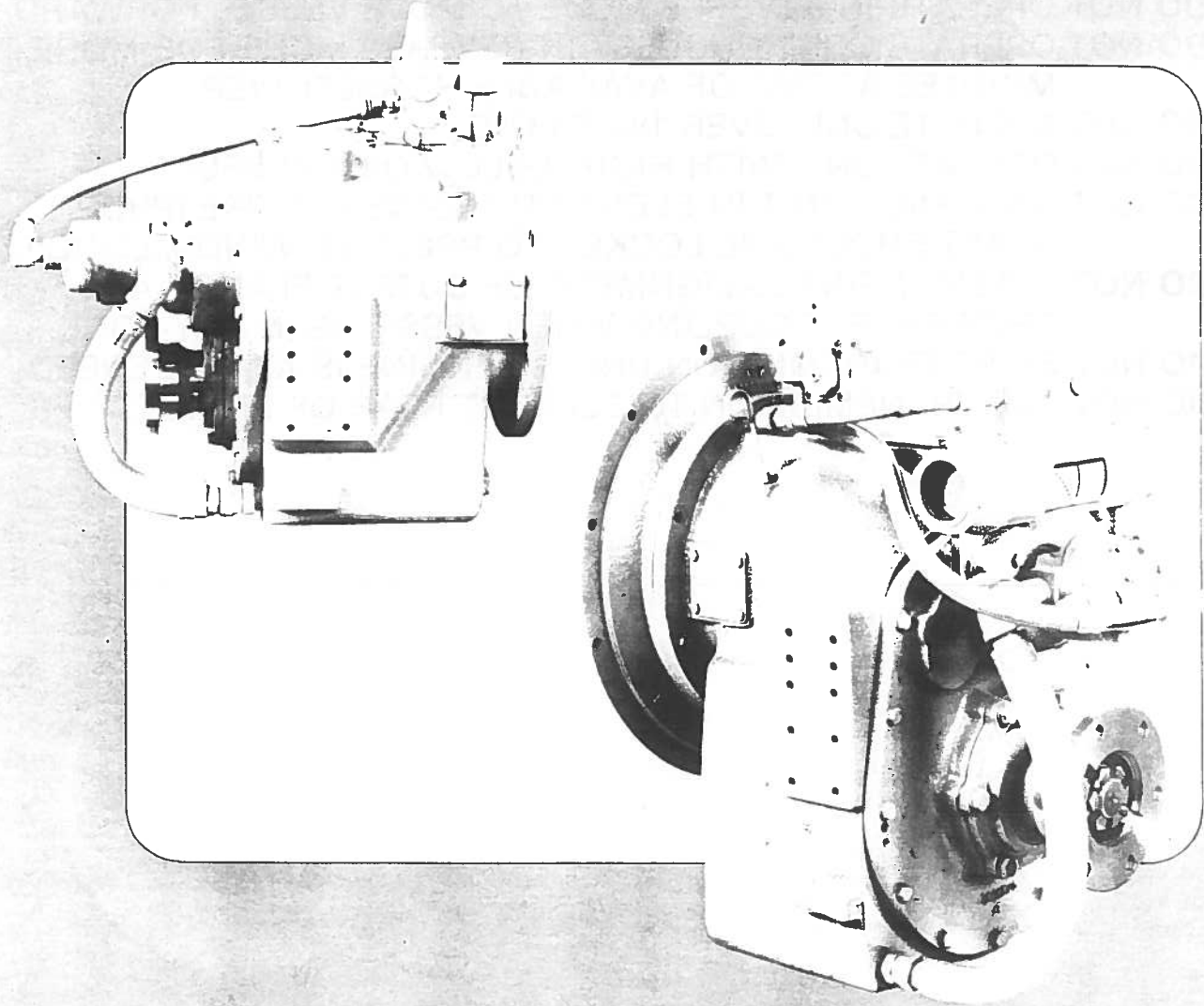


SERVICE MANUAL

HE 10200 & HE 10700 marine transmissions



Capitol Gears, Inc.

NOTE

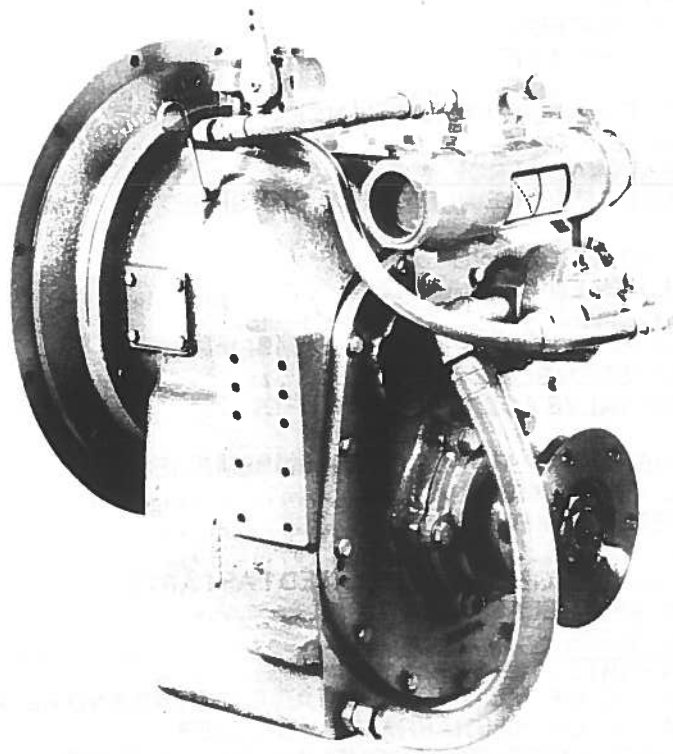
THIS SERVICE MANUAL IS
GUARANTEED EFFECTIVE
FOR SERIAL NO. **13625-0785**
ONLY.

CAUTION

- DO NOT OPERATE IN REVERSE MODE TO MOVE VESSEL FORWARD.**
- DO NOT OPERATE CONTINUOUSLY IN REVERSE MODE FOR MORE THAN 30 MINUTES AT 75% OF AVAILABLE HORSEPOWER.**
- DO NOT OPERATE UNIT OVER 180°F (82°C).**
- DO NOT OPERATE UNIT WITH HIGH OR LOW OIL PRESSURE.**
- DO NOT 'WINDMILL' UNIT IN EVENT OF ENGINE FAILURE (PROP SHAFT SHOULD BE LOCKED TO PREVENT 'WINDMILLING').**
- DO NOT ATTEMPT FINAL ALIGNMENT OF OUTPUT FLANGE AND PROP SHAFT COUPLING WHEN VESSEL IS IN DRY-DOCK.**
- DO NOT SHIFT TRANSMISSION UNLESS ENGINE IS AT IDLE SPEED.**
- DO NOT USE TRANSMISSION TO SUPPORT REAR OF ENGINE.**

SERVICE MANUAL

**HE 10200 &
HE 10700
marine
transmissions**

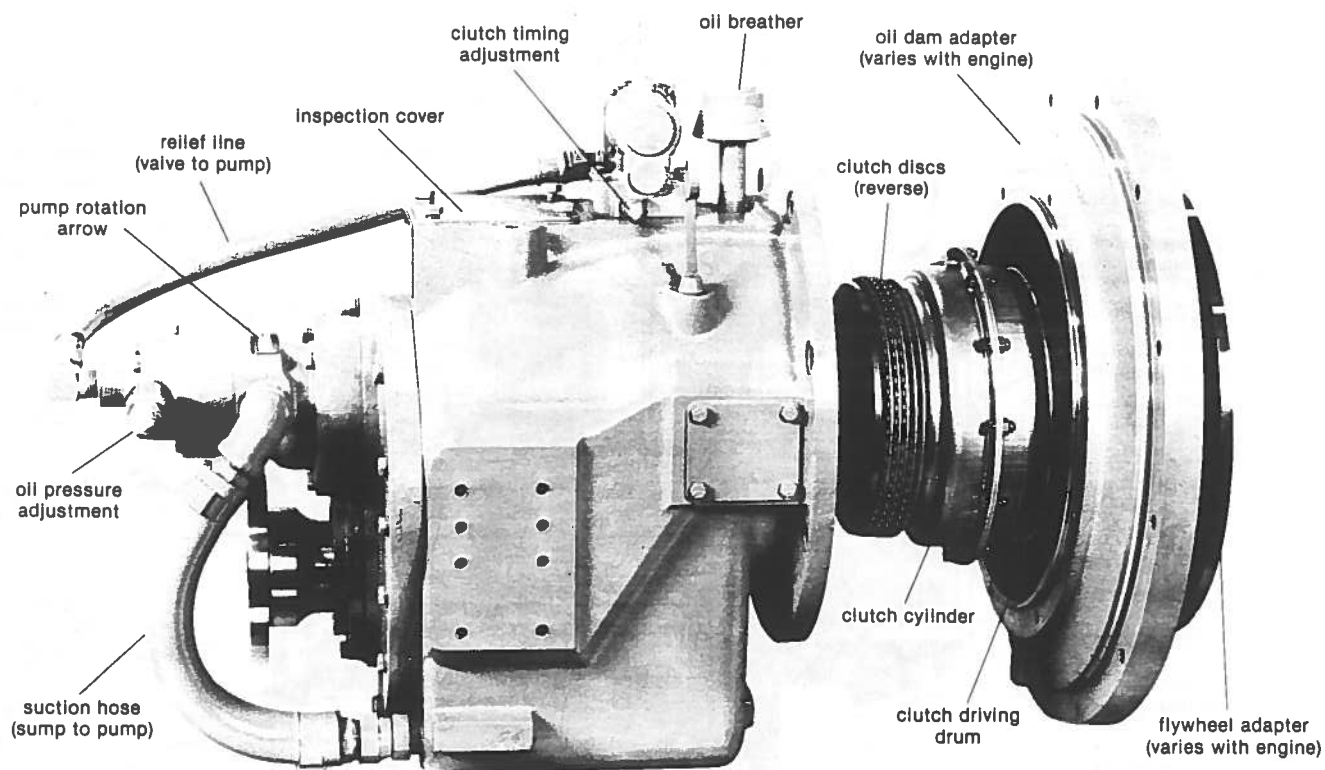


SERVICE MANUAL 2-HE100
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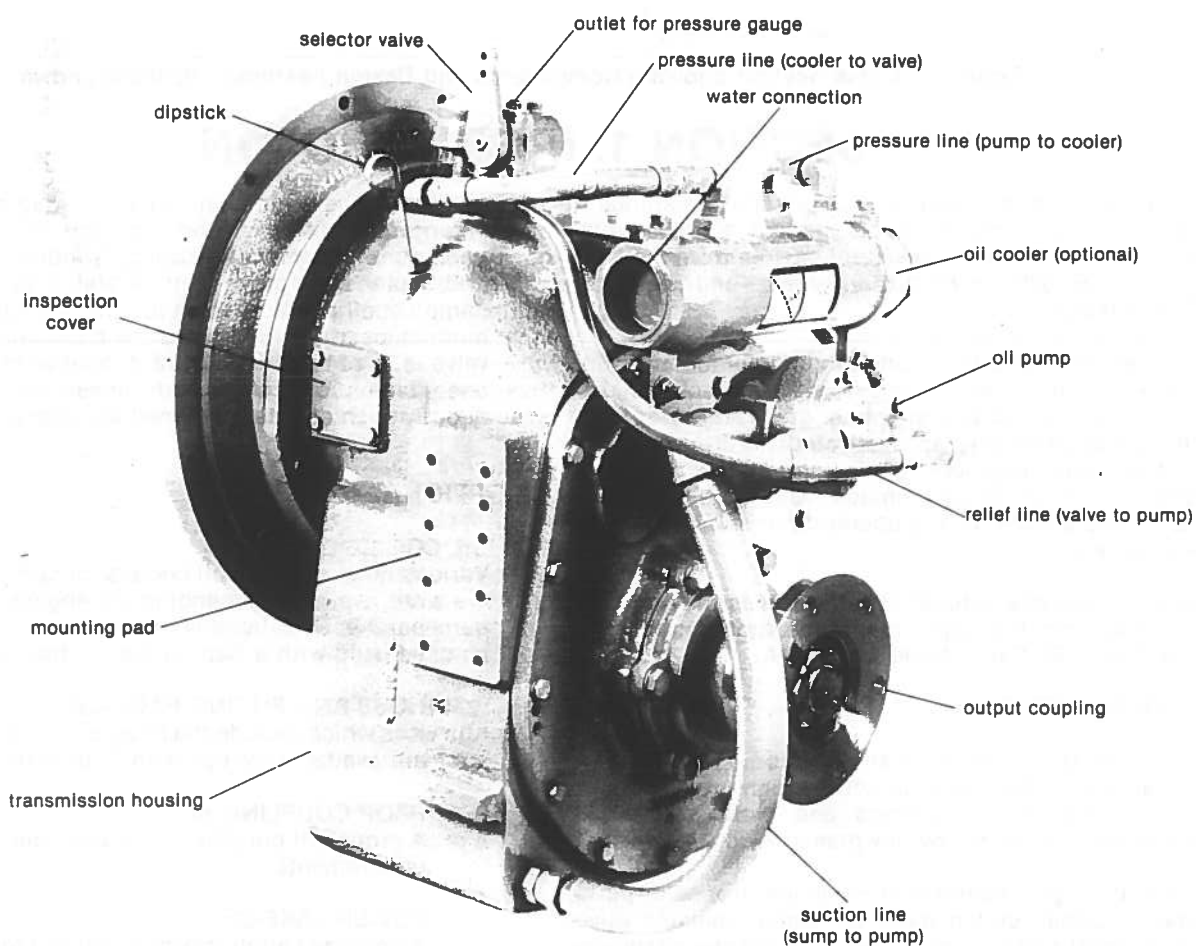
Capitol Gears, Inc.
349 NORTH HAMLINE AVE.
ST. PAUL, MINNESOTA 55104, U.S.A.

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HE-10200 (Left Hand Version): Side View Showing Adapter Parts



HE-10700 (Right Hand Version): Rear View Showing Optional Oil Cooler

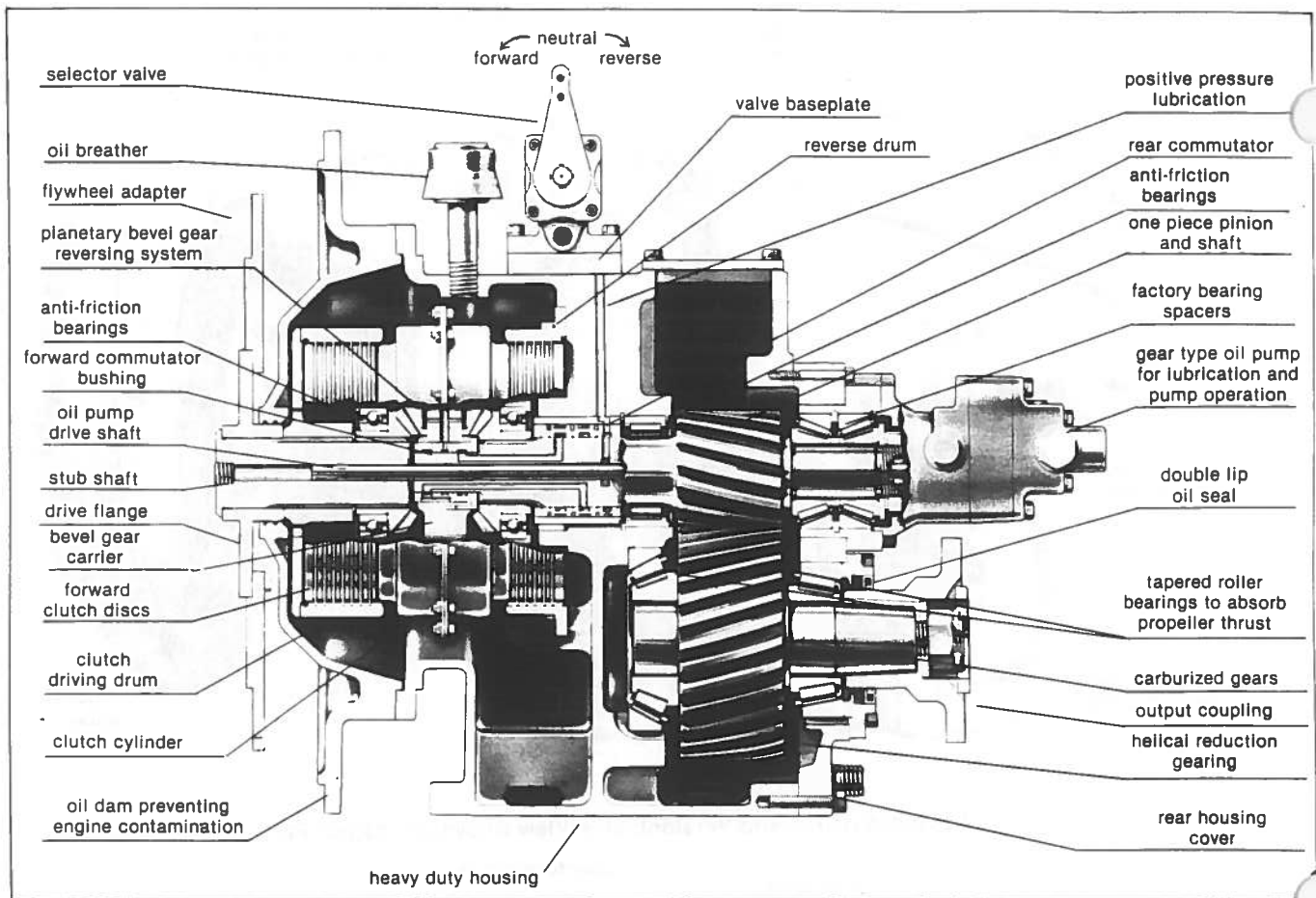


Figure 1. Cross Section Showing Components and Design Features (HE-10200 shown)

SECTION 1. INTRODUCTION

The purpose of this manual is to provide assistance to operation and maintenance personnel to reduce downtime and obtain consistent performance from the Capitol HE-10200 or HE-10700 Reverse and Reduction 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 Capitol marine 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 marine gear consists of six major groups of parts; adapter group, clutch pack, oil pump, selector valve, pinion shaft and reduction gear. The adapter parts vary according to engine application and include a flywheel

adapter, drive flange, an oil dam adapter to prevent engine contamination and a driving drum. 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 of bearings, gears and clutch. The selector valve is used to obtain forward, neutral or reverse. The one piece pinion and shaft drives the output gear directly or through an intermediary gear called an idler.

1.2 OPTIONAL EQUIPMENT

OIL COOLER

Various capacity oil coolers for salt or fresh water are available depending on engine size and are purchased optionally. However, an oil cooler must be used with a Capitol marine transmission.

HOSE AND FITTING PACKAGE

Kits which include the necessary hose and fittings are available for use with Capitol oil coolers.

PROP COUPLING KIT

A propshaft coupling kit is available to meet most requirements.

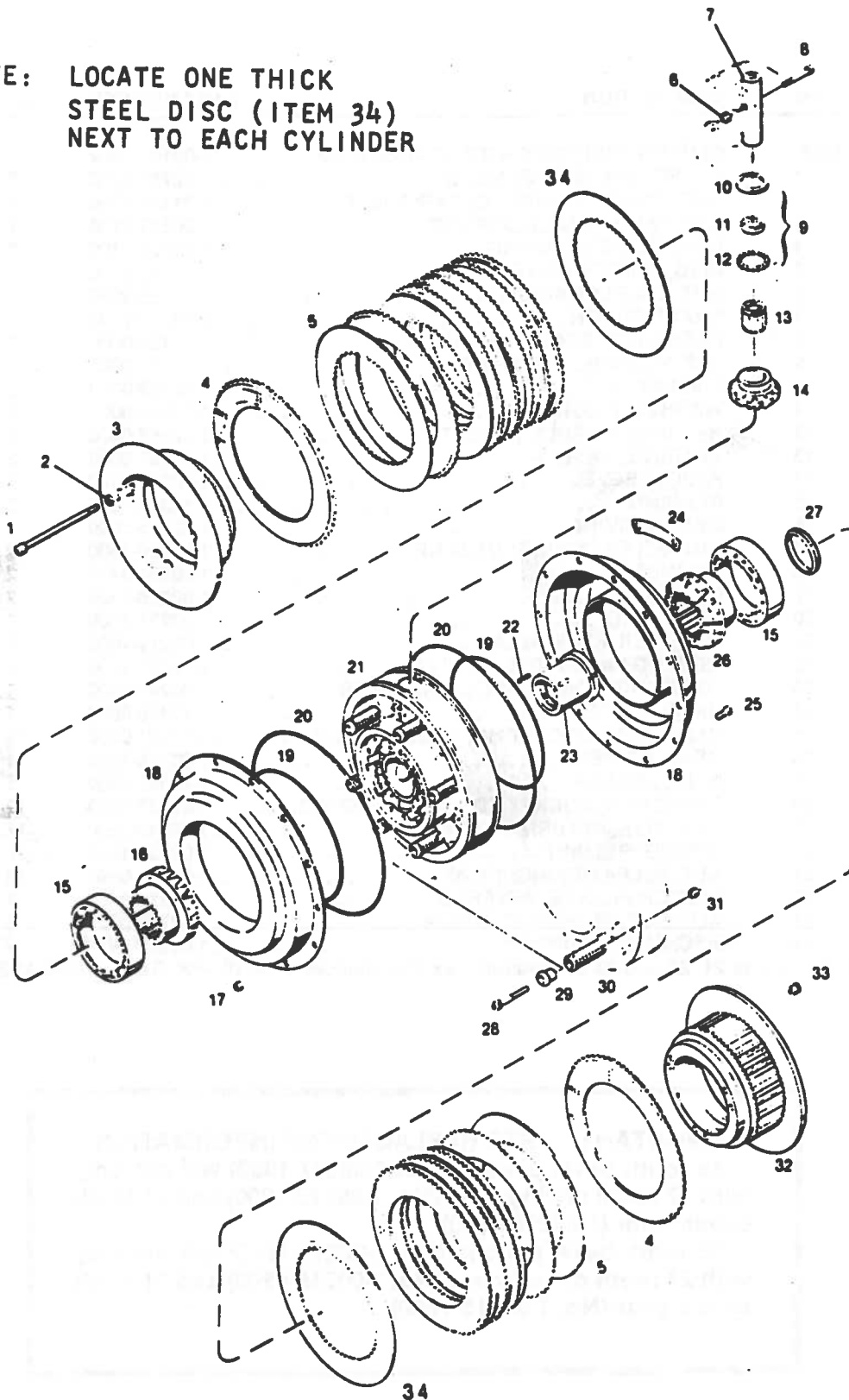
POWER TAKE-OFF

A one way clutch may be furnished for power take-off reduction gears (HE PTO Series).

CLUTCH ASSEMBLY WITH SPACER RING
CLUTCH NO. 1-00100-1002

**NOTE: LOCATE ONE THICK
 STEEL DISC (ITEM 34)
 NEXT TO EACH CYLINDER**

this end
 toward
 engine



CLUTCH ASSEMBLY WITH SPACER RING
CLUTCH NO. 1-00100-1002

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	CLUTCH ASSEMBLY WITH SPACER RING	1-00100-1002	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	10
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	WASHER, THRUST	1-12369-0000	3
11	WASHER, PILOT	1-12368-0000	3
12	BEARING, NEEDLE THRUST	1-12368-0000	3
13	BEARING, NEEDLE	1-12367-0000	3
14	PINION, BEVEL	1-00217-1000	3
15	BEARING	1-12364-0000	2
16	GEAR, DRIVING	1-00215-1000	1
17	NUT, SELF-LOCKING; 1/4-28 NF	1-00226-3600	12
18	CYLINDER	1-00234-8400	2
19	QUAD RING	1-00238-1500	2
20	QUAD RING	1-00237-1500	2
21	*CARRIER, BEVEL GEAR	1-00219-1800	1
22	*SPRING PIN 1/8" DIA. x 3/4" LG	1-12095-1200	2
23	*BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
24	NAME PLATE	1-13430-0000	1
25	CAPSCREW, SOCKET HD; 1/4-28 x 5/8" LG.	1-13424-0000	12
26	GEAR, DRIVEN	1-00215-2000	1
27	RING, SPACER	1-12530-0000	1
28	CAPSCREW, SOCKET HD; 1/4-20 x 1 1/2" LG.	1-07837-0800	12
29	RETAINER, RETURN SPRING	1-00243-3500	12
30	SPRING, RETURN	1-00239-1500	12
31	NUT, SELF-LOCKING; 1/4-20	1-07846-0800	12
32	CLUTCH FLANGE, REVERSE	1-00212-6100	1
33	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6
34	DISC, CLUTCH DRIVEN	1-00229-1700	2

*NOTE: Items 21, 22 and 23 are available as part number 1-00219-4400 GEAR CASE ASSEMBLY.

IMPORTANT PARTS REPLACEMENT INFORMATION

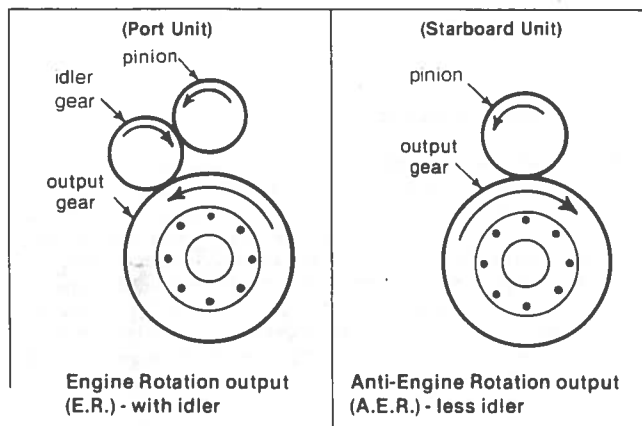
19 tooth bevel pinions (No. 1-00217-1000) will run only with 27 tooth driving gear (No. 1-00215-1000) and 27 tooth driven gear (1-00215-2000).

15 tooth bevel pinions (No. 1-00217-1700) will run only with 21 tooth driving gear (No. 1-00215-0900) and 21 tooth driven gear (No. 1-00215-1800).

SECTION 2. PRINCIPLES OF OPERATION

2.1 OUTPUT ROTATION

The Capitol marine gear in forward mode provides output rotation in the opposite direction as engine rotation. The marine gear unit is normally supplied for a right hand engine (when viewed from the front). This produces a right hand rotation output of the propshaft in forward (when viewed from the rear of the transmission). For twin screw installations, where two right hand engines are used, the port unit is furnished with an idler gear. The idler gear produces, in forward, an output rotation the same as engine rotation.* Thus the two propellers can be turning opposite each other in outboard direction (see diagram below). *Note: Engine rotation transmissions are installed on right hand engines only.



2.2 REDUCTION RATIO

The reduction ratio is the number of teeth in the reduction gear compared to the number of teeth in the pinion, for example, 36 teeth compared to 18, or 2 to 1. Output speed then is a product of engine r.p.m. and the reduction ratio, for example $1800 \text{ r.p.m.} \times \frac{1}{2} = 900 \text{ r.p.m.}$ output speed. The HE-10200 features seven reduction ratios available in anti-engine rotation output (A.E.R.); 1.037, 1.20, 1.50, 1.75, 2.00, 2.44, 2.93, and three ratios in engine-rotation output (E.R.); 1.083, 1.50, 2.00. The HE-10700 is available in six anti-engine rotation output ratios; 2.541, 3.047, 3.473, 4.000, 4.533 and 5.00, and six engine-rotation output ratios; 2.478, 3.00, 3.444, 4.00, 4.526 and 5.00.

2.3 POWER FLOW

The flywheel adapter, being directly fastened to the engine flywheel continually rotates the drive flange assembly, clutch driving drum and forward clutch discs at engine speed.

NEUTRAL

In neutral no direct torque is applied to clutch and pinion. Consequently reduction gear and output coupling do not rotate.

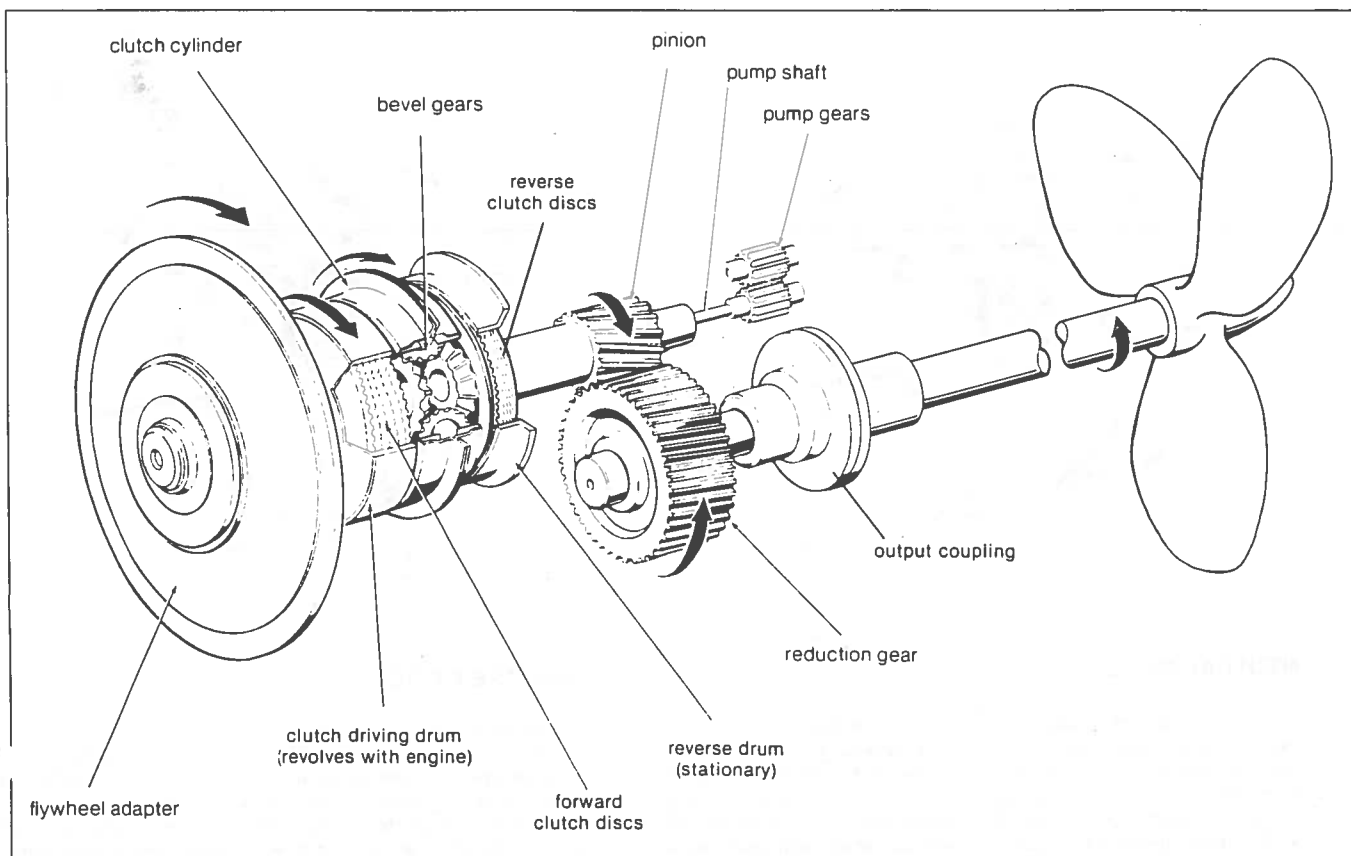


Figure 2. Power Flow (in forward mode)

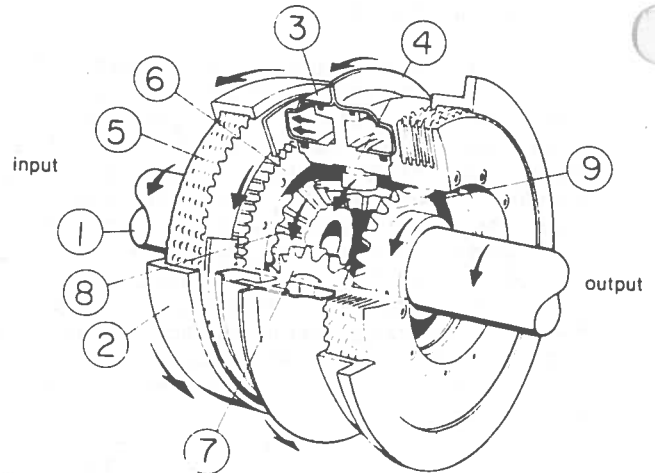
2.3 POWER FLOW (CONT'D.)

FORWARD (see Figure 2.)

When forward is selected the entire clutch becomes locked with the driving drum and rotates at engine speed. The clutch drives the pinion in engine direction and the pinion drives the reduction gear and output flange in anti-engine direction at a speed determined by the reduction ratio.

REVERSE

When reverse is chosen the clutch is held stationary to the housing. Engine power is transferred through the clutch bevel gears and the pinion is driven in anti-engine rotation at engine speed. This causes reduction gear and output flange to rotate in engine direction (reverse).



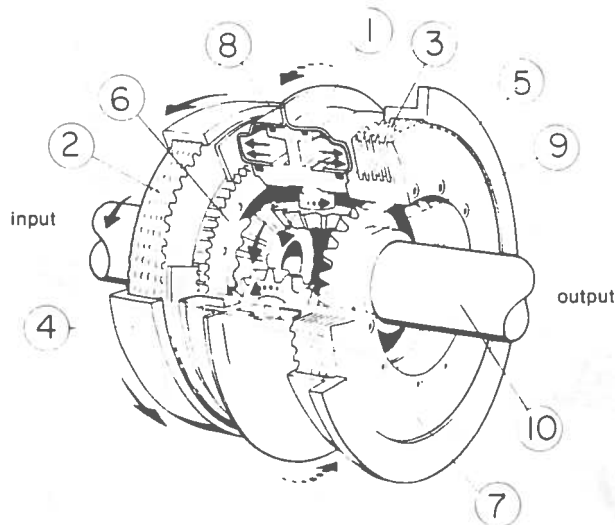
2.4 CLUTCH

The clutch assembly is a multiple disc type clutch activated by a hydraulic mechanism. This mechanism is formed by a carrier for 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.

FORWARD MODE

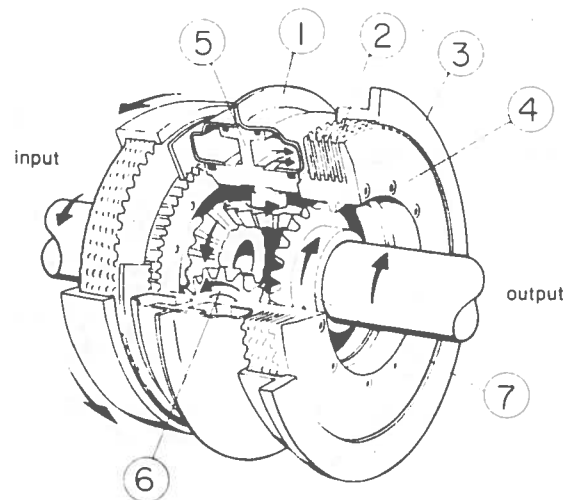
At all times, stub shaft (1), clutch driving drum (2) and driving gear (8) are turning in engine rotation direction at engine speed.

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 (8). 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.



REVERSE MODE

Reverse is achieved when cylinder (1) is pressurized and slides against reverse clutch discs (2) clamping them together. Half of 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.

2.5 HYDRAULIC SYSTEM

Pressurized oil is provided by a gear type oil pump which is externally mounted and engine driven by means of a splined shaft. The pump includes a pressure relief valve to maintain the correct operating pressure. Oil is drawn from the sump to the pump through a suction hose and then sent under pressure to an oil cooler and then to the selector valve. The selector valve is used to obtain forward, neutral or reverse by routing the high pressure oil through internal passages to the clutch. Low pressure oil is channeled to cool bearings, gears and clutch discs. An oil dam keeps the transmission oil within the transmission housing.

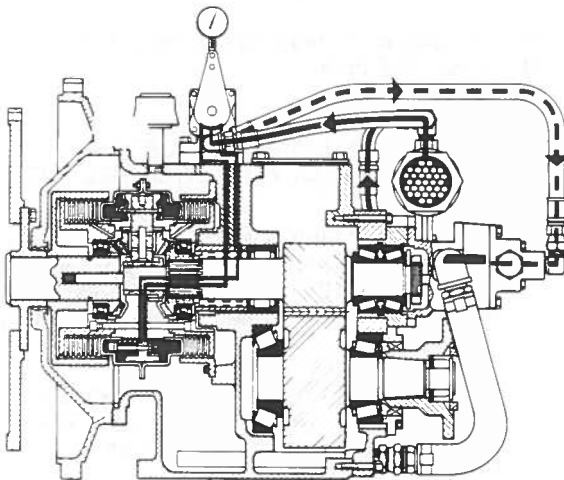
In neutral the ports to both the forward and reverse sides of the clutch cylinder are opened and the balanced pressure that results keeps the clutch cylinder centered between the forward and reverse clutch discs. Oil is distributed through the lubrication system.

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. In forward or reverse, oil is also distributed through the lubrication system.

High Pressure Oil ■

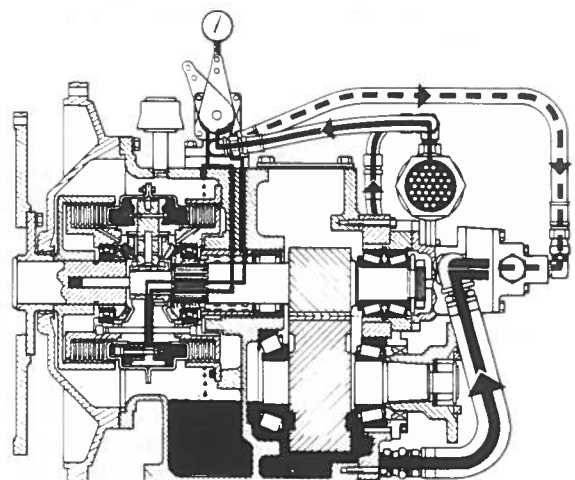
Exhaust Oil ■

Lubrication Oil ■



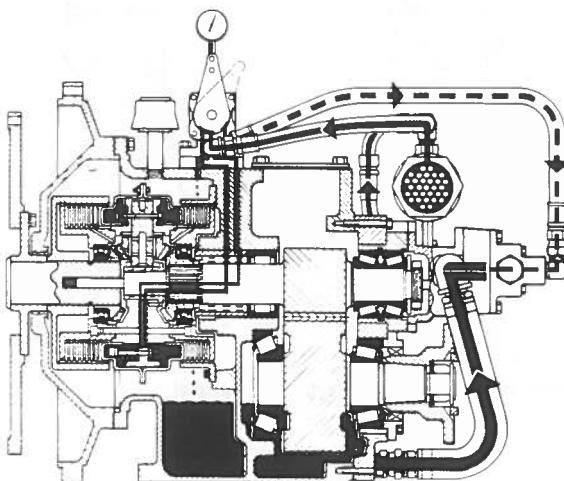
NEUTRAL

Both the forward and reverse halves of the clutch cylinder are opened to high pressure oil.



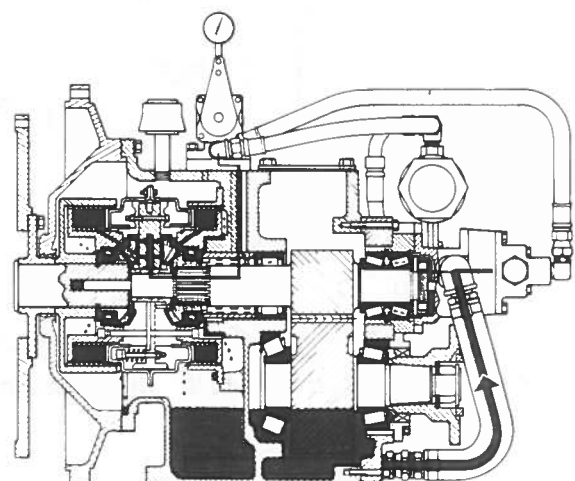
FORWARD

The forward half of the clutch cylinder is opened to high pressure oil while the reverse half of the cylinder is exhausted to sump.



REVERSE

The reverse half of the clutch cylinder is opened to high pressure oil while oil in the forward half is exhausted to sump.



LUBRICATION

Positive pressure oil is provided to all gears, bearings, clutch discs and moving parts.

SECTION 3. INSTALLATION AND OPERATION

NOTE: IMPROPER INSTALLATION AND ALIGNMENT IS THE GREATEST CAUSE OF TRANSMISSION FAILURE. PLEASE FOLLOW ALL INSTRUCTIONS CAREFULLY.

3.1 UNCRATING AND HANDLING

Tapped holes have been provided for insertion of lifting eyes to aid in handling of unit. Average weight of HE-10200 is 400 lbs., the 10700 is 600 lbs.

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 PREPARATION

SPECIAL TOOLS REQUIRED

- | | |
|-------------------------------|------------------|
| 1. Chain Hoist or equivalent | 3. Feeler Gauge |
| 2. Thousandths Dial Indicator | 4. Straight Edge |

To insure proper alignment of driving members it is necessary that engine flywheel housing, flywheel, oil dam and stub shaft be dial indicated to insure trueness. Make sure all surfaces are clean.

1. (Fig. 3A) 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. 3B) Mount indicator with stem 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.

3. (Fig. 3C) Mount indicator to flywheel housing so that stem is on inner face of flywheel. Record deviation of face runout. It must not exceed a **total indicator reading** of .007 inch.

4. (Fig. 3D) Set stem to ride on the pilot bore of the engine flywheel as shown. 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 inch.

NOTE: KEEP ALL MATING SURFACES CLEAN. USE CLEANING SOLVENT OR DIESEL FUEL.

5. Separate clutch from clutch driving drum and flywheel adapter.

Remove snap ring and drum from stub shaft. Do not remove drive flange assembly from flywheel adapter.

6. Thoroughly clean the flywheel adapter and flywheel mating surfaces and secure adapter to flywheel. **Note:** Do not tap stub shaft as a means to secure flywheel adapter.

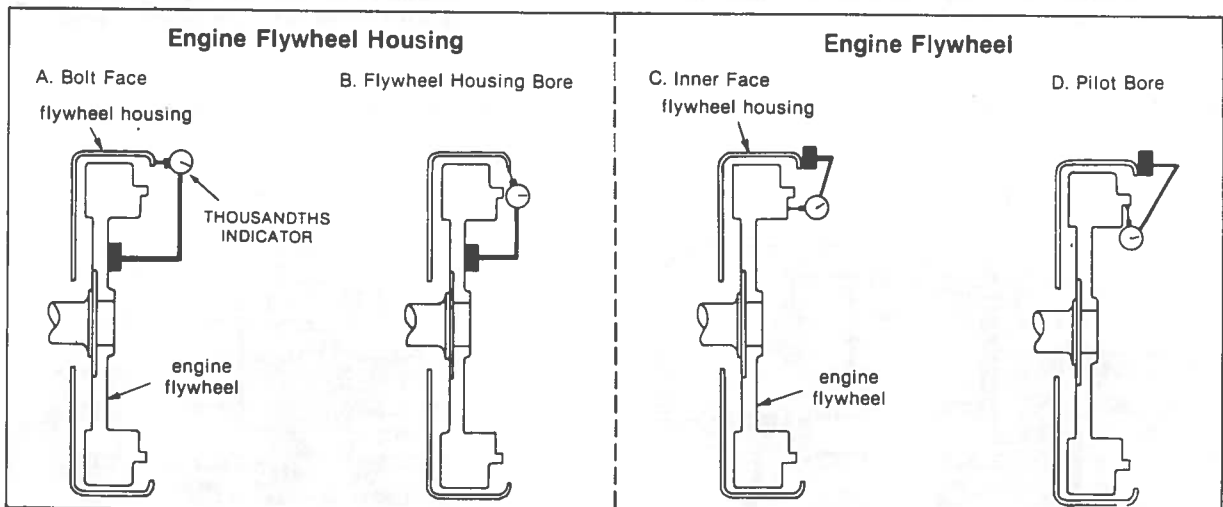


Figure 3. Dial Indicating Engine Flywheel Housing and Engine Flywheel.

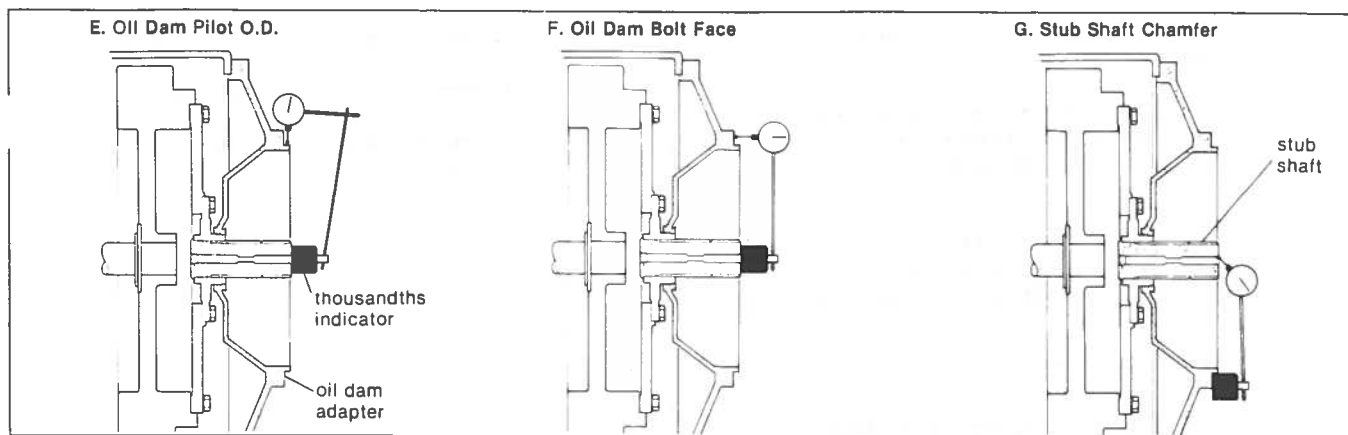


Fig. 4. Dial Indicating Oil Dam and Stub Shaft.

7. Place oil dam housing on engine flywheel housing. "Top" mark goes up. Tighten 2 capscrews to hold oil dam in place.

8. Dial indicate rear oil dam pilot O.D. as shown in figure 4E. Dial indicate bolt face as shown in figure 4F. Record both readings. **Total indicator readings must not exceed .007 inch.**

9. Dial indicate the stub shaft as shown in figure 4G. Record the reading. **Total indicator readings must not exceed .007 inch.**

The sum total of all readings in steps 7 & 8 must not exceed .007 inch.

10. Check clearance between stub shaft O.D. and oil dam ID with feeler gauge. **Minimum clearance must not be less than .006".** Secure with selflocking fasteners before continuing.

11. Install driving drum on splined stub shaft. Install snap ring in place making sure ring is seated in groove. See figure 5.

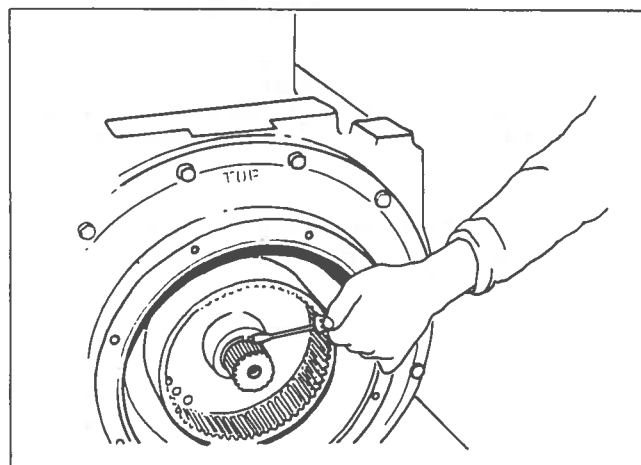


Fig. 5. Placement of snap ring on stub shaft.

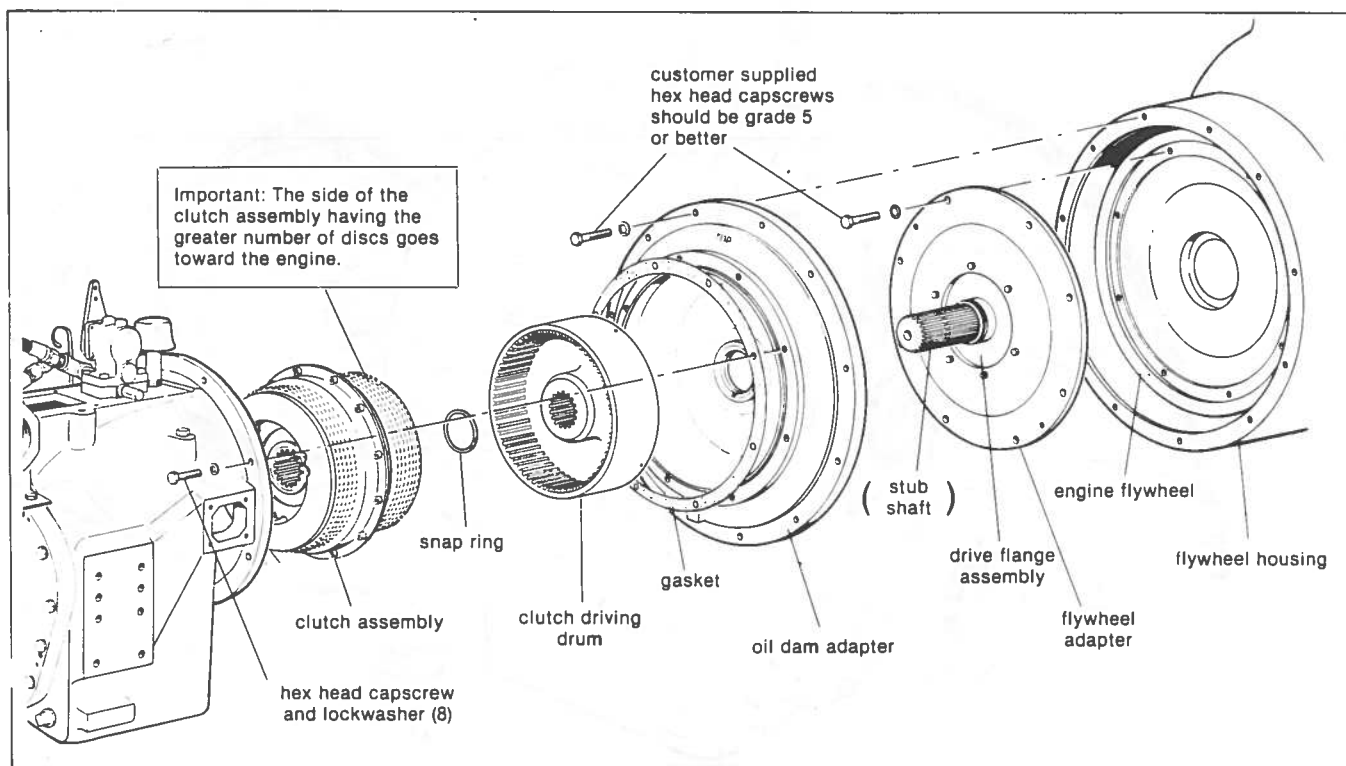


Fig. 6. Assembly Sequence of Clutch and Adapter Parts.

12. Install clutch into driving drum and on to stub shaft.

To facilitate installation: align teeth of clutch discs first; slide and twist assembly into driving drum until clutch assembly seats.

NOTE:

The end of clutch assembly having the greater number of discs must be installed toward engine.

13. Position gasket on oil dam mounting face.

14. Remove pump and pump shaft.

15. Remove side inspection cover to facilitate installation.

3.3 INSTALLATION OF TRANSMISSION

1. Using suitable hoist, lift marine gear assembly into position behind engine. Ease unit forward over clutch assembly, taking care that clutch discs enter reverse drum properly so that teeth are not damaged. See fig. 7.

NOTE:

Use screwdriver through side inspection hole and move disc teeth to align with reverse drum. See fig. 16.

2. Secure main housing to oil dam housing. Tighten capscrews to 31 pounds-foot torque.

3. Check clutch end float as follows:
a) Insert screwdriver through side inspection hole and pry clutch fore and aft.
b) End float should be $1/16''$ to $3/32''$.
c) Replace gasket and inspection covers.

4. Install pump shaft with short splined end toward engine making sure splines are engaged.

5. Secure oil pump and oil cooler. Tighten oil pump capscrews to 18 pounds - foot torque.

6. Connect all hoses.

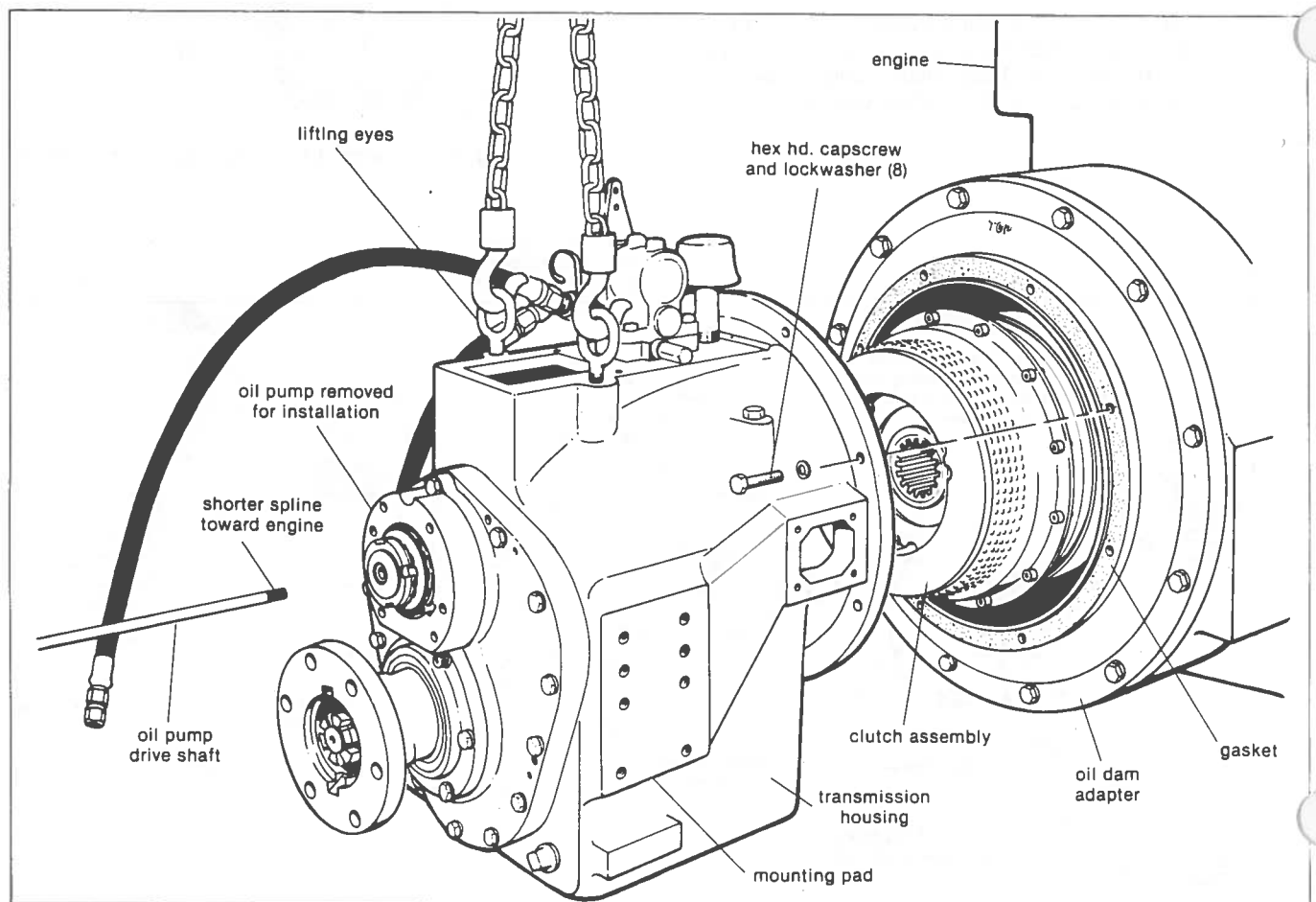


Fig. 7. Installation of Transmission Housing.

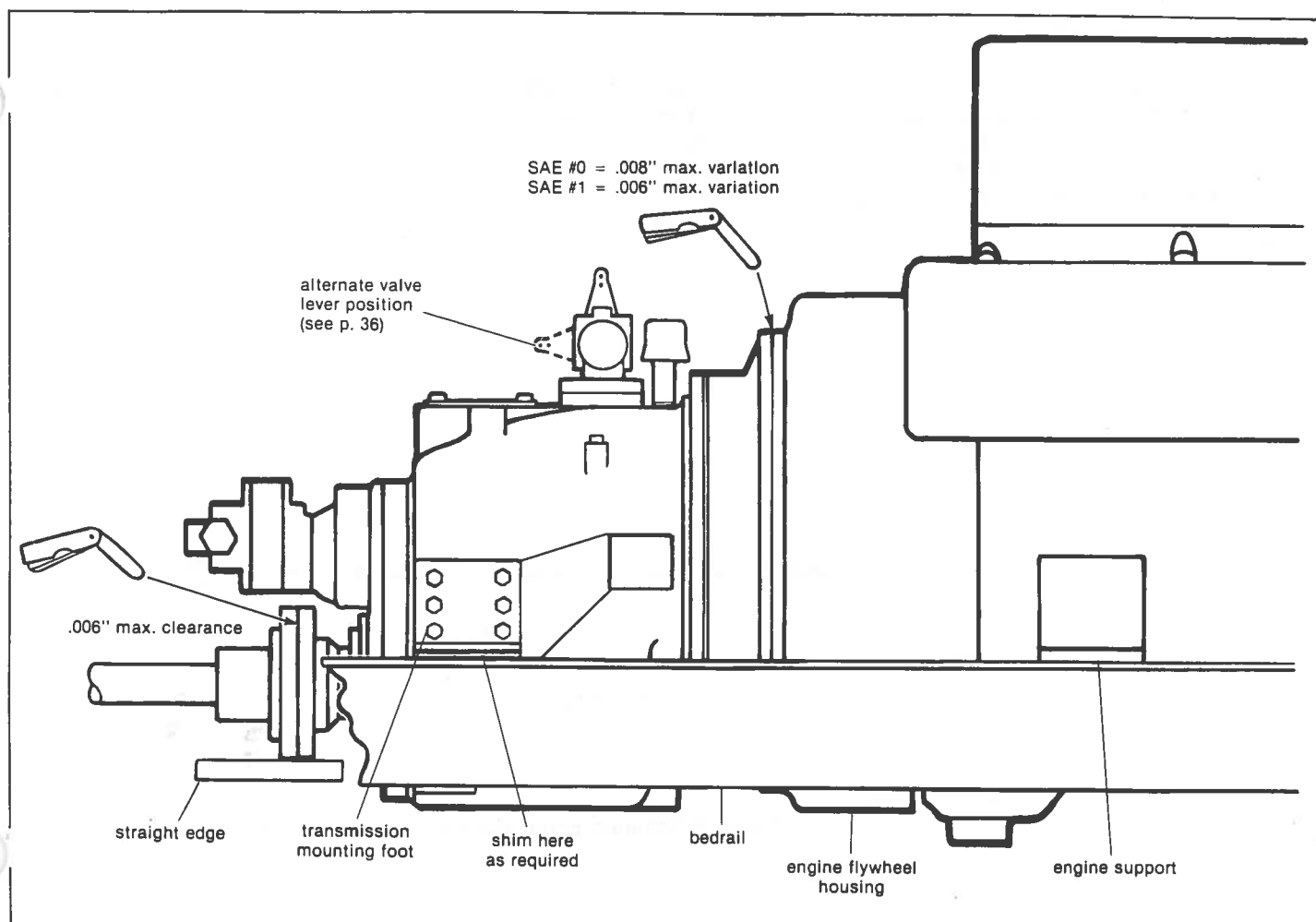


Fig. 8. Alignment of Output Coupling.

3.4 ALIGNMENT OF OUTPUT COUPLING

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 frame, keelsons, etc.

The distance of the first shaft bearing from the mating surface of the marine gear output coupling is extremely important. To avoid undue force on the marine gear bearings, the propeller shaft bearing should be located at least twelve and preferably twenty shaft diameters from the marine 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 align propeller shaft coupling to marine gear coupling. Lay a straight edge across the edges at top and sides to line up couplings. **Do not burr or mar mating surfaces.** Insert feeler gauge between couplings and run it all around the flange. Clearance should not be more than .006" at any point. Shim engine and marine gear as necessary.

Loosen capscrews holding oil dam adapter to engine flywheel housing and check with feeler gauge. Maximum variation for SAE #0 housing is .008"; for SAE #1 housing is .006".

Tighten four gear housing capscrews at 90° intervals. Secure engine and gear mounting feet. Loosen four gear housing bolts. Recheck housing and coupling parallelism. If within limits tighten housing and coupling bolts.

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.

NOTE: Oil coolers and hose and bracket kits are shown on pages 54-56.

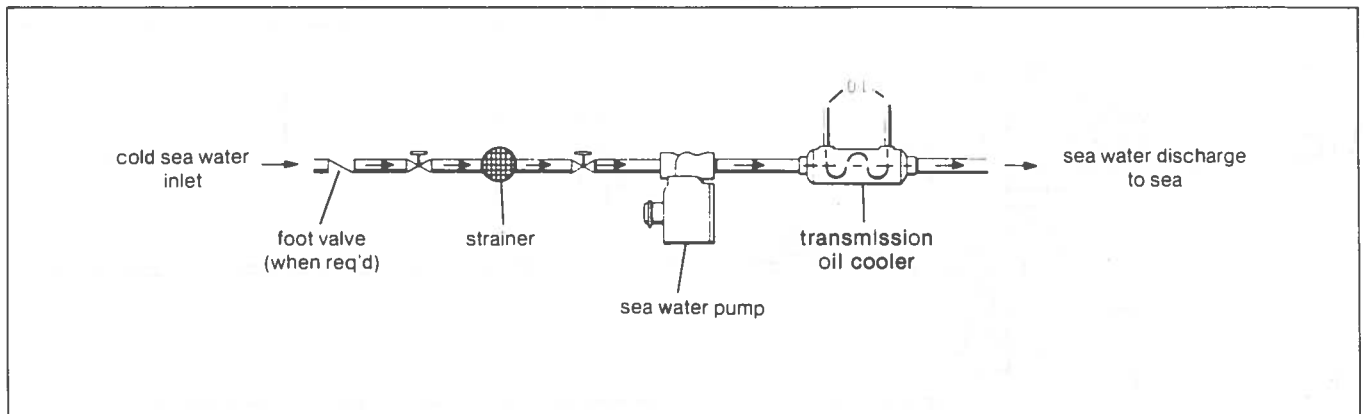


Figure 9. Separate pump system

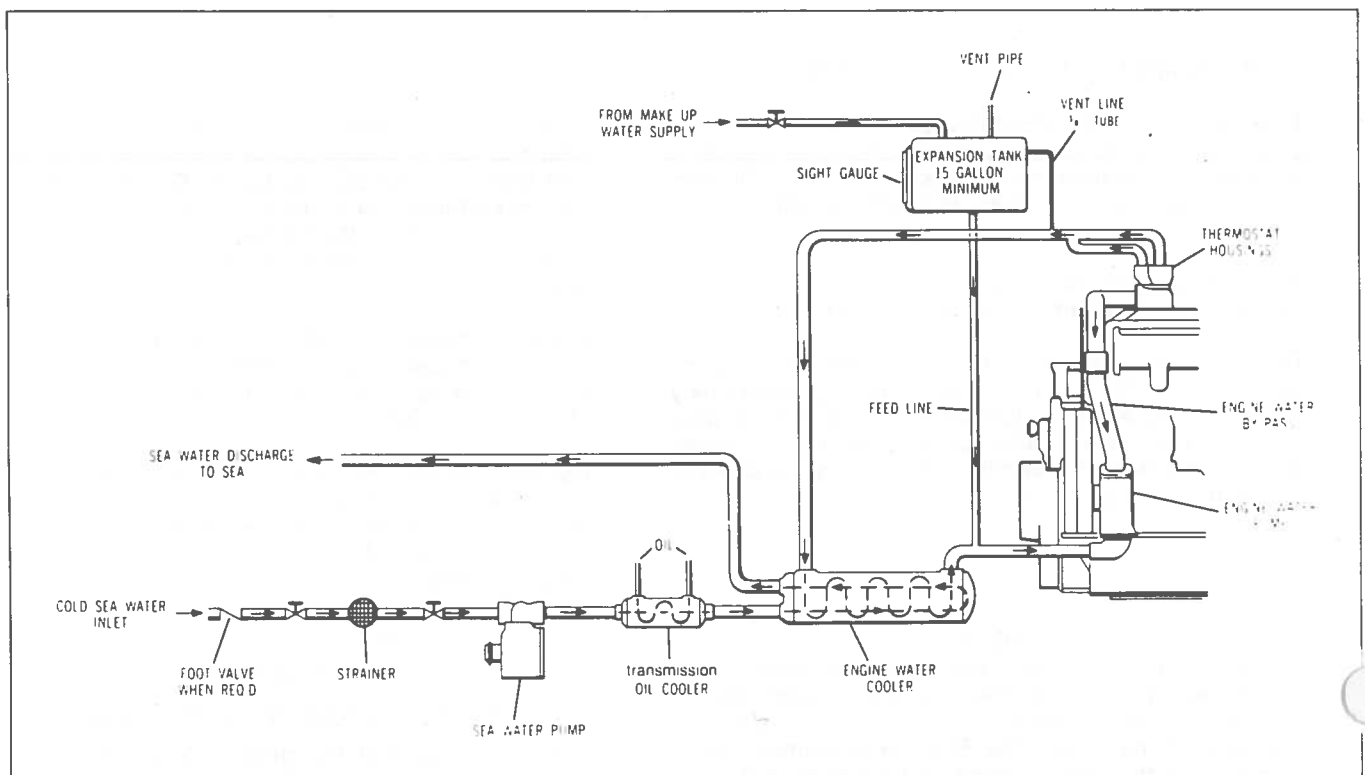


Figure 10. Heat exchange system

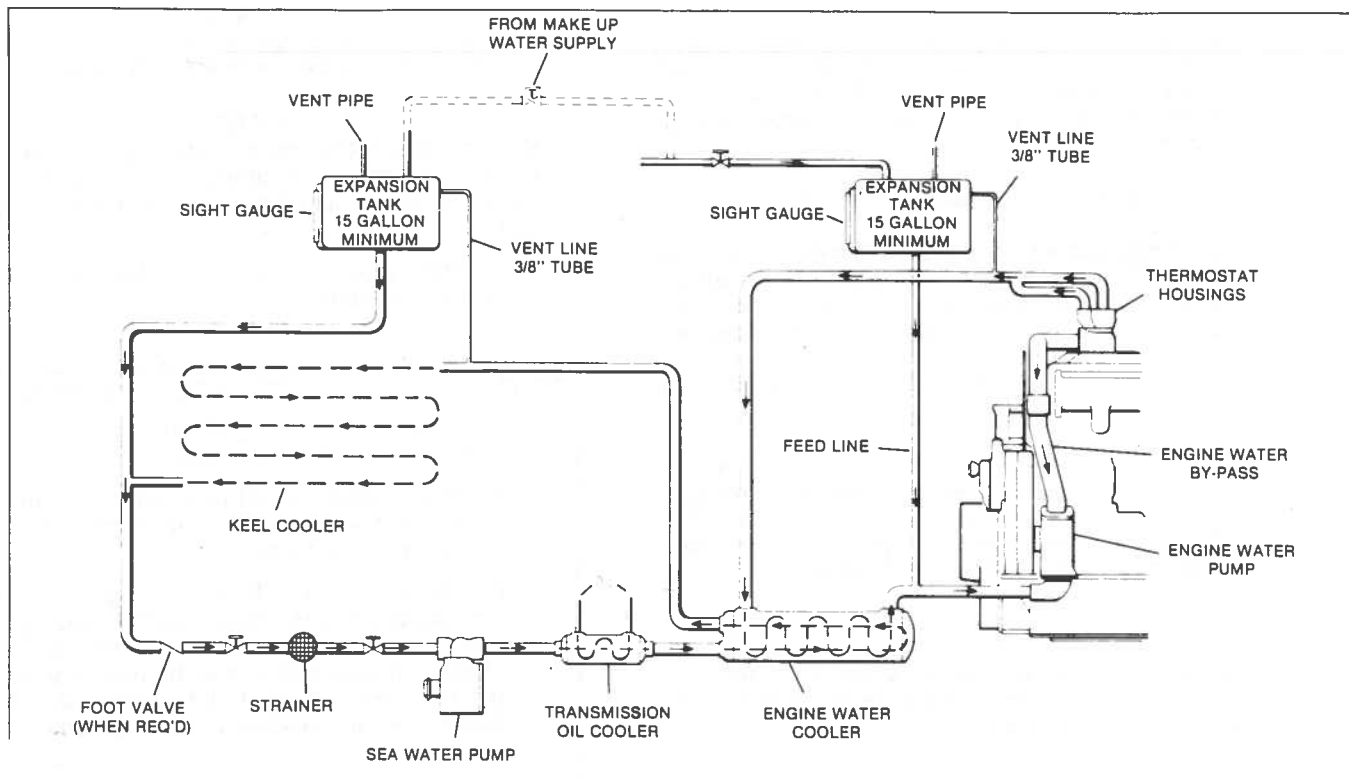
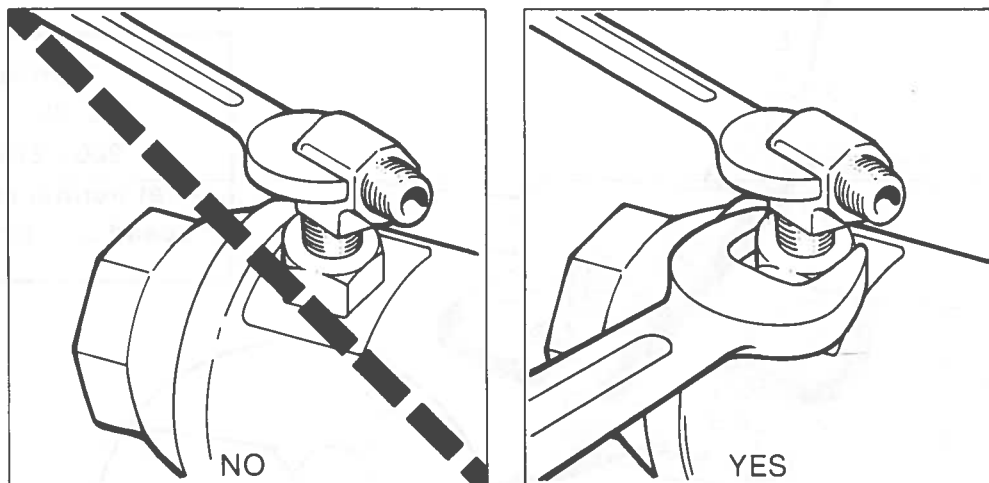


Figure 11. Keel cooler system



CAUTION: ALWAYS USE BACKUP WRENCH
ON COOLER FITTINGS

3.6 START-UP PROCEDURE

1. Remove reduction gear inspection cover and pour in recommended oil until level is up to full mark on dipstick (see lube chart). Replace inspection hole cover but do not secure.

2. Install pressure gauge of 300 pound capacity directly on top of gear or on bulkhead. Connect gauge to control valve with 1/8" hydraulic hose. (Note: Electric type oil pressure gauges are not recommended.)

Marine 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 marine gear, preventing premature wear before load is applied.

4. Start engine and check all connections for leaks.

5. Oil pressure is adjusted at factory for testing purposes only and it may be necessary to readjust pressure to the correct level (200-210 PSI). This should be done at normal operating speed only after maximum temperature is achieved.

NOTE:

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

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 page 12 for capacities).

7. Shift several times to 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 gear.

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

3.7 OPERATING PRACTICES (CAUTIONS)

1. A Capitol marine gear should not be shifted unless engine is at idle speed.

2. Marine gear cannot be operated continuously in reverse mode for more than 30 minutes at 75% of available horsepower.

3. '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).

4. Do not operate unit with high or low pressure or if oil temperature exceeds 180°F.

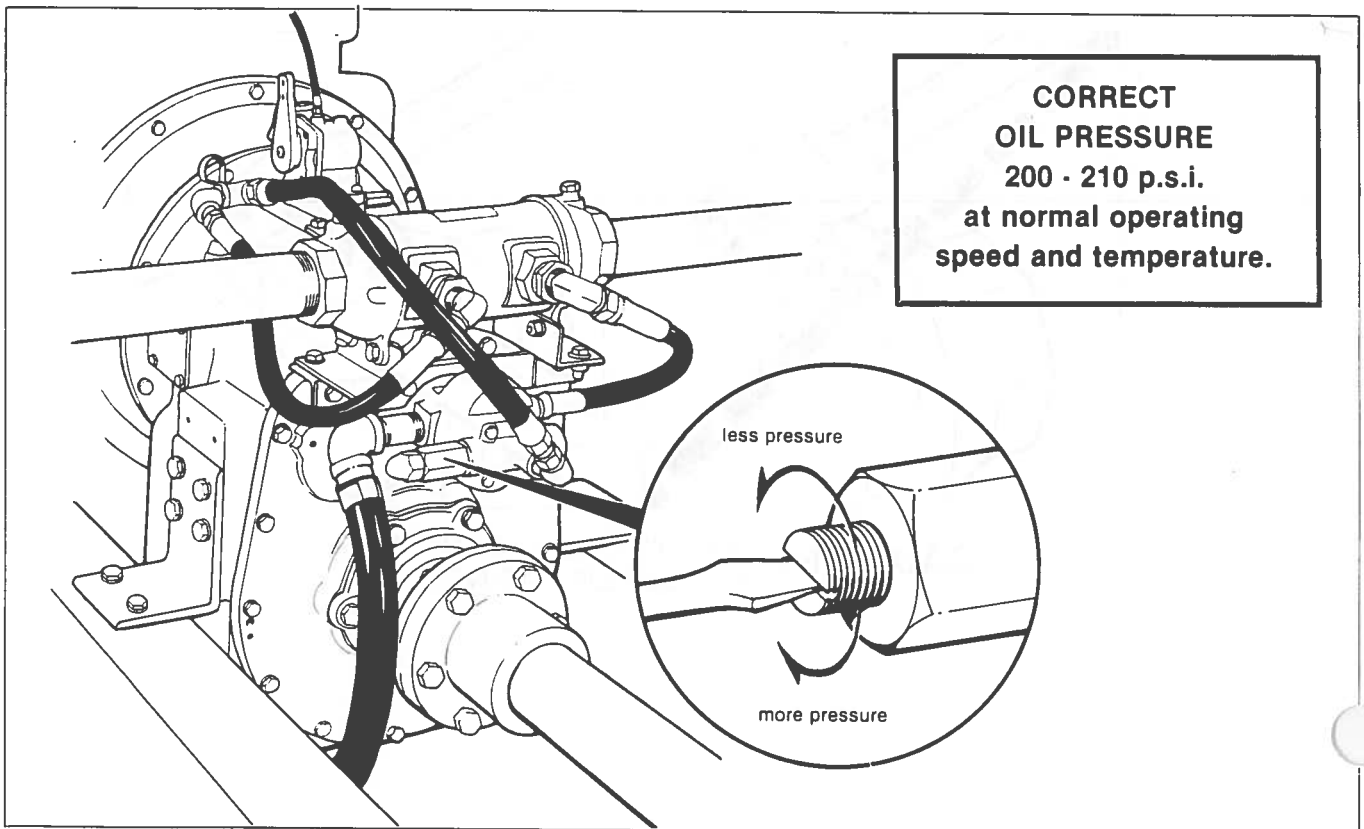


Fig. 12. Adjustment of Oil Pressure.

SECTION 4. PREVENTIVE MAINTENANCE

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

4.1 LUBRICANTS

Use oil meeting requirements of MIL-L-2104B or API SERVICE CLASS. SE/CC. Series 3 oils are not recommended because they may shorten clutch life.

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

Where high ambient temperatures are encountered, over 85°F (29°C), it may be necessary to use SAE 40 motor oil.

Where extremely cold ambient temperatures are encountered, under 30°F (-1°C), it may be necessary to use SAE 20 motor oil.

In all cases, it is recommended that the operating temperature of the lube oil should be approximately 100°F (38°C) to 150°F (66°C), with that temperature being taken at the oil line leaving the cooler or at the control valve.

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 (approximate, depending on cooler, hose length, etc.)

HE-10200: 7 quarts (6.5 liters)

HE-10700: 9 quarts (8.5 liters)

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 must be at least 200-210 PSI at normal operating speed and maximum operating temperature.

Pressure Adjustment

See fig. 12, p. 11.

Oil Temperature

Operating oil temperature range is 100°-150°F (38°-66°C) 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.

Screen Oil Filter

The screen filter should be removed and cleaned **every 400 hours** of operation or at the same time oil is changed. Fresh diesel fuel can be used. Use pipe thread compound when reinstalling screen filter.

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. 11.

Inspection/Overhaul Interval

A complete inspection of the Capitol marine 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 marine gear at this time (See section 7.)

4.3 MAINTENANCE SCHEDULE AND CHECK SHEET

Engineer _____

Reverse Gear Serial No. _____

Date Service Began _____

INTERVAL normal operation	MAINTENANCE DESCRIPTION	RECORD
DAILY	-Check oil level -Check oil pressure	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>
After first 100 hours	-Change oil. Flush sump if necessary.	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>
Every 400 hours	-Check zinc pencils -Change oil -Remove and clean oil breather	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>
Every 2000 hours	-Check water tubes in cooler	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>
At engine overhaul	-Inspect clutch and all gearing and replace as necessary - Inspect and/or overhaul entire transmission.	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>
Frequently	-Check all oil lines and connections -Check all external components -Check all mounting bolts -Check alignment	<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <!-- Grid representation --> </div>

SECTION 5. TROUBLE SHOOTING

5.1 TROUBLE/REMEDY CHART

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.
	2. Low oil level.	2. Inspect gaskets, seals, hoses and fittings for leakage. Pressure test oil cooler - tubes may leak.
	3. Clogged suction screen.	3. Remove screen and clean with solvent. Blow dry.
	4. Clogged parts in selector valve, baseplate or housing.	4. Flush clean with solvent and blow dry.
	5. Dirt or sludge in transmission.	5. Remove drain plugs, 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 to 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 (page 17) or fig. 12, p. 11.
	7. Incorrectly adjusted pressure relief valve.	7. See fig. 12, page 11.
	8. Oil too hot.	8. Check heat exchanger system for clogged oil cooler or hoses.
	9. Worn commutator bushings.	9. See wear limits chart (p. 22)
	10. Incorrect lubricant.	10. See lube chart (p. 12).
	11. Scratched clutch cylinders or hard O'rings in clutch cylinders.	11. Replace as necessary (p. 24).
B. High oil pressure (at full operating speed and temperature)	1. Incorrectly adjusted pressure relief valve.	1. Refer to fig. 12, p. 11.
	2. Incorrect oil.	2. See lube chart (p. 12).
	3. Cold oil.	3. Check heat exchanger system.
	4. Cold oil at start-up.	4. Transmission should be pre-heated see p. 11
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 page 12.

D. Overheating	<ol style="list-style-type: none"> 1. Insufficient oil cooler capacity. 2. Insufficient flow of cooling water. 3. Clutch slipping. 4. Water temperature too high at cooler. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Bearings worn or broken. 2. Gears worn or broken. 3. Noise in forward only. 4. Noise in reverse only. 5. Improper alignment. 	<ol style="list-style-type: none"> 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 section 3.
F. Noisy Pump	<ol style="list-style-type: none"> 1. Dirt or sludge in oil. 2. Clogged hoses. 3. Pump cavitation. 4. Defective oil pump assembly. 	<ol style="list-style-type: none"> 1. Remove oil pump and hoses. Clean thoroughly and reinstall. 2. Clean and replace as required. 3. Oil level may be too low. 4. Refer to oil pump section p. 17.
G. Clutch does not release	<ol style="list-style-type: none"> 1. Transmissiioin is misaligned. 2. Improper oil in sump. 3. Clutch discs warped. 4. Forward and reverse clutch cylinders dirty or distorted. 5. Rear commutator bushing is worn. 6. Incorrect linkage adjustment to selector valve assembly. 7. Clutch discs fused due to slippage and overheating. 	<ol style="list-style-type: none"> 1. Refer to Installation Section, p. 5-8. 2. Refer to lube chart, p. 12. 3. Replace as necessary. 4. Clean or replace as necessary. 5. Replace as necessary. See replacement wear limits chart, p. 22. 6. Adjust linkage. 7. Replace as necessary.
H. Clutch slipping	<ol style="list-style-type: none"> 1. Low oil pressure. 2. Transmission is misaligned. 3. Oil temperature too high. 4. Worn clutch discs. 5. Incorrect linkage adjustment to selector valve assembly. 6. Improper oil. 	<ol style="list-style-type: none"> 1. See symptom A. 2. Refer to Installation Section, p. 5-8. 3. Temperature should be 100° to 150 °F (38° to 66 °C.) at selector valve. Check heat exchanger system. 4. Replace as necessary, see replacement wear limits chart, p. 22. 5. Adjust linkage. 6. See lube chart, page 12.

5.1 TROUBLE/REMEDY CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
I. Clutch burned out	<ol style="list-style-type: none"> 1. Low oil pressure 2. Clutch is shifted at other than engine speed. 3. Transmission misaligned 4. Excessive heat. 	<ol style="list-style-type: none"> 1. See symptom A. 2. Install interlock shift controls. 3. Check installation and alignment as described in installation section, p. 5-8. 4. Check cooling system, see p. 9.
J. No neutral	<ol style="list-style-type: none"> 1. Transmission is misaligned 2. Warped clutch discs. 3. Scored clutch cylinders. 4. Damaged clutch o-rings. 5. Worn or damaged commutator bushings (forward or rear). 6. Worn selector valve. 	<ol style="list-style-type: none"> 1. Refer to Installation Section, p. 5-8. 2. Replace as necessary. 3. Replace as necessary. 4. Replace all 4 o-rings. 5. Replace as necessary. See replacement wear limits chart, p. 22. 6. Replace if necessary. Note: Selector valve is the least likely source of trouble. See p. 19.
K. Clutch engages too slow	<ol style="list-style-type: none"> 1. Cylinder timing screw out of adjustment. 	<ol style="list-style-type: none"> 1. Remove dome nut and adjust screw (counter-clockwise) to speed up reaction. See fig. 24, p. 27.
L. Clutch engages too fast	<ol style="list-style-type: none"> 1. Cylinder timing screw out of adjustment 	<ol style="list-style-type: none"> 1. Remove dome nut and adjust screw in (clockwise) to delay reaction. See fig. 24, p. 27.

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 temperature may exceed 200°.

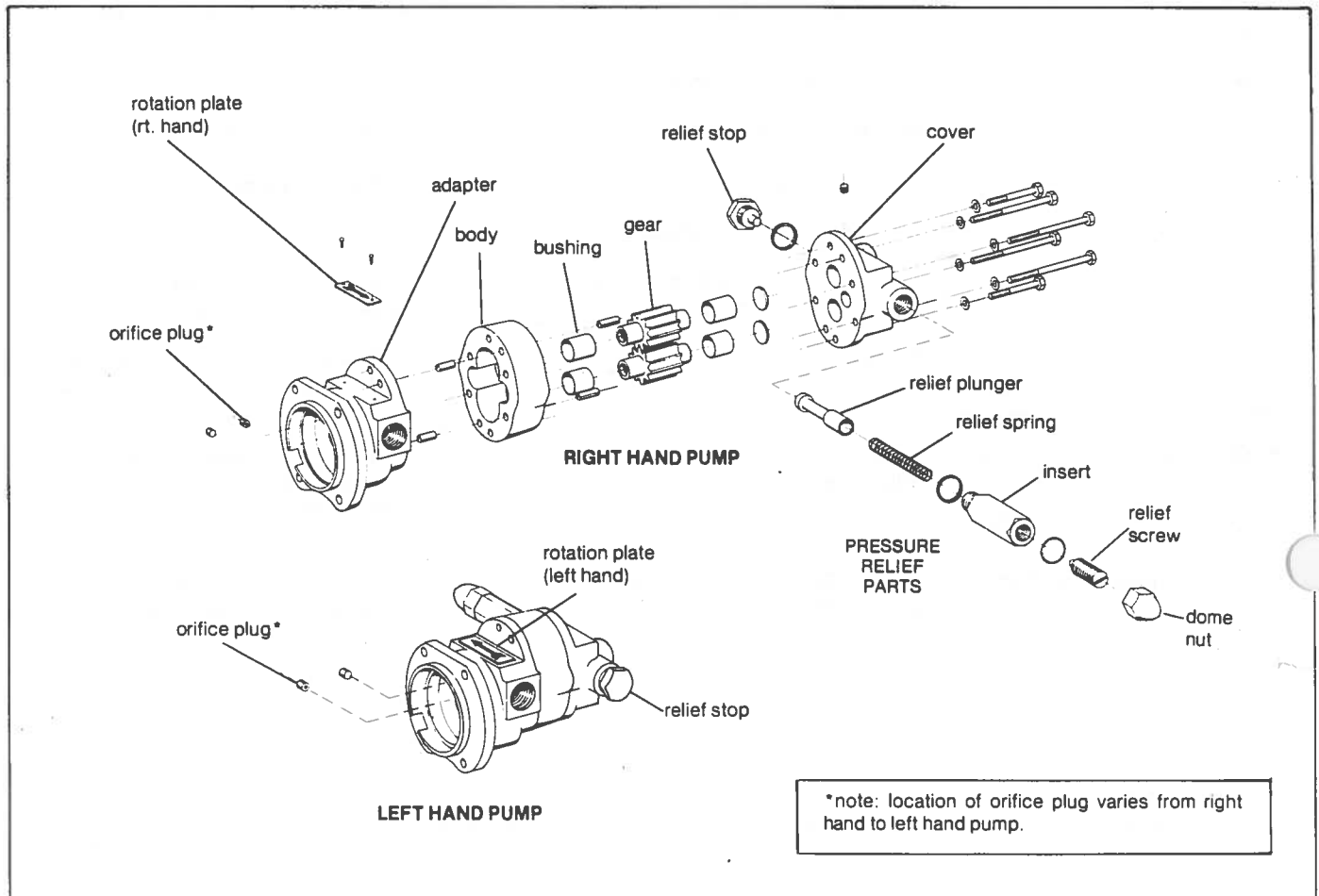


Fig. 13. Oil Pump Assembly

6.1 OIL PUMP ASSEMBLY

A. OIL PUMP DISASSEMBLY

1. Remove oil pump assembly and oil cooler bracket from main housing cover by removing upper capscrews (2), lower capscrews (2) and attached hoses.
2. Remove capscrews (6) and lockwashers (6) securing pump cover, pump body and pump adapter.
3. Using a soft hammer, separate cover, body and adapter from spring pins. NOTE: FOR REASSEMBLY, PUNCH MARK ALONG SIDE OF COVER, BODY AND ADAPTER.
4. Remove pump gears resting in adapter.

5. Remove relief stop carefully, dome nut, relief insert, and accompanying washers. NOTE: PRESSURE RELIEF SPRING IS UNDER TENSION.

6. Unscrew and separate pressure relief screw from insert and push pressure relief spring toward center of cover to push out relief plunger.

B. CLEANING AND INSPECTION

1. Remove all permatex and clean all parts with good grade cleaning solvent or diesel fuel. Blow dry with compressed air.
2. Check to see that each oil passage is clear.

3. Inspect gears and oil pump body for damage or excess wear. See replacement wear limits chart, page 16.

4. **INSPECT ALL MATING SURFACES FOR SMOOTHNESS.** Inspect cover and adapter for wear caused by gears. If grooving does not exceed .030" surfaces can be repaired by grinding smooth (.030" max. cut).

5. Inspect bushings in pump cover and adapter for excessive wear, out of round conditions, or burrs.

6. Check relief plunger for free movement in cover bore. Inspect plunger and plunger bore.

IF BUSHINGS, GEARS OR PLUNGER BORE ARE BADLY WORN WE RECOMMEND REPLACING THE ENTIRE PUMP AS AN ASSEMBLY.

C. ASSEMBLY

1. Generously lubricate pump gears with lubriplate, vaseline, or engine weight oil and position them in adapter. NOTE: BE SURE SPLINE ENDS (INSIDE DIAMETER OF PUMP GEARS) ARE TOWARD COVER.

2. To both mating surfaces of body, sparingly apply a **very thin coat** of 'SUPER 300' permatex or equivalent. Too much sealer can prevent pump from functioning.

3. Place body on adapter and cover on body following punch marks.

4. Secure cover and body to adapter with capscrews and lockwashers, -finger tight.

5. Drive two spring pins into cover and body until flush.

6. With spring pin driver (Special Tool No. 1-90009-0000) drive spring pins (2) down through cover into body and adapter until mark on spring pin driver is even with top of holes in cover (1 3/16 inches from surface).

7. Insert long splined end of pump shaft through adapter into pump gear and revolve shaft to check ease of operation.

8. Tighten all six capscrews to 8 foot-pounds torque.

9. Remove any excess permatex from seams with solvent.

10. Recheck for ease of operation.

11. Generously lubricate relief plunger with vaseline or lubriplate and position cup end first in bore of cover from relief stop end. Check to make sure plunger slides freely.

12. Apply washer and screw relief stop just enough to start threads.

13. Insert pressure relief spring into opposite side of cover.

14. Screw pressure relief screw into relief valve insert just enough to start threads.

15. Install insert and washer with pressure screw in place.

16. Tighten relief stop and relief valve insert. Do not tighten relief screw.

17. Cap and lock pressure relief screw with dome nut and washer, and re-check for ease of operation.

18. Apply a thin coat of lubriplate, vaseline, or grease to hold new gasket on adapter.

19. Install oil pump (with new gasket) and oil cooler bracket. Secure in position with lockwashers and capscrews. Tighten to 18 pounds-foot torque.

D. CONVERTING PUMP ROTATION

Capitol Gears, Inc. does not recommend converting a right hand rotation pump to a left hand rotation pump.

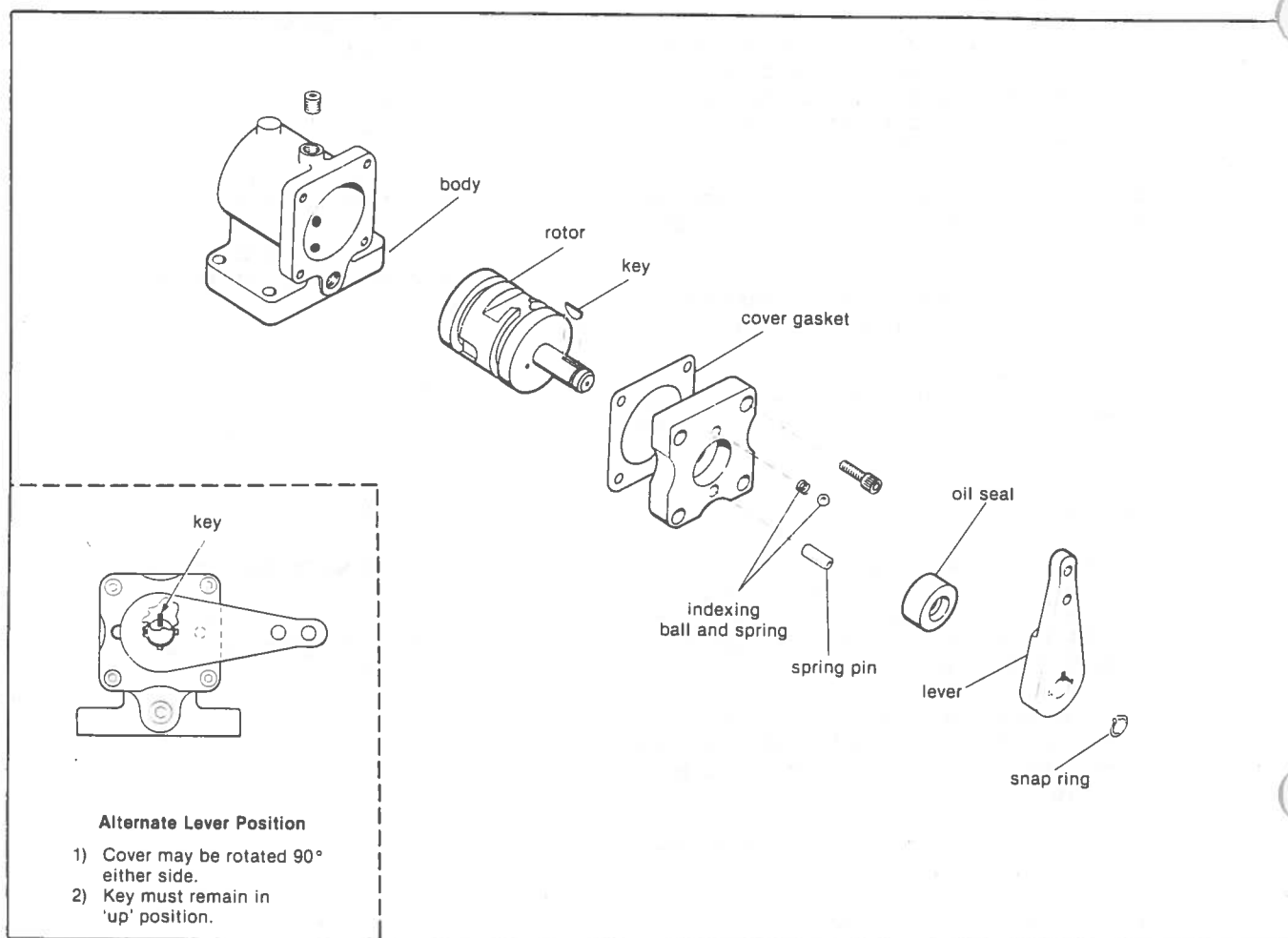


Figure 14. Selector Valve Assembly

6.2 SELECTOR VALVE

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. DISSASSEMBLY

1. Remove snap ring from rotor and note position of keyways on lever to rotor, (matchmark 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.)

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 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 pounds-foot 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. 15 below.

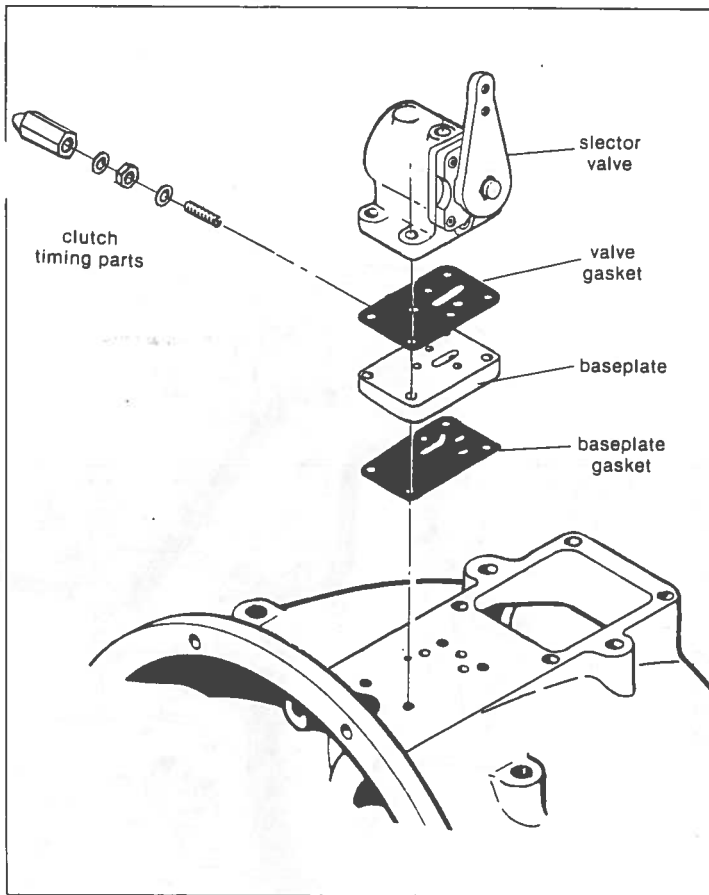


Fig. 15. Sequence of Parts

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 200°F.

7.1 REMOVAL OF TRANSMISSION

1. Remove drain plug at bottom rear of main housing and drain oil from sump.
2. Disconnect all oil lines from oil pump and selector valve, and remove water lines to cooler.
3. Disconnect control linkage from lever on selector valve.
4. Remove selector valve and baseplate and be **very careful** to keep gaskets in proper configuration for future replacement. Refer to fig. 15.
5. Remove side inspection covers.
6. Scribe alignment mark across outside diameter of flanges on output coupling and propeller shaft coupling for exact refit. Disconnect propeller shaft coupling from output coupling.
7. Remove or push propeller shaft back to obtain maximum clearance and remove pilot ring resting between propeller coupling and output drive coupling. NOTE: Protect mating faces of couplings and pilot rings to insure proper refit and alignment.
8. Remove oil cooler, oil pump and oil pump drive shaft at this time. If shaft cannot be completely removed, pull it out as far as possible to prevent bending forward end of shaft during removal.
9. Screw two 3/8"-16 eye bolts into lifting holes on top of main housing and connect hoist so it supports housing.
10. Remove capscrews and lockwashers holding main housing of marine unit to oil dam.
11. Insert screwdriver or similar object through inspection cover opening to hold clutch assembly inside forward drum. Slowly move main housing aft and away from oil dam leaving clutch assembly inside forward drum and on stub shaft.

CAUTION:

Clutch must be maintained in forward drum to prevent falling.

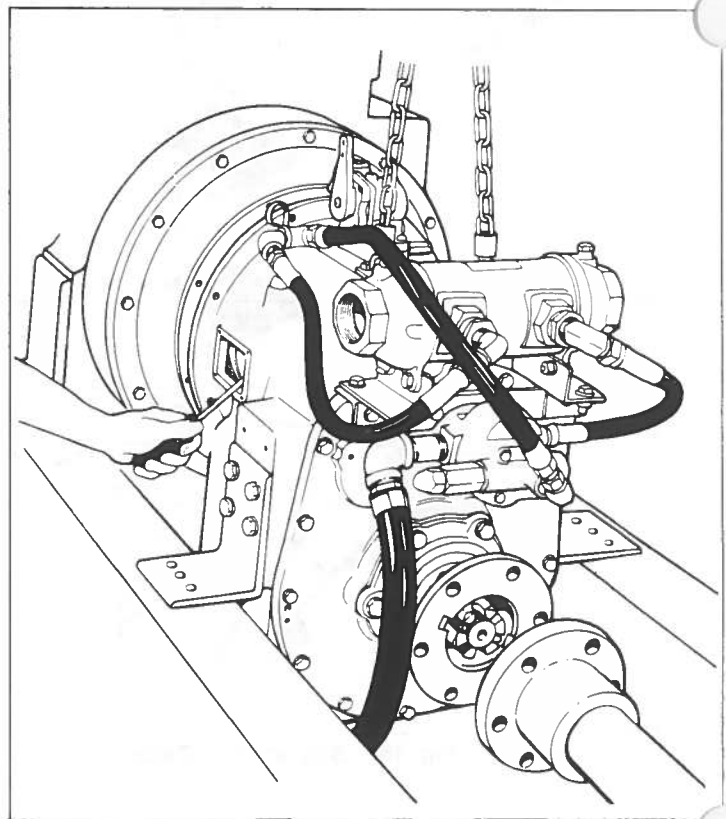


Fig. 16. Removing (or installing) Transmission

12. Remove clutch from clutch driving drum.
13. Remove snap ring from groove on stub shaft.
14. Remove clutch driving drum.

NOTE:

In most cases removal of oil dam, drive flange, and flywheel adapter is not necessary unless further inspection of stub shaft and labyrinth seal indicate damage (see p. 31).

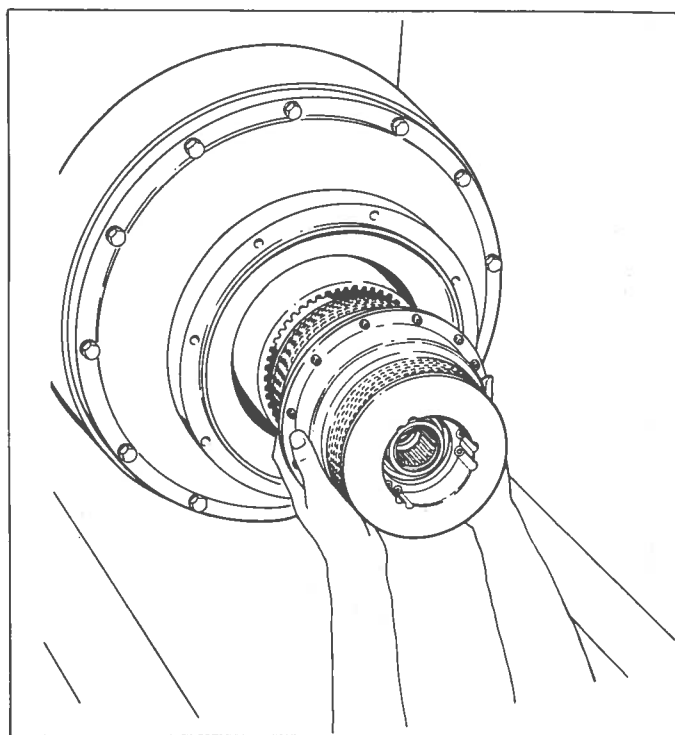


Fig. 17. Removing Clutch Assembly from Clutch Driving Drum.

7.2 TABLE: REPLACEMENT WEAR LIMITS

PART	NEW DIMENSIONS		REPLACEMENT WEAR LIMIT
	MINIMUM	MAXIMUM	
1. BACKLASH-BETWEEN REDUCTION GEARS	.004	.008	.030
2. PINION SHAFT			
O.D. At Forward Commutator	1.1215	1.1225	1.1205
O.D. At Rear Commutator	1.9660	1.9665	1.965
O.D. At Front Bearing	1.9660	1.9665	1.965
3. REAR COMMUTATOR—I.D.	1.9695	1.9700	1.9720
4. FORWARD COMMUTATOR—I.D.	1.1240	1.1260	1.1280
5. CLUTCH PACK THICKNESS—Clutch No. 1-00100-1000			
Forward Pack (Compressed)	1.526	1.675	1.500
Reverse Pack (Compressed)	1.090	1.195	.990
CLUTCH PACK THICKNESS—Clutch No. 1-00100-1500			
Forward Pack (Compressed)	1.526	1.675	1.500
Reverse Pack (Compressed)	1.090	1.195	.990
CLUTCH PACK THICKNESS—Clutch No. 1-00100-1103			
Forward Pack (Compressed)	1.151	1.255	1.050
CLUTCH PACK THICKNESS—Clutch No. 1-00100-1104			
Forward Pack (Compressed)	1.151	1.255	1.050
Reverse Pack (Compressed)	.497	.535	.457
6. CLUTCH DISC THICKNESS			
Driving Disc No. 1-00230-4300	.130	.140	.120
Driven Disc No. 1-00233-0700	.088	.100	.078
Driven Disc (Thick) No. 1-00229-1700	.149	.155	.139
7. OIL PUMP	If deep grooves are present or more than .006" clearance exists between O.D. of gears and body.		
8. SELECTOR VALVE	If grooves more than .025" deep are present.		
9. CLUTCH DRIVING DRUM	If grooves are present across the spline.		
10. REVERSE DRUM			
11. ALL SPLINED PARTS	Replace if fit is not snug.		

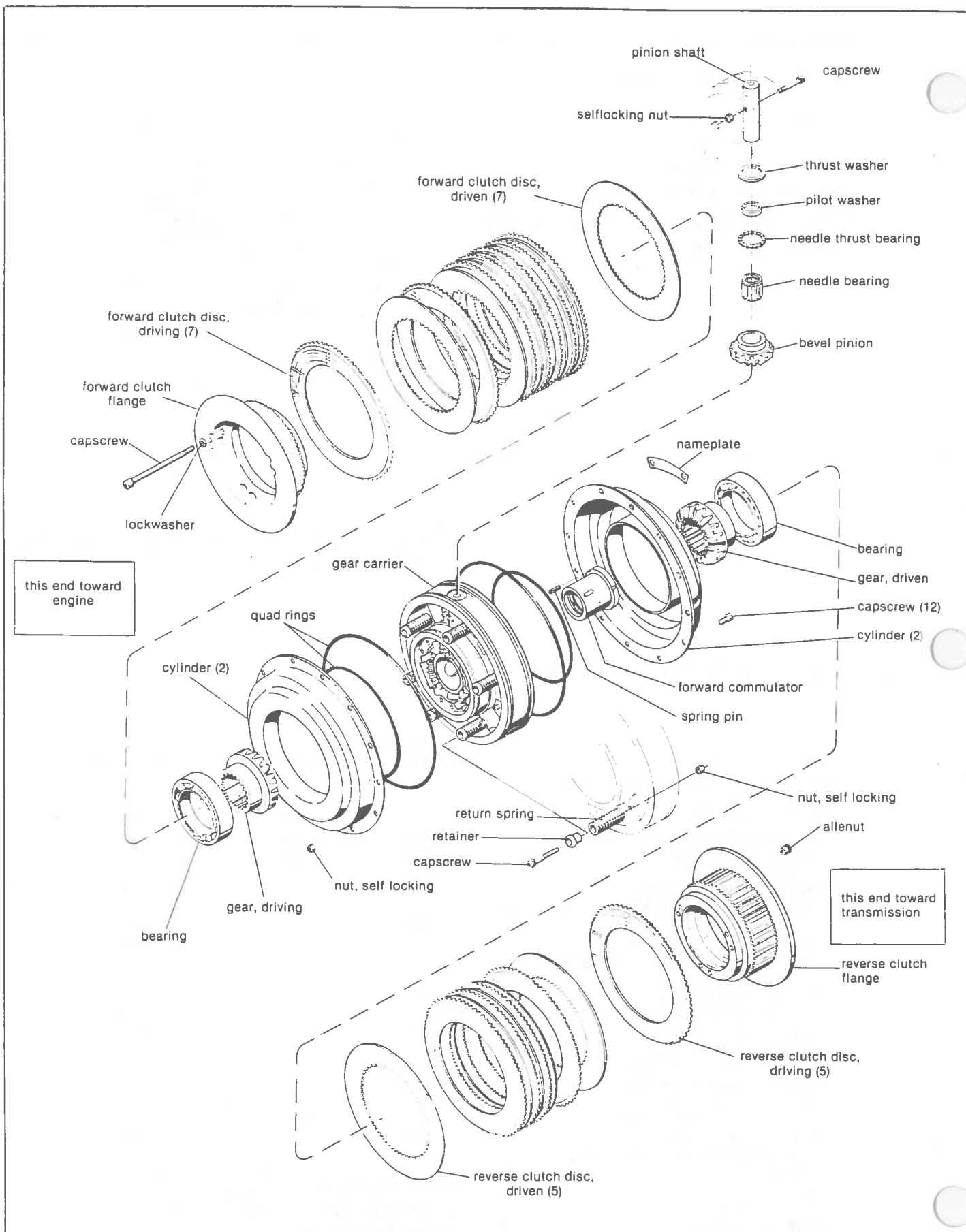


Figure 18. Exploded View of Standard Clutch Assembly No. 1-00100-1000. All other clutches are shown beginning on p. 41.

7.3 CLUTCH

A) DISASSEMBLY

NOTE: FOR REMOVAL INSTRUCTIONS SEE PAGE 21.

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 flanges.
4. Remove 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). Refer to fig. 19.

B) CLEANING AND INSPECTION

1. Inspect 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 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. 22). 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 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 recommended replacing both as a set.

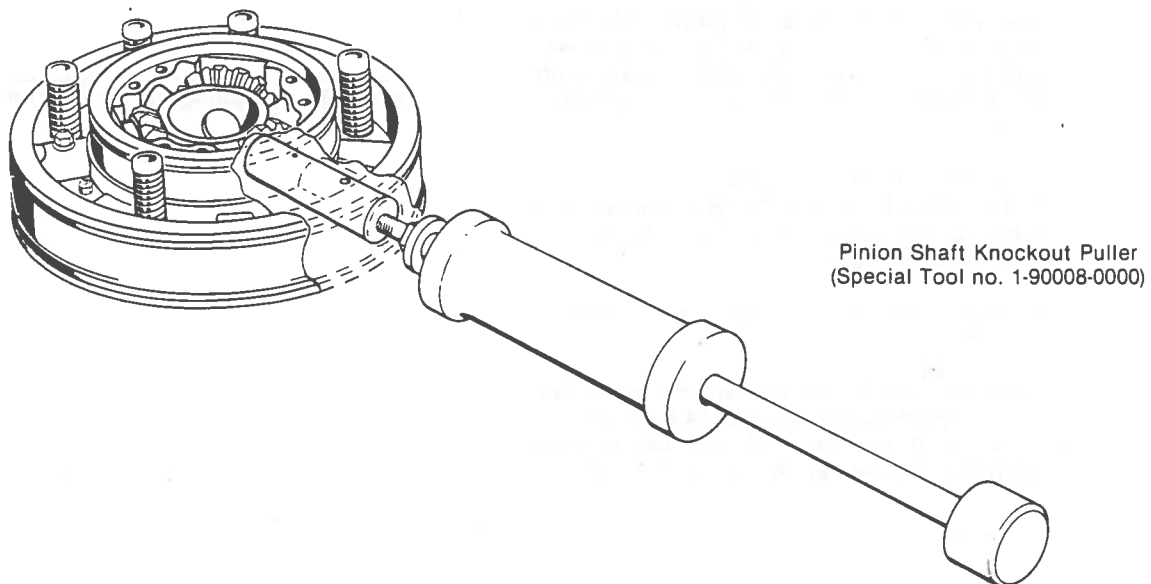


Figure 19. Removal of Pinion Shaft from Gear Carrier.

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 obstructions.

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

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.

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-sieze 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 shafts and bores to ease fit.

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

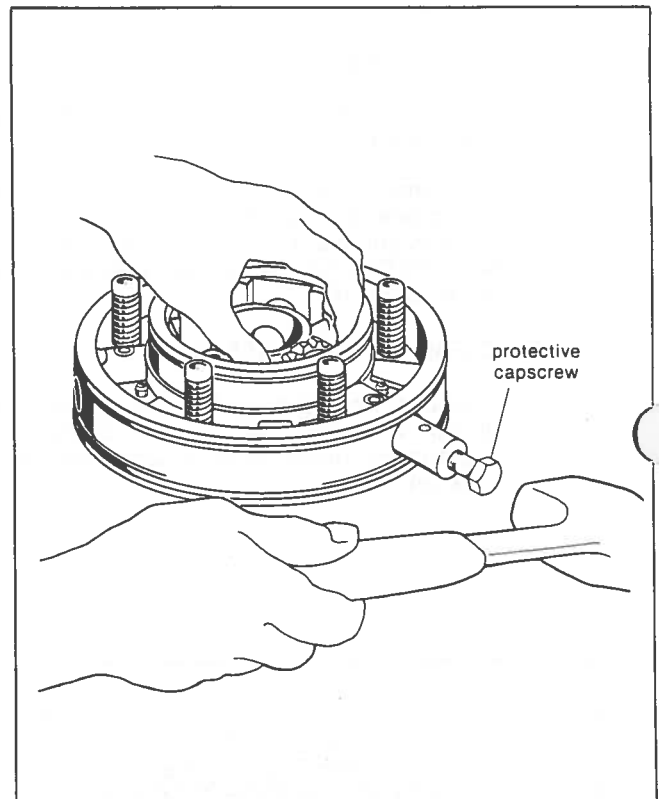


Figure 20. Installing Pinion Shaft in Gear Carrier.

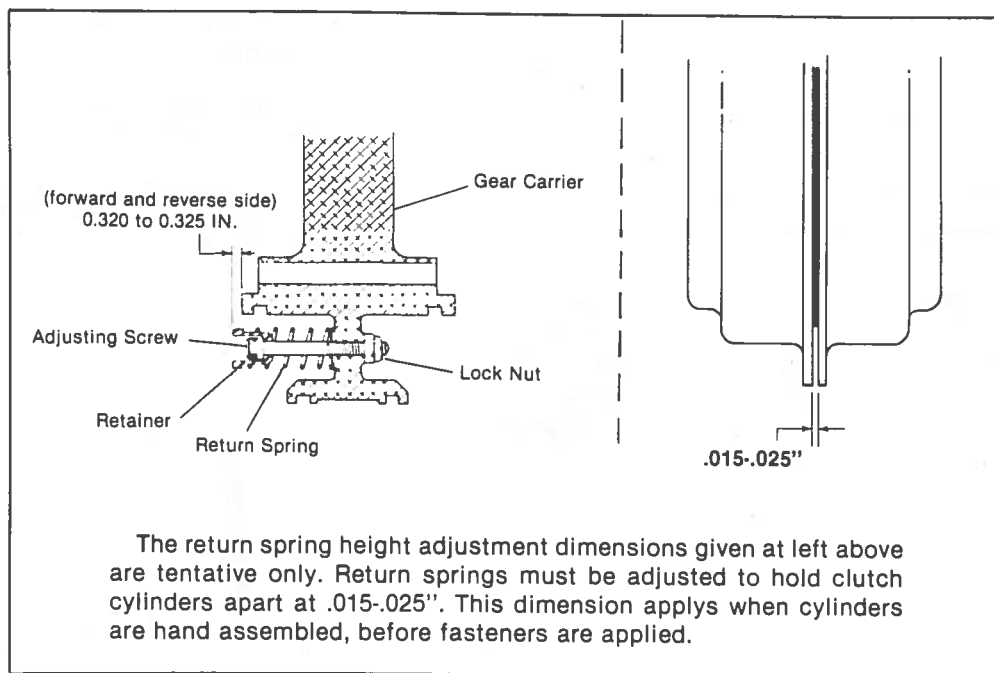


Figure 21. Clutch Return Spring Height Adjustment

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 capscrew holes in both cylinders are aligned properly.

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

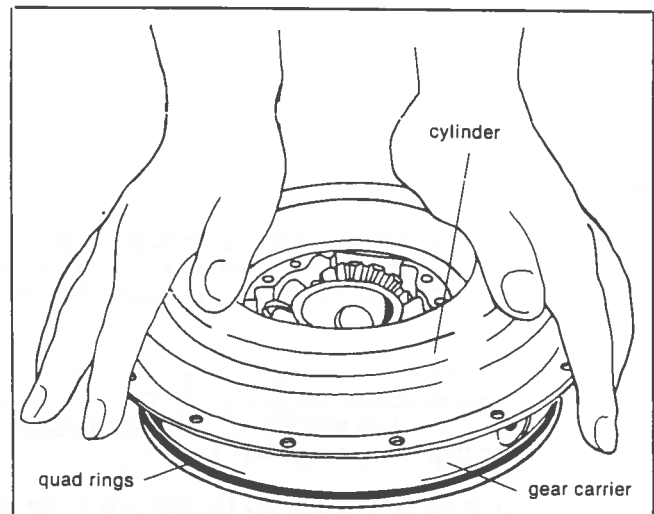


Figure 22. Pressing Cylinder on Bevel Gear Carrier

CAUTION:

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

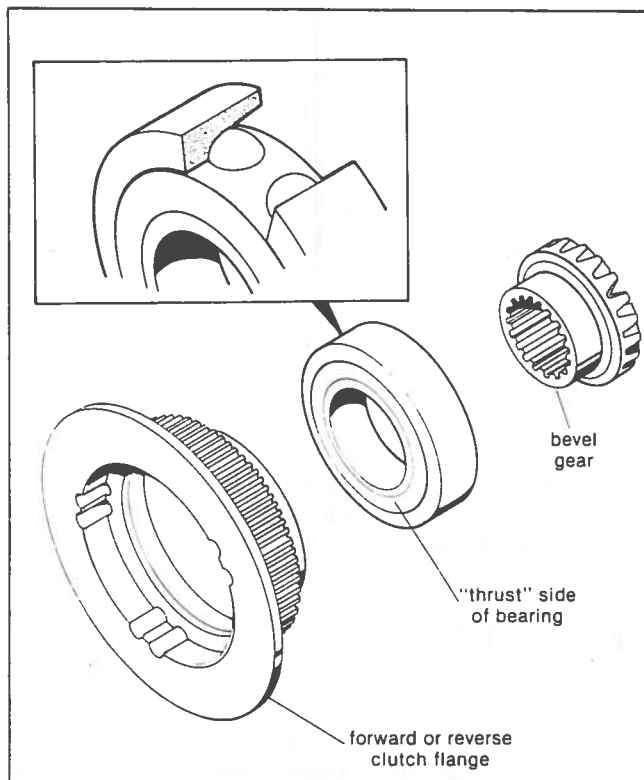


Figure 23. Clutch end flange, bearing and bevel gear. Bearing must be installed so that "thrust" side of bearing is toward clutch flange.

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 in 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. 1-90012-000) can be used to check if cylinders hold pressure.

Clutch assembly is now ready for installation on stub shaft. See page 7 for clutch mounting instructions.

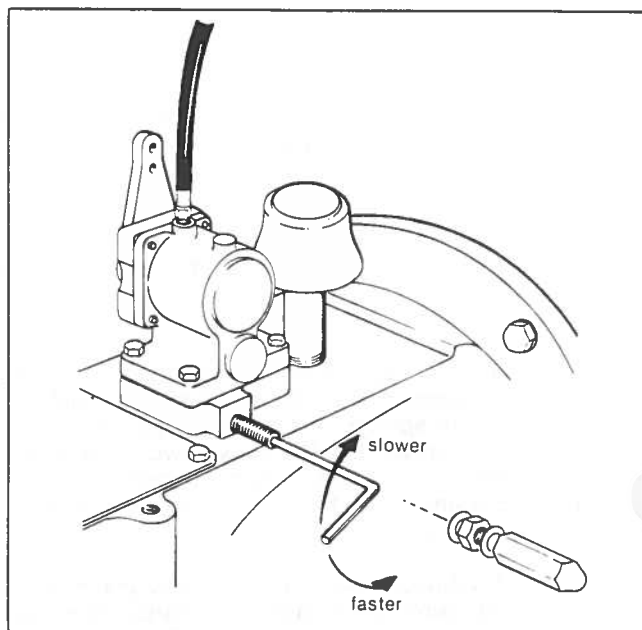


Figure 24. Clutch cylinder timing adjustment; To produce a faster shifting response, turn set screw COUNTER CLOCKWISE. To produce a slower response turn set screw CLOCKWISE.

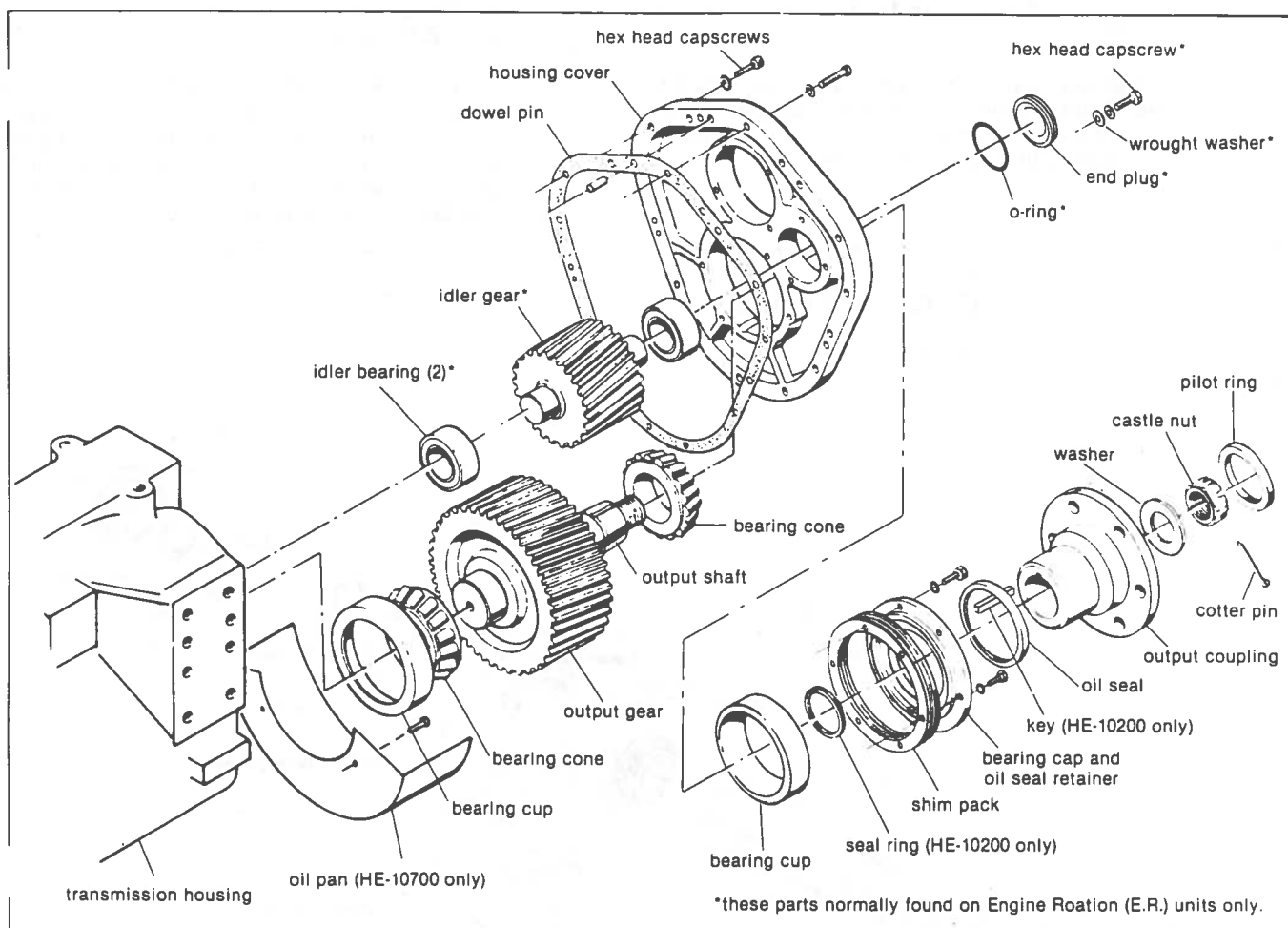


Fig. 25. Output Gear, Idler Gear, Cover and Related Parts.

7.4 OUTPUT GEAR, IDLER GEAR AND RELATED PARTS

Note: Oil pump and oil pump shaft, oil cooler and hoses must be removed prior to removal of cover and output gear.

1. Remove cotter pin from output shaft.
2. Hold output coupling securely (use Coupling Holder-Special Tool No. 1-90010-0000 for HE-10200 models; Special Tool No. 1-90011-0000 for HE-10700 models), and remove castle nut and flat washers.
3. With suitable puller (common 3 jaw type for HE-10200 models; Special Tool No. 1-90024-0000 for HE-10700 models, see Fig. 26) remove output coupling from output shaft.
4. Remove key.
5. Tip unit to rest on engine end. Remove bearing cap and oil seal retainer.
 - a. Note the quantity and thickness of shims under the bearing cap in the event bearings are re-used.
 - b. Remove and discard oil seal.

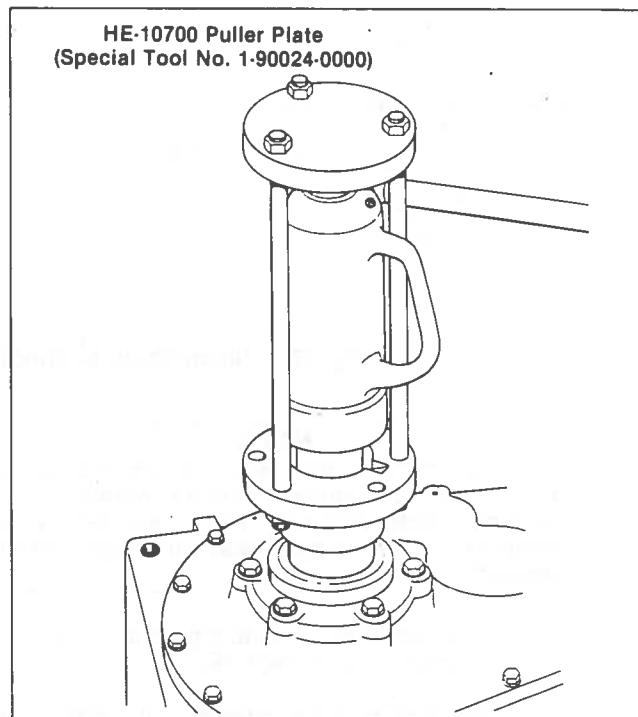


Fig. 26. HE-10700: Removing output coupling.

6. Inspect seal ring (HE-10200 only) and replace if necessary.

7. Remove capscrews and tap main housing cover from dowels with a soft hammer or use tapped holes available for jacking screws. Pinion shaft parts will accompany cover.

8. Remove idler from housing (transmission with idler (E.R.) only).

9. Remove output gear and shaft from main housing. Inspect bearings and replace if necessary and inspect gear teeth for excessive wear (refer to Wear Limits chart, page 22). Note: On HE-10700 models, the oil pan must be removed in order to remove bearing cup.

7.5 PINION SHAFT AND RELATED PARTS

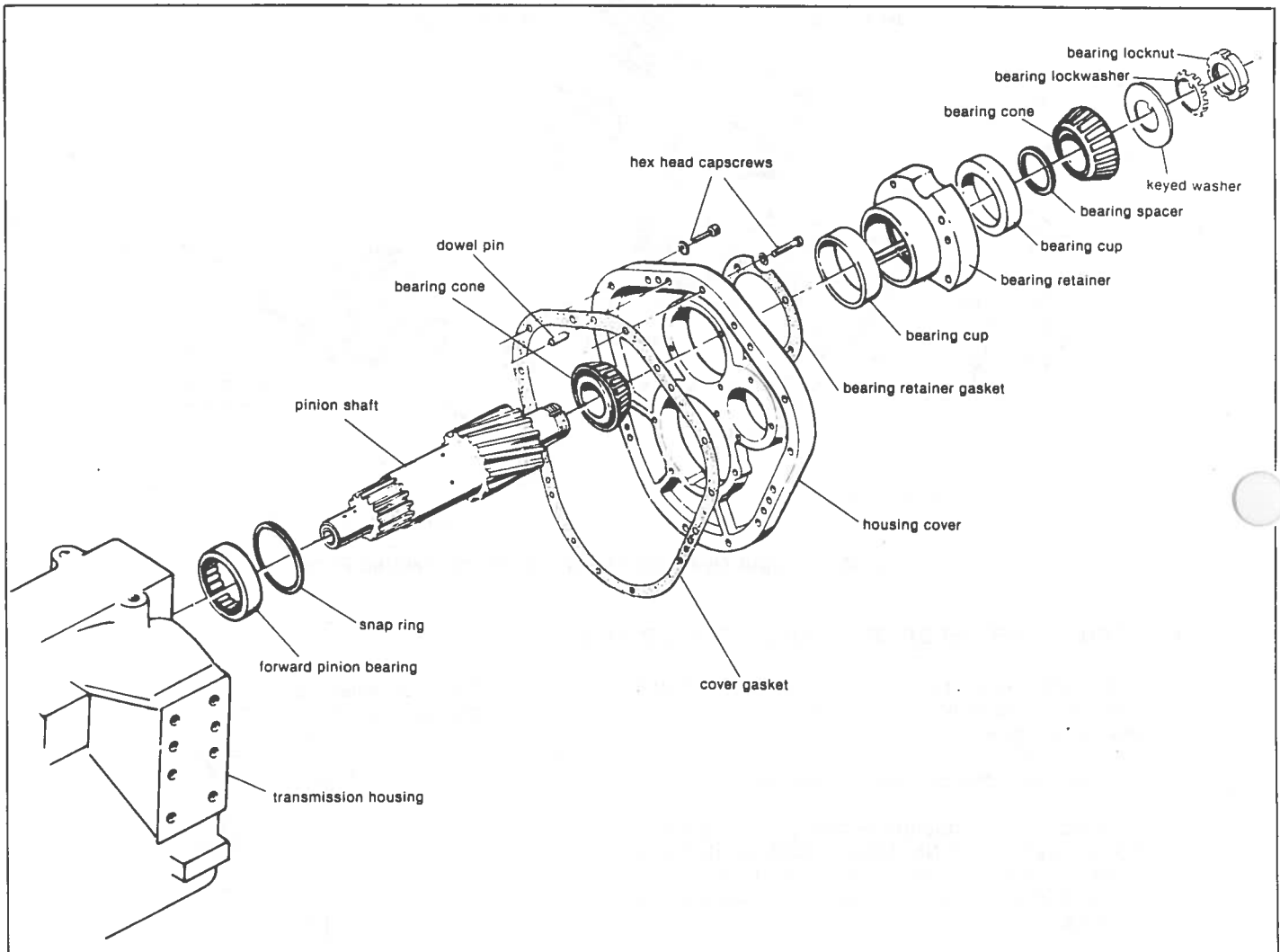


Fig. 27. Pinion Shaft, Bearings, Bearing Retainer, Cover and Related Parts

NOTE:

On most of the higher ratio models, the pinion shaft may be removed without removing the housing cover (however this does not allow inspection of output gear, bearings or idler gear (if present)).

1. Remove output coupling and cover (follow steps beginning on page 28).
2. Remove bearing retainer with pinion shaft through housing cover bore.

If pinion does **not** clear housing cover bore:

a. Release bearing locknut on pinion shaft by bending or punching tang of bearing lockwasher. Remove bearing locknut with spanner wrench and remove lockwasher.

b. Remove keyed washer.

c. With suitable press, extract the pinion shaft out of the bearing retainer. Care should be taken to protect threaded end of pinion shaft and bronze bushing.

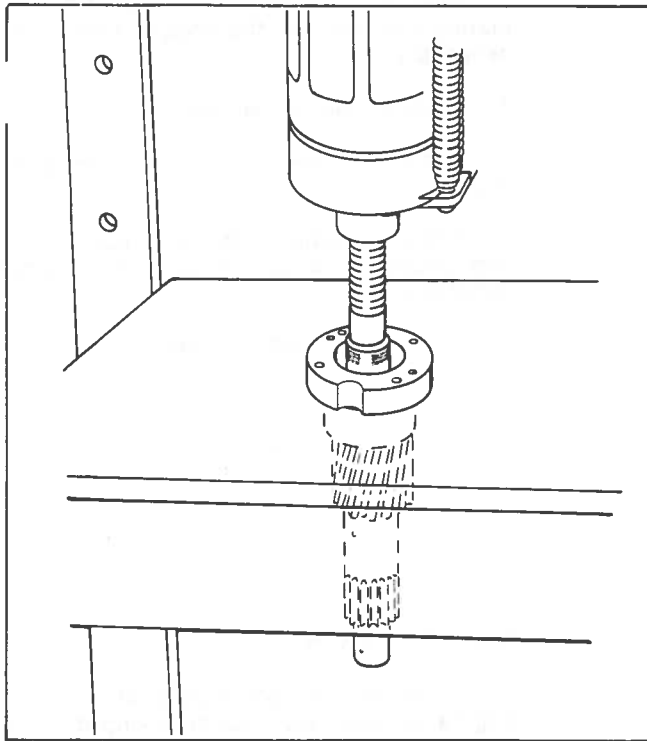


Fig. 28. Extracting Pinion Shaft

3. If pinion clears cover bore: extract pinion from bearing retainer using suitable press (see step 2, parts a, b, and c). See Figure 28.

4. Inspect both tapered roller bearing cones for rough rotation or signs of wear. Inspect bearing cups (in bearing retainer).

If damage or wear is found in any of these parts replace the entire MATCHED BEARING SET.

Clean bearings thoroughly with solvent.

5. Inspect pinion teeth and inspect forward and rear commutator surfaces on pinion shaft. See Wear Limits Chart on page 22 and replace pinion shaft if necessary.

6. Inspect bushing in threaded end of pinion shaft for chips or distortion. If bushing is damaged, remove it and press in new finish reamed bushing until it bottoms in bore.

7. Remove snap ring in housing bore and press out forward pinion bearing and rear commutator bushing to the output end of the transmission.

8. Inspect forward pinion bearing for roughness of rotation and signs of wear. Replace if necessary. Otherwise clean bearing with solvent.

9. See Fig. 29. Carefully remove snap ring from rear commutator bushing and carefully remove inner sleeve (with piston rings).

If front face of outer shell is grooved, shell must be replaced. Check inner bore of sleeve (see Wear

Limits Chart, page 22.), and replace if necessary. Replace any cracked or broken piston rings.

10. Clean all pinion shaft related parts thoroughly with cleaning solvent or diesel fuel.

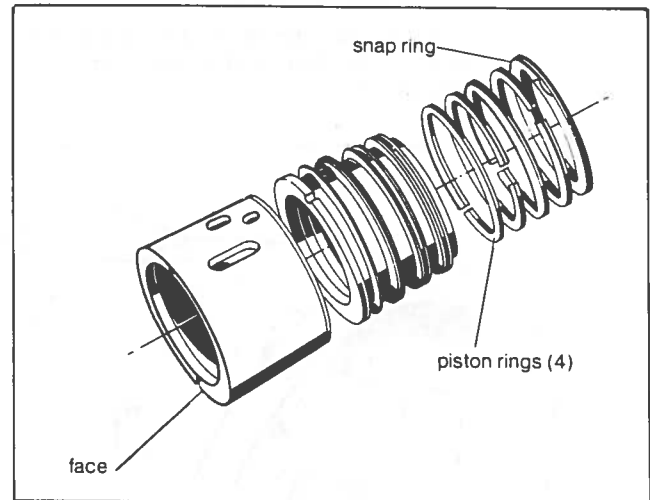


Fig. 29. Rear Commutator Bushing

7.6 HOUSING PARTS

1. Clean oil breather.
2. Flush clean and inspect main housing.
 - a. Clean sump.
 - b. Check front bell end for nicks and burrs.
 - c. Inspect aft end mounting surface. Use a flat file to deburr in all of the above cases.
 - d. Clean all internal oil passages in selector valve, baseplate and upper part of housing. See fig. 30.

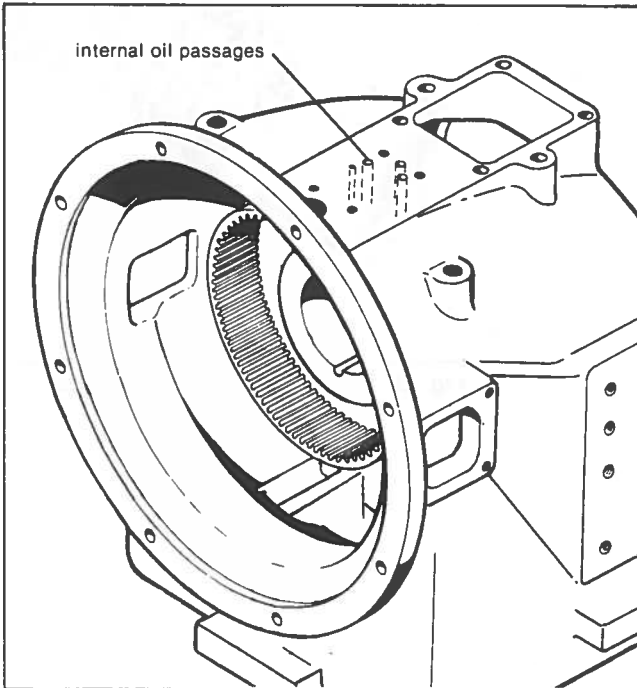


Fig. 30. Internal oil passages

3. Clean and inspect cover. Check front and rear mating surfaces and file smooth with a flat file if necessary.
4. Clean oil suction screen.
5. Inspect reverse drum for grooves or excess wear.
6. Inspect mating surfaces of output coupling and propeller coupling and file smooth if necessary.
7. Inspect and clean pilot ring.

7.7 ADAPTER PARTS

1. Clean and inspect stub shaft (mounted on engine flywheel) and clutch driving drum. Check fit on splines between driving drum and stub shaft. Replace as necessary if fit is not snug.
2. Remove oil dam adapter and inspect labyrinth oil seal on inside diameter (Some special units have a positive seal installed). Repair or replace as necessary (wear or damage to seal indicates misalignment—check further!) (See fig. 31).
3. While oil dam adapter is removed, inspect flywheel adapter and drive flange for distortion or rough mounting surfaces. Repair or replace as necessary.

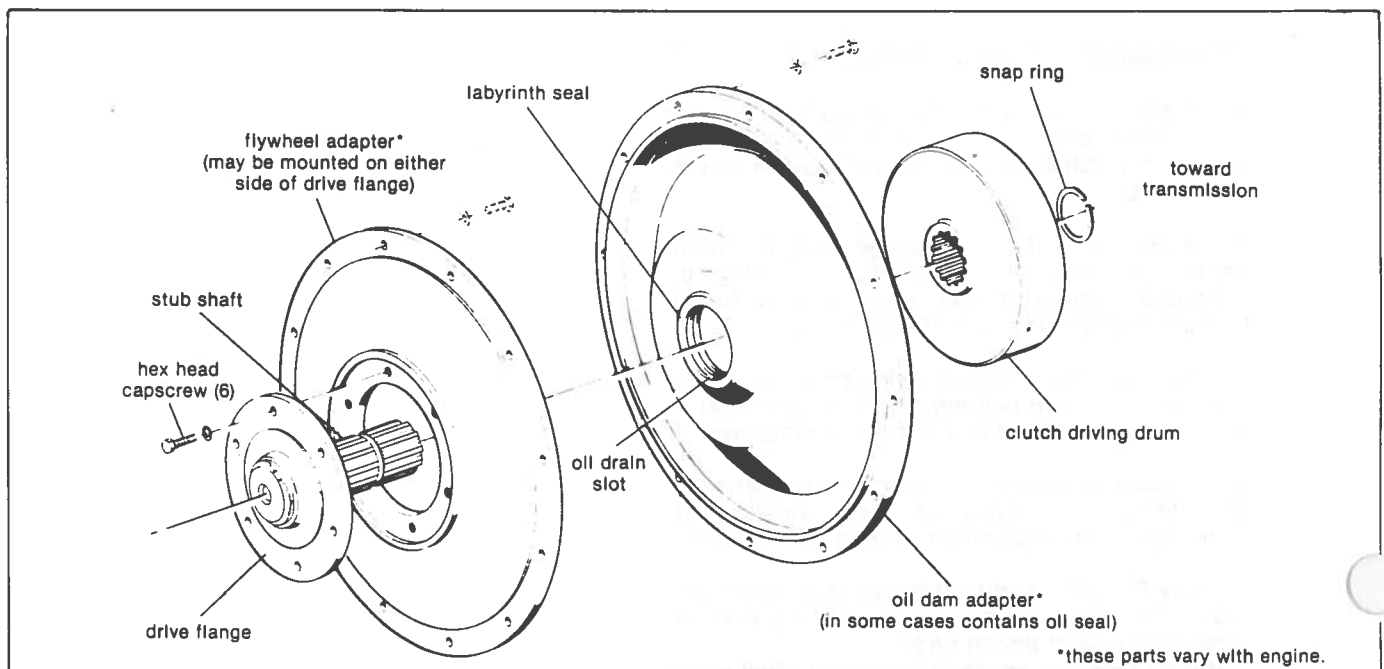


Fig. 31. Adapter Parts

7.8 INSTALLATION OF COMMUTATOR, OUTPUT GEAR AND RELATED PARTS

1. Place housing on press with engine end up.
2. Press in rear commutator bushing as follows:

NOTE:

To ease installation, housing may be heated and bushing cooled.

- a. Place commutator bushing over bore of housing with snap ring end down.
- b. Set guide (3/16" brass or steel rod, bent to a right angle) as shown to insure line up of spring pin groove in bore and commutator shell groove. See fig. 32.
- c. Set 1/8" flat stock, round or shim stops on each side of bore as shown to limit depth pressed.
- d. Apply lubricant to bushing and press it down to stops.
- e. Punch spring pin into groove flush with housing surface.

NOTE:

Check to see that commutator sleeve floats inside commutator shell.

3. Install reverse drum.
4. Tip housing to rest face down.
5. Press in front pinion bearing.

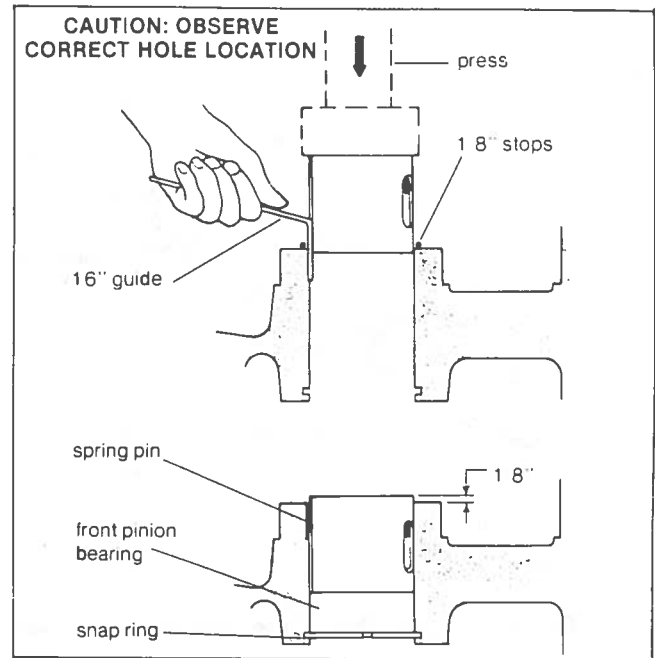
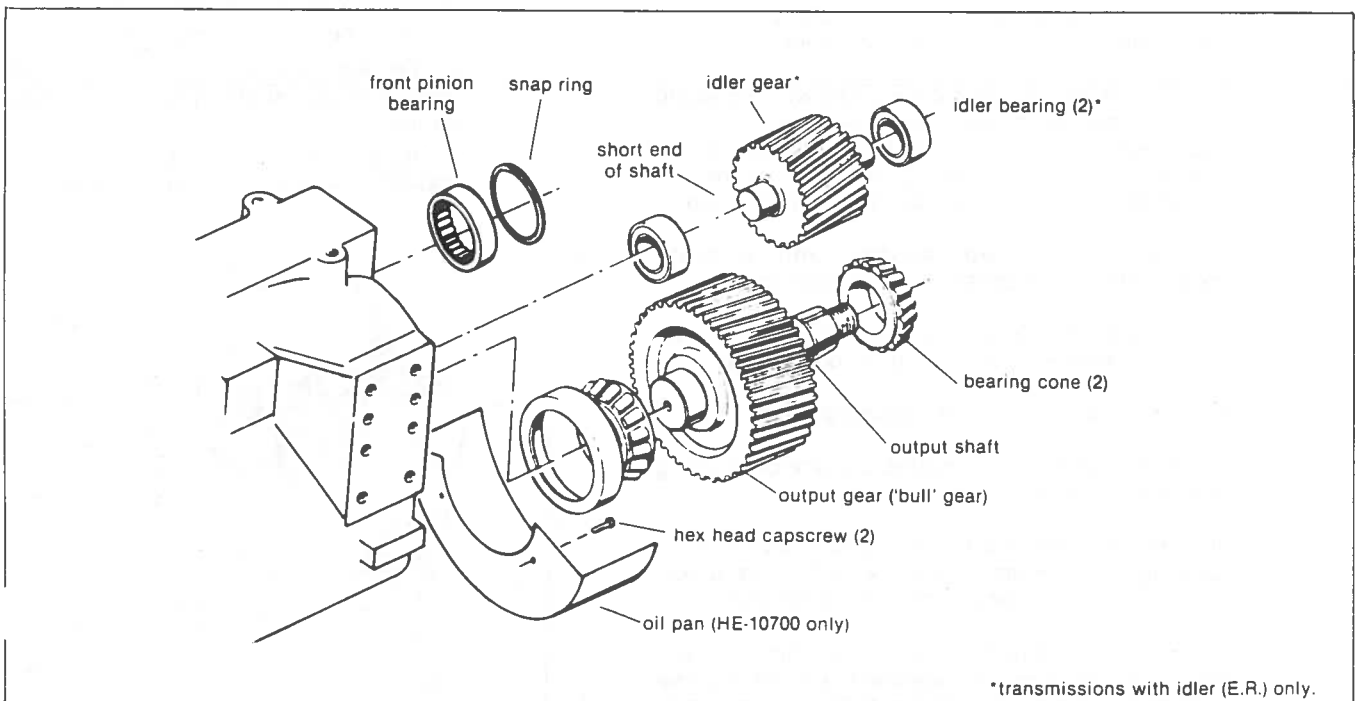


Fig. 32. Installing Rear Commutator Bushing

6. Replace snap ring behind pinion bearing.
7. Press bearing cup into lower bore of housing.
8. Locate oil pan (HE-10700 only) and secure with capscrews.
9. Replace bearings on gear shaft. Position output shaft in main housing seating large cone in cup in main housing.
10. If transmission employs an idler gear (E.R. ratios), position idler gear assembly in housing bore with short end of shaft in housing (see fig. 33).



*transmissions with idler (E.R.) only.

Fig. 33. Front Pinion Bearing, Idler, Output Gear and Related Parts

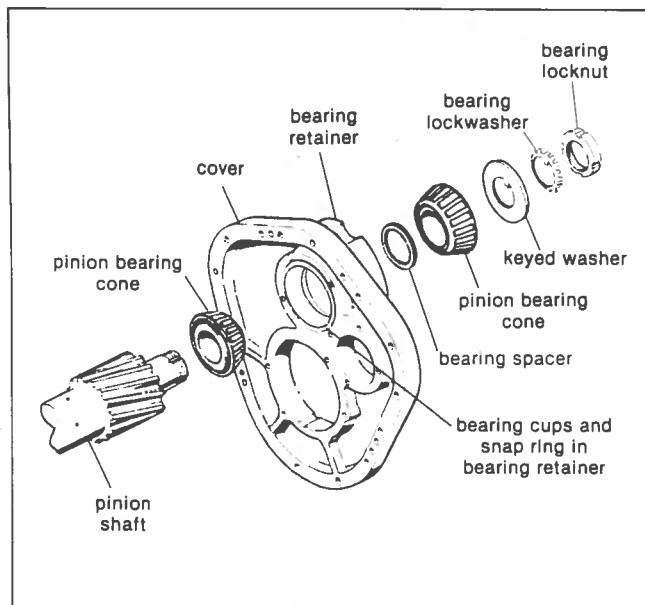


Fig. 34. Pinion Shaft, Cover and Bearing Assembly.

7.9 INSTALLATION OF PINION SHAFT AND COVER

1. Press pinion bearing cone onto threaded end of pinion shaft snug against the shoulder of gear.
2. Press tapered cups into bearing retainer. Position each cup with stamped part numbers against snap ring in center of retainer.
3. Apply lubricant on face of bearing retainer and position new gasket.
4. Position bearing retainer in housing cover and temporarily secure with one capscrew.
5. Secure pinion shaft onto press with threaded end up. Position housing cover onto pinion shaft. Slip bearing spacer onto shaft. Press pinion bearing cone into bearing retainer as far as possible. Pinion shaft is now installed in cover.
6. Installed keyed washer and bearing lockwasher on threaded end of pinion shaft.
7. Install bearing locknut, tighten with spanner, and secure locknut with tang of lockwasher.
8. Install dowel pins into housing.
9. Apply lubricant on mating surface of housing and apply gasket.
10. Place cover (with pinion shaft) on housing, rotating pinion shaft to engage teeth. Use a soft hammer to tap cover in position on dowels.
11. Check for free movement of pinion shaft and secure cover with lock washers and capscrews (tighten to 18 pounds-foot for 10200 series and to 31 pounds-foot torque for 10700 series).

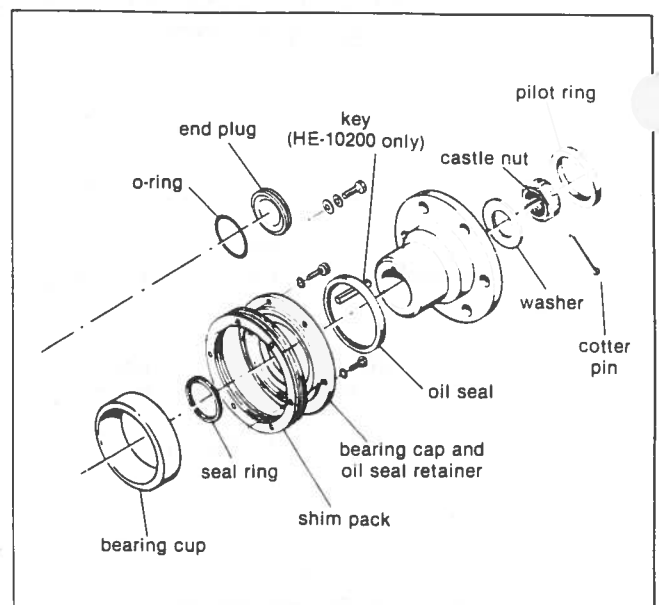


Fig. 35. Output Coupling, Idler End Plug, and Related Parts.

7.10 INSTALLATION OF OUTPUT COUPLING AND OIL PUMP

1. Install bearing cup into output bore of rear cover on bearing cone.
2. Press new oil seal into bearing cap retainer.
3. (HE-10200 only) Position new seal ring on output shaft against bearing cone. Be certain it is not twisted.
4. Install shim pack under bearing cap allowing .000-.002" end play (see fig. 36). Secure bearing cap with capscrews and washers.

To check end play on output shaft:

- a. Start hex nut on output shaft.
- b. Protect tapered surface of shaft with cloth and tap shaft side to side with soft hammer.
- c. Raise output shaft. End play should be .000-.002". Add or subtract shims accordingly.

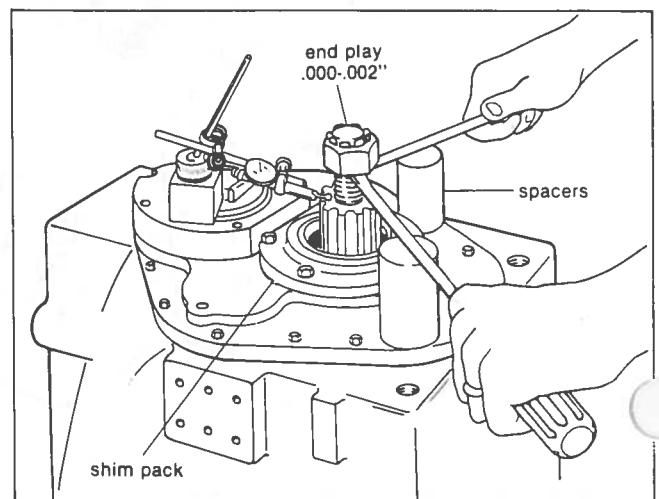


Fig. 36. Checking End Play on Output Shaft.

5. Lubricate inside surface of new oil seal in bearing cap.
6. Install key in output shaft (HE-10200 only).
7. Heat output coupling in hot oil or water at a maximum of 200°F (93°C) to insure proper fit.

HE-10200: Place hot coupling on output shaft aligning keyway with key.

HE-10700: Align cotter pin cutouts in coupling with cotter pin hole in output shaft (see Fig. 37).

Tap coupling into position with soft hammer.

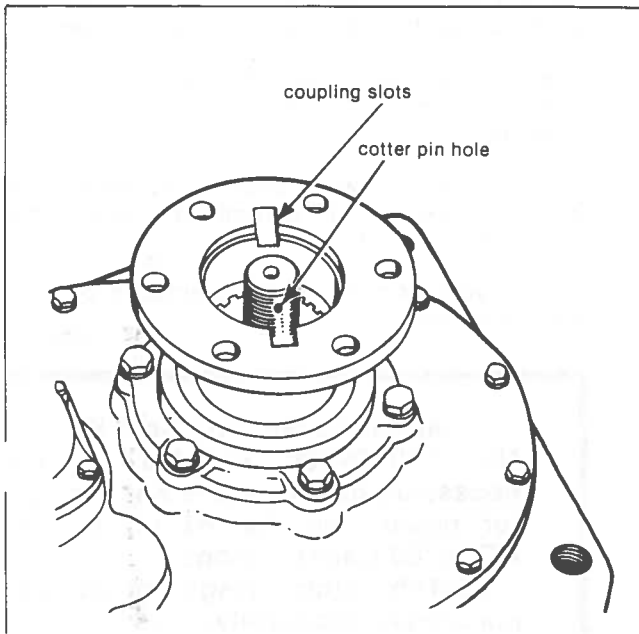


Fig. 37. Matching coupling slots with cotter pin hole (HE-10700 only).

8. Install flat washer and castle nut and tighten, aligning grooves in nut with cotter pin hole in output shaft.
9. Install cotter pin to secure output coupling. Rotate coupling and shaft to insure free movement.
10. If transmission contains an idler gear, be sure to replace o-ring, end plug, washers and capscrew in cover bore (see Fig. 35).
11. Locate new oil pump gasket with a small amount of grease on bearing retainer.
12. Secure oil pump with 4 hex head capscrews and lockwashers.
13. Install suction screen and drain plug using thread compound.

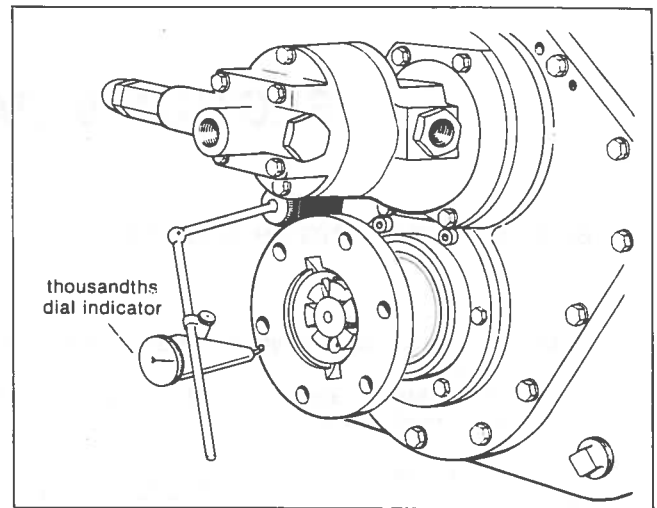


Fig. 38. Checking Output Coupling Mounting Face For Trueness.

Tip unit to rest upright:

14. Check for trueness of output coupling mounting face by mounting a thousandths dial indicator as shown in figure 38. Rotate coupling. Face deviation must not exceed .003".

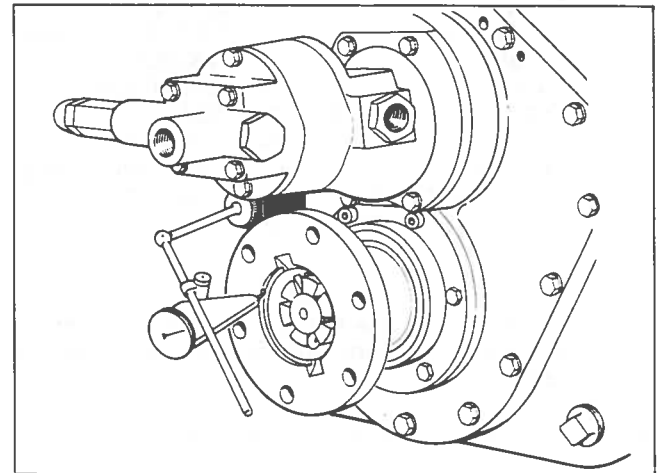


Fig. 39. Checking Pilot Ring Bore Diameter for Trueness.

15. Check pilot ring bore diameter as shown in Fig. 39. Deviation must not exceed .003".

7.11 INSTALLATION OF HOUSING PARTS

1. Install oil breather and dipstick.
2. Install selector valve gaskets, baseplate and selector valve (see Fig. 15, p. 20 for proper configuration).
3. Connect hoses and oil cooler.

Refer to Section 3 for proper installation and alignment procedures.

SECTION 8. PARTS INFORMATION

8.1 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). Write:

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

Cable Address:
"Capmarine"
Telephone: 645-9491
Area Code: 612
Telex: 29-7081

- c. Always give **complete** part description as shown in the sample column below:

Necessary Information	Sample
1. Model	1. HE-10200
2. Option Code	2. 2-10200-04012-50200
3. Serial #	3. 12400-0681
4. Ratio	4. 2.929:1 A.E.R.
5. Eng. Mfg. No. (if any)	5. 21898
6. Part Number	6. 1-00230-4300
7. Description	7. Clutch Disc, Driving
8. Figure number, item no.	8. Fig. 42, item 4
9. Quantity being ordered	9. 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 Not 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.

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

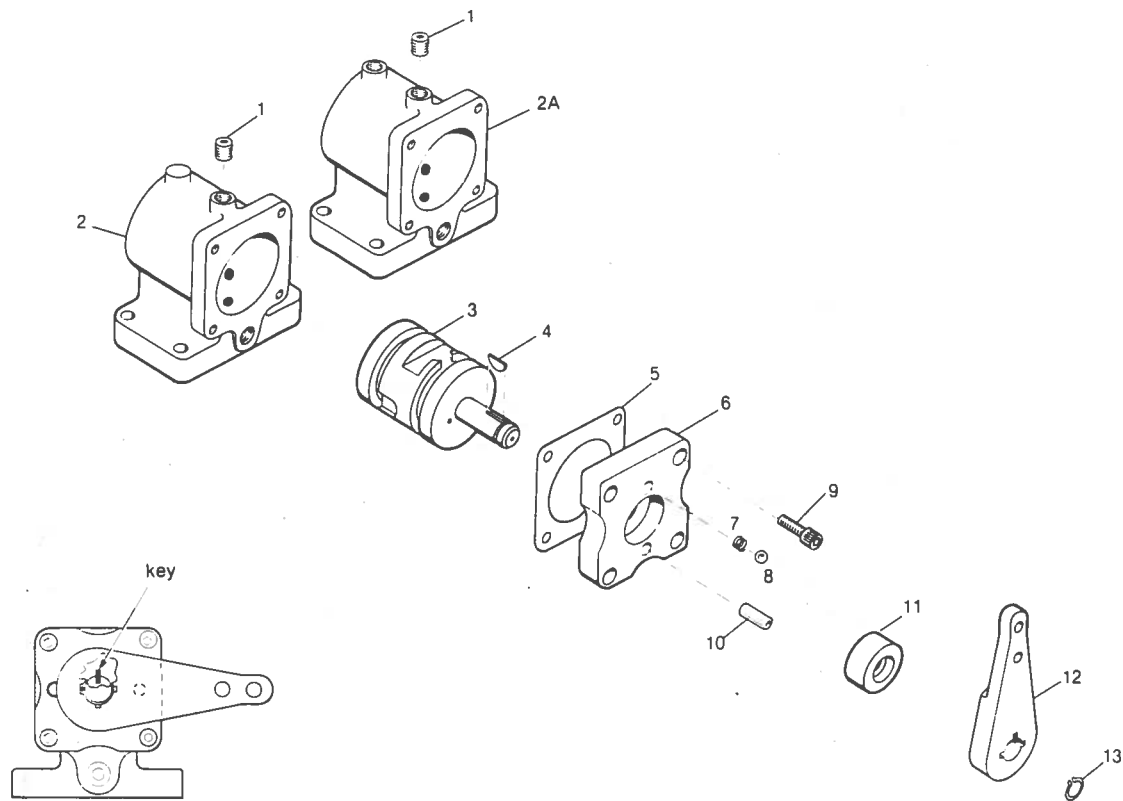
**Capitol Gasket and Seal Kit
No. 1-10165-000 includes all the
necessary gaskets, seals and o-rings
for repairs on the HE-10200 and
HE-10700 transmissions.**

**Clutch quad rings must be
purchased separately.**

8.2 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 _____

8.3 SELECTOR VALVE



Alternate Position

- 1) Cover is rotated 90° clockwise.
- 2) Rotor must be installed with key in **vertical position**.

Figure 40. Selector Valve Assembly

NOTE: HE-10700 MODELS, 4.526 E.R. AND 5.00 E.R. REQUIRE SELECTOR VALVE 1-01175-1100.

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	ASSEMBLY, SELECTOR VALVE (FOR MOST RATIOS)	1-01175-1000	1
REF.	ASSEMBLY, SELECTOR VALVE (FOR HE-10700 4.526 E.R. AND 5.00 E.R. ONLY)	1-01175-1100	1
1	PIPE PLUG, HEX SOCKET, 1/8" NPT	1-11279-0200	1
2	BLOCK, VALVE	1-01141-1600	1
2A	BLOCK, VALVE (FOR SELECTOR VALVE 1-01175-1100)	1-01141-2000	1
3	VALVE, ROTARY	1-01144-1500	1
4	KEY	1-01164-3200	1
5	GASKET, VALVE COVER	1-01156-1500	1
6	COVER, VALVE	1-12417-1000	1
7	SPRING, INDEXING	1-01132-1500	1
8	BALL, INDEXING, 1/4" DIA	1-11200-0000	1
9	CAPSCREW, SOCKET HEAD, 10-24 x 1/2" LG.	1-12844-0000	4
10	SPRING PIN 1/4 DIA. x 1/2" LG.	1-12097-0800	1
11	OIL SEAL	1-01155-1500	1
12	LEVER	1-12419-1000	1
13	RING, RETAINING	1-01180-1500	1

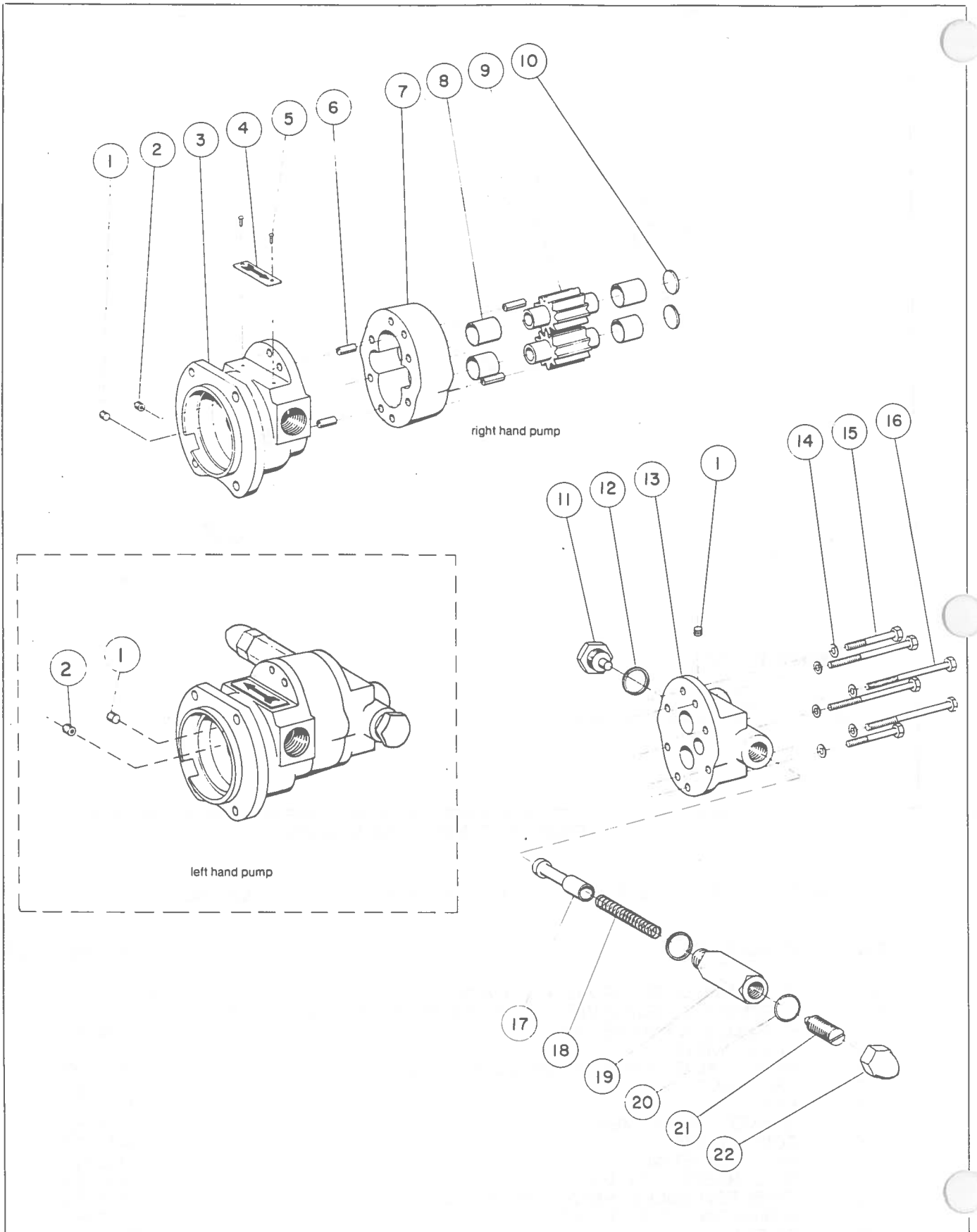


Fig. 41. Oil Pump Assembly

8.4 OIL PUMP

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	OIL PUMP ASSEMBLY, RIGHT HAND ENGINE ROTATION . . .	1-13410-0100	1
REF.	OIL PUMP ASSEMBLY, LEFT HAND ENGINE ROTATION	1-13410-0200	1
1	PLUG, PIPE (STANDARD)	1-11279-0100	2
2	PLUG, PIPE .052 ORIFICE	1-13414-0000	1
3	*ADAPTER, PUMP	1-13411-0000	1
4	PLATE, ROTATION	1-11212-0000	1
5	SCREW, DRIVE #2 x 3/16" LG.	1-13275-0000	2
6	PIN, SPRING 1/4" x 3/4" LG.	1-12097-1200	4
7	BODY, PUMP	1-10242-0000	1
8	BUSHING	1-11125-0000	4
9	GEAR, PUMP	1-10254-0200	2
10	DISC, FLAT 7/8" DIA. x .074"	1-13731-0000	2
11	STOP, RELIEF	1-10285-0100	1
12	WASHER, COPPER	1-10288-0700	2
13	COVER, PUMP	1-10243-0300	1
14	LOCKWASHER	1-05309-0800	6
15	CAPSCREW, HEX HEAD 1/4 - 20 x 2"	1-11512-0000	2
16	CAPSCREW, HEX HEAD 1/4 - 20 x 3 1/4"	1-10252-0000	4
17	PLUNGER, RELIEF	1-10258-0300	1
18	SPRING, PRESSURE RELIEF	1-13413-0000	1
19	INSERT, RELIEF VALVE	1-13412-0000	1
20	WASHER, COPPER	1-12902-0000	1
21	SCREW, PRESSURE RELIEF	1-06660-0800	1
22	NUT, DOME	1-06667-0800	1

*The following adapter assemblies may be ordered separately. They include items 1,2,3,4,5 and 8:

PUMP ADAPTER ASSEMBLY, RIGHT HAND	1-13411-0100
PUMP ADAPTER ASSEMBLY, LEFT HAND	1-13411-0200

8.5 CLUTCHES

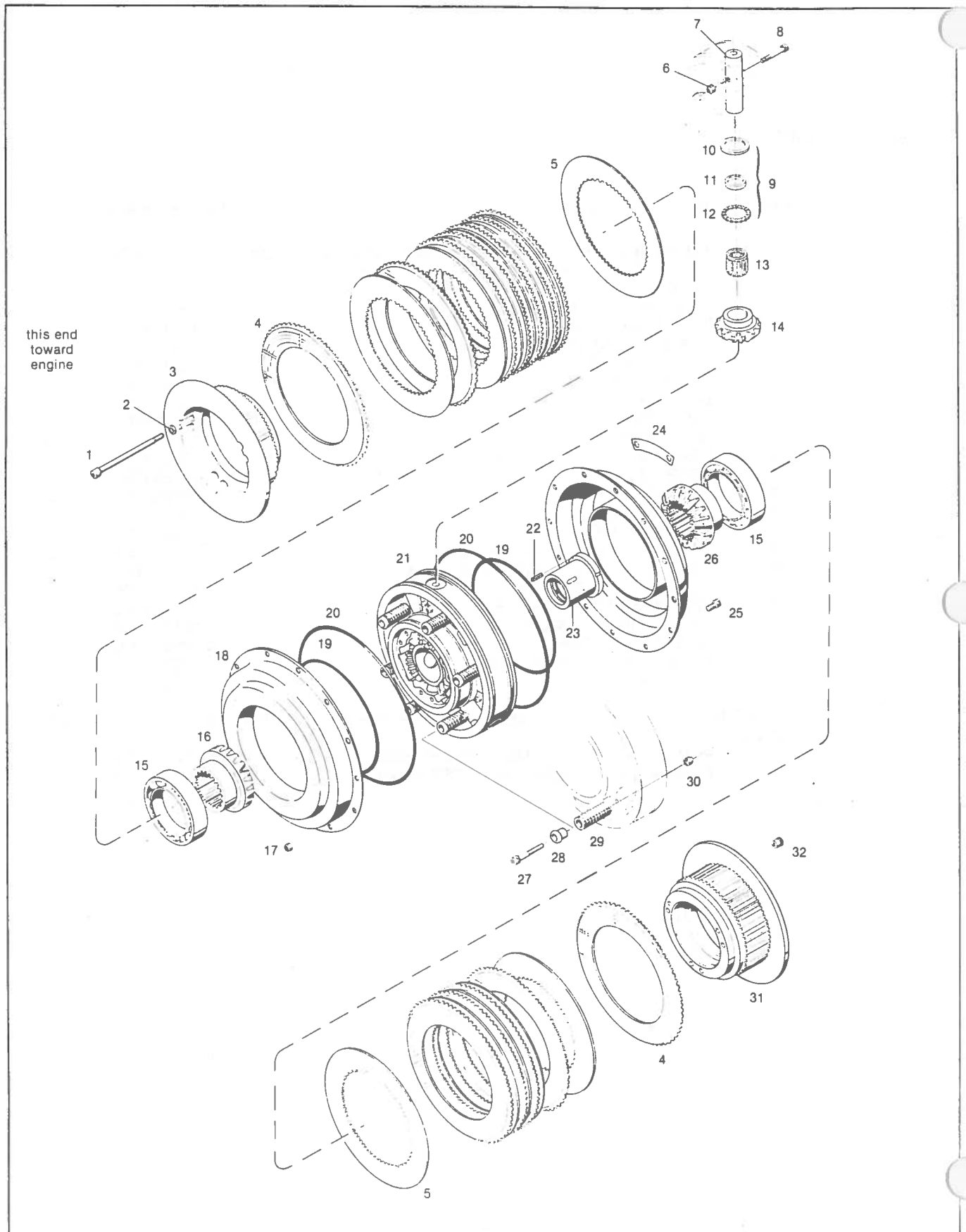


Figure 42. Clutch No. 1-00100-1000

STANDARD CLUTCH
CLUTCH NO. 1-00100-1000

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	CLUTCH ASSEMBLY	1-00100-1000	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	WASHER, THRUST	1-12369-0000	3
11	WASHER, PILOT	1-12366-0000	3
12	BEARING, NEEDLE	1-12368-0000	3
13	BEARING, NEEDLE	1-12367-0000	3
14	PINION, BEVEL	1-00217-1000	3
15	BEARING	1-12364-0000	2
16	GEAR, DRIVING	1-00215-1000	1
17	NUT, SELF-LOCKING; 1/4-28 NF.	1-00226-3600	12
18	CYLINDER	1-00234-8400	2
19	QUAD RING	1-00238-1500	2
20	QUAD RING	1-00237-1500	2
21	* CARRIER, BEVEL GEAR	1-00219-1800	1
22	* SPRING PIN 1/8" DIA. x 3/4" LG.	1-12095-1200	2
23	* BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
24	NAME PLATE	1-13430-0000	1
25	CAPSCREW, SOCKET HD; 1/4-28 x 5/8" LG.	1-13424-0000	12
26	GEAR, DRIVEN	1-00215-2000	1
27	CAPSCREW, SOCKET HD; 1/4-20 x 1 1/2" LG.	1-07837-0800	12
28	RETAINER, RETURN SPRING	1-00243-3500	12
29	SPRING, RETURN	1-00239-1500	12
30	NUT, SELF-LOCKING; 1/4-20	1-07846-0800	12
31	CLUTCH FLANGE, REVERSE	1-00212-6100	1
32	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6

*NOTE: Items 21, 22 and 23 are available as part number 1-00219-4400 GEAR CASE ASSEMBLY.

IMPORTANT PARTS REPLACEMENT INFORMATION

19 tooth bevel pinions (No. 1-00217-1000) will run only with 27 tooth driving gear (1-00215-1000) and 27 tooth driven gear (1-00215-2000).

15 tooth bevel pinions (No. 1-00217-1700) will run only with 21 tooth driving gear (No. 1-00215-0900) and 21 tooth driven gear (No. 1-00215-1800).

8.5 CLUTCHES (CONTINUED)

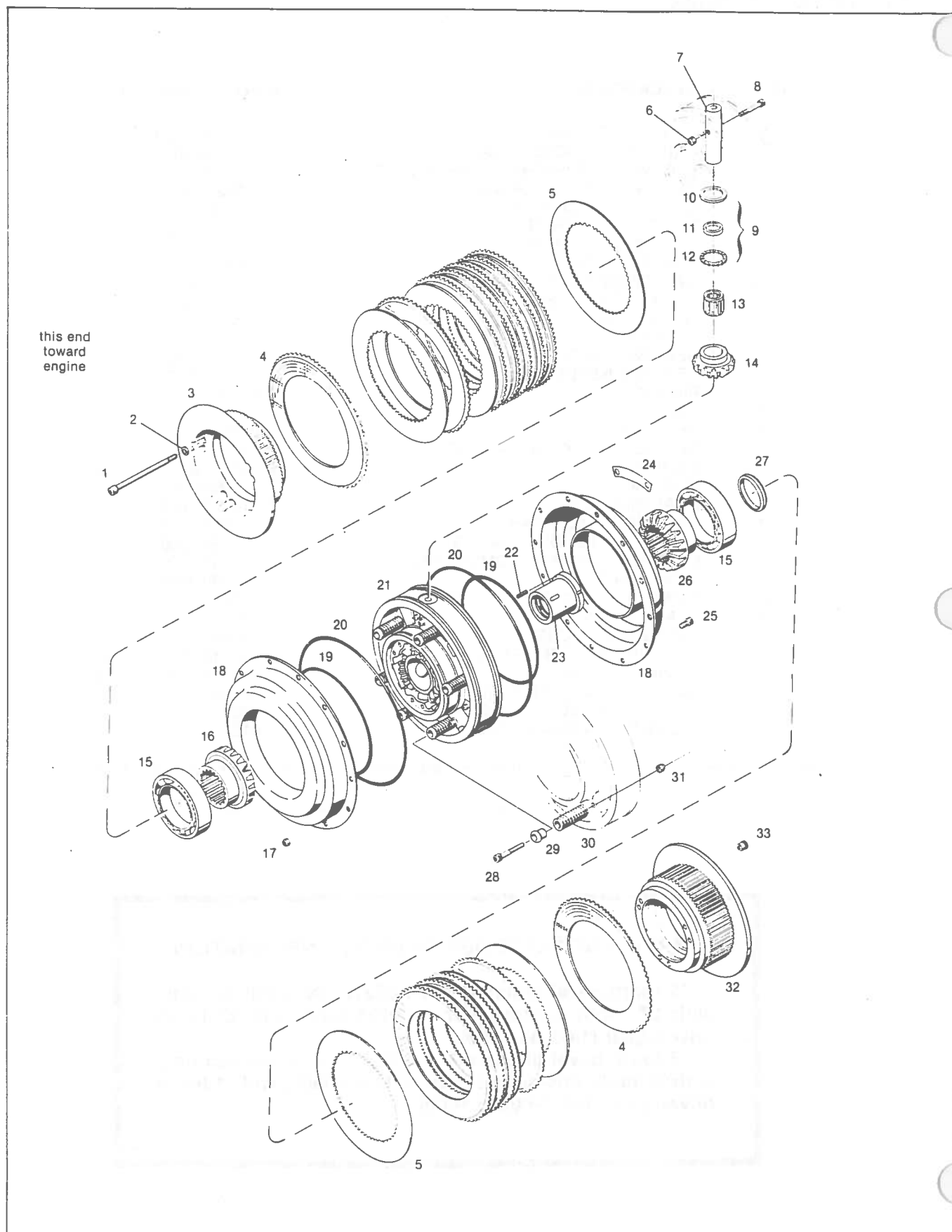


Figure 43. Clutch No. 1-00100-1500

CLUTCH ASSEMBLY WITH SPACER RING
CLUTCH NO. 1-00100-1500

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	CLUTCH ASSEMBLY WITH SPACER RING	1-00100-1500	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	WASHER, THRUST	1-12369-0000	3
11	WASHER, PILOT	1-12366-0000	3
12	BEARING, NEEDLE THRUST	1-12368-0000	3
13	BEARING, NEEDLE	1-12367-0000	3
14	PINION, BEVEL	1-00217-1000	3
15	BEARING	1-12364-0000	2
16	GEAR, DRIVING	1-00215-1000	1
17	NUT, SELF-LOCKING; 1/4-28 NF	1-00226-3600	12
18	CYLINDER	1-00234-8400	2
19	QUAD RING	1-00238-1500	2
20	QUAD RING	1-00237-1500	2
21	*CARRIER, BEVEL GEAR	1-00219-1800	1
22	*SPRING PIN 1/8" DIA. x 3/4" LG	1-12095-1200	2
23	*BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
24	NAME PLATE	1-13430-0000	1
25	CAPSCREW, SOCKET HD; 1/4-28 x 5/8" LG.	1-13424-0000	12
26	GEAR, DRIVEN	1-00215-2000	1
27	RING, SPACER	1-12530-0000	1
28	CAPSCREW, SOCKET HD; 1/4-20 x 1 1/2" LG.	1-07837-0800	12
29	RETAINER, RETURN SPRING	1-00243-3500	12
30	SPRING, RETURN	1-00239-1500	12
31	NUT, SELF-LOCKING; 1/4-20	1-07846-0800	12
32	CLUTCH FLANGE, REVERSE	1-00212-6100	1
33	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6

*NOTE: Items 21, 22 and 23 are available as part number 1-00219-4400 GEAR CASE ASSEMBLY.

IMPORTANT PARTS REPLACEMENT INFORMATION
 19 tooth bevel pinions (No. 1-00217-1000) will run only
 with 27 tooth driving gear (No. 1-00215-1000) and 27 tooth
 driven gear (1-00215-2000).
 15 tooth bevel pinions (No. 1-00217-1700) will run only
 with 21 tooth driving gear (No. 1-00215-0900) and 21 tooth
 driven gear (No. 1-00215-1800).

8.5 CLUTCHES (CONTINUED)

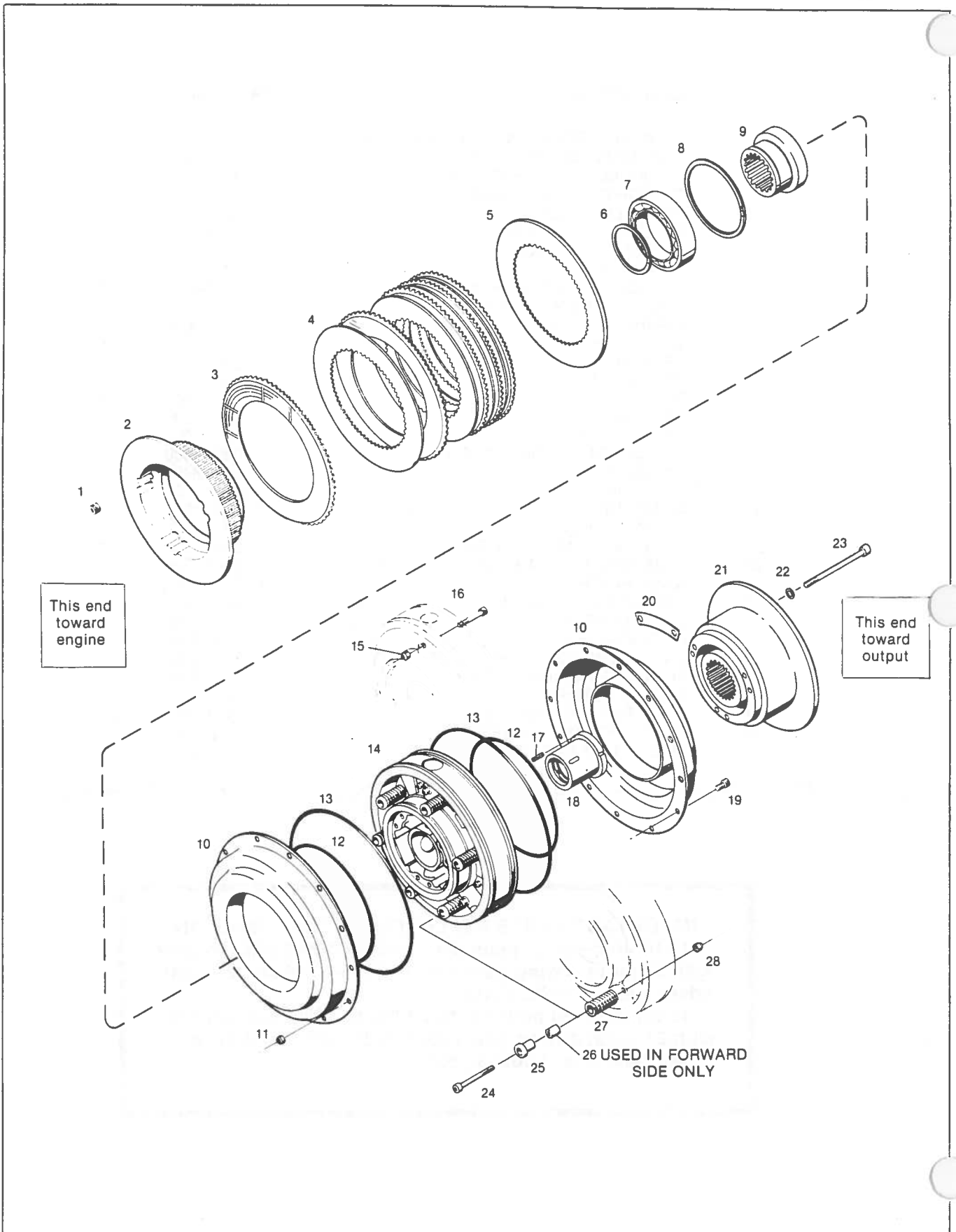
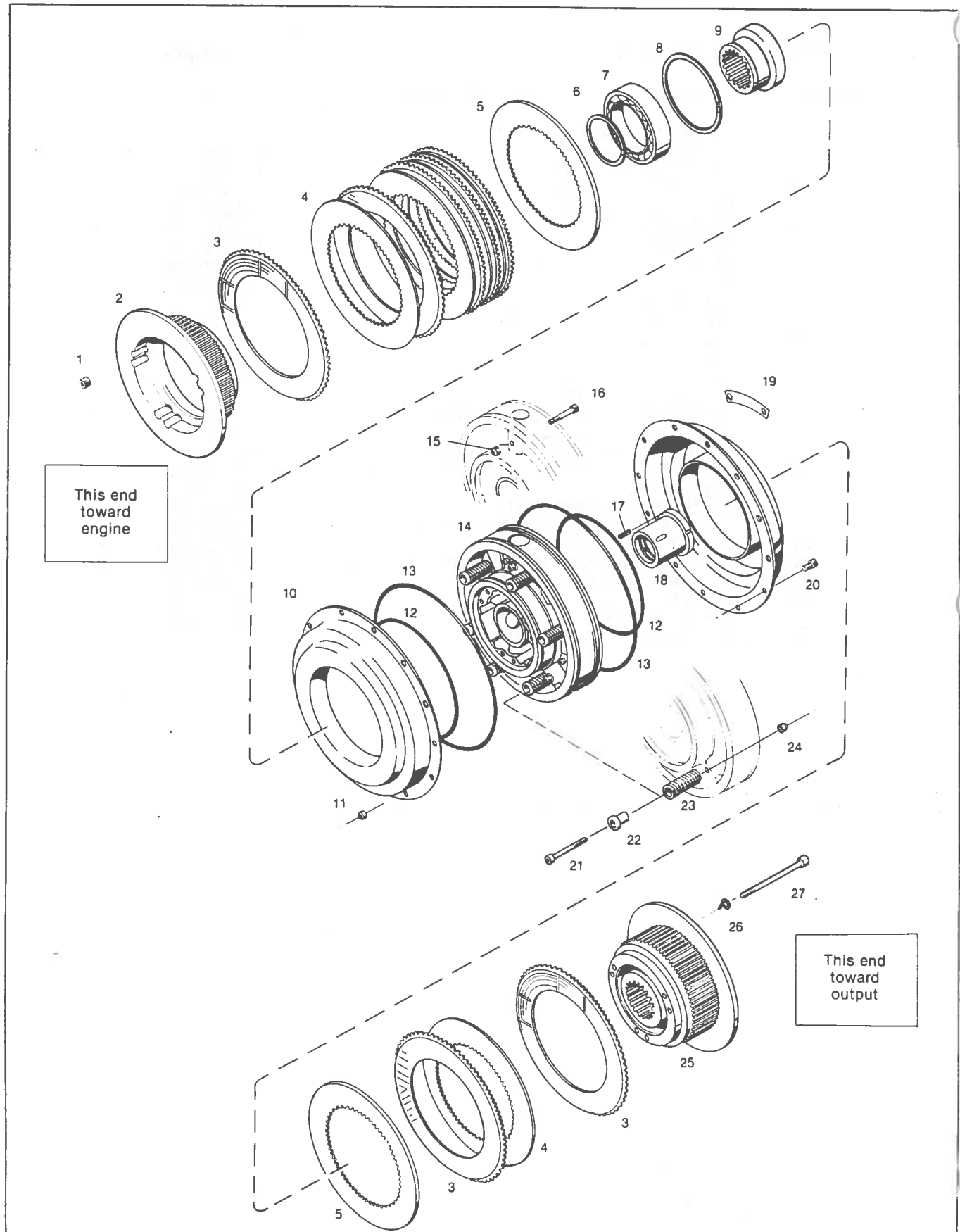


Figure 44. PTO Clutch Without Brake, No. 1-00100-1103

PTO CLUTCH WITHOUT BRAKE
CLUTCH NO. 1-00100-1103

ITEM	DESCRIPTION	PART NUMBER	QTY.
Reference	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; 1/4-28 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 HD; 10-32 NF x 1 3/4" LG.	1-11104-0000	3
17	SPRING PIN; 1/8 DIA. x 3/4 LG.	1-12095-1200	2
18	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
19	CAPSCREW, SOCKET HD; 1/4-28 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; 1/4-20 NC x 1 1/2" 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; 1/4-20 NC	1-07846-0800	12

8.5 CLUTCHES (CONTINUED)



PTO CLUTCH WITH BRAKE
CLUTCH NO. 1-00100-1104

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	CLUTCH ASSEMBLY, PTO WITH 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	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 3/4" LG.	1-11104-0000	3
17	SPRING PIN; 1/8 DIA. x 3/4 LG.	1-12095-1200	2
18	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
19	NAME PLATE	1-13430-0000	1
20	CAPSCREW, SOCKET HD; 1/4-28 NF x 5/8" LG.	1-13424-0000	12
21	CAPSCREW, SOCKET HD; 1/4-20 NC x 1 1/2" LG.	1-07837-0800	12
22	RETAINER, RETURN SPRING	1-00243-3500	12
23	SPRING, RETURN	1-00239-1500	12
24	NUT, SELF-LOCKING; 1/4-28 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

8.6 TRANSMISSION ASSEMBLY, PART A

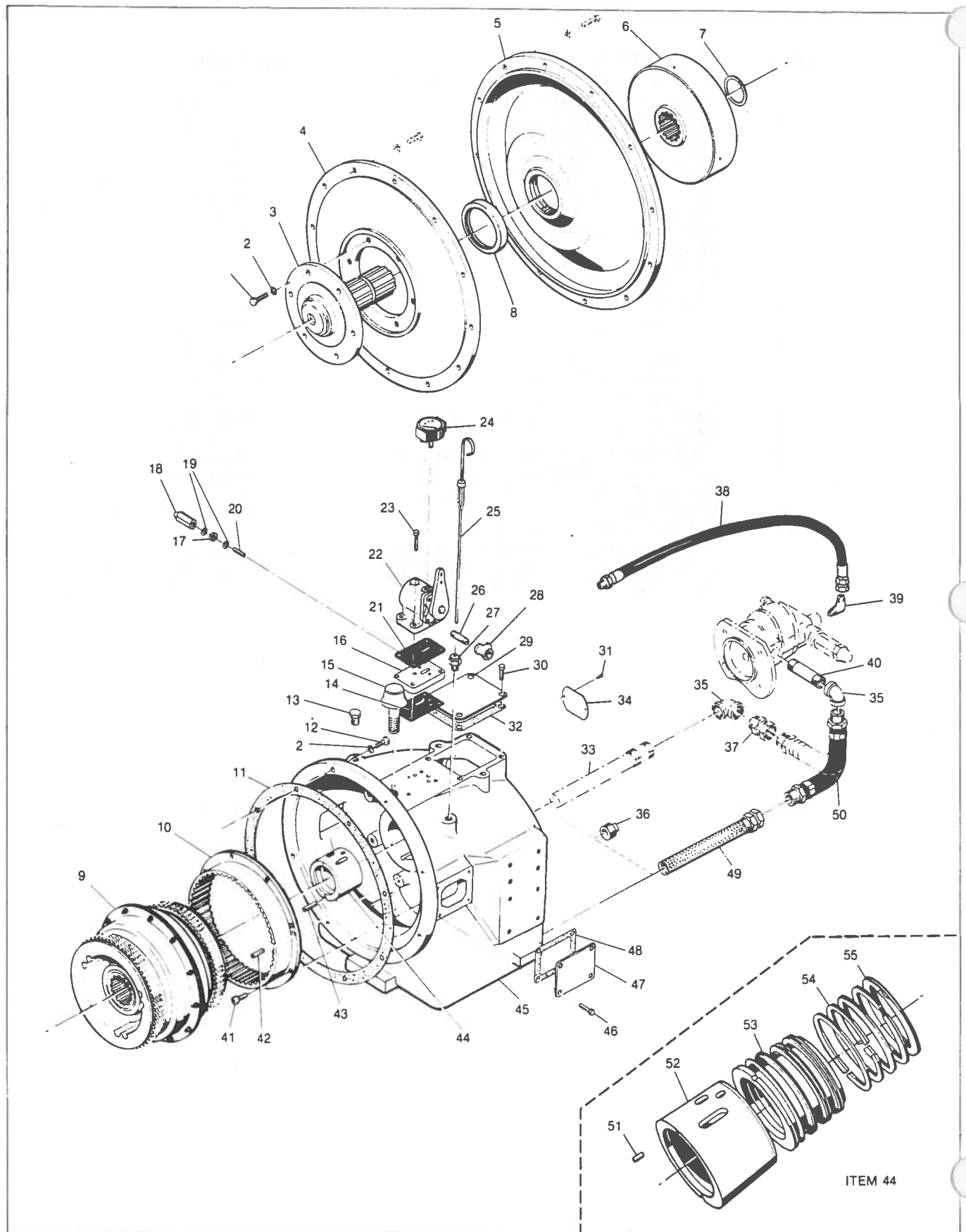


Fig. 46. Transmission Assembly, Part A. Housing Related Parts, Including Adapter Parts

8.6 TRANSMISSION ASSEMBLY, PART A

ITEM	DESCRIPTION	PART NUMBER	QTY.
1	CAPSCREW, HEX HD.; 3/8-24 x 1" LG.	1-07036-0800	6
2	LOCKWASHER, 3/8 LIGHT	1-09460-0800	14
3	ASSEMBLY, DRIVE FLANGE	SEE TABLE OF ADAPTATIONS	1
4	ADAPTER, FLYWHEEL	SEE TABLE OF ADAPTATIONS	1
5	ADAPTER, OIL DAM	SEE TABLE OF ADAPTATIONS	1
6	DRIVING DRUM, CLUTCH	1-01116-1800	1
7	SNAP RING	1-01151-1500	1
8	OIL SEAL (IF PRESENT)	1-13713-0000	1
9	ASSEMBLY, CLUTCH	SEE CLUTCH SECTION P. 39-46	1
10	DRUM, REVERSE	1-00250-1600 1700	1
11	GASKET, HOUSING TO OIL DAM ADAPTER	1-10277-0000	1
12	CAPSCREW, HEX HEAD; 3/8 - 16 x 1 1/4" LG.	1-06751-0800	8
13	CAPSCREW, HEX HEAD	1-11649-0000	1
14	GASKET, BASEPLATE TO HOUSING	1-01169-1500	1
15	BREATHER	1-01124-1300	1
16	BASEPLATE, VALVE	1-01150-1600	1
17	LOCKNUT	1-09464-0800	1
18	DOMENUT	1-09461-0800	1
19	GASKET	1-09471-0800	2
20	SCREW, TIMING	1-14141-0000 1-09466-0800	1
21	GASKET, BASEPLATE	1-01154-1500	1
22	ASSEMBLY, SELECTOR VALVE	(SEE PAGE 36)	1
23	CAPSCREW, HEX HEAD	1-07229-0800	4
24	GAUGE, PRESSURE	1-09669-0900	1
25	DIP STICK (HE-10200)	1-10213-0100	1
	DIP STICK (HE-10700)	1-10734-0100	1
26	PIPE, NIPPLE; 1/4 x 2" LG.	1-11259-3200	1
27	NUT, INVERTED FLARE; 1/2 - 20	1-11227-0400	1
28	TEE, REDUCING; 3/8 x 1/4 x 3/8"	1-11260-1500	1
29	COVER, INSPECTION	1-12405-0000	1
30	CAPSCREW, HEX HD.; 3/8-16 x 5/8" LG.	1-10836-0000	4
31	DRIVE SCREW, ROUND HD. #2 x 3/16" LG.	1-13275-0000	2
32	GASKET, INSPECTION COVER	1-12438-0000	1
33	SUCTION SCREEN AND PIPE NIPPLE	1-13336-0000	1
34	NAMEPLATE	1-11210-0000	1
35	ELBOW, 90°; 3/4 - 14 NPT	1-11246-0500	1 or 2
36	PIPE PLUG, SQUARE HD.; 3/4 - 14 NPT	1-11251-0500	1
37	FEMALE PIPE SWIVEL/MALE PIPE CONNECTOR	1-11268-0400	1
38	HOSE ASSEMBLY, PUMP TO VALVE	1-10952-0100	1
39	ELBOW, 90°; 1/2-14 N.P. x 3/4-16 JIC	1-11221-1300	1
40	PIPE NIPPLE; 3/4-14 NPT x 2 1/2" LG.	1-11259-0600	1
41	CAPSCREW, SOCKET HD.; 5/16 - 18 x 2" LG.	1-01307-1400	8
42	SPRING PIN, 3/8 DIA. x 1" LG.	1-12098-1600	2
43	SPRING PIN, 3/16 DIA. x 3/4" LG.	1-12096-1200	1
44	ASSEMBLY, REAR COMMUTATOR BUSHING	1-00248-2100	1
45	HOUSING, ALL RATIOS A.E.R. (EXCEPT 1.037)	1-12327-1000	1
HE-10200	HOUSING, 1.037 RATIO A.E.R. (NON IDLER)	1-12327-6000	1
	HOUSING, 1.083 RATIO E.R. (WITH IDLER)	1-12327-2000	1
	HOUSING, 1.500 RATIO E.R. (WITH IDLER)	1-12327-3000	1
	HOUSING, 2.00 RATIO E.R. (WITH IDLER)	1-12327-4000	1
HE-10700	HOUSING, ALL RATIOS A.E.R. (NON IDLER)	1-10702-3000	1
	HOUSING, 2.478 RATIO E.R. (WITH IDLER)	1-10724-3000	1
	HOUSING, 3.000 RATIO E.R. (WITH IDLER)	1-10722-3000	1
	HOUSING, 3.444 RATIO E.R. (WITH IDLER)	1-10732-3000	1
	HOUSING, 4.000 RATIO E.R. (WITH IDLER)	1-10742-3000	1
46	CAPSCREW, HEX HD.; 1/4-20 x 1/2" LG.	1-08087-0800	8
47	COVER, INSPECTION	1-01103-1500	2
48	GASKET, INSPECTION COVER	1-01131-1500	2
49	SUCTION SCREEN & SWIVEL CONNECTOR	1-13337-0000	1
50	HOSE ASSEMBLY, SUMP TO PUMP (HE-10200)	1-13334-0000	1
	HOSE ASSEMBLY, SUMP TO PUMP (HE-10700)	1-13341-0000	1
51	SPRING PIN	1-12096-0500	1
52	SHELL, COMMUTATOR	1-00500-1500	1
53	SLEEVE, COMMUTATOR	1-00501-1500	1
54	PISTON RING	1-00502-1500	4
55	SNAP RING	1-00503-1500	1

8.6 TRANSMISSION ASSEMBLY, PART B

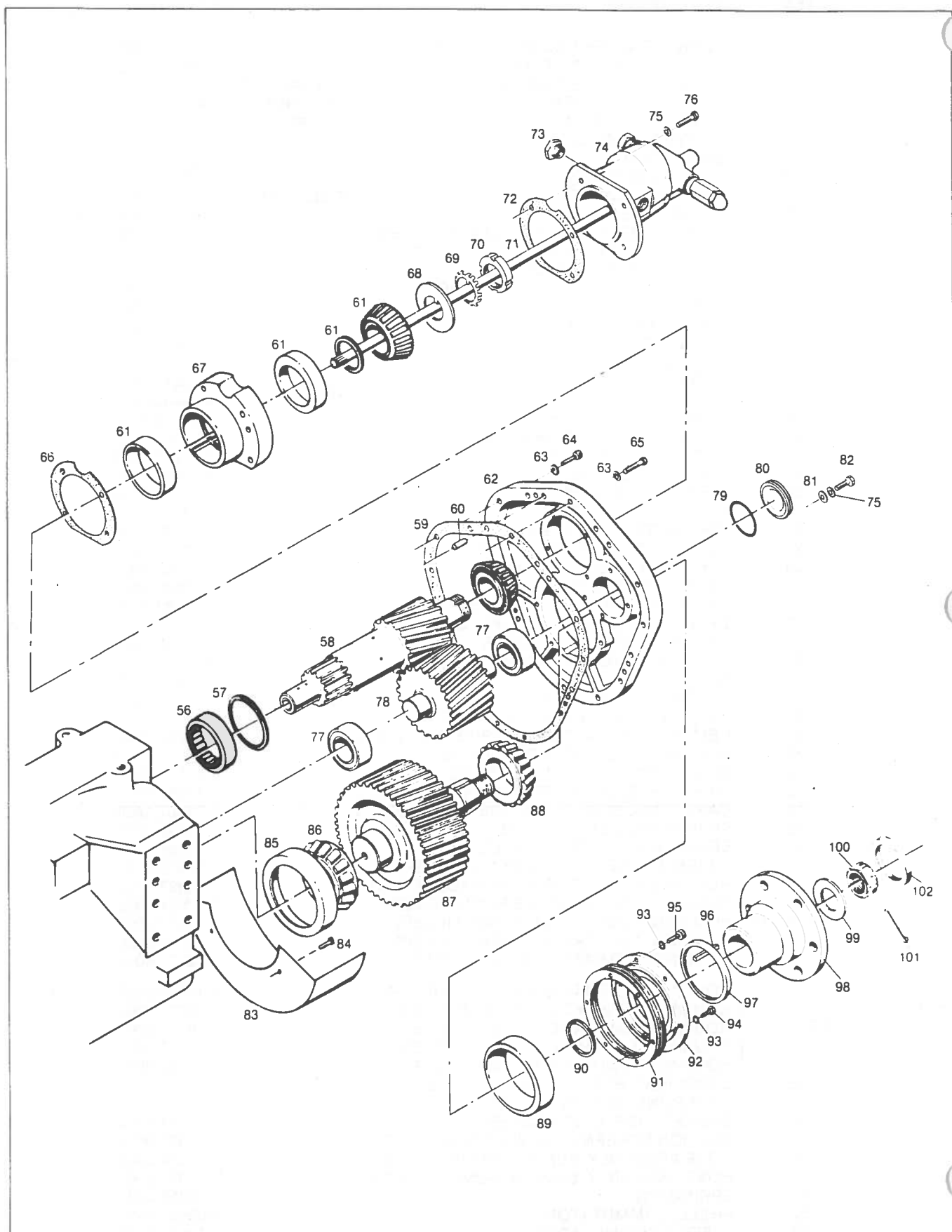


Fig. 47. Transmission Assembly, Part B: Pinion Parts, Idler Parts, Cover and Output Parts

8.6 TRANSMISSION ASSEMBLY, PART B

ITEM	DESCRIPTION	PART NUMBER	QTY.
56	BEARING, PINION SHAFT	1-10261-0000	1
57	SNAP RING	1-10263-0000	1
58	ASSEMBLY, PINION AND SHAFT	SEE SELECTION CHART, P. 53	1
59	GASKET, COVER TO HOUSING (HE-10200)	1-10278-0000	1
	GASKET, COVER TO HOUSING (HE-10700)	1-10735-0000	1
60	DOWEL PIN; 3/8 DIA. x 1"	1-11371-0000	3
61	ASSEMBLY, BEARING	1-12430-0000	1
62	COVER, REAR HOUSING (ALL RATIOS A.E.R.)	1-12330-2500	1
HE-10200	COVER, REAR HOUSING (1.083 E.R. RATIO)	1-12444-0400	1
	COVER, REAR HOUSING (1.50 E.R. RATIO)	1-12331-0400	1
	COVER, REAR HOUSING (2.00 E.R. RATIO)	1-12332-0400	1
	COVER, REAR HOUSING (ALL RATIOS A.E.R.)	1-12340-2500	1
HE-10700 (See also p. 52)	COVER, REAR HOUSING (2.478 E.R. RATIO)	1-12342-0400	1
	COVER, REAR HOUSING (3.00 E.R. RATIO)	1-12341-0400	1
	COVER, REAR HOUSING (3.444 E.R. RATIO)	1-12343-0400	1
	COVER, REAR HOUSING (4.00 E.R. RATIO)	1-12344-0400	1
63	LOCKWASHER, 5/16"	(HE-10200) 1-09458-0800	12
	LOCKWASHER, 3/8"	(HE-10700) 1-09460-0800	12
64	CAPSCREW, HEX. HD.	(HE-10200) 1-11365-0000	11
	CAPSCREW, HEX. HD.	(HE-10700) 1-07926-0800	11
65	CAPSCREW, HEX. HD.; 5/16-18 x 2"	(HE-10200) 1-11995-0000	1
	CAPSCREW, HEX. HD.; 3/8-16 x 2"	(HE-10700) 1-09662-0800	1
66	GASKET, BEARING RETAINER	1-12408-0000	1
67	ASSEMBLY, BEARING RETAINER	1-12424-2600	1
68	WASHER, KEYED	1-12437-0000	1
69	LOCKWASHER, BEARING	1-12371-0000	1
70	LOCKNUT, BEARING	1-09316-0800	1
71	SHAFT, PUMP	1-12412-0000	1
72	GASKET, OIL PUMP ADAPTER	1-12414-0000	1
73	BUSHING, EDUCING; 1/2 to 3/4"	1-11253-0900	1
74	ASSEMBLY, OIL PUMP	SEE PAGE 37	1
75	LOCKWASHER, 5/16"	1-09458-0800	1
76	CAPSCREW, HEX HD.; 5/16-18 x 2"	1-11995-0000	4
*77	BEARING	1-10281-0000	2
*78	IDLER GEAR AND SHAFT (21 TEETH)	1-10267-0100	1
*79	O-RING; 2 1/4 I.D. x 2 7/16" O.D.	1-12326-0000	1
*80	END PLUG	1-12325-0000	1
*81	WASHER, WROUGHT	1-10338-0000	1
*82	CAPSCREW, HEX HD.; 5/16-18 x 1/2"	1-12145-0000	1
83	OIL PAN	(HE-10700) 1-11836-0000	1
84	CAPSCREW, HEX HD.; 3/8-16 x 3/4"	(HE-10700) 1-13768-0000	2
85	CUP, BEARING	(HE-10200) 1-12431-0100	1
	CUP, BEARING	(HE-10700) 1-06725-0900	2
86	CONE, BEARING	(HE-10200) 1-12431-0200	1
	CONE, BEARING	(HE-10700) 1-06725-1000	1
87	GEAR OUTPUT	SEE SELECTION CHART, P. 53	1
88	CONE, BEARING	(HE-10200) 1-12432-0200	1
	CONE, BEARING	(HE-10700) 1-06726-1000	1
89	CUP, BEARING	(HE-10200) 1-12432-0100	1
	CUP, BEARING	(HE-10700) 1-06725-0900	2
90	SEAL RING	(HE-10200) 1-12446-0000	1
91	SHIM PACK (7 PIECES)	(HE-10200) 1-12409-2600	1
	SHIM PACK (7 PIECES)	(HE-10700) 1-03755-3400	1
92	BEARING CAP AND SEAL RETAINER	(HE-10200) 1-12406-0000	1
	BEARING CAP AND SEAL RETAINER	(HE-10700) 1-06718-1200	1
93	LOCKWASHER, 5/16"	(HE-10200) 1-09458-0800	6
	LOCKWASHER, 1/2"	(HE-10700) 1-11083-0000	6
94	CAPSCREW, HEX HD.; 5/16-18 x 1 1/4"	(HE-10200) 1-12339-0000	4
	CAPSCREW, HEX HD.; 1/2-13 x 1 1/2"	(HE-10700) 1-09141-0800	6
95	CAPSCREW, SOCKET HD.; 5/16-18 x 1 1/4"	(HE-10200) 1-07951-0800	2

*NORMALLY THESE PARTS ARE ONLY FOUND IN UNITS EMPLOYING AN IDLER GEAR (E.R.).

8.6 TRANSMISSION ASSEMBLY, PART B (Continued)

ITEM	DESCRIPTION	PART NUMBER	QTY.
96	KEY; 1/4 x 1/4 x 2".....(HE-10200)	1-10235-0000	1
97	OIL SEAL(HE-10200)	1-12974-0000	1
	OIL SEAL(HE-10700)	1-12976-0000	1
98	COUPLING, OUTPUT(HE-10200)	1-12407-0000	1
	COUPLING, OUTPUT(HE-10700)	1-06722-1000	1
99	WASHER(HE-10200)	1-12375-0000	1
	WASHER(HE-10700)	1-06745-0800	1
100	NUT, CASTLE(HE-10200)	1-10231-0000	1
	NUT, CASTLE(HE-10700)	1-06744-0800	1
101	COTTER PIN(HE-10200)	1-12769-5500	1
	COTTER PIN(HE-10700)	1-06746-0800	1
102	PILOT RING(HE-10200)	1-10222-0000	1
	PILOT RING(HE-10700)	1-01175-0400	1

8.6 TRANSMISSION ASSEMBLY, PART C: HE 10700 4½:1 and 5:1 RATIO MODELS

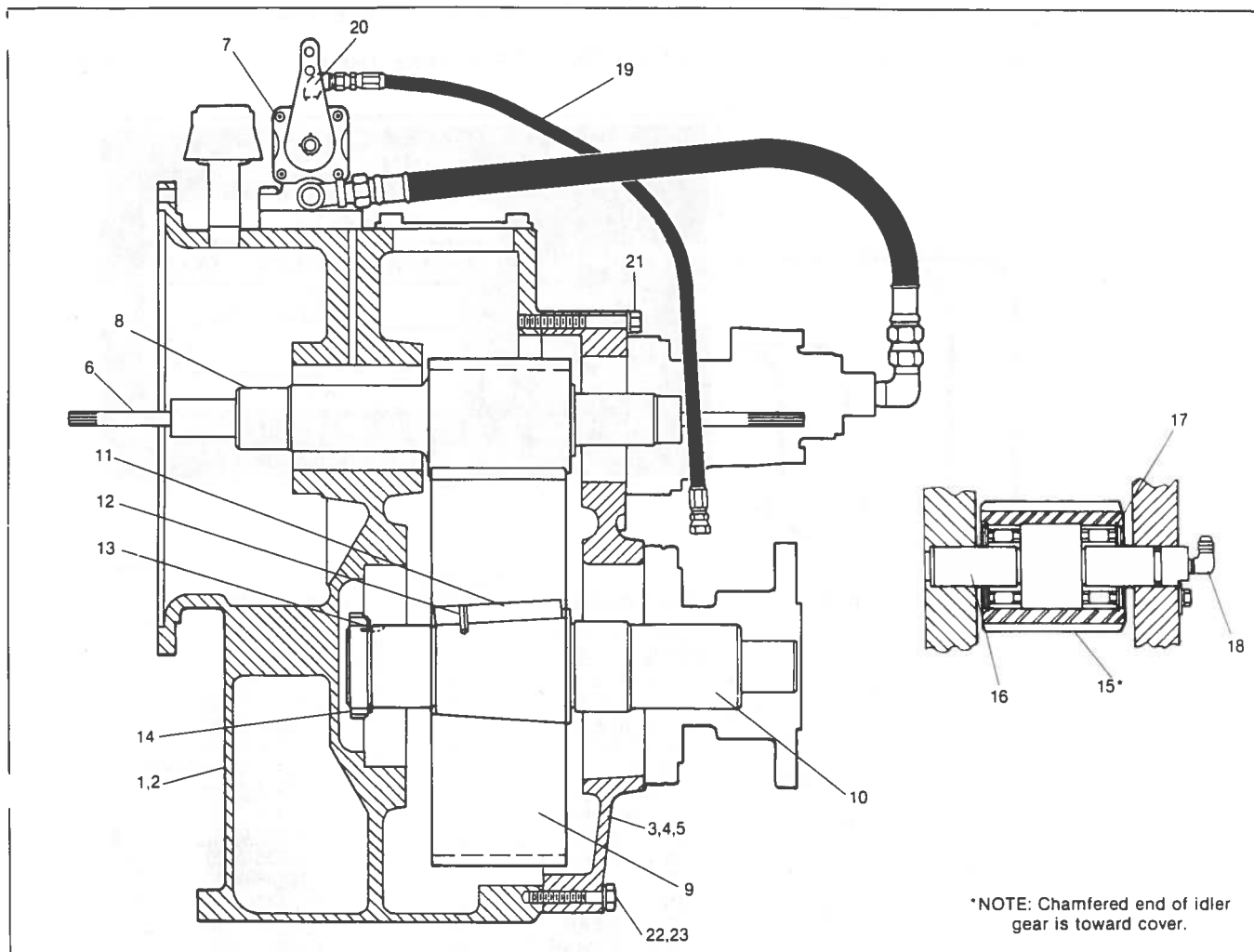


Fig. 48. Cross-Section View Showing Parts only found on HE-10700 Units with 4.533 AER, 4.526 ER, 5.00 AER and 5.00 ER Ratios.

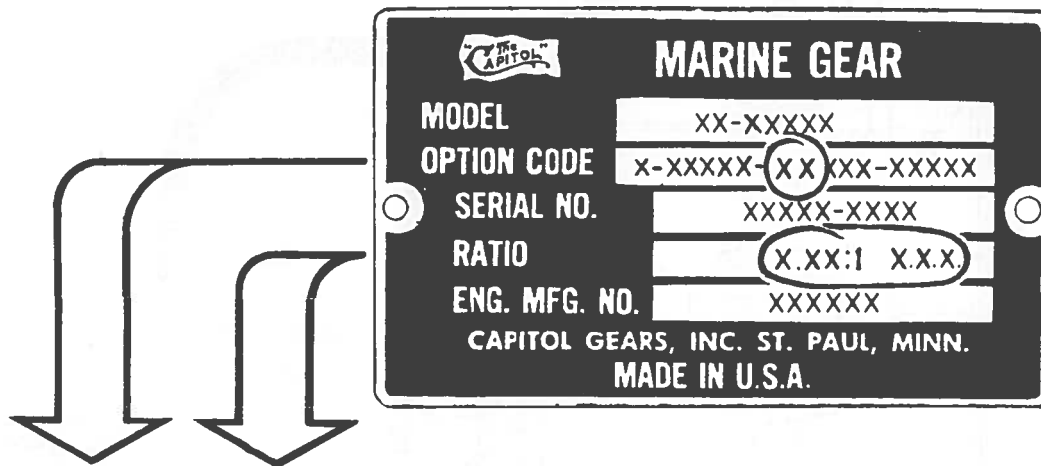
NOTE: The parts listed here are peculiar to 4 1/2 and 5 to 1 ratio models. All other parts not listed on this page may be found on preceding pages.

ITEM	DESCRIPTION	PART NUMBER	QTY.
1	HOUSING, REVERSE AND REDUCTION - 4.526 E.R. RATIO	1-10702-2000	1
2	HOUSING, REVERSE AND REDUCTION - 5.00 E.R. RATIO	1-10702-4000	1
3	COVER, HOUSING - 4.526 E.R. RATIO	1-12340-3000	1
4	COVER, HOUSING - 5.00 E.R. RATIO	1-12340-5000	1
5	COVER, HOUSING - 4.533 AND 5.00 A.E.R. RATIO	1-12340-2000	1
6	SHAFT, PUMP	1-13932-0000	1
7	ASSEMBLY, SELECTOR VALVE (4.526 ER and 5.00 ER RATIOS ONLY)	1-01175-1100	1
8	ASSEMBLY, PINION AND SHAFT	SEE SELECTION CHART P. 53	1
9	GEAR, OUTPUT	SEE SELECTION CHART P. 53	1
10	SHAFT, OUTPUT GEAR	1-13927-0000	1
11	KEY, SQUARE	1-13931-0000	1
12	SPRING PIN, 3/16 DIA. x 11/16"	1-12096-1100	1
13	LOCKWASHER, BEARING	1-00335-1900	1
14	LOCKNUT, BEARING	1-00335-2100	1
15	IDLER, 28 TEETH	1-13920-0000	1
16	SHAFT, IDLER	1-13919-0000	1
17	SNAP RING, INTERNAL	1-13933-0000	2
18	90° ELBOW	1-11221-0300	1
19	HOSE, IDLER	1-11884-0000	1
20	90° METERING ELBOW	1-11885-0000	1
21	CAPSCREW, HEX HD. 3/8-16 x 3"	1-13174-0000	1
22	CAPSCREW, HEX HD. 3/8-16 x 2 1/2"	1-04672-0800	13
23	DOWEL PIN, 3/8 DIA. x 2"	1-11535-0000	3

8.7 PINION AND OUTPUT GEAR SELECTION CHART

A. LOCATE THE NAMEPLATE (ON BACK OF HOUSING) AND DETERMINE THE TWO REDUCTION RATIO OPTION CODE NUMBERS (CIRCLED IN SAMPLE BELOW) AND THE RATIO. THE NUMBER OF TEETH MAY BE CHECKED ALSO.

B. MATCH THIS INFORMATION WITH THE CHART BELOW TO DETERMINE THE CORRECT PART NUMBER(S).



HE-10200

OPTION CODE	RATIO	PART NAME	NUMBER OF TEETH	PART NUMBER
01	1.50 A.E.R.	PINION AND SHAFT OUTPUT GEAR	22 33	1-12427-2600 1-12429-0000
02	2.00 A.E.R.	PINION AND SHAFT OUTPUT GEAR	18 36	1-13156-0100 1-13155-0000
03	2.44 A.E.R.	PINION AND SHAFT OUTPUT GEAR	16 39	1-12333-2600 1-12336-0000
04	2.93 A.E.R.	PINION AND SHAFT OUTPUT GEAR	14 41	1-12963-0100 1-12964-0000
05	1.50 E.R.	PINION AND SHAFT OUTPUT GEAR	20 30	1-12334-2600 1-12337-0000
06	2.00 E.R.	PINION AND SHAFT OUTPUT GEAR	17 34	1-12335-2600 1-12338-0000
07	1.037 A.E.R.	PINION AND SHAFT OUTPUT GEAR	27 28	1-12372-2600 1-12373-0000
08	1.083 E.R.	PINION AND SHAFT OUTPUT GEAR	24 26	1-12346-2600 1-12442-0000
09	1.75 A.E.R.	PINION AND SHAFT OUTPUT GEAR	20 35	1-12334-2600 1-12455-0000
10	1.20 A.E.R.	PINION AND SHAFT OUTPUT GEAR	25 30	1-12361-2600 1-12362-0000

HE-10700

OPTION CODE	RATIO	PART NAME	NUMBER OF TEETH	PART NUMBER
01	2.541 A.E.R.	PINION AND SHAFT OUTPUT GEAR	24 61	1-12346-2600 1-10739-0300
02	3.047 A.E.R.	PINION AND SHAFT OUTPUT GEAR	21 64	1-12347-2600 1-10707-0300
03	3.473 A.E.R.	PINION AND SHAFT OUTPUT GEAR	19 66	1-12348-2600 1-10709-0300
04	4.00 A.E.R.	PINION AND SHAFT OUTPUT GEAR	17 68	1-12335-2600 1-10711-0300
05	2.478 E.R.	PINION AND SHAFT OUTPUT GEAR	23 57	1-12345-2600 1-10737-0300
06	3.00 E.R.	PINION AND SHAFT OUTPUT GEAR	20 60	1-12334-2600 1-10713-0300
07	3.444 E.R.	PINION AND SHAFT OUTPUT GEAR	18 62	1-12426-2600 1-10716-0300
08	4.00 E.R.	PINION AND SHAFT OUTPUT GEAR	16 64	1-12333-2600 1-10717-0300
09	4.533 A.E.R.	PINION AND SHAFT OUTPUT GEAR	15 68	1-13923-0000 1-13924-0000
10	4.526 E.R.	PINION AND SHAFT OUTPUT GEAR	19 86	1-13947-0000 1-13948-0000
11	5.00 A.E.R.	PINION AND SHAFT OUTPUT GEAR	14 70	1-13921-0000 1-13925-0000
12	5.00 E.R.	PINION AND SHAFT OUTPUT GEAR	18 90	1-13922-0000 1-13926-0000

8.8 OIL COOLERS

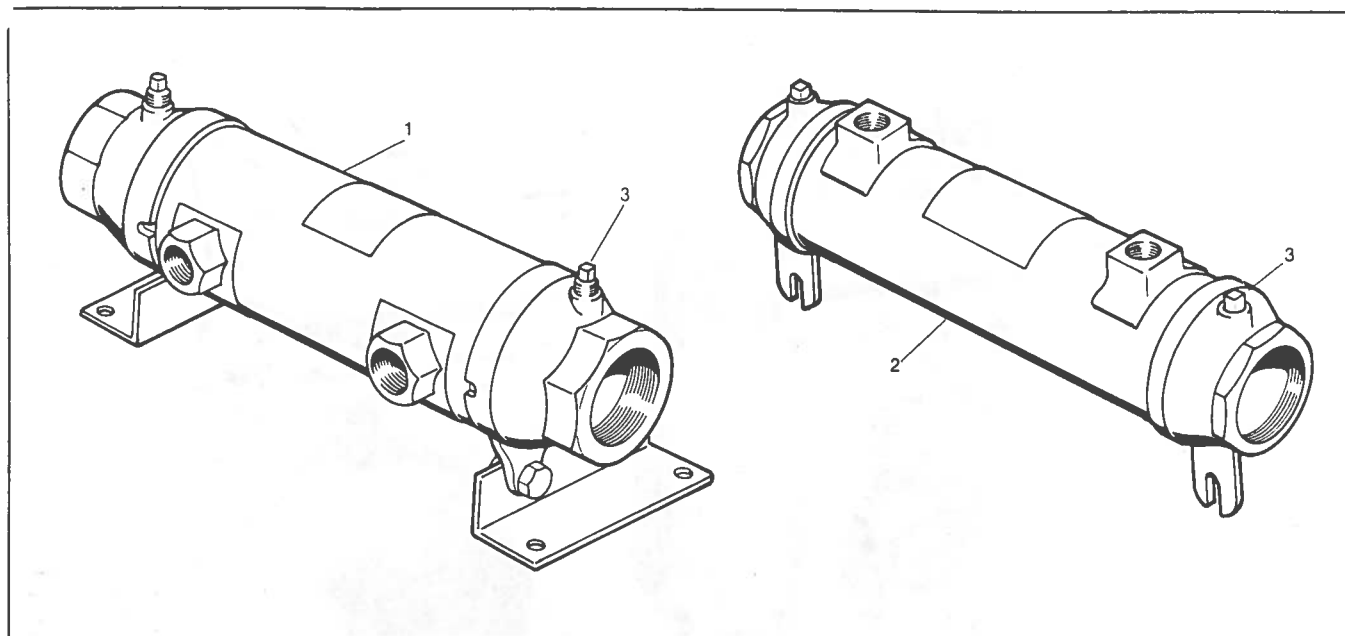


Figure 49. Oil Coolers

ITEM	DESCRIPTION	PART NUMBER	QTY.
1	OIL COOLER (SEA OR FRESH WATER) 4 3/8" DIA. x 12 3/4" 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

NOTE: HOSE AND BRACKET KITS ARE SHOWN ON PAGES 55 AND 56.

8.9 HOSE AND BRACKET KITS

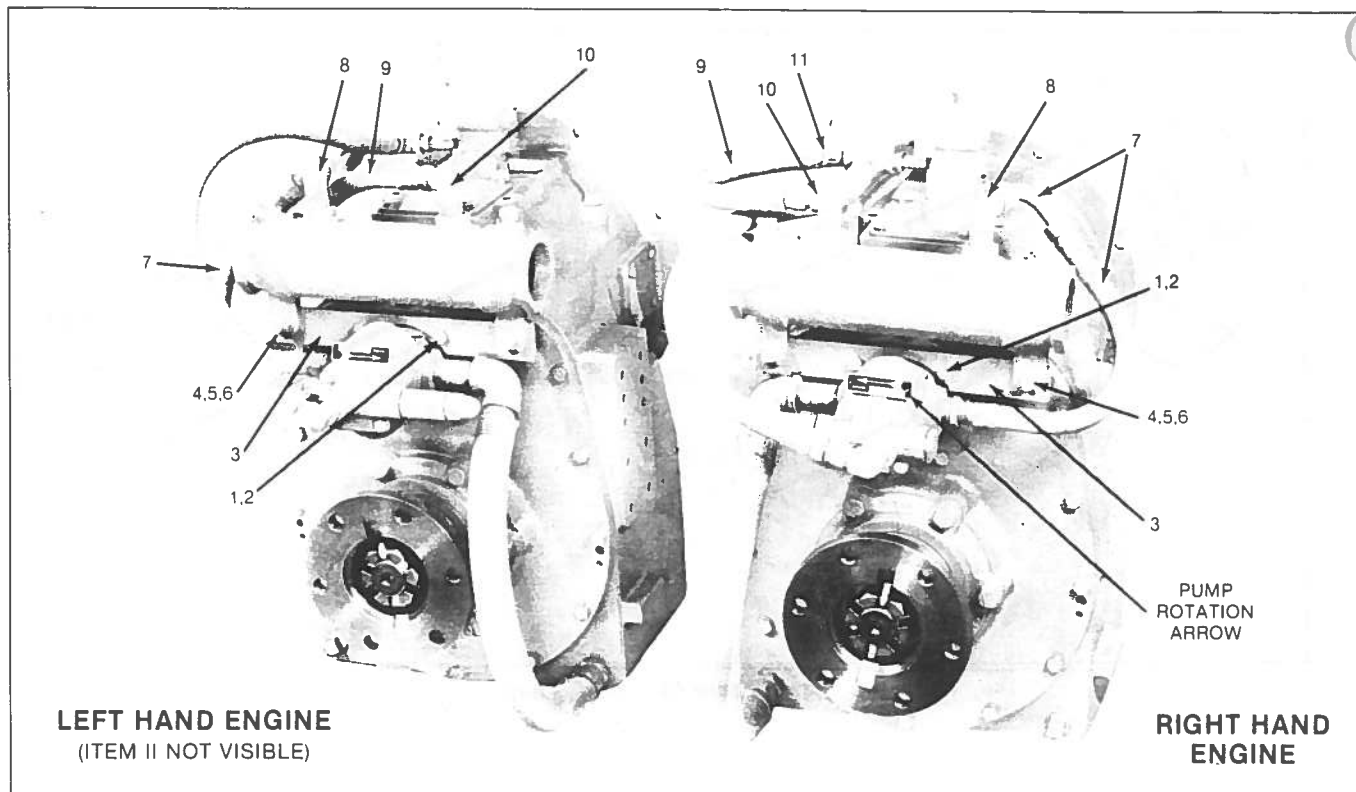


Fig. 50. Hose and Bracket Kit No. 1-13908-0000 to be used with Cooler No. 12445-2100

ITEM	DESCRIPTION	PART NUMBER	QTY
REFERENCE	HOSE AND BRACKET KIT	1-13908-0000	1
1	CAPSCREW	1-12452-0000	2
2	LOCKWASHER	1-09458-0800	2
3	BRACKET	1-12447-0000	1
4	CAPSCREW	1-00266-0600	2
5	WASHER	1-06671-0800	2
6	NUT, FLEX-LOC	1-09474-0800	2
7	HOSE	1-10219-1100	1
8	ELBOW	1-11221-1500	1
9	HOSE	1-07830-1500	1
10	ELBOW	1-11221-1300	1
11	STREET ELL	1-11248-0300	1

8.9 HOSE AND BRACKET KITS (CONTINUED)

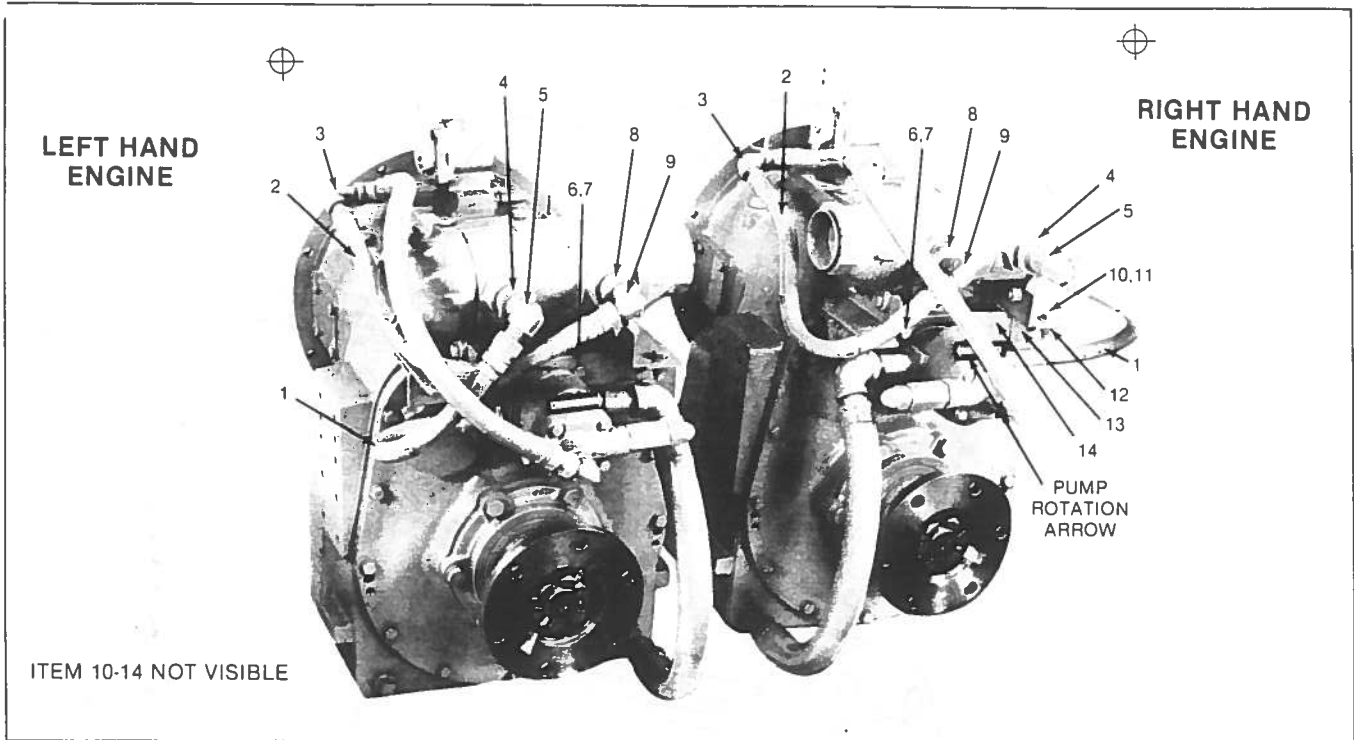


Fig. 51. Hose and Bracket Kit No. 1-13909-0000 to be used with Cooler No. 1-07808-5000

ITEM	DESCRIPTION	PART NUMBER	QTY.
REFERENCE	HOSE AND BRACKET KIT	1-13909-0000	1
1	HOSE	1-12049-0800	1
2	HOSE	1-08873-0900	1
3	STREET ELL	1-11248-0300	1
4	BUSHING, 1 x 3/4"	1-11253-1200	1
5	ELBOW	1-11221-1700	1
6	CAPSCREW	1-12452-0000	2
7	LOCKWASHER	1-09458-0800	2
8	BUSHING	1-11253-1100	1
9	ELBOW	1-11221-1300	1
10	FLAT WASHER	1-06671-0800	4
11	CAPSCREW	1-07432-0800	4
12	NUT, FLEX-LOC	1-13568-0000	4
13	BRACKET	1-11996-0000	2
14	BRACKET	1-12447-0000	1

8.10 PROP COUPLING KIT

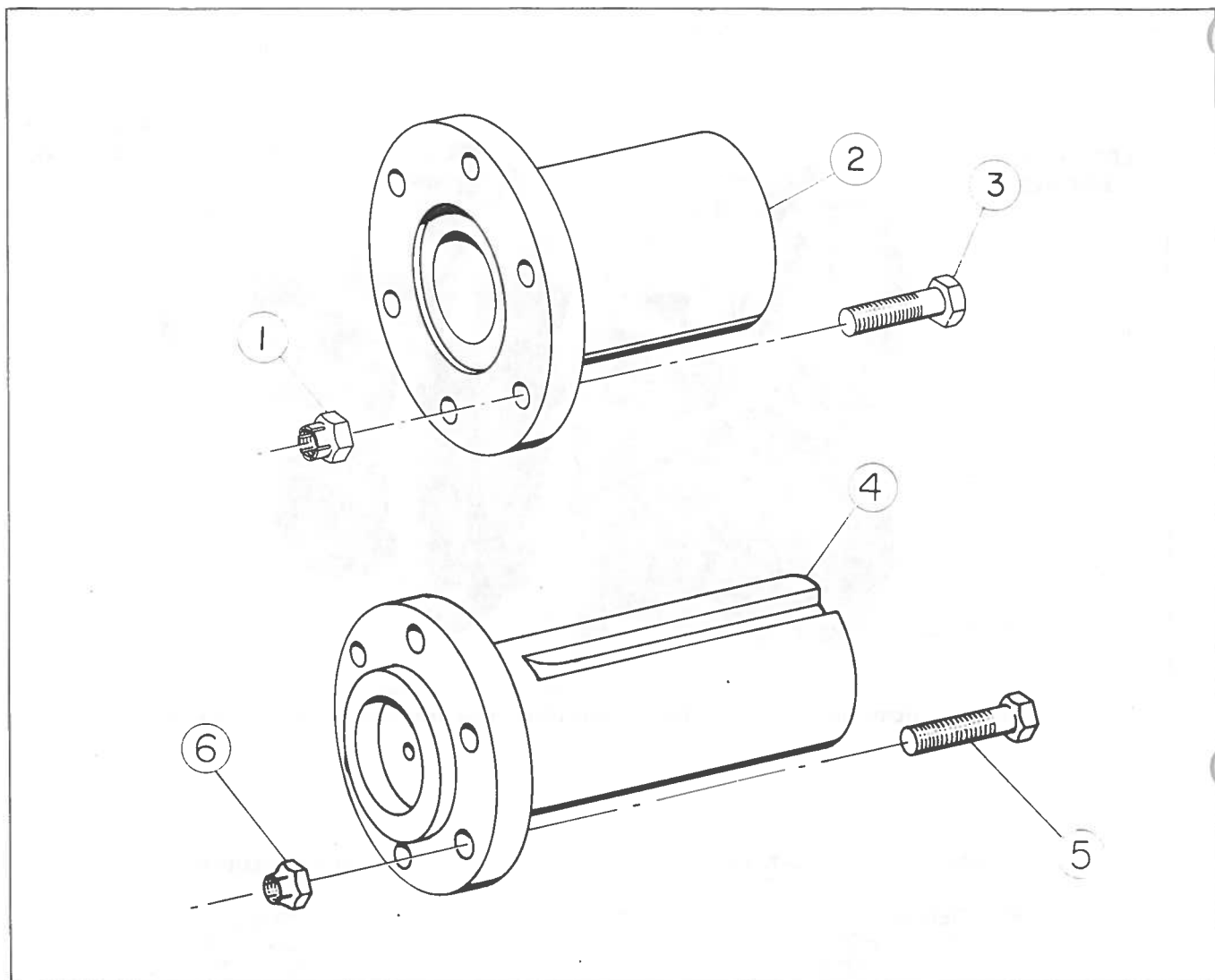
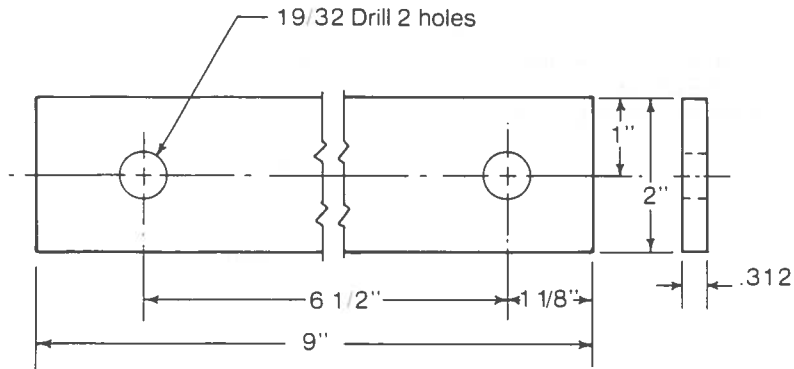


Fig. 52. Prop Coupling Kits

ITEM	DESCRIPTION	PART NUMBER	QTY.
REFERENCE	ASSEMBLY, PROP COUPLING (10200 ONLY)	1-13691-0000	1
1	HEX NUT, FLEXLOC	1-11389-0000	6
2	COUPLING	1-10221-0000	1
3	CAPSCREW, HEX HEAD	1-10058-0000	6
REFERENCE	ASSEMBLY, PROP COUPLING (10700 ONLY)	1-13578-0000	1
1	HEX NUT, FLEXLOC	1-13304-0000	6
2	COUPLING	1-13494-0000	1
3	CAPSCREW, HEX HEAD	1-07554-0800	6
REFERENCE	ASSEMBLY, KEYED SHAFT KIT (10200 ONLY)	1-13845-0000	1
4	KEYED SHAFT	1-13157-0000	1
5	CAPSCREW, HEX HEAD	1-10058-0000	6
6	NUT, FLEXLOC	1-11389-0000	6
REFERENCE	ASSEMBLY, KEYED SHAFT KIT (10700 ONLY)	1-13846-0000	1
4	KEYED SHAFT	1-12238-0000	1
5	CAPSCREW, HEX HEAD	1-07554-0800	6
6	NUT, FLEXLOC	1-13304-0000	6

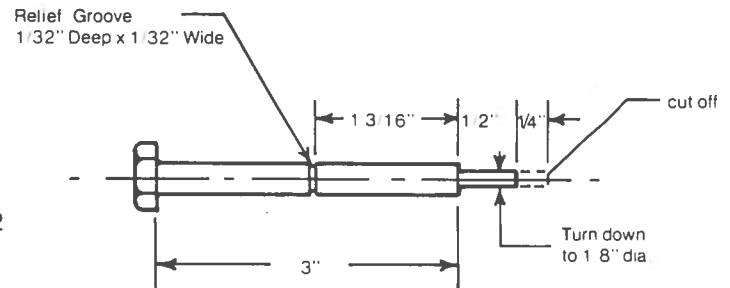
SECTION 9. SPECIAL TOOLS

Special tools which may be used in repair work are shown on the following pages. All pertinent information for fabrication is included. These tools are not normally available and may only be purchased by special order.



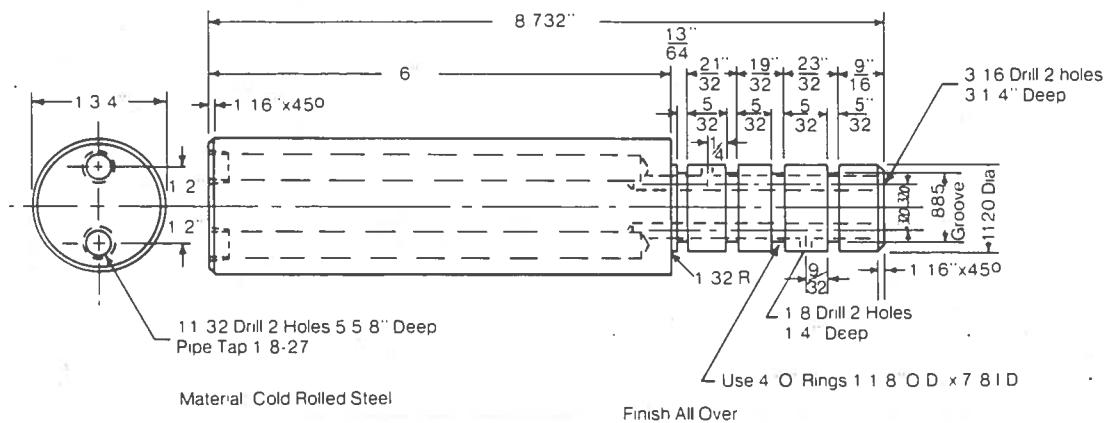
Material: Steel

Return Spring Height Adjustment Gauge
Special Tool no. 1-90000-0000



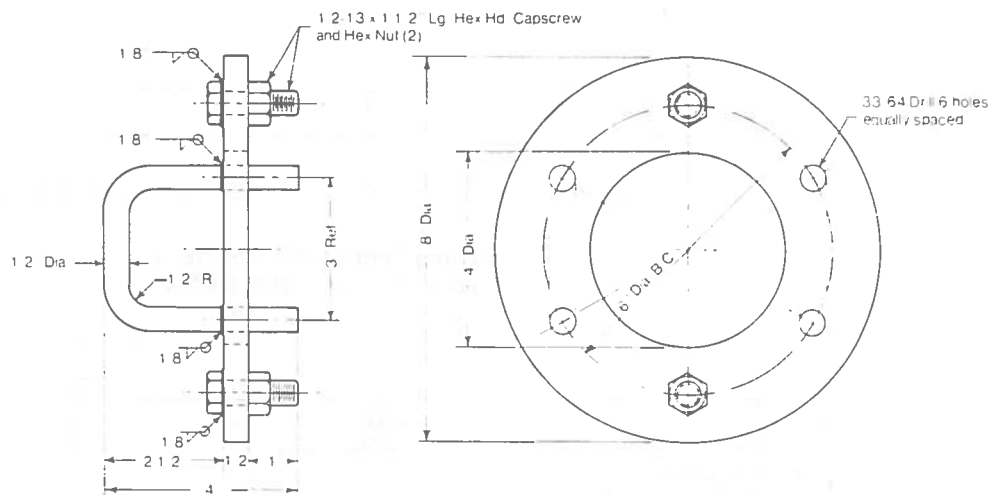
Material: 1/4-20 NC x 3 3/4" Lg.
Hex Head Capscrew

Spring Pin Driver
(for oil pump assembly)
Special Tool no. 1-90009-0000



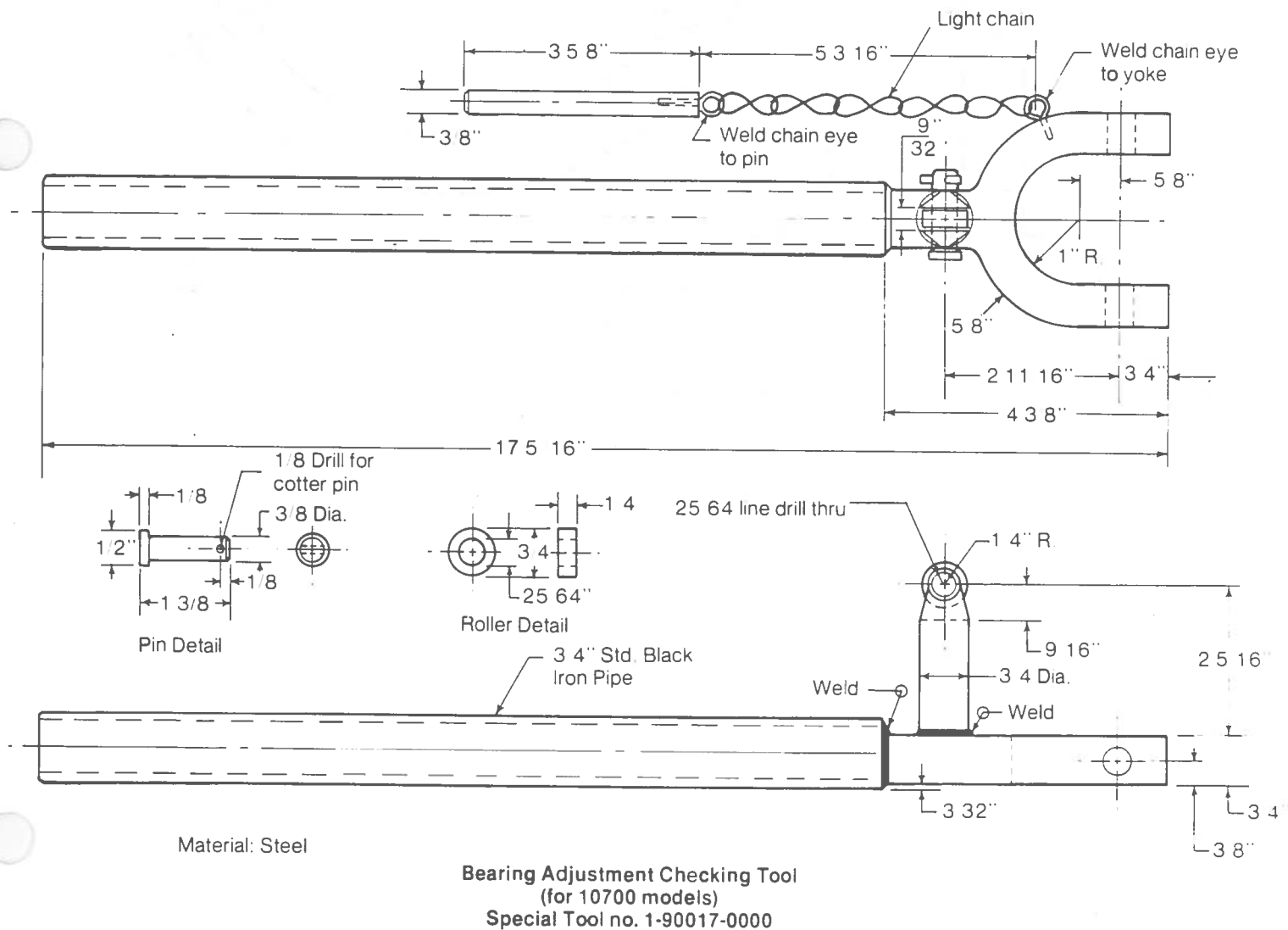
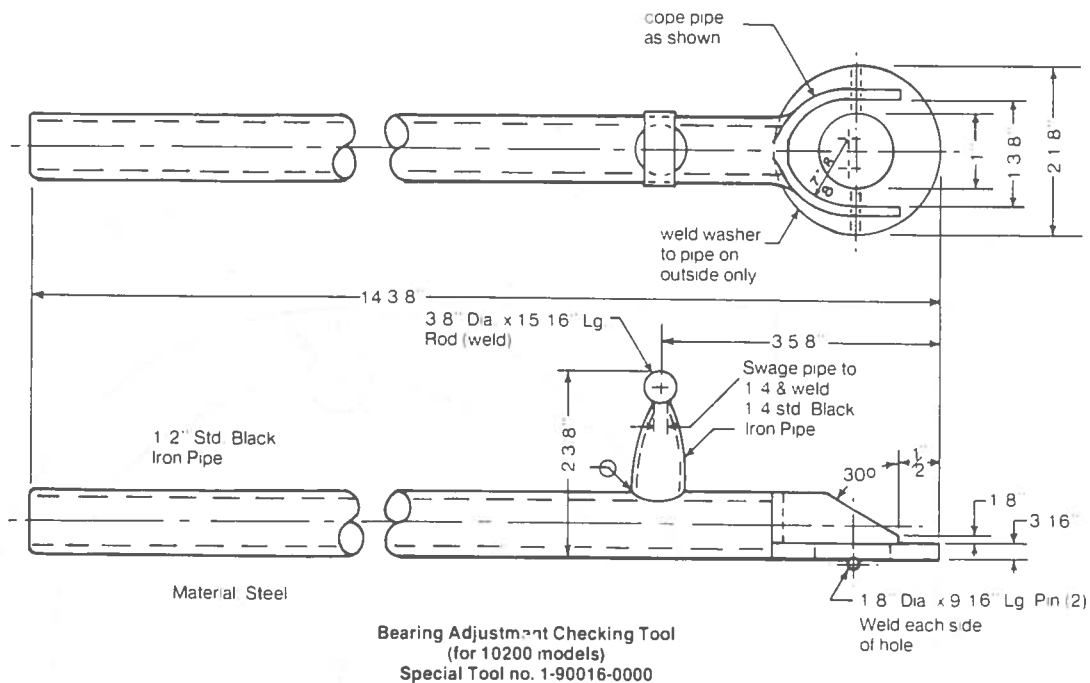
Material: Cold Rolled Steel

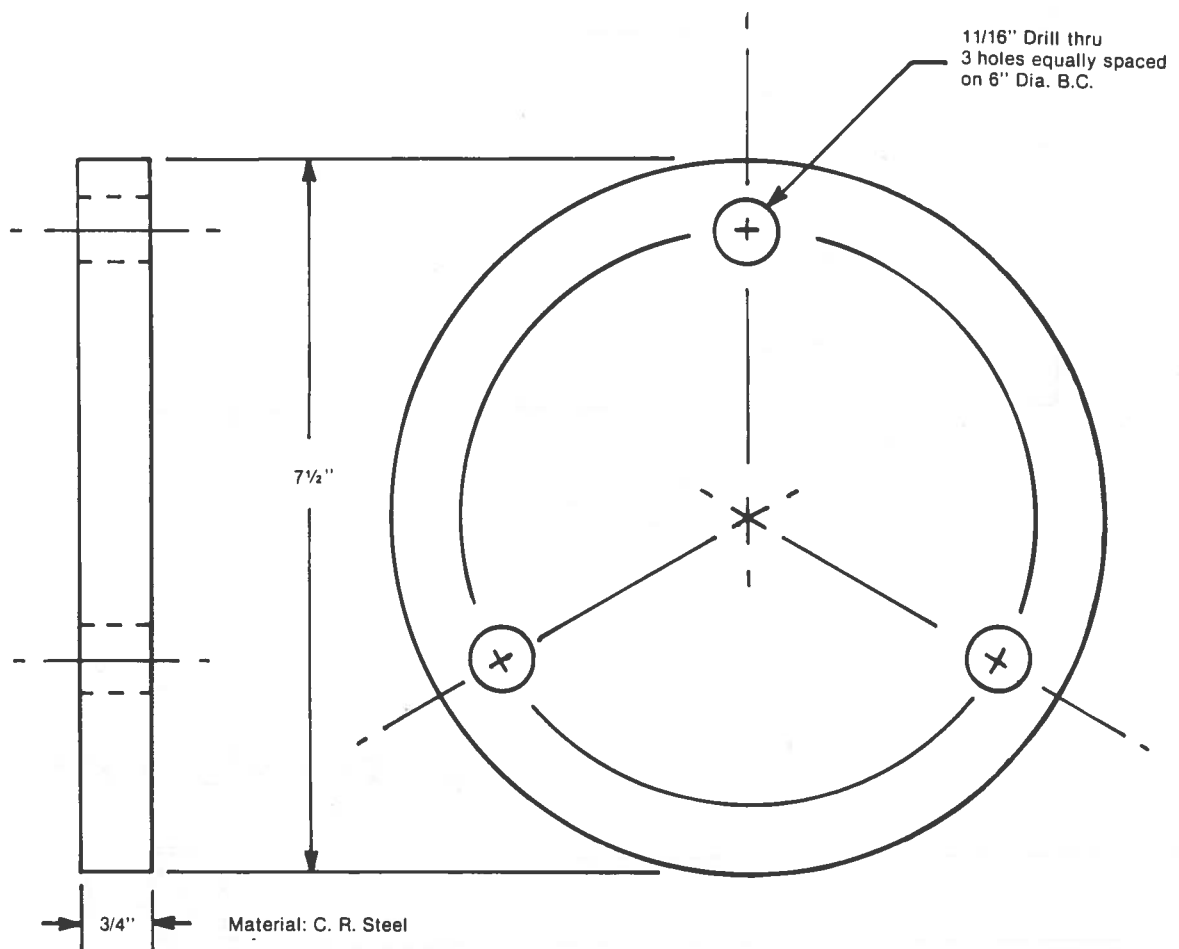
Test Plug for 4HE Clutch Pots
Special Tool no. 1-90012-0000



Material: Cold Rolled Steel

Coupling Holder (10700 models)
Special Tool no. 1-90011-0000



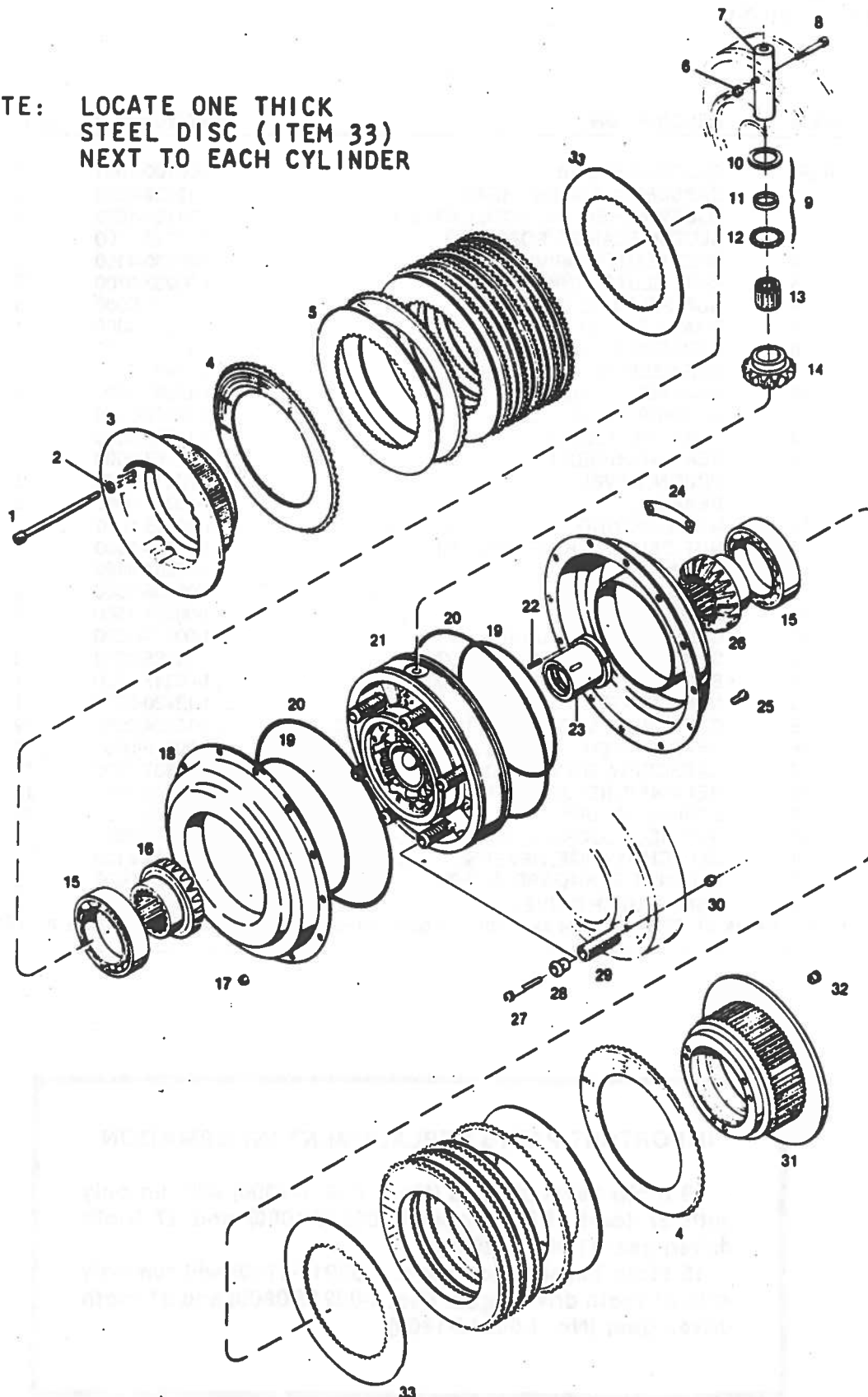


Puller Plate for Output Coupling
HE-10700
Special Tool No. 1-90024-0000

STANDARD CLUTCH
CLUTCH NO. 1-00100-1001

NOTE: LOCATE ONE THICK
STEEL DISC (ITEM 33)
NEXT TO EACH CYLINDER

this end
toward
engine



STANDARD CLUTCH
CLUTCH NO. 1-00100-1001

ITEM	DESCRIPTION	PART NUMBER	QTY.
REF.	CLUTCH ASSEMBLY	1-00100-1001	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	10
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	WASHER, THRUST	1-12369-0000	3
11	WASHER, PILOT	1-12366-0000	3
12	BEARING, NEEDLE	1-12368-0000	3
13	BEARING, NEEDLE	1-12367-0000	3
14	PINION, BEVEL	1-00217-1000	3
15	BEARING	1-12364-0000	2
16	GEAR, DRIVING	1-00215-1000	1
17	NUT, SELF-LOCKING; 1/4-28 NF	1-00226-3600	12
18	CYLINDER	1-00234-8400	2
19	QUAD RING	1-00238-1500	2
20	QUAD RING	1-00237-1500	2
21	CARRIER, BEVEL GEAR	1-00219-1800	1
22	SPRING PIN 1/8" DIA. x 3/4" LG	1-12095-1200	2
23	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
24	NAME PLATE	1-13430-0000	1
25	CAPSCREW, SOCKET HD; 1/4-28 x 5/8" LG.	1-13424-0000	12
26	GEAR, DRIVEN	1-00215-2000	1
27	CAPSCREW, SOCKET HD; 1/4-20 x 1 1/2" LG.	1-07837-0800	12
28	RETAINER, RETURN SPRING	1-00243-3500	12
29	SPRING, RETURN	1-00239-1500	12
30	NUT, SELF-LOCKING; 1/4-20	1-07846-0800	12
31	CLUTCH FLANGE, REVERSE	1-00212-6100	1
32	ALLENUT, STANDARD; 5/16-24	1-12733-0000	6
33	DISC, CLUTCH DRIVEN	1-00229-1700	2

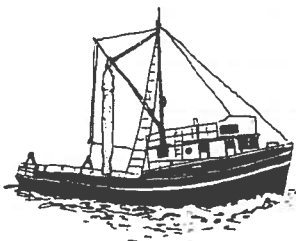
*NOTE: Items 21, 22 and 23 are available as part number 1-00219-4400 GEAR CASE ASSEMBLY.

IMPORTANT PARTS REPLACEMENT INFORMATION

19 tooth bevel pinions (No. 1-00217-1000) will run only with 27 tooth driving gear (1-00215-1000) and 27 tooth driven gear (1-00215-2000).

15 tooth bevel pinions (No. 1-00217-1700) will run only with 21 tooth driving gear (No. 1-00215-0900) and 21 tooth driven gear (No. 1-00215-1800).

[illegible]



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