THIS SERVICE MANUAL COVERS THE FOLLOWING CAPITOL MARINE TRANSMISSIONS

4HE 10200 & 10700

2HE 10200 & 10700

HE 11200& 11700

THIS GROUP OF TRANSMISSIONS FORM THREE GENERATIONS OF THE HE DROP CENTER MODEL. ALL UNITS HAVE A NUMBER OF COMMON PARTS.

THE MOST NOTABLE DIFFERENCES BETWEEN MODELS ARE UNIQUE ENGINE ADAPTATION, PUMP DRIVE SHAFT & PUMP, CLUTCH ASSEMBLY, FORWARD DRIVING DRUM, DRIVE FLANGE ASSEMBLY & CONTROL VALVE BASE PLATE.

IT IS ALWAYS VERY ADVENTAGEOUS TO KNOW WHICH MODEL YOU HAVE!

CONSULT YOUR LOCAL CAPITAL SERVICE CENTER FOR PARTS AND SERVICE.

INDEX

NOTE

THIS SERVICE MANUAL IS
GUARANTEED EFFECTIVE FOR
SERIAL NO.
ONLY.

HE 10200 & HE 10700 SERVICE MANUAL CHANGES AND ADDITIONS; OCT. 1, 1979

Page 19 Delete the words ‘thick’ and ‘thin’ in paragraphs 5R and 6R.

Page 20 Delete the words ‘thick’ and ‘thin’ in figure 27 and 28.

Page 33 Item 7 in figure 42 should be item 5(2 places).

Page 34 4he Clutch Assembly part number should be 1-00100-0902, not 1-00100-1102.
Item 5 quantity should be 12 not 10.
Item 7 should be deleted entirely.
Item 23: Part number should be 1-13430-1600.

Page 36

ITEM 41	DESCRIPTION	OLD PART NUMBER	NEW PART NUMBER	QTY
	HOUSING (WITH IDLER, 3 TO 1)	1-10722-0400	1-10722-3000	1
	HOUSING (WITH IDLER, 21/2 TO 1)	1-10724-0400	1-10724-3000	1
10700-	HOUSING (WITH IDLER, 31/2 TO 1)	1-10732-0400	1-10732-3000	1
	HOUSING (WITH IDLER, 4 TO 1)	1-10742-0400	1-10742-3000	1
	HOUSING (NON-IDLER, ALL RATIOS)	1-10702-2500	1-10702-3000	1

Page 39

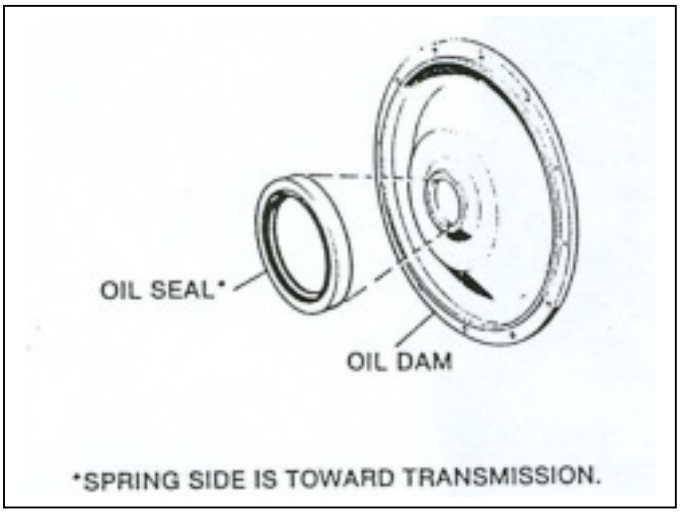
94	OIL PAN	(10700)	1-11836-0000	1
95	CAPSCREW, HEX HEAD	(10700)	1-13768-0000	2

CHANGE SECTION 7.5 – GEAR CASE AND CLUTCH

CLUTCH ASSEMBLY 1-00100-0902; EFFECTIVE, AUGUST 1979 FROM SERIAL NO. 11300-0779.
REFER TO ILLUSTRATION ON PAGE 33.

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	ASSEMBLY CLUTCH-4HE	1-00100-0902	1
1	CAPSCREW	1-12732-0000	6
2	LOCKWASHER, HIGH COLLAR	1-01104-1600	6
3	CLUTCH FLANGE, FORWARD	1-00212-1700	1
4	DISC, CLUTCH DRIVING	1-00230-4300	12
5	DISC, CLUTCH DRIVEN	1-00233-0700	12
6	ALLENUT, STANDARD	1-12733-0000	6
7	(SEE ITEM 5)		
8	BEARING	1-12364-0000	2
9	GEAR, DRIVING	1-00215-0900	1
10	CYLINDER	1-00234-8400	2
11	QUAD RING	1-00238-1500	2
12	QUAD RING	1-00237-1500	2
13	CARRIER, BEVEL GEAR	1-00219-1800	1
14	BEVEL GEAR, PINION	1-00217-1700	3
15	BEARING NEEDLE	1-12367-0000	3
16	BEARING, NEEDLE THRUST	1-12368-0000	3
17	WASHER, PILOT	1-12366-0000	3
18	WASHER, THRUST	1-12369-0000	3
19	NUT, FLEXLOC	1-11105-0000	3
20	SHAFT, PINION	1-00214-1800	3
21	PIN, SPRING	1-12095-1200	2
22	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
23	NAMEPLATE	1-13430-1600	1
24	CAPSCREW, SOCKET HEAD	1-11104-0000	3
25	NUT, SELF-LOCKING FLEXLOC	1-00226-3600	12
26	CAPSCREW, SOCKET HEAD	1-07837-0800	12
27	RETAINER, RETURN SPRING	1-00243-3500	12
28	SPRING, RETURN	1-00239-1500	12
29	NUT, FLEXLOC	1-07846-0800	12
30	CAPSCREW, SOCKET HEAD	1-13424-0000	12
31	GEAR, DRIVEN	1-00215-1800	1
32	CLUTCH FLANGE, REVERSE	1-00212-6100	1

ADDITION TO SECTION 7.6 MARINE GEAR ASSEMBLIES



OIL SEAL NO. 1-13713-0000 IS AVAILABLE SEPERATELY FOR OIL DAMS 1-11192-2600. 1-13040-2600 AND 12404-2600.

CHANGE: PARTS INFORMATION

7.6 MARINE GEAR ASSEMBLY

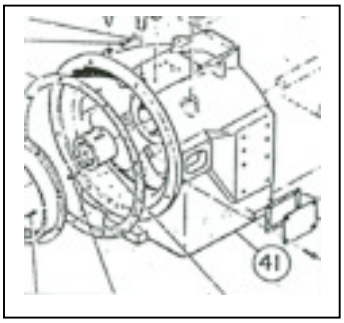


Fig. 43A

Page 36

41	HOUSING, (NON-IDLER: ALL RATIOS EXCEPT 1 TO 1)	1-12327-1000	1
	HOUSING, (WITH-IDLER: 1 TO 1 RATIO)	1-12327-2000	1
10200-	HOUSING, (NON-IDLER: 1 TO 1 RATIO)	1-12327-6000	1
	HOUSING, (WITH IDLER: 11/2 TO 1 RATIO)	1-12327-3000	1
	HOUSING, (WITH IDLER: 2 TO 1 RATIO)	1-12327-4000	1

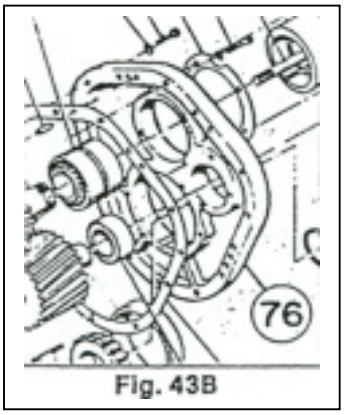
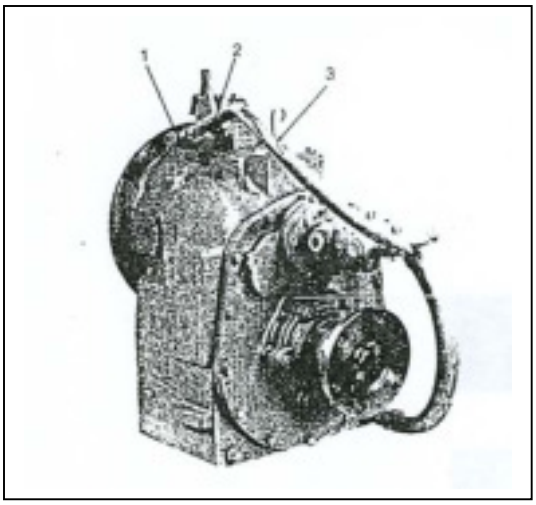


Fig. 43B

Page 39

76	COVER, (11/2 TO 1 WITH IDLER)	1-12330-3000	1
10200-	COVER, (2 TO 1 WITH IDLER)	1-12330-4000	1
	COVER, (1 TO 1 WITH IDLER)	1-12330-2000	1
	COVER, (NON-IDLER)	1-12330-1000	1

ADDITION TO SECTION 7.6 – MARINE GEAR ASSEMBLY

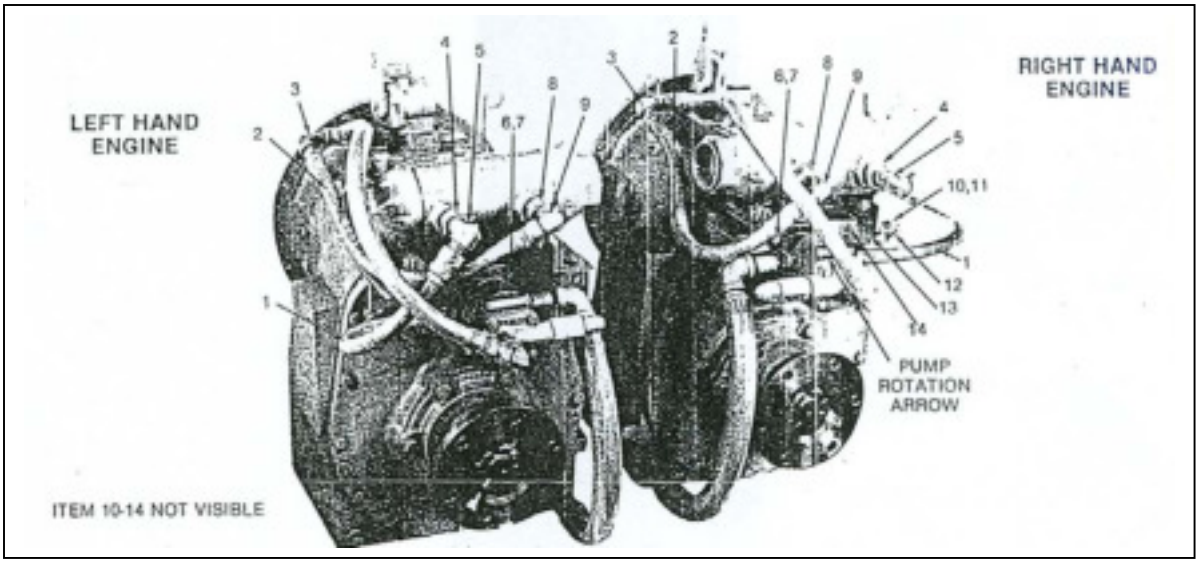


Hose, Tee and Pipe Nipple are now standard items on HE-10200 and HE 10700 Transmissions.

ITEM	DESCRIPTION	PART NUMBER	
1	Tee, Reducing (3/8x1/4x3/8")	1-11260-1500	1
2	Nipple, Pipe (1/4x 2" Lg.)	1-11259-3200	1
3	HOSE ASS'Y.(pump to Valve)	1-10952-0100	1

REAR COMMUTATOR BUSHING
NO. 1-00248-2100

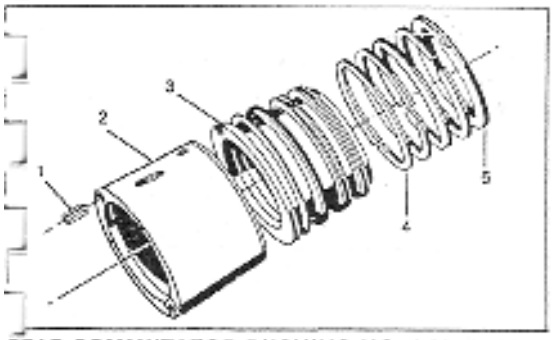
ADDITION TO SECTION 7.7 – COOLER KITS



HOSE AND BRACKET KIT NO. 1-13909-0000 TO BE USED WITH COOLER NO. 1-07808-5000

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	HOSE AND BRACKET KIT	1-13909-0000	1
1.	HOSE	1-12049-0800	1
2.	HOSE	1-08873-0900	1
3.	STREET ELL	1-11248-0300	1
4.	BUSHING 1X ¾	1-11253-1200	1
5.	ELBOW	1-11221-1700	1
6.	CAPSCREW	1-12452-0000	2
7.	LOCKWASHER	1-09458-0800	2
8.	BUSHING	1-11253-1100	1
9.	ELBOW	1-11221-1300	1
10.	FLAT WASHER	1-06671-0800	4
11.	CAPSCREW	1-07432-0800	4
12.	NUT, FLEX-LOC	1-13568-0000	4
13.	BRACKET	1-11996-0000	2
14	BRACKET	1-12447-0000	1

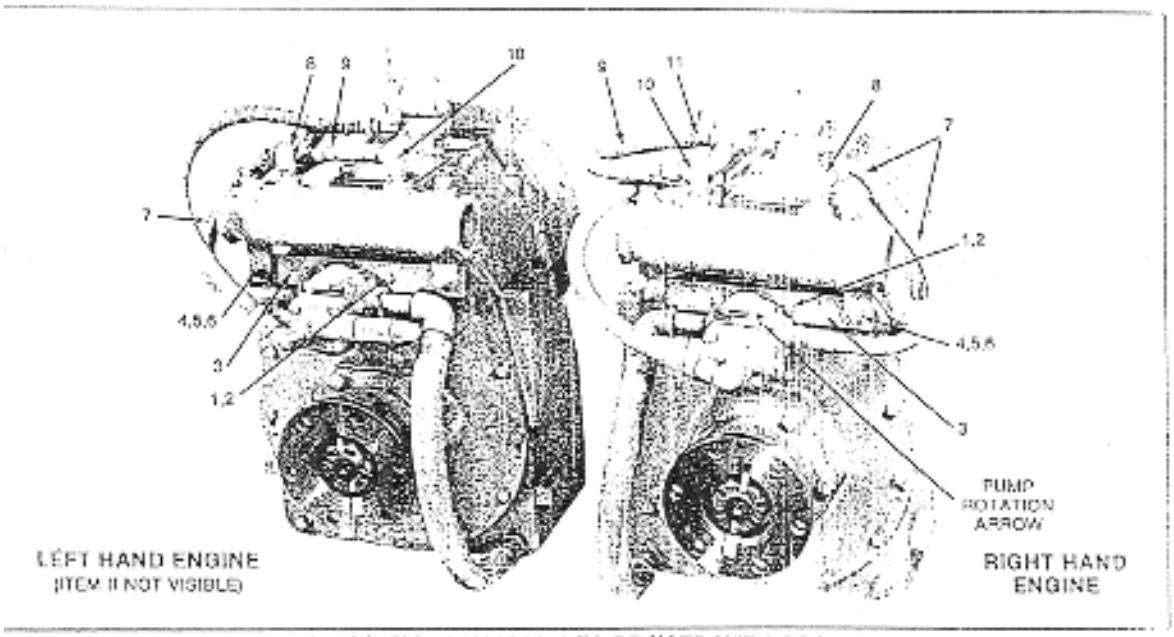
ADDITION TO SECTION 7.6- MARINE GEAR ASSEMBLY



REAR COMMUTATOR BUSHING NO. 1-00248-2100

The items listed below may now be ordered individually.

ITEM	*DESCRIPTION*	*PART NUMBER*	*QTY*
REF.	REAR COMMUTATOR BUSHING ASSEMBLY	1-00248-2100	1
1	COMMUTATOR SHELL	1-00500-1500	1
2	COMMUTATOR SLEEVE	1-00501-1500	1
3	PISTON RING	1-00502-1500	4
4	SNAP RING	1-00503-1500	1
5			



HOSE AND BRACKET KIT NO. 1-13908-0000 TO BE USED WITH COOLER NO. 12445-2100

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

ADDITION TO SECTION 7.6 – MARINE GEAR ASSEMBLY

CLUTCH ASSEMBLY 1-00100-1000; EFFECTIVE FROM SERIAL NO. 12000-0180
REFER TO ILLUSTRATION ON PAGE 33.

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	ASSEMBLY CLUTCH- 4HE	1-00100-1000	1
1.	CAPSCREW	1-12732-0000	6
2.	LOCKWASHER, HIGH COLLAR	1-01104-1600	6
3.	CLUTCH FLANGE, FORWARD	1-00212-1700	1
4.	DISC. CLUTCH DRIVING	1-00230-4300	12
5.	DISC. CLUTCH DRIVEN	1-00233-0700	12
6.	ALLENUT, STANDARD	1-12733-0000	6
7.	(SEE ITEM 5)		
8.	BEARING	1-12364-0000	2
9.	GEAR, DRIVING	1-00215-1000	1
10.	CYLINDER	1-00234-8400	2
11.	QUAD RING	1-00238-1500	2
12.	QUAD RING	1-00237-1500	2
13.	CARRIER, BEVEL GEAR	1-00219-1800	1
14.	BEVEL GEAR, PINION	1-00217-1000	3
15.	BEARING, NEEDLE	1-12367-0000	3
16.	BEARING, NEEDLE THRUST	1-12368-0000	3
17.	WASHER, PILOT	1-12366-0000	3
18.	WASHER, THRUST	1-12369-0000	3
19.	NUT, FLEXLOC	1-11105-0000	3
20.	SHAFT, PINION	1-00214-1800	3
21.	PIN, SPRING	1-12095-1200	2
22.	BUSHING, FORWARD COMMUTATOR	1-00247-1800	1
23.	NAMEPLATE	1-13430-1800	1
24.	CAPSCREW, SOCKET HEAD	1-11104-0000	3
25.	NUT, SELF-LOCKING FLEXLOC	1-00226-3600	12
26.	CAPSCREW, SOCKET HEAD	1-07837-0800	12
27.	RETAINER, RETURN SPRING	1-00243-3500	12
28.	SPRING, RETURN	1-00239-1500	12
29.	NUT, FLEXLOC	1-07846-0800	12
30.	CAPSCREW, SOCKET HEAD	1-13424-0000	12
31.	GEAR, DRIVEN	1-00215-2000	1
32.	CLUTCH FLANGE, REVERSE	1-00212-6100	1

NOTE: ALWAYS ORDER REPLACEMENT PARTS ACCORDING TO CLUTCH ASSEMBLY NUMBER STAMPED ON CLUTCH CYLINDER.

CHANGE SECTION 6.2 – TABLE: REPLACEMENT WEAR LIMITS

THE WEAR LIMITS CHART LOCATED ON PAGE 16 MUST CHANGE AS SHOWN FOR CLUTCHES 1-00100-0902 AND 1-00100-1000.

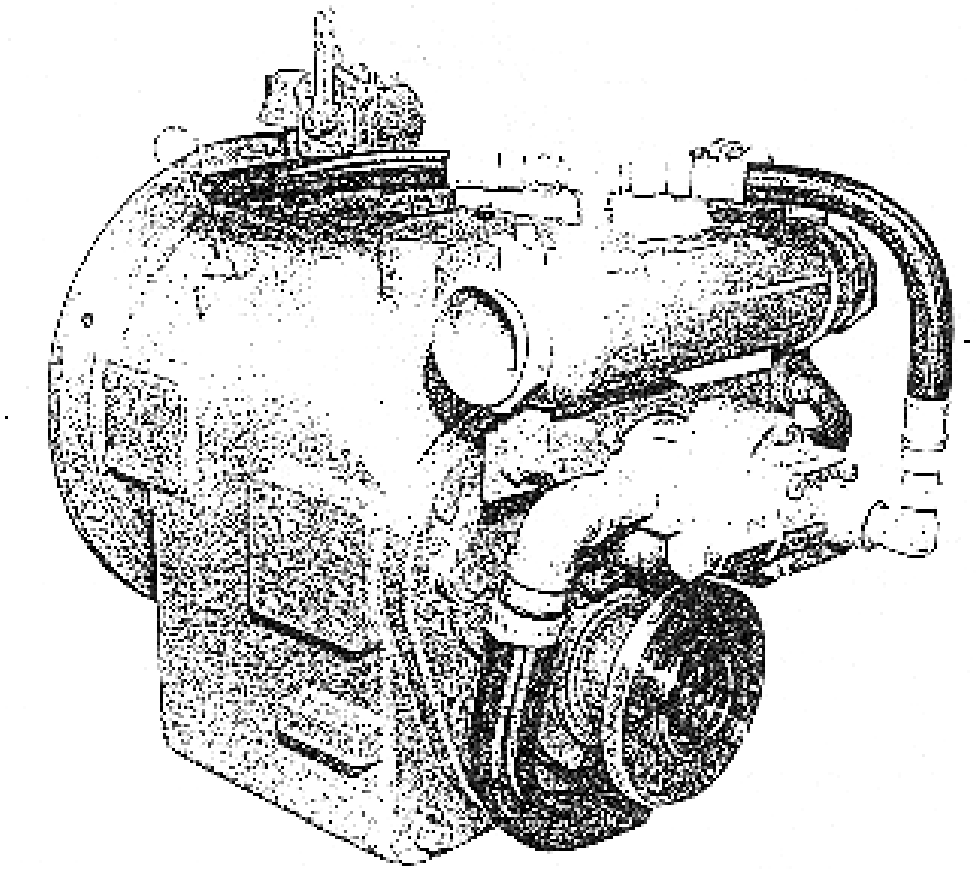
ITEM		NEW DIMENSIONS MIN.	NEW DIMENSIONS MAX.	REPLACEMENT WEAR LIMIT
CLUTCH PACK	THICKNESS: FORWARD PACK (COMPRESSED)	1.626	1.675	1.600
	THICKNESS: REVERSE PACK (COMPRESSED)	1.090	1.195	.990
CLUTCH DISC	THICKNESS: DRIVING	.130	.140	.120
	DRIVEN, STEEL	.088	.100	.078

CAUTION

DO NOT INSTALL AN ENGINE ROTATION UNIT ON L.H. ENGINE (CLOCKWISE AT FLYWHEEL.)
DO NOT OPERATE IN REVERSE MODE TO MOVE VESSEL FORWARD.
DO NOT OPERATE IN REVERSE FOR EXCESSIVE PERIOD OF TIME.
DO NOT OPERATE UNIT WITH LOW PRESSURE.
DO NOT "WINDMILL" UNIT IN EVENT OF ENGINE FAILURE (PROP SHAFT SHOULD BE LOCKED TO PREVENT "WINDMILLING").
DO NOT ATTEMPT FINAL ALIGNMENT OF OUTPUT FLANGE AND PROP SHAFT COUPLING WHEN VESSEL IS IN DRYDOCK.

SERVICE MANUAL

HE 10200 &
HE 10700
MARINE
TRANSMISSIONS



SERVICE MANUAL HE-100

TABLE OF CONTENTS

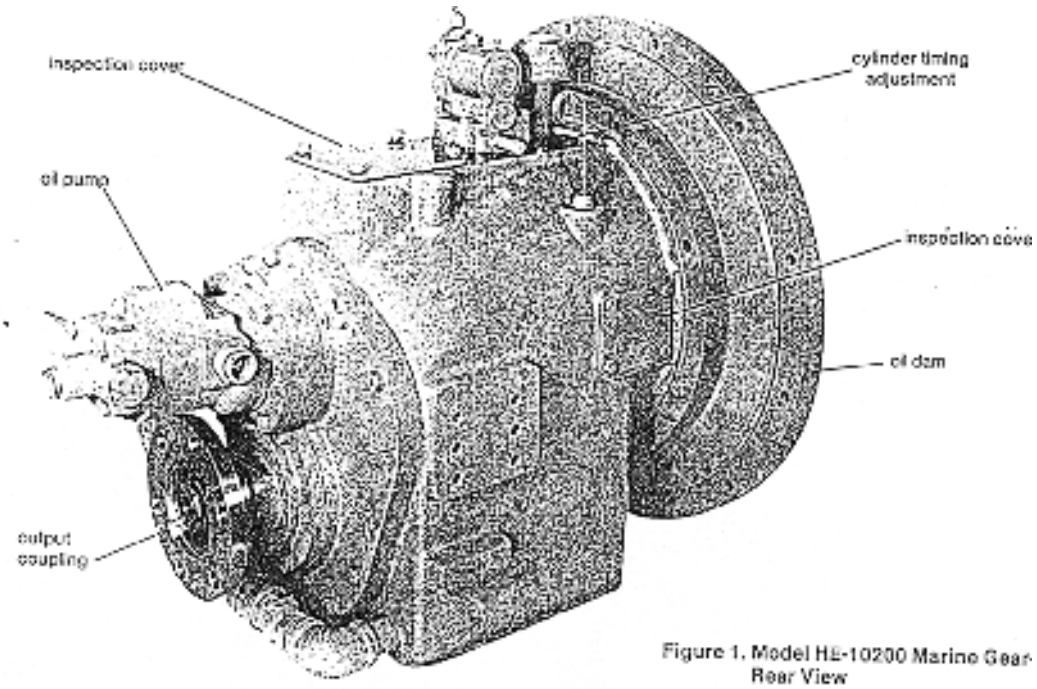


Figure 1. Model HE-10200 Marine Gear
Rear View

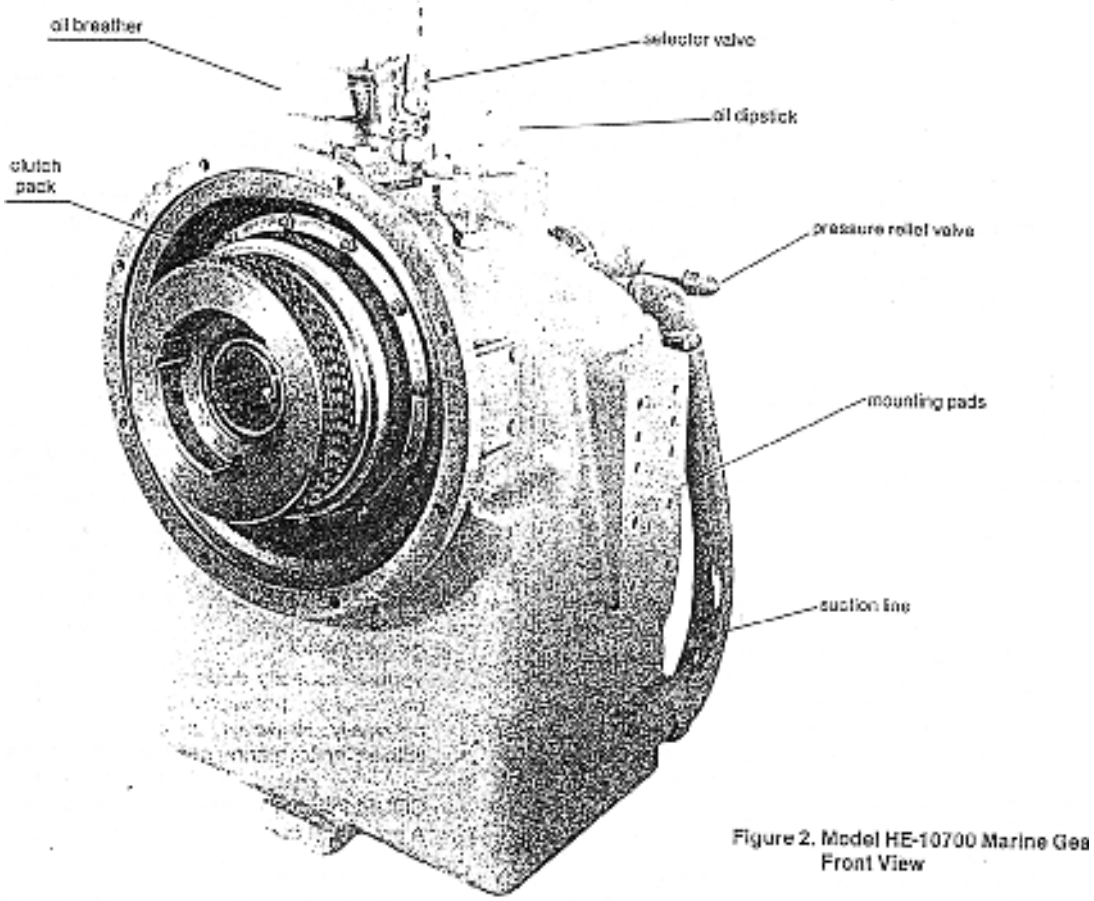


Figure 2. Model HE-10700 Marine Gea
Front View

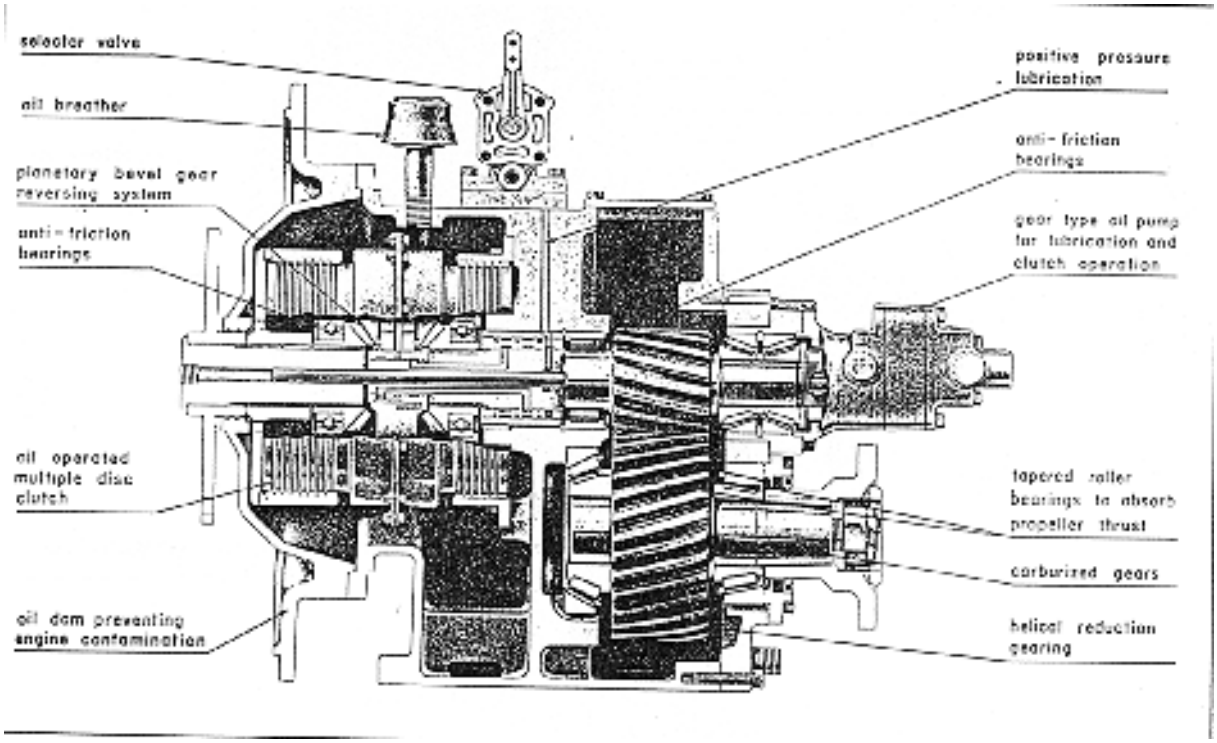


Fig.3 Cross section View showing internal components

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 responsible for the operation or servicing of the marine gear.

This service manual contains a troubleshooting guide, which will aid in assessing difficulties promptly. A series of exploded views are provided in the parts information section, and engineering drawings are included for fabrication of special tools that may be required.

1.1 DESCRIPTION

The capitol marine gear, described in this manual is a right hand rotation unit (when viewed from the front of the engine). For installation on a right hand engine, the marine gear can be converted for left hand rotation, if necessary, for use on a twin-screw installation.

The marine gear consists of four major subassemblies; the clutch pack, oil pump, selector valve, and the reduction gear assembly. The clutch pack consists of reciprocating 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. A selector valve provides option of forward, neutral or reverse. An oil pump supplies oil pressure for clutch engagement, and lubrication for bearings, gears and clutch. The marine gear is direct mounted to the engine fly-wheel 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 differences between engine speed and propeller speed. These ratios are subject to change and are available upon request. Because the 10700 model carries a larger bull gear, the center distance is greater and the housing is deeper than the 10200 models. The two models are identical in design and parts vary only slightly, the function of parts, maintenance, procedures etc. For all HE units are the same.

1.3 ACCESSORIES

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

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

SECTION 2. PRINCIPLES OF OPERATION

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). When a unit is supplied for a left hand engine a left hand pump is used. For twin-screw installations, where two right hand engines are used, the port unit is furnished with an idler gear. This produces and engine-rotation output, thus the propellers can be turning opposite to each other in outboard direction.

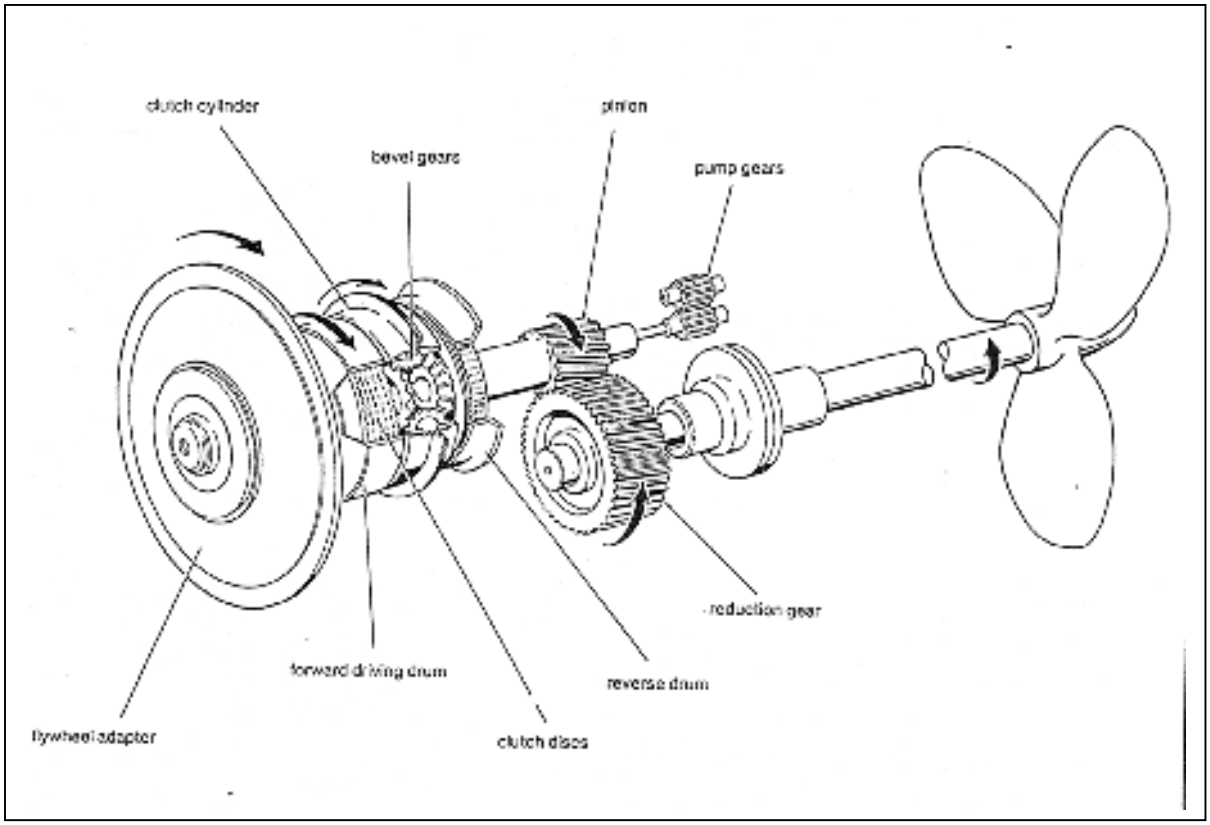
2.2 POWER FLOW

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 drives the reduction gear in an anti-engine direction at a speed determined by the reduction gear ratio.

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 clutch pack rotates as a solid lock up so there is minimal power loss from the engine through the marine gear.



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 two cylinders bolted together, which act as the clutch pistons and a carrier for the bevel gears. 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 gear carrier houses the five bevel gears that transmit power flow to the pinion when the selector valve is in reverse mode.

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 position.

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 that reverse the rotation of the pinion shaft. Thus – backward motion of the boat is obtained.

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 pinion (9) & (10). Bevel gears may revolve on their own pinions and gear carrier orbits at approximately half engine speed.

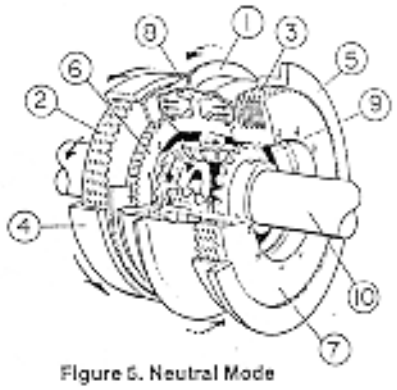


Figure 5. Neutral Mode

FORWARD MODE

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

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

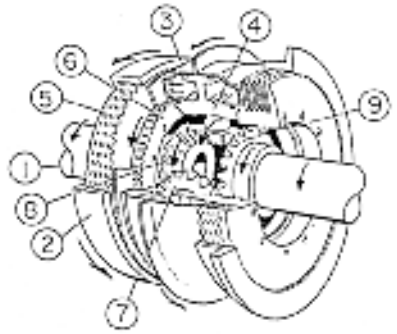


Figure 6. Forward Mode

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). Orbiting gear carrier then stops. The bevel gears (6) now rotate on their pinions causing driven gear (7) to turn in anti-engine direction producing reverse output.

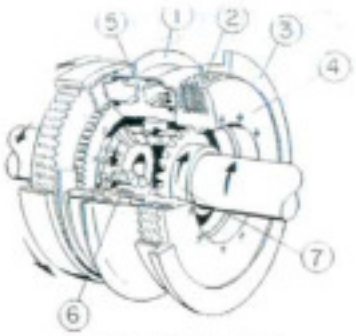


Figure 7. Reverse Mode

Figure 8.
Clutch Pressure Circuit
-neutral

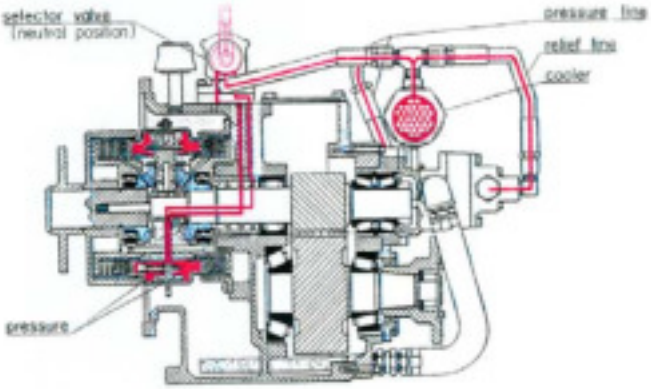


Figure 9.
Clutch Pressure and Exhaust
Circuit-forward

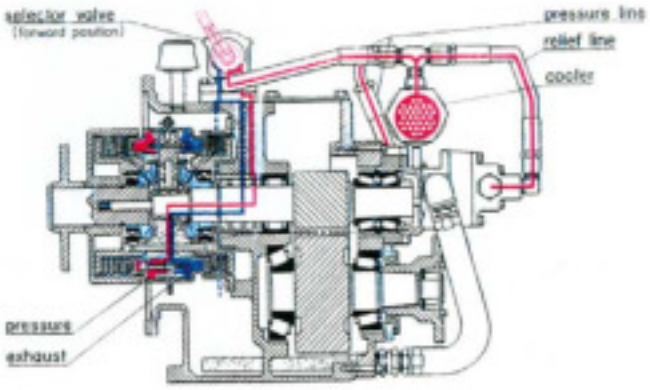
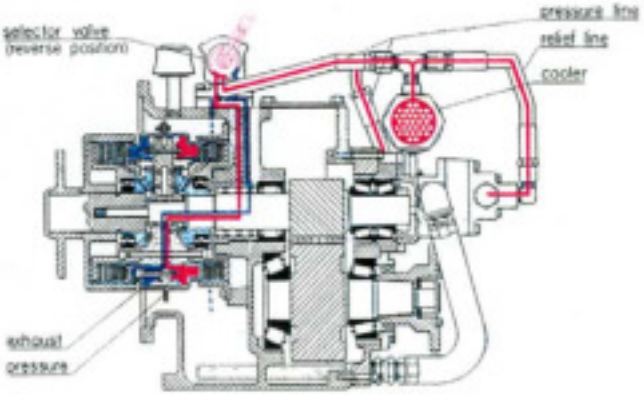


Figure 10.
Clutch Pressure and Exhaust
Circuit-reverse



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 id 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.

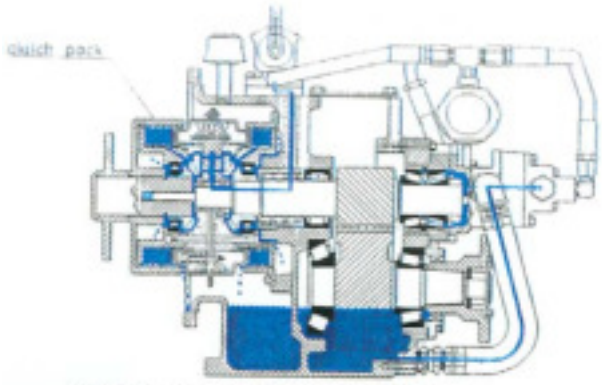


Figure 11. Internal Lubrication Oil Diagram

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 4HE 10200 is 400 lbs., the 10700 is 600 lbs.

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

3.2 PRELIMINARY INSTALLATION

SPECIAL TOOLS REQUIRED

1. Chain hoist or equivalent
2. Thousandths Dial indicator
3. Feeler Gauge
4. Straight Edge

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. Make sure all surfaces are clean.

1. (Fig. 12 A) Dial indicated 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. 12 B) Mount indicator with stem riding on flywheel housing bore as shown. Rotate flywheel and record Reading. The bore eccentricity must not exceed a **total indicator reading** of .007 inch.
3. (Fig. 12 C) Mount indicator to flywheel housing so that stem 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. 12 D) set stem to ride on the pilot bore of engine flywheel as shown. Record reading. Pilot bore eccentricity must not exceed a **total indicator reading** of .007 inch.

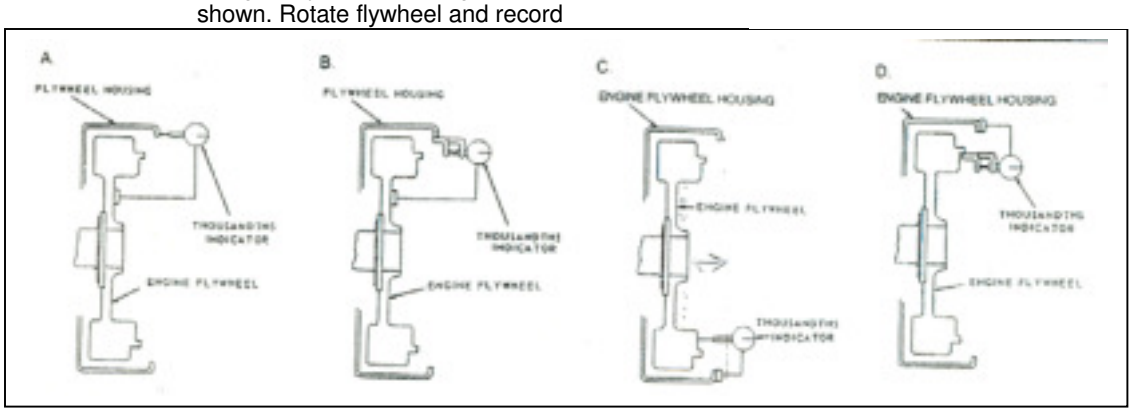
The sum total of all readings in step 1 through 4 must not exceed .007 inch.

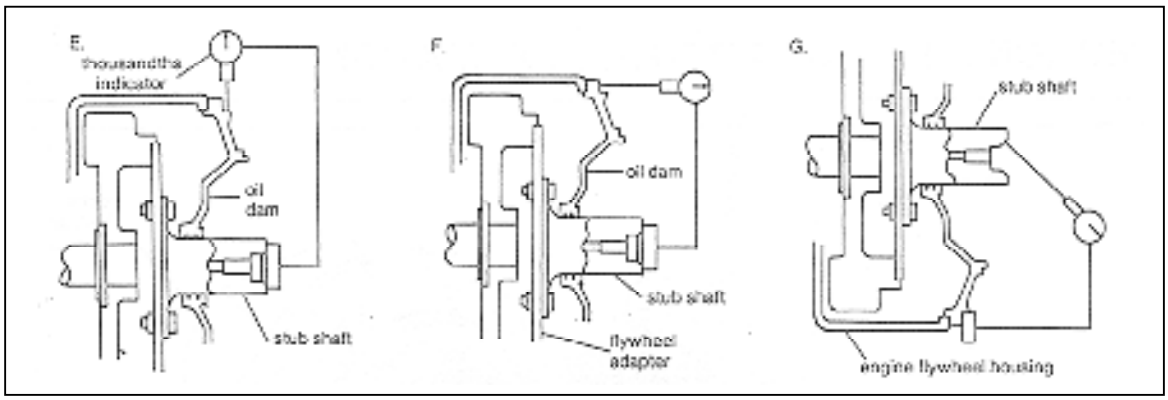
Note:

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

5. Separate clutch from forward driving drum and flywheel adapter. Remove snap ring and drum from stub shaft. So not remove drive flange/stub shaft from flywheel adapter.
6. Thoroughly clean the flywheel adapter and flywheel mating surfaces and secure adapter to flywheel.

Fig.12 Checking trueness of Engine Flywheel housing and flywheel





7. Place oil dam housing on engine flywheel housing, “top” mark goes up. Tighten 2 cap screws to hold oil dam in place. Dial indicate rear oil dam pilot O.D as shown in figure 13E and dial indicated bold face as shown in figure 13F. Record both readings. **Total indicator readings** must not exceed
.007 inch.

8.Dial indicated the drive flange/stub shaft as shown in figure 13G. Record the reading. **Total indicator readings** must not exceed .007 inch.

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

9.Check clearance between stub shaft O.D and oil dam ID with feeler gauge. Minimum clearance must not be less than .006”. Secure with self-locking fasteners before continuing on the next step.

10.Install driving drum on splined stub shaft Install snap ring in place making sure ring is seated in groove. See figure 14.

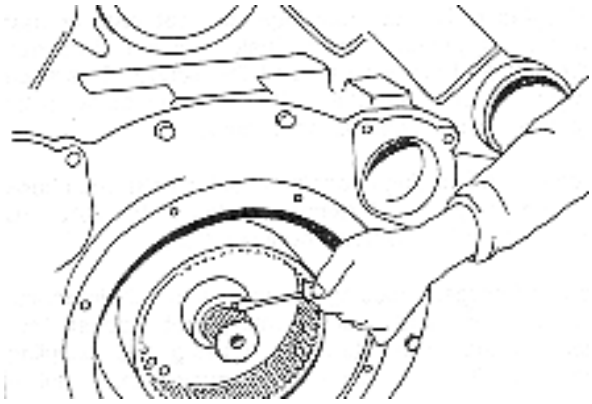


Fig.14 Placement of snap ring on stub shaft

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

Note:

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

NOTE:

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

12. Position gasket on oil dam mounting face.

13. Remove pump and pump shaft.

14. Remove side inspection cover to facilitate ease of installation.

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. See fig. 15,p.7.

NOTE:

Use screwdriver through slide inspection hole and Move disc teeth to align with reverse drum.

2.Secure main hous9ing to oil dam housing. Tighten cap screws to 31 foot-pounds torque.

Check clutch end float:

a) Insert screwdriver through side inspection hole and pry clutch fore and aft. End float should be 1/16” to 3/32”.

b) Replace gasket and inspection cover.

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

4. Secure oil pump and oil cooler bracket on main housing cover. Tighten to 18 foot-pounds torque.

5. Reconnect all hoses. Refer to fig. 44 or 45.

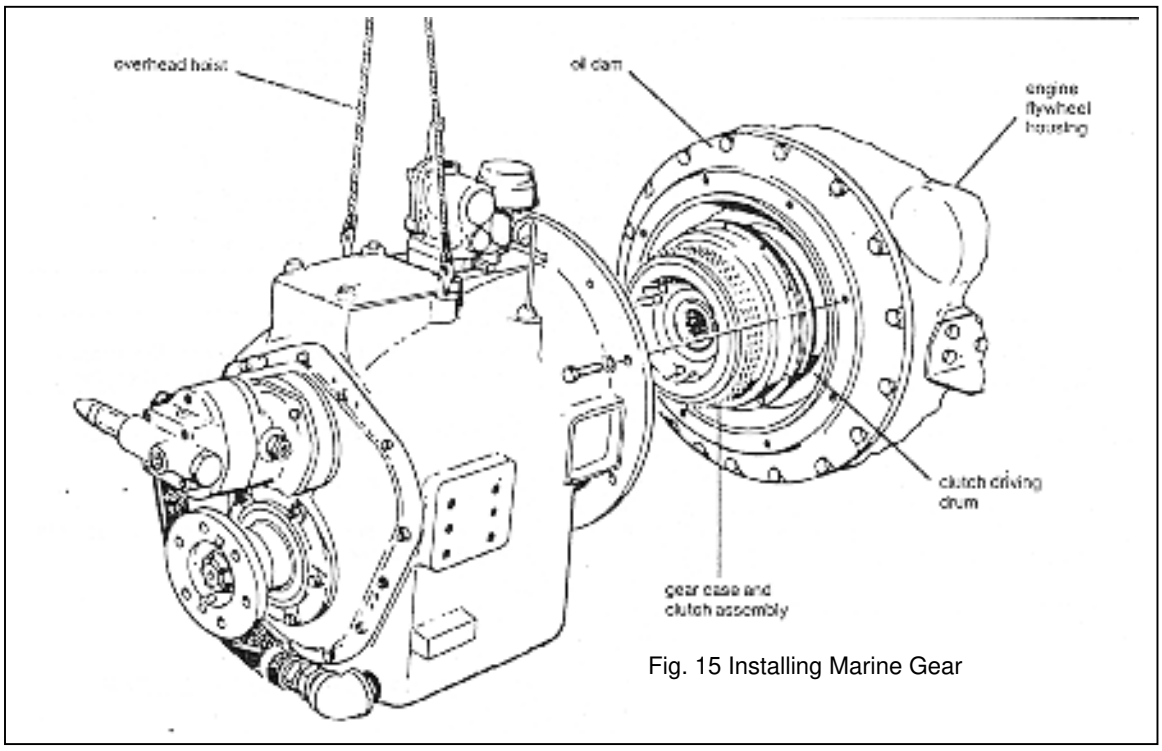


Fig. 15 Installing Marine Gear

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.

Now align propeller shaft coupling to marine gear coupling. Lay a straight edge across the edges at top and sides to line up couplings. DO not burr or mar mating surfaces. Insert feeler gauge between couplings and run it all around the flange. Clearance should not be more than .006” at any point. Shim engine and marine gear as necessary.

Loosen gear housing to engine housing bolts and check with feeler gauge; maximum variation for SAE #0 housing .008”; #1 housing .006”.

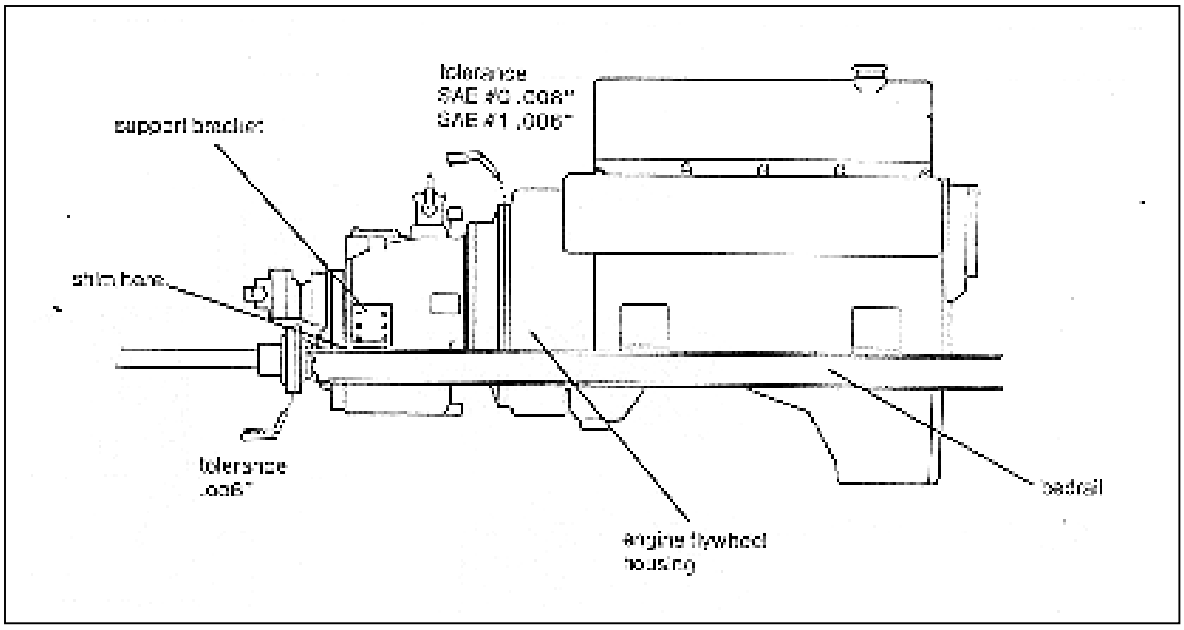
Tighten four gear-housing cap screws at 90-degree intervals. Secure engine and gear mounting feet. Loosen four gear-housing bolts. Recheck housing and coupling parallelism. If within limits tighten housing and coupling bolts.

NOTE:

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 coupling are used only to dampen noise and vibration not to correct misalignment.

NOTE:

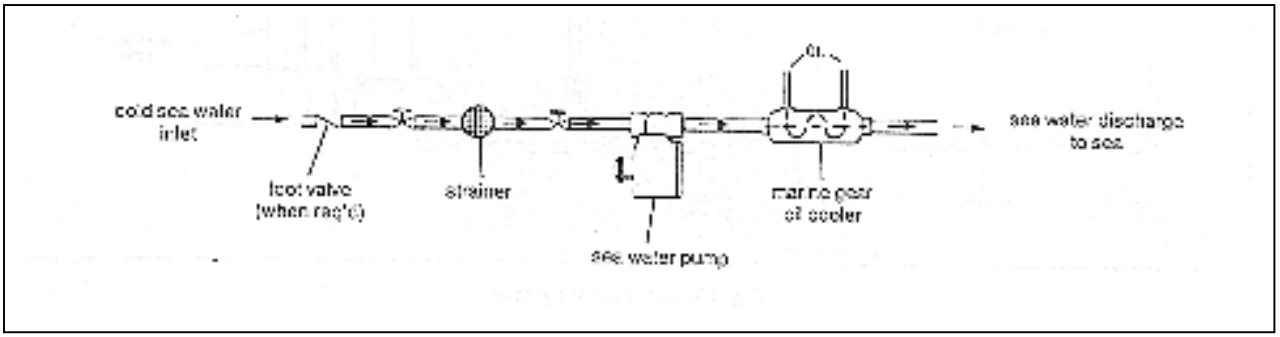
Under no condition is the engine to be supported by gear housing.



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.

The connections shown on the following diagrams are recommendations, which will give optimum performance.



SECTION 3. INSTALLATION AND OPERATION

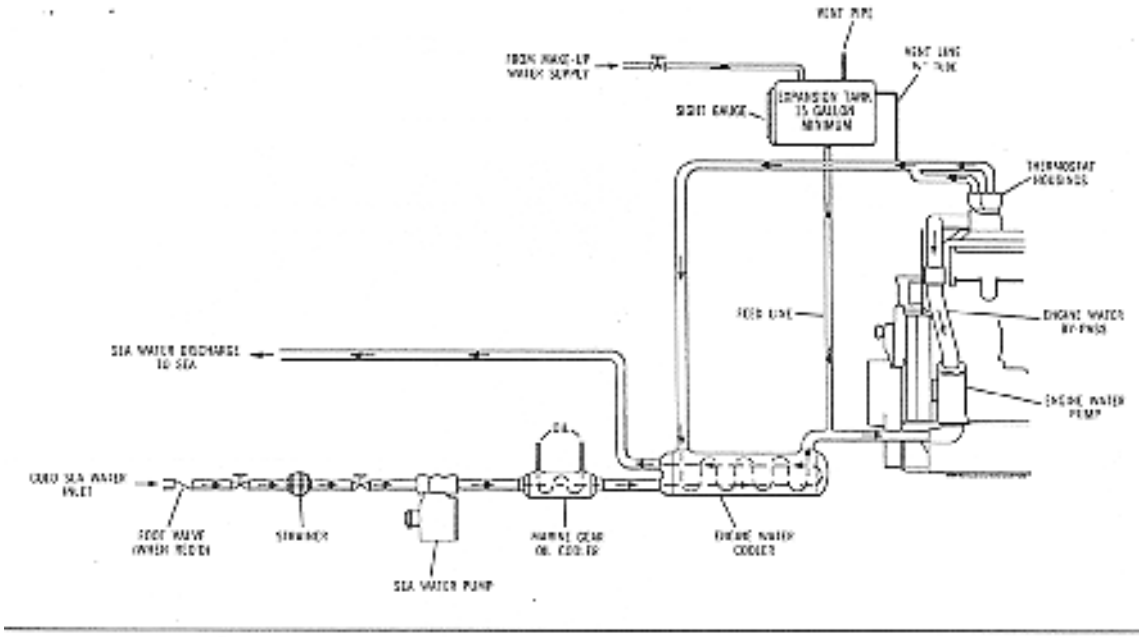


Fig. 18. Heat exchange system

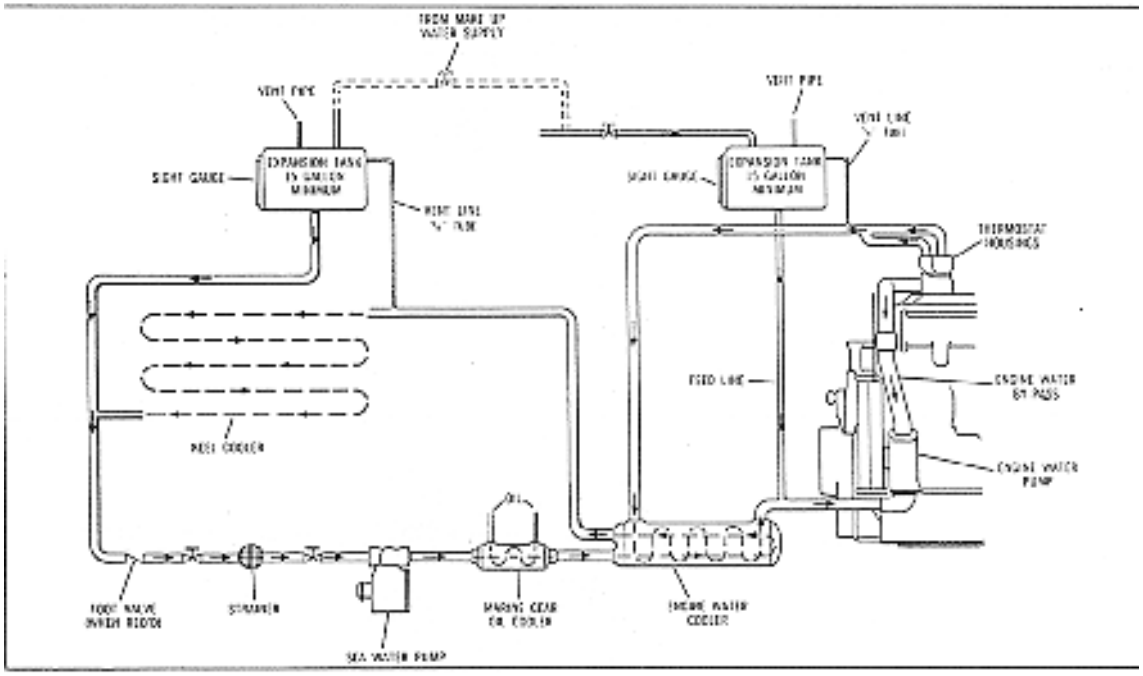


Fig. 19. Keel cooler system

3.6 START-UP PROCEDURE

1. Remove reduction gear inspection cover and pout 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 to start up.

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

4. Start engine and check all connections for leaks.

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

NOTE:
Normally, unit pressure at idle start-up will be 180 PSI, but final adjustments must be made as noted above. See figure 20, p. 13.

6. After unit has been operated as few minutes, stop engine, check oil level and add sufficient oil to bring level to full mark on dipstick. (See page 11 for capacities).

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

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

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

9. Marine gear is now ready for sea trials and final 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 minutes at 75% of available horsepower.
3. 'Wind milling' (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. PREVENTIVE MAINTENANCE

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

4.1 LUBRICANTS

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

Wher3e high ambient temperatures are encountered, over 85 degrees Fahrenheit (29C), it may be necessary to use SAE 40 motor oil.

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

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

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

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

Oil Capacity
10200- approximately 7 quarts

10700- approximately 9 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 add required oil to return level to “full” mark on dipstick.

Oil pressure

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

Pressure adjustment
See Fig. 20, p.13.

Oil temperature

Operating oil temperature range is 150 degrees at control valve, 150 to 170 degrees at pump.

4.2 ROUTINE MAINTENANCE

Oil Cooler Assembly

Check zinc pencils in oil cooler and change if badly eroded. Check zinc pencils at approximately **every 350** hours of operation.

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

Screen Oil Filter

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

Oil Breather

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

Pressure Gauge

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

Visual Inspection

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

Wear Analysis

At periodic intervals, record pressure readings at idle speed. A gradual decline is normal. Readjust pressure relief valve to maintain proper operating pressures. See fig. 20, p.13.

Inspection/ Overhaul Interval

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

4.3 MAINTENANCE SCHEDULE AND CHECK SHEET

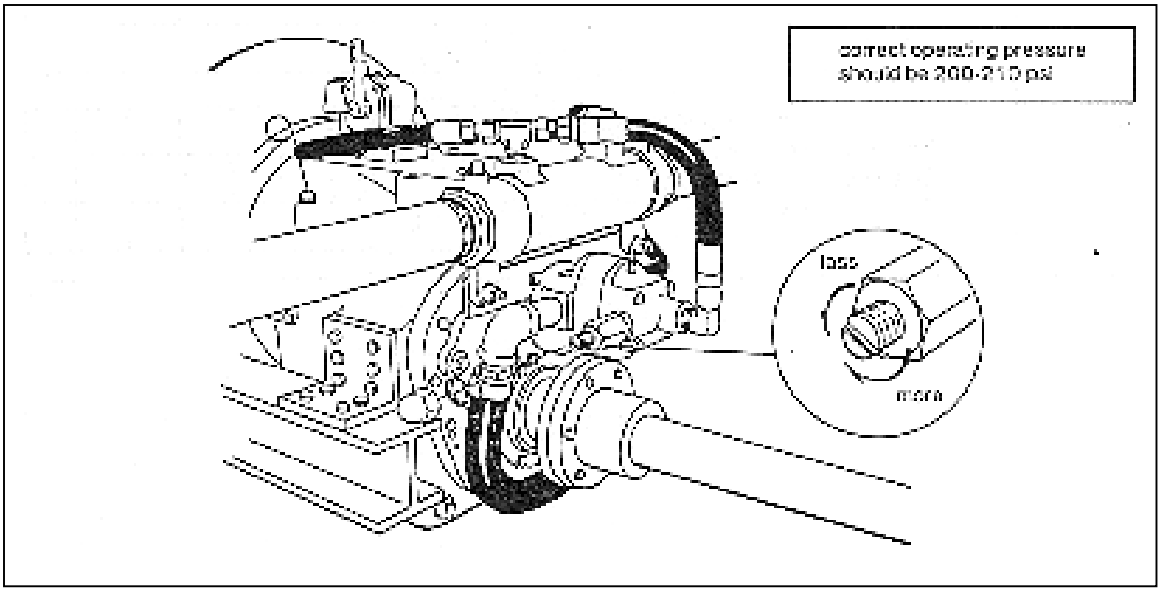
Ship's No._____
Engineer_____
Marine Gear Serial No._____
Date Service Began_____

INTERVAL **Normal operation**	**MAINTENANCE DESCRIPTION**	**RECORD**
DAILY	-Check Oil level -Check Oil pressure	
After first 100 hours	-Change oil and flush sump	
Every 350 Hours	-Check Zinc pencils	
Every 400 Hour	-Change oil -Remove and clean filter -Remove and clean oil breather	
Every 2000 Hours	-Check gear backlash -Check water tubes in cooler	
At engine Overhaul	-Inspect clutch and all gearing and replace as necessary	
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 operating speed and temperature)	1. low oil level	1.Inspect gaskets, seals and hoses and fittings for leakage.
	2. clogged oil filter screen	2.Remove oil filter screen and clean with a good grade solvent or diesel fuel.
	3. Dirt or sludge in marine gear	3.Remove drain plugs, flush gear with commercial solvent or diesel fuel. Start engine; at idle shift gear several times. Full forward to reverse for approx. 5-7 mins. Shut down engine and drain gearbox thoroughly. Refill gear with proper oil and run for approx. 25-50 hours. Drain gearbox and refill with correct oil. This will remove any residual solvent.
	4. Worn or incorrectly adjusted pump assembly	4.Refer to oil pump section (page 21) or fig.20.
	5. Oil too hot	5.Check heat exchanger system for clogged oil cooler or hoses.
	6. Worn commutator bushings or broken piston rings in rear floating commutator bushing	6.See wear limits chart (p.16) see clutch section (p.17) for front commutator bushing and gearbox section (p.25) for rear bushing.
	7. Incorrect lubricant	7.See lube chart (p.11)
	8. Scratched clutch cylinders or hard “O” rings in clutch cylinders.	8.Replace as necessary



B. High oil pressure (At full operating speed and temperature)	1.Incorrectly adjusted pump assembly	1.Refer to fig.20.
	2. Inoperable relief plunger in pump	2.Refer to p.20.
	3. Incorrect oil	3. See lube chart (p.11)
	4. Oil too cold	4. Check heat exchanger system.
C. Overheating	1. In sufficient 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.
D. Excessive noise in marine gear.	1. Bearing worn or broken	1.Inspect bearings for scored races, broken roller, flat spots, etc.
	2. Gears worn or broken	2. Inspect gears and measure backlash (refer to “replacement wea limits” chart).
	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 5 gears are in operation in reverse mode.
E. Noisy Pump	1. Dirt or sludge in oil	1.Remove oil pump and hoses. Clean thoroughly and reinstall.
	2. Clogged hoses	2.Clear or replace as required
	3. Pump cavitation	3. Inspect suction hoses for leaks. Oil level may be too low.
	4. Defective oil pump assembly	4. Refer to repair and overhaul section, page. 20.
F. Clutch slipping	1. Low oil pressure	1. See symptom A.
	2. Oil temperature too high	2. Temperature should be 150 degrees at selector valve 180 at sump. Check heat exchanger system.
	3.Worn clutch discs	3.See repair and overhaul section, page 18.
	4.Improper oil	4. See lube chart page 11.

G. 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. Marine gear misaligned	3. Check alignment as described in installation section, page 7.
	4. Excessive heat	4. Check cooling system.
H. Clutch does not release	1. Improper oil in sump	1. Refer to lube chart, page 11.
	2. Clutch discs warped	2. Replace as necessary, see page 19.
	3. Forward and reverse clutch cylinders dirty or distorted	3. Clean or replace as necessary, see page 18.
	4.Broken piston rings in rear commutator busing	4. Replace as necessary, see page 25.
	5. Clutch discs fused due to slippage and overheating.	5. Replace as necessary, see page 19.
I. No neutral	1. Warped clutch discs	1. Replace as necessary, see page 19.
	2. Scored clutch cylinders	2. Replace as necessary, see page 18
	3. Damaged quad rings	3. Replace as necessary, see page 18.
	4. Worn or damaged commutator busing.	4. Replace as necessary, see page 25
	5. Worn control valve	5. 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	1. Remove dome nut and adjust screw (Counter-clockwise) to speed up reaction. See figure 21 below.
k. Clutch engages too fast	1. Cylinder timing screw out of adjustment	1.Remove dome nut and adjust screw in (clockwise) to delay reaction. See below.

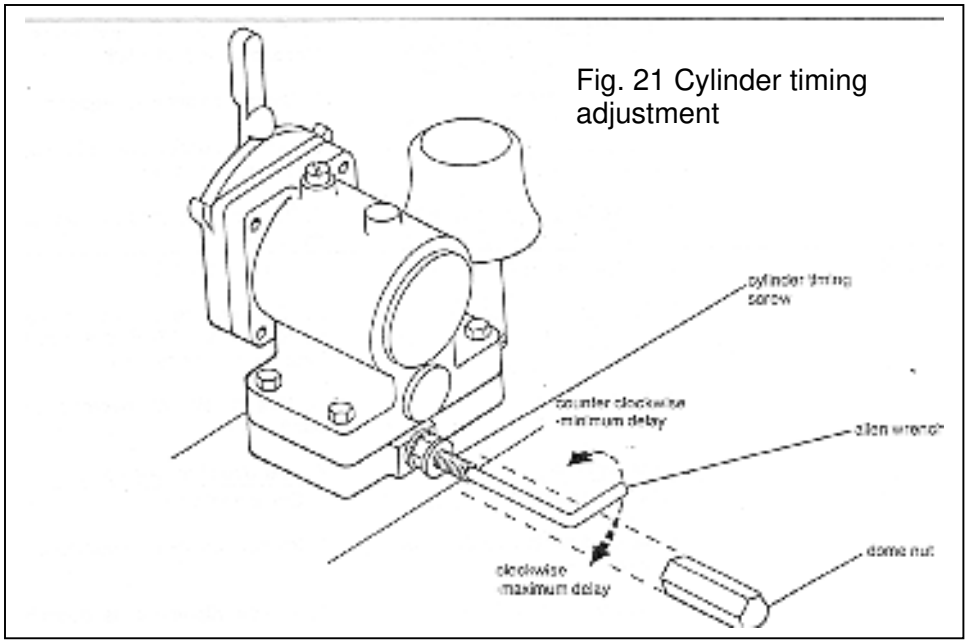


Fig. 21 Cylinder timing adjustment