

SERVICE MANUAL

HY 28000 & HP 28000
MARINE TRANSMISSIONS

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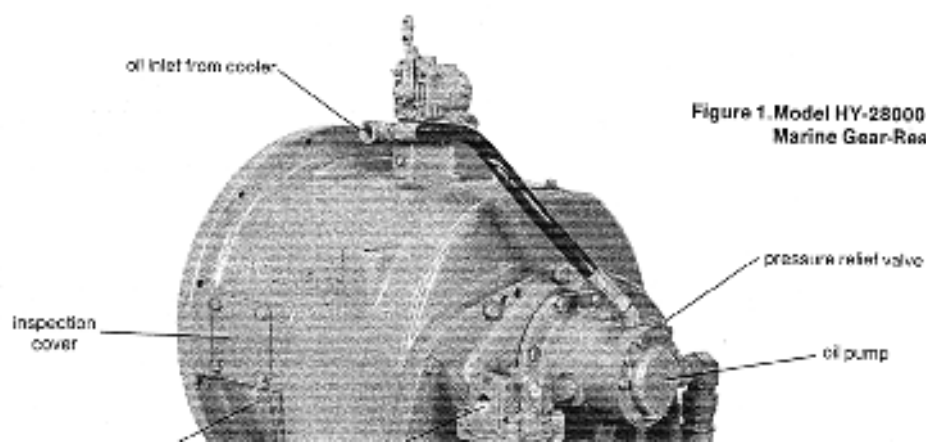


Figure 1. Model HY-28000 and HP-28000
Marine Gear-Rear View

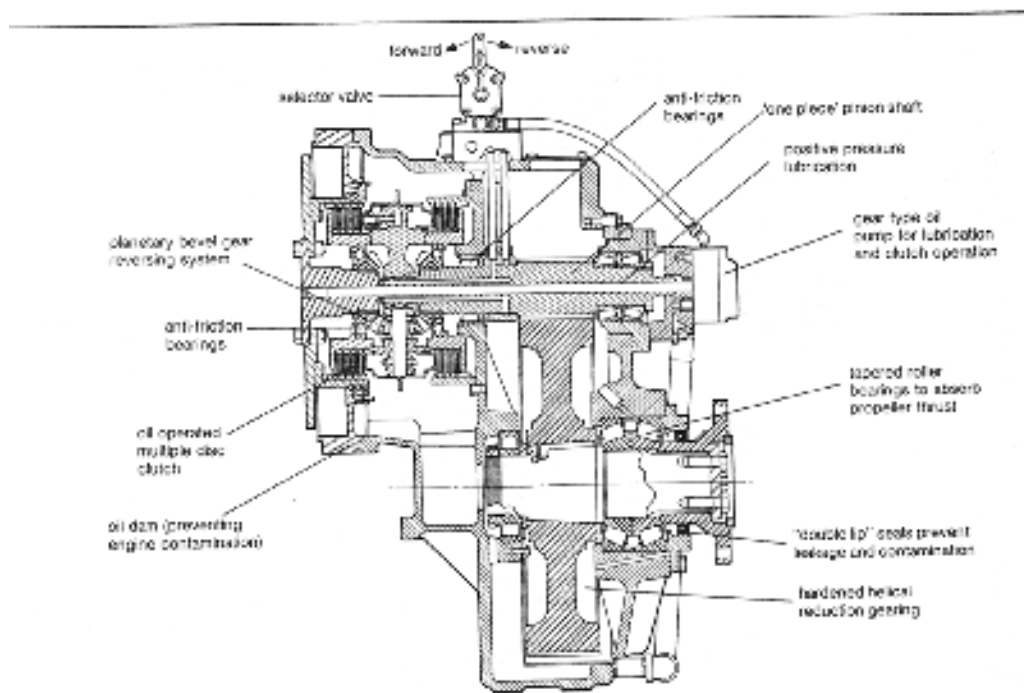


Figure 3. Cross-Section With Special Features

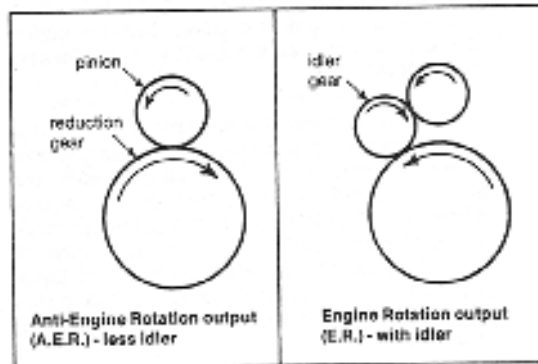
SECTION 1. INTRODUCTION

The function of this manual is to provide information for the installation, operation, maintenance and repair of the "CAPITOL" reverse and reduction marine gear. This manual should be made readily available to all those

cylinders, clutch discs and a planetary bevel gear reversing system. The reduction gear assembly for anti-engine rotation consists of a pinion and driven gear arrangement. The engine rotation unit is created by the addition of an idler gear to the reduction assembly. A selector valve provides shifting to forward, neutral or reverse. An oil

2.1 GENERAL

The Capitol reverse and reduction gears are available in several reduction ratios. The marine gear unit is normally supplied for a right hand engine (when viewed from the front) and an anti-engine rotation output. This results in a right-hand rotation of the propshaft in forward. For twin screws installations, where two right hand engines are used, the port unit is furnished with an idler gear. This produces an engine rotation output, thus the propellers can be turning opposite to each other in outboard direction.



pump supplies oil pressure for clutch engagement, and lubrication for bearings, gears and clutch. The marine gear is direct mounted to the engine flywheel by means of a flywheel adapter and an oil dam keeps the marine gear sump free from engine contamination.

1.2 REDUCTION RATIOS

Various reduction ratios are available depending on the desired difference between engine speed and propeller speed. These ratios are subject to change and are available upon request.

The HP series is of greater capacity than the HY and the clutch pack and pinion shaft diameter vary slightly. However, the two models are similar in design and the function of parts, maintenance procedures, etc. for both units is the same.

1.3 ACCESSORIES

OIL COOLER

Various capacity coolers are available depending on engine horsepower and type of use, and are purchased optionally. However, an oil cooler must be used with a Capitol marine gear unit.

COUPLING KIT

A prop shaft coupling kit, included mounting bolts is available to meet most requirements.

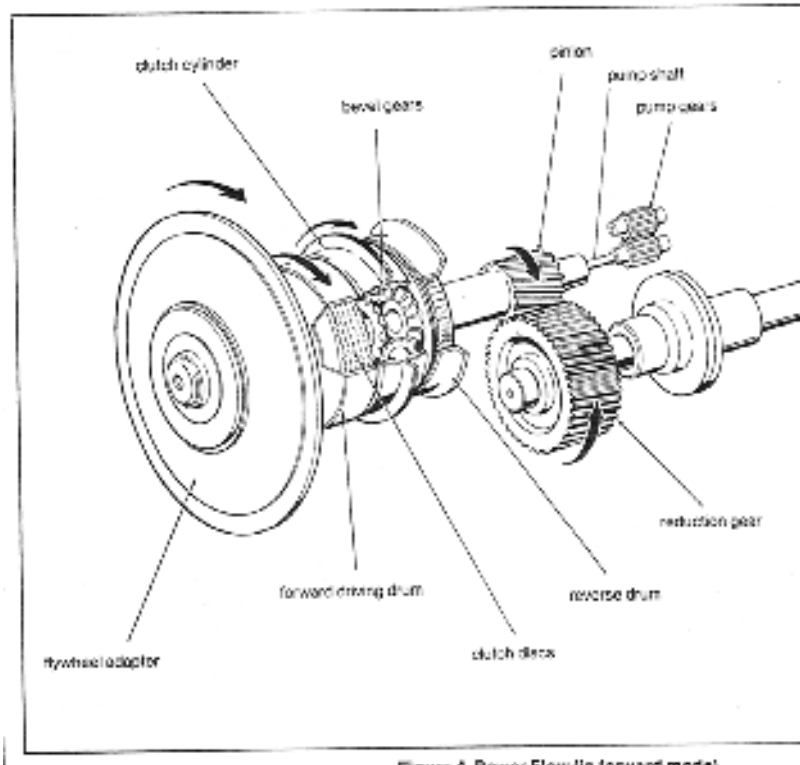


Figure 4 - Drive Flow in forward model

SECTION 2. PRINCIPLES OF OPERATION

The stub shaft, clutch driving drum and forward clutch driving discs always rotate at engine speed. When the forward clutch is activated the clutch pack rotates in engine direction. The pinion, rotating at engine speed, drives the reduction gear. The output speed is determined by the reduction ratio (The number of teeth in the reduction gear compared to the number of teeth in the pinion, e.g. 3:1, 4:1, etc.)

When the reverse clutch is activated, the clutch pack is held stationary to the housing. Power is transferred through the bevel gears, reversing the rotation of the pinion gear, thus causing the reduction gear and output coupling to rotate in reverse mode.

In forward mode the entire clutch pack rotates in fixed conjunction with the engine. In this way there is minimal loss of power from the engine.

2.3 REVERSE GEAR CASE AND CLUTCH ASSEMBLY

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.

The clutch operates as follows:

A. Neutral position: Oil pressure is applied simultaneously to both sides of the piston to keep the cylinder centered and clear of both multiple disc clutches. Springs in the gear case aid in centering the cylinder when returning to neutral from forward or reverse positions.

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 flange ⑥. Consequently no direct torque is applied to gear carrier ⑦ or driven gear and pinion shaft ⑧ & ⑨. Bevel gears may revolve on their own shafts and gear carrier orbits at full engine speed.

FORWARD MODE

At all times, stub shaft ①, forward driving drum ② and driving gear ③ are turning in engine rotation at engine speed.

Forward is achieved when selector valve is shifted to allow oil to pressurize forward half of cylinder ①. 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 reduction gears driving output shaft in forward rotation.

2.3 REVERSE GEAR CASE AND CLUTCH ASSEMBLY

Figure 5. Neutral

Figure 6. Forward

B. Forward position: Oil is exhausted from the rear cylinder while pressure is maintained in the forward cylinder, thus moving the cylinder forward. When the cylinder moves forward, the clutch driven discs (splined to the bevel gear carrier) are clamped against the clutch driving discs splined to the forward clutch driving drum. This provides a transfer of power from the engine to the reduction gears resulting in the forward motion of the boat.

C. Reverse position: Oil is exhausted from the forward cylinder. The pressure in the rear cylinder clamps the rear clutch driven discs against the stationary clutch discs splined to the reverse clutch drum. This locks the entire clutch assembly in a stationary position causing the engine to transmit power to the pinion shaft via the bevel gears, which reverse the rotation of the pinion shaft. Thus- backward motion of the boat is obtained.

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). Holding gear carrier drum allows the bevel gears (6) now rotate on their shafts causing driven gear (7) to turn in opposite engine direction producing reverse output.

pressure oil ■ exhaust oil ■

Figure 8. Clutch Pressure Circuit
—Neutral

Figure 9. Clutch Pressure and Exhaust Circuit
—Forward

Figure 10. Clutch Pressure and Exhaust Circuit
—Reverse

2.4 HYDRAULIC SYSTEM

Oil is supplied to the hydraulic and lubrication systems of the marine gear by means of an oil pump provided with a pressure regulating valve to maintain the correct oil pressure. The pump is driven directly from the engine flywheel by means of a splined shaft. Consequently, oil is being circulated throughout the unit when the engine is running. The oil is continually circulated through a filtering screen and an oil cooler. An oil dam completely separates the marine gear lubrication system from the engine lubricating system.

SECTION 3. INSTALLATION AND OPERATION

3.1 UNCRATING AND HANDLING

Tapped holes have been provided for insertion of lifting hooks to aid in handling of unit. Average weight of HY 28000 is 1800 lbs. The HP-28000 is 1900lbs.

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 PRELIMINARY INSTALLATION

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 and stub shaft be dial indicated to insure trueness.

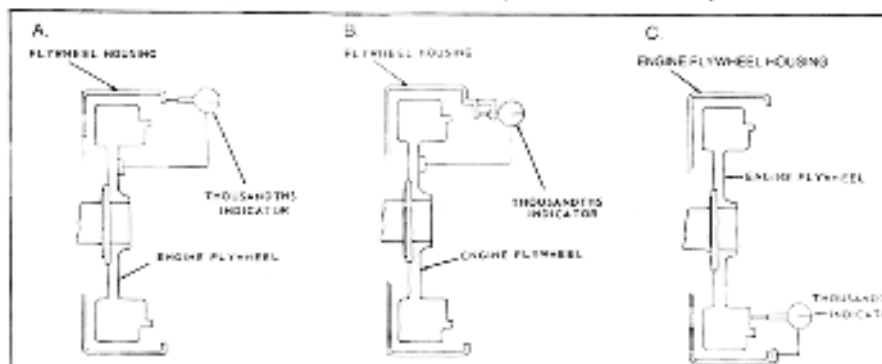


Figure 12. Dial Indicating Engine Flywheel and Flywheel Housing

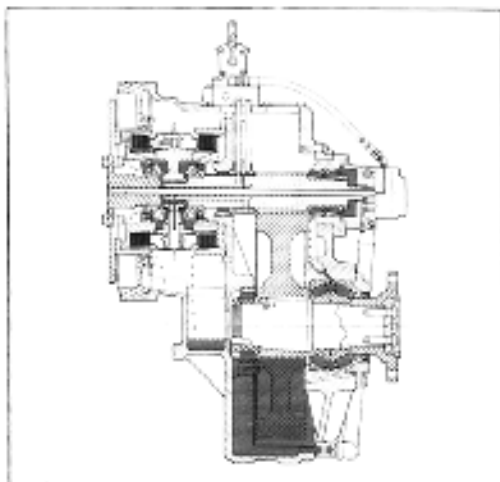


Figure 11. Internal Lubrication Oil Diagram

1. (fig 12A) 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 12A) 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. 12C) 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 total of all readings in steps 1 through 4 must not exceed .007".

5. Separate the clutch driving drum and flywheel drive flange assembly from the clutch assembly.

Remove clutch driving drum from the flywheel drive flange, leave stub shaft attached.

6. Thoroughly clean the drive flange to flywheel mating surface and secure drive flange to flywheel.

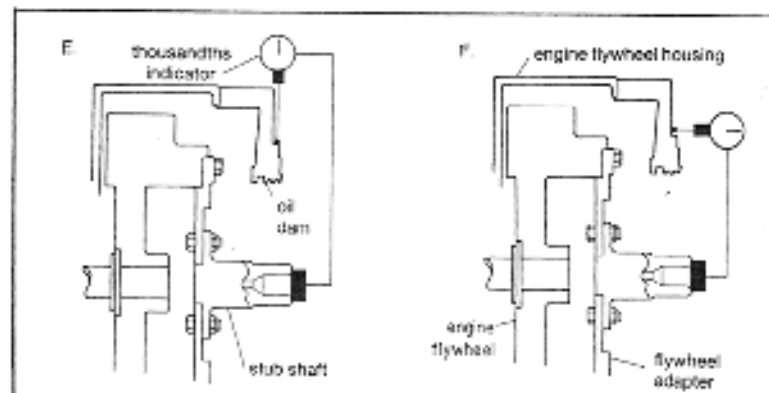


Fig. 13. Dial Indicating Oil Dam and Stub S

7. Bolt on flywheel adapter and stub shaft assembly to engine flywheel.

8. Secure oil dam on engine flywheel housing with 2 cap screws. "Top" mark goes up, or drain slots down.

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

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

The sum total of all readings in steps 9 and 10 must not exceed .007 inch.

11. Check clearance between drive flange O.D and oil dam ID with feeler gauge. Minimum clearance must not be less than .006". Secure with self locking fasteners.

12. If slinger shield is present on unit, remove slinger shield.

13. Install clutch driving drum on flywheel adapter sealing with #2 Permatex.

14. Reassemble slinger shield, if present, to oil dam, replace and tighten cap screws. Secure cap screws with lockwire.

15. Place subassembly consisting of clutch and gear carrier in position on splines of driving stub shaft. Note: The forward pack contains the greater number of discs and it goes toward the engine. Also the forward end flange is stamped "this side toward engine".

16. Remove the side inspection covers to facilitate installation.

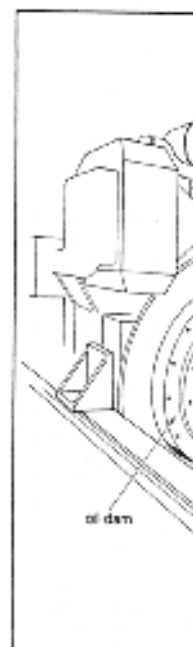


Fig. 14.

3.3 INSTALLATION OF MARINE GEAR

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 clutch drum properly so that teeth are not damaged.

NOTE:

Use screwdriver through side inspection hole and move disc teeth to align with reverse drum

2. Secure main housing to oil dam housing. Tighten cap screws to 42 foot-pounds torque (HY units) and 30 foot-pounds torque (HP units)

Check clutch end float:

- a) insert screwdriver through side inspection hole and pry clutch fore and aft. End float should be 1/6" to 3/32".
- b) Replace gasket and inspection covers.

3. Turn reduction gear over for several revolutions with bar making sure gear is free to turn.

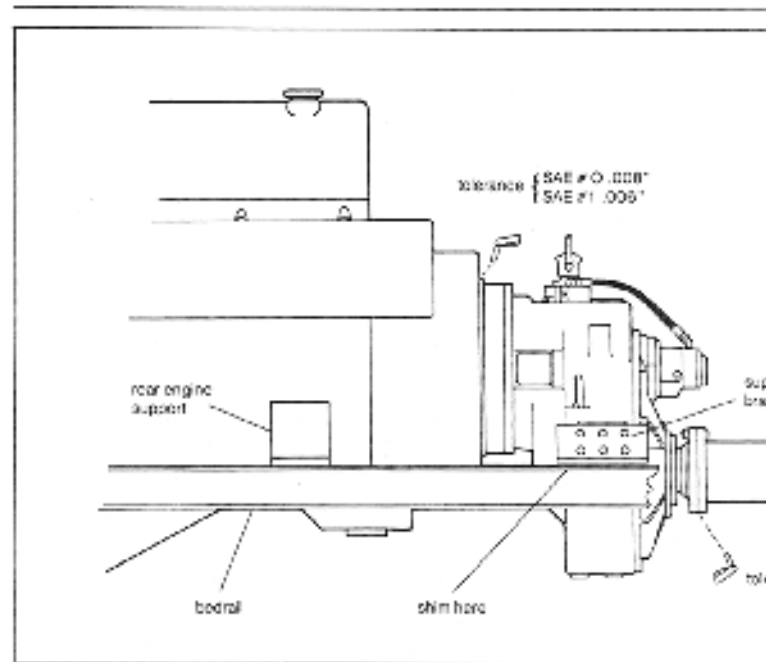


Fig. 15. Alignment of the Engine and the Marine Gear

3.4 ALIGNMENT

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 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.

3.5 WATER PIPING

To assure proper cooling of Capitol's marine 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.

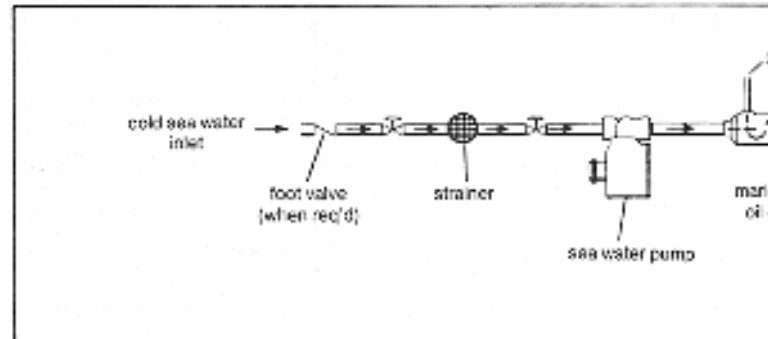


Fig. 16. Separate pump system

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 no 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 gear housing to engine housing bolts and check with feeler gauge. Maximum variation for SAE #0 housing .008"; for SAE #1 housing .006".

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

NOTE:

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

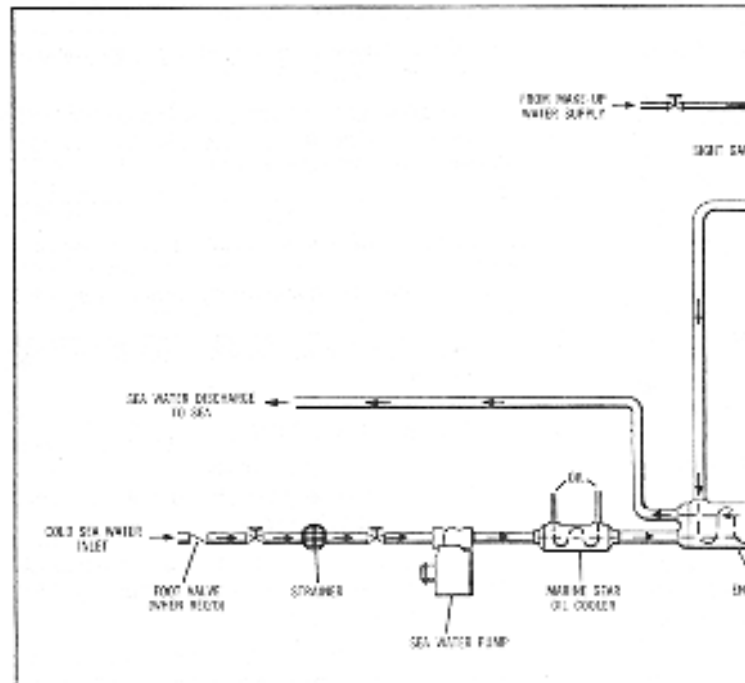


Fig. 17. Heat exchange system

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

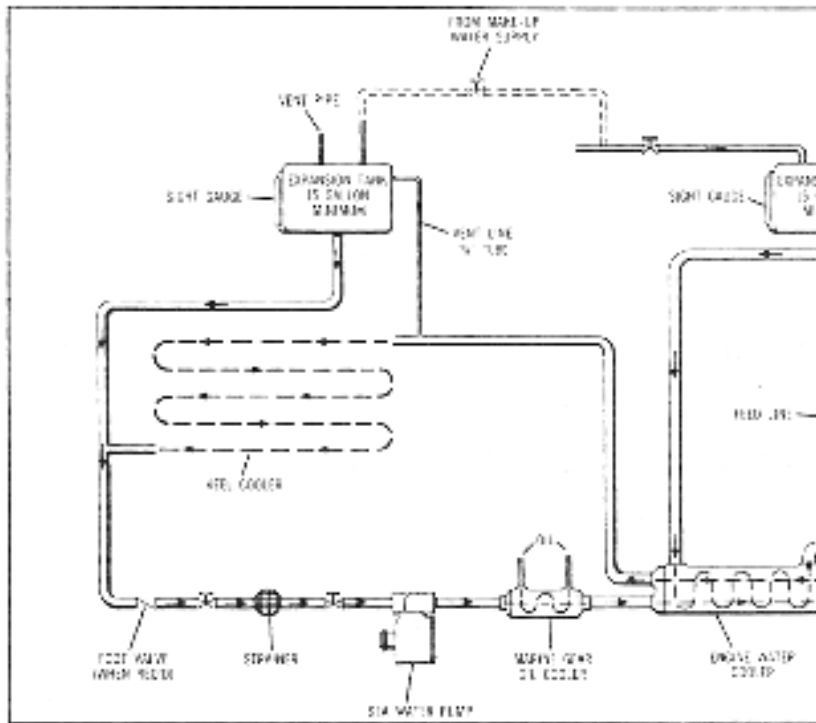


Fig. 18. Keel cooler system

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" steel tubing or 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.

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

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.

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, opposite.)

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.

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

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 mins 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 breaks should be installed (as an alternative an auxiliary lube system may be installed).

SECTION 4. PREVENTATIVE MAINTENANCE

Oil capacity

HY and HP 28000:

Approximately 30 to 32 quarts.

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 all 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. 20 p.17

Oil temperature

Operating oil temperature range is 160°F (71°C) at control valve, 160° to 180° (82°C).

Every 2000 hours	-Check gear backlash -Check water tubes in cooler	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>																																													
At engine overhaul	-Inspect clutch and all gearing and replace as necessary	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>																																													
Frequently	-Check all oil lines and connections -Check all external components -Check all mounting bolts -Check alignment	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>																																													

SECTION 5. TROUBLE SHOOTING

5.1 TROUBLE SHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
A. Low oil pressure (at full operating speed And temperature).	1. Low oil level	Inspect gaskets, seals, hoses & fittings for leakage.
	2. Clogged suction screen	Remove suction screen and clean with a good grade solvent or diesel fuel.
	3. Clogged filter element	Replace element
	4. Dirt or sludge in marine gear	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 approx. 5-7 min. Shut down engine and drain gearbox thoroughly. Refill gear with proper oil and run for approx. 25 to 50 hours. Drain gearbox and refill with new oil. This will remove any residual solvent.

	5. Worn or incorrectly adjusted pump assembly	Refer to oil pump section (page 16) or fig. 20 p.17
	6. Oil too hot	Check heat exchanger system for clogged oil cooler or hoses.
	7. Worn commutator bushings	See wear limits chart (p.21)
	8. Incorrect lubricant	See lube chart
	9. Scratched clutch cylinders or hard 'O' rings in clutch cylinders	replace as necessary
<hr/>		
B. High oil pressure (at full operating speed and temperature).	1. Incorrectly adjusted pump assembly	Refer to figure 20.
	2. Inoperable relief plunger	Refer to p.16
	3. Incorrect oil	See lube chart
	4. Oil too cold	Check heat exchanger system
<hr/>		
C. Overheating	1. Insufficient oil cooler Capacity	Install adequate oil cooler
	2. Insufficient flow of cooling water	Increase water line size
	3. Clutch slipping	Refer to symptom A
	4. Water temperature too high at cooler	Decrease water temperature to cooler or relocate heat exchanger in cooling system
<hr/>		
D. Excessive noise in Marine gear	1. Bearings worn or broken	Inspect bearings for scored races, broken roller, flat spots...
	2. Gears worn or broken	Inspect gears and measure backlash (refer to replacement wear limits chart).
	3. Noise in forward only	Reverse position may be mistakenly used for forward. Selector valve lever must point forward when boat is in forward motion.
	4.Noise in reverse only	This is normal because more gears are in operation in reverse mode
<hr/>		

E. Noisy Pump	1. Dirt or sludge in oil	Remove oil pump and hoses. Clean thoroughly and reinstall
	2. Clogged hoses	Clean and replace as required
	3. Pump cavitation	Inspect suction hoses for leaks. Oil level may be too low.
	4. Defective oil pump assembly	Refer to repair and overhaul selection
F. Clutch does not release	1. Improper oil in sump	Refer to lube chart
	2. Clutch disc warped	Replace as necessary
	3. Forward and reverse clutch cylinders dirty or distorted	clean or replace as necessary
	4. Rear commutator bushing is worn	Replace as necessary see wear limits
	5. Clutch discs fused due to slippage and overheating	replace as necessary
G. Clutch slippage	1. Low oil pressure	see symptom A
	2. Oil temperature too high	Temperature should be 160F (71C), selector valve, 160-180 at sump. Check heat exchanger system.
	3. Worn clutch discs	Replace as necessary
	4. Improper oil	See lube chart
H. Clutch burned out	1. Low oil pressure	1. See symptom A
	2. Clutch is shifted at other than engine speed	install interlock shift control
	3. Marine gear misaligned	Check alignment as described in installation section pg.7.
	4. Excessive heat	Check cooling system
I. No neutral	1. Warped clutch discs	replace as necessary
	2. Scored clutch cylinders	replace as necessary
	3. Damaged seal rings	Replace all seal rings
	4. Worn or damaged	refer to repair and overhaul

	commutator bushing	section. See wear limits
	5. Worn control valve	Replace if necessary. Note: Control valve is the least likely source of trouble.
J. Delay in clutch engagement	1. Cylinder timing screw out Of adjustment	remove dome nut and adjust screw (counter-clockwise) to speed up reaction
K. Clutch engages too fast	1. Cylinder timing screw out Of adjustment	Remove dome nut and adjust screw in (clockwise) to delay reaction

SECTION 6. REPAIR OF EXTERNAL SUBASSEMBLIES

6.1 SAFETY NOTICE

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°

6.2 OIL PUMP

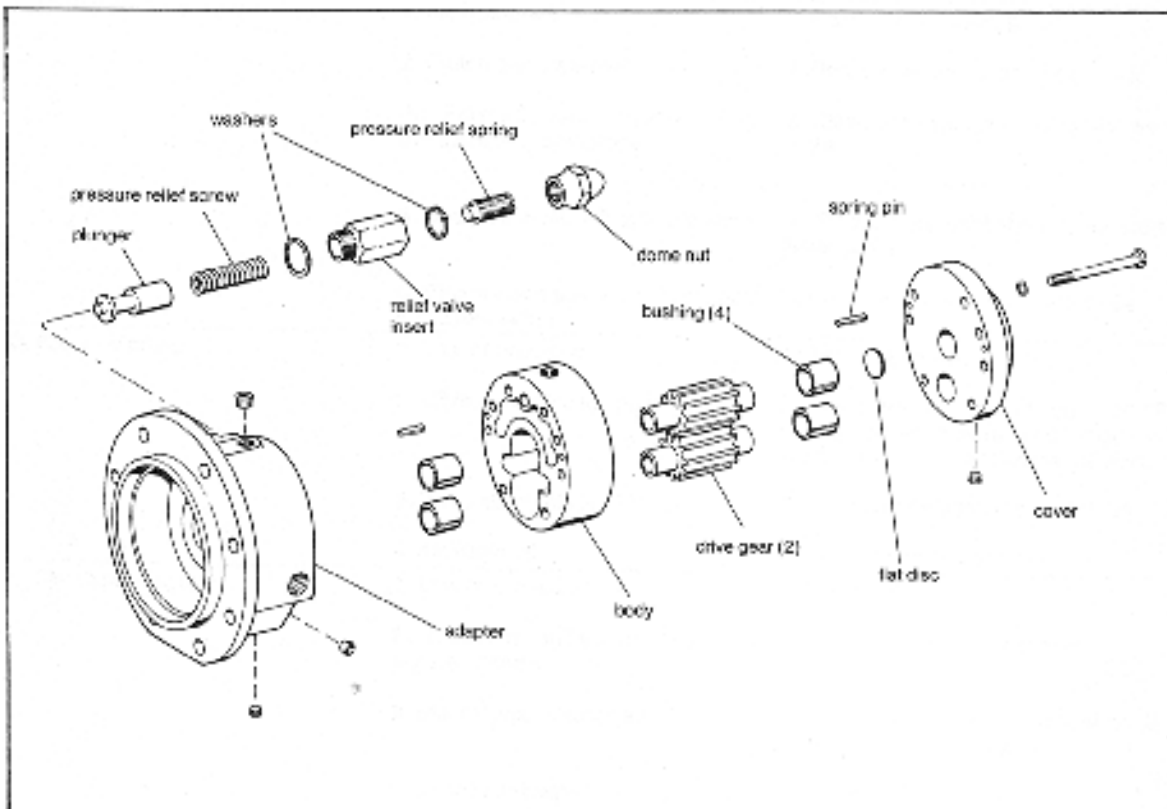


Fig. 19. Oil Pump Assembly

6.2 OIL PUMP

A. RELIEF PLUNGER

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 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

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

7. Apply washer and install relief valve insert with pressure relief screw. Tighten insert, do not tighten relief screw.

8. 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 cap screws and hoses.

2. Remove cap screws and lock washers 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 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, both surfaces can be repaired by grinding smooth (.030" max cut).

4. Inspect bushings (2) in cover for wear, out of round condition or burrs. If bushings are damaged or if expansion plugs (2) are worn or loose, replace as necessary or order cover with flat discs and finish reamed bushings installed. (REFER TO WEAR LIMITS)

5. Inspect bushings (2) in adapter for wear, out of round condition or burrs. If bushings are damaged, replace as necessary, and ream to size. (REFER TO WEAR LIMITS).

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 cap screws 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 six cap screws to 16 foot-pounds torque.

8. Remove any excess permatex from seams with solvent.

last in bore of adapter. Check to make sure plunger slides free.

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

17. Apply a thin coat of lubriplate, Vaseline or grease to hold new gasket in place on pump adapter.

18. Install oil pump (with new gasket) and oil filter. Secure in position with lock washers and cap screws. Tighten to 42 foot-pounds torque.

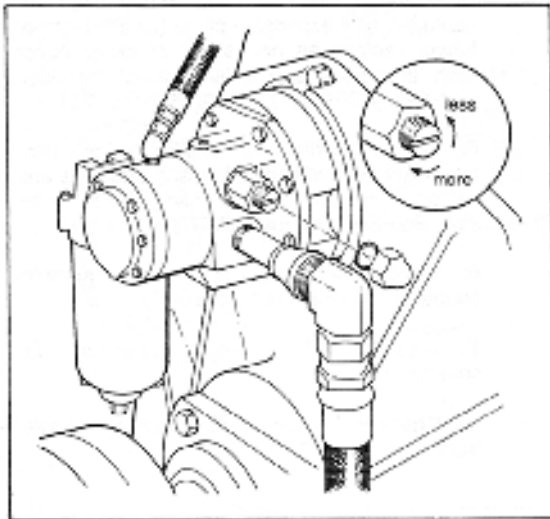


Fig. 20. Adjustment of Oil Pressure

Correct operating
oil pressure:
200-210 PSI

9. Recheck for ease of operation

10. Generously lubricate relief plunger with Vaseline or lubriplate and position cup end

6.3 SELECTOR VALVE

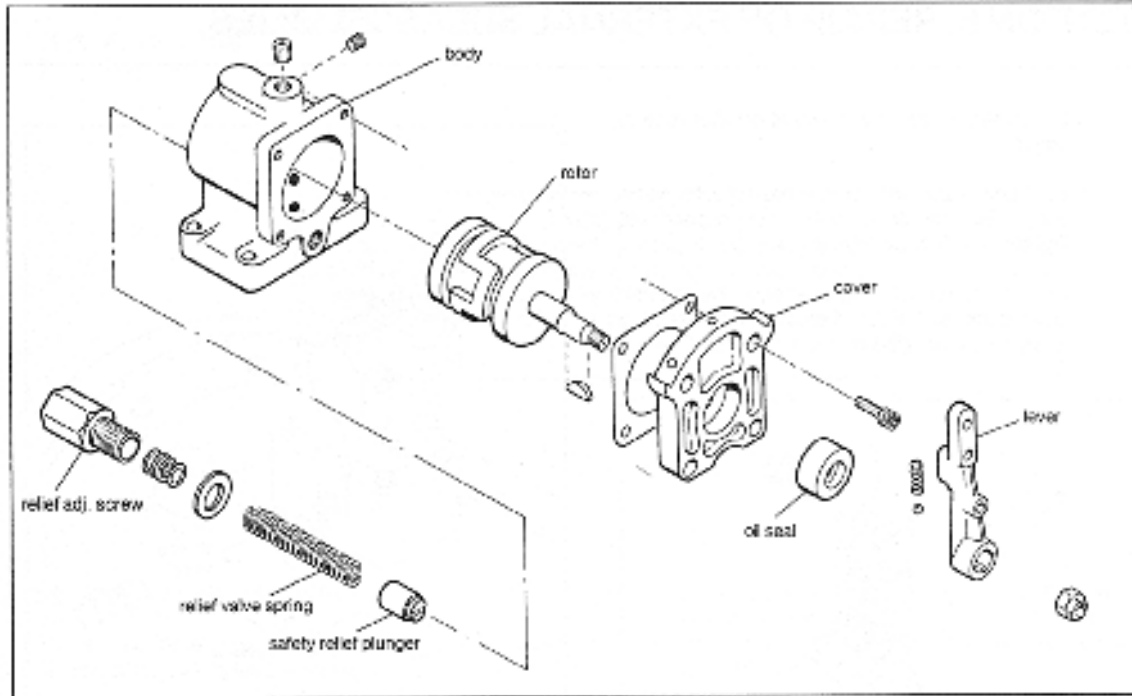


Fig. 21. Selector Valve Assembly

A.REMOVAL

1. Disconnect hoses and control linkage from lever on selector valve
2. Remove cap screws and lock washers and lift off selector valve and base plate being very careful to keep gaskets in proper configuration for replacement. (They may be fixed in position with wire etc.)

B. DISASSEMBLY

1. Remove lock nut from rotor and note position of keyways on level 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 oil and clean all oil ports. Blow dry with compressed air.

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

3. Inspect oil seals 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 lock nut.
5. Position new cover gasket on pilot face of cover.
6. Install rotor with cover into selector valve body. Secure cover with four cap screws. Tighten to 4 foot-pounds torque.
7. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on main housing.

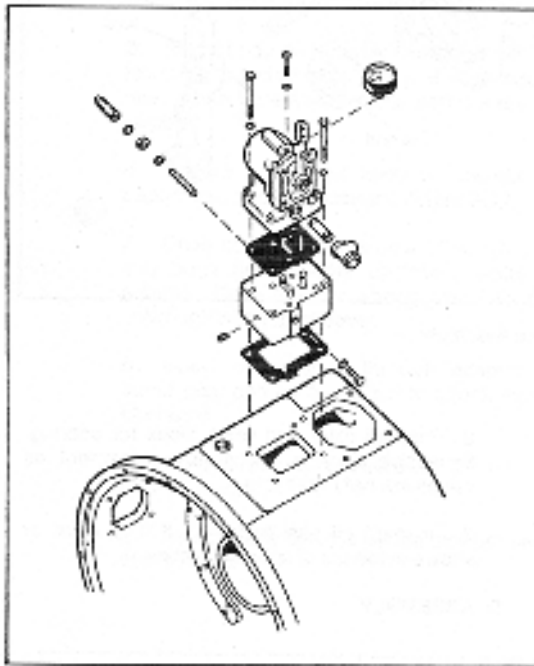


Fig. 22. Installation of Selector Valve

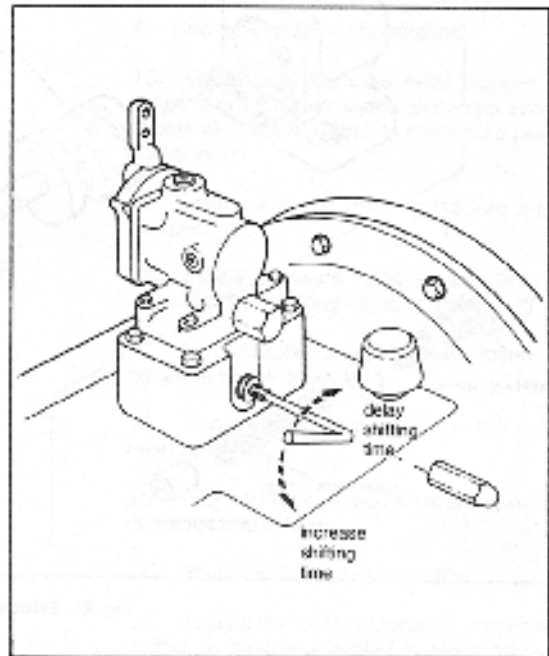


Fig. 23. Clutch Cylinder Timing Adjustment

SECTION 7. REPAIR OF INTERNAL SUBASSEMBLIES

7.1 SAFETY NOTICE

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°.

7.2 REMOVAL OF MARINE GEAR

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

2. Disconnect all oil lines from the oil pump and control valve, and remove water lines to cooler.

3. Disconnect control linkage from lever on selector valve.

4. Remove all inspection covers

5. 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.

6. 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.

7. Remove oil pump with filter, 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.

8. Screw two ¾"-10 eye bolts into lifting holes on top of main housing and connect hoist so it supports housing. Use hoist guide (special tool no. 1-90019-0000).

9. Remove cap screws and lock washers holding main housing of marine unit to oil dam.

10. 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

11. Remove clutch from forward driving drum

12. Remove forward clutch driving drum

NOTE:

In most cases removal of oil dam and stub shaft is not necessary unless further inspection of stub shaft and labyrinth seal indicate damage.

7.3 TABLE: REPLACEMENT WEAR LIMITS

7.4 CLUTCH AND GEAR REPAIR

A) DISASSEMBLY

1. Remove socket head cap screws, 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 cap screws from outer perimeter of cylinders.

5. Separate and remove cylinders

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

7. Remove cap screws and locknuts securing pinion shafts in bevel gear carrier and remove bevel pinions with puller (see fig 24.)

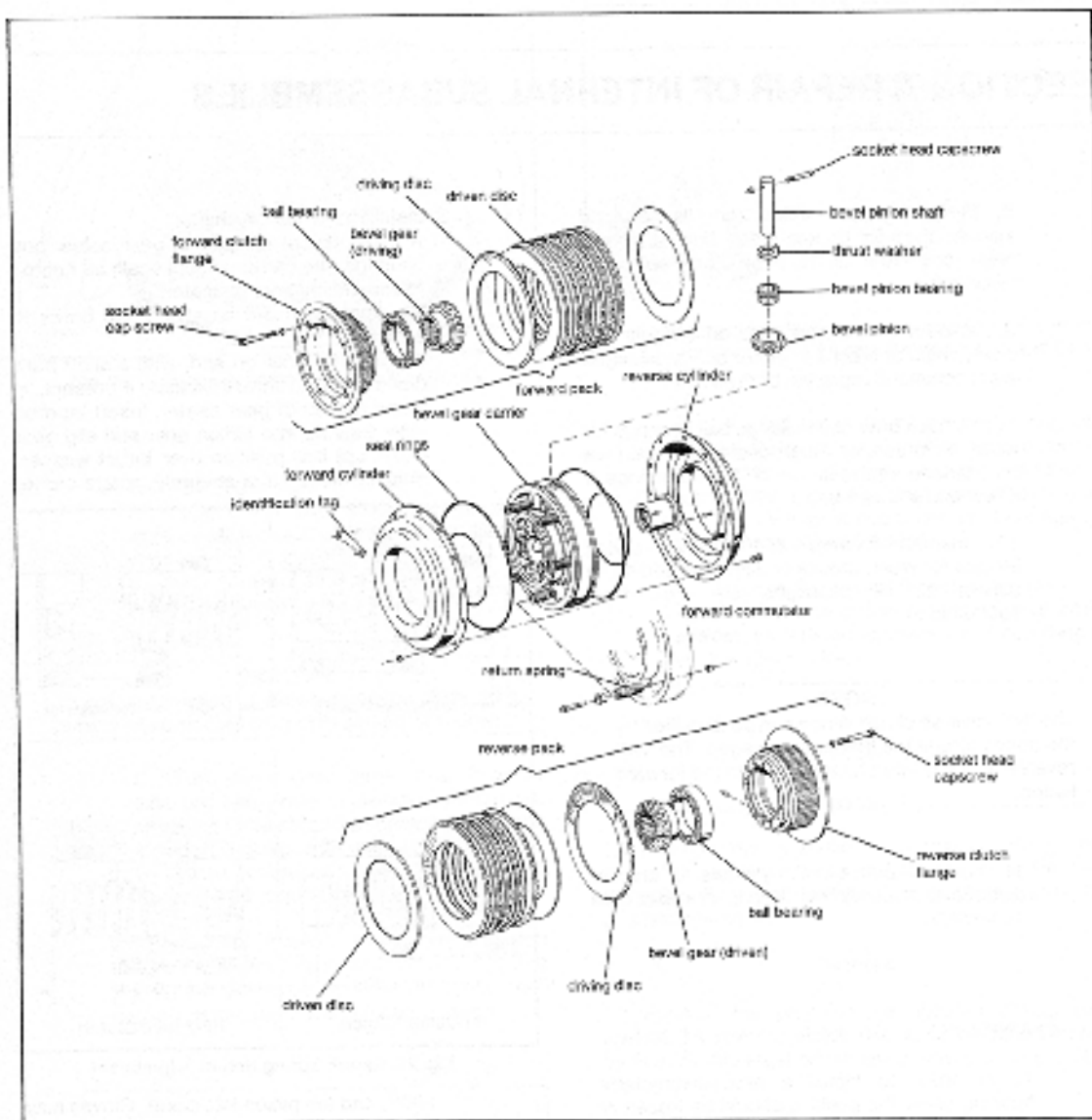


Fig. 24. Clutch and Gear Carrier Assembly ('HY' clutch shown)

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 bushings for chips, heat scores, scratches, distortion or wear (see wear limits). Repair or replace as necessary.
7. Inspect all hardware and springs for wear or distortion (see wear limits). Repair or replace as necessary.

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

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

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

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

NOTE:

The 'HY' reverse clutch flange can be identified by the spring pins in the three oil passages. The 'HP' reverse flange is interchangeable with the forward flange.

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

C) ASSEMBLY

1. In order to install a new commutator bushing either the bushing should be frozen or the bevel gear carrier heated. This will allow ease and 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 (275°F, 135°C maximum).

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

3. 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. Stand carrier on end, with a shaft bore down, position thrust washer, if present, in round recess of gear carrier. Insert tapered roller bearing into pinion gear and slip gear (teeth up) into position over thrust washer. Holding these parts securely rotate carrier 180 deg. And tap pinion into place. Gloves may be required since gear carrier is hot.

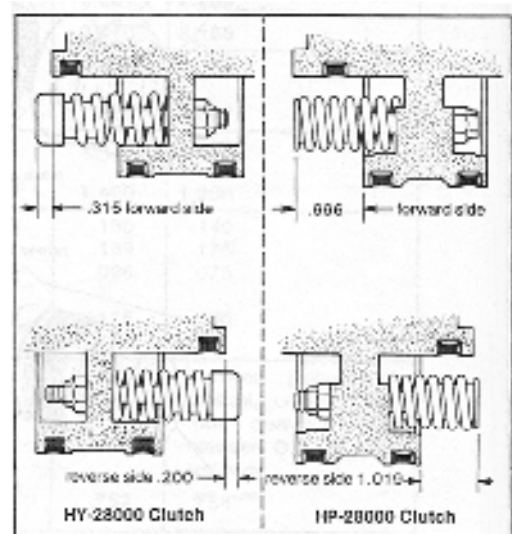


Fig. 25. Return Spring Height Adjustment

D. Repeat steps B and C for each of the remaining pinion shafts.

E. Secure shafts with cap screws and locknuts.

4. Replacement of return springs and retainers:

A. Insert return spring retainers into return springs and secure in gear carrier using cap screws alternating from forward to reverse side of bevel gear carrier. Tighten cap screws until top of spring retainer protrudes the specified distance from face of bevel gear carrier hub. (see fig.25)

B. Hold capscrew in place with 3/16" allen wrench, install locknuts and tighten.

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

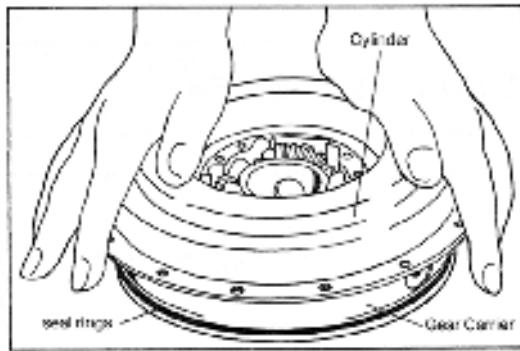


Fig. 26. Pressing Cylinder on Bevel Gear Carrier

6. To install cylinders:

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

B. With forward side of gear carrier up, press cylinder on by hand. (See fig, 26).

CAUTION:

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

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 cap screws and locknuts and tighten to 15-foot pounds torque.

7. Press ball bearing into forward clutch flange. Press bevel gear into ball bearing. See fig.27. In 'HP' units be sure to replace snap ring in innermost groove of forward flange.

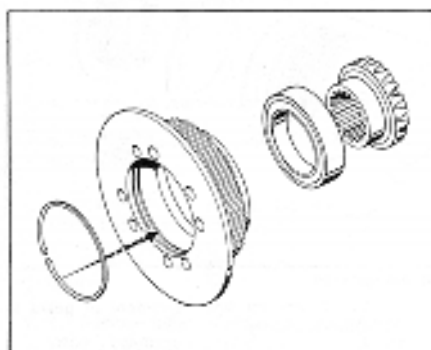


Fig. 27. Forward Clutch Flange, Roller Bearing and Bevel Gear.

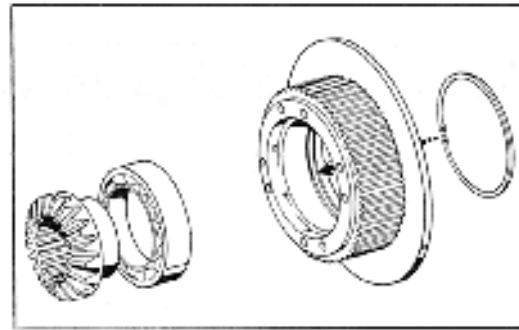


Fig. 28. Reverse Clutch Flange, Roller Bearing and Bevel Gear.

8. Likewise press the other ball bearing into reverse clutch flange. On HP clutch be sure to install snap ring in outermost groove of reverse flange (see fig.28). Then press bevel gear into ball bearing. Check that ball bearings on both flanges are well sealed.

9. Arrange the driving friction discs (external tooth) with the steel driven discs (internal tooth) against the forward and reverse clutch flanges as described below:

'HP' 28000 Clutch

Forward

1. Position the graphitic impregnated driving disc against the face of the forward clutch flange. Followed alternately by six (6) thin steel driven discs and six (6) graphitic driving discs.

Reverse

2. Position the graphitic impregnated driving disc against the reverse clutch flange, followed alternately by five (5) thin steel driven discs and four (4) graphitic driving discs.

'HY' 28000 Clutch

Forward

1. Position the graphitic impregnated driving disc against the face of the forward clutch flange. Followed alternately by seven (7) thin steel driven discs and six (6) graphitic driving disc.

Reverse

2. Position the graphitic impregnated driving disc against the face of the reverse clutch flange followed alternately by five (5) thin steel driven discs and five (5) graphitic driving discs, followed by one (1) thick steel driven disc.

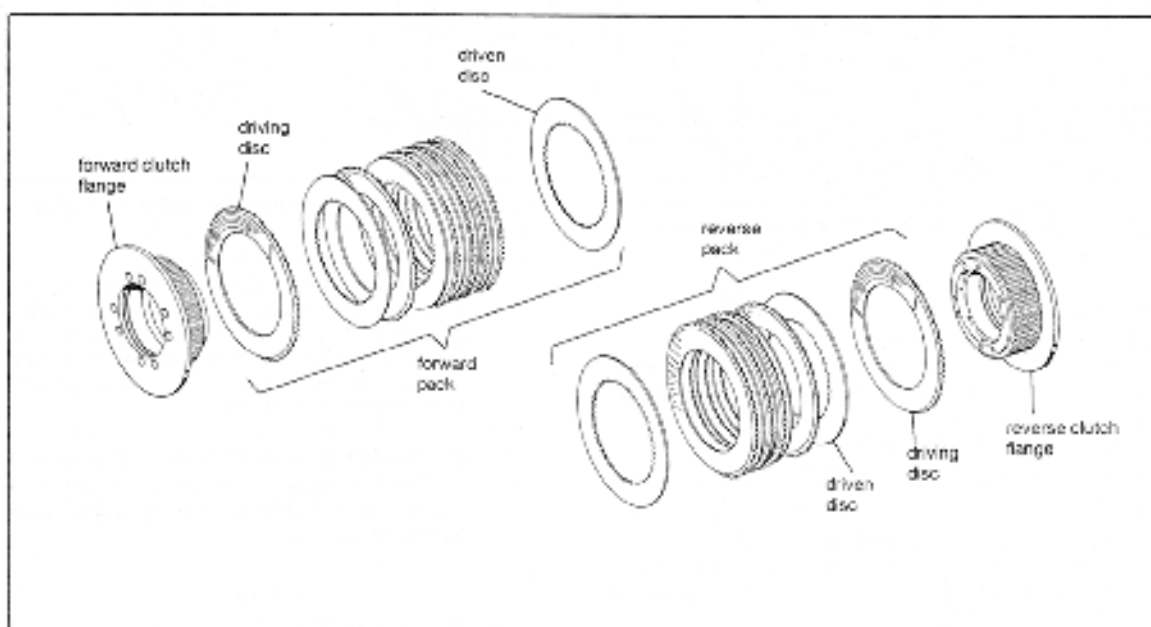


Fig. 29. "HP" Clutch Disc Configuration

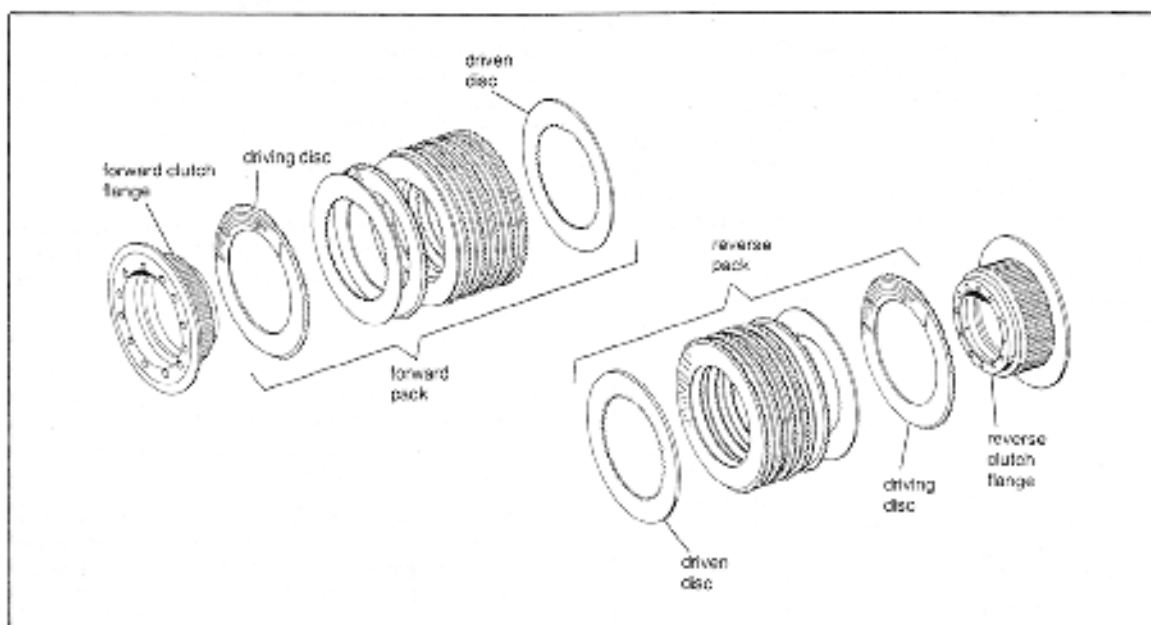


Fig. 30. "HY" Clutch Disc Configuration

10. Position reverse clutch flange and reverse clutch discs on reverse side of gear carrier (flange on bushing is on reverse side). Position forward clutch flange with forward clutch discs and fasten both flanges to gear carrier. Tighten cap screws to 28 foot pounds torque.

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

Clutch is now ready for installation

7.5 REDUCTION GEARBOX

A. Output Coupling

1. Remove 4 hex head cap screws from retainer plate and remove retainer plate.
2. Inspect o-ring and replace if necessary
3. With suitable puller, pull drive coupling from output shaft. See fig 31.

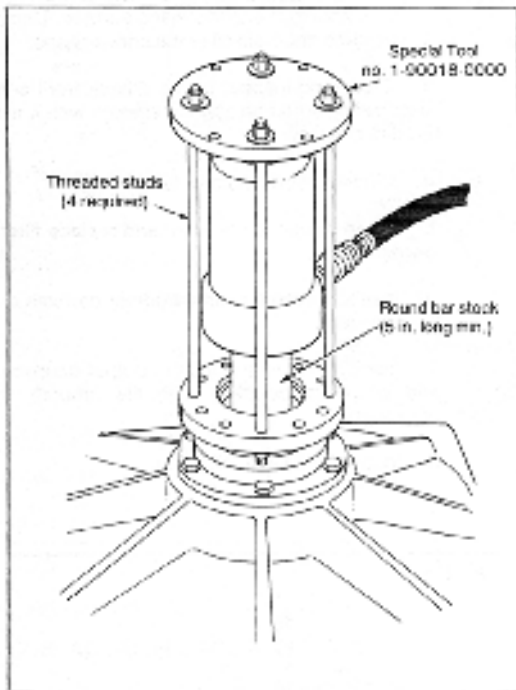


Fig. 31. Pulling Coupling from Output Shaft.

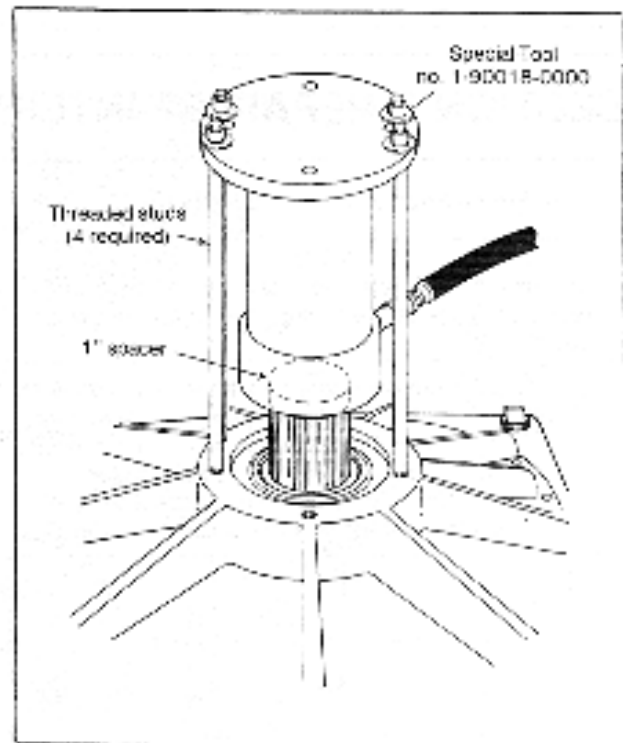


Fig. 32. Pulling Cover from Housing.

4. Inspect oil seal and replace if necessary
5. Tip unit to rest on bell end and remove bearing retainer
6. Remove cap screws and pull main housing cover from housing. (see fig 32)
7. Remove idler from housing (idler units only).
8. Remove output shaft from main housing. Inspect bearings and replace if necessary and inspect gear teeth for excessive wear (refer to wear limits chart).

B. Pinion shaft and related parts

NOTE:

The pinion shaft assembly can be removed and replaced without removing the main housing cover.

- 1.a. Release bearing locknut on pinion shaft by bending or punching tang of lockwasher.
- b. Unscrew bearing locknut with spanner wrench and remove keyed flat washer.
- c. With a suitable press, extract the pinion shaft out of the bearing retainer. See fig 33.

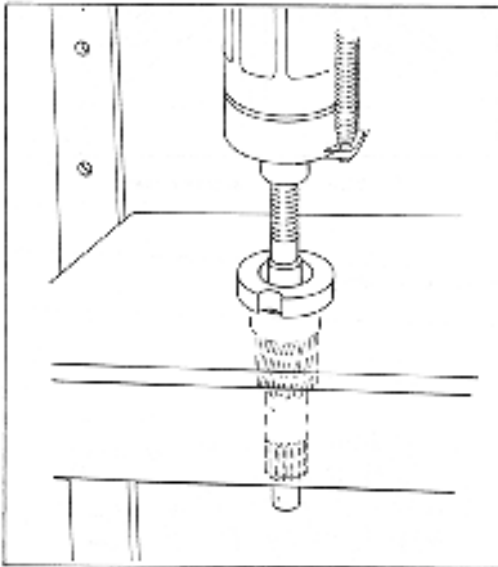


Fig. 33. Extracting Pinion Shaft

2. If rear pinion bearings are believed to be damaged or worn remove bearings and replace as necessary. See fig 34.

CAUTION: Because of close tolerance between pinion and inner cone of bearing, Puller must be applied to bearing cage which will destroy the bearing.

NOTE:

The bearing spacer, two tapered cones and the two tapered cups constitutes a matched set: if any one part is damaged the entire set must be replaced

3. Inspect pinion teeth and front and rear commutator surfaces for excessive wear (see wear limits chart).

IF CHANGING RATIOS: Order new output gear, plus the following: Pinion shaft, rear pinion bearing set, bearing container (snap-ring installed), bearing locknut and bearing lockwasher.

C. 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 surfaces. Use a flat file to deburr in all of the above cases.
3. Clean and inspect cover. Check front and rear mating surfaces and file smooth with a flat file if necessary.
4. Clean rear commutator tubes
5. Clean oil suction screen, and replace filter element
6. Inspect reverse clutch drum for grooves or excess wear.
7. Inspect mating surfaces of output coupling and propeller coupling and file smooth if necessary.
8. Inspect and clean pilot ring.

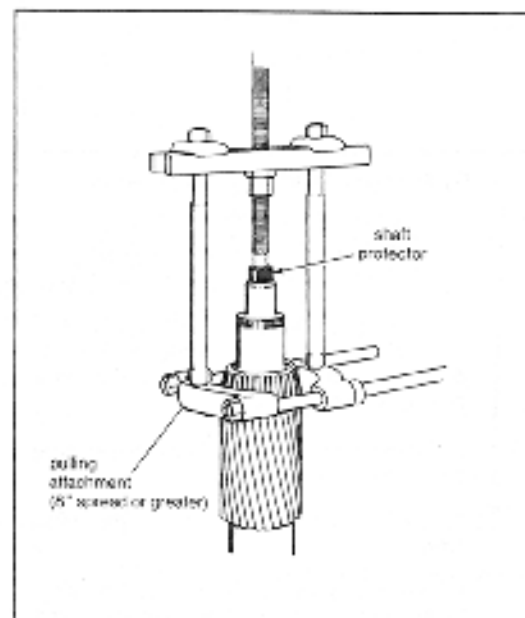


Fig. 34. Pulling Rear Pinion Shaft Bearing.

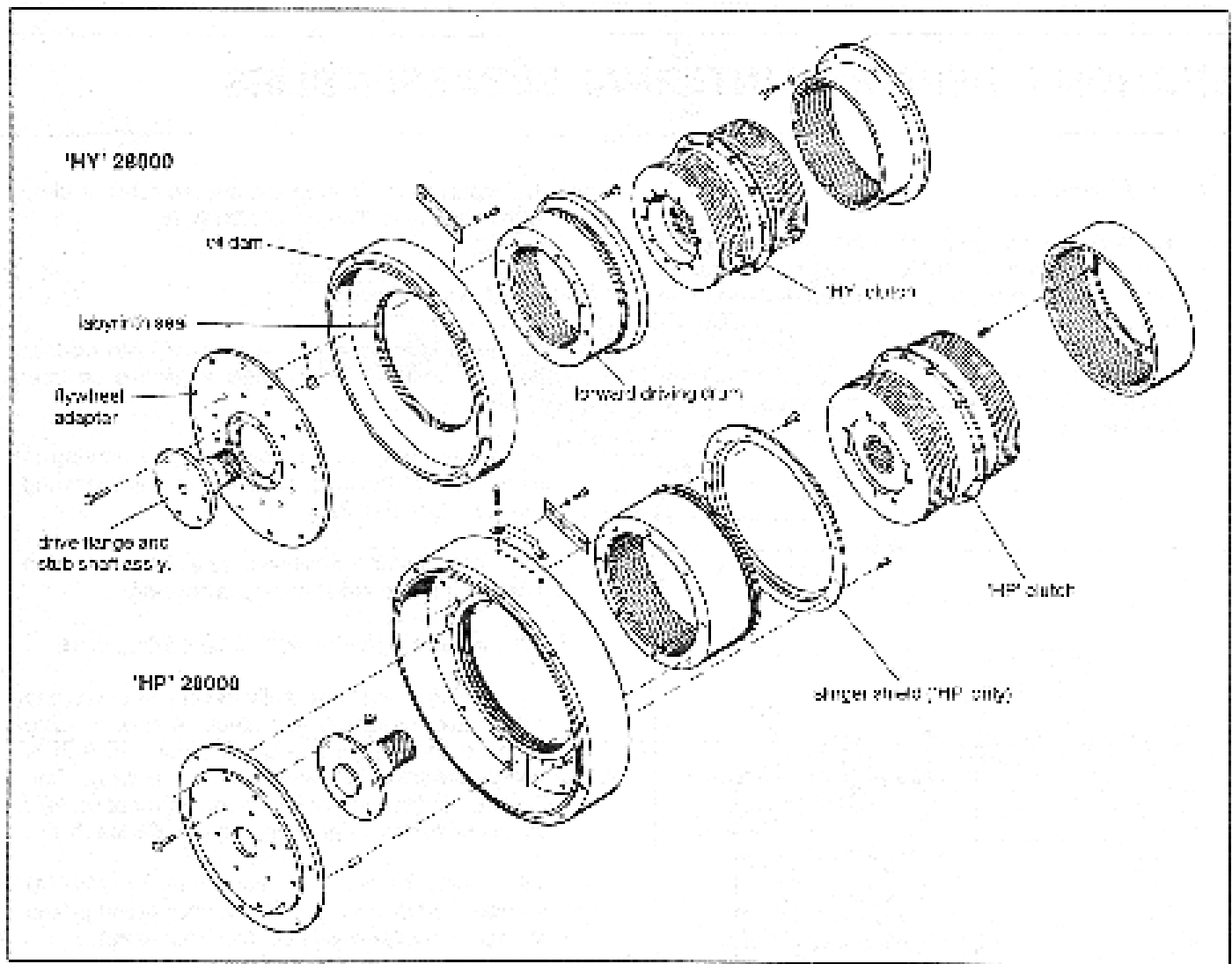


Fig. 35. Adapter Group and Clutch

7.6 ADAPTER GROUP

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

2. Remove oil dam and inspect labyrinth oil seal on inside diameter. Repair or replace as necessary (wear or damage to seal indicates misalignment-check further!) (see fig 35).

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

7.7 RE ASSEMBLY

1. With output gear on shaft, install bearing spacer, forward output bearing, bearing lockwasher and bearing locknut on threaded end of shaft.

2. Install first bearing cup (A) into output bore of housing cover, making sure cup seats in bore. See fig 36.

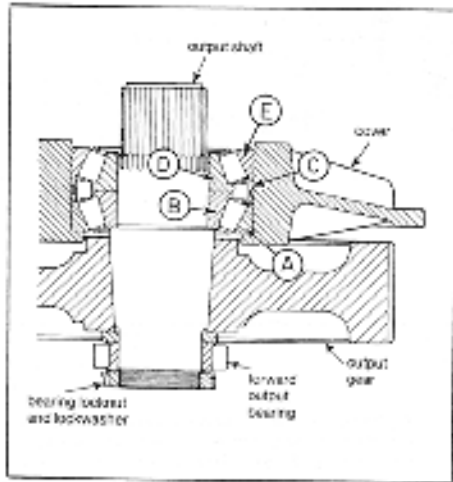


Fig. 36. Sub-assembly including output gear and shaft, cover and bearings.

3. With threaded end of output shaft resting on table, install cover on output shaft. Note: Bearings are a matched set. Do not mix parts.

4. Install heated bearing cone (B) onto the shaft and into cup. Install bearing spacer (C) and install second bearing cone (D) onto output shaft. Install second bearing cup (E) into cover. See fig 36.

5. Press output shaft seal into bearing retainer. Install retainer gasket and bearing retainer onto cover and secure with capscrew.

6. Install output flange on shaft (heat flange if necessary).

7. Install new 'O' rings and secure retainer plate with cap screws. Torque to 130lb ft.

Rest housing on bell end:

8. Slide idler assembly (if present) into bore in housing. Install new 'O' ring in groove on idler shaft.

9. Install outer race of output shaft bearing in lower bore of housing. Install oil pan and bearing retainer (see fig 38).

10. At this time, install snap ring. Forward pinion bearing and second snap ring in housing.

11. Secure cover gasket in place with grease.

12. Using a hoist, carefully lower the cover and output gear assembly into place. A slow twisting of the output flange can aid in proper location of bearing rollers into bearing race (in housing). See fig. 38 secure cover into place with cap screws and lock washers (tighten torque 65 lbs. Ft).

13. Install the first rear pinion bearing cone (A) on pinion shaft. See fig 37. Note: Bearings and spacers are a matched set. Don't mix parts!

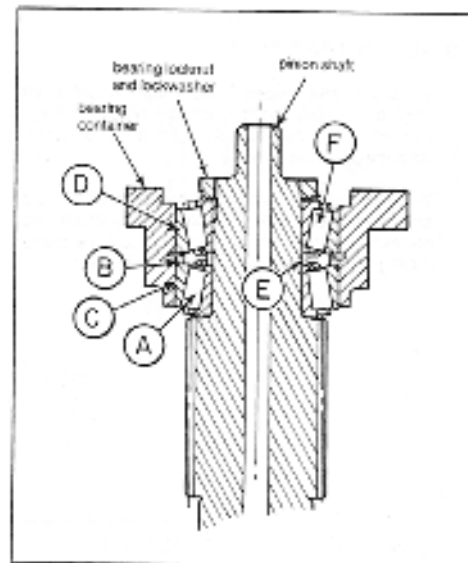


Fig. 37. Pinion shaft and bearing sub-assembly.

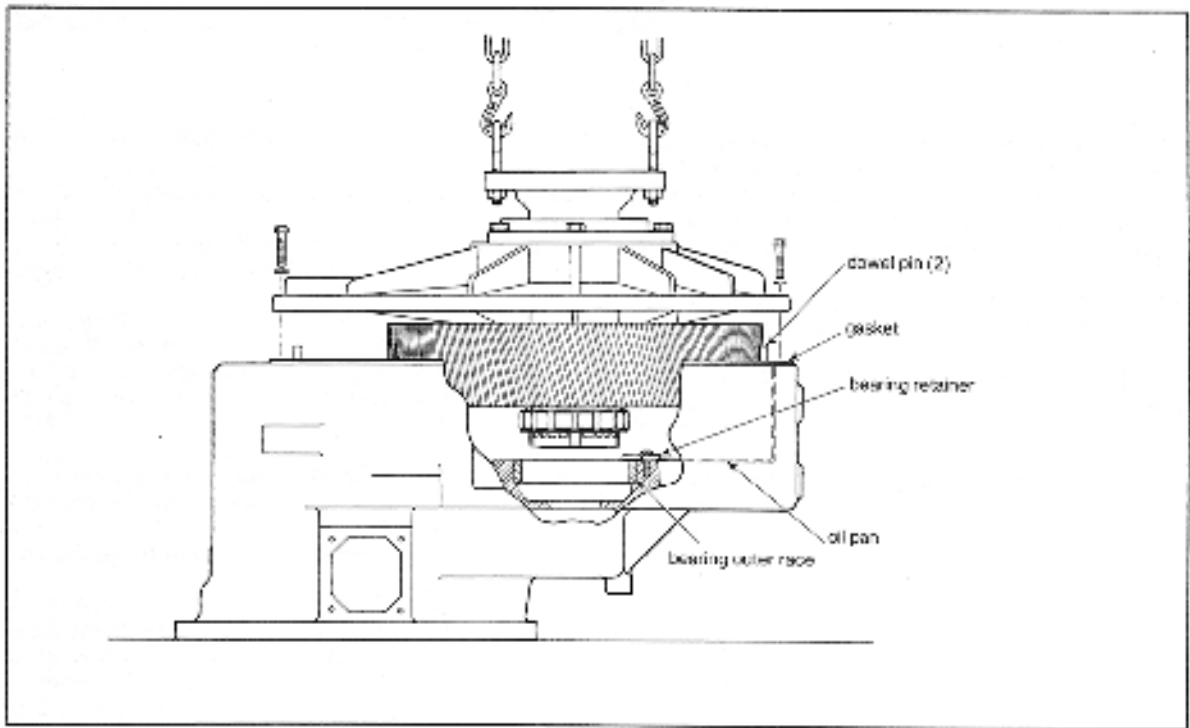


Fig. 38. Installing cover and output gear assembly into housing.

14. Install bearing spacer (B) into bearing container, and install both bearing cups (C) and (D) into container. See fig 37.

15. Install bearing container onto pinion shaft.

16. Install spacer (E) on pinion shaft and press rear bearing cone (F) on pinion shaft. Install bearing lock washer and bearing locknut on pinion shaft.

Stand housing upright:

17. Install new 'O' rings in commutator. Hold commutator in place, (anti-rotation sub on starboard side) and slide pinion shaft and bearing container assembly into housing and through commutator, seating bearing container in cover bore. Check pinion shaft for free rotation.

18. Install commutator tubes and new "O" rings in selector valve base plate. Install base plate gasket and base plate. Install selector valve gasket and selector valve (see fig 22).

19. Place gasket on bearing container and install oil pump and oil filter. Install oil pump shaft from bell end of housing.

20. Install reverse clutch drum in front half of housing.

21. On units with idler gear: connect hose from oil pump to idler shaft

22. Install oil breather and suction screen.

SECTION 8. PARTS INFORMATION

8.1 PART ORDERING PROCEDURE

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

B. Contact Capitol Gears inc. if the above cannot supply the part(s) you need. Write:

Customer service	Cable address:
Capitol Gears inc.	"Cap marine"
349 North Hamline ave	tel: 645-9491
St. Paul MN 55104	Area code: 612
USA	telex: 28-7081

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

Necessary Information sample

1. Model	HP-28000 AER
2. Option code	2-28010-03011-10111
3. Serial #	10403-0578
4. Ratio	6.00 to 1
5. Eng.Mfg.No (if any)	218196
6. Part Number	1-011116-3600
7. Description	Drum, clutch driving
8. Fig number and reference number	fig.41 item 10
9. Quantity being Ordered	one (1)

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 Customers 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

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 and address) _____

Date purchased _____

8.3 OIL PUMP

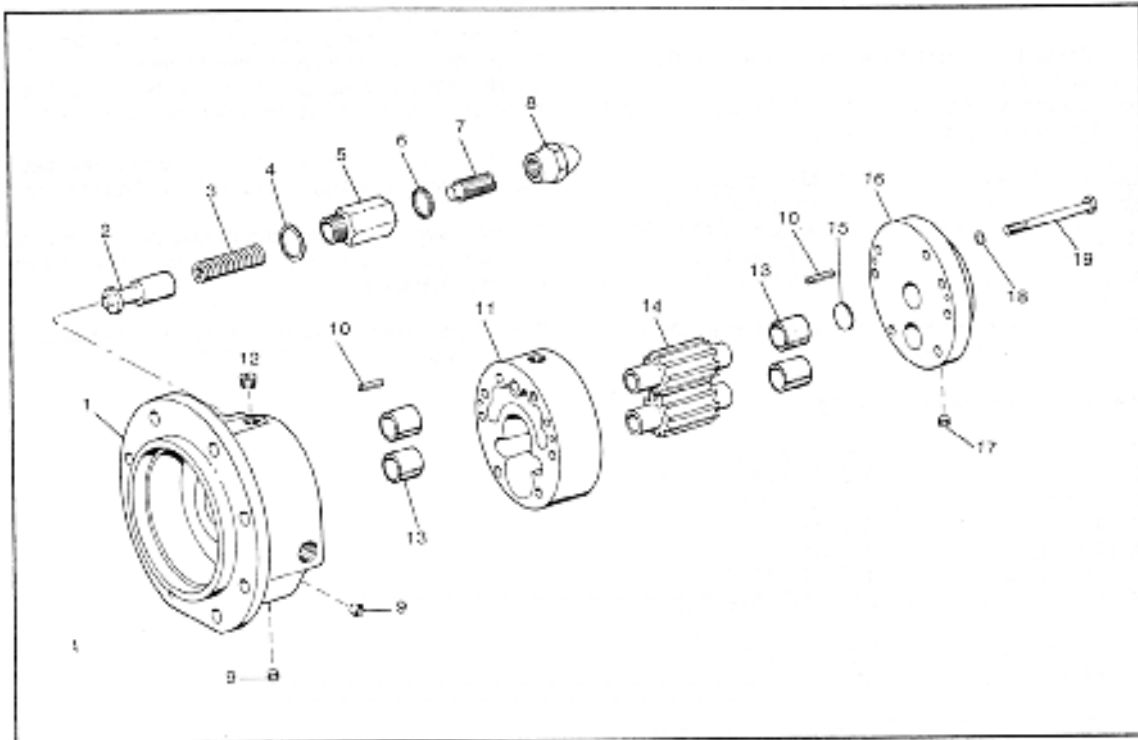


Fig. 39. Oil Pump Assembly

ITEM	DESCRIPTION	PART NO	QTY
REF	ASSEMBLY, OIL PUMP	1-13041-1000	1
1	ADAPTER OIL PUMP	1-13045-0000	1
2	PLUNGER	1-07725-0800	1
3	SPRING, PRESSURE REGULATING	1-12602-0000	1
4	WASHER	1-12901-0000	1
5	INSERT, RELIEF VALVE	1-12603-0000	1
6	WASHER	1-12902-0000	1
7	SCREW, PRESSURE RELIEF	1-06660-0800	1
8	NUT, DOME	1-06667-0800	1
9	PIPE PLUG, HEX SOCKET	1-11279-0200	2
10	SPRING PIN	1-12097-1200	4
11	BODY, OIL PUMP	1-07856-3100	1
12	PIPE PLUG	1-11279-0300	1
13	BUSHING, SPLIT	1-11380-0000	4
14	GEAR, DRIVE	1-09688-3100	2
15	DISC, FLAT	1-13731-0000	1
16	COVER, OIL PUMP	1-07723-1100	1
17	PIPE PLUG, HEX SOCKET	1-11279-0100	1
18	LOCKWASHER	1-09458-0800	7
19	CAPSCREW, HEX HEAD	1-12692-0000	7

8.4 SELECTOR VALVE

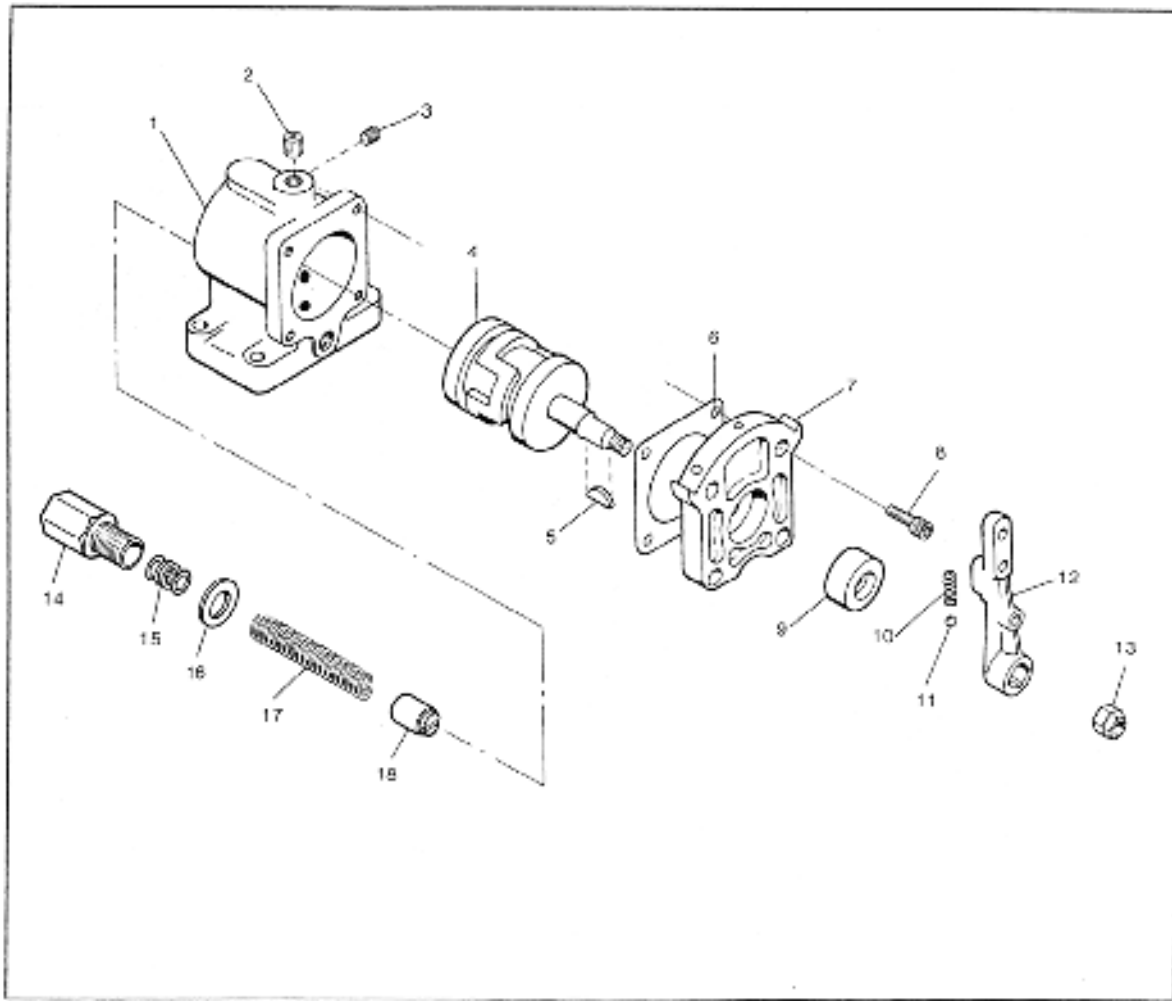


Fig. 40. Selector Valve Assembly

ITEM	DESCRIPTION	PART NO	QTY
REF	ASSEMBLY, SELECTOR VALVE	1-09427-0800	1
1	BODY	1-01141-3500	1
2	PIPE PLUG, HEX SOCKET	1-11279-0300	1
3	PIPE PLUG, HEX SOCKET	1-11279-0200	1
4	ROTARY VALVE	1-01144-3500	1
5	WOODRUFF KEY	1-01164-3200	1
6	GASKET, VALVE COVER	1-01156-3700	1
7	COVER	1-01142-3200	1
8	CAPSCREW, SOCKET HEAD	1-09432-0800	4
9	OIL SEAL	1-01152-3200	1
10	SPRING, INDEXING	1-01132-1700	1
11	BALL, INDEXING	1-01151-1600	1
12	LEVER	1-01143-3900	1
13	NUT, LEVER	1-09474-0800	1
14	ADJUSTMENT SCREW, RELIEF	1-12617-0000	1
15	WASHER	1-12619-0000	5
16	WASHER	1-10288-0700	1
17	SPRING RELIEF VALVE	1-12618-0000	1
18	PLUNGER, SAFETY RELIEF	1-12616-0000	1

8.5 ADAPTER GROUP
'HY' 28000 MARINE GEAR

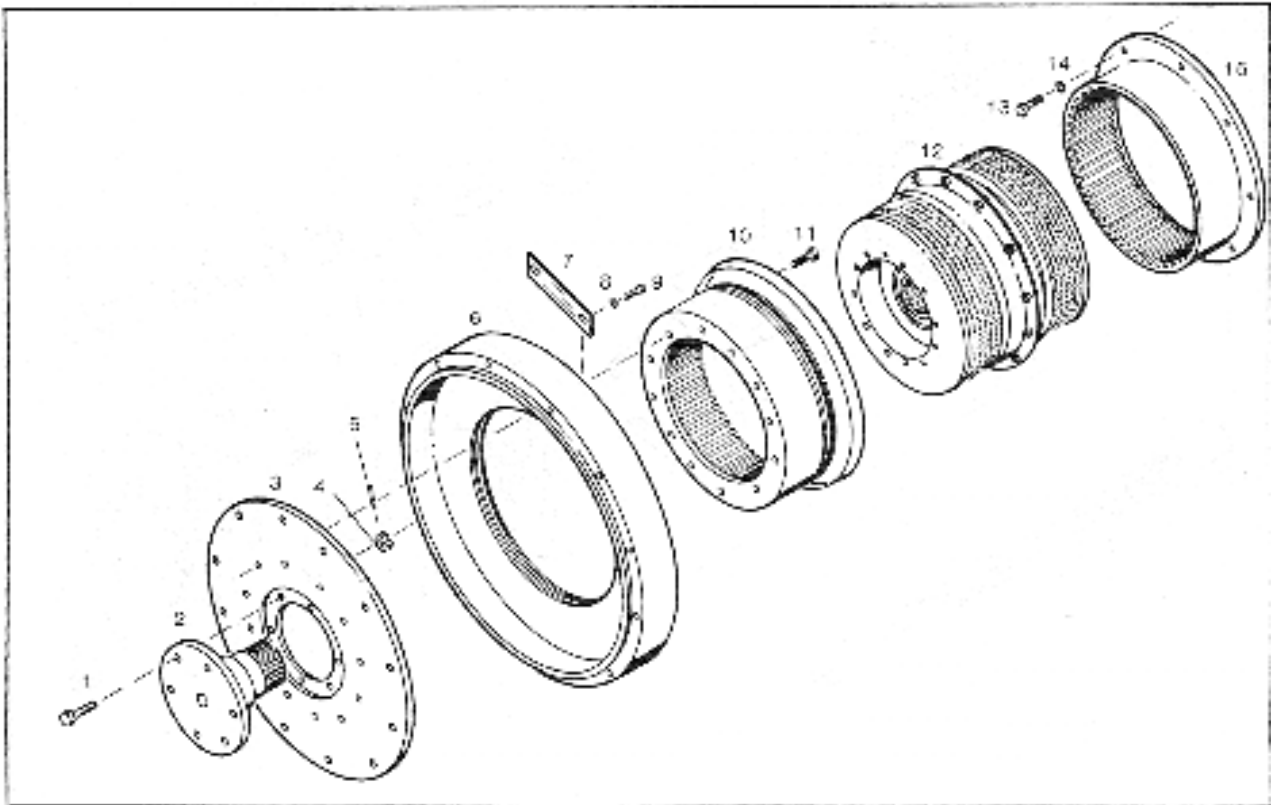


Figure 41. 'HY' Adapter Group and Clutch Pack

ITEM	DESCRIPTION	PART NO	QTY
1	CAPSCREW, HEX HD. DRILLED END	1-06972-0800	6
2	DRIVE FLANGE ASSEMBLY (SEE HY INSTALLATION DRAWINGS		1
3	FLYWHEEL ADAPTER (SEE HY...)		1
4	HEX. NUT HEAVY SLOTTED	1-06973-0800	6
5	COTTER PIN	1-12769-5400	6
6	OIL DAM ADAPTER (SEE HY...)		1
7	COVER, AIR VENT	1-01118-2700	1
8	LOCKWASHER, 5/16 DIA	1-09458-0800	9
9	CAPSCREW, HEX HD. 5/16-18X 1/2"	1-12145-0000	4
10	DRUM CLUTCH, DRIVING	1-01116-3600	1
11	CAPSCREW, HEX HD. (POLYLOK)	1-13804-0000	12
12	CLUTCH ASSEMBLY "HY"	1-00100-5900	1
13	CAPSCREW, HEX.HD. 5/16-18X 1/2"	1-09450-0800	8
14	LOCK WASHER 1/2" DIA	1-11083-0000	18
15	DRUM, REVERSE	1-13472-0000	1

8.5 ADAPTER GROUP

HP 28000 MARINE GEAR

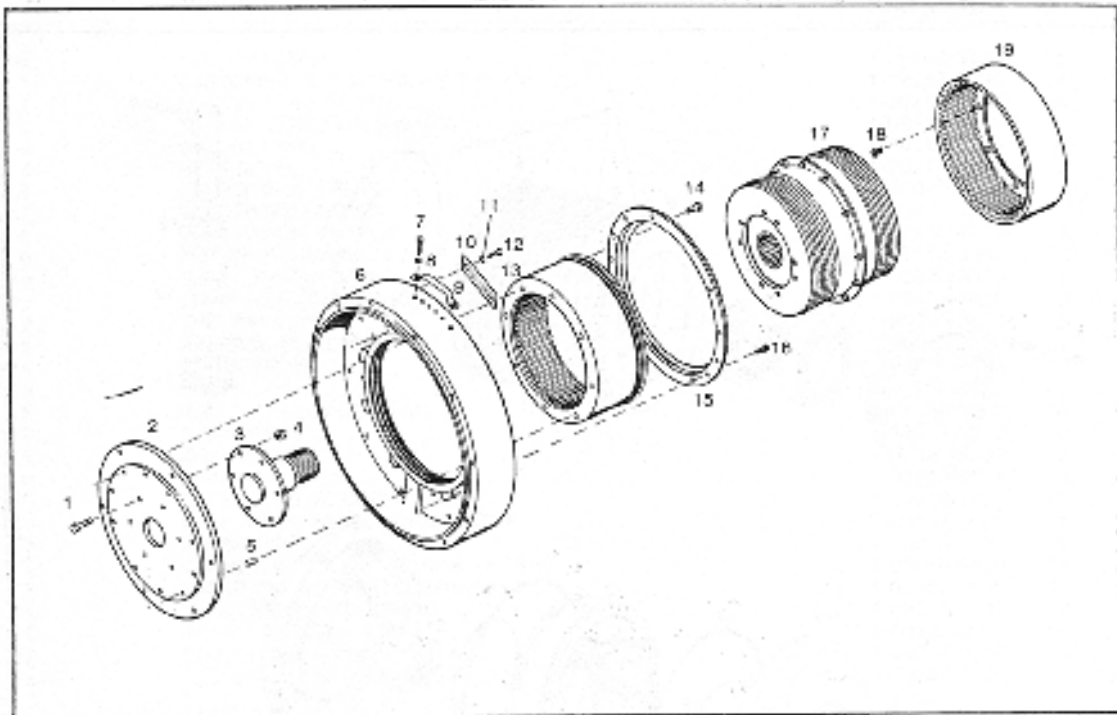


Figure 42. 'HP' Adapter Group and Clutch Pack

ITEM	DESCRIPTION	PART NO	QTY
1	CAPSCREW, HEX.HD. 3/4-10X 2"	1-12793-0000	6
2	FLYWHEEL ADAPTER (SEE HP INSTAL.)		1
3	DRIVE FLANGE ASS'Y (SE HP INSTAL.)		1
4	NUT, SELF LOCKING 3/4-10 NC	1-13095-0000	6
5	DOWEL PIN 1/2" DIA X 1 1/2"	1-11142-0000	2
6	OIL DAM ADAPTER (SEE HP INSTAL.LATION)		1
7	CAPSCREW, HEX HD. 1/4-20 X 3/4"	1-11101-0000	2
8	LOCKWASHER, 1/4" DIA	1-05309-0800	2
9	COVER, AIR VENT	1-10528-0000	1
10	COVER, AIR VENT	1-01118-2700	1
11	LOCKWASHER 5/16" DIA	1-09458-0800	1
12	CAPSCREW HEX HEAD 5/16"-18 X 5/8"	1-06987-0800	2
13	DRUM, CLUTCH DRIVING	1-01116-6800	1
14	CAPSCREW, HEX HEAD (POLYLOK)	1-13134-0000	8
15	SLINGER SHIELD	1-01119-2700	1
16	CLUTCH ASSEMBLY, 'HP'	1-00100-2418	1
17	CAPSCREW, FLAT SOCKET HEAD 1/2"-13X 1"	1-09741-0800	1
18	CAPSCREW, FLAT SOCKET HEAD 1/2"-13 X 1"	1-09741-0800	8
19	DRUM, REVERSE	1-00250-4100	1

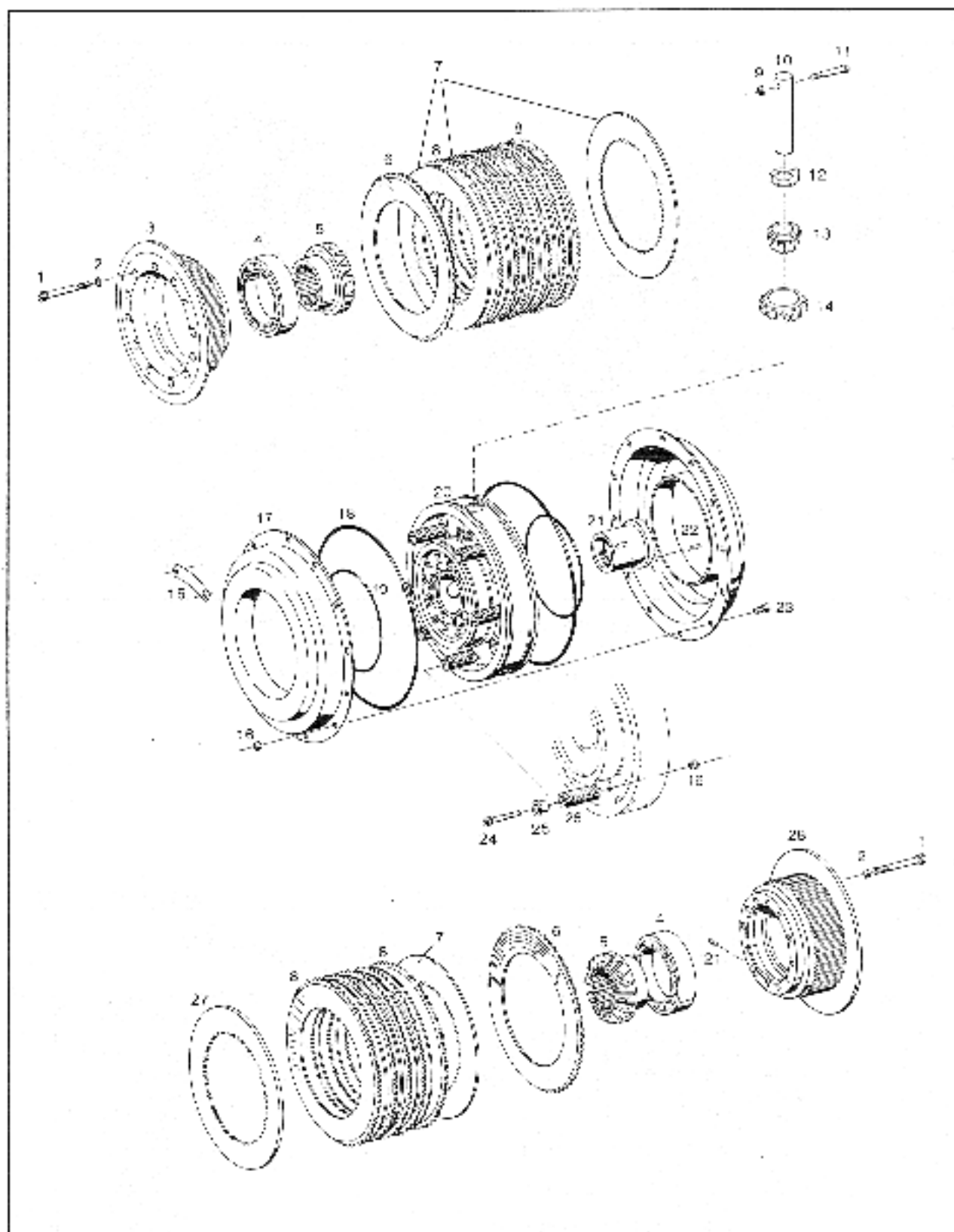


Figure 43. 'HY' - 28000 Clutch and Gear Carrier Assembly

CLUTCH AND GEAR CARRIER
HY 28000

ITEM	DESCRIPTION	PART NO	QTY
REF	CLUTCH ASSEMBLY	1-00100-5900	1
1	CAPSCREW, SOCKET HD. 3/8-16 X 3 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	2
7	CLUTCH DISC, DRIVEN	1-00233-1200	12
8	CLUTCH DISC, DRIVING	1-00230-4000	11
9	NUT, SELF LOCKING 1/4-28 NF	1-00226-3600	3
10	SHAFT, BEVEL PINION	1-00220-3600	3
11	CAPSCREW, SOCKET HD 1/4-28X 2"	1-09433-0800	3
12	THRUST WASHER	1-00221-3600	3
13	BEARING, BEVEL PINION	1-00218-2500	3
14	PINON, BEVEL	1-00217-2600	3
15	NAMEPLATE	1-11208-0000	1
16	NUT, SELF LOCKING 5/16-18 NC	1-11399-0000	36
17	CYLINDER	1-00234-5500	2
18	QUAD RING	1-00237-3600	2
19	QUAD RING	1-00238-5800	2
20	CARRIER, BEVEL GEAR	1-00219-3700	1
21	BUSHING, FORWARD COMMUTATOR	1-00247-3600	1
22	SPRING PIN	1-12096-1000	9
23	CAPSCREW, SOCKET HD 5/16-18 X 5/8"	1-09468-0800	24
24	CAPSCREW, SOCKET HD 5/16-18X2"	1-05386-0800	12
25	RETAINER, RETURN SPRING	1-00243-3600	12
26	SPRING, RETURN	1-00239-3700	12
27	CLUTCH DISC, DRIVEN	1-00233-2900	1
28	FLANGE, CLUTCH (REVERSE)	1-00212-3600	1

8.6 CLUTCH AND GEAR CARRIER

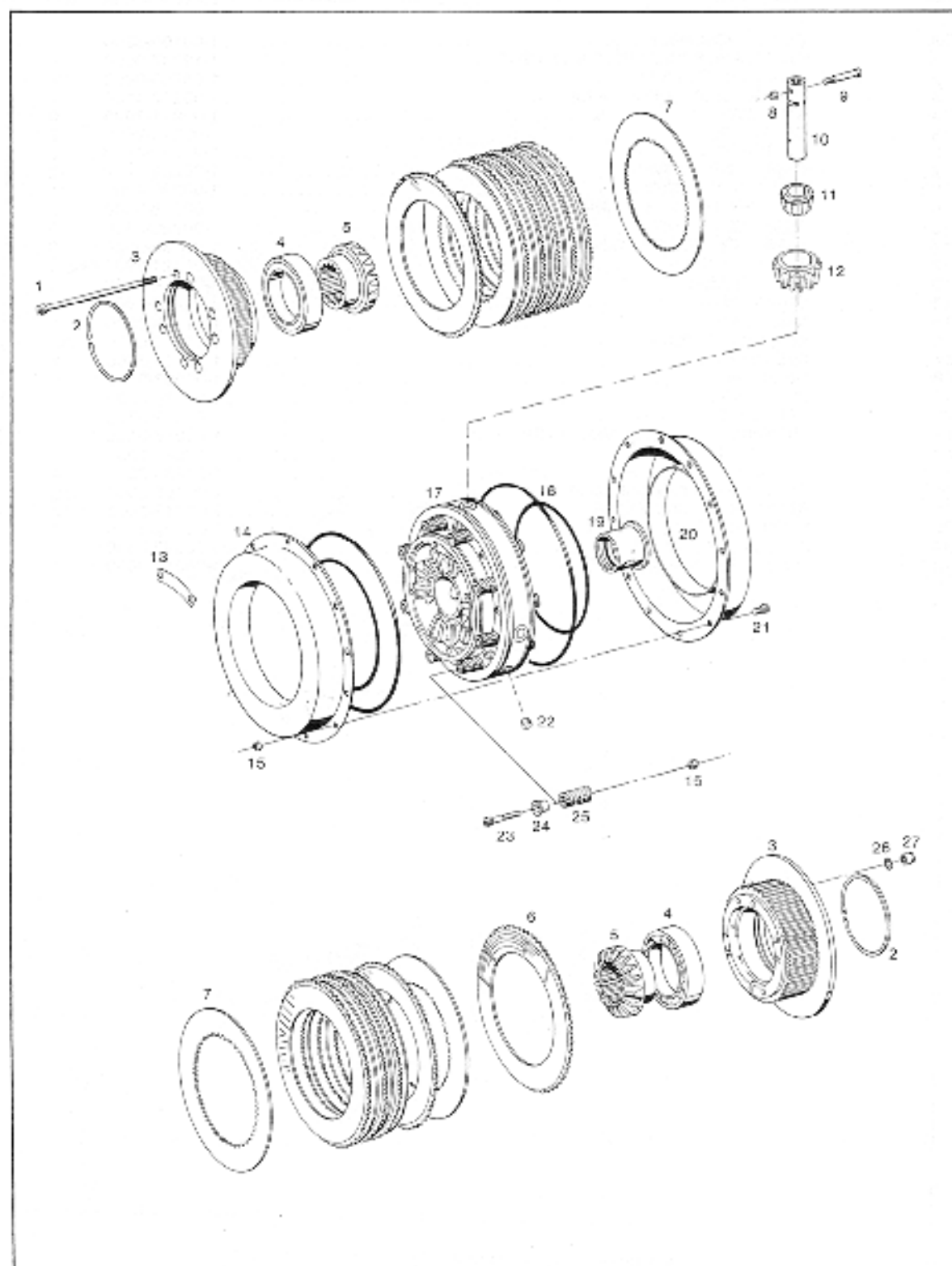


Figure 44. 'HP'-28000 Clutch and Gear Carrier Assembly

CLUTCH AND GEAR CARRIER

HP 28000

ITEM	DESCRIPTION	PART NO	QTY
REF	CLUTCH ASSEMBLY	1-00100-2418	1
1	CAPSCREW, SOCKET HEAD 3/8-24X 8 1/4"	1-12973-0000	8
2	SNAP RING, TRUARC	1-00222-3200	2
3	END FLANGE	1-00210-2500	2
4	BALL BEARING	1-00211-5400	2
5	GEAR, BEVEL (DRIVEN AND DRIVING)	1-00216-2400	2
6	CLUTCH DISC DRIVING	1-00230-2800	11
7	CLUTCH DISC DRIVEN	1-00233-2400	11
8	NUT FLEX-LOC 1/4 -20	1-07846-0800	4
9	CAPSCREW, SOCKET HD 1/4-20X 2	1-12028-0000	4
10	SHAFT, BEVEL PINION	1-00220-2400	4
11	BEARING, PINION	1-00218-2500	4
12	GEAR, BEVEL PINION	1-00217-1800	4
13	NAME PLATE	1-11208-0000	1
14	CYLINDER	1-00234-2400	2
15	NUT, FLEX-LOC 5/16-18	1-11399-0000	28
16	O RING	1-12785-0000	2
17	CARRIER, BEVEL GEAR	1-00219-2400	1
18	O RING	1-12784-0000	2
19	COMMUTATOR BUSHING	1-00247-3200	1
20	SPRING PIN	1-12096-1000	3
21	CAPSCREW, SOCKET HD 5/16-18 X 3/4"	1-07546-0800	12
22	PIPE PLUG, HEX SOCKET 1/4-18 NPT	1-11279-0300	2
23	CAPSCREW, SOCKET HD 5/16-18 X 2"	1-09439-0800	16
24	RETAINER RETURN SPRING	1-00243-2400	16
25	SPRING RETURN	1-00239-3700	16
26	LOCKWASHER, HIGH COLLAR 3/8 DIA	1-08755-0800	8
27	ALLENUT, 3/8-24	1-12999-0000	8

8.7 MARINE GEAR ASSEMBLY

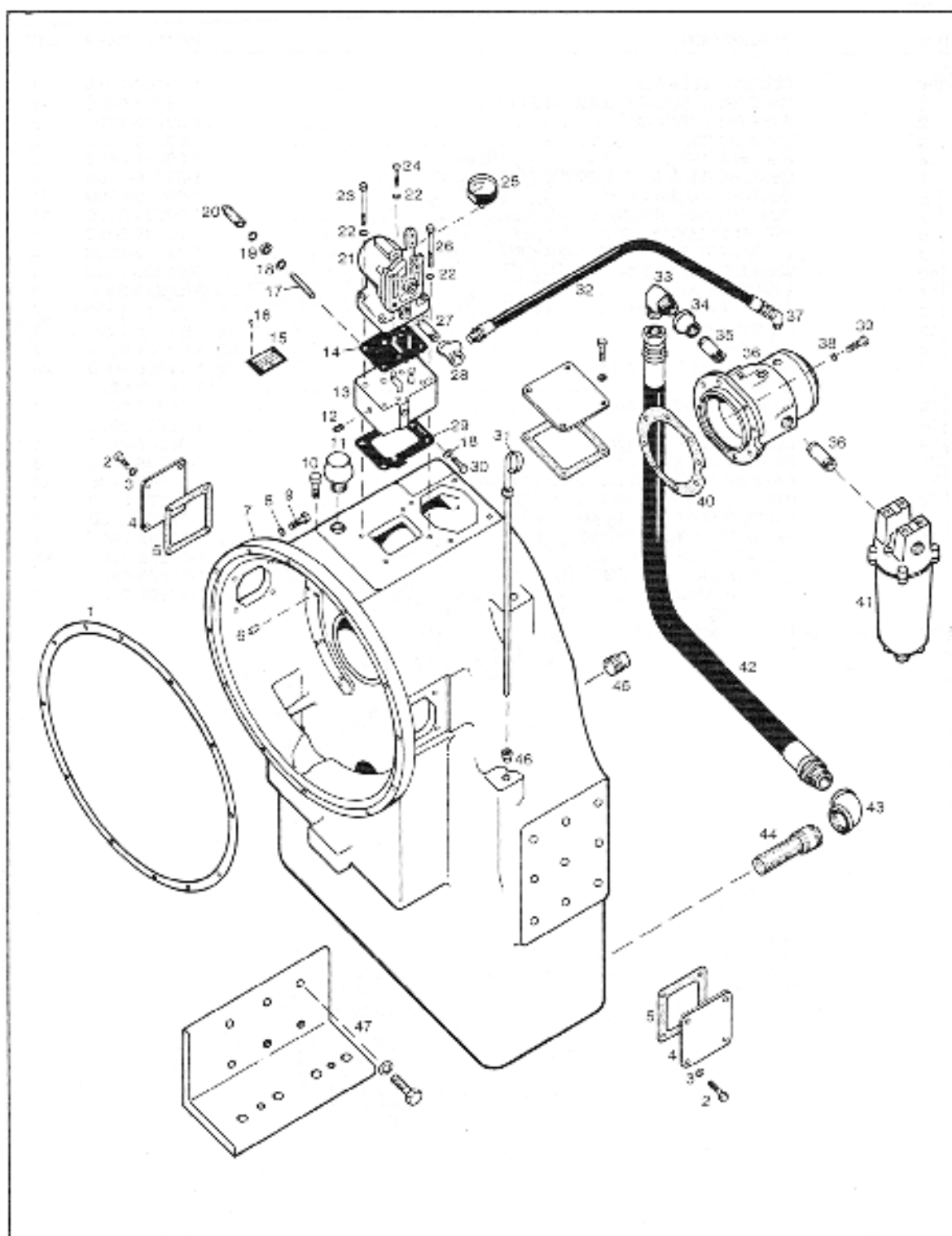


Fig. 45. Marine Gear Assembly, Part A

MARINE GEAR ASSEMBLY**PART A**

ITEM	DESCRIPTION	PART NO	QTY
1	GASKET, HSG TO OIL DAM	1-1102-3600	1
2	CAPSCREW HEX HD 3/8-16 X 3/4"	1-10965-0000	12
3	LOCKWASHER, 3/8" DIA	1-09460-0800	24
4	COVER	1-12405-0000	3
5	GASKET COVER	1-12438-0000	3
6	DOWEL PIN 1/2 DIA X 3/4	1-13077-0000	2
7	HOUSING (ALL RATIOS LESS IDLER)	1-13482-0000	1
	(4:5:1 WITH IDLER)	1-13482-0200	1
	(5:0:1 WITH IDLER)	1-13482-0300	1
	(6:0:1 WITH IDLER)	1-13482-0500	1
8	LOCKWASHER 7/16 DIA	1-09462-0800	12
	LOCKWASHER 3/8 DIA	1-09460-0800	12
9	CAPSCREW DEX HD 7/16-14 X 2"	1-13327-0000	12
	CAPSCREW, HEX HD. 1/2-20 X 3/4"	1-09662-0800	12
10	CAPSCREW HEX HD 1/2-20 X 3/4"	1-11649-0000	1
11	BREATHER	1-13511-0000	1
12	PIPE PLUG, HEX SOCKET	1-11279-0300	1
13	BASE PLATE	1-13860-0000	1
14	GASKET, VALVE	1-13861-0000	1
15	NAME PLATE	1-11210-0000	1
16	DRIVE SCREW	1-13275-0000	2
17	SET SCREW, SOC	1-09466-0800	1
18	GASKET	1-09471-0800	3
19	LOCKNUT, LIGHT 5/16-18 NC	1-09464-0800	1
20	DOME NUT	1-09461-0800	1
21	CONTROL VALVE ASSEMBLY	1-09427-0800	1
22	LOCKWASHER, 5/16-18 NC	1-09458-0800	9
23	CAPSCREW, HEX HD. 5/16-18 X 31/4"	1-12278-0000	2
24	CAPSCREW, HEX HD. 5/16-18X 11/4"	1-12339-0000	2
25	PRESSURE GAUGE	1-09669-0900	1
26	CAPSCREW, HEX HD. 5/16-18 X 23/4"	1-12259-0000	2
27	NIPPLE, 3/8x2"	1-11259-0100	1
28	REDUCING TEE	1-11260-0200	1
29	GASKET, BASE PLATE	1-13613-0000	1
30	CAPSCREW, HEX. HD. 5/16-18X 1/2"	1-12145-0000	2
31	DIP STICK	1-00330-3600	1
32	HOSE	1-01335-1500	1
33	90 DEG. MALE ELBOW	1-11221-2400	1
34	REDUCER 1" 3/4"	1-11224-1100	1
35	PIPE NIPPLE	1-11259-0700	2
36	OIL PUMP ASSEMBLY	1-13041-1000	1
37	45 DEG. ELBOW	1-11220-1100	1
38	LOCKWASHER, 7/16 DIA	1-09462-0800	8
39	CAPSCREW HEX HD 7/16-14 X 21/4"	1-13608-0000	8
40	GASKET, BRG, CONTAINER TO PUMP	1-13049-0000	1
41	OIL FILTER	1-13811-1000	1
42	HOSE	1-13621-0000	1
43	90 DEG. PIPE ELBOW	1-11246-0700	1
44	SUCTION SCREEN	1-13802-0000	1
45	PIPE PLUG, SQ. HD	1-11251-0700	1
46	NUT, INVERTED FLARE	1-11227-0400	1
47	MOUNTINF FOOT KIT	1-13635-0000	1

8.7 MARINE GEAR ASSEMBLY

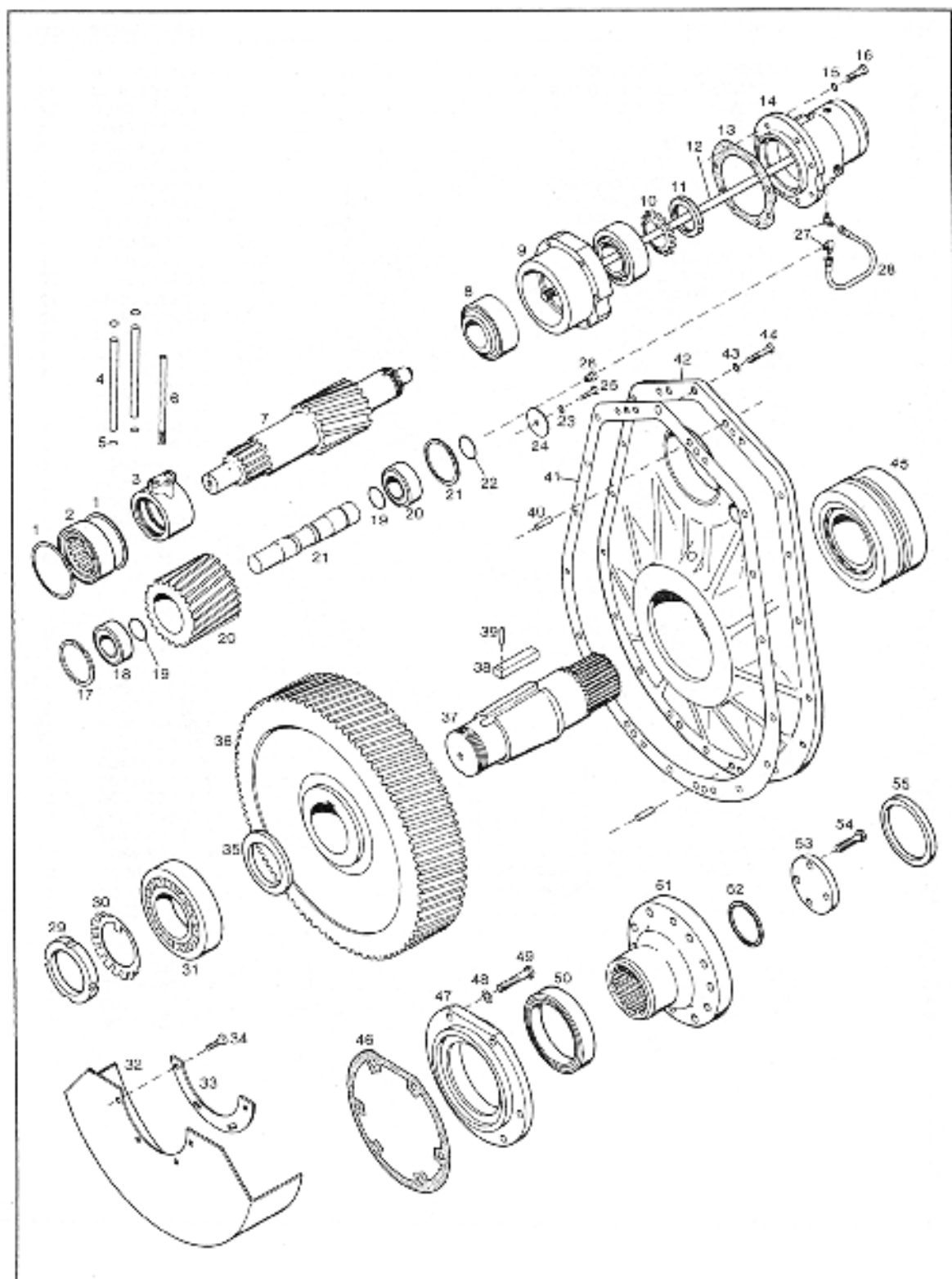


Fig. 46 Marine Gear Assembly, Part B

MARINE GEAR ASSEMBLY

PART B

ITEM	DESCRIPTION	PART NO	QTY
1	SNAP RING	1-13479-0000	2
2	BEARING, FORWARD PINION	1-13507-0000	1
3	COMMUTATOR	1-13471-0000	1
4	TUBE, COMMUTATOR	1-13474-0000	2
5	"O" RING	1-13076-0000	4
6	STUD, ANTI-ROTATION	1-10641-0000	1
7	PINION SHAFT ASSEMBLY	(see page 45)	
8	BEARING ASSEMBLY	1-13476-0000	1
9	CONTAINER, BEARING	1-13470-1000	1
10	LOCKWASHER, BEARING	1-10036-0000	1
11	LOCKNUT, BEARING	1-10037-0000	1
12	SHAFT, PUMP DRIVE	1-13615-0000	1
13	GASKET, BEARING CONTAINER TO PUMP	1-13049-0000	1
14	OIL PUMP ASSEMBLY	1-13041-1000	1
15	LOCK WASHER, 7/16" DIA	1-09462-0800	8
16	CAPSREW, HEX. 7/16-14 x2 1/4"	1-13608-0000	8
17	SNAP RING	1-10112-0000	2
18	BEARING ASSEMBLY	1-10117-0000	2
19	SNAP RING	1-12763-0000	2
20	GEAR, IDLER	1-10107-0000	1
21	SHAFT, IDLER	1-10105-0200	1
22	"O" RING	1-10336-0000	1
23	WROUGHT WASHER	1-10338-0000	1
24	LOCKWASHER	1-09458-0800	9
25	CAPSCREW, HEX. HD. 5/16-18x 1/2" LG	1-12145-0000	4
26	PIPE ADAPTER	1-12320-0000	1
27	MALE ELBOW	1-11237-0300	2
28	HOSE	1-07875-1000	1
29	LOCKNUT, BEARING	1-06830-0800	1
30	LOCKWASHER, BEARING	1-06846-0800	1
31	BEARING, FORWARD	1-10811-0000	1
32	OIL PAN	1-13803-0000	1
33	RETAINER, BEARING	1-10640-0000	1
34	CAPSCREW, HEX. HD. 5/16-18x 1/2" LG	1-13768-0000	4
35	SPACER, BEARING	1-13484-0000	1
36	GEAR OUTPUT	(see page 45)	
37	SHAFT, DRIVEN GEAR	1-10635-0000	1
38	KEY	1-10815-0000	1
39	SPRING PIN, 3/16 DIA. x 1" LG	1-12096-1600	1
40	DOWEL PIN, 1/2" DIA. x 1 1/4" LG	1-12311-0000	2
41	GASKET, COVER TO HOUSING	1-13614-0000	1
42	COVER, REAR, ALL RATIOS LESS IDLER	1-13483-0000	1
	(4.5: 1 WITH IDLER)	1-13483-0200	1
	(5.0:1 WITH IDLER)	1-13483-0300	1
	(6.0:1 WITH IDLER)	1-13483-0500	1
43	LOCKWASHER, 1/2" DIA	1-11083-0000	18
44	CAPSCREW, HEX. HD. 1/2-13x1 3/4" LG	1-10058-0000	18
45	BEARING & SPACER ASSEMBLY	1-13070-0000	1
46	GASKET, RETAINER	1-13194-0000	1

47	BEARING, RETAINER	1-13043-0000	1
48	LOCKWASHER, 5/8" DIA	1-06074-0800	6
49	CAPSCREW, HEX. HD. 5/8-11 x 2" LG.	1-07754-0800	6
50	SEAL, DRIVEN SHAFT	1-13197-0000	1
51	FLANGE, OUTPUT	1-13825-0000	1
52	"O" RING	1-10637-0000	1
53	PLATE, RETAINER	1-10638-0000	1
54	CAPSCREW, HEX. HD. 3/4-10 x 2 1/4" LG	1-13628-0000	4
55	PILOT RING	1-06022-0800	1

8.7 MARINE GEAR ASSEMBLY PART B

ITEMS 7 and 36:
(pictured page
43)

Choose correct parts listed below according to the ratio number (e.g. 4.518:1 E.R.) and the option code (i.e. **(XX)**). These numbers are located on the nameplate on the top of the marine gear housing.

MARINE GEAR	
MODEL	XX-28000-XXX
OPTION CODE	2-280XX- (XX) XXX-XXXXX
SERIAL NO.	XXXXXX-XXXXX
RATIO	X.XX:1
ENG. MFG. NO.	XXXXXX
CAPITOL GEARS, INC. ST. PAUL, MINN.	
MADE IN U.S.A.	

ITEM NO.	PART NAME	OPTION CODE	RATIO	TEETH	PART NUMBER — HY 28000	PART NUMBER — HP 28000
7	PINION	01	4.50:1 A.E.R.	28	1-13590-0000	1-13600-0000
36	GEAR			125	1-10627-3000	1-10627-3000
7	PINION	02	5.160:1 A.E.R.	25	1-13592-0000	1-13602-0000
36	GEAR			129	1-10607-3000	1-10607-3000
7	PINION	03	6.00:1 A.E.R.	22	1-13595-0000	1-13605-2000
36	GEAR			132	1-10608-2000	1-10608-3000
7	PINION	04	4.518:1 E.R.	27	1-13591-0000	1-13601-0000
36	GEAR			122	1-10630-3000	1-10630-3000
7	PINION	05	5.166:1 E.R.	24	1-13593-0000	1-13603-0000
36	GEAR			124	1-10626-3000	1-10626-3000
7	PINION	06	6.095:1 E.R.	21	1-13596-0000	1-13606-0000
36	GEAR			128	1-10610-3000	1-10610-3000
7	PINION	07	6.00:1 A.E.R.	22		1-13605-0000
36	GEAR			132		1-10608-2000

8.8 OIL COOLERS

8.8 OIL COOLERS

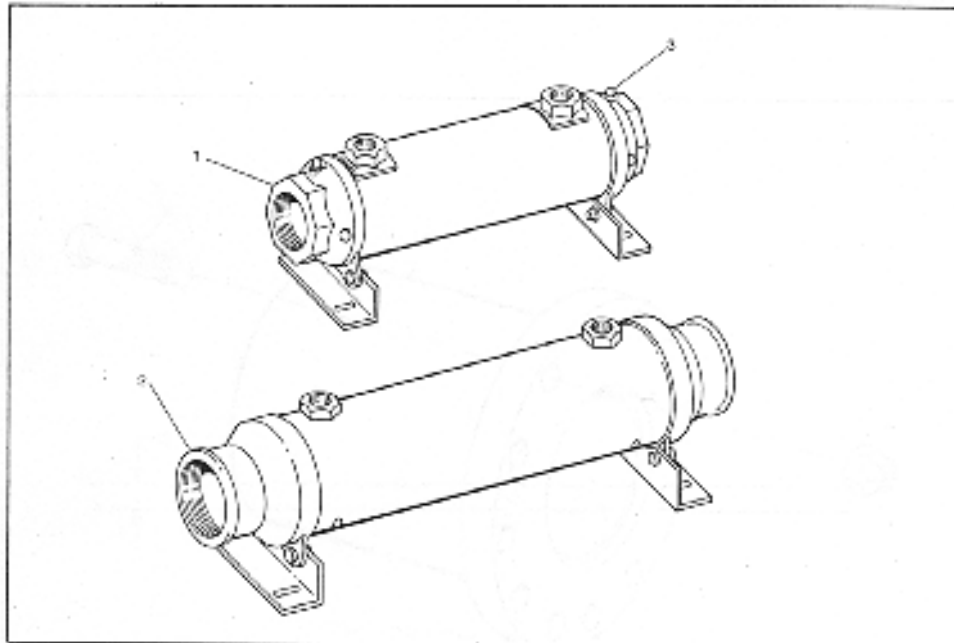


Fig. 47. Oil Coolers

ITEM	DESCRIPTION	PART NO	QTY
'HY'-28000 OIL COOLERS			
1	SEA WATER, 12 3/4" x 4 1/8" DIA	1-07808-5000*	1
	SEA WATER KIT, 12 3/4 x 4 1/8" DIA (includes hose and fittings)	1-07808-5100*	1
	HOSE (1/2" I.D. x 6 FT.)	1-11505-0000	1
	MALE FITTING	1-11283-0800	2
	BUSHING, 1" x 3/4"	1-11253-1200	2
	FEMALE FITTING	1-11282-0500	2
	90 DEG. ELBOW (JIC)	1-11221-1700	2
	BUSHING, 3/4" x 1/2"	1-11253-0900	1
	SEA WATER, 17" x 5 1/8" DIA	1-13769-0000*	1
	SEAWATER KIT 17" x 5 1/8" DIA (includes hoses and fittings)	1-13769-1000*	1
	HOSE (1/2" I.D. x 6 FT.)	1-11505-0000	1
	MALE FITTING	1-11283-0800	2
	BUSHING, 1" x 3/4	1-11253-1200	2
	FEMALE FITTING	1-11282-0500	2
	90 DEG. ELBOW (JIC)	1-11221-1700	2
	BUSHING, 3/4" x 1/2"	1-11253-0900	1
2	FRESH WATER, 19 1/2" x 6 1/8" DIA	1-13795-0000	1
	FRESH WATER, 30 3/4" x 6 1/8 DIA	1-13814-0000	1
3	ZINC PENCILS	1-12445-0400	2
'HP'- 28000 OIL COOLERS			
1	SEA WATER, 17" x 5 1/8" DIA	1-13769-0000*	1
	SEA WATER KIT, 17" x 5 1/8 DIA. (see above)	1-13769-1000*	1
2	FRESHWATER, 30 3/4" x 3 1/8" DIA	1-13814-0000	1
3	ZINC PENCILS	1-12445-0400	2

8.9 PROP COUPLING KIT

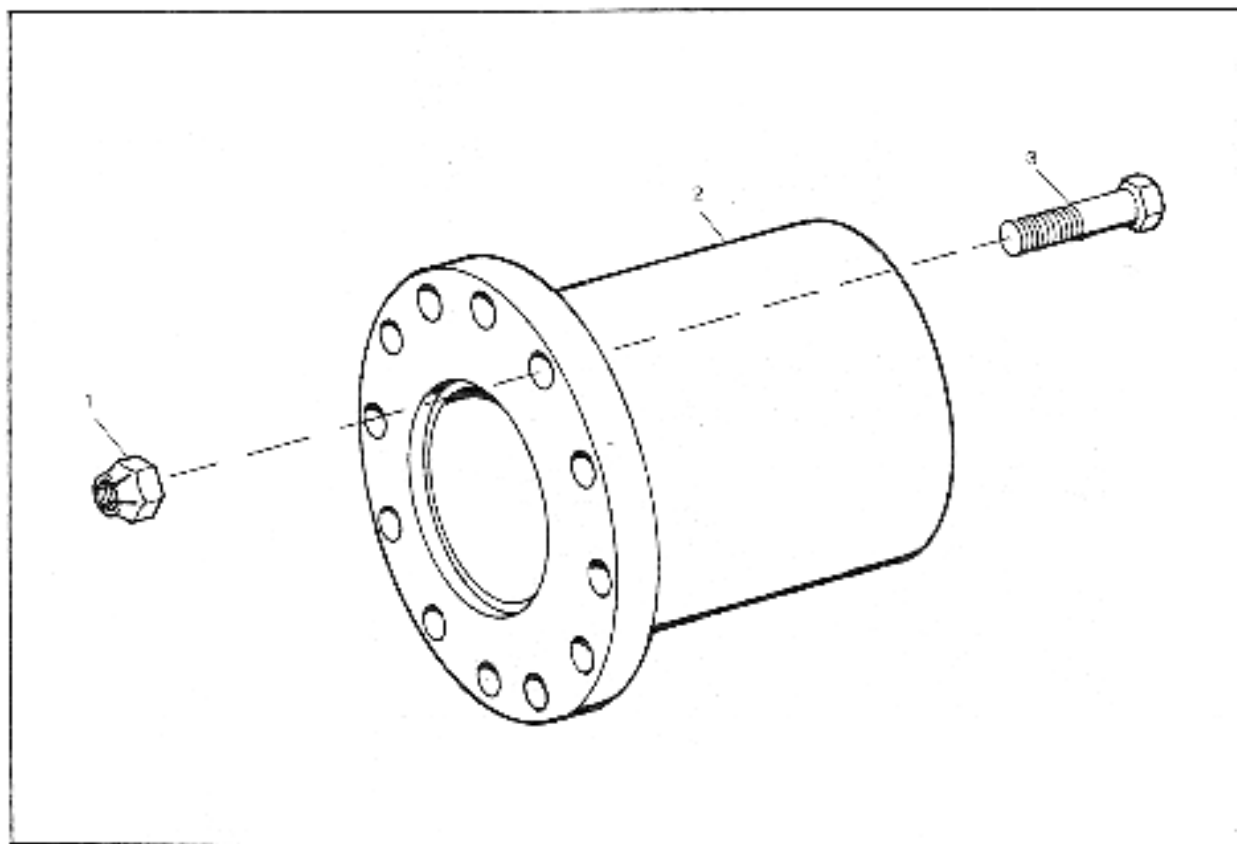


Fig. 48. Prop Coupling Kit

ITEM	DESCRIPTION	PART NUMBER	QTY
REF	PROPELLER COUPLING KIT	1-13577-1000	1
1	NUT, SELF LOCKING, $\frac{3}{4}$ -10 NC	1-13095-0000	12
2	COUPLING, PROP SHAFT	1-13826-0000	1
3	CAPSCREW, HEX HEAD $\frac{3}{4}$ -10 NC X 3 $\frac{1}{4}$ "	1-08793-0800	12