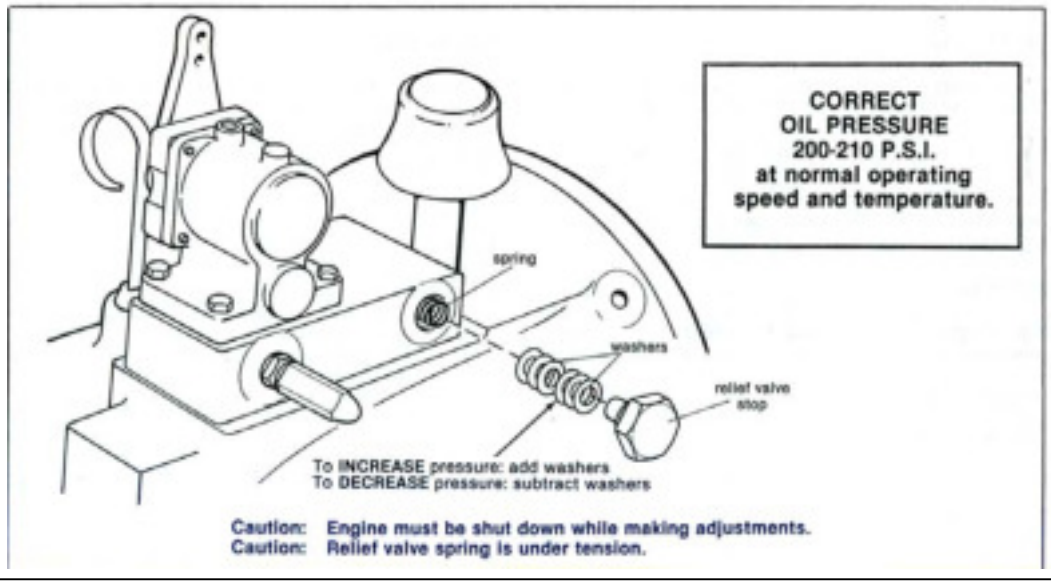
9. Reverse gear is now ready for sea trials and final adjustment.

MAXIMUM INPUT SPEED… 3000 RPM

3.7 OPERATING PRACTICES

(CAUTION)

1. A Capitol reverse gear should not be shifted unless engine is at idle speed.
2. Reverse gear cannot be operated continuously in reverse mode for more than 30 minutes at 75% of available horsepower.
3. In marine application 'Windmilling" (freewheeling) is strictly prohibited as extensive internal damage may result. In the case of a twin-screw application where only one engine may be used a great deal, shaft brakes should be installed. (As an alternative an auxiliary lube system may be installed).



SECTION 4. PREVENTIVE MAINTENANCE

To insure a long service life of the Capitol direct drive gear and to prevent costly and unexpected failures it is very important that a regular maintenance schedule be established and followed.

4.1 LUBRICANTS

For all normal ambient operating conditions, 30ºF, (-1ºC) to 85F (29ºC), we recommend a good grade, anti-foaming, heavy duty, SAE motor oil.

Where high ambient water temperatures are encountered, over 85ºF (29ºC), it may be necessary to use SAE 40 motor oil.

Where extremely cold ambient water temperatures are encountered, under 30ºF (-1ºC), it may be necessary to use SAE motor oil.

Series 3 motor oils are not recommended as they may shorten clutch life.

CAUTION:
When using SAE 20 motor oil be very attentive to oil pressures. If proper pressure cannot be maintained (200-210 P.S.I), it may be necessary to use SAE 30 and warm engine and gearbox thoroughly before engaging clutch. This condition would only be encountered at extremely low temperatures.

OIL CAPACITY
Oil capacity is 3.5 to 4 quarts. Total capacity may be more depending on hose length and cooler size.

Bring oil up to “Full” mark on dipstick. Operate unit in forward and reverse for several minutes. This will fill cooler, clutch cylinders, pump hoses etc. Stop engine and add required oil to return level to “Full” mark on dipstick.

OIL PRESSURE
Operating oil pressure should be 200-210 PSI at normal operating speed and maximum operating temperature.

PRESSURE ADJUSTMENT
See fig.12, page 13.

OIL TEMPERATURE
Operating oil temperature range is 100º-150º F (38º-66ºC) at control valve. Unit will tolerate higher temperatures but clutch life may be shortened considerably.

4.2 ROUTINE MAINTENANCE

OIL COOLER ASSEMBLY
Check zinc pencils in oil cooler and change if badly eroded. Check zinc pencils at approximately every 400 hours of operation.

Check water tubes for obstructions at approximately every 2000 hours of operation and flush if necessary.

OIL BREATHER
Remove oil breather every 400 hours of operation or at the same time oil is changed. Clean diesel fuel can be used for flushing.

PRESSURE GAUGE
Periodically check pressure gauge by substituting a calibrated pressure gauge of known accuracy.

VISUAL INSPECTION
At frequent intervals check all oil lines, water hoses, and connections for leaks. Tighten all external bolts and connections and visually inspect external components for wear or damage.

WEAR ANALYSIS
At periodic intervals record pressure readings at idle speed; a gradual decline is normal. Readjust pressure relief valve to maintain proper operating pressures. See fig.12 p.13.

INSPECTION/OVERHAUL INTERVAL
A complete inspection of the Capitol reverse gear should be made at least as often as the engine is overhauled. Parts such as commutator bushings, oil seals, quad rings, clutch discs, bearings etc. Showing any fatigue or wear should be replaced. It may be desirable to completely rebuild the reverse gear at this time (See section 6 and 7.)

4.3 MAINTENANCE SCHEDULE AND CHECK SHEET

Engineer_____
Reverse Gear Serial No._____
Date Service Began_____

INTERVAL **Normal operation**	**MAINTENANCE** **DESCRIPITION**	**RECORD**
Daily	-Check oil level Check oil pressure	
After first 100 hours	-Change oil and flush sump	☐
Every 400 hours	-Check Zinc pencils -Change oil -Remove and clean oil breather	
Every 2000 hours	-Check water tubes in cooler	
At engine overhaul	-Inspect clutch and all gearing and replace as necessary -Inspect and/or overhaul entire transmission.	
Frequently	-Check all oil lines and connections -Check all external components -Check all mounting bolts -Check alignment	

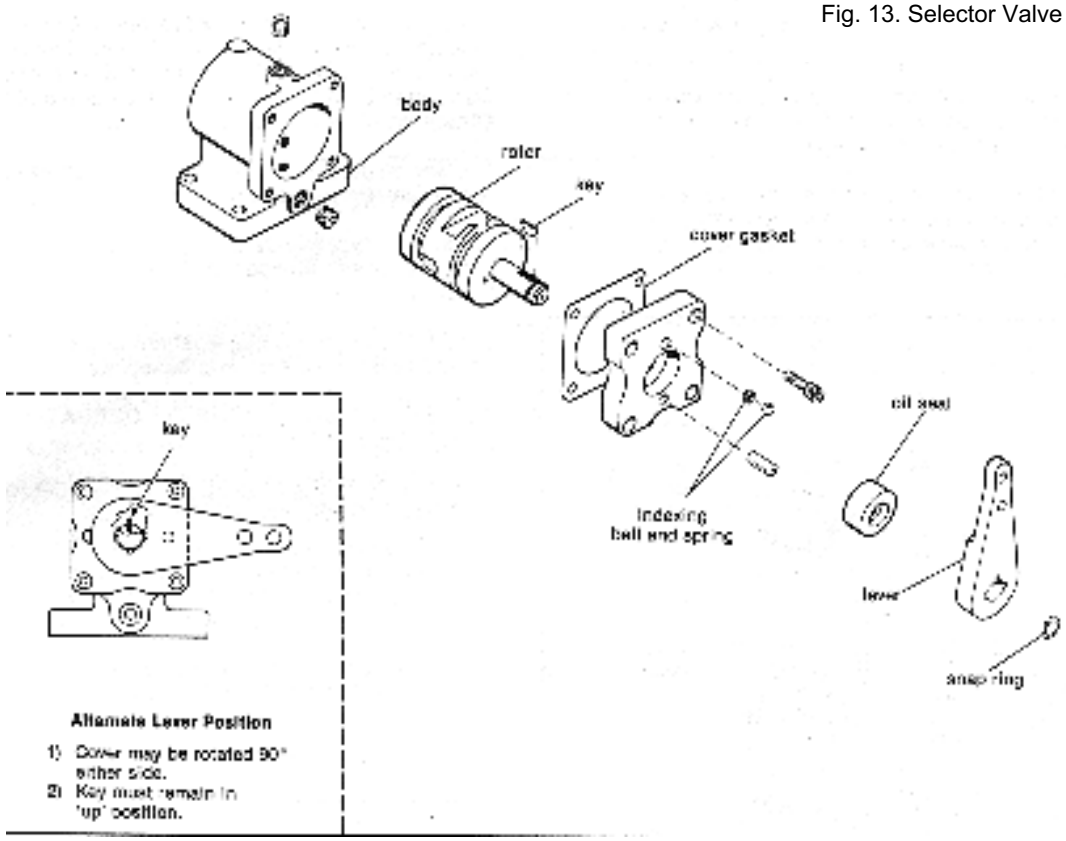
SYMPTOM	PROBABLE CAUSE	REMEDY
A. Low oil pressure (at full operating speed and temperature.)	1. Faulty pressure gauge	1. Check gauge against one of known accuracy.
	1. Low oil level	1. Inspect gaskets, seals, hoses and fittings for leakage.
	2. Partially clogged oil filter	2. Remove oil filter and clean with a good grade solvent or diesel fuel.
	3. Damaged or clogged pump discharge tube	3. Remove tube and clean with solvent. Blow dry.
	4. Clogged parts in selector valve, base plate or housing.	4. Flush clean with solvent and blow dry.
	5. Dirt or sludge in transmission	5. Remove drain plug, flush gear with commercial solvent or diesel fuel. Start engine; at idle shift gear several times, full forward to full reverse for 3-5 minutes maximum. Shut down engine and drain gearbox thoroughly. Refill gear with proper oil and run for 25-50 hours. Drain sump and refill with new oil. This will remove any residual solvent.
	6. Worn pump assembly	6. Refer to oil pump section (p.22) or fig.12 p.122
	7. Incorrectly adjusted pressure relief valve	7. See fig.12 p.13.
	8. Oil too hot	8. Check heat exchanger system for clogged oil cooler or hoses.
	9. Worn commutator bushing	9. See wear limits chart (p.23). For replacement see pg.26 and 30.
	10. Incorrect lubricant	10. See lube chart (p.14)
	11. Scratch clutch cylinders or hard O-ring in clutch cylinders	11. Replace as necessary (p.26, 27)
B. High oil pressure* (At full operating speed and temperature) ** Note: High oil pressure may also be caused by cold oil. Unit should be pre-heated, see section 3.6*	1. Incorrectly adjusted pressure relief valve	1. Refer to fig. 12, p.13.
	2. Inoperable relief plunger in base plate	2. Refer to p.20
	3. Incorrect oil	3. See lube chart (p.14)
C. No oil pressure	1. Faulty pressure gauge	1. Check pressure with gauge of known accuracy.
	2. Broken hose	2. Replace hose, inspect all hoses.
	3. No oil in transmission	3. Fill with proper oil. See pages 13-14.

D. Overheating	1.Insufficient oil cooler capacity 2. Insufficient flow of cooling water 3. Clutch slipping 4. Water temperature too high at cooler	1.Install adequate oil cooler 2. Increase water line sizes. 3. Refer to symptom A. 4. Decrease water temperature to cooler or relocate heat exchanger in cooling system.
E. Excessive noise in transmission	1. Bearings worn or broken. 2. Gears worn or broken 3. Noise in forward only 4. Noise in reverse only 5. Improper alignment	1. Inspect bearings for scored races, broken roller, flat spots, etc. 2. Inspect gears and replace if necessary 3. Reverse position may be mistakenly used for forward. Selector valve lever must point forward when boat is in forward motion. 4. This is normal because more gears are in operation in reverse mode. 5. Refer to sect. 3.4, page 10
F. Noisy Pump	1. Dirt or sludge in oil 2. Clogged hoses 3. Pump cavitation 4. Defective oil pump assembly	1. Remove oil pump and hoses. Clean thoroughly and reinstall. 2. Clean and replace as required 3. Oil filter may be clogged. Oil level may be too low 4. Refer to oil pump sect. p.22
G. Clutch does not release	1. Improper oil in sump 2. Clutch discs warped 3. Forward and reverse clutch cylinders dirty or distorted. 4. Rear commutator bushing is worn 5.Incorrect linkage adjustment to selector valve assembly 6. Clutch discs fused due to slippage and overheating	1. Refer to lube chart, p.14. 2. Replace as necessary 3. Clean or replace as necessary 4. Replace as necessary. See p.23, 29, 30 5. Adjust linkage 6. Replace as necessary

H. Clutch slipping	1. Low oil pressure	1. See symptom A
	2. Oil temperature too high	2. Temperature should be 150ºF to 160ºF (71ºC). Check heat exchanger system
	3. Worn clutch discs	3. Replace as necessary, see p.29.
	4. Incorrect linkage adjustment to selector valve assembly	4. Adjust linkage
	5. Improper oil	5. See lube chart, pg.14.
I. Clutch burned out	1.Low oil pressure	1. See symptom A.
	2. Clutch is shifted at other than engine speed.	2. Install interlock shift controls
	3. Transmission misaligned	3. Check alignment as described in installation section p.10
	4. Excessive heat	4. Check cooling system see p.11 ,12
J. No Neutral	1. Warped clutch discs	1. Replace as necessary
	2. Scored clutch cylinders	2. Replace as necessary
	3. Damaged quad rings	3. Replace all 4 quad rings
	4. Worn or damaged commutator bushings (forward or rear).	4. Replace as necessary
	5.Worn selector valve	5. Replace if necessary. Note: Selector valve is the least likely source of trouble. See p.19
K. Clutch engages too slow	1. Cylinder timing screw out of adjustment	1. Remove dome nut and adjust screw (Counter-clockwise) to speed up reaction. See figure 24
L. Clutch engages too fast	1. Cylinder timing screw out of adjustment	1. Remove dome nut and adjust screw in (clockwise) to delay reaction. See fig. 24

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.

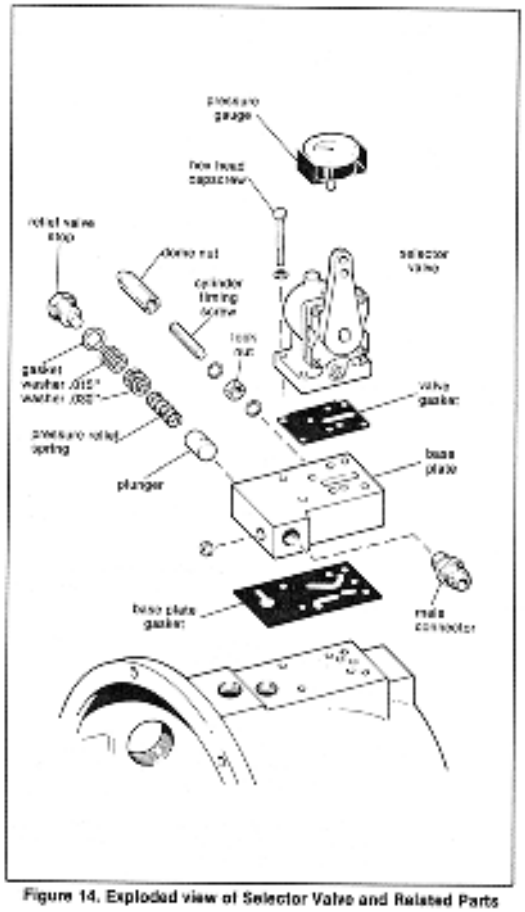


Figure 14. Exploded view of Selector Valve and Related Parts

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)

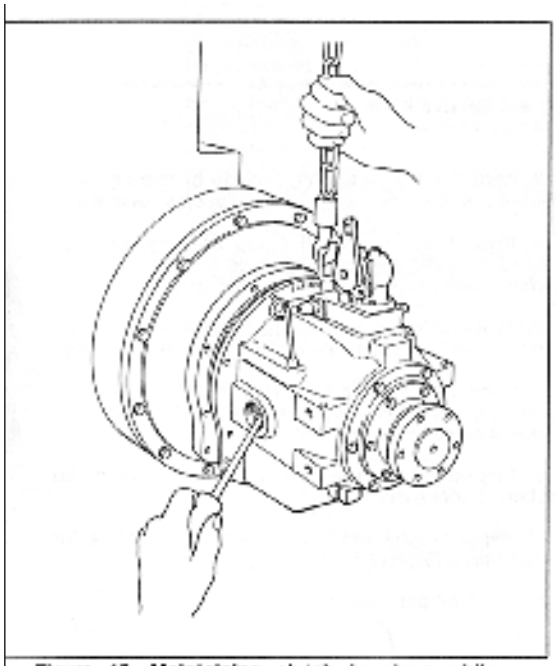


Figure 15. Maintaining clutch in place while removing transmission.

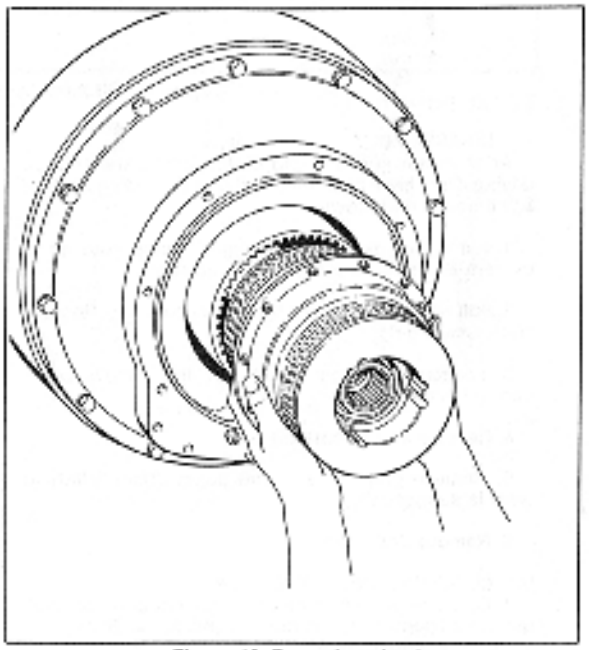


Figure 16. Removing clutch.

18

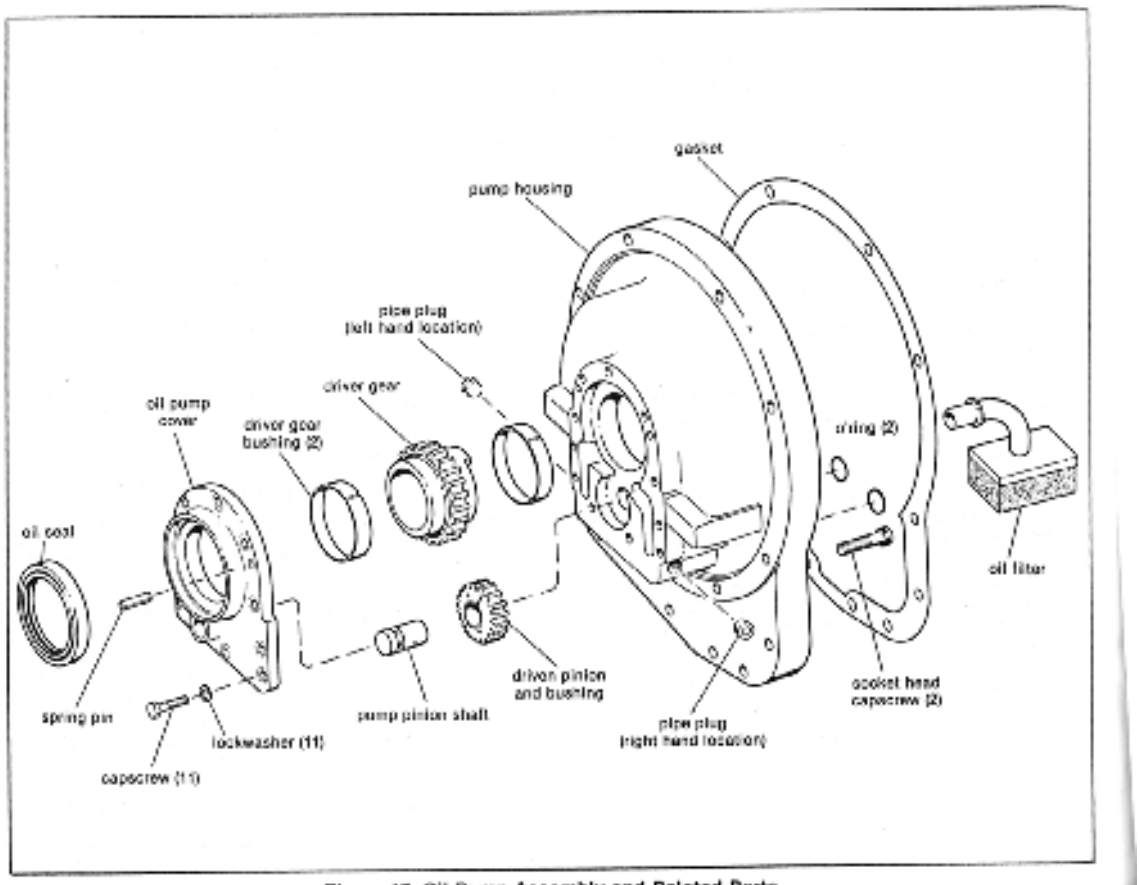


Figure 17. Oil Pump Assembly and Related Parts.

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.

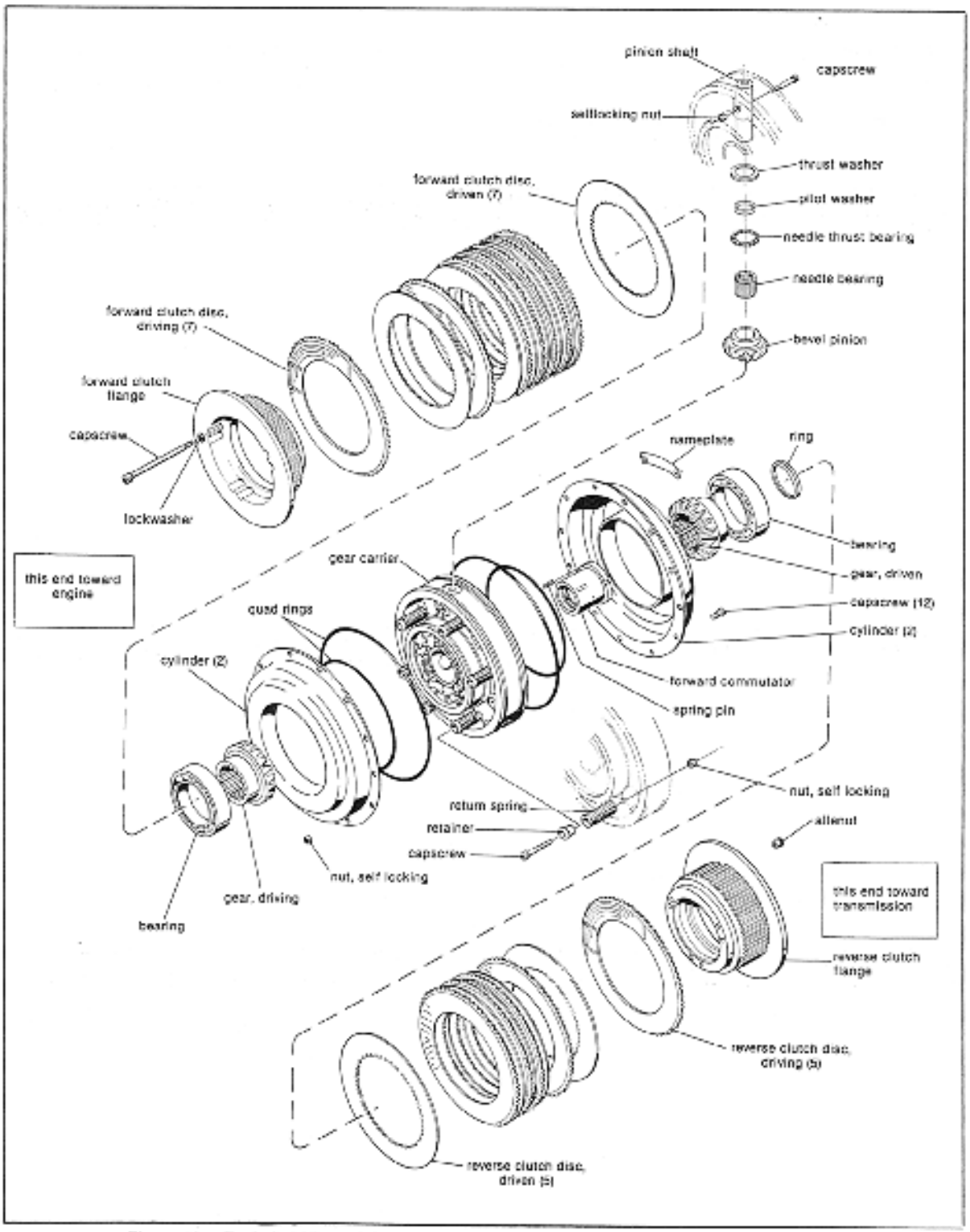


Figure 18. Exploded View of Standard Clutch Assembly No. 1-00100-1300. PTO clutches No. 1-00100-1103 and No. 1-00100-1104 are shown on pages 36 and 37 respectively.

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.

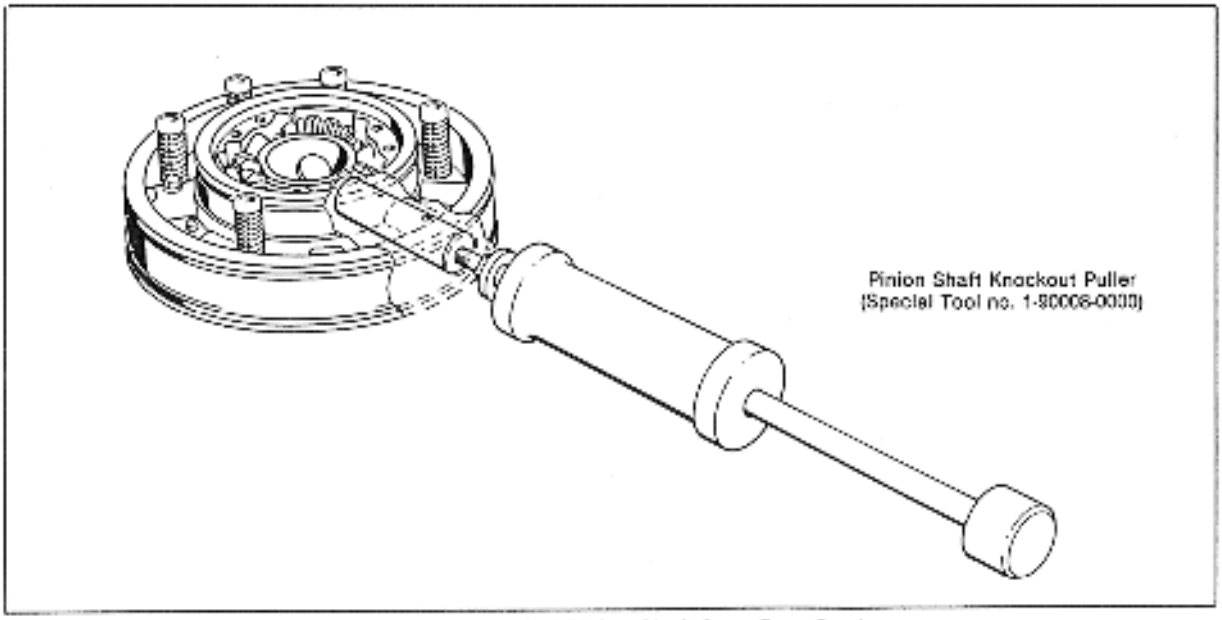


Figure 19. Removal of Pinion Shaft from Gear Carrier.

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

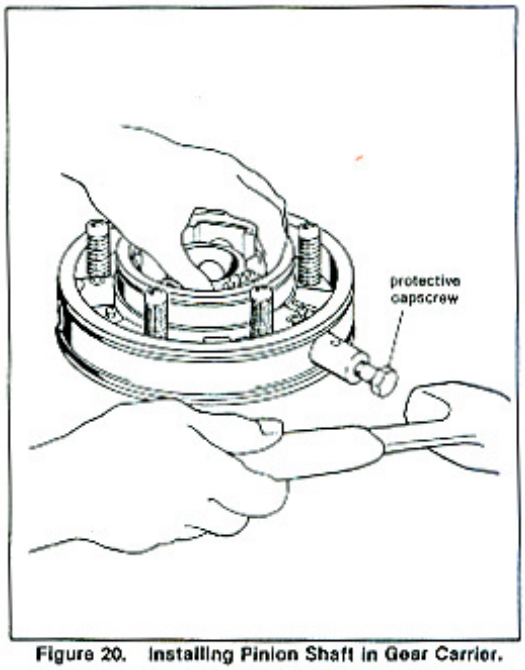


Figure 20. Installing Pinion Shaft in Gear Carrier.

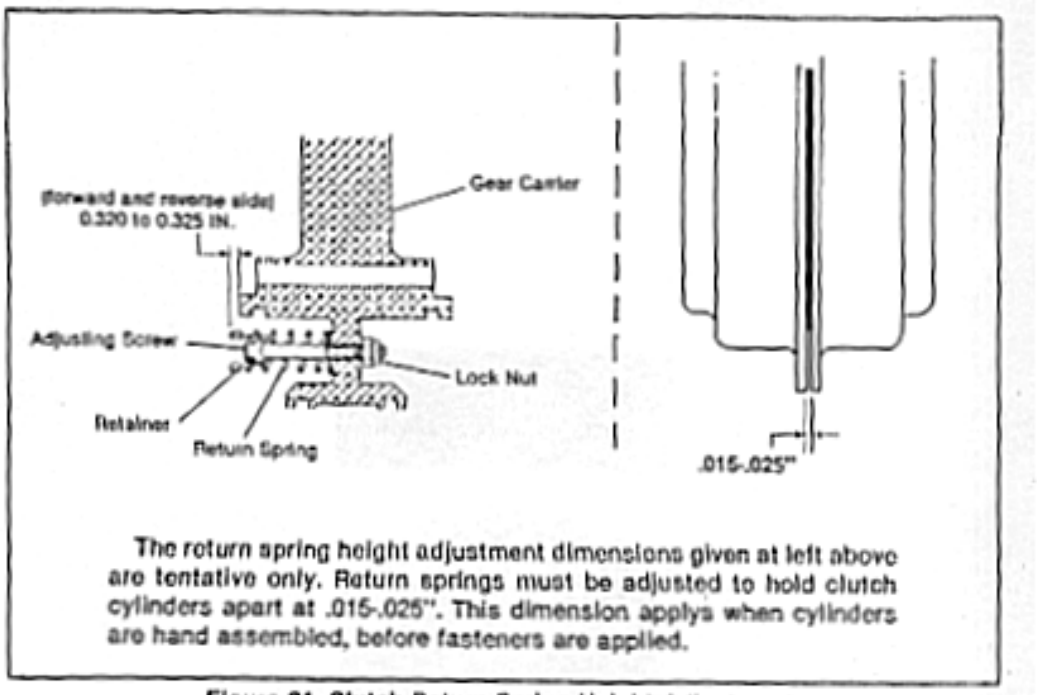


Figure 21. Clutch Return Spring Height Adjustment

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.

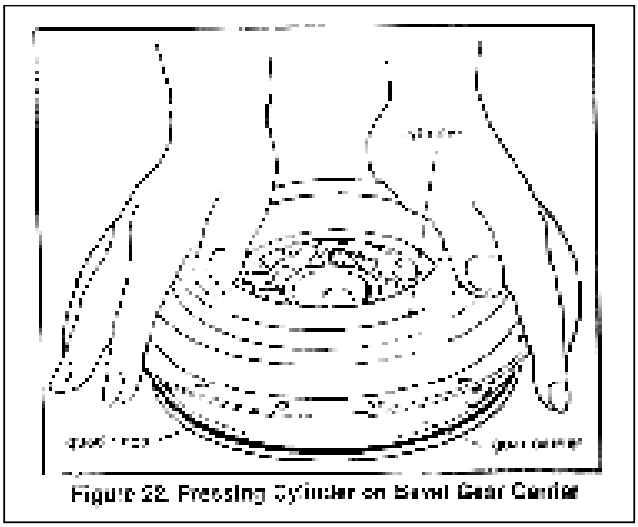


Figure 22. Pressing Cylinder on Bevel Gear Carrier

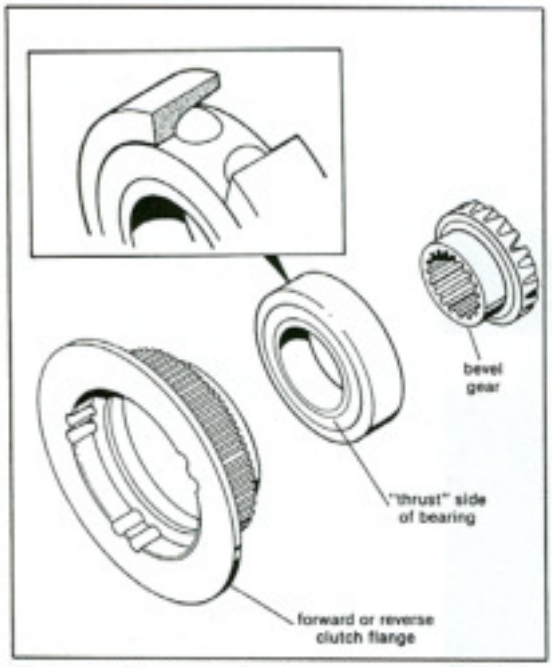


Figure 23. Clutch end flange, bearing and bevel gear. Bearing must be installed so that "thrust" side of bearing is toward clutch flange.

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.

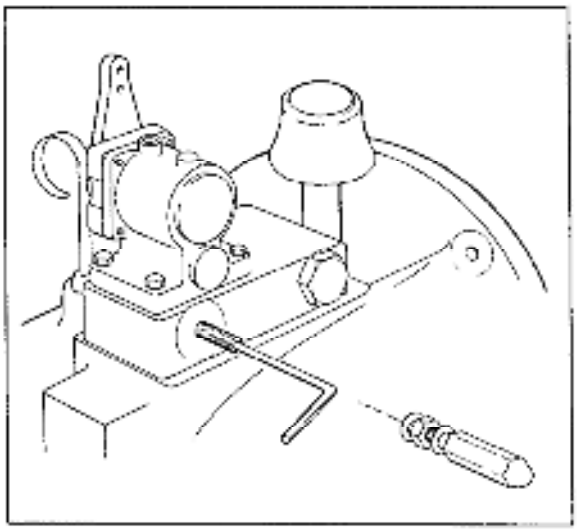


Figure 24. Clutch cylinder timing adjustment; To produce a faster shifting response, turn set screw COUNTER CLOCKWISE. To produce a slower response turn set screw CLOCKWISE.

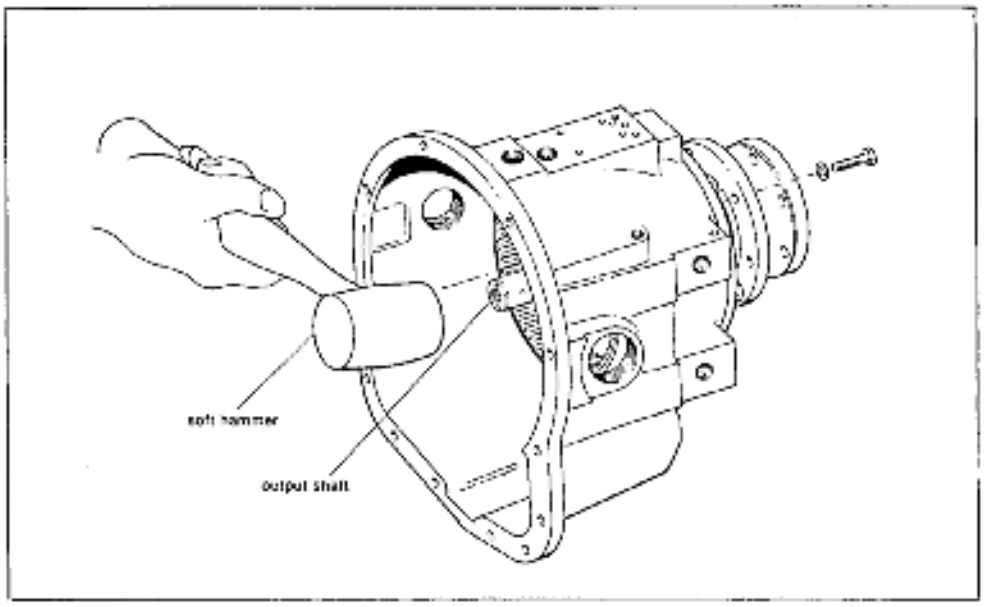


Figure 25. Removal of output shaft from housing.

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.

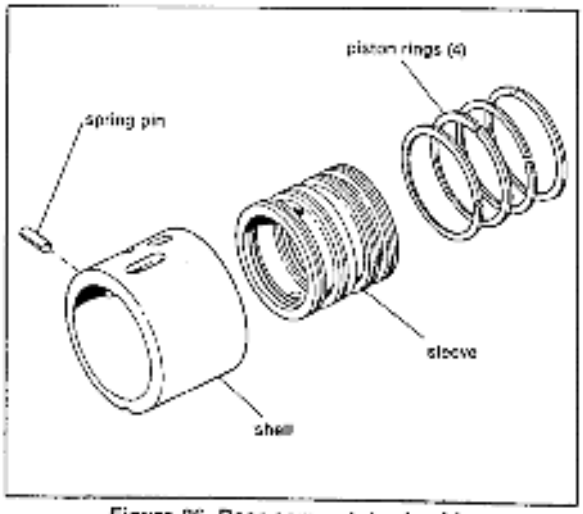


Figure 26. Rear commutator bushing.

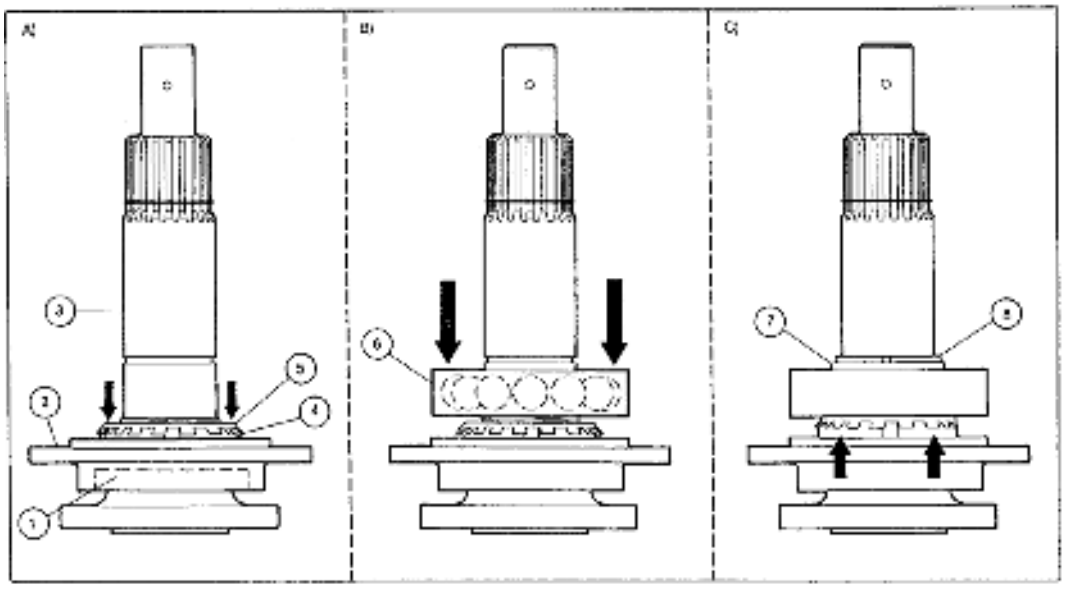


Figure 27. Assembly of Output Shaft Parts Prior to Installation in Housing.

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.

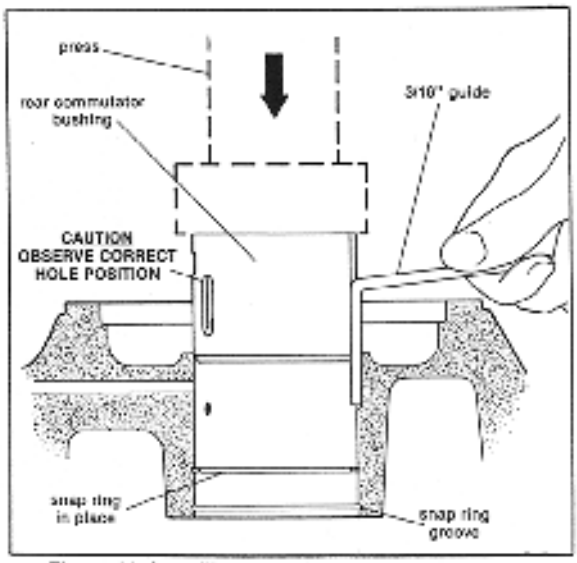


Figure 28. Installing Rear Commutator Bushing.

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).

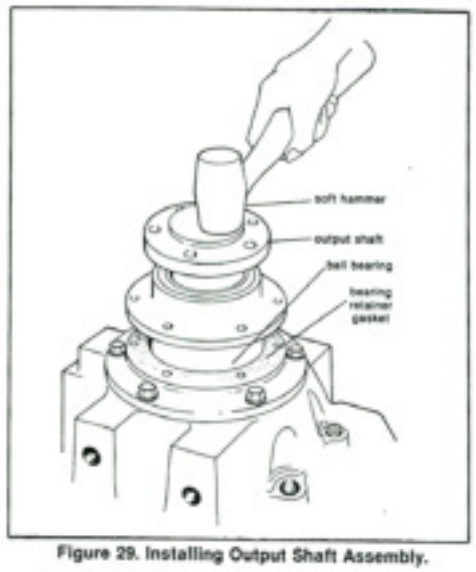


Figure 29. Installing Output Shaft Assembly.

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.

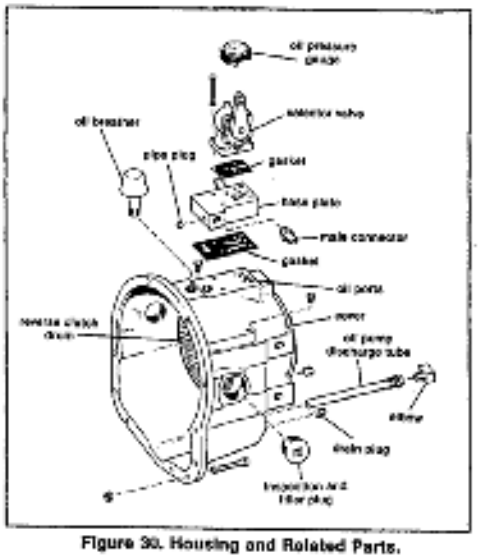


Figure 30. Housing and Related Parts.

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.

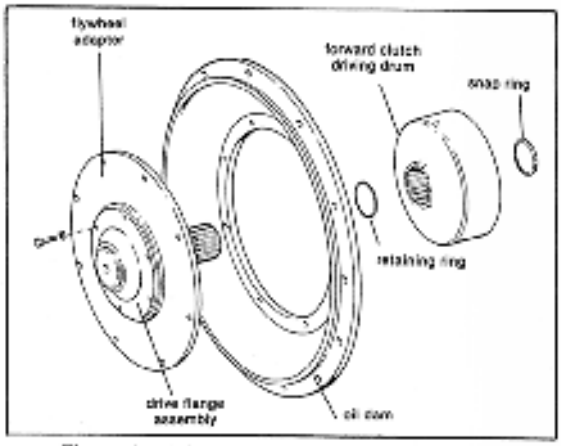


Figure 31. Adapter Group and Related Parts

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	Cable address:
Capitol Gears, Inc.	"Cap marine"
349 North Hamline Ave.	Tel: 645-9491
St. Paul, MN 55104	area code: 612
USA	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_____

7.3 SELECTOR VALVE

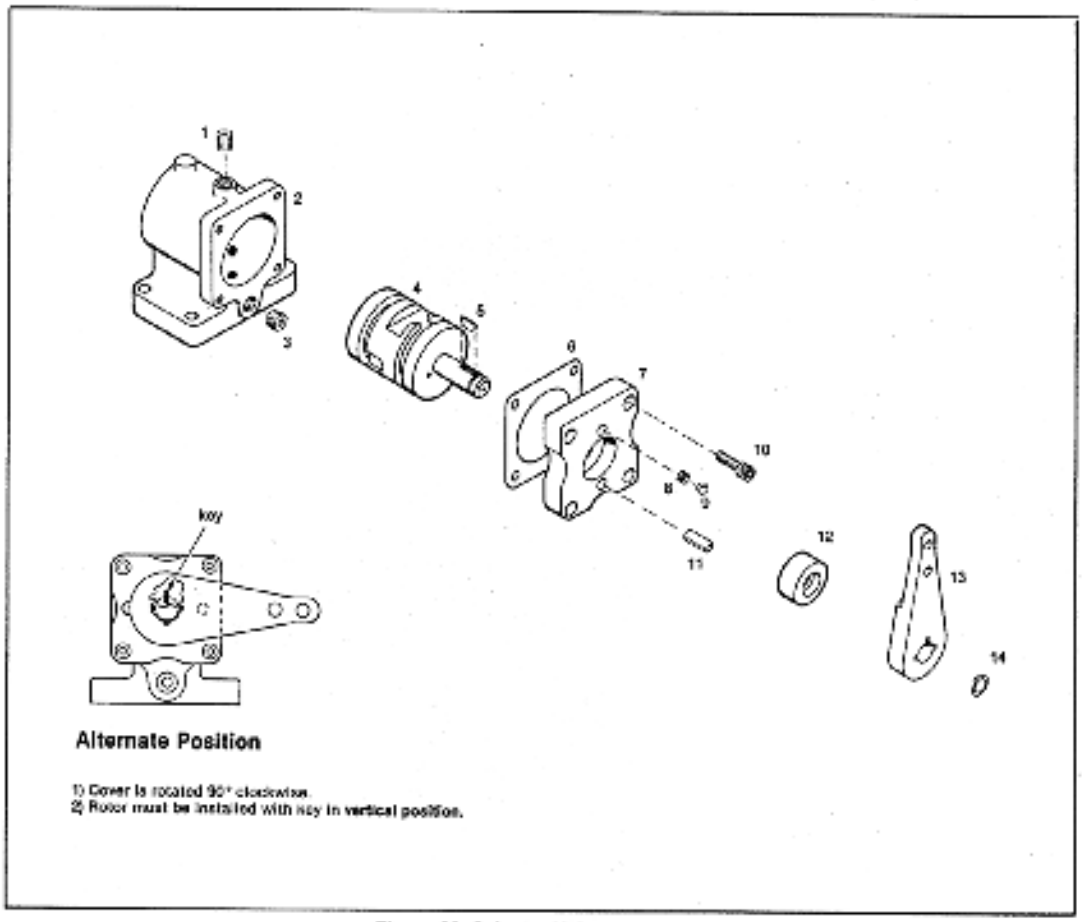


Figure 32. Selector Valve Assembly

ITEM	DESCRIPTION	PART NO.	QTY
REF	ASSEMBLY SELECTOR VALVE	1-01175-2000	1
1	PIPE PLUG, HEX SOCKET, 1/8" NPT	1-11279-0200	1
2	BLOCK VALVE	1-01141-1600	1
3	PIPE PLUG, HEX SOCKET, ¼" NPT	1-11279-0300	1
4	VALVE ROTARY	1-01144-1500	1
5	KEY	1-01164-3200	1
6	GASKET, VALVE COVER	1-01156-1500	1
7	COVER, VALVE	1-12417-1000	1
8	SPRING, INDEXING	1-01132-1500	1
9	BALL, INDEXING, ¼" DIA	1-11200-0000	1
10	CAPSCREW, SOCKET HEAD, 10-24X ½" LG	1-12844-0000	1
11	SPRING PIN ¼ DIA.X ½" LG	1-12097-0800	1
12	OIL SEAL	1-01155-1500	1
13	LEVER	1-12419-1000	1
14	RING, RETAINING	1-01180-1500	1

7.4 OIL PUMP

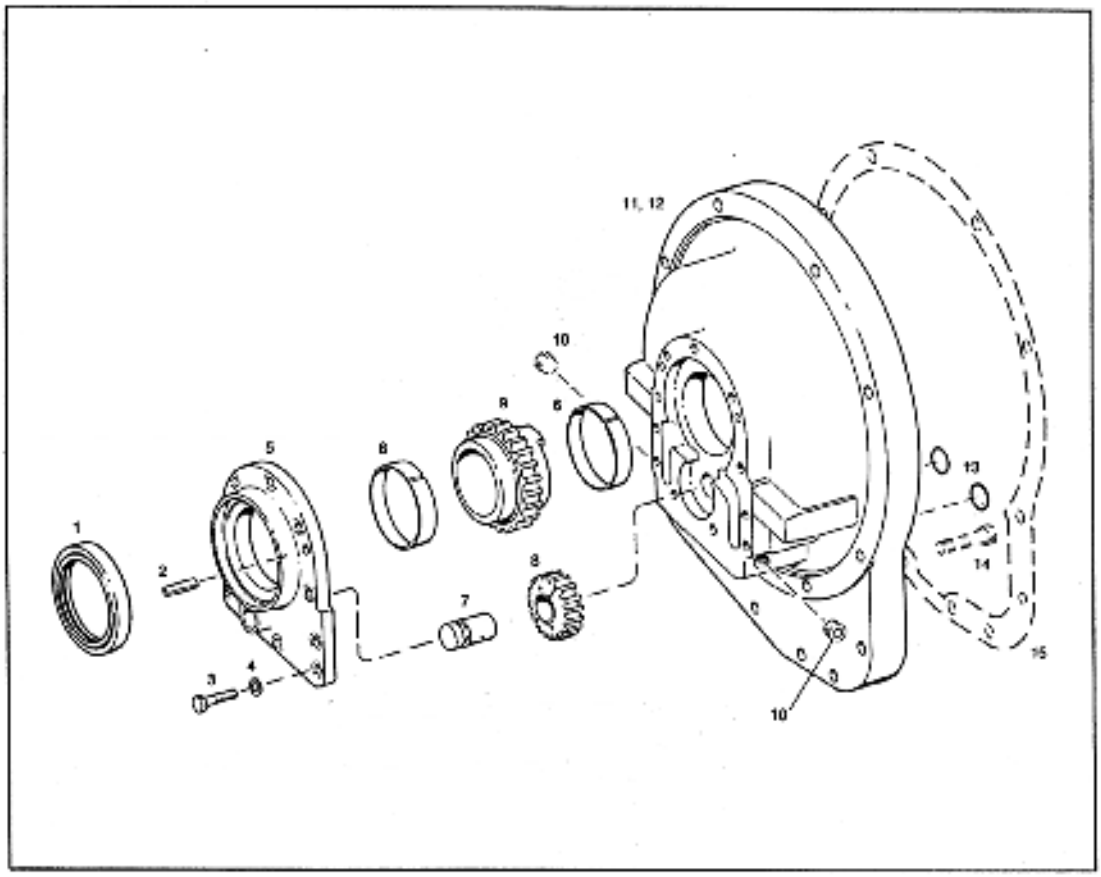


Figure 33. Oil Pump Assembly

ITEM	DESCRIPTION	PART NO.	QTY
REF	ASSEMBLY, RIGHT HAND OIL PUMP (DOES NOT INCLUDE ITEMS 14 AND 15)	1-01200-4300	1
REF	ASSEMBLY, LEFT HAND OIL PUMP (DOES NOT INCLUDE ITEMS 14 AND 15)	1-01200-3700	1
1	OIL SEAL	1-13713-0000	1
2	SPRING PIN, 1/4X ¾" LG	1-12097-1200	2
3	CAPSCREW, HEX HEAD, 1/4X 1" LG	1-11366-0000	1
4	LOCKWASHER, ¼" ID	1-05309-0800	11
5	COVER, OIL PUMP	1-01121-1400	1
6	BUSHING, DRIVER GEAR	1-01127-1400	2
7	PINION SHAFT, PUMP	1-01303-1400	1
8	PINION & BUSHING DRIVEN	1-01126-4000	1
9	GEAR DRIVER	1-01125-1400	1
10	PIPE PLUG	1-11279-0400	1
11	HOUSING, PUMP, RIGHT HAND	1-01120-1800	1
12	HOUSING, PUMP, LEFT HAND	1-01120-3000	1
13	O-RING	1-12919-0000	2
14	CAPSCREW, SOCKET HEAD	1-10956-0000	2
15	GASKET, HOUSING TO PUMP	1-01308-1400	1

7.5 CLUTCHES

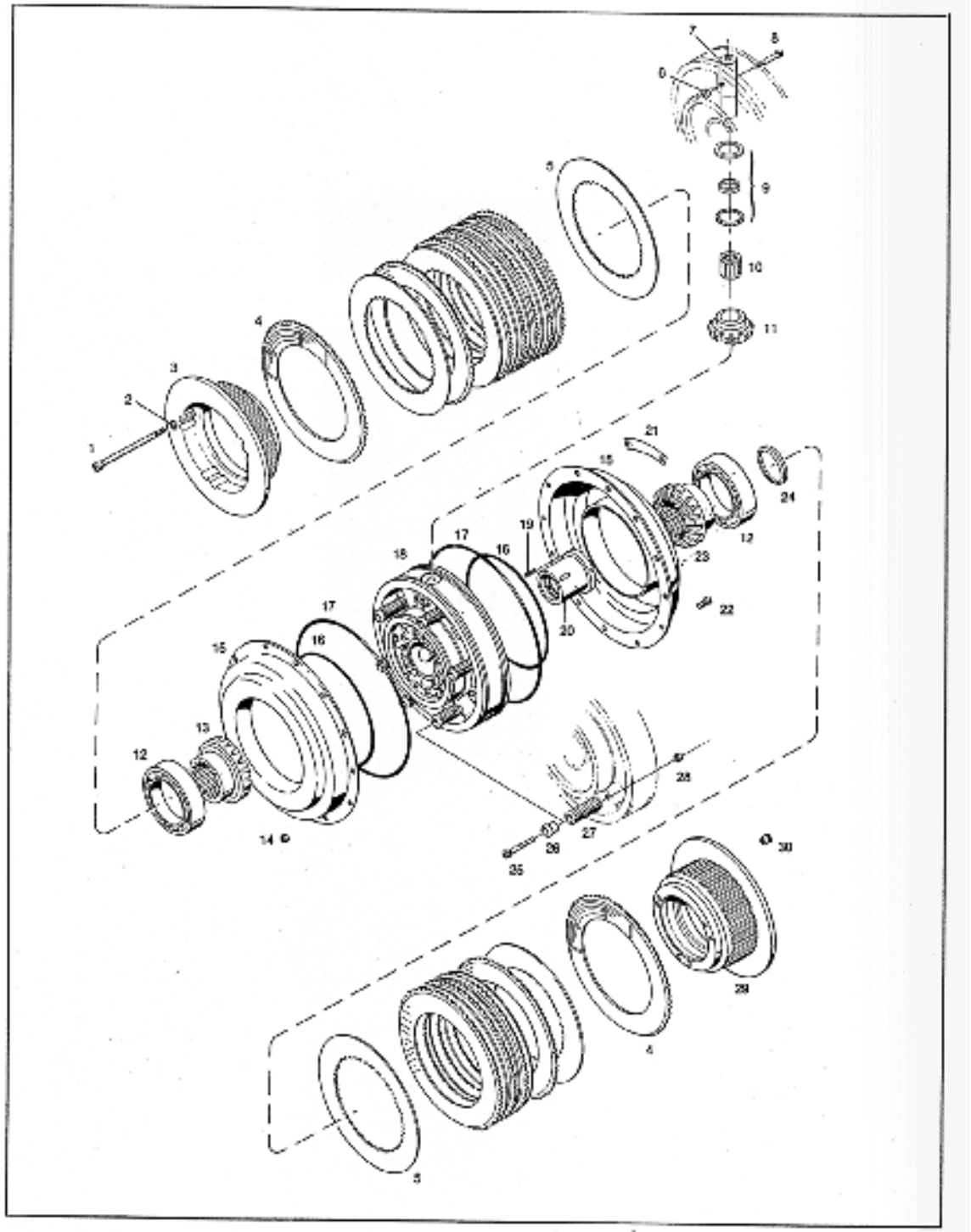


Figure 34. Clutch No. 1-00100-1300

5HD-200 STANDARD CLUTCH
CLUTCH NO. 1-00100-1300

ITEM	DESCRIPTION	PART NO.	QTY
REF.	CLUTCH ASSEMBLY	1-00100-1300	1
1	CAPSCREW, SOCKET HEAD	1-12732-0000	6
2	LOCKWASHER, HIGH COLLAR; 5/16” I.D	1-01104-1600	6
3	CLUTCH FLANGE, FORWARD	1-00212-1700	1
4	DISC, CLUTCH DRIVING	1-00230-4300	12
5	DISC, CLUTCH DRIVEN	1-00233-0700	12
6	NUT, SELF LOCKING	1-11105-0000	3
7	SHAFT, PINION	1-00214-1800	1
8	CAPSCREW, SOCKET HEAD	1-11104-0000	3
9	SUB-ASSEMBLY, BEARING	1-12434-0000	3
10	BEARING, NEEDLE	1-12367-0000	3
11	PINION, BEVEL	1-00217-1000	3
12	BEARING	1-12364-0000	2
13	GEAR, DRIVING	1-00215-1000	1
14	NUT, SELF LOCKING; ¼-28 NF	1-0026-3600	12
15	CYLINDER	1-00234-8400	2
16	QUAD RING	1-00238-1500	2
17	QUAD RING	1-00237-1500	2
*18	CARRIER, BEVEL GEAR	1-00219-1800	1
*19	SPRING PIN, 1/8” DIA. X ¾” LG	1-12095-1200	2
*20	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
21	NAME PLATE	1-13430-0000	1
22	CAPSCREW, SOCKET HD; ¼-28X 5/8” LG	1-13424-0000	12
23	GEAR, DRIVEN	1-00215-2000	1
24	RING	1-12303-0000	1
25	CAPSCREW, SOCKET HD; ¼-20-20x 1 ½” LG	1-07837-0800	12
26	RETAINER, RETURN SPRING	1-00243-3500	12
27	SPRING, RETURN	1-00239-1500	12
28	NUT, SELF-LOCKING; ¼-20	1-07846-0800	12
29	CLUTCH FLANGE, REVERSE	1-00212-6100	1
30	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6

*NOTE: items 18,19 and 20 are available as part number 1-00219-4400 GEAR CASE ASSEMBLY

7.5 CLUTCHES

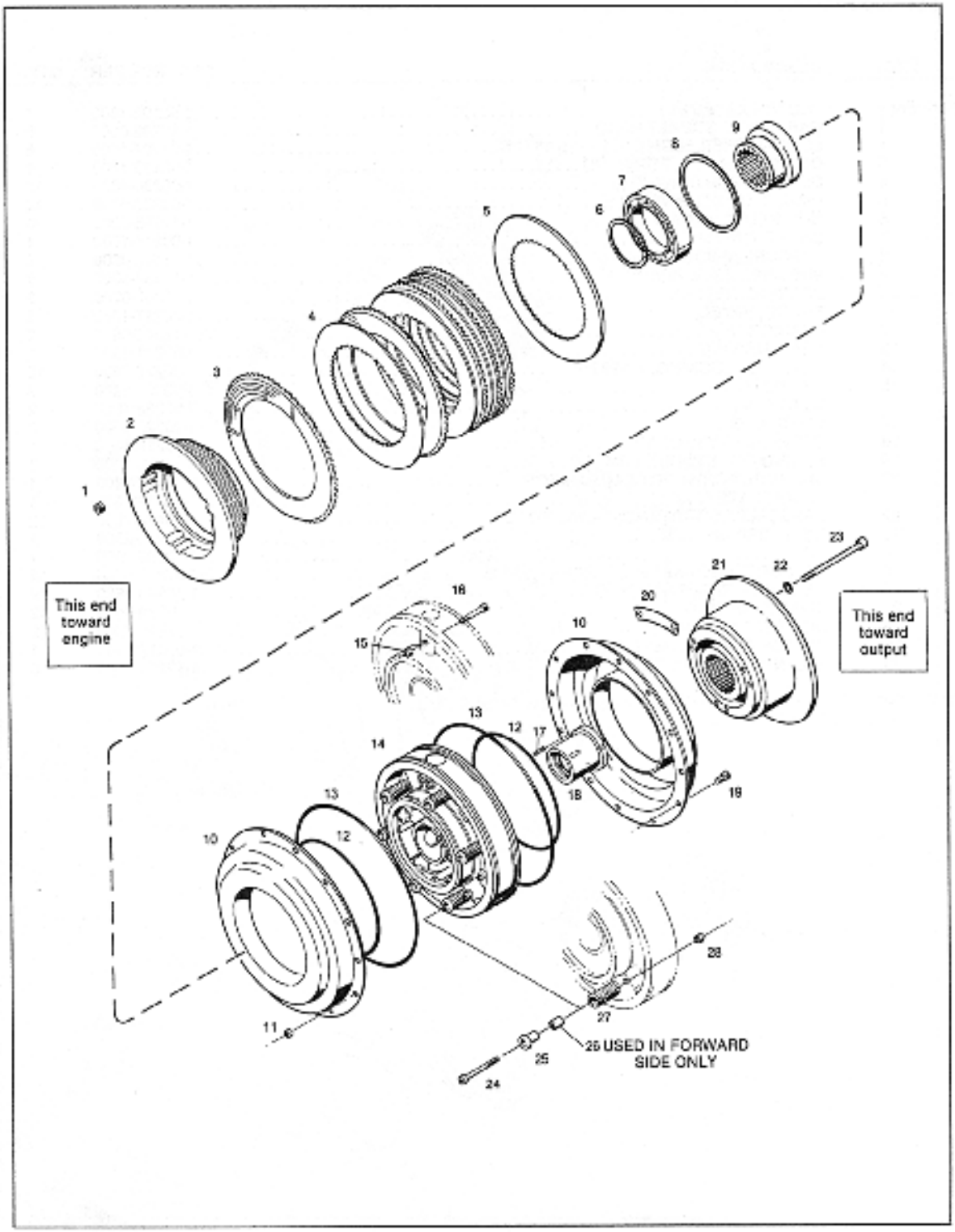


Figure 35. PTO Clutch Without Brake, No. 1-00100-1103

5HD 200 CLUTCH-PTO WITHOUT BRAKE
CLUTCH NO. 1-00100-1103

ITEM	DESCRIPTION	PART NO.	QTY
REF.	CLUTCH ASSEMBLY, PTO WITHOUT BRAKE	1-00100-1103	1
1	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6
2	FLANGE, FORWARD CLUTCH	1-13285-0000	1
3	DISC, CLUTCH DRIVING	1-00230-4300	5
4	DISC, CLUTCH DRIVEN	1-00233-0700	4
5	DISC, CLUTCH DRIVEN	1-00229-1700	1
6	SNAP RING, EXTERNAL	1-13282-0000	1
7	BEARING	1-13206-0000	1
8	SNAP RING, INTERNAL	1-13283-0000	1
9	SPACER	1-13280-0000	1
10	CYLINDER, CLUTCH	1-00234-8400	2
11	NUT, SELF LOCKING; ¼-28 N.F	1-00226-3600	12
12	QUAD RING	1-00238-1500	2
13	QUAD RING	1-00237-1500	2
14	CARRIER	1-00219-1800	1
15	NUT,SELF LOCKING	1-11105-0000	3
16	CAPSCREW; SOCKET HEAD; 10-32 NF x 1 ¾" LG	1-11104-0000	3
17	SPRING PIN; 1/8 DIA. X ¾ LG	1-12095-1200	2
18	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
19	CAPSCREW, SOCKET HD; ¼-28 NF X 5/8" LG	1-13424-0000	12
20	NAME PLATE	1-13430-0000	1
21	CLUTCH FLANGE, REVERSE	1-13152-0000	1
22	LOCKWASHER, HIGH COLLAR; 5/16" I.D	1-01104-1600	6
23	CAPSCREW, SOCKET HEAD	1-12732-0000	6
24	CAPSCREW, SOCKET HD; ¼-20 NCX 1 ½" LG	1-07837-0800	12
25	RETAINER, RETURN SPRING	1-00243-3500	12
26	SLEEVE	1-13177-0000	6
27	SPRING, RETURN	1-00239-1500	12
28	NUT, SELF-LOCKING; ¼-20 NC	1-07846-0800	12

7.5 CLUTCHES

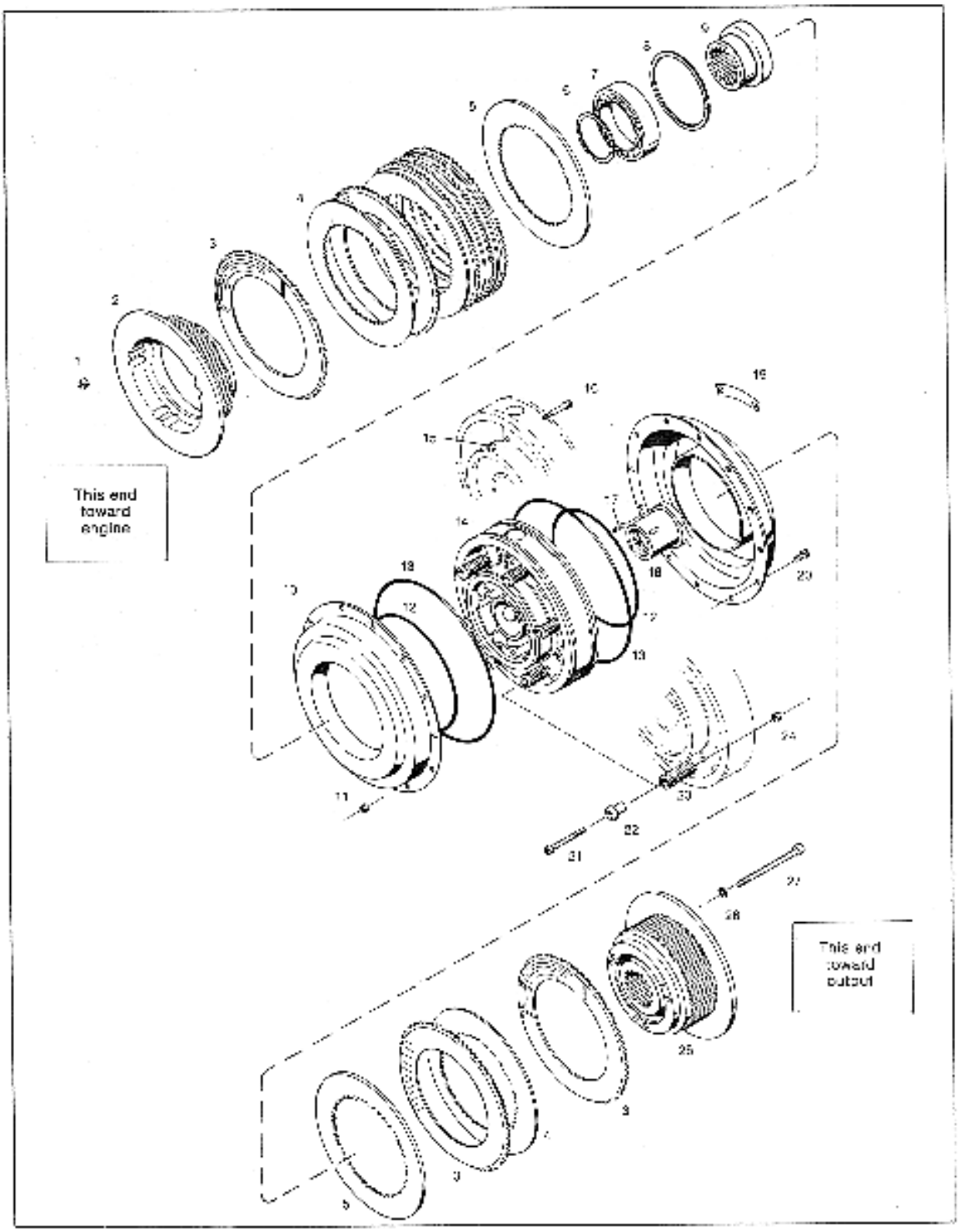


Figure 36. PTO Clutch With Brake, No. 1-00100-1104

37

5HD 200 CLUTCH-PTO WITH BRAKE
CLUTCH NO. 1-00100-1104

ITEM	DESCRIPTION	PART NO.	QTY
1	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6
2	FLANGE, FORWARD CLUTCH	1-13285-0000	1
3	DISC, CLUTCH DRIVING	1-00230-4300	7
4	DISC, CLUTCH DRIVEN	1-00233-0700	5
5	DISC, CLUTCH DRIVEN, THICK	1-00229-1700	2
6	SNAP RING, EXTERNAL	1-13282-0000	1
7	BEARING	1-13206-0000	1
8	SNAP RING, INTERNAL	1-13283-0000	1
9	SPACER	1-13280-0000	1
10	CYLINDER, CLUTCH	1-00234-8400	2
11	NUT, SELF-LOCKING	1-00226-3600	12
12	QUAD RING	1-00238-1500	2
13	QUAD RING	1-00237-1500	2
14	CARRIER	1-00219-1800	1
15	NUT, SELF-LOCKING	1-11105-0000	3
16	CAPSCREW, SOCKET HD; 10-32 NF X 1 ¾" LG	1-11104-0000	3
17	SPRING PIN; 1/8 DIA. X ¾ LG	1-12095-1200	2
18	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
19	NAME PLATE	1-13430-0000	1
20	CAPSCREW, SOCKET HD; ¼-28 NF X 5/8" LG	1-13424-0000	12
21	CAPSCREW, SOCKET HD; ¼ –20 NC X 1 ½" LG	1-07837-0800	12
22	RETAINER, RETURN SPRING	1-00243-3500	12
23	SPRING RETURN	1-00239-1500	12
24	NUT, SELF-LOCKING ¼-28 NF	1-07846-0800	12
25	CLUTCH FLANGE ASSEMBLY REVERSE	1-13165-1000	1
26	LOCKWASHER, HIGH COLLAR; 5/16 I.D	1-01104-1600	6
27	CAPSCREW, SOCKET HEAD	1-12732-0000	6

7.6 OUTPUT SHAFT AND RELATED PARTS

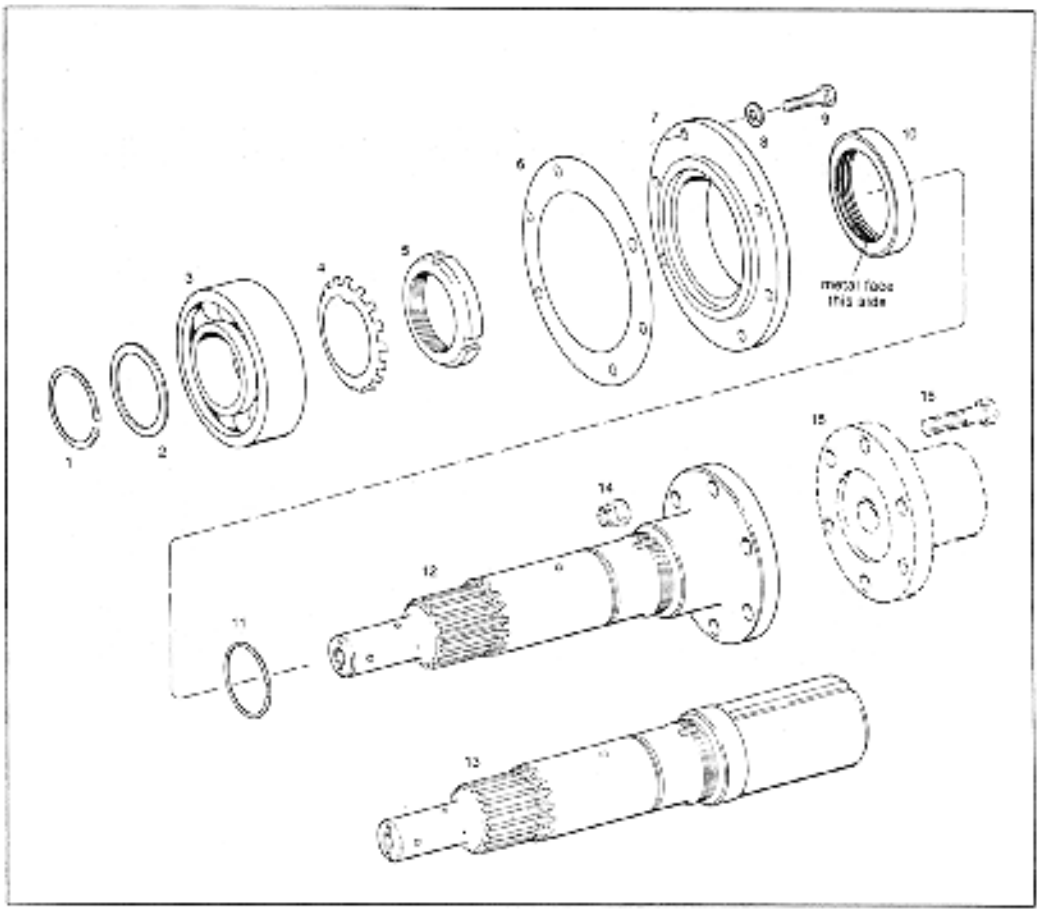


Figure 37. Output Shaft and Related Parts

ITEM	DESCRIPTION	PART NO.	QTY
1	SNAP RING	1-13036-0000	1
2	SPACER, OUTPUT SHAFT	1-01301-1400	1
3	OUTPUT BEARING, REAR	1-01313-1400	1
4	LOCKWASHER, BEARING	1-06032-1000	1
5	LOCKNUT, BEARING	1-06031-1000	1
6	GASKET, BEARING RETAINER	1-01118-1400	1
7	RETAINER, BEARING	1-00332-1700	1
8	LOCKWASHER, 5/16” DIA.	1-09458-0800	6
9	CAPSCREW, HEX HEAD, 5/16-18X1”	1-08372-0800	6
10	OIL SEAL	1-12823-0000	1
11	SNAP RING	1-04302-1400	1
12	OUTPUT SHAFT, FLANGED	1-00327-4300	1
13	OUTPUT SHAFT, KEYED	1-13284-1000	1
REFERENCE	KIT, PROP SHAFT COUPLING (SHOWN DOTTED)	1-13679-0000	1
14	HEX NUT, FLEXLOC	1-13329-0000	6
15	COUPLING, PROP SHAFT	1-12783-0000	1
16	CAPSCREW, HEX HEAD	1-09738-0800	6

7.7 OUTPUT SHAFT SUPPORT PARTS

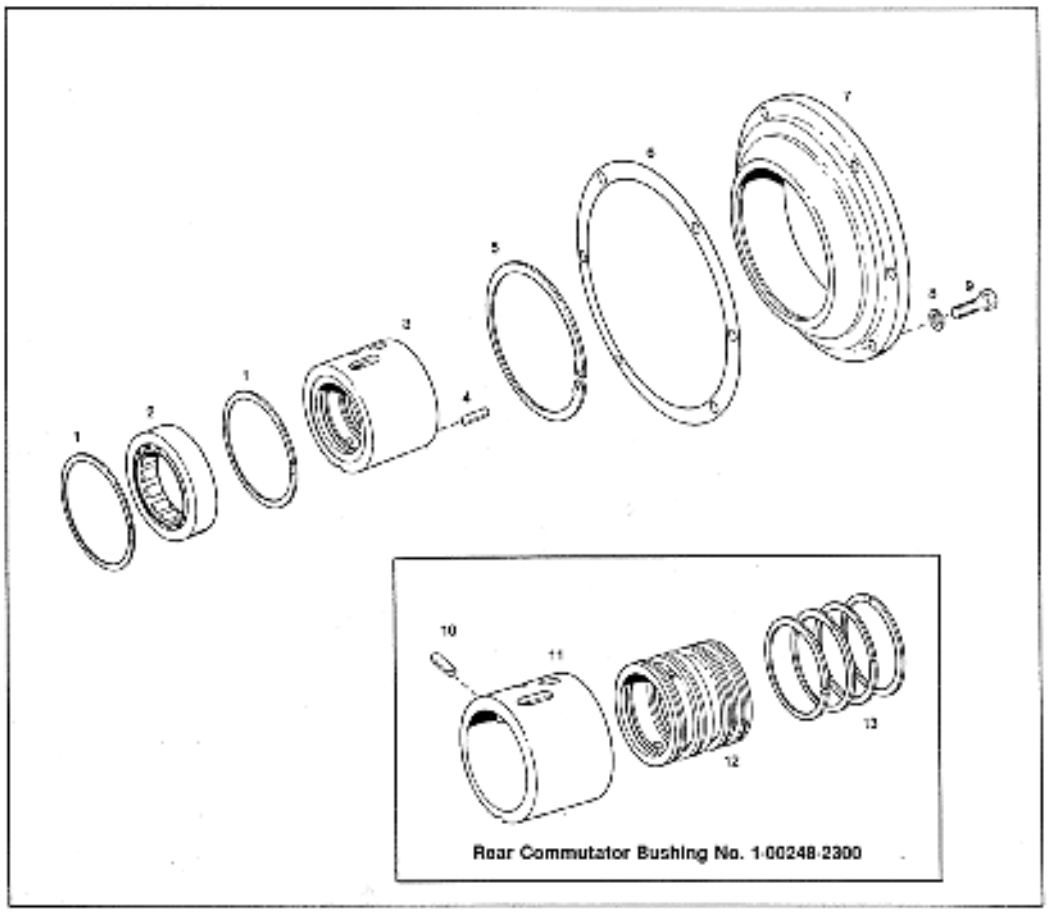


Figure 38. Output Shaft Support Parts

ITEM	DESCRIPTION	PART NO.	QTY
1	SNAP RING	1-10263-0000	2
2	ROLLER BEARING, OUTPUT SHAFT	1-01304-1400	1
3	COMMUTATOR BUSHING, REAR	1-00248-2300	1
4	SPRING PIN	1-12096-1200	1
5	RING, RETAINING	1-01314-1400	1
6	GASKET, COVER	1-01112-1100	1
7	COVER, REAR	1-01203-1400	1
8	LOCKWASHER, 3/8 DIA	1-09460-0800	6
9	CAPSCREW, HEX HEAD 3/8-16X 1”	1-07432-0800	6
10	SPRING PIN	1-12096-0700	1
11	SHELL, COMMUTATOR	1-00500-1700	1
12	SLEEVE, COMMUTATOR	1-00501-1700	1
13	RING, PISTON	1-00502-1500	4

7.8 HOUSING AND RELATED PARTS

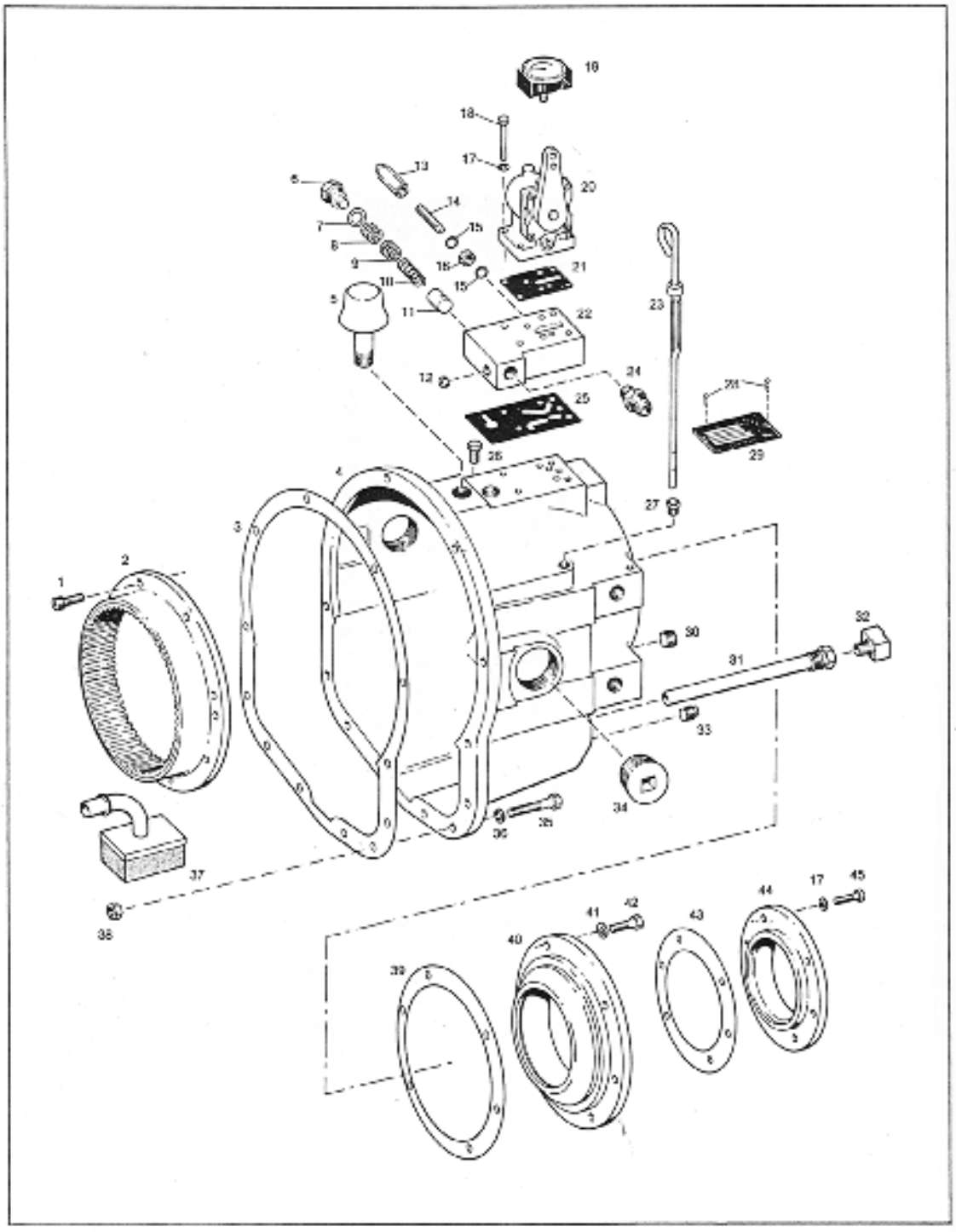


Figure 39. Housing and Related Parts

7.8 HOUSING AND RELATED PARTS

ITEM	DESCRIPTION	PART NO.	QTY.
1	CAPSCREW, SOCKET HEAD, 5/16-18X1" LG	1-01307-1400	8
2	DRUM, REVERSE	1-00250-1600	1
3	GASKET, HOUSING TO PUMP	1-01308-1400	1
4	HOUSING, REVERSE GEAR	1-01101-1500	1
5	OIL BREATHER	1-01124-1300	1
6	STOP, RELIEF VALVE	1-10285-0100	1
7	GASKET, RELIEF VALVE	1-10288-0700	1
8	WASHER, PLAIN, .015" THICK	1-10740-0000	3
9	WASHER, PLAIN,.030" THICK	1-10741-0000	3
10	SPRING, RELIEF VALVE	1-07743-0800	1
11	PLUNGER, RELIEF VLAVE	1-01177-1400	1
12	PIPE PLUG, HEX SOCKET ¼-18	1-11279-0300	1
13	DOME NUT, 5/16-18	1-09461-0800	1
14	SET SCREW, SOCKET HEAD: 5/16-18X ½"	1-09466-0800	1
15	GASKET	1-09471-0800	2
16	NUT, LOCK (LIGHT); 5/16-18	1-09464-0800	1
17	LOCKWASHER, 5/16-18	1-09458-0800	0
18	CAPSCREW, HEX HEAD; ¼-20X2 ¼" LG	1-12377-0000	4
19	GAUGE, PRESSURE	1-09669-0900	1
20	ASSEMBLY, SELECTOR VALVE (SEE PG 31)	1-01175-2000	1
21	GASKET, BASEPLATE TO VALVE	1-01154-1500	1
22	BASEPLATE, SELECTOR VALVE	1-12821-0000	1
23	OIL STICK	1-01115-1400	1
24	CONNECTOR, MALE; ¼ NP X ¾-16	1-11241-1400	1
25	GASKET, BASEPLATE TO HOUSING	1-12822-0000	1
26	CAPSCREW, HEX HEAD; ½-20 NF	1-11649-0000	1
27	NUT, INVERTED FLARE; 5/16" TUBE SIZE ½-20 N.F	1-11227-0400	1
28	DRIVE SCREW, ROUND HEAD; #2X 3/16" LG	1-13275-0000	2
29	NAMEPLATE	1-11210-0000	1
30	PIPE PLUG, SOCKET HEAD; ½ N.P.T	1-11225-0300	1
31	TUBE, PUMP DISCHARGE	1-01318-1600	1
32	STREET ELBOW	1-11270-0600	1
33	PIPE PLUG, SQUARE HEAD; 3/8" N.P.T	1-11251-0300	1
34	PLUG, INSPECTION AND FILLER; 1 ½ N.P.T	1-11225-0700	2
35	CAPSCREW, HEX HEAD (SEE INSTALLATION DRAWING)		
36	LOCKWASHER	1-09460-0800	12
37	ASSEMBLY, OIL FILTER	1-01123-1400	1
38	NUT, HEX 3/8-16 NC	1-11397-0000	6
39	GASKET, COVER TO HOUSING	1-01112-1100	1
40	COVER, REAR	1-01203-1400	1
41	LOCKWASHER, 3/8" DIA.	1-09460-0800	6
42	CAPSCREW, HEX HEAD; 3/8-16X 1" LG	1-07432-0800	6
43	GASKET, BEARING RETAINER	1-01118-1400	1
44	RETAINER, BEARING	1-00332-1700	1
45	CAPSCREW, HEX HEAD; 5/16-18X1"	1-08372-0800	6

7.9 ADAPTER PARTS

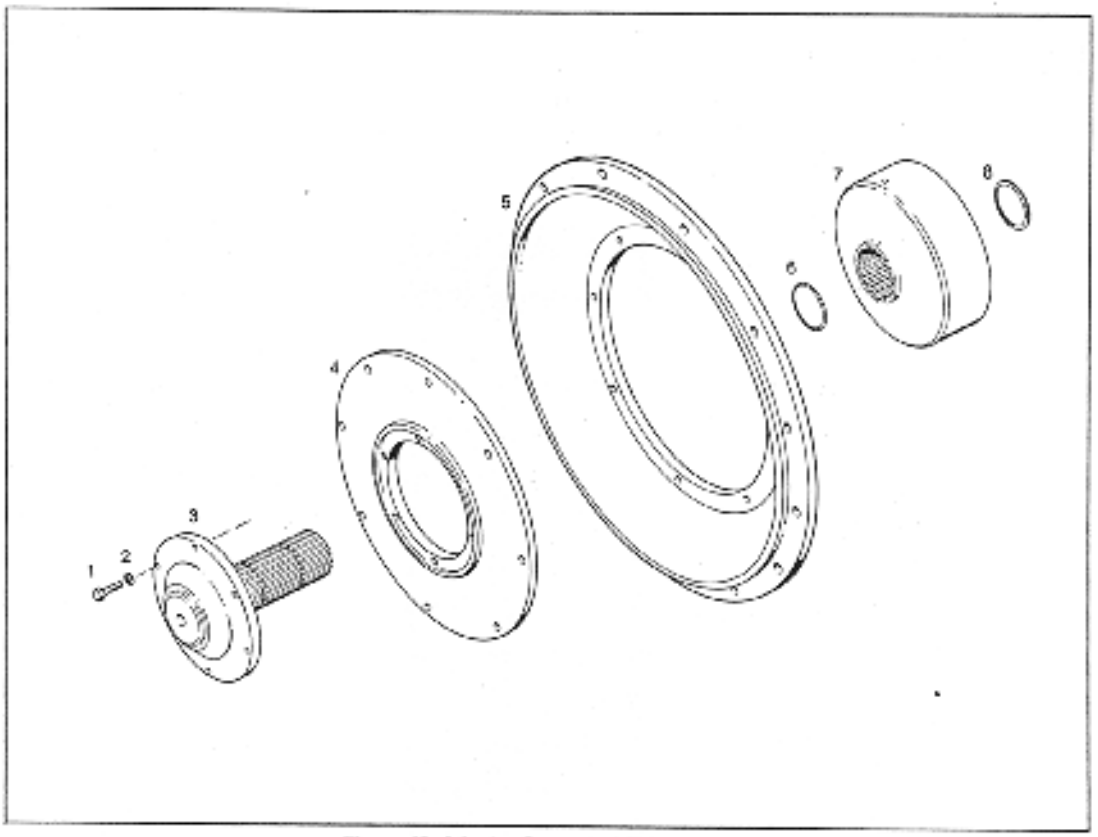
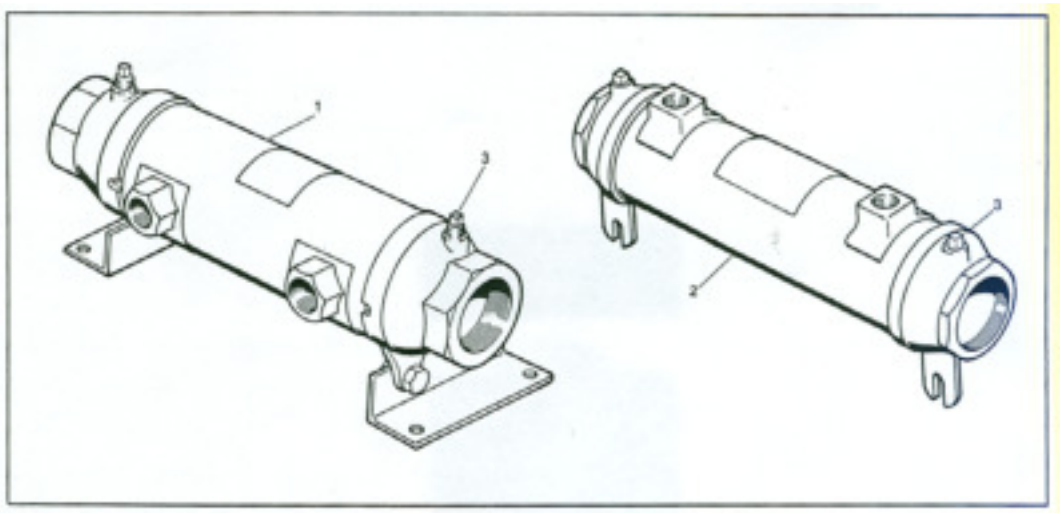


Figure 40. Adapter Group and Related Parts

ITEM	DESCRIPTION	PART NO	QTY
1	CAPSCREW, HEX HEAD	(SEE INSTALLATION DRAWING)	6
2	LOCKWASHER	(SEE INSTALLATION DRAWING)	6
3	ASSEMBLY DRIVE FLANGE & STUB SHAFT	(SEE INSTALLATION DRAWING)	1
4	ADAPTER, FLYWHEEL	(SEE INSTALLATION DRAWING)	1
5	OIL DAM	(SEE INSTALLATION DRAWING)	1
6	RING, RETAINING	1-01138-1400	1
7	DRUM, CLUTCH DRIVING	1-01116-1500	1
8	SNAP RING	1-01151-1500	1

7.10 OIL COOLERS AND HOSE FITTING KIT



ITEM	DESCRIPTION	PART NUMBER	QTY
1	OIL COOLER (SEA OR FRESH WATER) 4 3/8" DIA. X 12 ¾" LG	1-07808-5000	1
2	OIL COOLER (SEA OR FRESH WATER) 3 1/8" DIA. X 12 5/8" LG	1-12445-2100	1
3	ZINC PENCILS (SUPPLIED WITH COOLER)	1-12445-0400	2

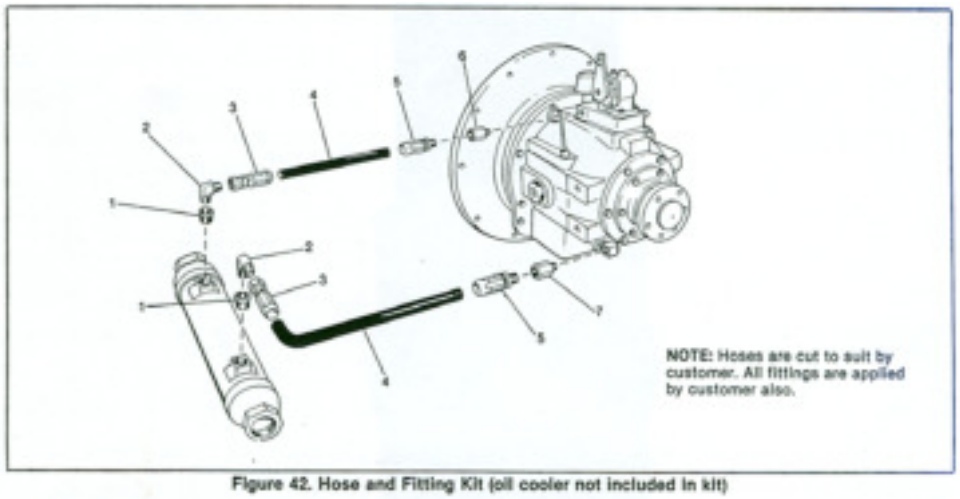


Figure 42. Hose and Fitting Kit (oil cooler not included in kit)

Hose and Fitting Kit No. 1-13887-0000 is available for use with the coolers listed above. Parts included in the kit are:

1	BUSHING 1X ½"	1-11253-1100	2
2	ELBOW, 90º, 7/8-14 JIC X ½ NPT	1-11221-1500	2
3	FEMALE FITTING	1-11282-0500	2
4	HOSE ½" I.D X 6'	1-11505-0000	1
5	MALE FITTING, ½-14 NPT	1-11283-0800	2
6	ADAPTER, 1/2X ¼" NPT	1-11254-0200	1
7	ADAPTER, 1/2X 3/8" NPT	1-11254-0300	1