SERVICE MANUAL
HY-24000 & HY- 25000
Marine Transmission

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 UNTIL OVER 150° F (65°C)

DO NOT OPERATE UNIT WITH HIGH OR LOW OIL PRESSURE

DO NOT 'WINDMILL' UNIT IN EVEN 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.

MODEL HY-25000 MARINE GEAR CAPITOL GEARS INC.

The purpose of this supplement is to provide information pertinent to the installation and servicing of the HY-25000 marine gear.

I. How to use the service manual

The following service manual sections apply fully to both HY-24000 and HY-25000 marine gears:

Section 1. Introduction
Section 2. Principles of Operation
Section 3. Installation
Section 4. Preventative Maintenance
Section 5. Trouble shooting
Section 6. Repair of external subassemblies

Section 7. "Repair of Internal Subassemblies" applies to HY-24000 models. When repairing or overhauling HY-25000 marine gears, consult the appropriate sections of this supplement first, and then go to the service manual.

Section 8. "Repair Parts" applies to HY-24000 models only. When ordering parts for HY-25000 marine gears, refer to the appropriate cross section drawing.

II. Installation

For marine gears furnished with #5 adapter kit (with labyrinth groove type oil seal), follow the procedure given in paragraphs 1 through 11 of section 3.2, "Installation Preparation." Use gasket # 1-01102-3600 between the engine Flywheel housing and oil dam adapter.

Paragraphs 12 through 15 do not apply. Instead, substitute the following procedure:

" At this point, flywheel adapter, drive flange, and oil dam are in place. Clutch driving drum is to be installed directly onto the flywheel adapter. Coat the mating surfaces with sealant, then install drum using the 12 self locking hex head cap screws provided."

Follow the remainder of the installation procedure as given in the manual.

For units with other adapter kits, use the complete installation procedure given in section 3.

III. Remote oil pump

HY-25000 marine gears adapted to Detroit Diesel engines are sometimes furnished with remote oil pumps that are mounted on the engine and driven by one camshaft. Installation of these pumps requires the use of parts not furnished by Capitol Gears. Also, pumps are available for both clockwise rotation (part #1 14279-0000) and counterclockwise rotation (part # 1-14279-0200). See the pump drawing, and plumbing diagram SK880223 furnished with this manual.

IV. Internal Subassemblies- Clutch

HY-2500 marine gears are furnished with clutch parts number 1-00100-5400 (standard clutch). The assembly and disassembly procedure given in the manual may be used, and is correct for either clutch. When ordering repair parts, consult the appropriate subassemblies drawing.

V. Internal subassemblies- Pinion Shaft

On some units, the roller bearing cones are secure at the rear of the pinion shaft by a retainer plate and five socket head, self-locking screws. The method of disassembly and assembly are self-evident. We recommend heating the bearing cones in hot oil to ease installation. Torque the screws evenly to 25 LB. FT torque; Re-torque after parts have cooled.

NOTE: For 2.04 ratio models only, pinion with its bearings and bearing retainer may be removed or installed while the rear cover remains in place on the housing.

VI. Internal subassemblies- Output gear rear bearing

The bearing cup is pressed into an iron cap that also carries the rear oil seal, bearing endplay is adjusted by adding or removing shims as necessary. Correct endplay is between zero and .002 inches.

VII. Oil Filters

HY-2500 marine gears in current production (serial numbers 10200-0186 and higher) are supplied with a 25-micron, paper element type oil filter to be pumped into the high-pressure oil circuit (part # 1-13811-1000). The filter element should be replaced after the first 100 hours of operation and every 400 hours thereafter. This element cannot be cleaned, see the drawing on page 58 a.

Earlier HY-25000 marine gears as well as all HY-24000 and HY-22000 were furnished with a metal screen type oil filter mounted in the suction line between sump and oil pump. The elements in these filters may be cleaned and re-used. See the drawing on page 58. NEVER USE PAPER FILTER ELEMENTS IN A SUCTION SIDE FILTER!

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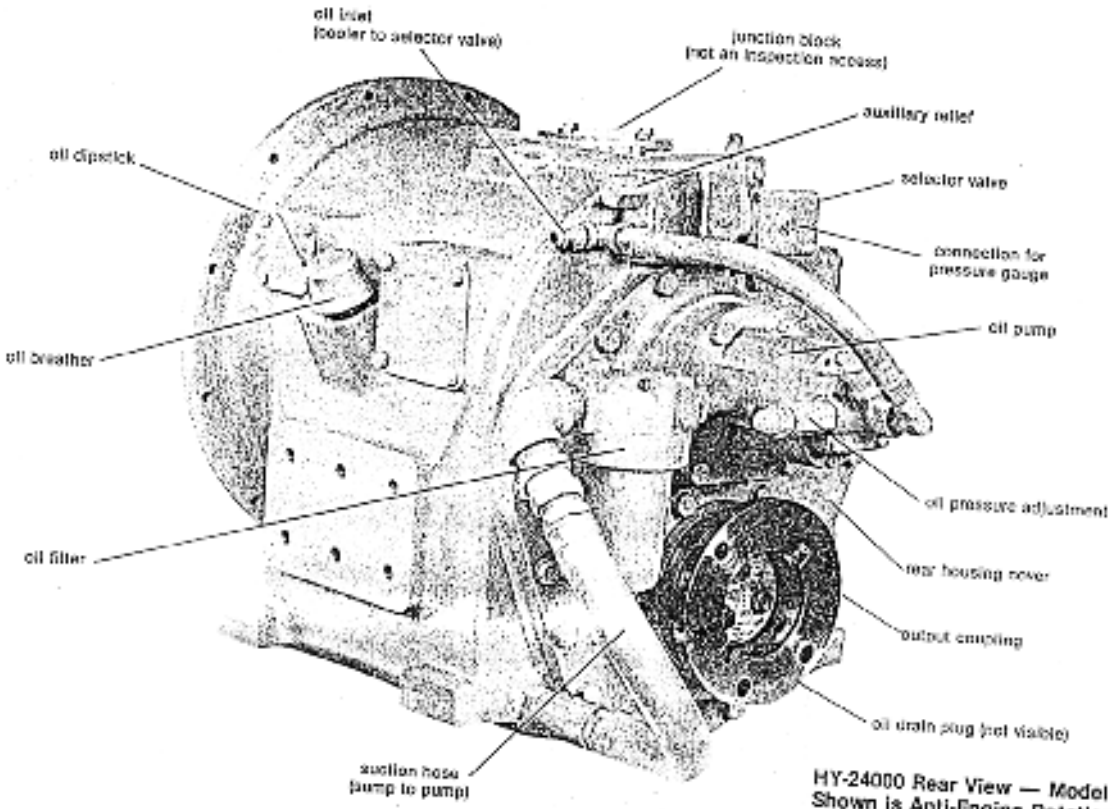
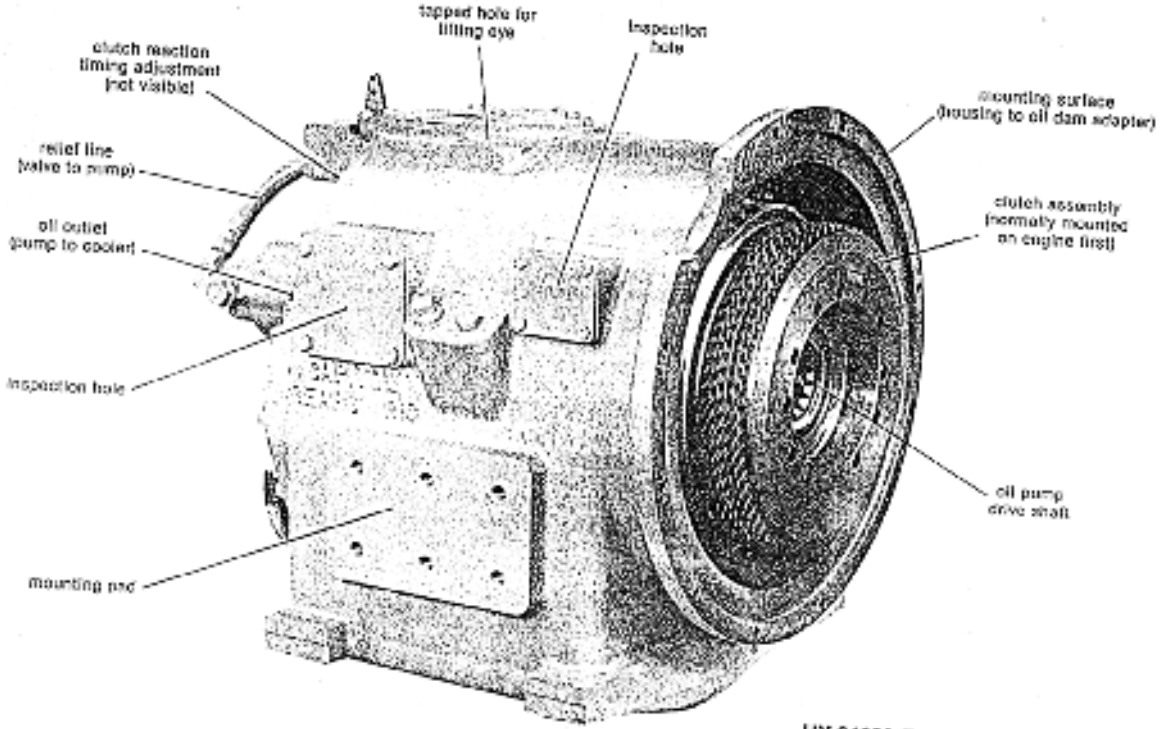


HY-24000 Rear View — Model Shown is Anti-Engine Rotation (A.E.R.) for Right Hand Engine.



HY-24000 Front View — Adapter Parts are Not Shown.

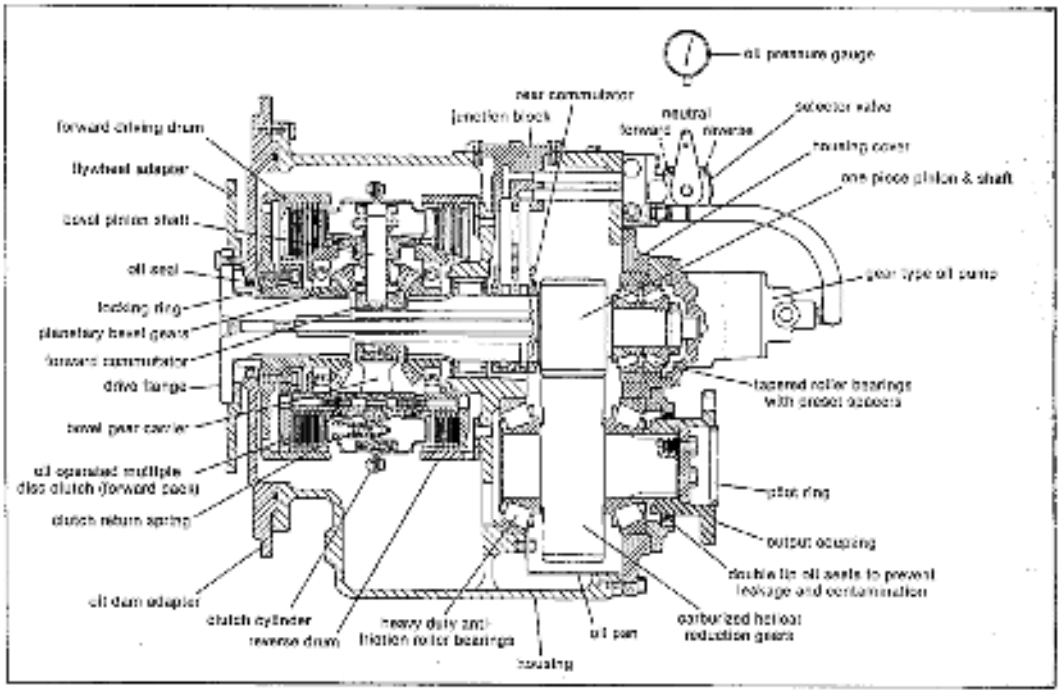


Figure 1. Cross Section Showing Components and Design Features.

SECTION 1. INTRODUCTION

The purpose of this manual is to provide assistance to operation and maintenance personnel to reduce downtime and obtain consistent performance from the Capitol HY-24000 Marine Transmission.

This service manual contains thorough installation and operation procedures, steps for proper maintenance and repair, a trouble-shooting guide for assessing difficulties promptly, and 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 transmission.

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

1.1 DESCRIPTION

The Capitol marine transmission is operated hydraulically, the clutch is activated by high-pressure oil and the gears, bearings and clutch discs are lubricated and cooled by low-pressure oil.

The marine gear consists of six major groups of parts; adapter group, clutch pack, oil pump, selector valve, pinion, shaft and reduction gear. The adapter parts vary according to engine application and include a flywheel adapter, drive flange, an oil dam/housing adapter that prevents engine oil contamination and a clutch driving drum. The clutch pack consists of reciprocating cylinders, clutch discs and a planetary bevel gear reverse system. The oil pump supplies oil pressure for clutch engagement and lubrication of bearings, gears and clutch. The selector valve is used to obtain forward neutral or reverse. The one-piece pinion and shaft drives the output gear directly or through an intermediary gear called an idler.

1.2 OPTIONAL EQUIPMENT

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

HOSE AND FITTING KIT
Kits that include the necessary hose and fittings are available for use with Capitol oil coolers.

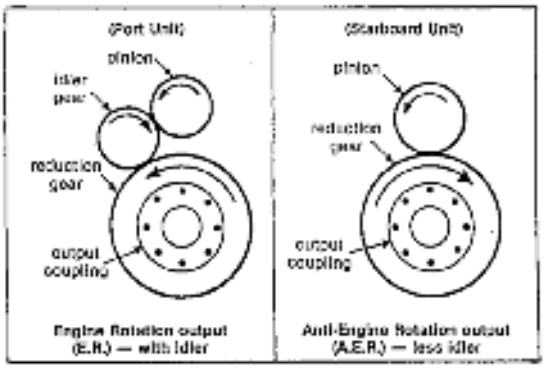
CLUTCHES
A forward-neutral clutch and a forward-neutral brake clutch are available in addition to the standard forward-neutral-reverse model.

KEYED OUTPUT SHAFT & COUPLING KIT
A keyed output shaft and a pilot bored prop shaft coupling kit are also 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, and 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 is then a product of engine r.p.m and the reduction ratio; for example 2000 r.p.m x 1/4 = 500 r.p.m output speed. The HY-24000 features three reduction ratios available in anti-engine or engine rotation output. They are 1.00 (to 1) 1.53 and 2.04.

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 fig.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.

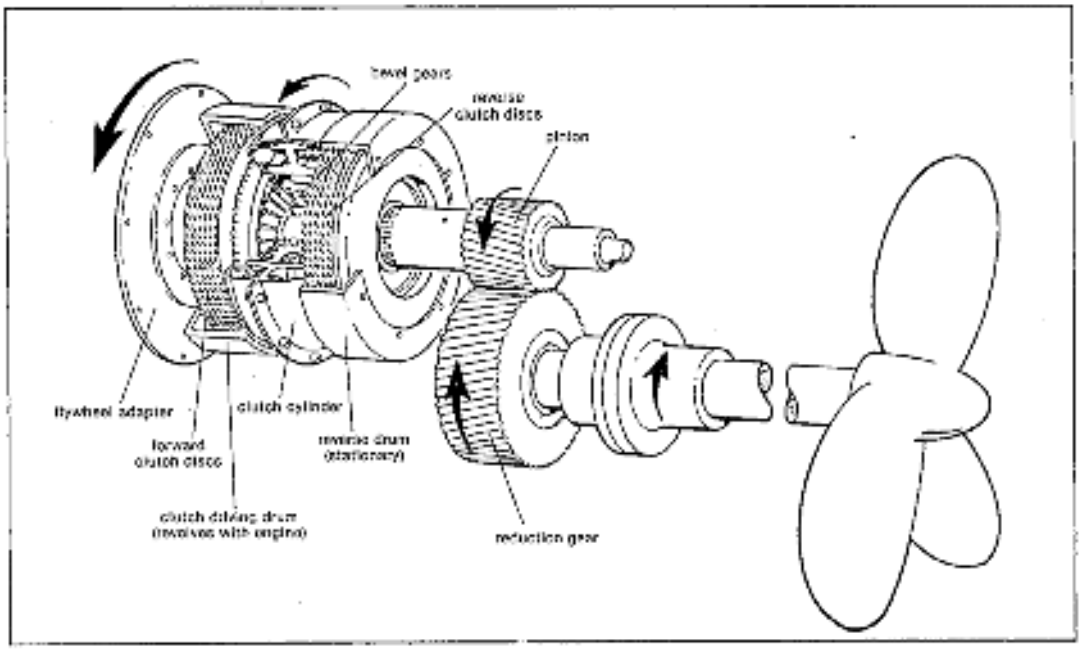
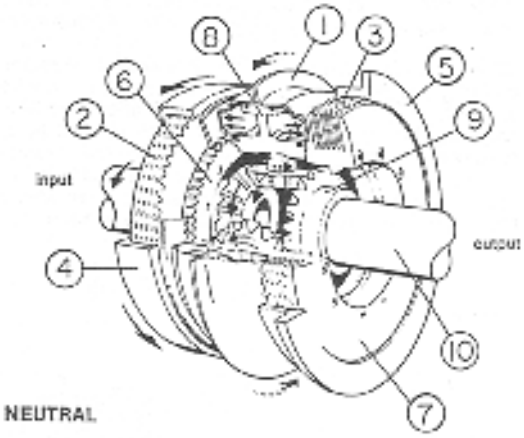


Figure 2. Power Flow (in forward mode).

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).

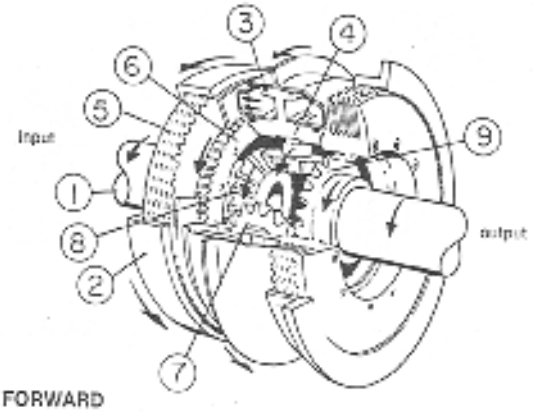
2.4 CLUTCH

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 acts 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.



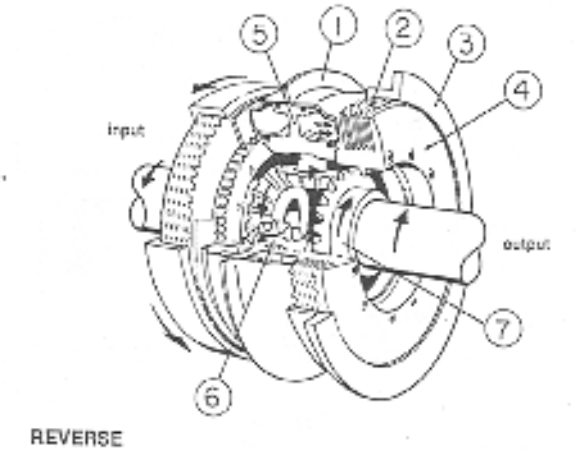
NEUTRAL

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

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) claming clutch discs (5) together. Half of discs are splined to forward driving drum and half are splined to forward driving drum and half are splined to the end flange (8). Because end flange is bolted to gear carrier and discs are now locked together, gear carrier with bevel gears (7) now rotates at engine speed along with driving gear. Rotating bevel gears cause driven gear (9) to turn with them and this causes rotation of output shaft in forward rotation.



REVERSE

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 the end flange (4) bolted gear carrier (5). Rotating gear carrier then stops. The bevel gears (6) now rotate on their shafts causing driven gear (7) to turn in anti-engine direction producing reverse output.

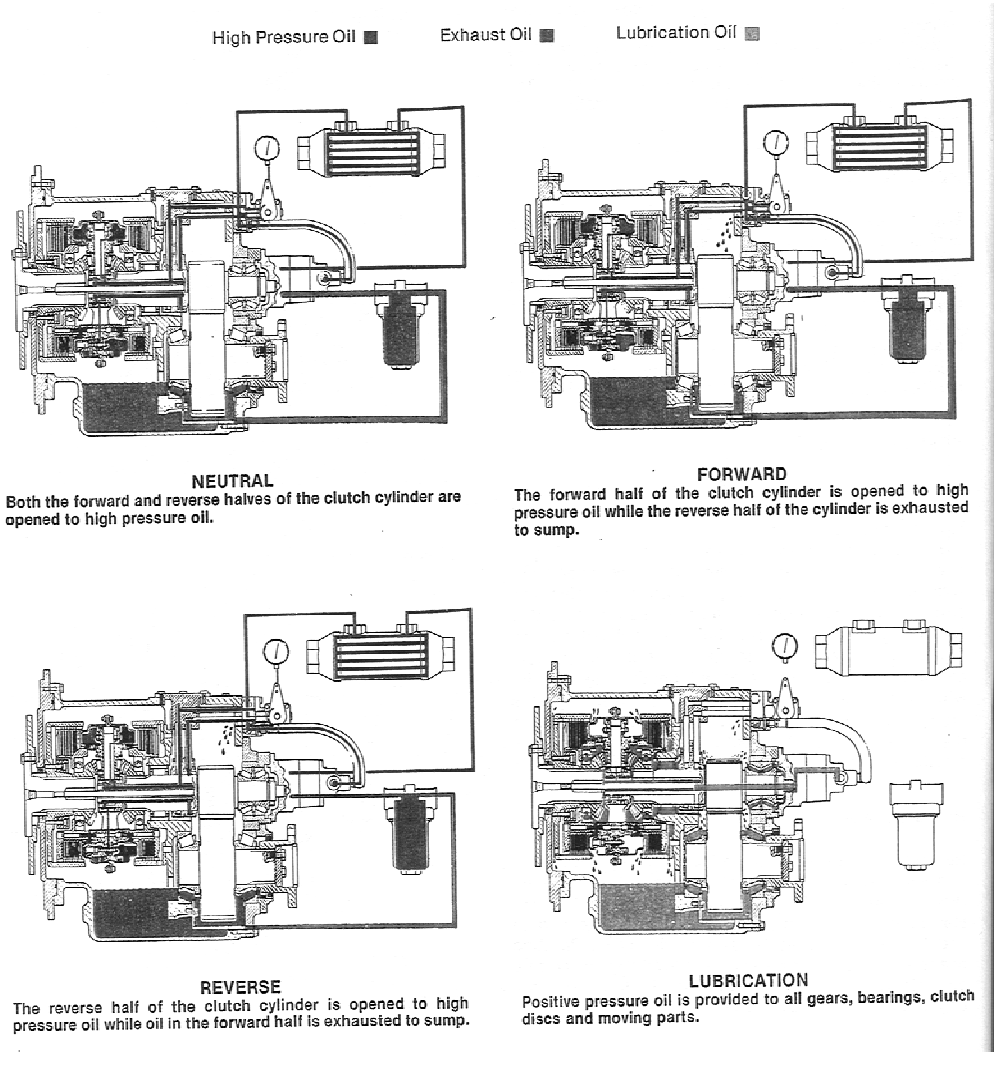
2.5 HYDRAULIC SYSTEM

Pressurized oil is provided by a gear type oil pump, which is externally mounted, and engine driven by means of a splined shaft. The pump includes a pressure relief valve to maintain the correct operating pressure.

Oil is drawn from the sump through a suction hose and oil filter, and then sent under pressure through the oil cooler and to the selector valve and pressure relief 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.



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

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

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

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

SECTION 3. INSTALLATION AND OPERATION

NOTE: IMPROPER INSTALLATION AND ALIGNMENT IS THE GREATEST CAUSE OF TRANSMISSION FAILURE. PLEASE FOLLOW 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-24000 housing is 465lbs; clutch is 115 lbs; adapter parts weigh approximately 100 lbs.

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

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 housing adapter, and drive flange shaft be dial indicated to insure trueness.

1.Mount thousandths dial indicator as shown (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 total of all readings in steps 1 through 4 must not exceed .007".

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

5.Separate the clutch assembly and clutch-driving drum (if necessary).

6. Remove oil dam adapter from transmission housing (if necessary).

7. Thoroughly clean flywheel adapter to engine mating surfaces and secure flywheel adapter (and drive flange) to engine flywheel with cap screws and lock washers (not furnished). Refer to figure 10.

8. Locate oil dam housing adapter (with new oil seal) on engine flywheel housing (be careful not to damage oil seal on splines of drive flange shaft). Secure adapter tentatively with cap screws and lock washers (not furnished).

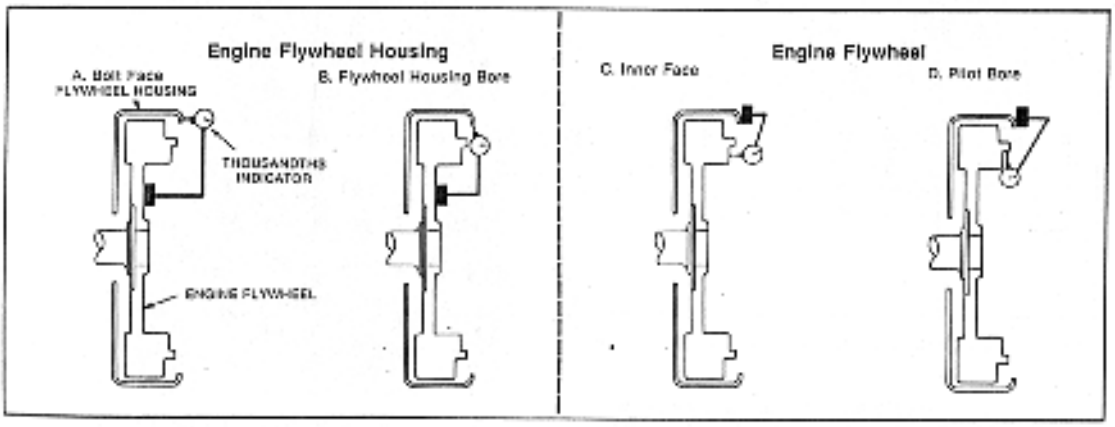


Figure 3. Dial Indicating Flywheel Housing and Engine Flywheel.

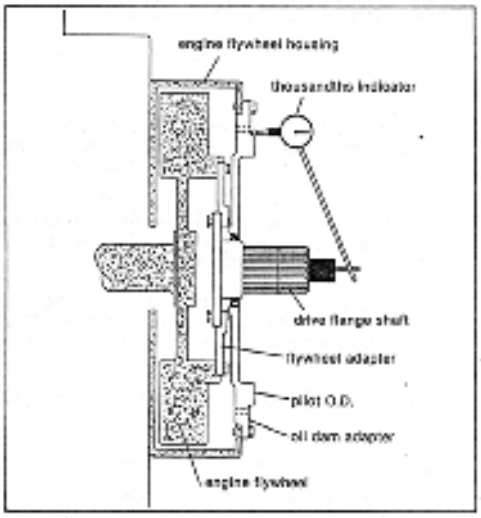


Figure 4. Dial Indicating Oil Dam Adapter Pilot O.D.

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

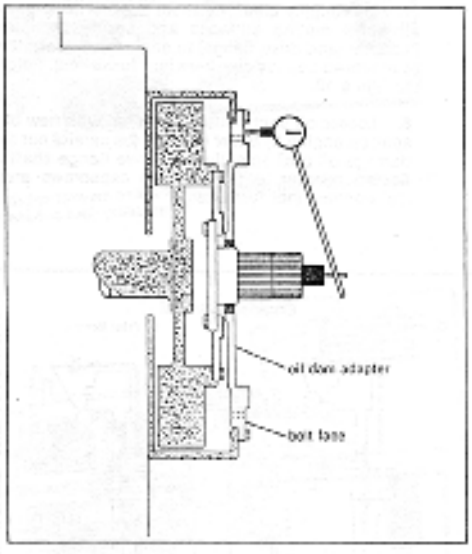


Figure 5. Dial Indicating Oil Dam Adapter Bolt Face.

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

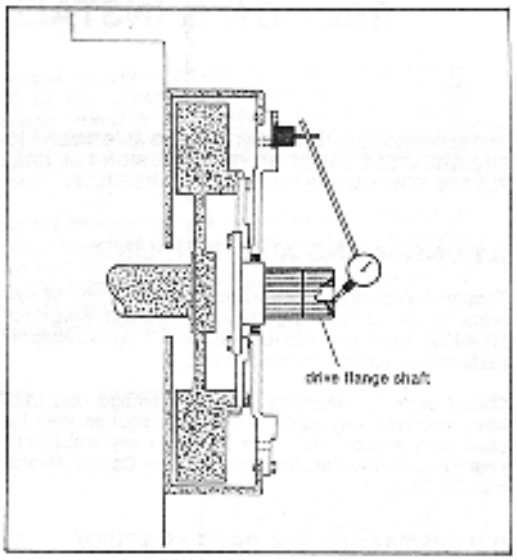


Figure 6. Dial Indicating Drive Flange Shaft.

11. Dial indicate drive flange on chamfer as shown in fig. 6. Record reading. Total indicator reading must not exceed .007 in.

The sum total of plus and minus readings in steps 9,10, and 11 must not exceed .007 in.

12. Apply anti-seize compound to splines of clutch driving drum and to tapered surface of drum where locking ring is applied.

13. Locate clutch driving drum on drive flange shaft and install snap ring in groove on drive flange shaft to secure drum see fig. 7.

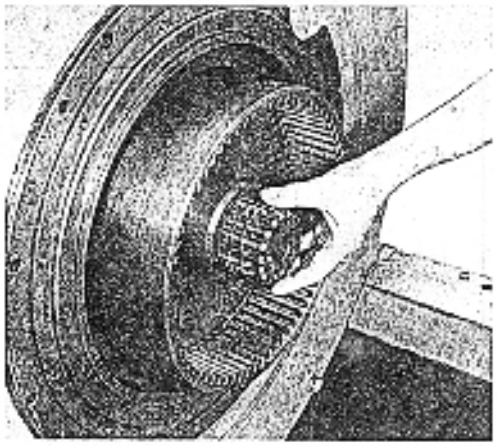


Figure 7. Installing Snap Ring in Groove on Drive Flange Shaft.

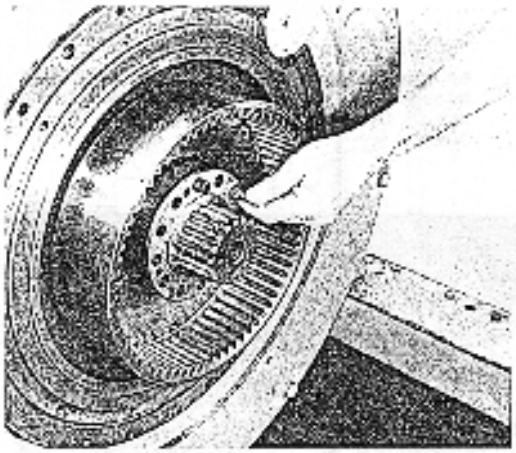


Figure 8. Installing Locking Ring on clutch Driving Drum.

15. Apply locking ring (see fig. 8) on clutch driving drum. Secure by torquing socket head cap screws* alternately as follows: 8 lb-ft the first time, 15 lb-ft the second time and 21 lb-ft the third time around. Torque all cap screws again at 21 lb-ft. for evenness. DON'T NOT OVER TORQUE!

*Note: Special self-locking cap screws are used. Do not substitute.

16. Using adequate hoist, install clutch on drive flange shaft (see fig.9) being careful that disc teeth enter driving drum properly. Forward end flange marked "toward engine" must be placed toward the engine flywheel. The forward pack contains more discs and must go toward the engine or severe damage may result.

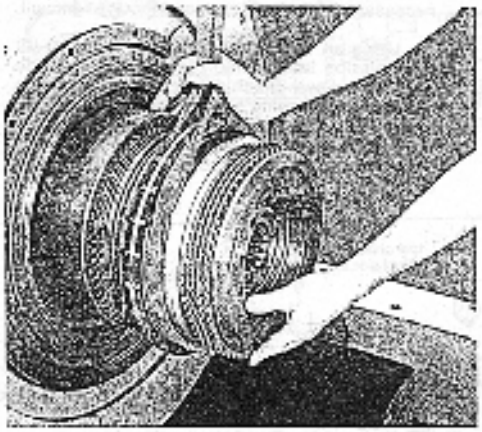


Figure 9. Installing Clutch on Drive Flange Shaft.

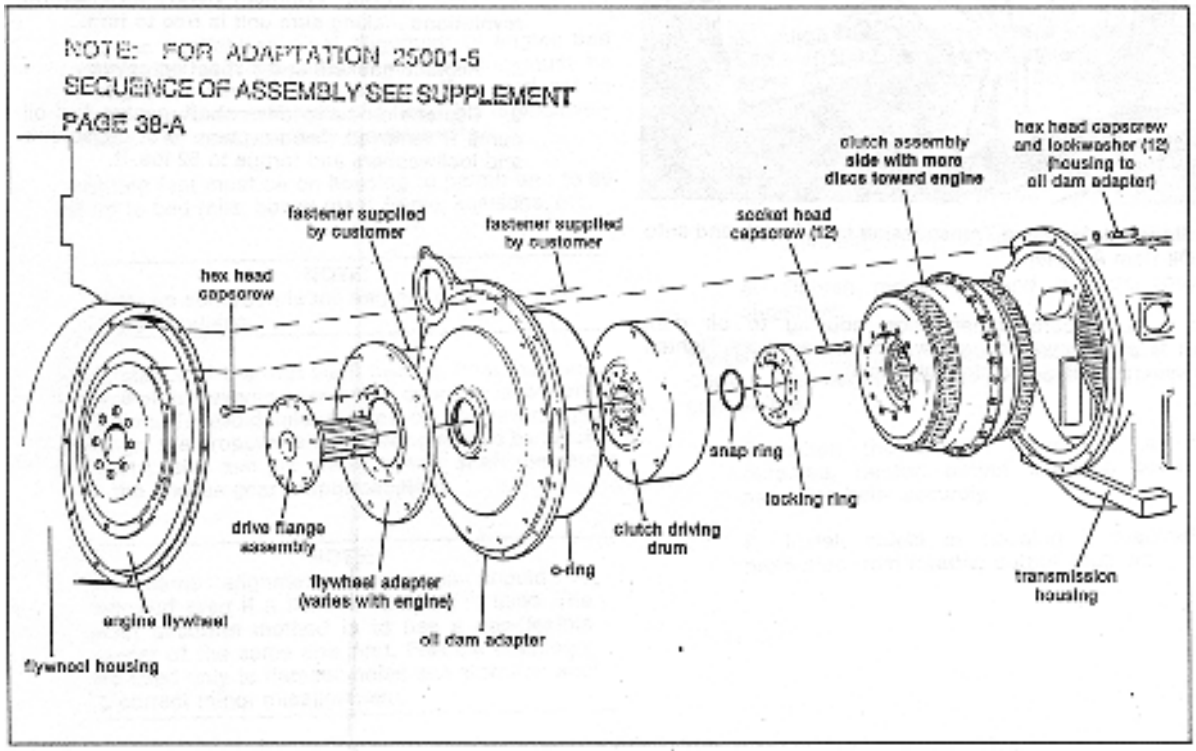


Figure 10. Sequence of Assembly: Adapter Parts, Clutch and Housing.

3.3 INSTALLATION OF TRANSMISSION

1.Apply a small amount of grease to oil dam adapter and locate large o-ring.

2. Remove side inspection covers to facilitate installation.

3. Remove oil pump and oil pump drive shaft if necessary, for limited space or difficult alignment.

4.Using an adequate hoist (see fig 11) 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 cap screws and lock washers. Tighten to 28 pounds-foot torque.

6. Check clutch end float: insert screwdriver through side inspection hole and pry clutch fore and aft. See fig.12. End float should be 1/16” to 3/32”.

7. Turn output coupling over for several revolutions making sure unit is free to turn.

8. Replace gaskets and inspection covers

9. Replace oil pump drive shaft, gasket and oil pump if removed. Secure pump with cap screws and lock washers and torque to 62lbs-ft.

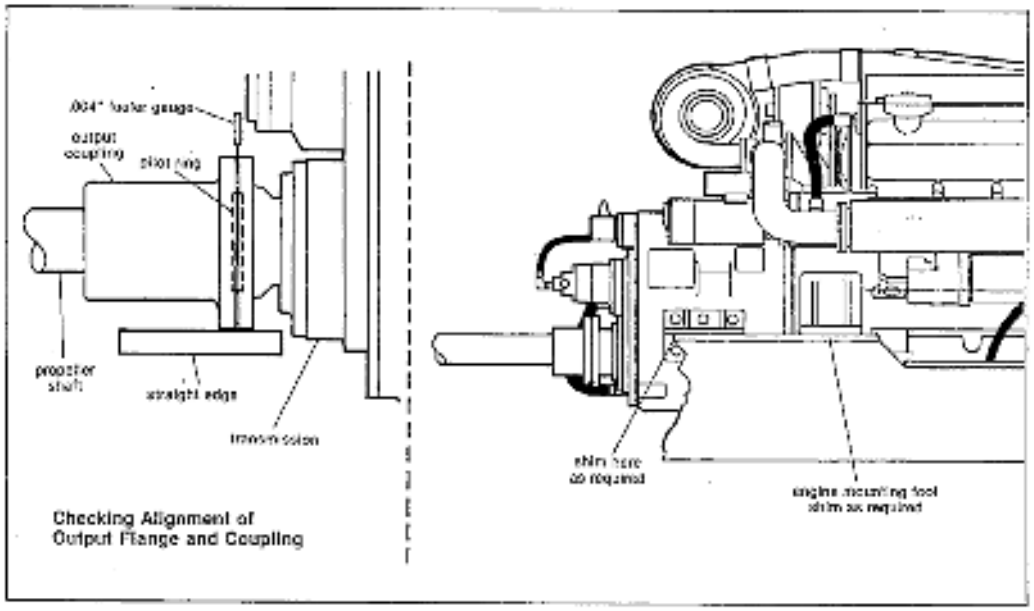


Figure 13. Alignment of Transmission and Engine to Prop Shaft Coupling.

3.4 ALIGNMENT

In marine application, final alignment of engine and transmission with 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 must be on housing to permit unit to be bolted to bed rails, power plant frame, keelsons, etc.

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

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.

1. 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.

2. Insert feeler gauge between couplings and run it all around the flange. Clearance should not be more than .004” at any point.

3. Shim engine and transmission as necessary

4. Tighten mountings and recheck coupling alignment.

These steps may have to be repeated several times. Correct alignment is extremely important in preventing gear failure.

5. When the correct clearance has been obtained tighten output coupling bolts and mounting bolts securely.

6. Install shield or housing if required for protection from rotating output coupling.

3.5 WATER PIPING

To assure proper cooling of a capitol marine transmission, 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. Transmission oil temperature should not exceed 150°F (65°C).

See installation drawing or page 57 for oil cooler plumbing instructions.

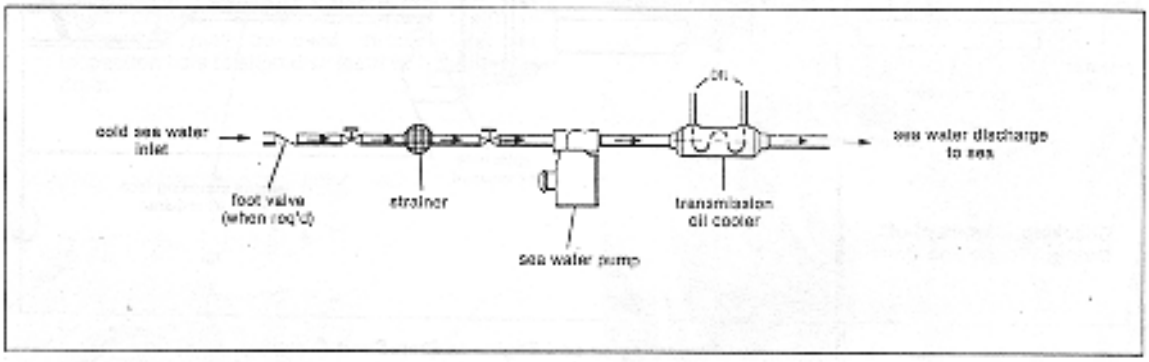


Figure 14. Separate Pump System.

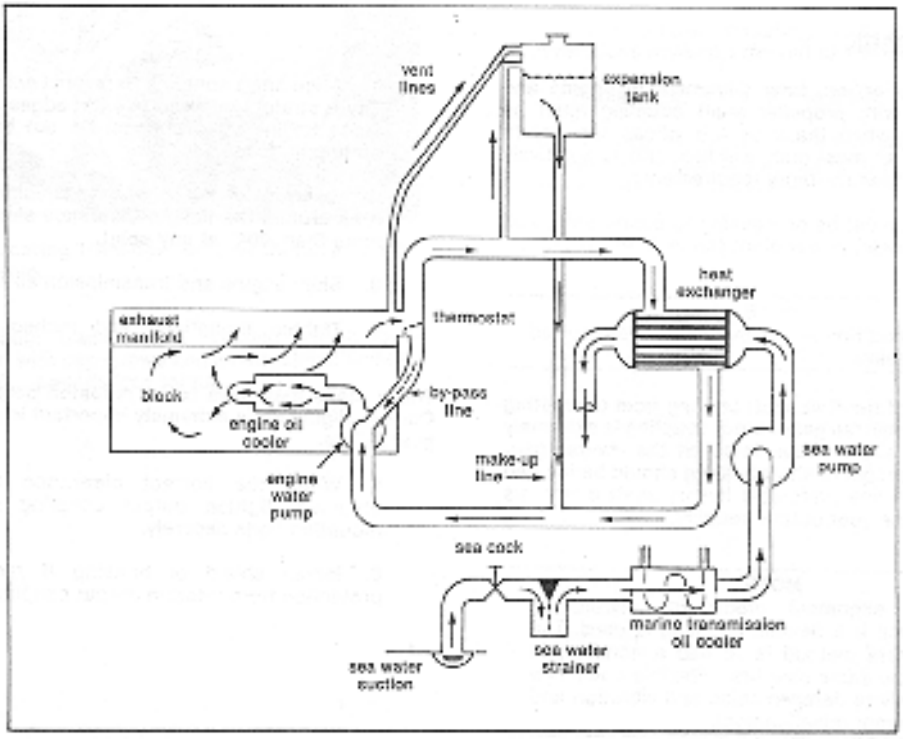


Figure 15. Heat Exchanger System.

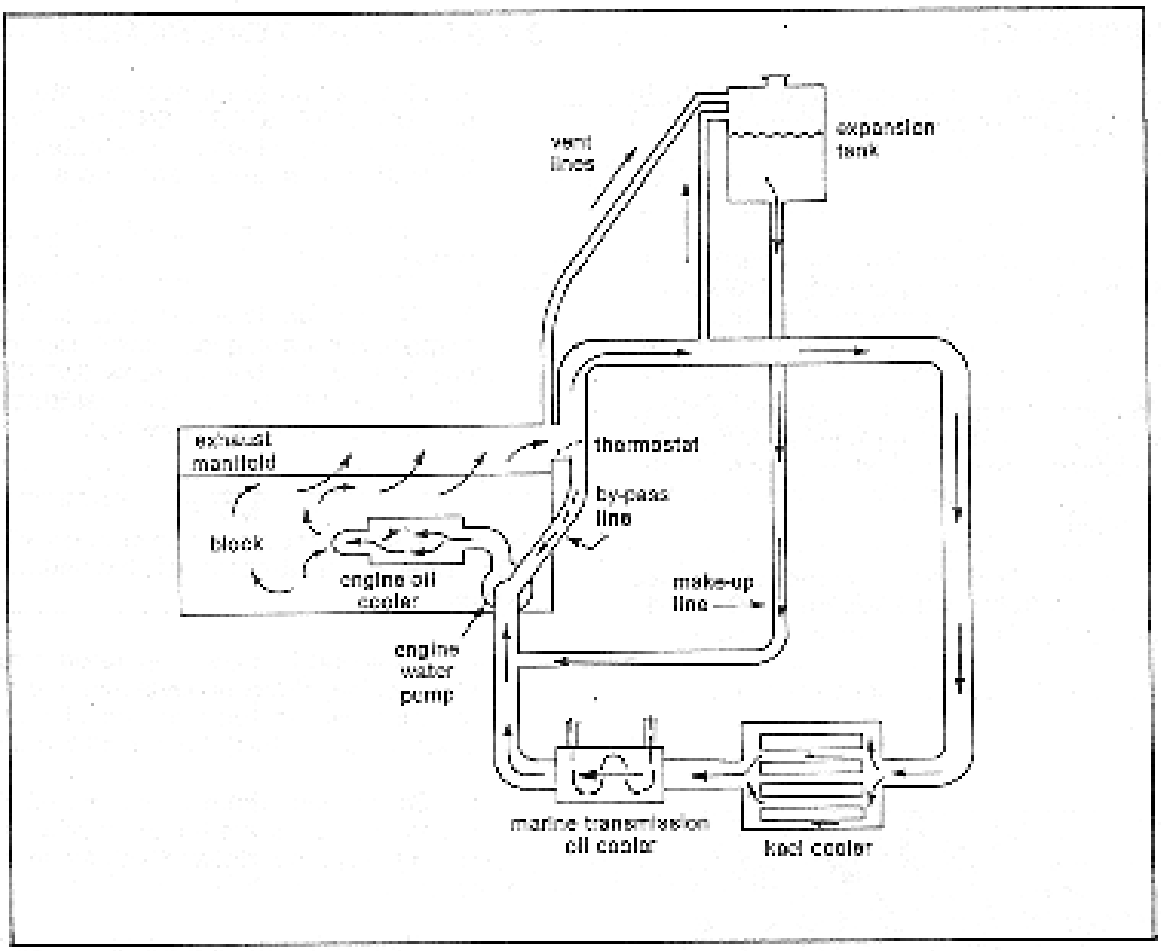
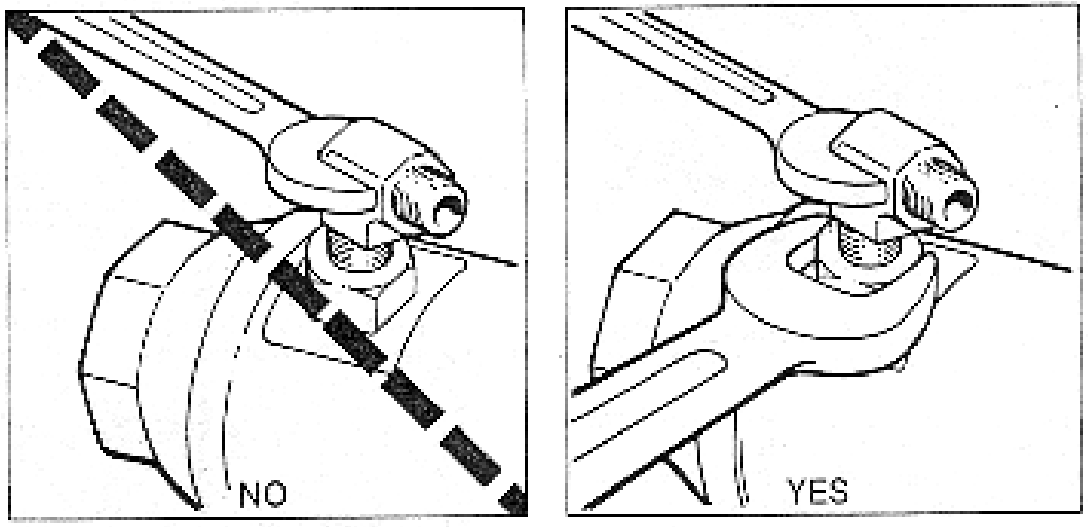


Figure 16. Keel Cooler System.



CAUTION: ALWAYS USE BACKUP WRENCH ON COOLER FITTINGS

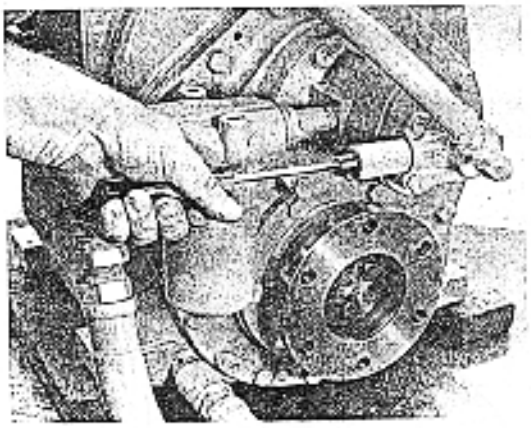
3.6 PRE-OPERATION

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

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.)

3. Remove oil breather and add recommended oil until level is up to full mark on dipstick (see lube chart p.13) replace but do not secure.

4. Make sure all mounting bolts are tight.



CORRECT OIL PRESSURE: 200-210 PSI
AT NORMAL OPERATING SPEED AND TEMPERATURE

Figure 17. To adjust oil pressure, remove dome nut and turn relief screw to the right (clockwise) for greater pressure, and to the left (counter-clockwise) for reduced pressure. CAUTION: Screw is under tension.

3.7 START-UP & OPERATION

1. Engage starter for approximately 30 seconds, but DO NOT START ENGINE. This activates pressure pump which pre-lubricates transmission, preventing premature wear before load is applied.

2. Start engine and check all connections for leaks.

3. 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 at normal operating speed and temperature (see fig.17 below).

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

4. 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.

5. Shift several times to insure that all cylinders, hoses and cooler are full of oil (level should point toward engine in forward, away from engine in reverse).

6. Check oil temperature at the selector valve. Temperature should be 120 to 150F. If overheating occurs it may be an indication of misalignment, inadequate cooling system, incorrect endplay etc. Engine should be shut down immediately and the problem located. See sec. 5.

Figure 18. Clutch Cylinder Timing Adjustment; used to regulate shifting time. Turn screw clockwise for slower response and counter-clockwise for faster response.

3.8 OPERATING PRACTICES

CAUTION

1. Transmission should not be in reverse mode (Lever away from engine) to move vessel

2. Transmission should not be operated in reverse for more than 30 minutes at 75° of Available horsepower.

3. Transmission should not be operated with Temperature over 150°F (65°C)

4. Shifting should only occur with engine at idle speed.

5. Never support rear of engine with forward transmission housing.

6. 'Wind milling' or freewheeling will almost certainly cause extensive internal damage to the Transmission. In the case of a twin screw application where only one engine is used primarily, shaft brakes must be installed. Another alternative is an auxiliary lubrication system.

7. Final alignment of engine and transmission With proper shaft coupling must be accomplished when vessel is afloat and not in dry-dock.

SECTION 4. PREVENTATIVE MAINTENANCE

To insure a long service life of the Capitol Marine Transmission and to prevent costly and unexpected Failures, it is very important that a regular maintenance Schedule is established.

4.1 LUBRICANTS

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

Oil Capacity (approximate, depending on cooler, hoses, etc.)
14.5 quart (13.7 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 200-1210 PSI at normal operating speed and maximum operating temperature.

Pressure adjustment
See fig. 17, p.12.

Oil temperature
Ideal operating oil temperature range is 130-150F (55-65C) at selector valve. Unit will tolerate higher temperatures but clutch life may be shortened considerably.

4.2 ROUTINE MAINTENANCE

Oil Cooler Assembly

If seawater is used for coolant, 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 cleaned every 400 hours of operation or at the same time oil is changed.

Oil breather

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

Pressure Gauge

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

Visual Inspection

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

Wear Analysis

At periodic intervals record pressure readings at idle speed. A gradual decline is normal. Readjust pressure relief valve to maintain proper operating pressures. See fig. 17 p.12.

Inspection/Overhaul Interval

A complete inspection of the Capitol marine transmission 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 sec.7)

See schedule sheet, next page.

4.3 MAINTENANCE SCHEDULE AND CHECK SHEET

Engineer_____
Transmission serial No_____
Date Service Began_____

INTERVAL **MAINTENANCE DESCRIPTION** **RECORD**
Normal operation

DAILY	-Check Oil level -Check oil pressure	
After first 100 hours	-Change oil and flush sump	☐
Every 400 hours	-Check zinc pencils -Change oil if contaminated -Remove and clean oil breathers -Wash filter element	
Every 2000 hours	-Check gear backlash (see p.37) -Check water tubes in cooler	
At engine overhaul	-Inspect clutch and all gearing and replace as necessary -Inspect and or overhaul entire transmission	
Frequently	-Check all oil lines and connections -Check all external components -Check all mounting bolts -Check alignment	

SECTION 5. TROUBLE SHOOTING

5.1 TROUBLE/REMEDY CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
A. Low oil pressure (At full operation speed and temperature).	1. Faulty pressure gauge	1. Check gauge against one of known accuracy
	2. Low oil level	2. Inspect gaskets, seals, hoses, and fittings for leakage. Pressure test oil cooler-tubes may leak.
	3. Clogged filter element	3. Clean filter element. Replace if damaged
	4. Clogged parts in selector valve, base plate or housing	4. Flush clean with solvent and blow dry.
	5. Clogged suction hose	5. Remove hose and clean with solvent. Blow dry.
	6. Dirt or sludge in transmission	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 gearbox thoroughly. Refill gear with proper oil and run for 25-50 hours. Drain sump and refill with new oil. This will remove any residual solvent.
	7. Worn pump assembly	7. Refer to oil pump section or fig. 17.
	8. Incorrectly adjusted pressure relief valve	8. See fig. 17
	9. Oil too hot	9. Check heat exchanger system for clogged oil cooler or hoses.
	10. Worn commutator bushing	10. See wear limits chart
	11. Incorrect lubricant	11. See lube chart
	12. Scratched clutch cylinders or hard quad rings in clutch cylinders	12. Replace as necessary
B. High oil pressure (at full operating speed and temperature)	1. Incorrectly adjusted pressure relief valve.	1. Refer to fig. 17
	2. Inoperable relief plunger in base plate	2. Refer to p. 21

	3. Incorrect oil	3. See lube chart
	4. Cold oil	4. Check heat exchanger system
	5. Cold oil at start-up	5. Transmission should be preheated see p.12
C. No oil pressure	1. Faulty pressure gauge	1. Check pressure with gauge of Known accuracy
	2. Broken hose	2. Replace hose, Inspect all hoses.
	3. No oil in transmission	3. Fill with proper oil see pg. 12
D. Overheating	1. Insufficient oil cooler capacity	1. Install adequate oil cooler
	2. Insufficient flow of cooling water	2. Increase water line sizes.
	3. Clutch slipping	3. Refer to symptom A.
	4. Water temperature too high at cooler	4. Decrease water temperature to cooler or relocate heat exchanger in cooling system.
E. Excessive noise in Transmission	1. Bearings worn or broken	1. Inspect bearings for scored, races, broken roller, flat spots etc.
	2. Gears worn or broken	2. Inspect gears and replace if necessary
	3. Noise in forward only	3. 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	4. This is normal because more gears are in operation in reverse mode.
	5. Improper alignment	5. Refer to section 3. p. 9
F. Noisy Pump	1. Dirt or sludge in oil	1. Remove oil pump and hoses. Clean thoroughly and reinstall
	2. Clogged hoses	2. Clean and replace and required
	3. Pump Cavitations	3. Oil level may be too low
	4. Defective oil pump assembly	4. Refer to oil pump section
G. Clutch does not release	1. Transmission is misaligned	1. Refer to installation section
	2. Improper oil in sump	2. Refer to lube chart
	3. Clutch discs warped	3. Replace as necessary
	4. Forward and reverse clutch	4. Clean or replace as necessary

	cylinders dirty or distorted 5. Rear commutator bushing is worn	5. Replace as necessary. See replacement wear limits chart
	6. Incorrect linkage adjustment to selector valve assembly	6. Adjust linkage
	7. Clutch discs fused due to slippage and overheating	7. Replace as necessary
G. Clutch slippage	1. Low oil pressure	1. See symptom A.
	2. Improper oil in sump	2. Refer to lube chart
	3. Clutch discs warped	3. Replace as necessary
	4. Forward and reverse clutch cylinders dirty or distorted	4. Clean or replace as necessary
	5. Rear commutator bushing is worn	5. Replace as necessary. See replacement wear limits chart
	6. Incorrect linkage adjustment to selector valve assembly	6. Adjust linkage
	7. Clutch discs fused due to slippage and overheating	7. Replace as necessary
H. Clutch slippage	1. Low oil pressure	1. See symptom A.
	2. Transmission is misaligned	2. Refer to installation section
	3. Oil temperature too high	3. Temperature should be 130 to 150F (55 to 65 C) at selector valve. Check heat exchanger system.
	4. Worn clutch discs	4. Replace as necessary, see replacement wear limits chart
	5. Incorrect linkage adjustment to selector valve assembly	5. Adjust linkage
	6. Improper oil	6. See lube chart
I. Clutch burned out	1. Low oil pressure	1. See symptom A.
	2. Clutch is shifted at other than engine speed	2. Install interlock shift controls
	3. Transmission misalignment	3. Check installation and alignment as described in installation section.
	4. Excessive heat	4. Check cooling system see p.10.
J. No neutral	1. Transmission is misaligned	1. Refer to installation Section
	2. Warped clutch discs	2. Replace as necessary

	3. Scored clutch cylinders 4. Worn or damaged commutator bushings (forward or rear)	3. Replace as necessary 4. Replace all 4 quad rings
	5. Worn selector Valve	5. Replace as necessary. See replacement wear limits
K. Clutch engages too slow	1. Cylinder timing screw Out of adjustment	1. Remove dome nut and adjust screw (counter-clockwise) to speed up reaction. See fig, 18.
L. Clutch engages too fast	1. Cylinder timing screw Out of adjustment	1. Remove dome nut and adjust screw (counter-clockwise) to delay Reaction. See fig, 18.