

**HY- 6900
HY-7700
SERVICE MANUAL**

NOTE

THIS SERVICE MANUAL IS
GUARANTEED EFFECTIVE
FOR SERIAL NO.
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.

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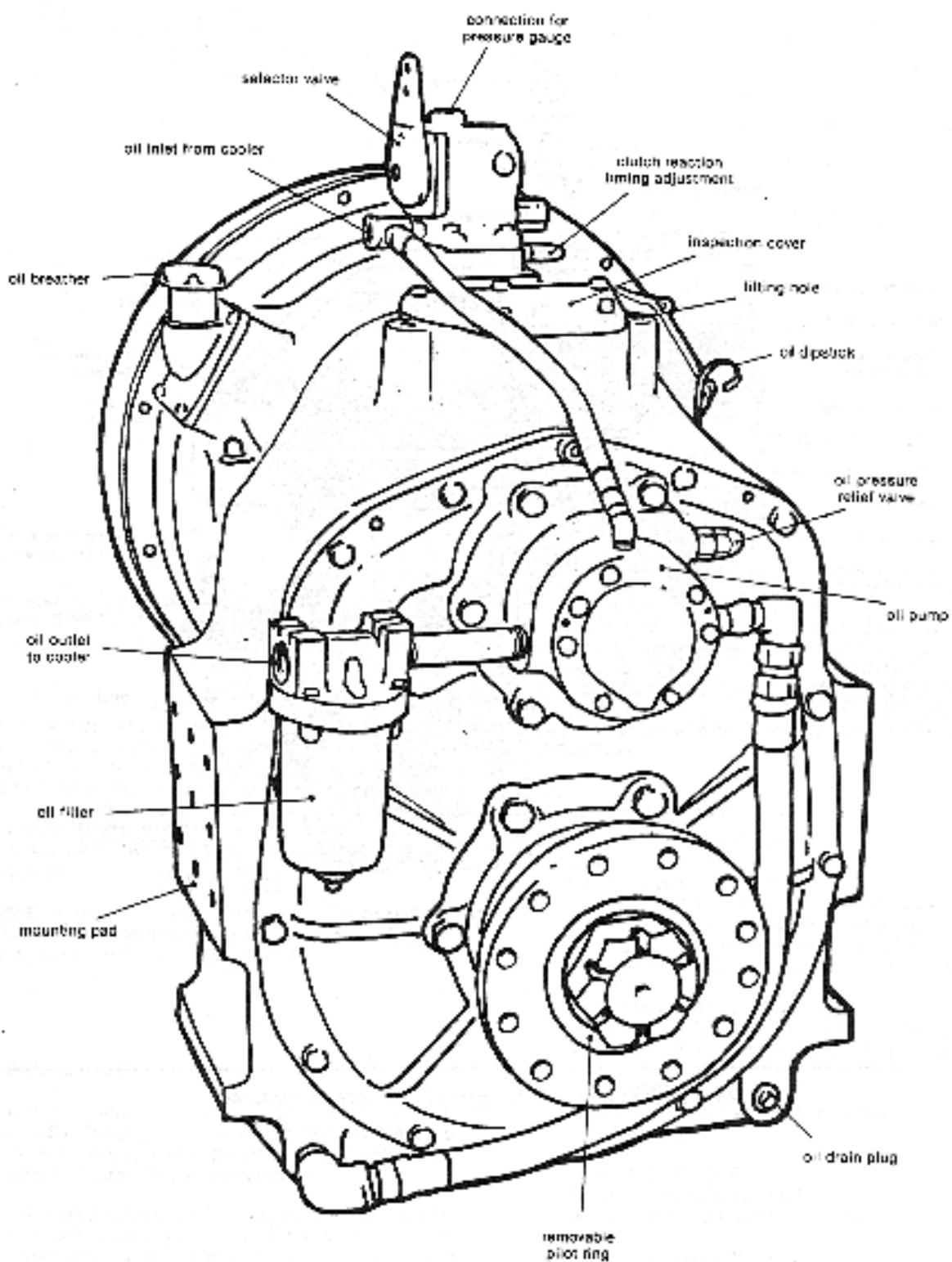
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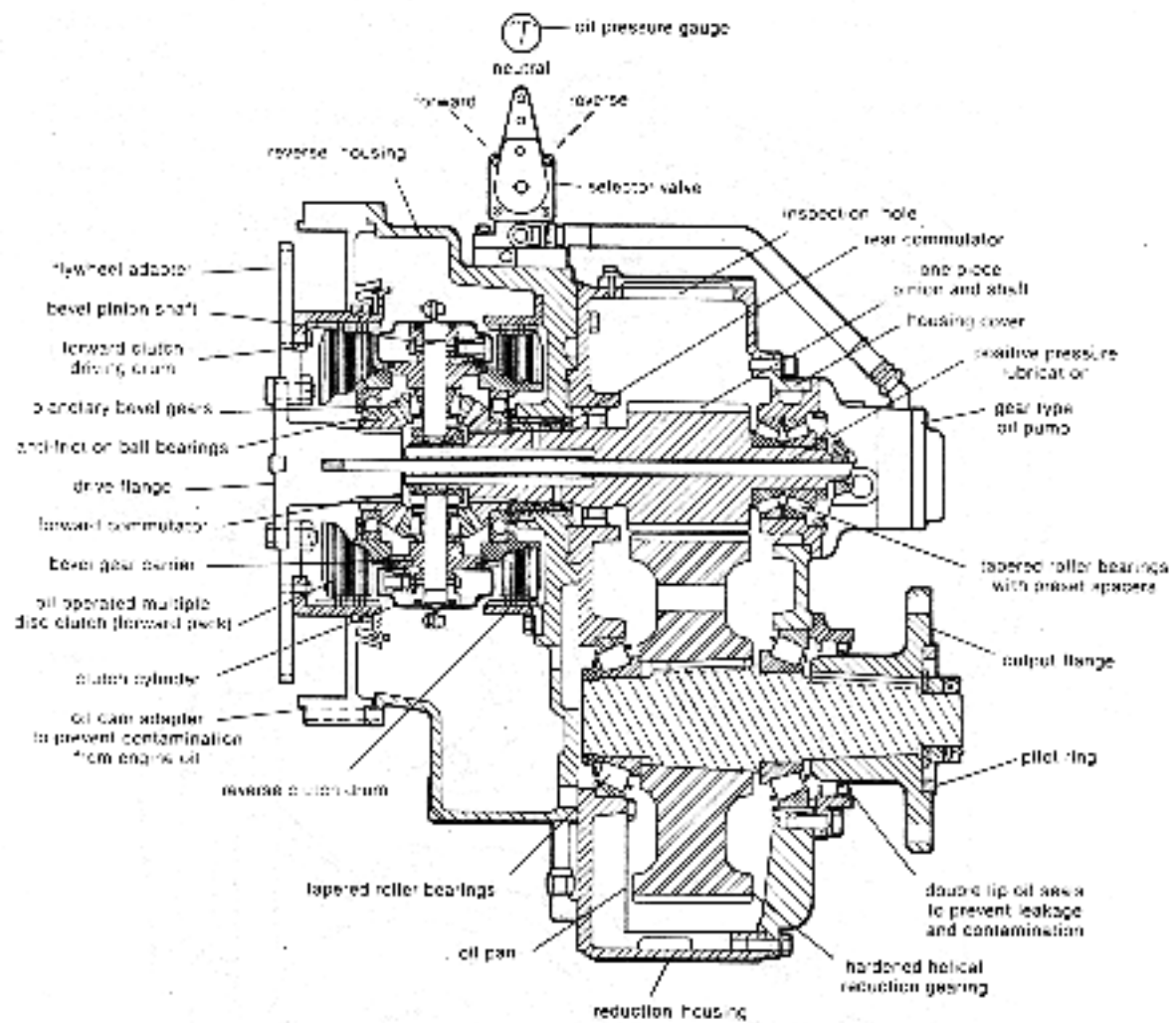
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SECTION 1. INTRODUCTION

The purpose of this manual is to provide assistance to operation and maintenance personnel to reduce downtime and obtain consistent performance.

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, and oil dam adapter to prevent engine contamination and driving drum. The clutch pack consists of reciprocating cylinders, clutch discs and a planetary bevel gear reversing system. The oil and 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 and intermediary gear called and 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, oil cooler must be used with a capitol marine transmission.

HOSE AND FITTING PACKAGE

Kits that include the necessary hose and fittings are available for use with capitol oil coolers.

PROP COUPLING KIT

A prop shaft coupling kit is available to meet most requirements

POWER TAKE-OFF

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

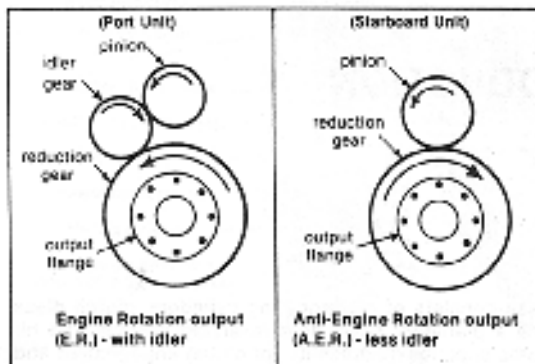
INDEPENDENT MOUNT

For installations where the transmission is not to be bolted directly to the engine, a keyed input shaft is available.

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 prop shaft 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, 144 teeth compared to 36, or 4 to 1. Output speed then is a product of engine r.p.m. and the reduction ratio, for example 200 r.p.m. X $\frac{1}{4}$ = 500 r.p.m. output speed.

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 flange do not rotate.

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.

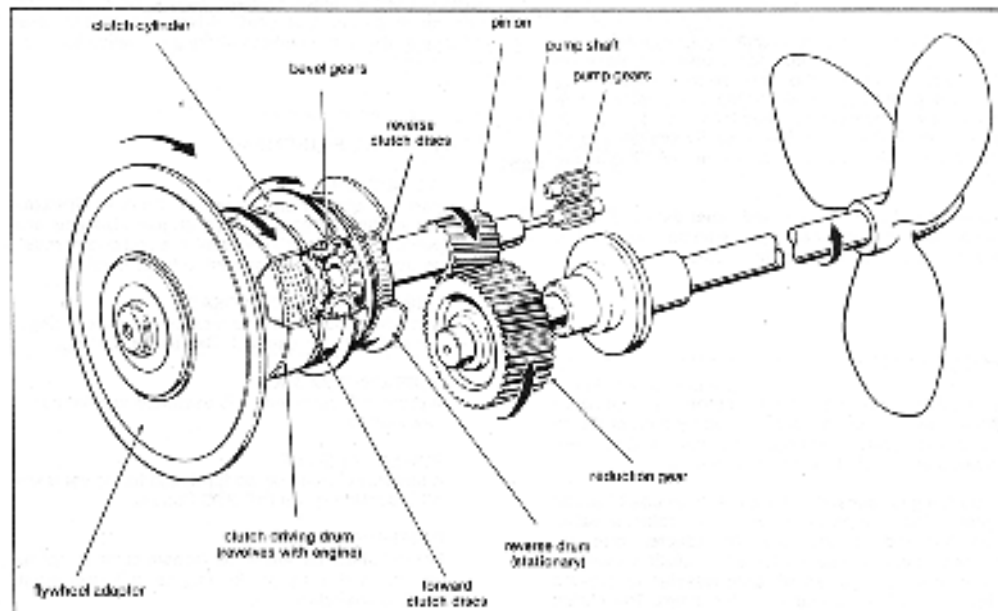


Figure 2. Power Flow (in forward mode)

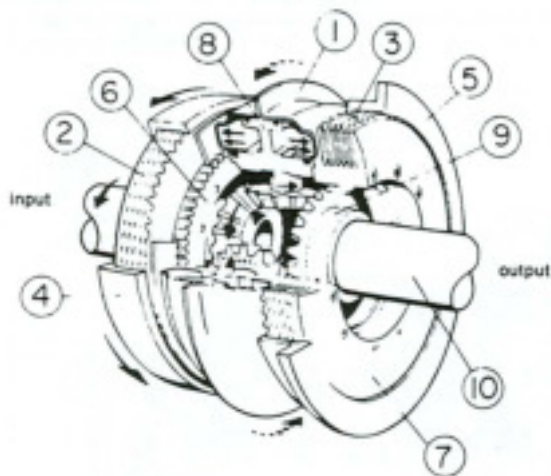
2.3 POWER FLOW (CONT'D.)

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).

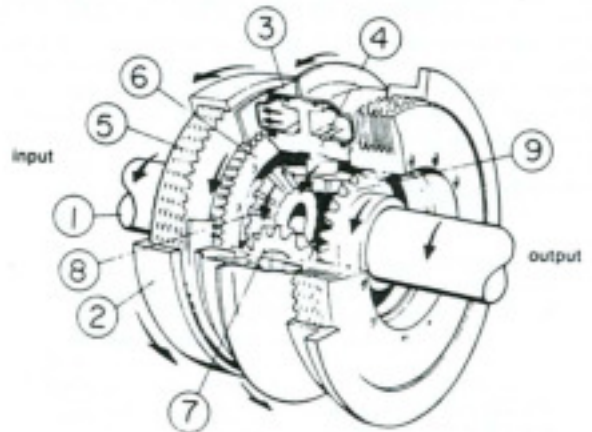
2.4 CLUTCH

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.



NEUTRAL MODE

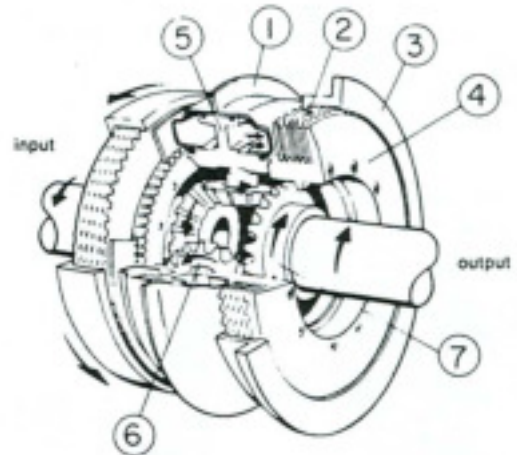
Both halves of clutch cylinder (1) are filled with pressurized oil. Cylinder cannot press against either forward (2) or reverse clutch discs (3). Discs splined to driving drum (4) and reverse drum (5) remain separate from discs splined to end flanges (6) & (7). Consequently no direct torque is applied 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.



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 (6). Because end flange is bolted to gear carrier and discs are now locked together, gear carrier with bevel gears (7) now rotates at engine speed along with driving gear. Rotating bevel gears cause driven gear (8) to turn with them and this causes rotation of output shaft in forward rotation.



REVERSE MODE

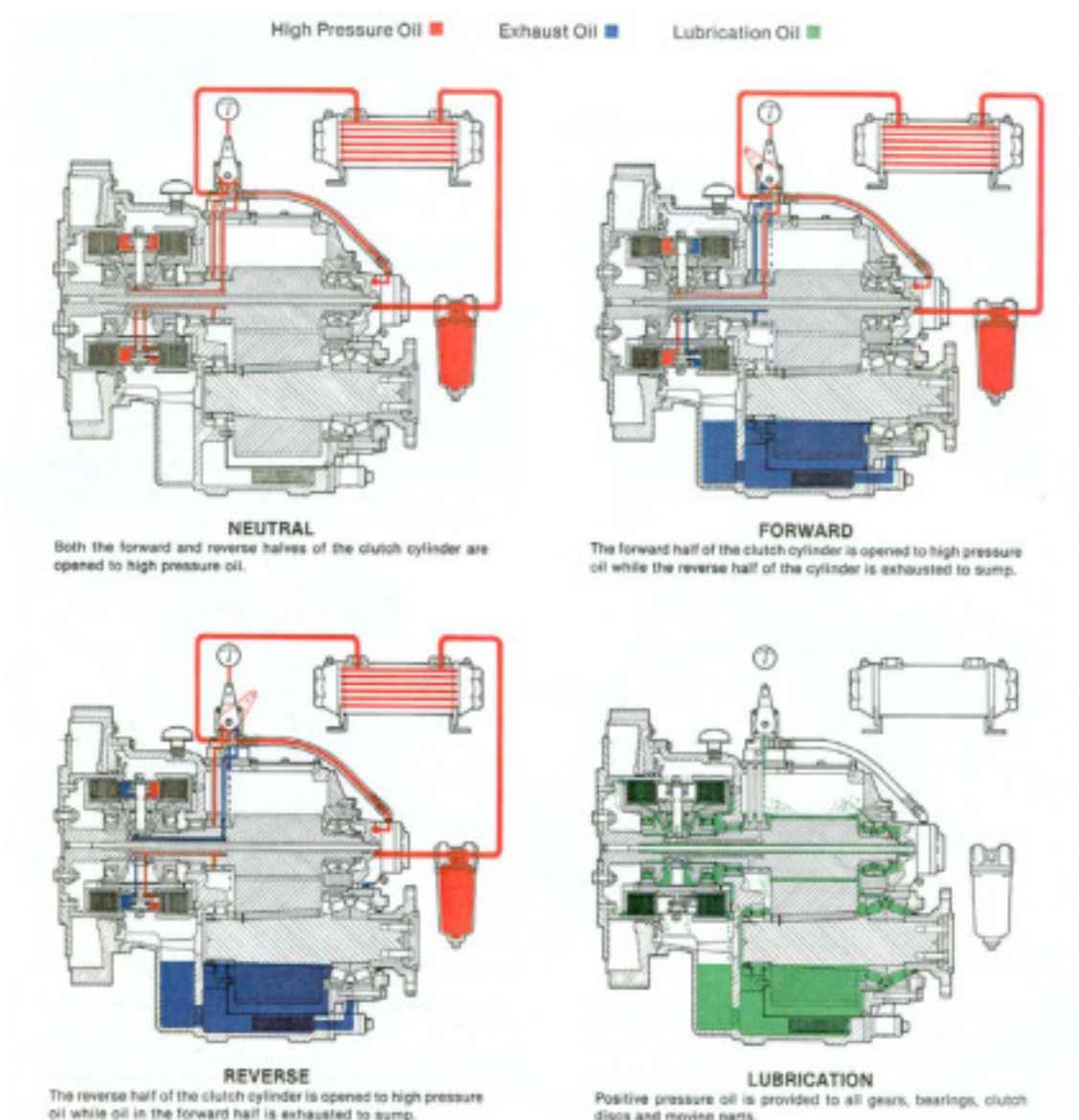
Reverse is achieved when cylinder (1) is pressurized and slides against reverse clutch discs (2) clamping them together. Half of the discs are splined to the stationary reverse drum (3) and half are splined to end flange (4) bolted to gear carrier (5). Rotating gear carrier then stops. The bevel gears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

2.5 HYDRAULIC SYSTEM

is drawn from the sump through a suction hose and then sent under pressure to a filter and 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.



SECTION 3. INSTALLATION AND OPERATION

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

3.1 UNCRATING AND HANDLING

Tapped holes have been provided for insertion of eyebolts to aid in handling the unit. Average weight of HY-7700 is 1230 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 INSTALLATION PREPARATION

SPECIAL TOOLS REQUIRED

1. Chain hoist or equivalent
2. Straight edge
3. Feeler Gauge
4. Thousandths dial indicator

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

1. (Fig.3A) Dial indicates 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 stern riding on flywheel housing bore as shown. Rotate flywheel and record reading. The bore eccentricity must not exceed a **total indicator reading** of .007 inch.

3. (Fig.3c) Mount indicator to flywheel housing so that stern is on inner face of flywheel; record deviation of face run out. It must not exceed a **total indicator reading** of .007 inch.

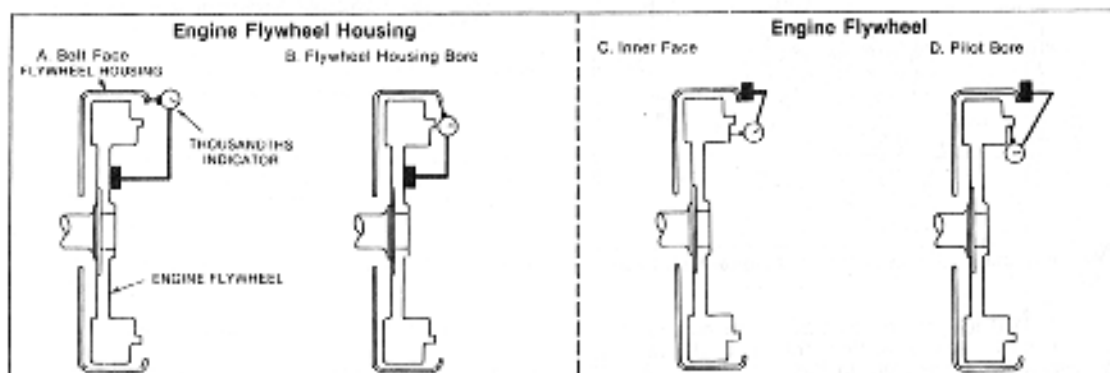
4. (Fig.3D) set stern to ride on the pilot bore of the engine flywheel as shown. Record reading. Pilot bore eccentricity must not exceed a **total indicator reading** of .007 inch.

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

NOTE:

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

5. Remove the clutch assembly from the clutch-driving drum and drive flange assembly (drive flange and flywheel adapter).
6. Remove clutch-driving drum from flywheel adapter (Leave drive flange attached to flywheel adapter).
7. Thoroughly clean flywheel adapter to engine flywheel-mating surfaces and secure flywheel adapter (and drive flange) to engine flywheel with capscrews and lock washers.
8. Locate oil dam adapter on engine flywheel housing with drain slots down. Secure oil dam tentatively with capscrews and lockwashers.



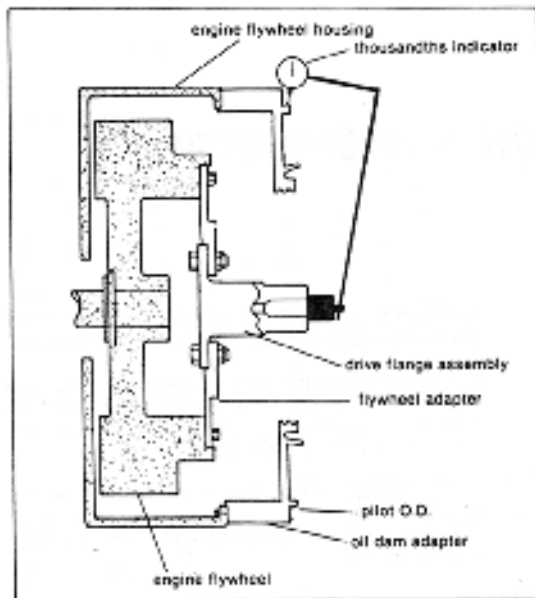


Figure 4. Dial Indicating Oil Dam Adapter Pilot O.D.

9. Dial oil dam pilot O.D. as shown in figure 4. record reading. Total indicator reading must not exceed .007 inch.

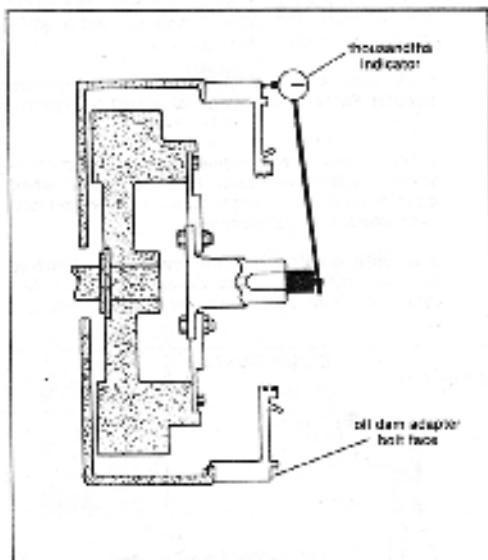


Figure 5. Dial Indicating Oil Dam Adapter Bolt Face

10. Dial indicates oil dam bolt face as shown in figure 5. Record reading. Total indicator reading must not exceed .007 inch

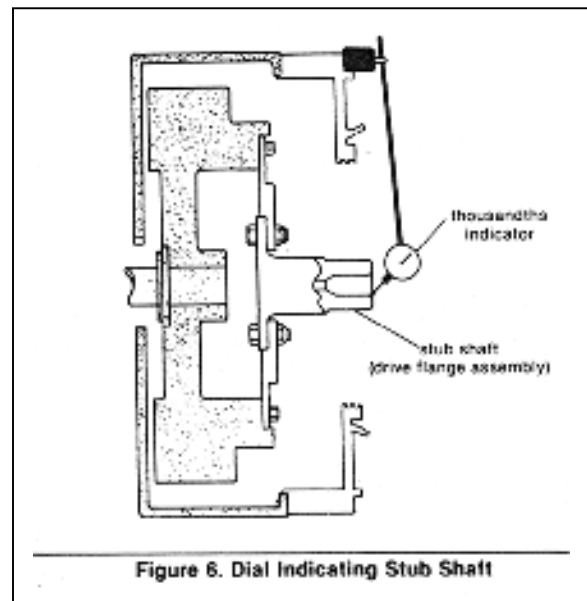


Figure 6. Dial Indicating Stub Shaft

11. Dial indicate stub shaft on chamfer as shown in figure 6. Record reading. Total indicator reading must not exceed .007 inch.

The sum of readings in steps 4, 5 and 6 must not exceed .007 inch.

12. Using and adequate hoist, install clutch on splines of drive flange shaft being careful that clutch disc teeth enter driving drum properly. Be sure that the forward end flange marked "toward engine" is placed toward the engine flywheel. The forward pack contains the greater number of clutch discs and must go toward the engine flywheel. Otherwise reverse damage to clutch may result.

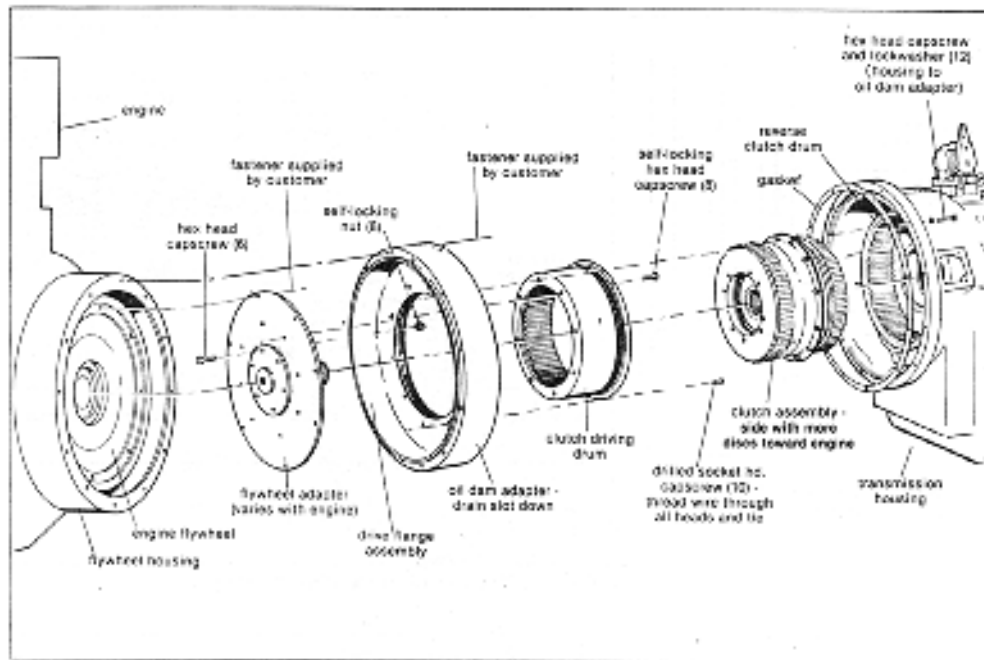


Figure 7. Sequence of Assembly: Adapter Parts, Clutch and Housing

3.3 INSTALLATION OF TRANSMISSION

1. Apply a small amount of grease to oil dam adapter and locate gasket.
2. Remove side inspection covers to facilitate installation.
3. Remove oil pump and oil pump drive shaft.
4. Using an adequate hoist and hoist guide (special tool no. 1-90021-0000) lift transmission into position behind engine. Ease unit forward over clutch assembly gently twisting transmission housing so that discs enter reverse drum properly without damaging teeth. A screwdriver may be used through the side inspection hole to align disc teeth with the reverse drum.
5. Secure transmission housing to oil dam adapter with capscrews and lockwashers.
6. Check clutch end float: insert screwdriver through side inspection hole and pry clutch fore and aft. See fig. 20, page 22. End float should be $1/16"$ to $3/32"$.
7. Turn output coupling over for several revolutions making sure unit is free to turn.
9. Replace oil pump drive shaft, gasket and oil pump. Secure pump with cap screws and lock washers.

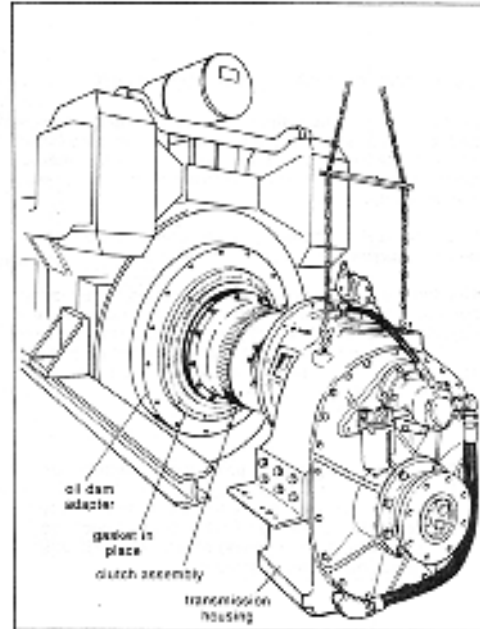


Figure 8. Locating Transmission Housing on Oil Dam Adapter

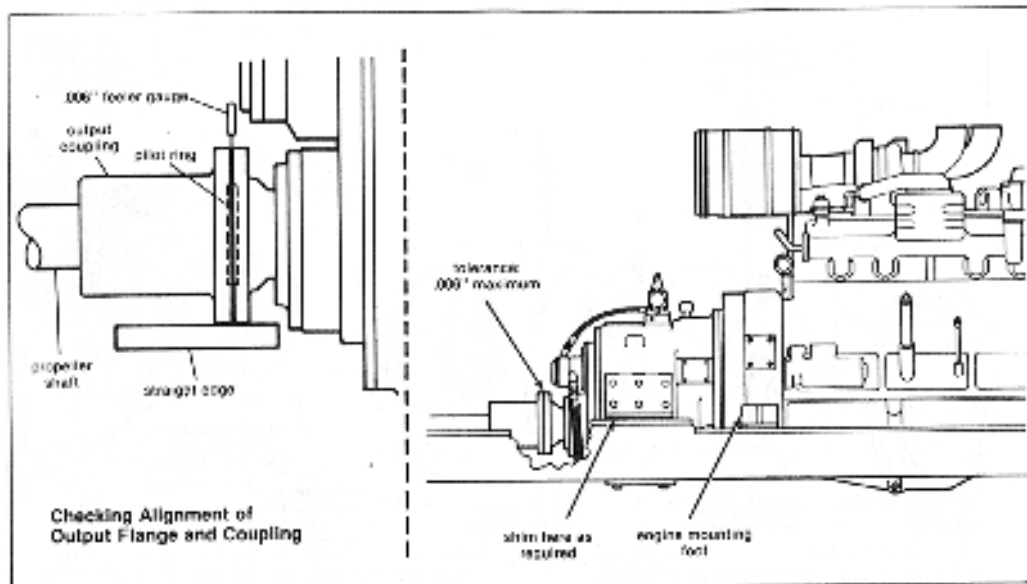


Figure 9. Alignment of Output Flange and Propeller Shaft Coupling

3.4 ALIGNMENT OF OUTPUT COUPLING

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

Mounting feet 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 reverse gear output coupling is extremely important. To avoid undue force on the reverse gear bearings, the propeller shaft bearing should be located at least twelve and preferably twenty shaft diameters from the reverse gear output coupling.

NOTE:

The same alignment procedures should be followed even if a flexible coupling is used. The most accurate method is to use a non-flexible spacer of the same size first. Flexible couplings are used only to dampen noise and vibration and to correct minor misalignment.

Now align shaft coupling to reverse 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 reverse gear as necessary. Mounting feet have threaded holes for jacking screws.

Loosen gear housing to engine housing bolts 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.

Be sure transmission is connected to oil cooler.

NOTE:

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

3.5 WATER PIPING

To assure proper cooling of the 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.

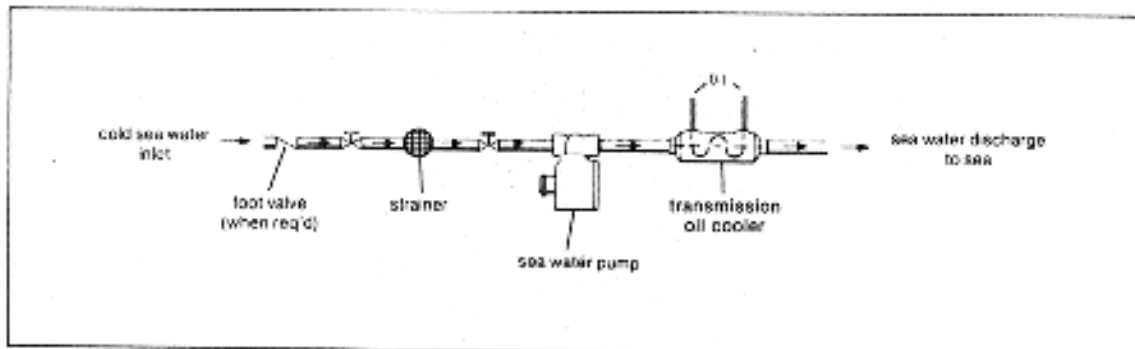


Figure 10. Separate pump system

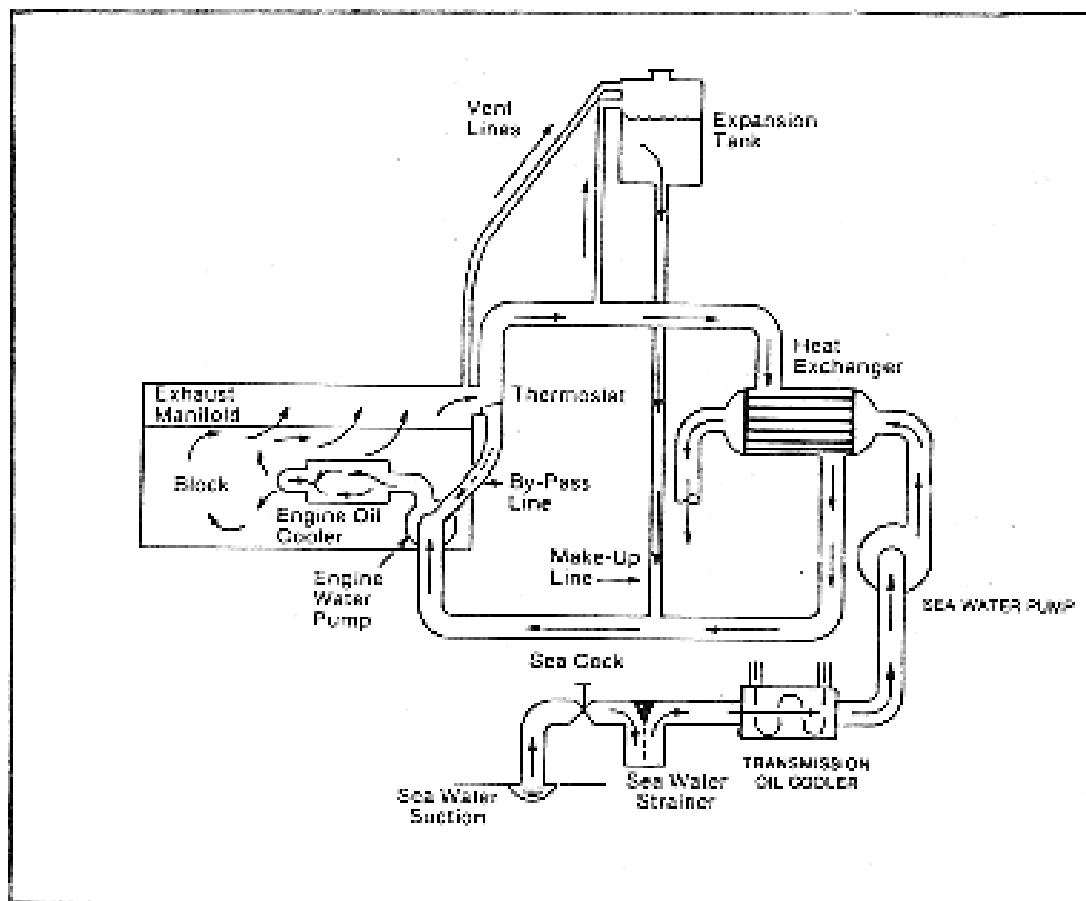


Figure 11. Heat exchange system

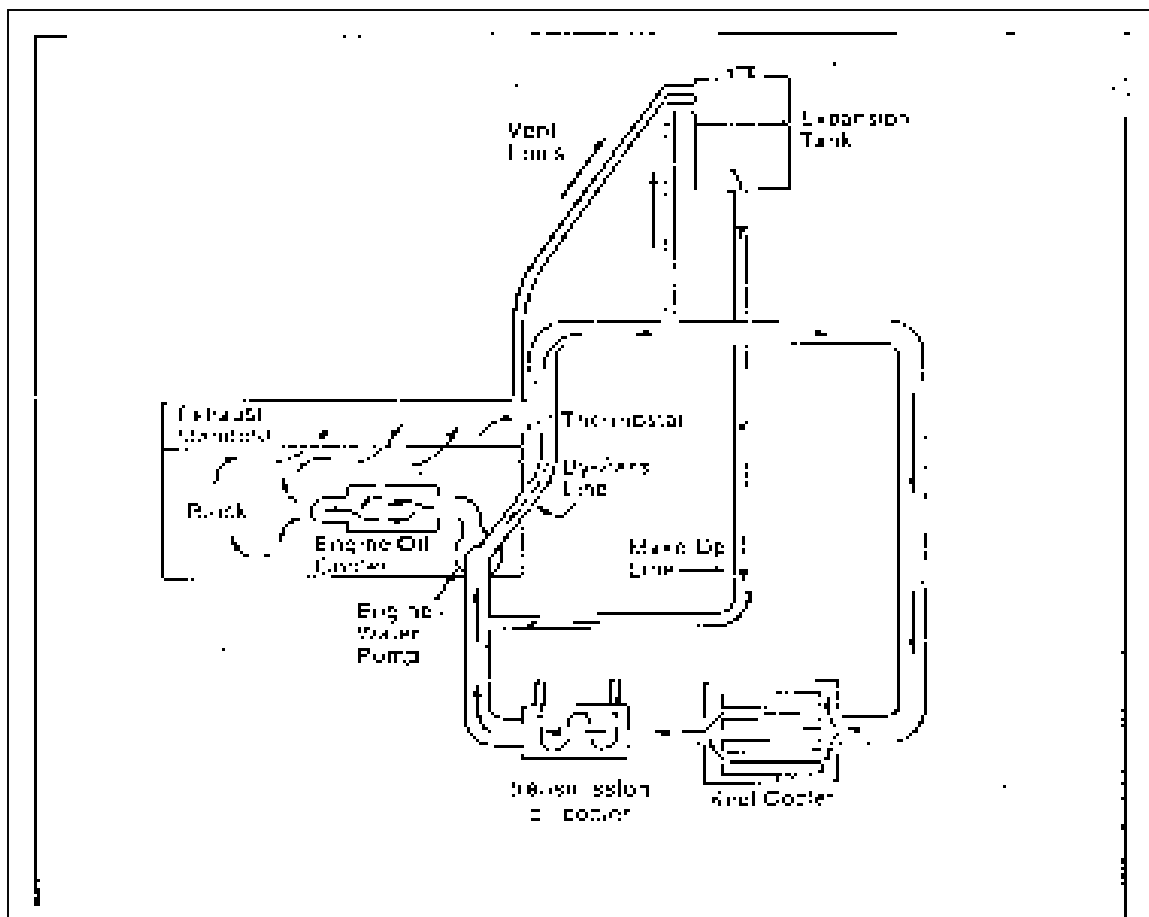
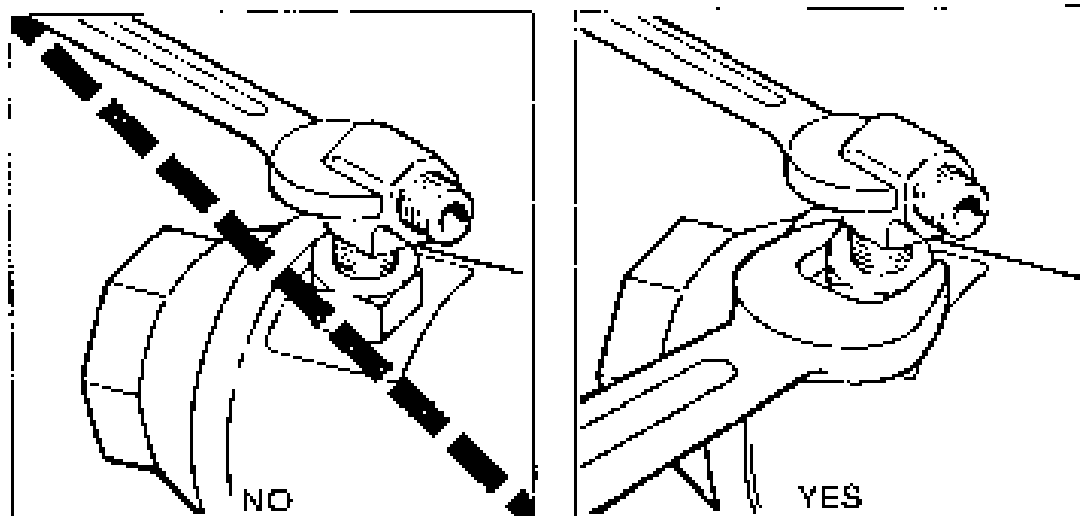


Figure 12. Keel cooler system.



CAUTION: ALWAYS USE BACKUP WRENCH
ON COOLER FITTINGS

3.6 START-UP PROCEDURE

1. Remove oil breather or top inspection cover and add recommended oil until level is up to full mark on dipstick (see lube chart, p.12). Replace 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 hydraulic hose. (Note: Electric type oil pressure gauges are not recommended.)

Reverse gear is now ready to start up:

3. Engage starter for approximately 30 seconds, but DO NOT START ENGINE. This activates pressure pump which pre-lubricates reverse gear, preventing premature wear before load is applied.
4. Start engine and check all connections for leaks.
5. Oil pressure is adjusted at factory for testing purposes only and it may be necessary to readjust pressure to the correct level (200-210 PSI). This should be set for normal operating speed and temperature (See fig. 12 below).

NOTE:

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

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

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 the gear.

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

3.7 OPERATING PRACTICES

CAUTION

1. A Capitol reverse gear should normally not be shifted unless engine is at idle speed.
2. Reverse gear cannot be operated continuously in reverse mode for more than 30 minutes at 75% of available horsepower.
3. In marine application 'windmilling' (freewheeling) is strictly prohibited as extensive internal damage may result. IN the case of a twin screw application where only one engine may be used a great deal, shaft brakes should be installed. (As an alternative an auxiliary lube system may be installed).
4. Do not operate unit with high or low oil pressure or if oil temperature exceeds 180°F.

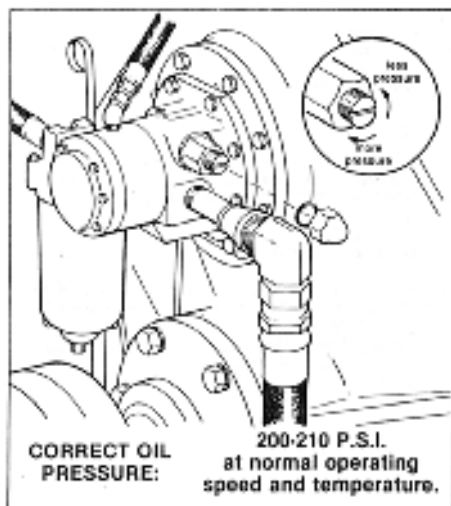


Fig. 13. Adjustment of Oil Pressure. CAUTION: Relief Screw is Under Tension.

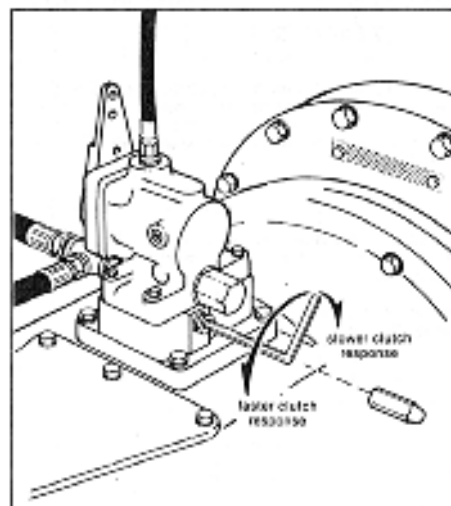


Fig. 14. Clutch Cylinder Timing Adjustment; used to regulate shifting time.

SECTION 4. PREVENTATIVE MAINTENANCE

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

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.

CAUTION:

When using SAE 20 motor oil be very attentive to oil pressures. If proper pressure cannot be maintained 9200-210 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, hoses etc.)

7.5 Gallons (28 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. 13, 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.

Oil Filter

The oil filter element should be replaced **every 400 hours** of operation or at the same time oil is changed.

Oil Breather

Remove oil breather **every 400 hours** of operation or 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.13, 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, o-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_____

[illegible]

SECTION 5. TROUBLE SHOOTING

5.1 TROUBLE/REMEDY CHART

SYMPTOM	PROBABLY CAUSE	REMEDY
A. Low oil pressure (at full operating speed and temperature)	<ol style="list-style-type: none"> 1. Faulty pressure gauge 2. Low oil level 3. Clogged filter element 4. Clogged suction tube 5. Clogged parts in selector valve, base plate or housing 6. Dirt or sludge in transmission 7. Worn pump assembly 8. Incorrectly adjusted pressure relief valve 9. Oil too hot 10. Worn commutator bushing 11. Incorrect lubricant 12. Scratched clutch cylinders or hard O-ring in clutch cylinders 	<ol style="list-style-type: none"> 1. Check gauge against one of known accuracy 2. Inspect gaskets, seals, hoses and fittings for leakage. Pressure test oil cooler-tubes may leak 3. Replace filter element 4. Remove tube and clean with solvent. Blow dry 5. Flush clean with solvent and blow dry 6. 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 7. Refer to oil pump section (Page 17) or fig. 13, p.11. 8. See fig.13 page 11 9. Check heat exchanger system for clogged oil cooler or hoses. 10. See wear limits chart (p.23) 11. See lube chart (p.12) 12. Replace as necessary (p.25)
B. High Oil pressure (At full operating speed and temperature)	<ol style="list-style-type: none"> 1. Incorrect adjusted pressure relief valve 2. Inoperable relief plunger in base plate 3. Incorrect oil 4. Cold oil 5. Cold oil at start-up 	<ol style="list-style-type: none"> 1. Refer to fig.13 p.11 2. Refer to p.17 3. See lube chart (p.12) 4. Check heat exchanger system 5. Transmission should be pre-heated see p.11
C. No Oil Pressure	<ol style="list-style-type: none"> 1. Faulty pressure gauge 2. Broken hose 3. No oil in transmission 	<ol style="list-style-type: none"> 1. check pressure with gauge of known accuracy 2. Replace hose. Inspect all hoses 3. Fill with proper oil. See p.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, pg.8
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. Transmission is misaligned 2. Improper oil 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 2. Refer to lube chart 3. Replace as necessary 4. Clean or replace as necessary 5. Replace as necessary. See replacement wear limits chart 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 is 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 3. Temperature should be 140° to 160°F (60° to 71°C) at selector valve. Check heat exchanger system 4. Replace as necessary, see replacement wear limits chart 5. Adjust linkage 6. See lube chart

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 4. Check cooling system
J. No Neutral	<ol style="list-style-type: none"> 1. Transmission is misaligned 2. Warped clutch discs 3. Scored clutch cylinders 4. Damaged clutch quad 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 2. Replace as necessary 3. Replace as necessary 4. Replace all 4 5. Replace as necessary. See replacement wear limits chart 6. Replace if necessary. Note: selector valve is the least likely source of trouble
k. Clutch engages too low	<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.
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.

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°.

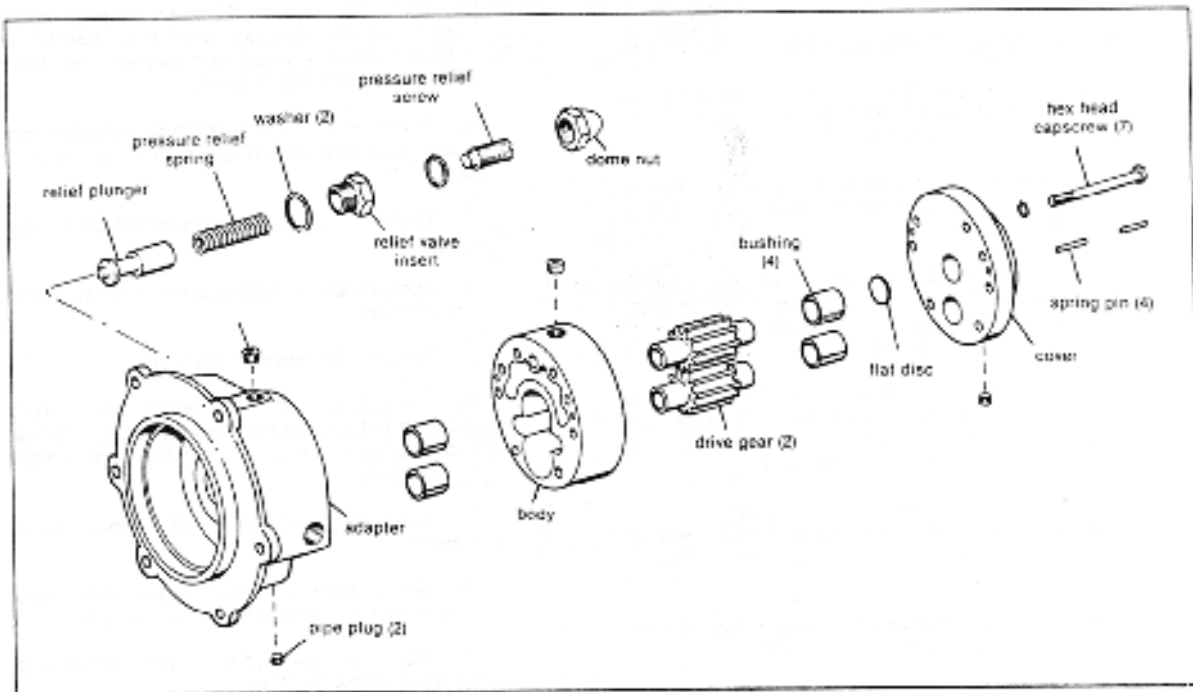


Fig. 15. Oil Pump Assembly

6.1 OIL PUMP

A.PRESSURE RELIEF ASSEMBLY

1. With oil pump in place on marine gear remove dome nut, relief valve insert with screw, spring and accompanying washers. NOTE: UNSCREW INSERT CAREFULLY BECAUSE PRESSURE RELIEF SPRING IS UNDER TENSION.

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

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

4. Generously lubricate relief plunger with oil or Vaseline. Insert plunger, cup end last. Check plunger for free movement

5. Insert pressure relief spring into cup of plunger.

1. Screw pressure relief screw into relief valve insert just enough to start threads.
2. Apply washer and install relief valve insert with pressure relief screw. Tighten insert, do not tighten relief screw.
3. Cap and lock pressure relief screw with dome nut and washer

B. OIL PUMP DISASSEMBLY

1. Remove oil pump assembly and filter from main housing cover by removing capscrews and hoses.
2. Remove capscrews and lockwashers securing pump cover, pump body and adapter.
3. Using as 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 dome nut and relief valve insert. **NOTE:** PRESSURE RELIEF SPRING IS UNDER TENSION.
6. Unscrew and separate pressure relief screw from relief valve insert. Remove pressure relief spring and plunger.

C. 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. Inspect gears and oil pump for damage or excess wear. See replacement wear limits chart.
3. Inspect cover and adapter for wear caused by gears. Note: if grooving does not exceed .030, grinding smooth can repair both surfaces. (.030" max cut).

4. Inspect bushings in cover for wear (see wear limits p.23), out of round condition or burrs. If they are worn, damaged or loose, replace and ream to size (see p.23).
5. Inspect bushings (2) in adapter for wear, out-of-round condition burrs. If bushings are damaged, replace as necessary, and ream to size (see p.23).
6. Check relief plunger for free movement in adapter bore. Replace if necessary
7. Inspect all mating surfaces for smoothness
8. Check to see that each oil passage is free from obstruction.

D. ASSEMBLY

1. Generously lubricate pump gears with lubriplate, Vaseline, or engine weight oil and position them in adapter. NOTE: BE SURE SPLINED 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. Note: If new body is used make sure sharp inside corners are filed smooth.
4. Secure cover and body to adapter with capscrews and lock-washers, finger tight.
5. Drive spring pins (2) down through cover into body and adapter until they bottom in adapter. Drive 2 more spring pins into body until flush with top of cover.
6. Insert pump shaft through adapter into pump gear and revolve shaft to check ease of operation.
7. Tighten all 6 capscrews to 16 foot-pounds torque.
8. Remove any excess permatex from seams with solvent
9. Recheck for ease of operation

10. Generously lubricate relief plunger with Vaseline or lubriplate and position cup end last in bore of adapter. Check to make sure plunger slides freely.
11. Insert pressure relief spring into cup of plunger.
12. Screw pressure relief screw into relief valve insert just enough to start threads
13. Install washer and relief valve insert with pressure screw in place.
14. Tighten relief valve insert. Do not tighten relief screw
15. Cap and lock pressure relief screw with dome nut and washer
16. Recheck for ease of operation.
3. Apply grease to bearing container and locate new oil pump gasket on container.
4. Install oil pump (and filter) on bearing container. Secure pump with capscrews and lockwashers and torque to 32 lb. ft.
5. Install suction hose to tee and oil pump
6. On units with idler gear, connect hose from oil pump to idler shaft.
7. Be sure to re-adjust oil pressure to correct operating level when engine is started up. See fig.17.

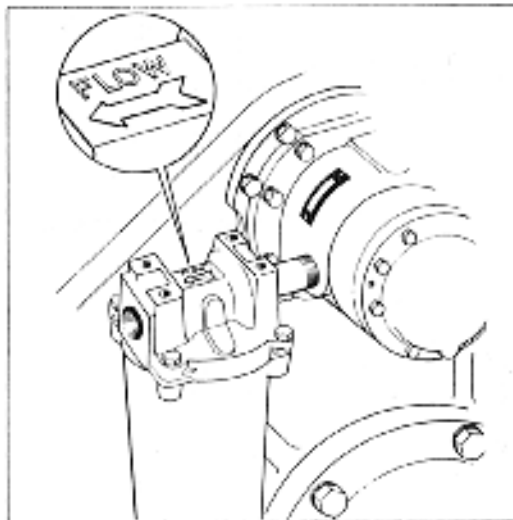


Fig. 16 CAUTION: Flow Arrow on Filter Must Point Away From Oil Pump.

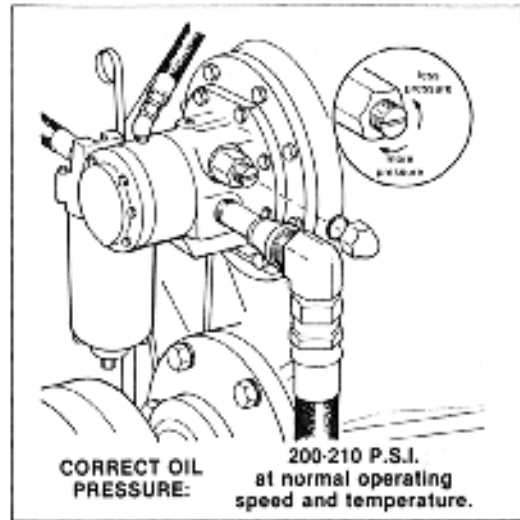


Fig. 17. Correct Operating Oil Pressure Should Be 200-210 P.S.I.

E. RE-INSTALLATION

NOTE: DO NOT use Teflon Tape. It may clog the pump.

1. Flush canister and install new filter element in filter
2. Apply joint compound to threads and install pipe nipples, bushing and oil filter to oil pump.
CAUTION: FLOW ARROW ON FILTER MUST POINT AWAY FROM PUMP. SEE FIG 16.

F. PUMP ROTATION

The direction of pump rotation is the same as engine rotation. If engine rotation is changed the plumbing to the pump must be changed. See cross section assembly drawing for details.

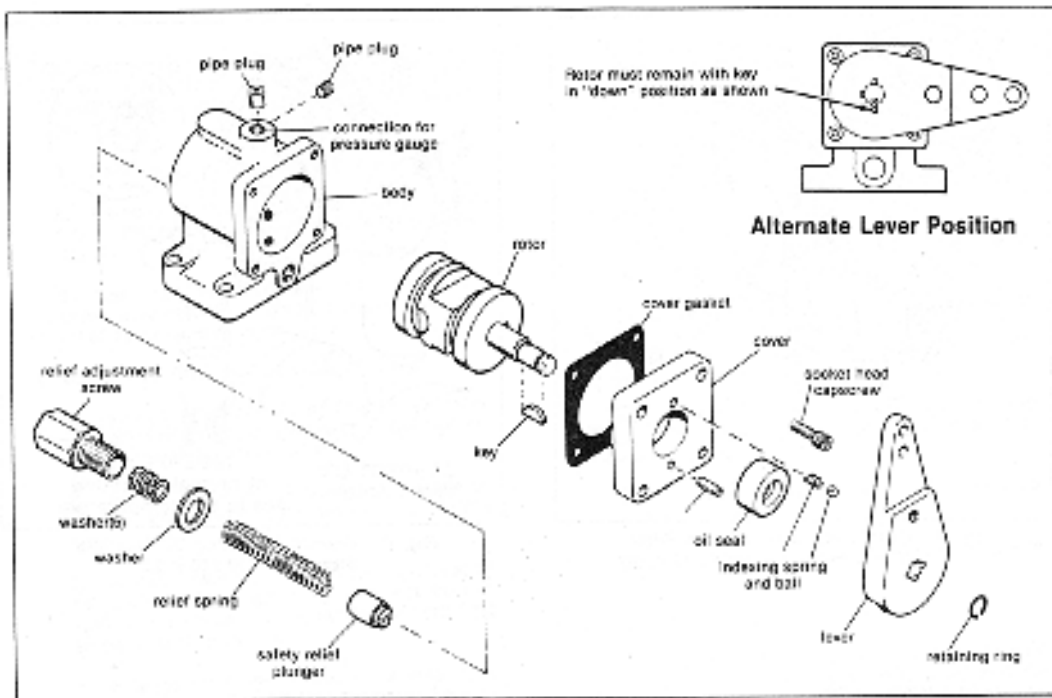


Fig. 18 Selector Valve Assembly

6.2 SELECTOR VALVE AND RELATED PARTS

A. REMOVAL

1. Disconnect hoses and 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. DISASSEMBLY

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

3. Note position of cover). Remove cover, cover gasket, and rotor from block.
4. Remove safety relief adjustment screw, washers, spring and plunger.
NOTE: SPRING IS UNDER TENSION.

C. CLEANING AND INSPECTION

1. Clean all parts thoroughly with oil and clean all oil ports. Blow dry with compressed air.
2. Inspect rotor and valve block for scoring. Excessive scoring indicates replacement. Valves are not repairable.
3. Inspect oil seal in cover. If it is worn or shows evidence of leaking, replace it.

D. ASSEMBLY

NOTE:

On all fittings use Permatex 'super 300' sealant, graphite paste, or equivalent. **CAUTION:** Do not use No.1 Permatex or Teflon tape.

1. If necessary install new seal in cover. Press seal in until it bottoms in bore (rubber face out). Apply lubricant to seal.
2. Insert rotor shaft through oil seal in cover
3. Set key in rotor shaft and install lever with indexing ball and spring. Make sure that keyway in rotor shaft remains toward bottom of cover.
4. Tap control lever into position with a soft hammer and secure with retaining 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. Install safety relief adjustment parts in rear of valve body.
8. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on main housing. See fig.19.

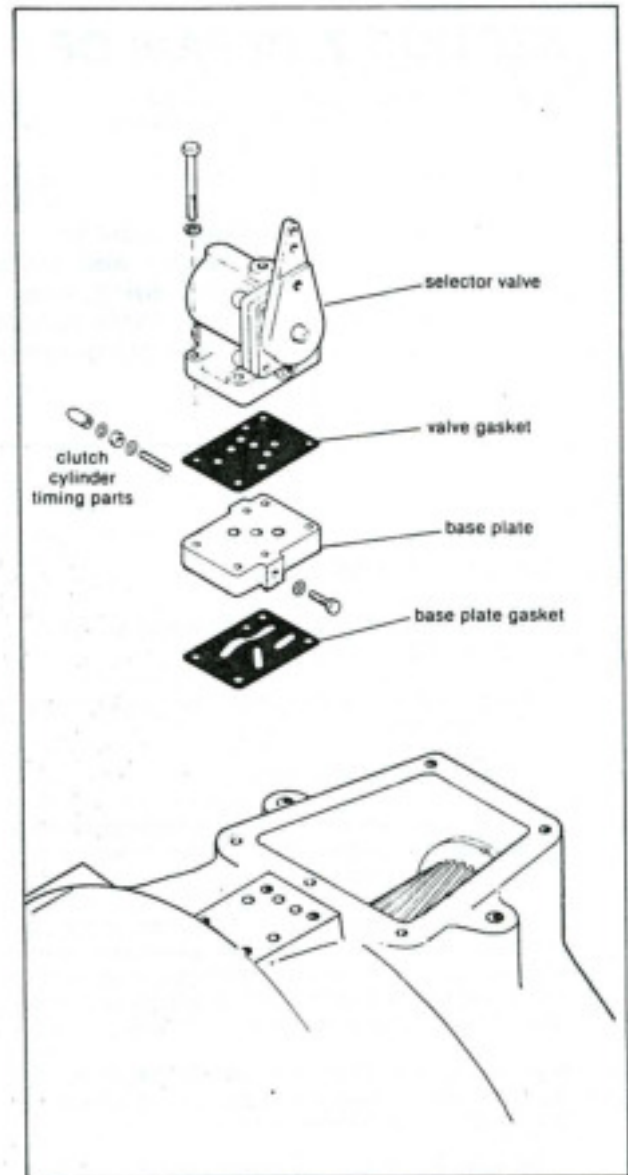


Fig. 19. Exploded View: Selector Valve and Related Parts.

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 REVERSE GEAR

1. Remove drain plug at rear of housing and drain oil from sump
2. Disconnect all plumbing and wiring and disconnect control linkage.
3. Remove inspection covers
4. Scribe alignment mark across outside diameter of flanges on output coupling for exact refit. Disconnect coupling
5. Remove or push back propeller-coupling member to obtain maximum clearance and remove pilot ring resting between couplings.
NOTE: Protect mating faces of couplings and pilot ring to insure proper refit and alignment.
6. Screw two ½"-13 eye bolts into lifting holes on top of housing and connect hoist so it supports the weight of the transmission.
7. Remove capscrews and lockwashers holding housing to oil dam
8. Insert screwdriver or similar object through side inspection hole to hold clutch assembly inside housing. Slowly move housing aft and away from oil dam. See fig.20.

CAUTION

Clutch must be maintained in forward driving drum to prevent falling.

9. Remove clutch from forward driving drum.

Note: See page 38 for adapter group repair.

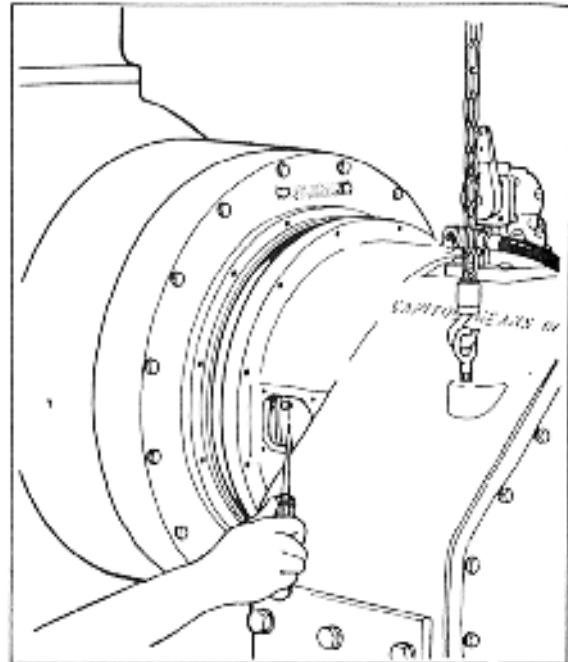


Fig. 20 Maintaining clutch in housing.

CAPITOL GASKET AND SEAL KIT NO.
1-10169-0000 (HY-7700)
1-10168-0000 (HY-6900)

Includes the necessary gaskets, seals and o-rings commonly used for repair.

Clutch quad rings must be purchased separately.

7.2 TABLE: REPLACEMENT WEAR LIMITS

ITEM	NEW DIMENSIONS		REPLACEMENT WEAR LIMIT
	MINIMUM	MAXIMUM	
REDUCTION GEARS- Backlash	.004	.008	.020
PINION SHAFT			
O.D At Forward Commutator	1.7450	1.7455	1.7440
O.D At rear Commutator	2.997	2.998	2.996
O.D At Forward Bearing	3.3380	3.3387	3.3360
O.D At Rear Bearing	1.7721	1.7726	1.7711
FORWARD COMMUTATOR BUSHING			
I.D	1.7495	1.7505	1.7525
REAR COMMUTATOR BUSHING			
I.D	3.001	3.002	3.004
CLUTCH DISC THICKNESS			
Driving (External Teeth)	.150	.160	.140
Driven (Internal Teeth)	.085	.095	.075
Driven, Thick (Internal Teeth)	.160	.175	.150
CLUTCH PACK THICKNESS-Clutch 1-00100-6000			
Forward Pack (Compressed)	1.645	1.785	1.505
Reverse Pack (Compressed)	1.410	1.530	1.290
CLUTCH PACK THICKNESS-Clutch 1-00100-6300			
Forward Pack (Compressed)	1.485	1.620	1.365
Reverse Pack (Compressed)	1.250	1.355	1.150
OIL PUMP	IF DEEP GROOVES ARE PRESENT, OR MORE THAN .006" CLEARANCE EXISTS BETWEEN PUMP GEARS AND BODY		
Ream new bushings to .750"			
SELECTOR VALVE	IF DEEP GROOVES ARE PRESENT (.25" DEEP)		
DRIVING DRUM SPLINES CLUTCH END FLANGE SPLINES	IF GROOVES ARE PRESENT VERTICAL TO THE SPLINE		
ALL SPLINED PARTS	REPLACE IF FIT IS NOT SNUG		

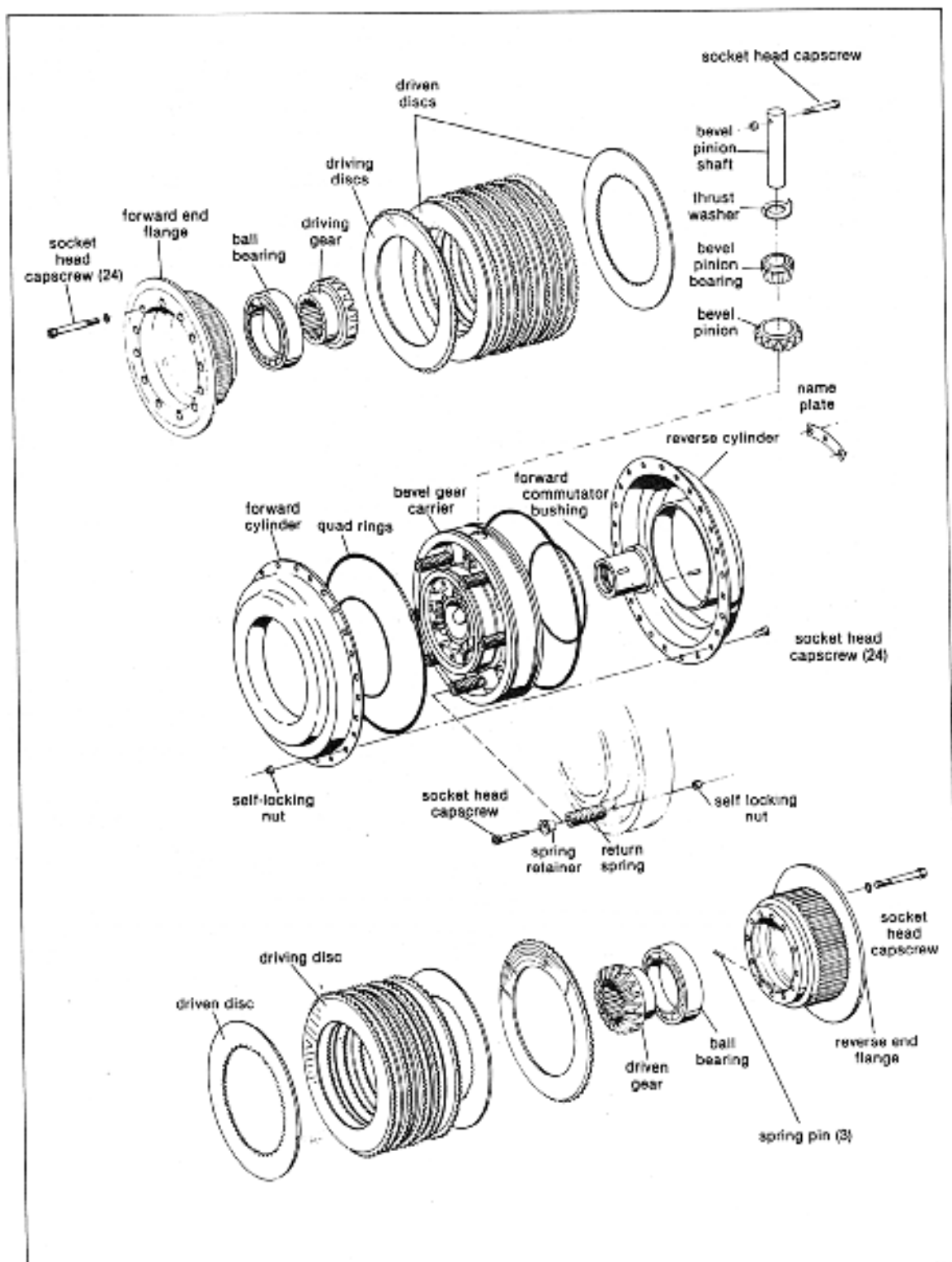


Fig. 21. Clutch and Gear Carrier.

Clutch No. 1-00100-6000 Shown

7.3 CLUTCH

A) DISASSEMBLY

NOTE: FOR REMOVAL
INSTRUCTIONS SEE PAGE 22.

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 cylinder
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.22
2. Check all pinion bearings and washers for distortion or rough operation. If one bearing needs replacement we recommend replacing all of them as a set.
3. Clean all parts with a good grade cleaning solvent or diesel fuel. Blow dry with compressed air.
4. Inspect all oil passages in bevel gear carrier to see that they are free from obstruction.
5. Inspect bevel gear carrier for cracks, chips or worn mounting surfaces. Pay special attention to seal ring grooves. Discard carrier if damaged.
6. Inspect forward commutator bushing for chips, heat scores, scratches, distortion or wear (See Wear limits, p. 23). Repair or replace as necessary.
7. Inspect all hardware and springs for wear or distortion. Repair or replace as necessary.

B) CLEANING AND INSPECTION

1. Inspect bevel pinions for wear, chips, and breaks or out of round condition. If there is any damage we recommend replacing all of them as a set.
8. Remove clutch discs from flanges and inspect discs for broken teeth, heat scores or wear (See Wear Limits, page 23). Replace as necessary.
9. Inspect driving gear, and driven gear, for wear, chips or cracks. If either one is damaged we recommend replacing both as a set.

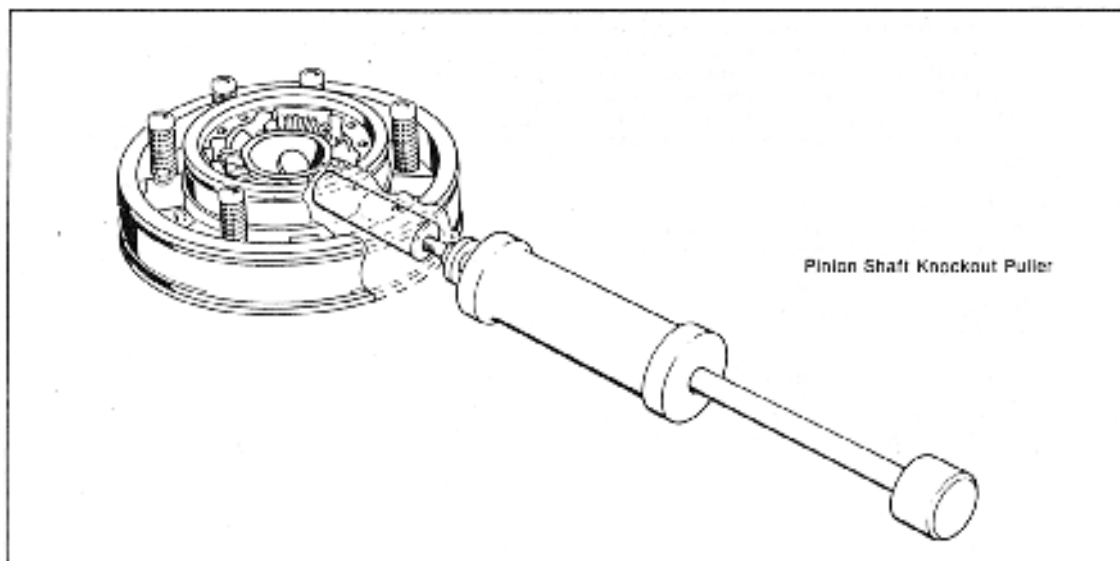


Figure 22. Removal of Pinion Shaft from Gear Carrier.

10. Check both clutch flange ball bearings for wear, distortion, or rough operation. Again we recommend replacement of both bearings if either one shows wear.
11. Inspect forward and reverse clutch end flanges, for wear, cracks or distortion and make certain all oil passages are free from obstruction.
12. Inspect both clutch cylinders for cracks, distortions or scratches. Repair or replace as necessary/

carrier bore making sure holes are in line (See fig.22).

Tap shaft about half way into bore so it protrudes just slightly into recess. Position thrust washer on protruding shaft.

Insert bearing into pinion gear and slip gear (Teeth toward center of carrier) into position.

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-seize compound should be used on the bushing also.

NOTE:

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

- 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 shaft:
 - 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 ½-20 cap screw in pinion shaft and tap shaft into

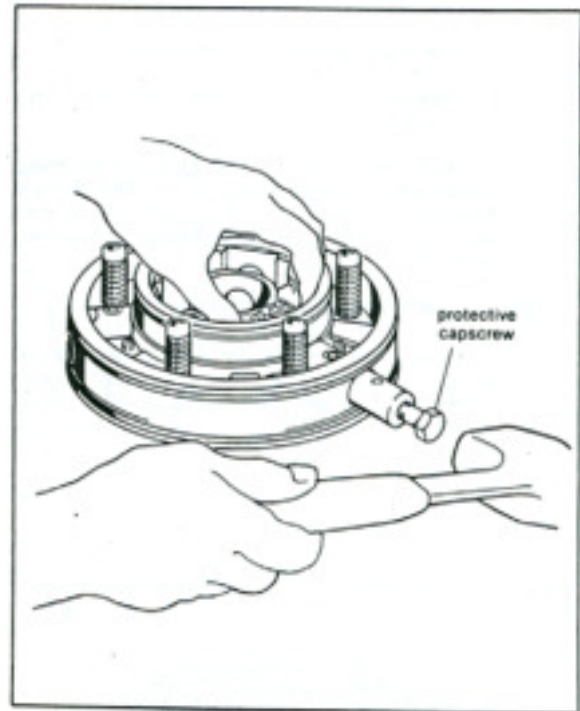


Figure 23. Installing Pinion Shaft in Gear Carrier.

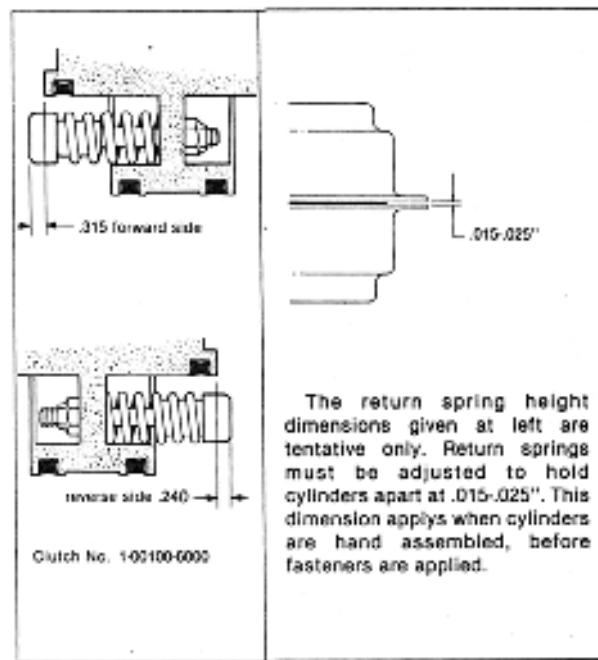


Figure 24. Clutch Return Spring Height Adjustment

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 24.
4. Without installing quad rings, place cylinders on bevel gear carrier by hand. (See fig.25) 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 fig. 25).

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

D. Insert capscrews and locknuts and tighten to 16 pounds-foot torque.

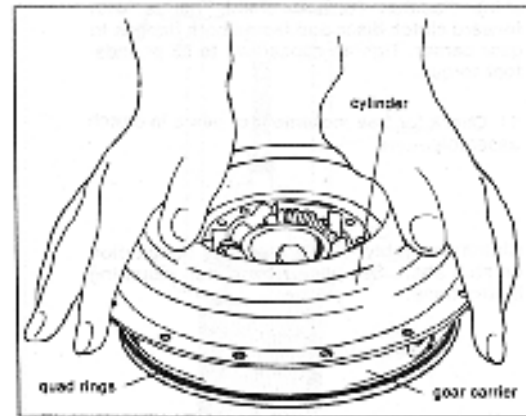


Figure 25. Pressing Cylinder on Bevel Gear Carrier

CAUTION:

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

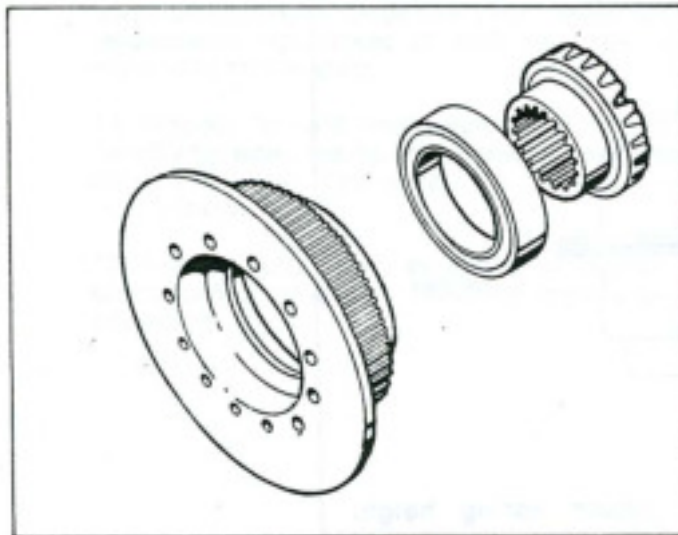


Fig. 26. Clutch end flange, bearing and bevel gear.

7. Press ball bearing into forward clutch flange. Press bevel gear into ball bearing.
8. Likewise press the other ball bearing into reverse clutch flange (fig.26). 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.

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

7.4 PINION SHAFT- REMOVAL AND RE-ASSEMBLY

Set transmission housing upright and support if necessary.

1. Disconnect hose from selector valve to oil pump and pump to sump. Disconnect idler hose, if present from pump.

2. Remove selector valve selector valve base plate and gaskets.

A. REMOVAL AND DISASSEMBLY

1. Remove oil filter canister from filter head. Discard element.

2. Remove oil pump mounting bolts. Remove oil pump, discard gasket and remove oil pump drive shaft.

3. Remove bearing retainer from cover (Pinion will accompany it) by tapping on pinion shaft, if necessary from engine side of housing.

4. Release tang of lockwasher and remove locknut and lockwasher from shaft.

5. Using a suitable press, extract pinion shaft from bearing retainer (a protective spacer should be used). Note: Be careful that pinion doesn't fall.

6. Pull remaining bearing cone from pinion shaft if it is damaged or worn.

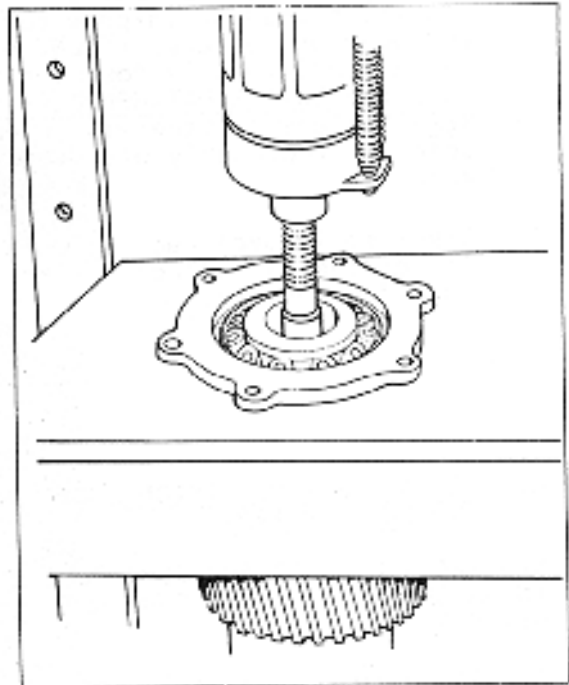


Fig. 27. Extracting Pinion Shaft

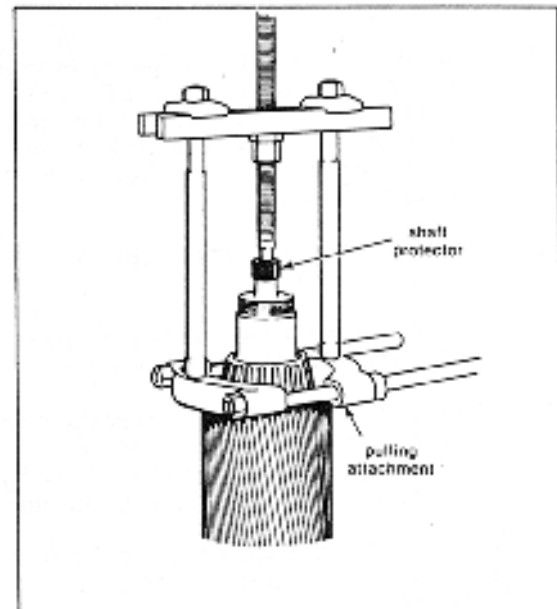


Fig. 28. Pulling Bearing Cone from Pinion Shaft.

25

B. CLEANING INSPECTION AND REPAIR

1. Inspect tapered roller bearings for rough rotation. Corrosion, scoring, scratches, burrs, cracks, pitted or chipped races and wear of rollers. If ONE of these conditions is found, discard the ENTIRE MATCHED BEARING SET (5 pieces). Otherwise clean bearings thoroughly with solvent.

2. Likewise inspect bearing cups in retainer- replace entire set if necessary.

C. RE-ASSEMBLY OF PINION SHAFT AND RELATED PARTS.

NEW BEARING CONES AND CUPS COME IN MATCHED PAIRS. BE SURE NOT TO MIX PARTS.

1. Apply lubricant to inside diameter of bearing retainer. Press new bearing cups (if necessary) into bearing retainer snug against spacer.

2. Apply lubricant to bearing surface at threaded end of pinion shaft. Press * new bearing cone onto shaft snug against shoulder of gear. Locate bearing spacer on shaft.

3. Locate bearing retainer on pinion shaft.

4. Press* remaining bearing cone onto shaft. Locate lockwasher.

5. Apply lubricant to threads and install bearing locknut on shaft. Secure by bending tang of lockwasher into slot on nut.

* A protective spacer is recommended to prevent damage to bearing.

3. Inspect pinion teeth, threads and spline for damage. Inspect all bearing surfaces and commutator surfaces for grooved, burred or galled conditions. If damage cannot be repaired with crocus cloth. Discard shaft.

4. Clean pinion thoroughly. Flush oil ports clean with solvent.

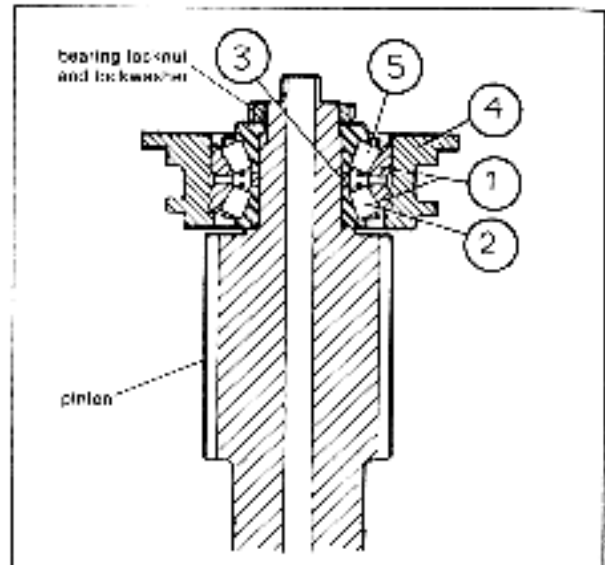


Fig. 29. Cross Section Showing Sequence of Assembly for Pinion Bearings.

Note: Wear to pinion indicates wear to other internal parts. A complete inspection is recommended at this point.

7.5 OUTPUT GEAR AND RELATED PARTS

A. REMOVAL AND DISASSEMBLY

1. Remove cotter pin from output shaft
2. Remove slotted nut and washer
3. With engine end of transmission down, pull output coupling from output shaft using suitable puller.

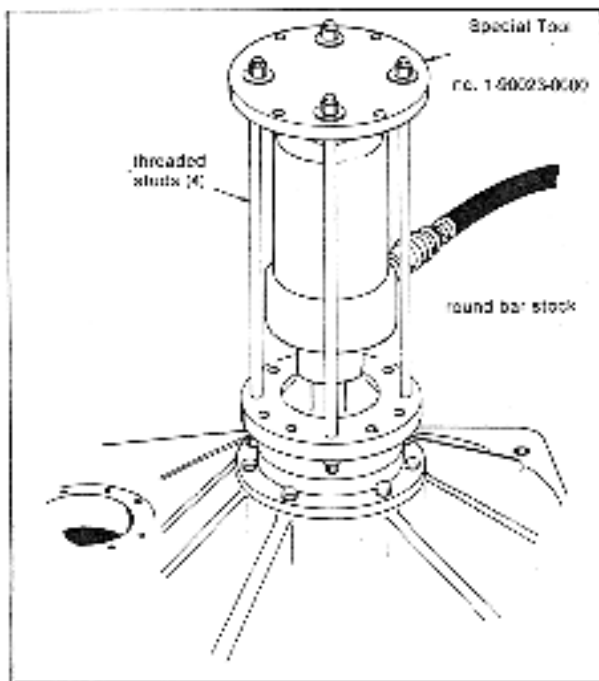


Fig. 30. Removing Output Coupling from Shaft.

4. Remove output bearing cap/oil seal retainer and shims.
5. Press out oil seal from bearing cap/oil seal retainer. Discard oil seal.
6. Remove capscrews and lock washers and remove housing cover. Discard gasket.
7. Using suitable hoist, remove output gear assembly from housing.

8. Remove oil pan
9. Engine Rotation (E.R) Models only: Remove idler gear assembly from housing (or cover). Remove snap rings and bearings. Discard o-ring.
10. Remove snap ring and remove pinion roller bearing mounted in housing.
11. Press out rear commutator bushing. Disassemble commutator by first removing snap ring at rear of assembly.

B. CLEANING, INSPECTING AND REPAIR

1. Inspect disassembled commutator bushing for cracked piston rings, damage or wear- see wear limits chart.
2. Inspect tapered roller bearings on both ends of output shaft for rough rotation, corrosion, scoring, scratches, burrs, cracks, pitted or chipped races and wear. If one of these conditions is found discard bearing(s).
3. Inspect bearing cup in housing bore and cover bore for any sign of damage or wear. Discard if necessary.

NOTE: If bearing cone warrants replacement the bearing cup should be replaced also and visa versa.

4. Inspect output gear for nicks, burrs, scratches, damage or wear of any kind. Teeth may be repaired with a flat file or grinding wheel, otherwise gear must be replaced.

5. E.R. Models only: Inspect idler gear for nicks, burrs, damage or wear. Check bearings for rough rotation or wear. Discard if necessary. Make sure internal oil passage in shaft is clear. Flush idler hose.
6. Inspect output coupling at bearing mating surface for nicks or burrs. File smooth or discard coupling. Inspect oil seal surface for grooves. Discard coupling if it is grooved.
7. Inspect mating surfaces of output coupling and propeller coupling and file smooth if possible. Otherwise replace parts.
8. Inspect housing cover bores and mating surfaces front and back. Repair nicks or burrs with file or crocus cloth. Clean all of the above parts thoroughly with solvent.

2.6 HOUSING PARTS

Set transmission-housing upright.

1. Flush clean and inspect main housing. Inspect front and rear mating surfaces and repair with file or crocus cloth.
2. Inspect reverse clutch drum for deep grooves or wear. Repair or replace as necessary. Clean with solvent.
3. Flush clean oil breather and suction hose (sump to filter).

7.7 RE-ASSEMBLY AND INSTALLATION OF OUTPUT GEAR AND RELATED PARTS

1. Re-assembly rear commutator bushing parts. Be careful not to crack piston rings. Check that inner sleeve 'floats' in commutator shell.

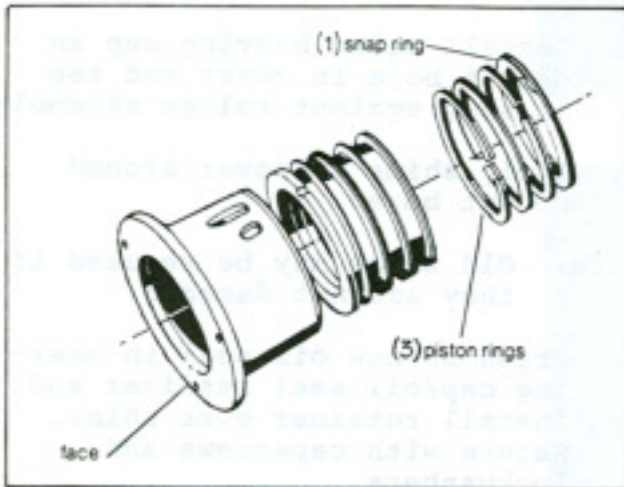


Fig. 31. Rear Commutator Bushing

2. Install rear commutator bushing in housing as follows:

a). Commutator ports MUST GO TOWARD TOP OF TRANSMISSION HOUSING.

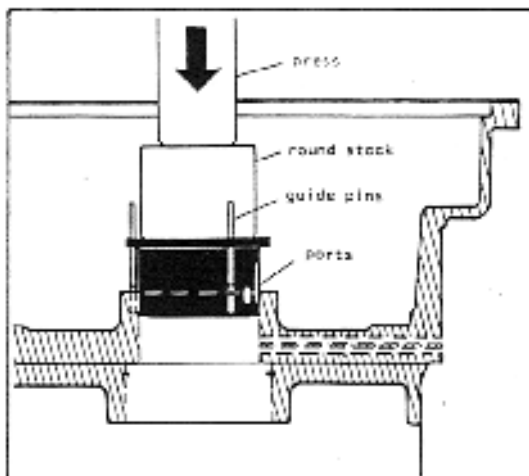


Fig. 32. Installing Rear Commutator in Housing

b). To make sure holes in commutator flange match up with spring pins in housing, three guide pins (3/16" dia.) Should be used.

c). Apply lubricant to commutator and press it into housing bore.

d). Check that commutator sleeve 'floats' in shell.

3. If necessary replace reverse drum and secure with capscrews and lock washers. Turn transmission housing engine end down.

4. Install pinion roller bearing in housing bore. Secure with snap ring.

5. Install new output bearing cup (if necessary) in housing bore. Make sure cup seats firmly.

6. Install oil pan and secure capscrews with locking wire.

7. Install new tapered roller bearings (if necessary) on both ends of output gear shaft. Roller assembly must be heated in oil then pressed onto shaft snug against shoulder of gear. When bearings have cooled, check that they are still snug against shoulder.

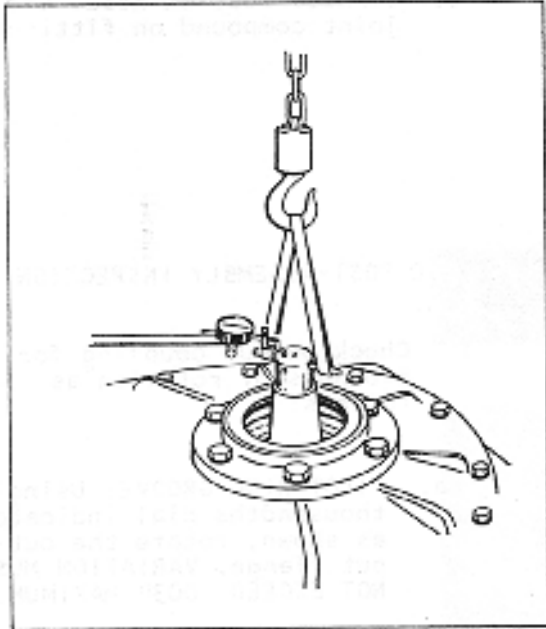


Fig. 34. Checking End Play in Output Shaft.

7.8 INSTALLATION OF OUTPUT COUPLING

1. If new coupling is used, check clearance between key and keyway in output coupling by locating key and coupling temporarily on shaft. Clearance should be .010" to .015". Otherwise file key as necessary.

2. Heat output coupling in hot oil or water at 180° Fahrenheit (or 82° Celsius) for at least ½ hour before installation.

4. Install hot output coupling on output shaft. Make sure coupling seats firmly against bearing. If it does not, a soft hammer should be used while coupling is hot.

4. Secure coupling with washer, slotted nut and cotter pin.

7.9 INSTALLATION OF PINION SHAFT AND RELATED PARTS

Tip housing upright.

1. If a new pinion or a new rear commutator is being installed, check the clearance between the two parts. It must be .002" or assembly will be very difficult and commutator may freeze on the shaft.

16. Check endplay in output shaft as follows:

a). Connect hoist to end of output shaft. Slotted nut may be used for this purpose.

b). Mount thousandths dial indicator with tip resting on end of shaft.

c). Raise and lower output shaft with hoist. Twist shaft back and forth several times to seat rollers in bearing.

d). END PLAY MUST BE BETWEEN .000" and .003". Otherwise remove bearing cap and add or subtract shims as necessary; check endplay again.

2. E.R. Models only: Mount a thousandths dial indicator on rear cover at pinion bore so that tip is resting on the side of an idler gear tooth. Hold output gear stationary and gently twist idler back and forth. The amount of play or 'backlash' between the teeth must be .004" to .008".

3. Apply lubricant to rear commutator mating surface on pinion shaft.

4. Install pinion assembly (including bearing retainer) into pinion bore in housing cover.

5. Apply oil pump gasket onto pinion bearing retainer with a small amount of grease.

6. Install oil pump. Secure with capscrews and lockwashers. E.R. Models Only: Connect idler hose to pump and idler shaft.

7. Install new oil filter element in canister and install canister on filter head. If head was removed make sure FLOW ARROW POINTS AWAY FROM PUMP when re-installing.

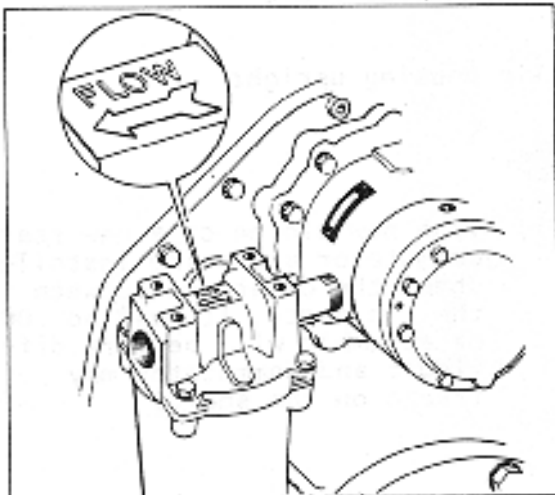


Fig. 35. CAUTION: Flow Arrow on Filter Must Point Away From Oil Pump.

8. Connect suction hose. Use joint compound on fittings.

7.10 POST-ASSEMBLY INSPECTION

1. Check output coupling for trueness of rotation as follows:

a). PILOT RING GROOVE: Using thousandths dial indicator as shown, rotate the output flange. VARIATION MUST NOT EXCEED .003" MAXIMUM.

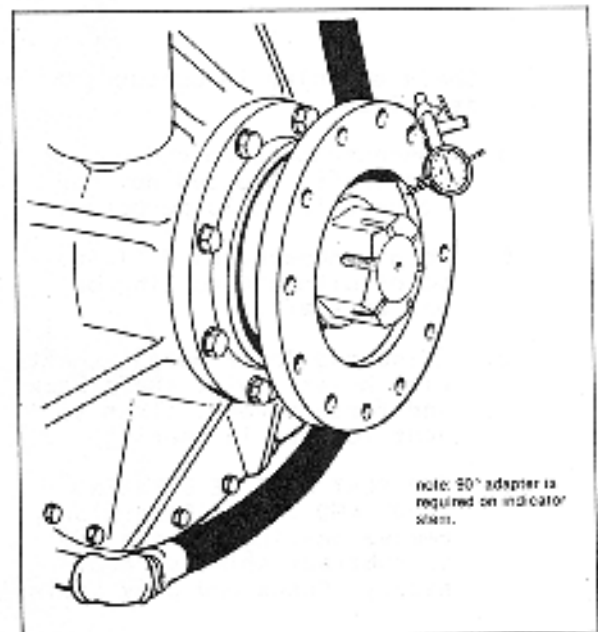


Fig. 36 Dial Indicating Output Flange Pilot Ring Groove

b). MOUNTING FACE: Mount thousandths indicator as shown and rotate coupling. VARIATION MUST NOT EXCEED .003" MAXIMUM.

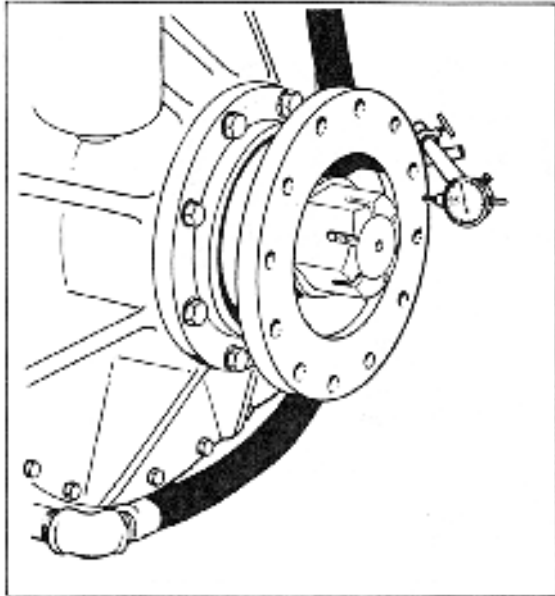


Fig. 37. Dial Indicating Output Flange Mounting Face

2. Check for gear backlash as follows:
A.E.R. MODELS (without idler gear): Mount thousandths dial indicator on top of housing so that arm extends through top inspection hose and tip rests on the side of a pinion tooth. Hold output coupling stationary and gently twist pinion back and forth. The play or 'backlash' must be between .004" and .008".

3. Check for gear tooth contact:

If a NEW pinion and or idler gear are installed check for tooth contact with marking compound. Models without idler gear, apply compound to pinion. Units with idler gear apply compound to idler gear.

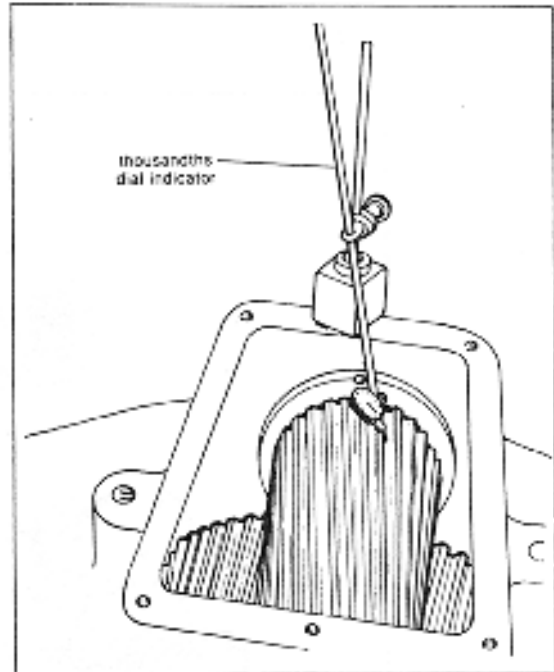


Fig. 38. Checking 'Backlash' with Thousandths Dial Indicator.

7.11 ADDITIONAL ASSEMBLY

1. Install inspection covers and gaskets
2. Install oil breather and dipstick
3. Install oil drain plug
4. Install gasket and baseplate
5. Install gasket and selector valve on baseplate
6. Connect hose from selector valve tee to oil pump.

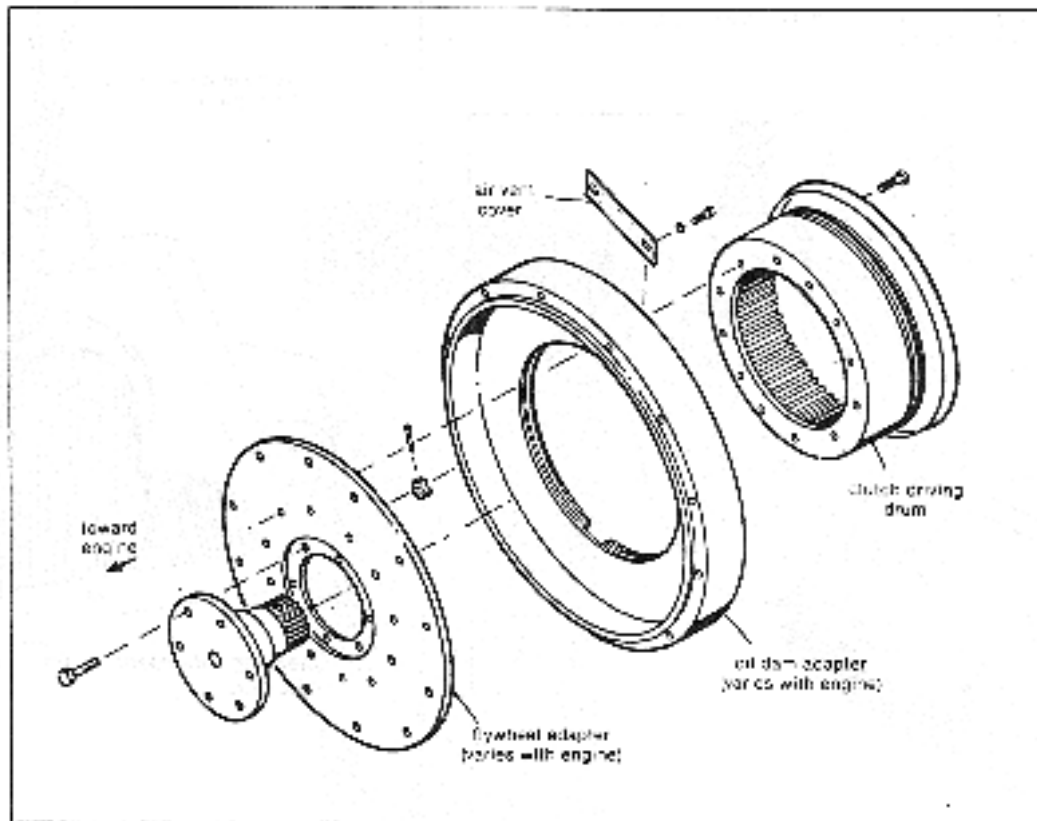


Fig. 38. 'HY' Adapter Group

7.12 ADAPTER PARTS

1. Clean and inspect stub shaft, clutch driving drum. Check splines for chips, deep grooves or wear. Replace parts as necessary.

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

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

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) you need write:

Customer service	Cable address:
Capitol Gears, Inc.	"Cap marine"
349 North Hamline Ave.	Tel: (612) 645-9491
St. Paul, MN 55104	Telex: 29-7081
USA	

Necessary Information	Sample
1. Model	HP-9400
2. Option Code	1-09400-03011-10111
3. Serial No.	1-105-0680
4. Ratio	3.074:1 A.E.R
5. Eng.Mfg.No (if any)	
6. Part Number	1-00230-2800
7. Description	Clutch disc, driving
8. Figure Number and item number	Fig. 46, item 6
9. Quantity being ordered	19

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 customer's 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.
1-10169-0000 (HY-7700)
1-10168-0000 (HY-6900)

Includes the necessary gaskets, seals and o-rings commonly used for repair.

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

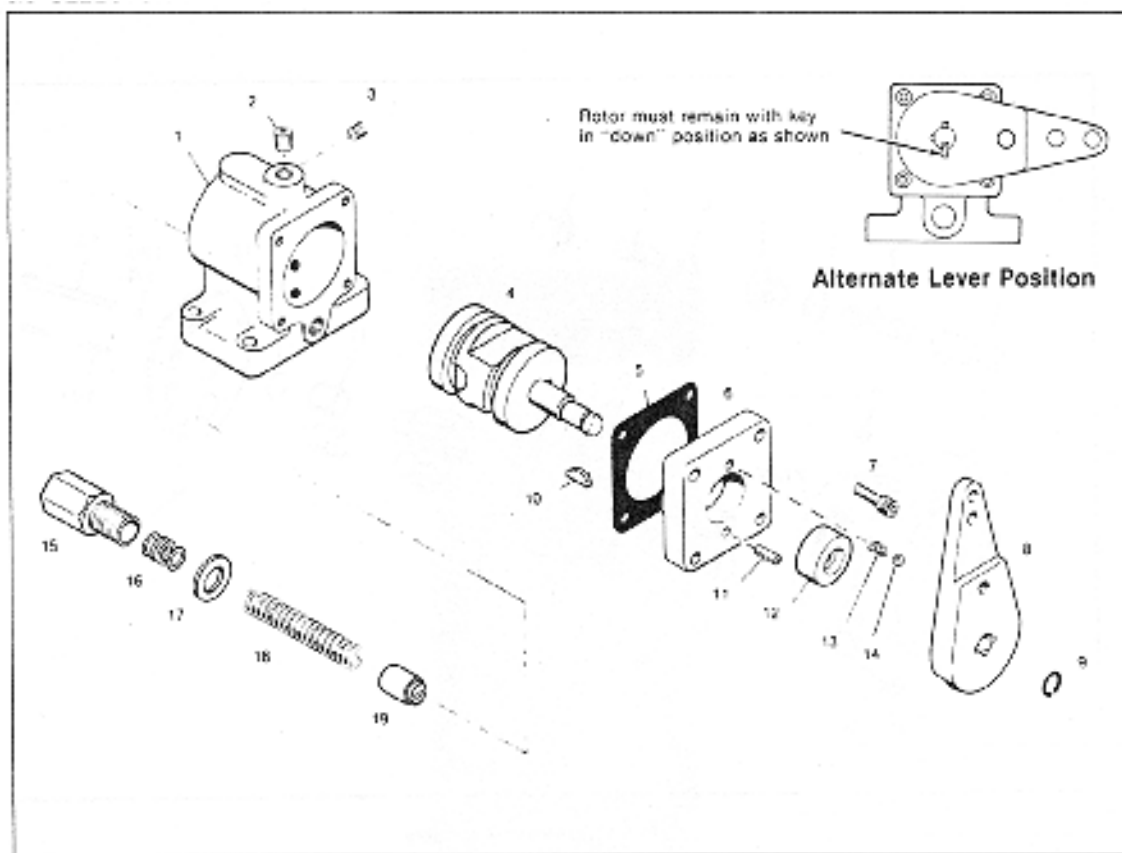


Fig. 40. Selector Valve Assembly, no. 1-09427-2000

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	ASSEMBLY, SELECTOR VALVE	1-09427-2000	1
1	BODY	1-01141-3500	1
2	PIPE PLUG, HEX SOCKET; 1/4 N.P	1-11279-0300	1
3	PIPE PLUG, HEX SOCKET; 1/8 N.P	1-11279-0200	1
4	VALVE (ROTOR)	1-01144-1000	1
5	GASKET, VALVE COVER	1-01156-3700	1
6	COVER	1-01142-3400	1
7	CAPSCREW, SOCKET HEAD; 1/4-20X 1/2 LG	1-09432-0800	4
8	LEVER	1-01143-4200	1
9	RETAINING RING, EXTERNAL	1-13125-0000	1
10	KEY, 3/32x 1/2" DIA	1-01164-3200	1
11	SPRING PIN, 1/4" DIA.X 1/2" LG	1-12097-0800	1
12	OIL SEAL	1-01152-3200	1
13	SPRING, INDEXING	1-01132-1500	1
14	BALL, INDEXING; 1/4" DIA	1-11200-0000	1
15	ADJUSTMENT SCREW, RELIEF	1-12617-0000	1
16	WASHER,.003" THICK	1-12619-0000	5
17	WASHER,. 1/16" THICK	1-10288-0700	1
18	SPRING, RELIEF VALVE	1-12618-0000	1
19	PLUNGER, SAFETY RELIEF	1-12616-0000	1

8.4 OIL PUMP

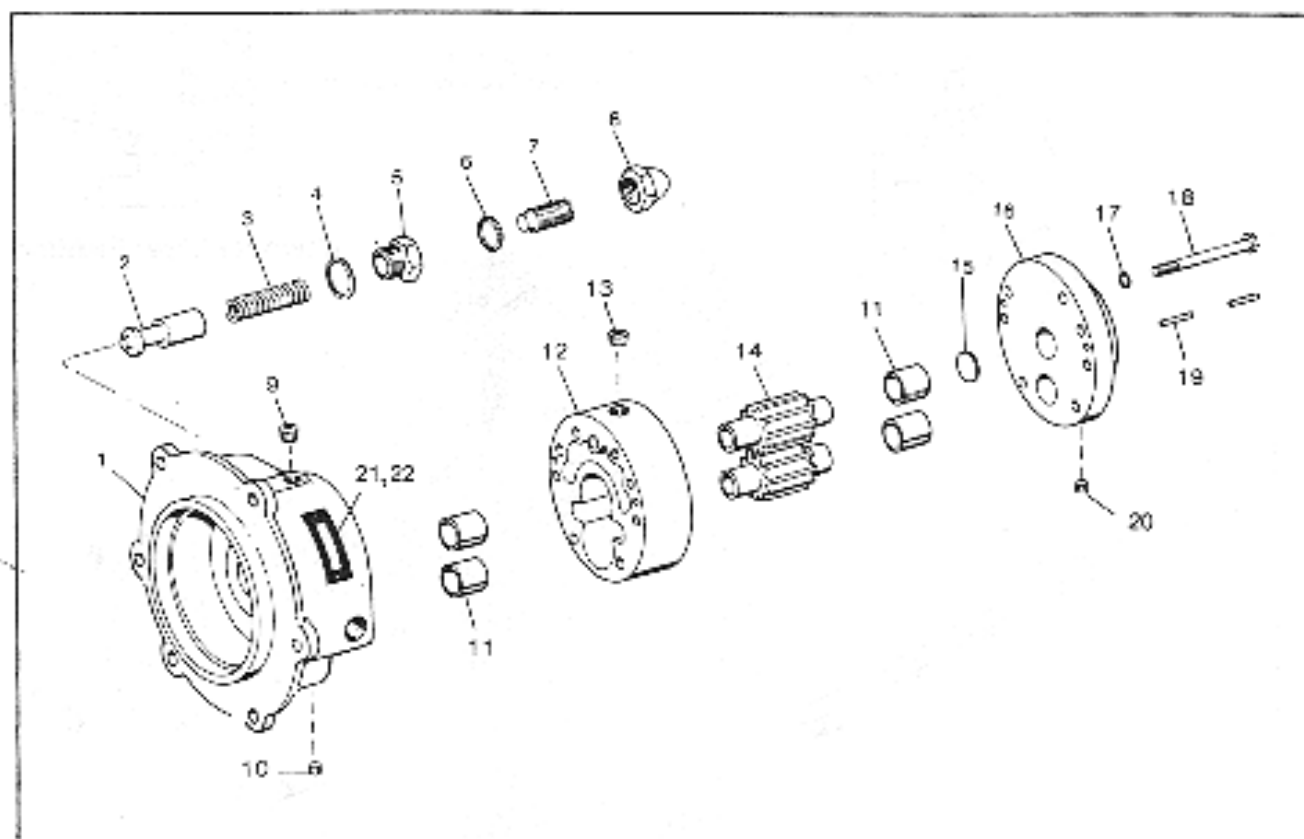


Fig. 41. Oil Pump Assembly

OIL PUMP ASSEMBLY
NO. 1-07800-0100

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	ASSEMBLY, OIL PUMP	1-07800-0100	1
1*	ADAPTER, OIL PUMP	1-07721-0900	1
2	PLUNGER, RELIEF VALVE	1-07725-0800	1
3	SPRING, PRSSURE REGULATING	1-07743-0800	1
4	WASHER; 11/4" O.D	1-12901-0000	1
5	INSERT, RELIEF VALVE	1-07724-0800	1
6	WASHER; 7/8" O.D	1-12902-0000	1
7	SCREW, PRESSURE RELIEF	1-06660-0800	1
8	NUT, DOME	1-06667-0800	1
9	PIPE PLUG, HEX SOCKET; ¼ N.P.T	1-11279-0300	1
10	PIPE PLUG, HEX SOCKET; 1/8-27 N.P.T	1-11279-0200	1
11	BUSHING 7/8 O.D X ¾ LG X ¾ BORE (12 DUR)	1-11380-0000	4
12	BODY, OIL PUMP	1-07856-0800	1
13	PIPE PLUG, HEX SOCKET; 3/8 N.P.T	1-11279-0400	1
14	GEAR, PUMP	1-09688-0900	2
15	DISC, FLAT	1-13731-0000	1
16**	COVER, OIL PUMP	1-07723-1100	1
17	LOCKWASHER; 5/16"	1-09458-0800	7
18	CAPSCREW, HEX HD. ; 5/16-18 NC X 2/12	1-10946-0000	7
19	SPRING PIN; ¼ X ¾	1-12097-1200	4
20	PIPE PLUG, HEX SOCKET; 1/16-27 N.P.T	1-11279-0100	1
21	PLATE, PUMP NUMBER	1-11209-0000	1
22	DRIVE SCREW, RD. HD.	1-13275-0000	2

* OIL PUMP ADAPTER ASSEMBLY NO. 1-07721-3500 includes items 1,9,10 and 11. Bushings are installed and reamed to size.

** OIL PUMP COVER ASSEMBLY NO. 1-07723-1300 includes items 11, 15, 16 and 20. Bushings are installed and reamed to size.

1.5 CLUTCH

Clutch no. 1-00100-6000

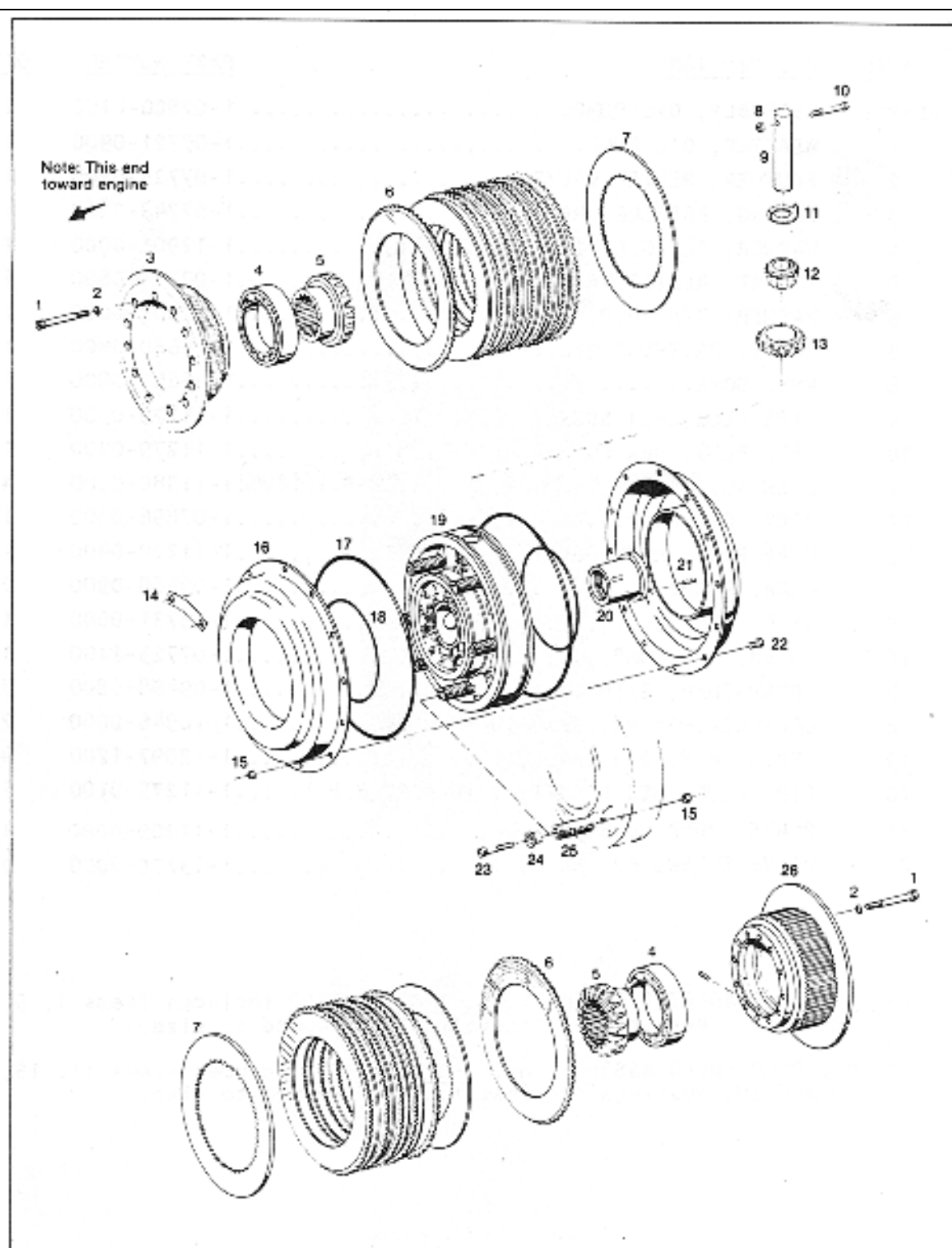


Fig. 42. Clutch Assembly

PART NO. 1-00100-6000

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	CLUTCH ASSEMBLY	1-00100-6000	1
1	CAPSCREW, SOCKET HD 3/8-16X3 1/4"	1-12247-0000	24
2	LOCKWASHER 3/8 STD	1-08755-0800	24
3	FLANGE, CLUTCH (FORWARD)	1-00212-4100	1
4	BALL BEARING	1-00211-2500	2
5	GEAR BEVEL	1-00215-2600	2
6	CLUTCH DISC, DRIVING	1-00230-4400	13
7	CLUTCH DISC, DRIVEN	1-00233-1200	13
8	NUT, SELF-LOCKING 1/4-28NF	1-00226-3600	3
9	SHAFT, BEVEL PINION	1-00220-3600	3
10	CAPSCREW, SOCKET HD 1/4-28X 2 "	1-09433-0800	3
11	THRUST WASHER	1-00221-3600	3
12	BEARING, BEVEL PINION	1-00218-2500	3
13	PINION, BEVEL	1-00217-2600	3
14	NAMEPLATE	1-12398-1200	1
15	NUT, SELF-LOCKING, 5/16-18 NC	1-11399-0000	36
16	CYLINDER	1-00234-5500	2
17	QUAD RING	1-00237-3600	2
18	QUAD RING	1-00238-5800	2
19	CARRIER, BEVEL GEAR	1-00219-3700	1
20	BUSHING, FORWARD COMMUTATOR	1-00247-3600	1
21	SPRING PIN	1-12096-1000	3
22	CAPSCREW, SOCKET HD, 5/16-18X 5/8"	1-09468-0800	24
23	CAPSCREW, SOCKET HD, 5/16-18X 2 "	1-05386-0800	12
24	RETAINER, RETURN SPRING	1-00243-3600	12
25	SPRING, RETURN	1-00239-3700	12
26	FLANGE, CLUTCH (REVERSE)		
	-(INCLUDES SPRING PINS)	1-00210-6700	1

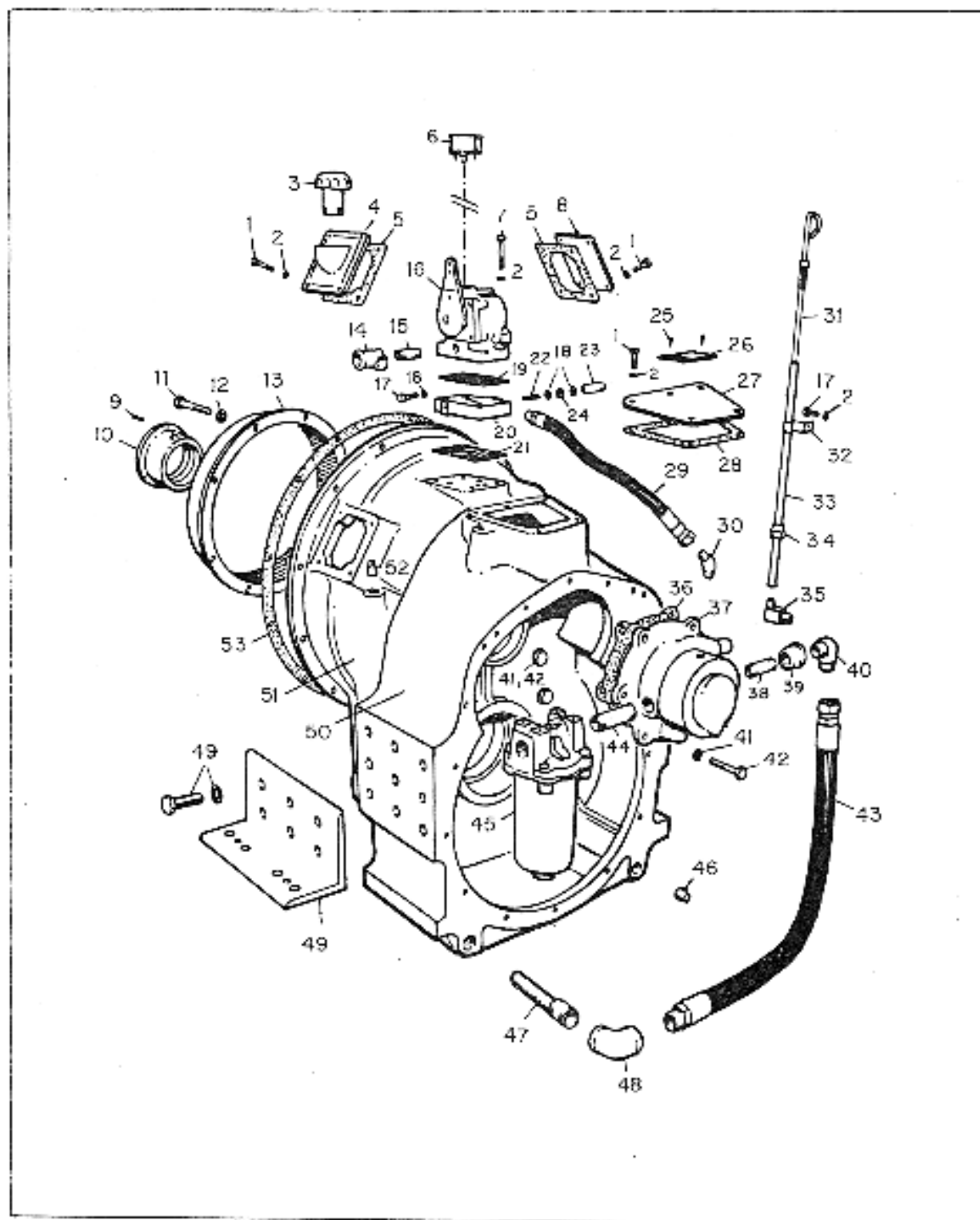


Fig. 43 Housing and Related Parts 1W-7790

1.6 TRANSMISSION HOUSING AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	CAPSCREW, HEX HD; 5/16-18X1"	1-08372-0800	13
2	LOCKWASHER, LIGHT; 5/16	1-09458-0800	12
3	BREATHER	1-05243-0800	1
4	COVER, BREATHER/ INSPECTION	1-09188-0800	1
5	GASKET, INSPECTION COVER	1-01225-1500	2
6	GAUGE, PRESSURE	1-09669-0900	1
7	CAPSCREW, HEX HD.; 5/16-18X2 ¼	1-12452-0000	4
8	COVER, INSPECTION	1-01228-1500	1
9	SPRING PIN; 3/16 DIA. X 5/8"	1-12096-1000	3
10	BUSHING ASSEMBLY, REAR COMMUTATOR	1-00248-4200	1
11	CAPSCREW, HEX HD; 7/16-14X1 ¾	1-07106-0800	8
12	LOCKWASHER, LIGHT; 7/16	1-09462-0800	8
13	DRUM, REVERSE CLUTCH	1-00250-3600	1
14	TEE, REDUCING; 1/2X 3/8X3/8	1-11260-0200	1
15	NIPPLE, PIPE; 3/8 dia. X 2"	1-11259-0100	1
16	SUB-ASSEMBLY, SELECTOR VALVE	1-09427-2000	1
17	CAPSCREW. HEX HD; 5/16-18 1/2"	1-12145-0000	1
18	GASKET, 5/16	1-09471-0800	3
19	GASKET, VALVE TO BASE PLATE	1-13015-0000	1
20	BASE PLATE	1-01150-3400	1
21	GASKET, BASE PLATE TO HOUSING	1-01154-3400	1
22	SET SCREW, SOCKET; 5/16-18 ½	1-09466-0800	1
23	DOME NUT; 5/16-18	1-09461-0800	1
24	LOCK NUT, LIGHT; 5/16-18	1-09464-0800	1
25	DRIVE SCREW, ROUND HD; #2X3/16"	1-13275-0000	2
26	NAMEPLATE	1-11210-0000	1
27	INSPECTION COVER, REDUCTION HOUSING	1-06966-1100	1
28	GASKET, INSPECTION COVER	1-06968-0800	1
29	HOSE; ¾ I.D	1-08873-0900	1
30	ELBOW, MALE 45°	1-11220-1100	1
31	OIL STICK	1-07916-0800	1
32	BRACKET, OIL STICK	1-07915-0900	1
33	TUBE, OIL STICK	1-07915-0900	1
34	SHORT NUT; 45° FLARE	1-11243-0800	1
35	ELBOW, 90°	1-11237-1600	1
36	GASKET, BEARING RETAINER TO PUMP	1-06762-0800	1
37	SUB-ASSEMBLY, OIL PUMP OIL PUMP FOR 4.524: 1 E.R MODEL	1-07800-0100	1
38	PIPE NIPPLE; ¾ dia. X3"	1-11259-0700	1
39	BUSHING, REDUCER; 1/3/4	1-11224-1100	1
40	ELBOW, 90° MALE	1-11221-2100	1
41	LOCKWASHER, LIGHT; ½	1-11083-0000	16
42	CAPSCREW, HEX HD; ½-13 X 1 ¾	1-10058-0000	16
43	HOSE	1-13192-0000	1
44	PIPE NIPPLE, ¾ dia. X 2"	1-11259-1700	1
45	OIL FILTER	1-13811-0000	1
46	PIPE PLUG; 1/11 ½ NPT	1-11251-0500	1
47	SUCTION SCREEN	1-13801-0000	1
48	ELBOW, 90°; 1" NPT	1-11246-0600	1
49	KIT, MOUNTING FEET (OPTIONAL)	1-13635-0000	1
50	HOUSING, REDUCTION; ALL A.E.R RATIO HOUSING, REDUCTION; 3.035: E.R RATIO HOUSING, REDUCTION; 3.50: 1 E.R RATIO HOUSING, REDUCTION; 3.875:1 E.R RATIO HOUSING, REDUCTION; 4.524:1 E.R RATIO	1-10302-6000 1-10302-6100 1-10302-6200 1-10302-6300 1-10302-6400	1 1 1 1 1
51	HOUSING, REVERSE	1-01101-3600	1
52	PIPE PLUG, SQ. HD; 3/8-18 NPT	1-11251-0300	2
53	GASKET, HOUSING TO OIL DAM	1-01102-3600	1

8.7 ADAPTER GROUP

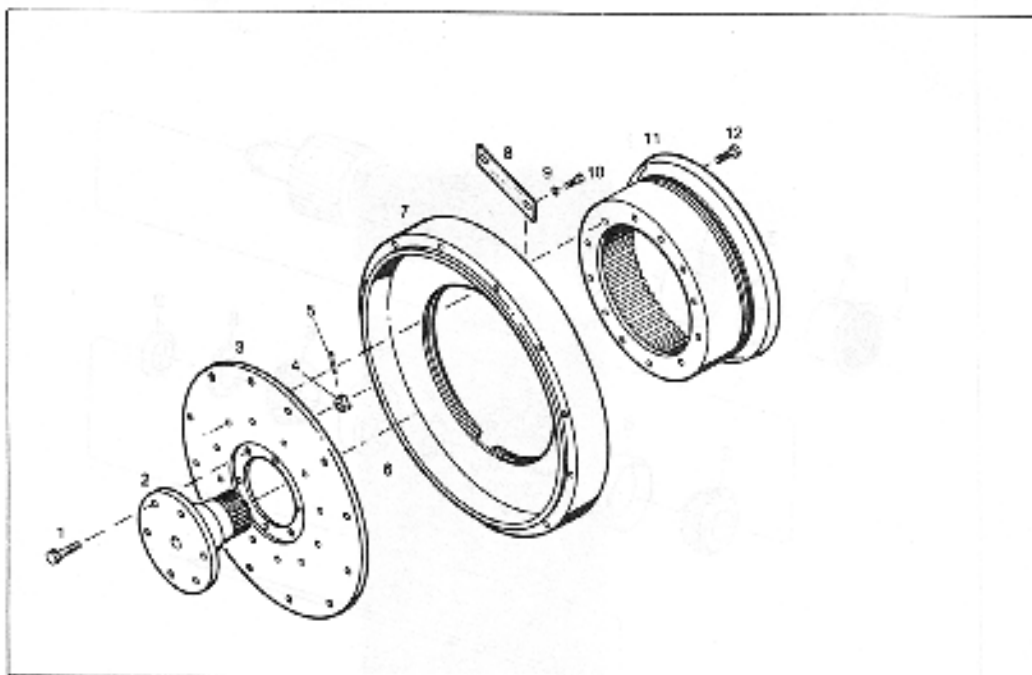


Fig. 44. 'HY' Adapter Group

ITEM	DESCRIPTION	PART NUMBER	QTY
1	CAPSCREW, HEX HD. DRILLING END	1-06972-0800	6
2	DRIVE FLANGE ASSEMBLY (SEE "HY" INSTALLATION DRAWING)		1
3	FLYWHEEL ADAPTER (SEE "HY" INSTALLATION DRAWING)		1
4	HEX.NUT HEAVY SLOTTED	1-06973-0800	6
5	COTTER PIN	1-12769-5400	6
6	BUSHING, DRIVE FLANGE	1-00326-2600	1
7	OIL DAM ADAPTER (SEE "HY" INSTALLATION DRAWING)		1
8	COVER, AIR VENT	1-01118-2700	1
9	LOCKWASHER, 5/16 DIA	1-09458-0800	9
10	CAPSCREW, HEX. HD 5/16-18 X ½	1-12145-0000	4
11	DRUM CLUTCH, DRIVING	1-01116-3600	1
12	CAPSCREW, HEX. HD (POLYLOK)	1-13804-0000	12

8.8 PINION SHAFT AND RELATED PARTS

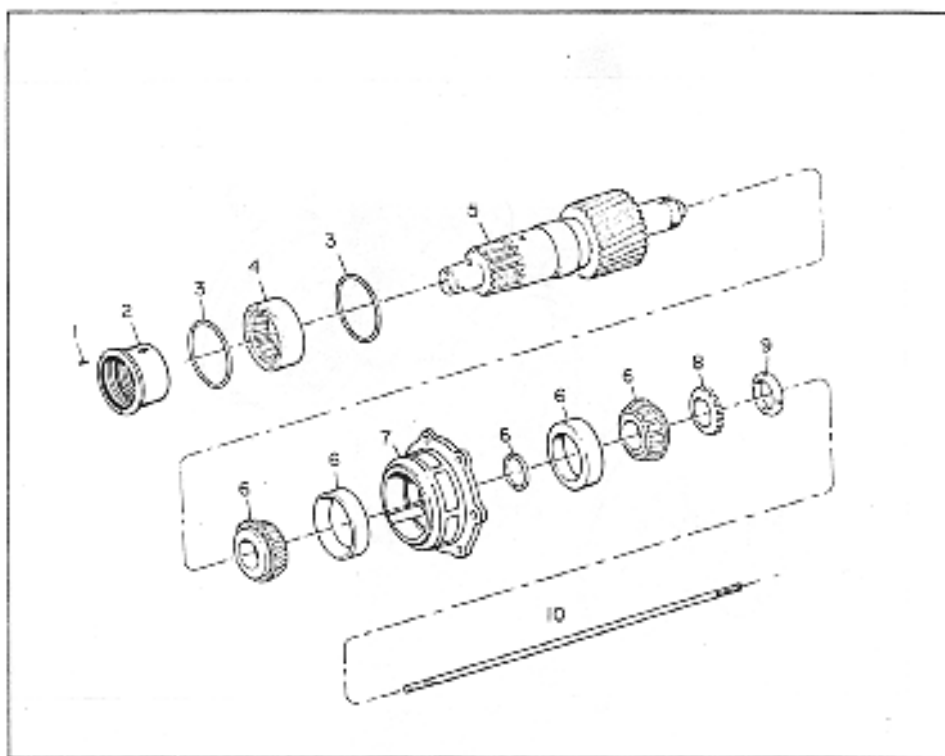


Fig. 45.

8.9 IDLER GEAR AND RELATED PARTS

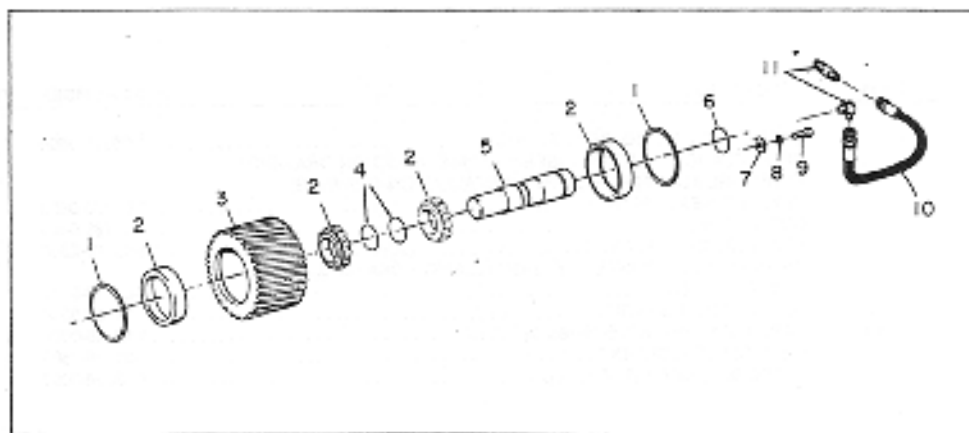


Fig. 46.

PINION SHAFT AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SPRING PIN	1-12096-1000	3
2	BUSHING ASSEMBLY, REAR COMMUTATOR	1-00248-4200	1
3	SNAP RING	1-07732-0800	2
4	BEARING, ROLLER	1-07727-0800	1
5	PINION AND SHAFT ASSEMBLY	(SEE CHART P.54)	1
6	BEARING ASSEMBLY (5 PIECES)	1-12958-0000	1
7	RETAINER, BEARING (INCLUDES RING)	1-12959-2600	1
8	LOCKWASHER, BEARING	1-13235-0000	1
9	LOCKNUT, BEARING	1-06903-0800	1
10	SHAFT, PUMP DRIVE	1-07892-0800	1

IDLER GEAR AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SNAP RING	1-10112-0000	2
2	BEARING, IDLER (4 PIECES)	1-10117-0000	2
3	IDLER; 30 TEETH	1-10107-0000	1
4	SNAP RING	1-12763-0000	2
5	SHAFT IDLER	1-10105-0200	1
6	O-RING	1-10336-0000	1
7	WROUGHT WASHER	1-10338-0000	1
8	LOCKWASHER, LIGHT; 5/16"	1-09458-0800	1
9	CAPSCREW, HEX HD.; 5/16-18X 1/2"	1-12145-0000	1
10	HOSE ASSEMBLY	1-07875-1000	1
11	MALE ELBOW	1-11237-0300	2

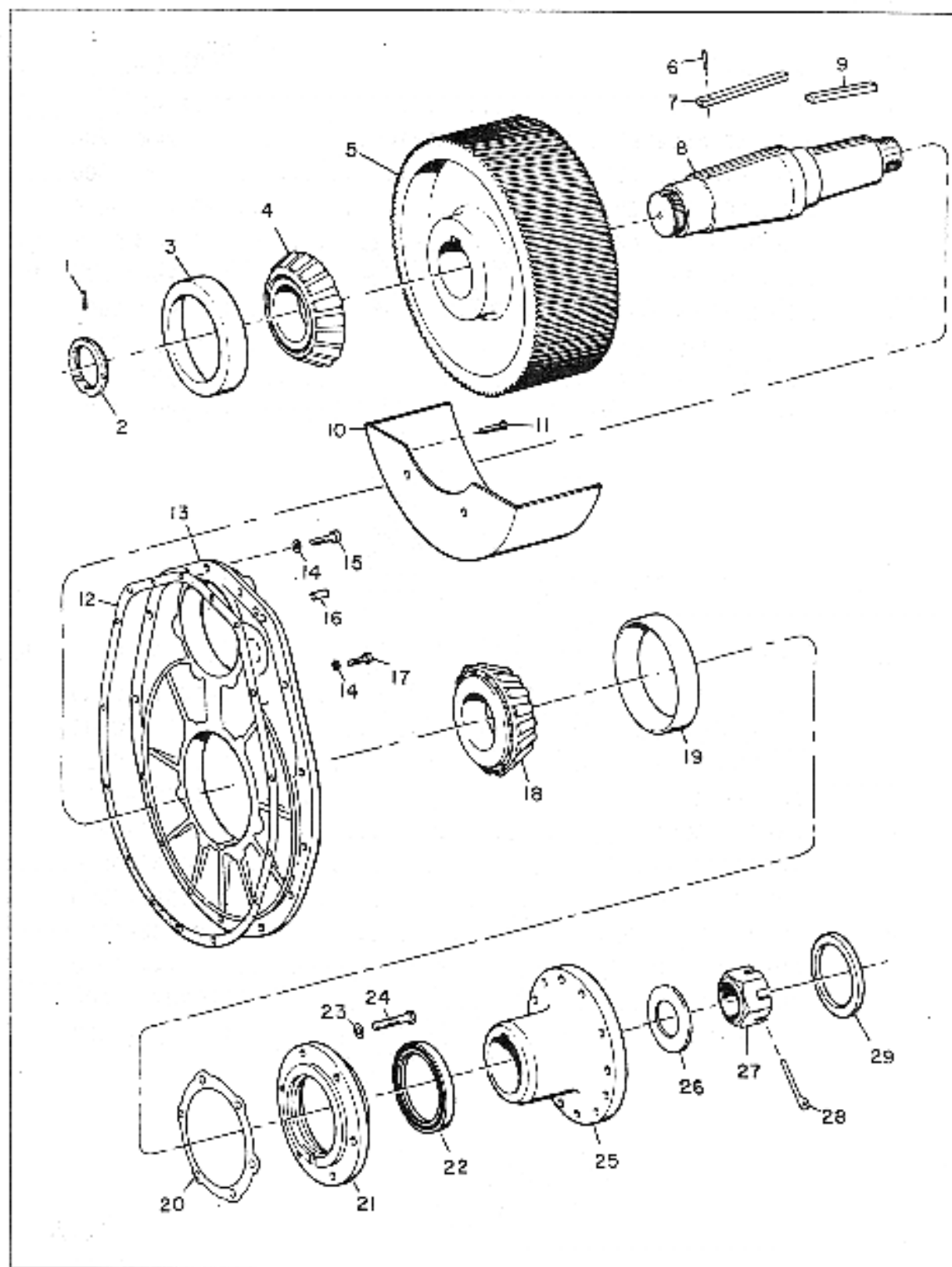


Fig. 47. Output Gear and Related Parts

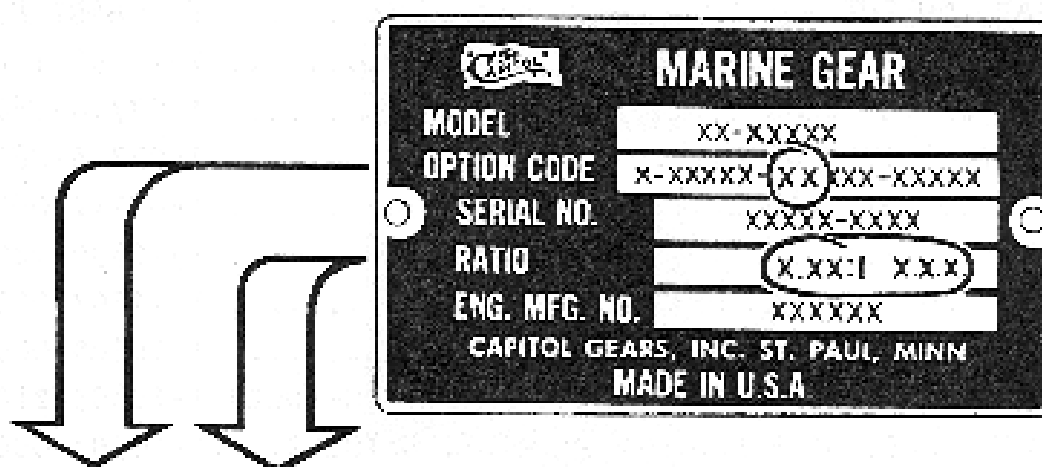
8.10 OUTPUT GEAR, COVER AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SET SCREW, SOCKET : ¼-20 X 3/8"	1-11993-0000	1
2	LOCKNUT, BEARING (MODIFIED)	1-07706-1200	1
3	CUP, BEARING	1-07706-1200	1
4	CONE, BEARING	1-07706-1000	1
5	GEAR, OUTPUT	(SEE CHART P.54)	1
6	SPRING PIN	1-12096-1000	1
7	KEY, DRIVEN GEAR	1-07714-0800	1
8	SHAFT, DRIVEN GEAR	1-07715-0800	1
9	KEY, OUTPUT FLANGE	1-07712-0800	1
10	OIL PAN	1-10339-0000	1
11	CAPSCREW, DRILLED HEX HD	1-11363-0000	1
12	GASKET, REDUCTIN GEAR COVER	1-10304-0000	1
13	COVER, RED. GEAR HSG. – ALL RATIOS NON-IDLER	1-10303-2100	1
	COVER, RED. GEAR HSG. – 3:1 RATIO WITH IDLER	1-10303-0000	1
	COVER, RED. GEAR HSG. – 3 1/2: 1 RATIO W/ IDLER	1-10313-0000	1
	COVER, RED. GEAR HSG. - 4:1 RATIO W/ IDLER	1-10323-0000	1
	COVER, RED. GEAR HSG. – 4 1/2:1 RATIO W/ IDLER	1-10333-0000	1
14	LOCKWASHER, LIGHT	1-11083-0000	16
15	CAPSCREW, HEX HD.	1-09141-0800	15
16	DOWEL, COVER TO HSG.	1-12311-0000	2
17	CAPSCREW, SOCKET HD.	1-07544-0800	1
18	CONE, BEARING	1-07707-1000	1
19	CUP, BEARING	1-07707-1200	1
20	SHIM PACK	1-07711-3400	1
21	BEARING CAP AND OIL SEAL RETAINER	1-07704-0800	1
22	OIL SEAL	1-12971-0000	1
23	LOCKWASHER, LIGHT: 5/8"	1-06074-0800	6
24	CAPSCREW, HEX HD.: 5/8- 11X 11/2"	1-03738-0800	6
25	FLANGE, OUTPUT	1-07705-1200	1
26	WASHER	1-07717-0800	1
27	NUT	1-07716-0800	1
28	COTTER PIN	1-07718-0800	1
29	RING PILOT	1-06022-0800	1

8.11 REDUCTION GEAR SELECTION CHART

HOW TO SELECT THE CORRECT PINION AND OUTPUT GEAR FOR YOUR TRANSMISSION:

- A. LOCATE THE NAMEPLATE (ON TOP OF HOUSING) AND DETERMINE THE TWO REDUCTION REATIO 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).



OPTION CODE	RATIO	PART NAME	NO. OF TEETH	PART NUMBER
01	2.485:1 AER	PINION GEAR	35 87	1-11872-0000 1-13382-2000
02	4.524:1 ER	PINION GEAR	21 95	1-11883-0000 1-13386-2000
03	2.697:1 AER	PINION GEAR	33 89	1-11873-0000 1-13377-2000
04	3.067:1 AER	PINION GEAR	30 92	1-11874-0000 1-13378-2000
05	3.519:1 AER	PINION GEAR	27 95	1-11877-0000 1-13387-2000
06	3.88:1 AER	PINION GEAR	25 97	1-11879-0000 1-13385-2000
07	4.545:1 AER	PINION GEAR	22 100	1-11882-0000 1-13384-2000
08	3.035:1 ER	PINION GEAR	29 88	1-11875-0000 1-13379-2000
09	3.500:1 ER	PINION GEAR	26 91	1-11878-0000 1-13381-2000
10	3.875:1 ER	PINION GEAR	24 93	1-11880-0000 1-13380-2000

8.12 OIL FILTER

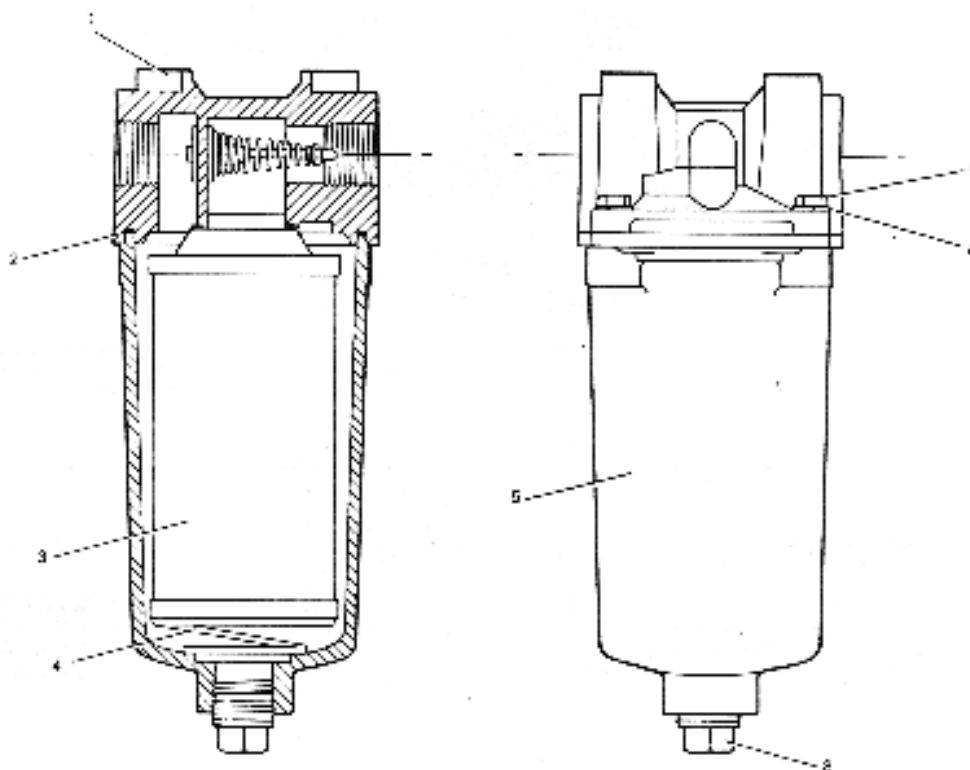


Fig. 48. Oil Filter No. 1-13811-0000

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	ASSEMBLY, OIL FILTER	1-13811-0000	1
1	HEAD	1-13811-0100	1
2	SEAL, HOUSING	1-13811-0500	1
3	ASSEMBLY, ELEMENT (INCLUDES ELEMENT SEAL)	1-13811-0300	1
4	SPRING, ELEMENT	1-13811-0600	1
5	HOUSING	1-13811-0200	1
6	CAPSCREW, HEX HEAD	1-12339-0000	4
7	LOCKWASHER	1-09458-0800	4
8	PLUG, DRAIN	1-11251-0500	1

8.13 PROPELLER COUPLING KITS

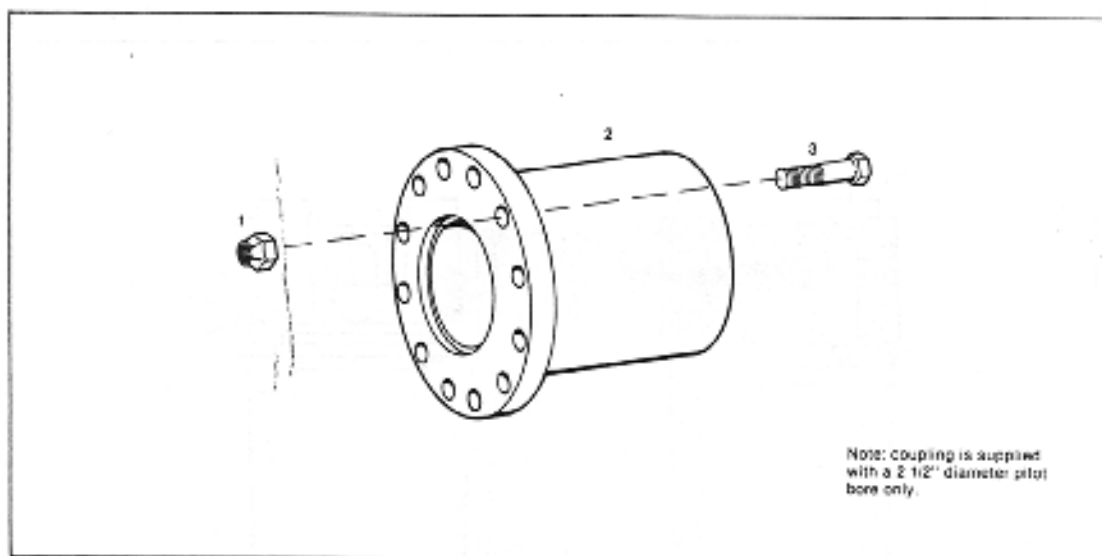


Fig. 48 Propeller Coupling Kit

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	PROPELLER COUPLING KIT	1-13577-1000	1
1	NUT, SELF-LOCKING 3/4-10 NC	1-13095-0000	12
2	COUPLING, PROP SHAFT	1-13826-0000	1
3	CAPSCREW, HEX HEAD 3/4-10 NCX3 1/4"	1-08793-0800	12

1.14 OIL COOLERS

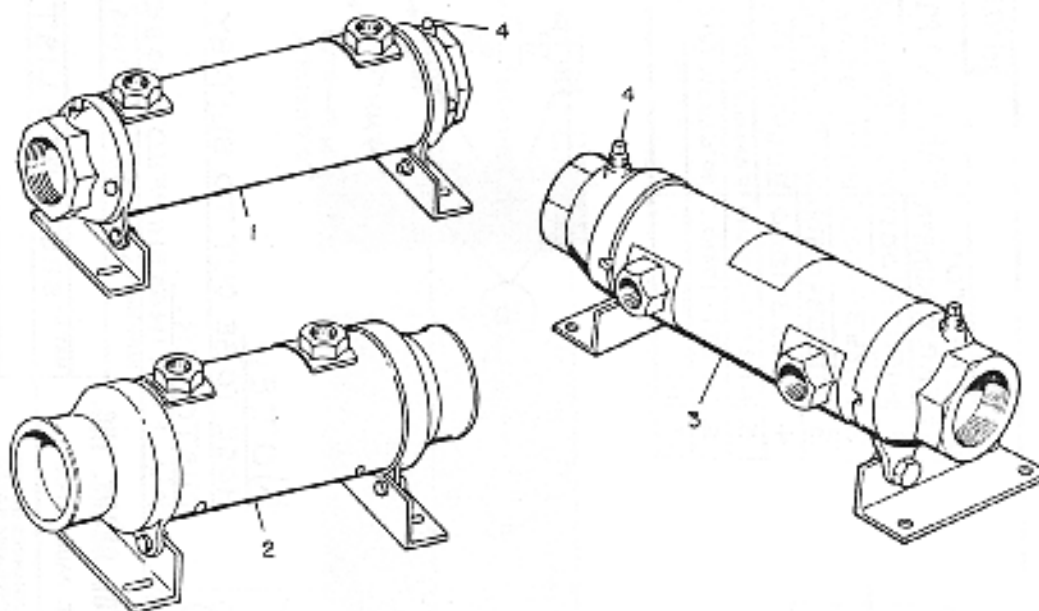
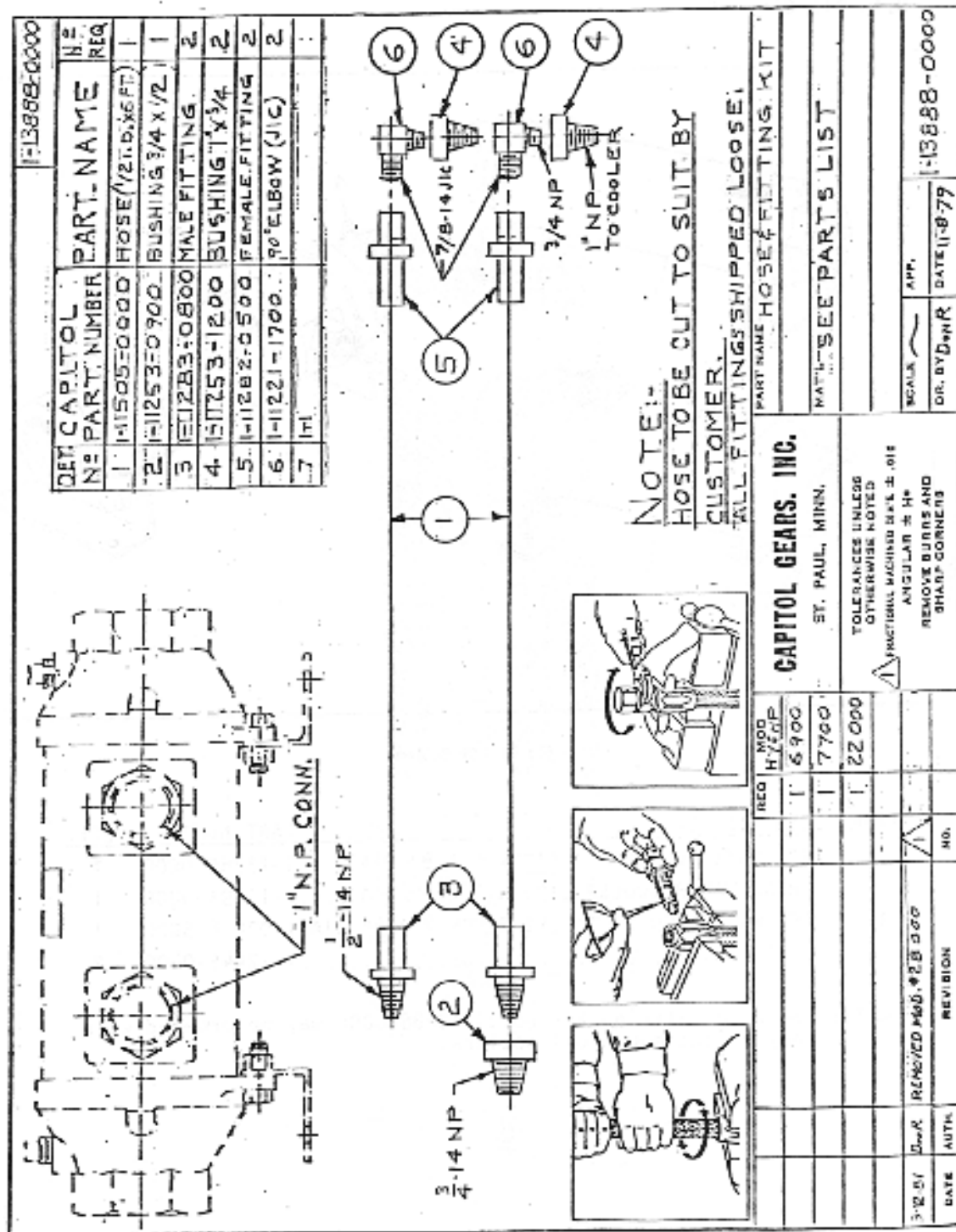


Fig. 50. Oil Coolers

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SEA WATER COOLER (17"X 5 1/8" DIA)	1-13769-0000	1
2	FRESH WATER COOLER (19 1/2" X 6 1/8" DIA)	1-13795-0000	1
3	SEA WATER COOLER (12 3/4"X 4 3/8" DIA)	1-07808-5000	1
4	ZINC PENCILS	1-12445-0400	2

NOTE: Hose and fitting kit no. 1-13888-0000 may be ordered with any of the above oil coolers.



8.16 HY- 6900

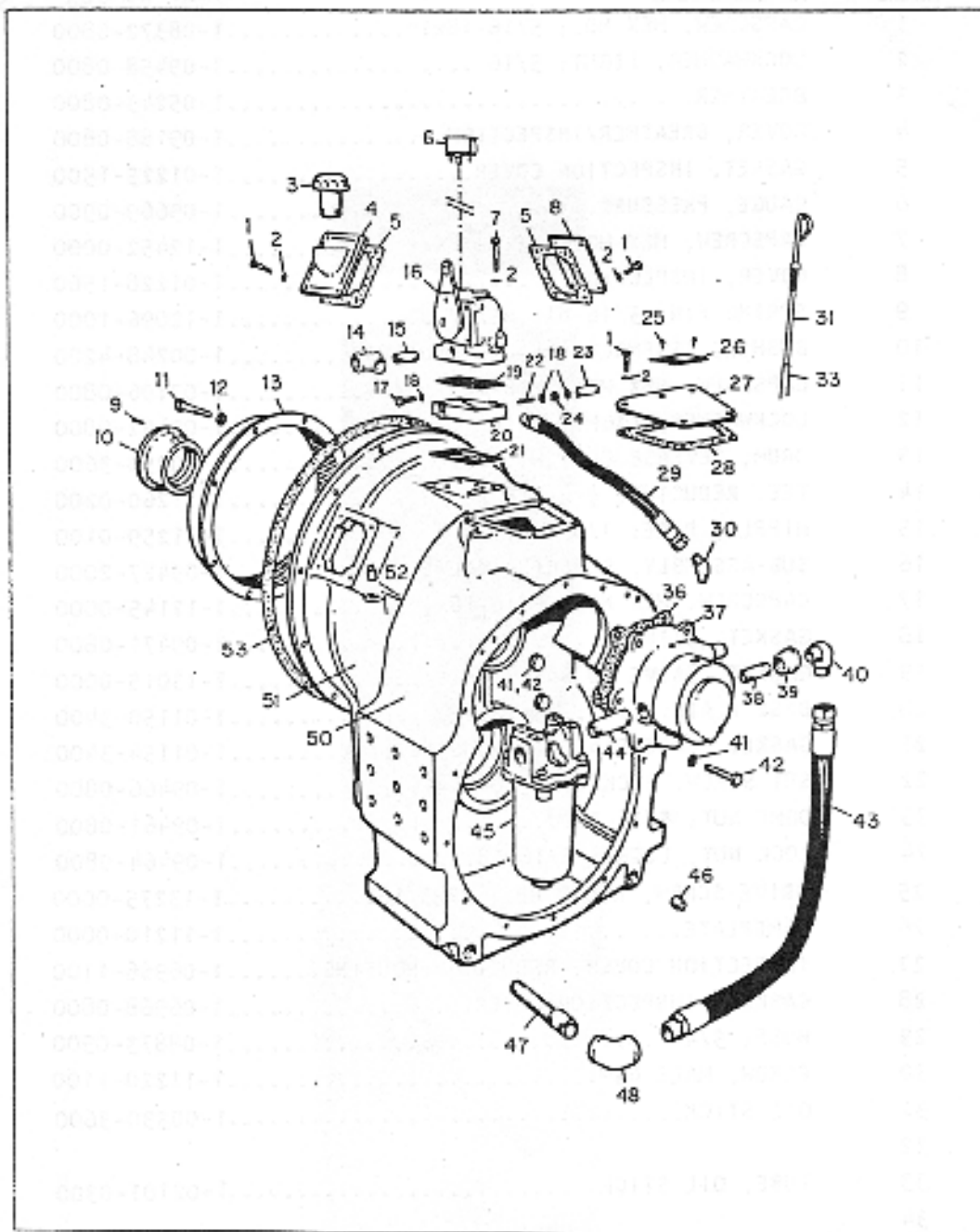


FIG. 51 HOUSING AND RELATED PARTS HY-6900

**TRANSMISSION HOUSING AND RELATED PARTS
HY-6900**

ITEM	DESCRIPTION	PART NUMBER	QTY
1	CAPSCREW, HEX HD.; 5/16-18X 1"	1-08372-0800	13
2	LOCKWASHER, LIGHT; 5/16	1-09458-0800	12
3	BREATHER	1-05243-0800	1
4	COVER, BREATHER/ INSPECTION	1-09188-0800	1
5	GASKET, INSPECTION COVER	1-01225-1500	2
6	GAUGE, PRESSURE	1-09669-0900	1
7	CAPSCREW, HEX. HD ; 5/16- 18 X 21/4	1-12452-0000	4
8	COVER, INSPECTION	1-01228-1500	1
9	SPRING PIN; 3/16 dia. 5/8"	1-12096-1000	3
10	BUSHING ASSEMBLY, REAR COMMUTATOR	1-00248-4200	1
11	CAPSCREW, HEX HD. : 7/16- 14X 1 3/4	1-07106-0800	8
12	LOCKWASHER, LIGHT; 7/16	1-09462-0800	8
13	DRUM, REVERSE CLUTCH	1-00250-3600	1
14	TEE, REDUCING; 1/2 X 3/8 X 3/8	1-11260-0200	1
15	NIPPLE, PIPE; 3/8 dia. X 2"	1-11259-0100	1
16	SUB-ASSEMBLY, SELECTOR VALVE	1-09427-2000	1
17	CAPSCREW, HEX HD.; 5/16-18X1/2"	1-12145-0000	1
18	GASKET, 5/16	1-09471-0800	3
19	GASKET, VALVE TO BASE PLATE	1-13015-0000	1
20	BASE PLATE	1-01150-3400	1
21	GASKET, BASE PLATE TO HOUSING	1-01154-3400	1
22	SET SCREW, SOCKET ; 5/16-18X11/2	1-09466-0800	1
23	DOME NUT ; 5/16-18	1-09461-0800	1
24	LOCK NUT, LIGHT; 5/16-18	1-09464-0800	1
25	DRIVE SCREW, ROUND HD; #2X3/16"	1-13275-0000	2
26	NAMEPLATE	1-11210-0000	1
27	INSPECTION COVER, REDUCTION HOUSING	1-06966-1100	1
28	GASKET INSPECTION COVER	1-06968-0800	1
29	HOSE; 3/4 I.D	1-08873-0900	1
30	ELBOW, MALE 45°	1-11220-1100	1
31	OIL STICK	1-00330-3600	1
32			
33	TUBE, OIL STICK	1-02101-0300	1
34			
35			
36	GASKET, BEARING RETAINER TO PUMP	1-06762-0800	1
37	SUB-ASSEMBLY, OIL PUMP	1-07800-0100	1
	OIL PUMP FOR 4.524: 1 E.R MODEL	1-07800-01200	1
38	PIPE NIPPLE; 3/4 dia. X 3"	1-11259-0700	1
39	BUSHING, REDUCER; 1X 3/4	1-11224-1100	1
40	ELBOW 90° MALE	1-11221-2100	1
41	LOCKWASHER, LIGHT; 1/2	1-11083-0000	16
42	CAPSCREW, HEX HD.; 1/2-13 X 1 3/4	1-10058-0000	16
43	HOSE	1-07845-1400	1
44	PIPE NIPPLE, 3/8 dia. X 2"	1-11259-1700	1
45	OIL FILTER	1-13811-0000	1
46	PIPE PLUG; 1-11 1/2 NPT	1-11251-0600	1
47	SUCTION SCREEN	1-13801-0000	1
48	ELBOW, 90°; 1' NPT	1-11246-0600	1
49			
50	HOUSING REDUCTION; ALL A.E.R RATIOS	1-10102-3000	1
	HOUSING, REDUCTION; 1.277: 1 E.R RATIO	1-10102-3100	1
	HOUSING, REDUCTION; 1.484: 1 E.R RATIO	1-10102-3200	1
	HOUSING, REDUCTION; 2.037:1 E.R RATIO	1-10102-3300	1
	HOUSING, REDUCTION; 2.521:1 E.R RATIO	1-10102-3400	1
51	HOUSING, REVERSE	1-01101-3600	1
52	PIPE PLUG, SQ. HD.; 3/8-18 NPT	1-11251-0300	2
53	GASKET, HOUSING TO OIL DAM	1-01102-3600	1

8.17 PINION SHAFT AND RELATED PARTS HY-6900

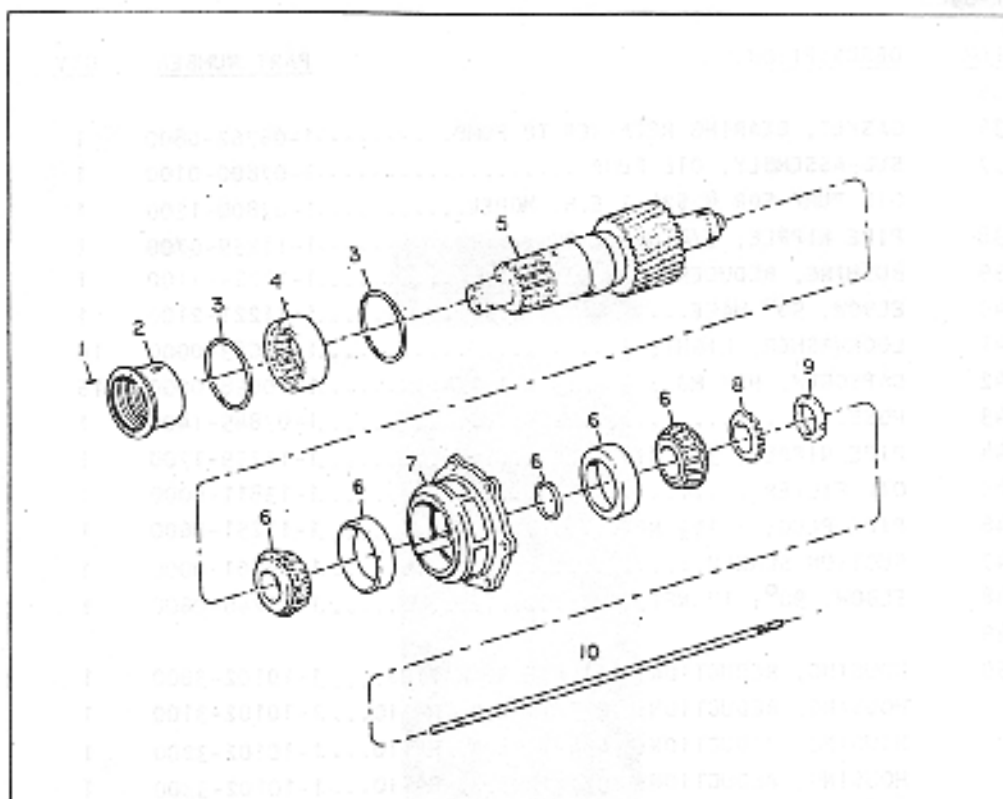


FIG. 52

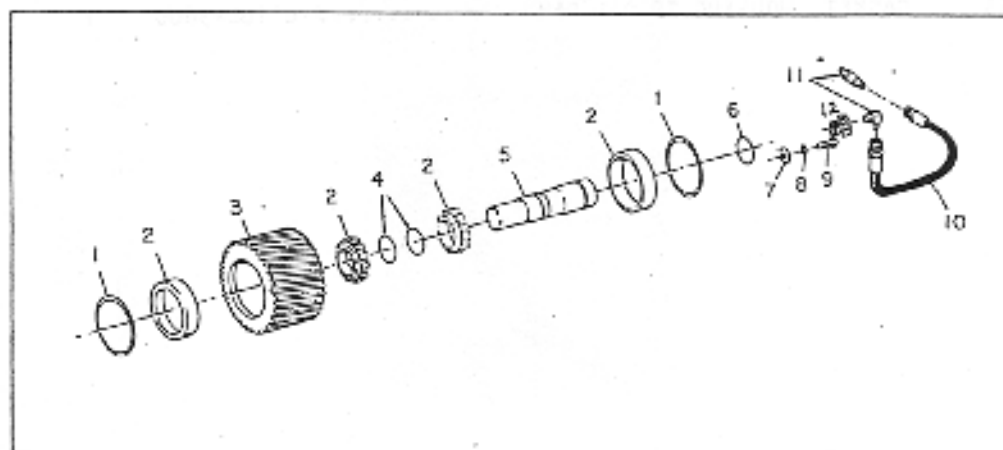


FIG. 53 IDLER GEAR AND RELATED PARTS HY-6900

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PINION SHAFT AND RELATED PARTS
HY-6900

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SPRING PIN	1-12096-1000	3
2	BUSHING ASSEMBLY, REAR COMMUTATOR	1-00248-4200	1
3	SNAP RING	1-07732-0800	2
4	BEARING ROLLER	1-07727-0800	1
5	PINION AND SHAFT ASSEMBLY	(SEE CHART P.54-2)	1
6	BEARING ASSEMBLY (5 PIECES)	1-12958-0000	1
7	RETAINER, BEARING (INCLUDES RING)	1-12959-2600	1
8	LOCKWASHER, BEARING	1-13235-0000	1
9	LOCKNUT, BEARING	1-06903-0800	1
10	SHAFT, PUMP DRIVE	1-07892-0800	1

IDLER GEAR AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	SNAP RING	1-13991-0000	2
2	BEARING, IDLER 9 4 (PIECES)	1-10117-0000	2
3	IDLER; 30 TEETH	1-10107-1000	1
4	SNAP RING	1-12763-0000	2
5	SHAFT, IDLER	1-10105-0200	1
6	O-RING	1-10336-0000	1
7	WROUGHT WASHER	1-10338-0000	1
8	LOCKWASHER, LIGHT ; 5/16"	1-09458-0800	1
9	CAPSCREW, HEX HD ; 5/16-18 X ½"	1-12145-0000	1
10	HOSE ASSEMBLY	1-07875-1000	1
11	MALE ELBOW	1-11237-0300	2
12	PIPE ADAPTER	1-12320-0000	1

HY-6900

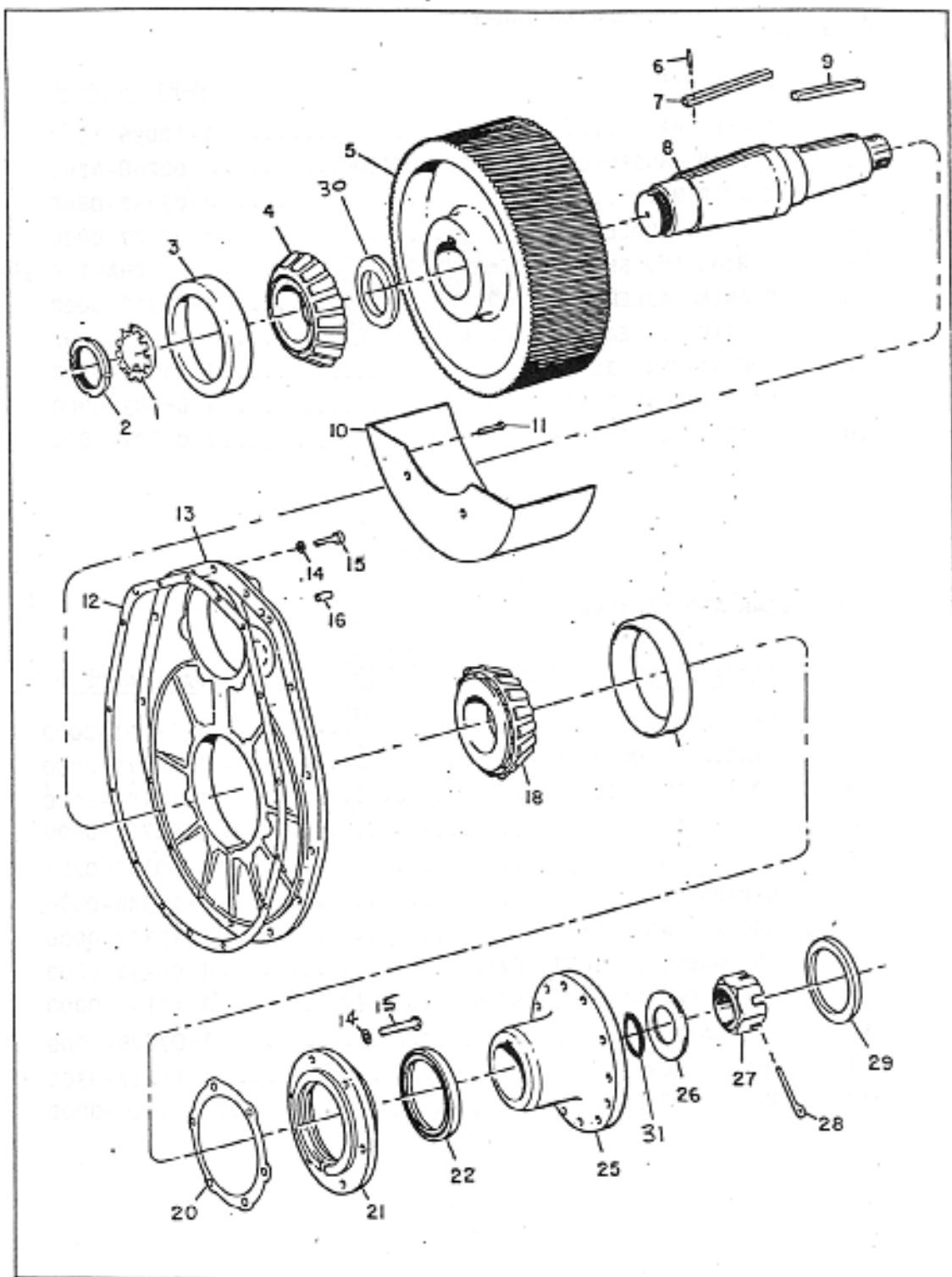


FIG. 54 OUTPUT GEAR AND RELATED PARTS HY-6900

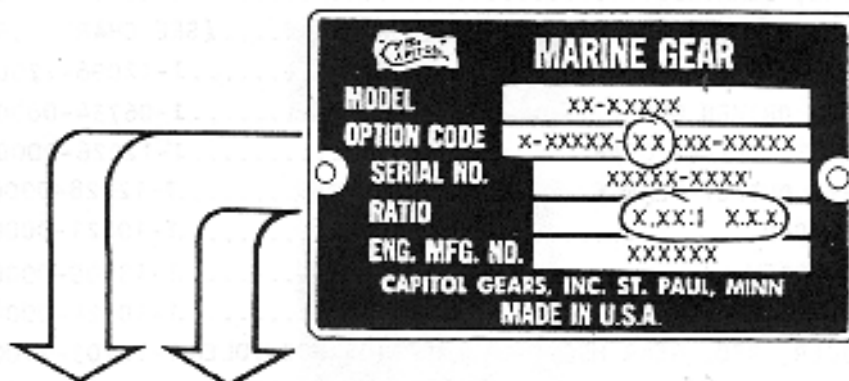
OUTPUT GEAR, COVER AND RELATED PARTS
HY-6900

ITEM	DESCRIPTION	PART NUMBER	QTY
1	LOCKWASHER, BEARING	1-00335-1900	1
2	LOCKNUT, BEARING	1-00335-2100	1
3	CUP, BEARING	1-06725-0900	2
4	CONE, BEARING	1-06725-1000	1
5	GEAR, OUTPUT	(SEE CHART P.54-2)	1
6	SPRING PIN	1-12096-1200	1
7	KEY, DRIVEN GEAR	1-06734-0800	1
8	SHAFT, DRIVEN GEAR	1-12226-0000	1
9	KEY, OUTPUT FLANGE	1-22228-0000	1
10	OIL PAN	1-10121-0000	1
11	CAPSCREW	1-13805-0000	1
12	GASKET, REDUCTION GEAR COVER	1-10124-0000	1
13	COVER, RED. GEAR HSG. – ALL RATIOS NON-IDLER	1-10103-2100	1
	COVER, RED. GEAR HSG. 1.277:1 RATIO W/ IDLER	1-10163-0000	1
	COVER, RED. GEAR HSG. 1.484:1 RATIO W/ IDLER	1-10123-0000	1
	COVER, RED. GEAR HSG. 2.037:1 RATIO W/ IDLER	1-10103-0000	1
	COVER RED. GEAR HSG. 2.521:1 RATIO W/ IDLER	1-10133-0000	1
14	LOCKWASHER, LIGHT ½	1-11083-0000	22
15	CAPSCREW, HEX HD.	1-09141-0800	22
16	DOWEL, COVER TO HSG.	1-12311-0000	2
17			
18	CONE, BEARING	1-06726-1000	1
19			
20	SHIM PACK	1-03755-3400	1
21	BEARING CAP & OIL SEAL RETAINER	1-06718-1100	1
22	OIL SEAL	1-12970-0000	1
23			
24			
25	FLANGE, OUTPUT	1-12227-1000	1
26	WASHER	1-06745-0800	1
27	LOCKNUT	1-06744-0800	1
28	COTTER PIN	1-06746-0800	1
29	RING PILOT	1-01175-0400	1
30	BEARING SPACER	1-12244-0000	1
31	O-RING	1-06731-0800	1

8.19 REDUCTION GEAR SELECTION CHART HY-6900

HOW TO SELECT THE CORRECT PINION AND OUTPUT GEAR FOR YOUR TRANSMISSION:

- A. LOCATE THE NAMEPLATE (ON TOP 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).



OPTION CODE	RATIO	PART NAME	NO. OF TEETH	PART NUMBER
01	1.289:1 AER	PINION GEAR	38 49	1-11870-0000 1-13362-2000
02	1.485:1 AER	PINION GEAR	35 52	1-11872-0000 1-13363-2000
03	2.107:1 AER	PINION GEAR	28 59	1-11876-0000 1-13369-2000
04	2.480 AER	PINION GEAR	25 62	1-11879-0000 1-13372-2000
05	2.954:1 AER	PINION GEAR	22 65	1-11882-0000 1-13374-2000
06	1.277:1 ER	PINION GEAR	36 46	1-11871-0000 1-13358-2000
07	1.484:1 ER	PINION GEAR	33 49	1-11873-0000 1-13360-2000
08	2.037:1 ER	PINION GEAR	27 55	1-11877-0000 1-13365-2000
09	2.521 ER	PINION GEAR	23 58	1-11881-0000 1-13367-2000
10	1.150:1 AER	PINION GEAR	40 46	1-11886-0000 1-13609-2000

