TWIN DISC
INCORPORATED

Service Manual

Marine Transmission

Model:
MG-506A

Document Number: 1015978

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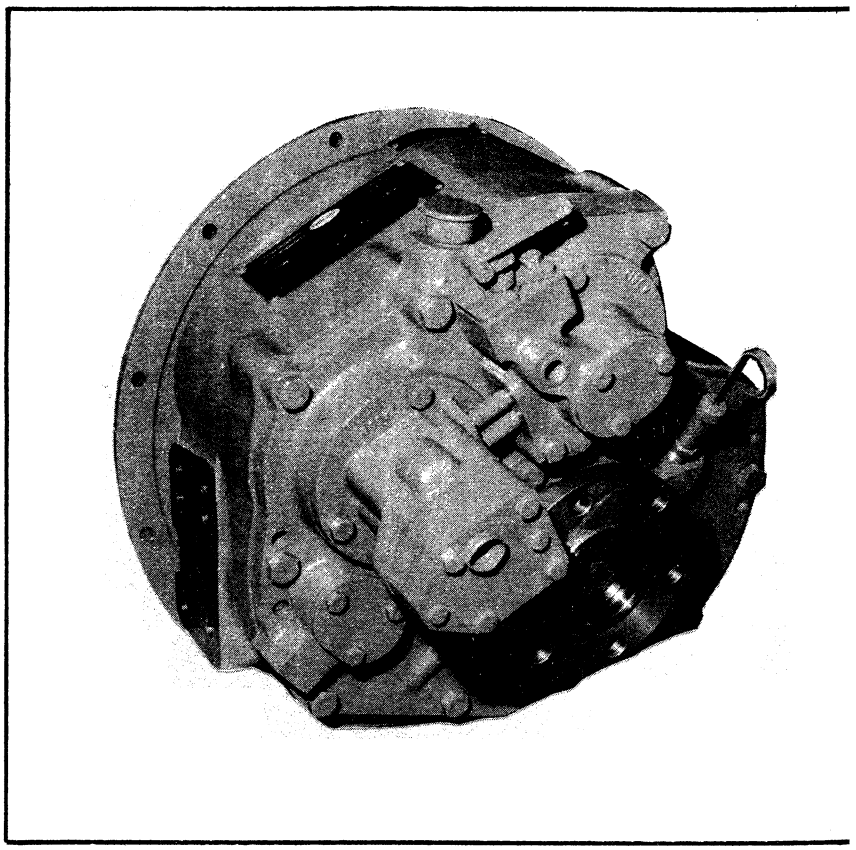
MARINE TRANSMISSION

SM-252
#1015978



SERVICE MANUAL
FOR
MG-506A

TWIN DISC
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TWIN DISC
POWER TRANSMISSION EQUIPMENT

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SERVICE MANUAL SM-252

MODEL MG-506 A
MARINE TRANSMISSION

REVISED – AUGUST 1999

TWIN DISC INTERNATIONAL SA.
CHAUSSEE DE NAMUR, 54
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BELGIUM

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SECTION 1 - INTRODUCTION.

GENERAL INFORMATION.

Scope.

This publication provides the information necessary for the operation and maintenance of the TWIN DISC equipment specified on the cover of this manual. Specific engineering details and performance characteristics can be obtained from the Service Engineering Department of TWIN DISC INTERNATIONAL S.A. NIVELLES - BELGIUM or TWIN DISC INCORPORATED RACINE, WI. U.S.A. 53403.

Operation and maintenance personnel responsible for this equipment should have this manual at their disposal and be familiar with its contents. Applying the information in the manual will result in consistent performance from the unit and help reduce downtime.

Special Tools.

Engineering drawings are included for the fabrication of special tools that should be used during disassembly and assembly of a unit. Repair of this equipment should not be attempted without special tools. TWIN DISC does not manufacture these tools for general use.

REPLACEMENT PARTS.

Parts Lists.

Illustrations with complete parts listings are provided in appropriate sections of the manual to facilitate ordering spare or replacement parts.

WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Parts.

Renewal Parts and Service Parts Kits may be obtained from any authorized TWIN DISC distributor or service dealer.

NOTE

Do NOT use planographs included in this manual for ordering parts. Parts must be ordered from the bill of material. Bill of material numbers are stamped on the unit's nameplate.

If the bill of material sheet from which part numbers are obtained is unavailable, proceed as follows :

1. Provide the figure number of the illustration containing the part, the item number of the part, the description of the part, and the quantity required.

2. Do not use the word 'complete', but state exactly each item wanted.

3. Do not designate the quantity by 'sets', but specify the part required.

4. Specify the model, bill of material, and serial number of the unit involved. These numbers are stamped on the unit's nameplate.

Parts Shipment.

Furnish the complete shipping destination and postal address. All parts shipments made from the factory will be F.O.B. TWIN DISC INTERNATIONAL S.A. NIVELLES - BELGIUM or TWIN DISC INCORPORATED, RACINE, WI. U.S.A. 53403.

If shipping instructions are not specified on the order, the equipment will be shipped the best way, considering time and expense. Twin Disc will not be responsible for any charges incurred by this procedure.

Twin Disc, having stipulated the bill of material of the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment which has been subjected to such changes will not be covered by a Twin Disc warranty.

PREVENTIVE MAINTENANCE - TROUBLE SHOOTING.

Frequent reference to the information provided in this manual regarding daily operation and limitations of this equipment will assist in obtaining trouble free operation. Schedules are provided for the recommended maintenance of the equipment, and if observed, minimum repairs, aside from normal wear, will result.

In the event a malfunction does occur, a trouble shooting guide is provided to help identify the problem area, and list information that will help determine the extent of the repairs necessary to get a unit back into operation.

LIFTING BOLT HOLES.

Most TWIN DISC products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the TWIN DISC product.

CAUTION

These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

SAFETY.

General.

Safe operating practices should be employed by all personnel servicing this unit. TWIN DISC will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unaccepted maintenance/working practices.

Important safety notice.

Because of the possible danger to person(s) or property from accidents which may result from the use of manufactured products, it is important that correct procedures be followed. Products must be used in accordance with the engineering information specified. Proper installation, maintenance, and operation procedures must be observed. Inspection should be made as necessary to assure safe operations under prevailing conditions. Proper guards and other suitable safety devices or procedures that may be desirable or specified in safety codes should be provided. These devices are neither provided by TWIN DISC nor are they the responsibility of TWIN DISC.

SOURCE OF SERVICE INFORMATION.

Each series of maintenance manuals issued by TWIN DISC is current at the time of printing. When required, changes are made to reflect advancing technology and improvements in state of the art.

Individual product service bulletins are issued to provide the field with immediate notice of new service information. These service bulletins are distributed to all the TWIN DISC distributorships and in many foreign countries.
For the latest service information on TWIN DISC products, contact TWIN DISC distributor, or write to the Service Engineering Department, TWIN DISC INTERNATIONAL S.A. NIVELLES - BELGIUM or TWIN DISC INCORPORATED, RACINE, WISCONSIN, U.S.A. 53403.

WARRANTY.

Equipment for which this manual was written has a limited warranty. For details of the warranty, contact any TWIN DISC distributor, service dealer, or the Service Department, TWIN DISC INTERNATIONAL S.A. NIVELLES - BELGIUM or TWIN DISC INCORPORATED, RACINE, WISCONSIN, U.S.A. 53403.

SECTION 2 - DESCRIPTION AND SPECIFICATION.

GENERAL. (See figures 2-1 and 2-2)

1. The Twin Disc MG 506A Marine Transmission 10° down angle configuration described in this manual is right-hand rotation (when viewed from the front of the engine) for installation on a right-hand engine. Never use these marine transmissions with a left-hand engine.

2. The marine transmission consists of four major subassemblies : the forward clutch group of parts, the reverse clutch group of parts, the input group of parts, and the output group of parts. The selector valve assembly is the control device that hydraulically engages the desired clutch. A 2.65 gpm at 2000 rpm oil pump assembly is externally mounted at the rear of the unit over the reverse clutch location. The oil pump assembly supplies oil under pressure to the selector valve assembly through the pump mount for clutch engagement, clutch cooling, and bearing and gear lubrication. The oil is strained and filtered (when filter used) before entering the marine transmission hydraulic system. The MG 506A Marine Transmission is a flange-type unit that is bolted directly to the engine flywheel housing. The driving ring furnished with the transmission is installed on the engine flywheel. The standard driving ring is designed to mesh with the rubber blocks installed on the drive spider which is installed on the input shaft. This method of drive is used because of the comparative ease of removal and installation; however, care must be exercised during installation to ensure that proper alignment between the marine transmission and the engine is attained. An optional driving ring and drive spider is also available.

3. The designation "Forward or Reverse" clutch assembly does not necessarily mean that the boat propulsion direction agrees. In marine transmission engineering terms, the "Forward" clutch assembly when engaged, means the drive from input to output is through the least number of gears. The "Reverse" clutch, when engaged, directs the drive through the greatest number of gears from input to output. In the model MG 506A the forward clutch drive train includes four gears, the reverse clutch drive train includes five gears.

REDUCTION RATIOS.

The following reduction ratios are available with the model MG 506A Marine Transmission described in this maintenance manual : 1.09:1; 1.50:1; 1.97:1, 2.50:1 and 2.96:1.

OPTIONAL EQUIPMENT.

The accessories described below are available with the model MG 506A Marine Transmission.

1. **Companion Flange.**

2. **Hose and Heat Exchanger Kit.** A hose and heat exchanger kit, when included as part of the marine transmission will consist of the heat exchanger, flexible hose, and attaching parts. The heat exchanger should be mounted in a location convenient to both engine water and marine transmission oil. A heat exchanger must be used with the marine transmission; however, a heat exchanger other than those available from Twin Disc may be selected, provided it meets the requirements of Table 2-3. It is also advisable to install an oil pressure gauge with a range of 0 to 500 psi between the heat exchanger and the oil inlet entry port of the selector valve assembly.

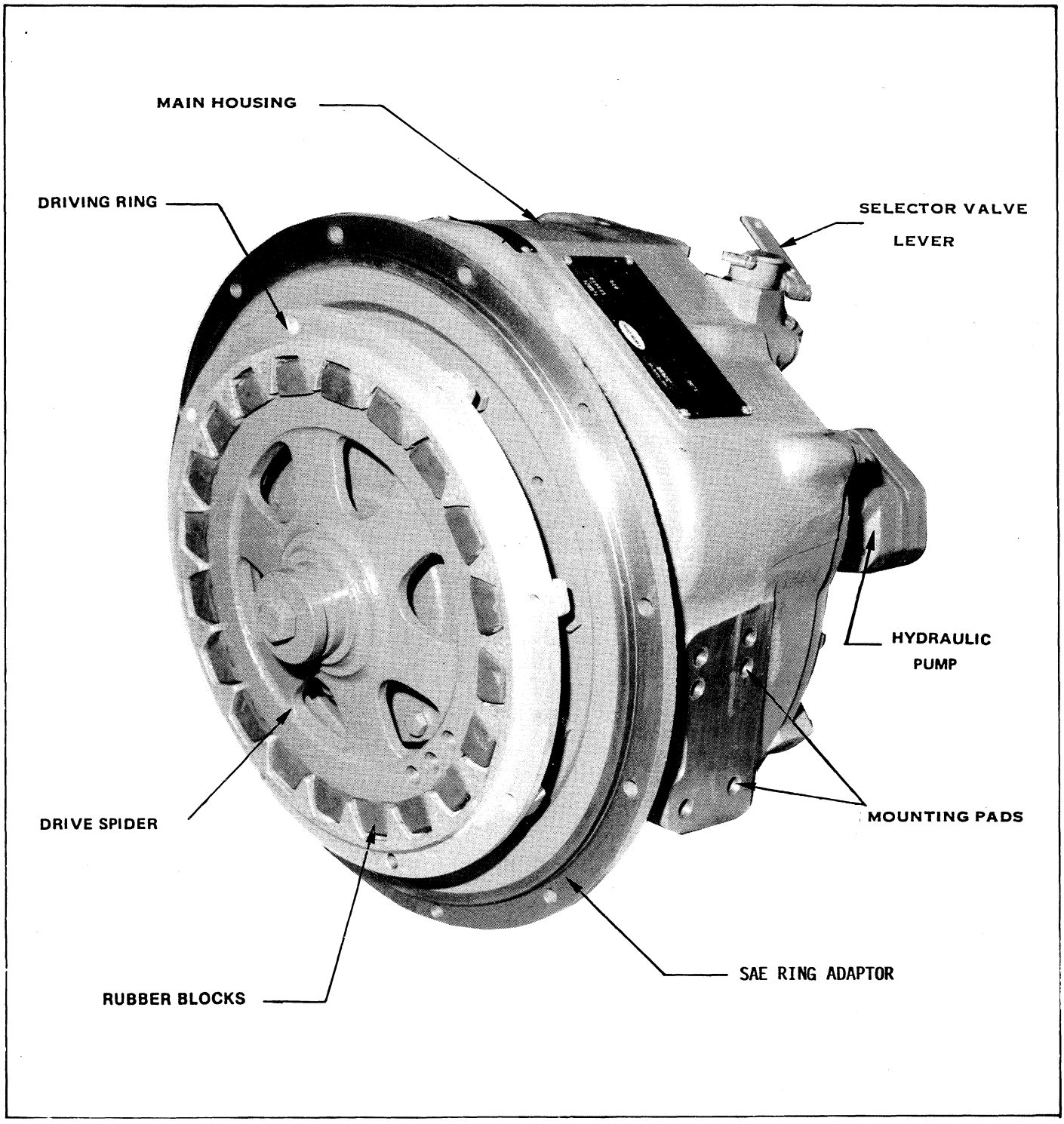


Figure 2-2 MG-506-A Marine Transmission — Front View.

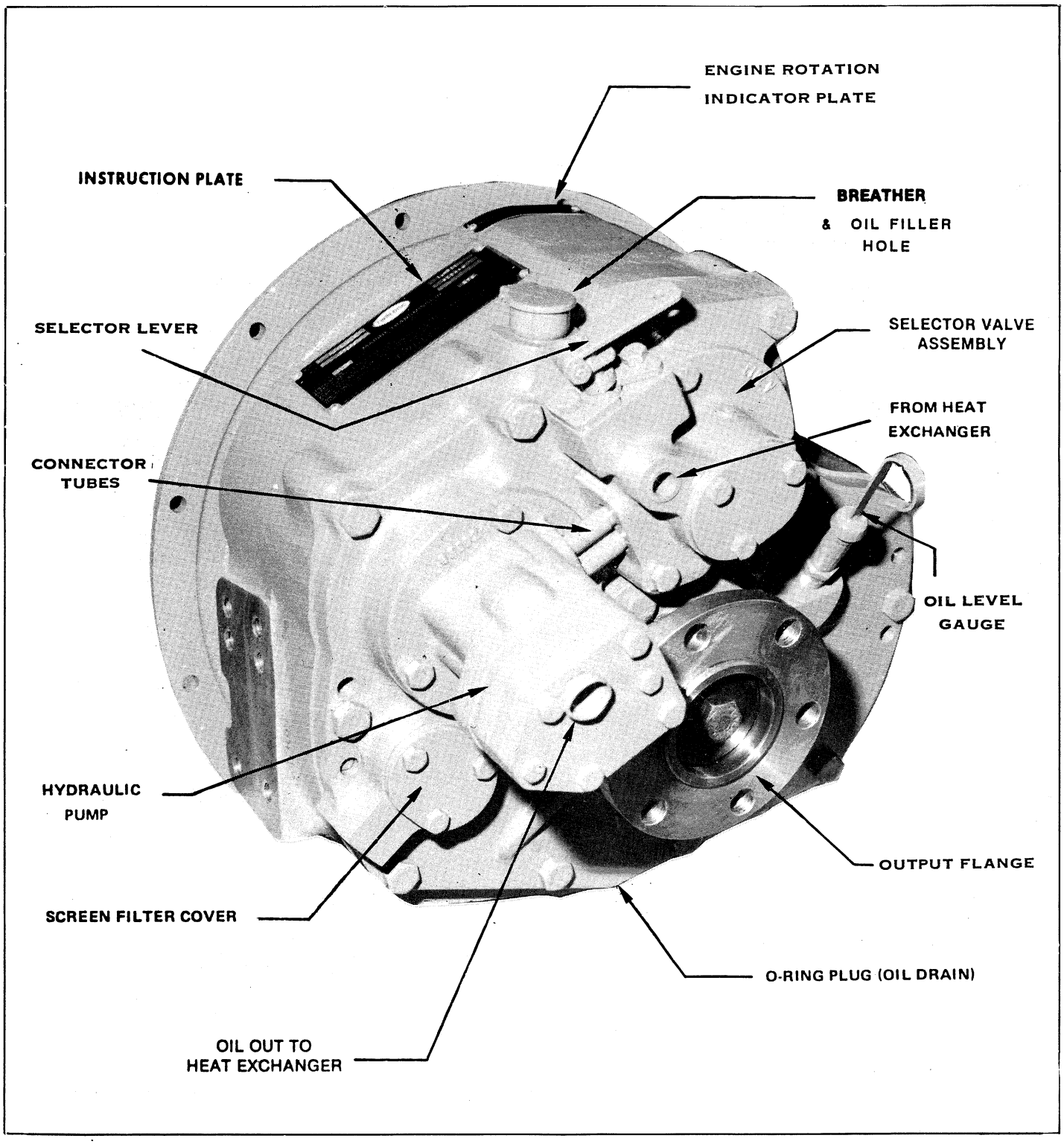


Figure 2-1 MG-506-A Marine Transmission — Rear View.

3. **Oil Filter Assembly.** Twin Disc recommends that an oil filter assembly be installed in the hydraulic system between the heat exchanger and the selector valve assembly. The oil filter assembly should have sufficient capacity for oil pressures to 400 psi with a flow rate of 4 gpm. A replaceable 25 Micron (minimum) element should be contained in the oil filter assembly. Contact Marine Application Engineering Department, TWIN DISC INTERNATIONAL S.A. NIVELLES - BELGIUM or TWIN DISC INCORPORATED, RACINE, WI 53403 - U.S.A. for further information.

4. **Input Shaft.** The protruding end of the input shaft contains a keyway and is tapered for the installation of the drive spider. Tapered roller bearings are mounted on the shaft on both sides of the input gear. One bearing cup is installed in the bearing support, and the other bearing cup is installed in a web of the main housing.

5. **Input Gear.** The input gear is made in one piece with the input shaft and located between tapered roller bearings. The input gear turns in engine direction, and is in constant mesh with the forward clutch housing gear.

INPUT GROUP OF PARTS (See figure 2-3).

1. **Driving Ring.** The driving ring is a high-quality aluminium casting that is bolted to the engine flywheel. The ring machined internal gear teeth that mesh with the rubber blocks installed on the drive spider.

2. **Drive Spider.** The drive spider, with rubber blocks installed, is the connecting member between the driving ring on the engine flywheel and the marine transmission. (External lugs are machined on the drive spider for rubber block installation). The drive spider is keyed on the tapered input shaft, and secured on the shaft with a retainer washer, and a capscrew.

3. **Rubber Blocks.** The rubber blocks, molded in an involute tooth shape, are installed on the external lugs of the drive spider. Misalignment caused by hull distortion is absorbed by the cushioning effect of the rubber blocks; however, extreme care must be observed during the marine transmission installation to achieve the dial indicator tolerances specified in the section on installation. The rubber blocks also tend to absorb torsional vibrations which may be present.

FORWARD AND REVERSE CLUTCH GROUP OF PARTS.

1. **General.** The forward clutch group of parts and the reverse clutch gourp of parts are identical in construction and parts, except for the width of the clutch housing gears. Therefore, the following description will apply to both the forward and reverse clutch groups of parts.

2. **Clutch Shaft.** The clutch shaft is made of steel, and contains two horizontally-drilled passages that are intersected by cross-drilled holes. One passage supplies oil pressure for clutch engagement, and the other passage supplies oil pressure for clutch cooling and lubrication of moving parts. A solid ball plug is installed at the rear end of the clutch engagement passage in the clutch shaft to contain the oil. An orifice is drilled at the front end of the cooling and lubrication passage of the clutch shaft to permit a metered flow of oil to return to lubricate the front tapered bearings. A slot milled in the rear end of the clutch shaft is used to drive the oil pump assembly. A tapered roller bearing installed on each end of the clutch shaft (and in the main

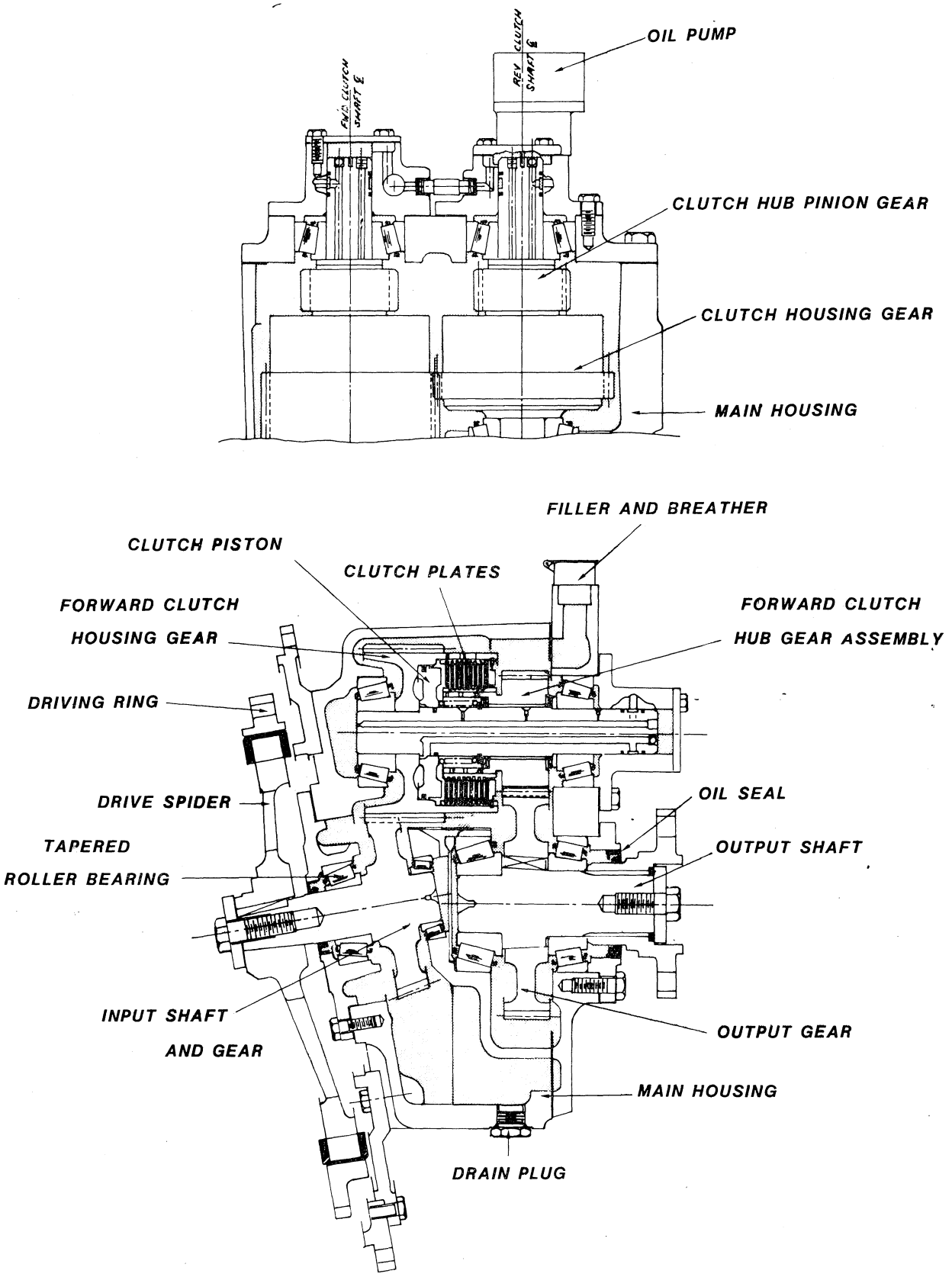


Figure 2-3. MG-506-A Marine Transmission — Cross Section Drawing.

housing) supports the clutch shaft, and therefore, the clutch pack in the marine transmission. Ring shaped grooves are machined in the clutch shaft for a snap ring and three piston rings. Two piston rings are installed in the grooves at the rear end of the clutch shaft to direct oil to the proper passage. Another piston ring is installed in the groove of the clutch shaft at the clutch piston location. An external snap ring used to retain the return spring, is installed in the groove of the clutch shaft at approximately the mid-point of the shaft.

3. **Clutch Housing Gear.** The clutch housing gear is installed on the clutch shaft adjacent to the front tapered roller bearing, and contains the clutch pack. The forward clutch housing gear is in constant mesh with the input gear and the reverse clutch housing gear. The external teeth of the back plate and the nine sintered-metal clutch plates are aligned with the internal teeth of the clutch housing gear. Three cross-drilled holes in the clutch housing gear permit the cooling and lubricating oil to return to sump.

4. **Clutch Pack.** The clutch pack is contained within the clutch housing gear, and consists of the clutch piston, the clutch piston spring, nine sintered-metal clutch plates, eight steel clutch plates, and back plate, the clutch hub pinion assembly and two needle bearings. The clutch housing gear is bored internally to contain the clutch piston. The piston ring installed on the clutch shaft seals the inside diameter of the clutch piston, and the piston ring installed on the outer periphery of the clutch piston seals the outside diameter of the clutch piston. The clutch piston spring is positioned around the clutch piston. The clutch piston spring is positioned around the clutch shaft, between the clutch piston and the external snap ring installed in the clutch shaft. The clutch hub pinion assembly is installed on the clutch shaft between the thrust bearings and the cone of the rear tapered roller bearing. Two thrust needle bearings and four thrust races separate the clutch hub pinion assembly from the snap ring and the bearing cone. The external teeth of the sintered-metal clutch plates and the back plate are aligned with the internal teeth of the clutch housing gear. The back plate is retained in the clutch housing gear by an internal snap ring. The internal teeth of the steel clutch plates are aligned with the smaller diameter external teeth of the clutch hub pinion assembly. The larger diameter external gear teeth of each clutch hub pinion assembly is in constant mesh with the output gear.

MAIN HOUSING GROUP OF PARTS.

1. **Main Housing Assembly.** The main housing, two dowel pins, the rear cover, and nine capscrews from the main housing assembly. The main housing and the rear cover are dowel pin located prior to machining of the shaft bores. Therefore, these parts are a matched assembly and not serviced separately.

2. **Main Housing.** The main housing is a high-quality casting that has integral mounting pads for the support of the marine transmission on the engine bed rails. The oil level gauge tube is installed in the main housing and contains the oil level gauge.
A hex-head pipe plug installed in the bottom of the main housing functions as a drain plug for the marine transmission.

3. **Rear Cover.** The rear cover is indexed to the main housing with two dowel pins, and secured to the housing with a gasket and nine hex-head capscrews. Tapped pusher screw holes are machined in the rear cover adjacent to the dowel pin holes to facilitate removal. A machined bore in the rear

cover provides for the installation of the filter screen. Bearing bores for installation of the filter screen. Bearing bores for installation of the clutch shaft bearings an the output shaft bearing also are provided in the rear cover. In addition, external mounting pads on the rear cover permit the installation of the selector valve assembly, the pump mount, and the bearing retainer. The breather-filler cap is also installed in the rear cover.

4. **Bearing Retainer.** The bearing retainer is secured to the rear cover with six hex-head capscrews. The bearing retainer is installed around the output shaft, and bearing retainer shims are used to adjust the end play of the output shaft tapered roller bearings. LOCTITE plastic gasket material is used to prevent oil leakage around the bearing retainer. The bearing retainer oil seal is installed in the bearing retainer to prevent oil leakage past the output flange.

5. **Bearing Support.** The bearing support is secured to the front of the main housing with six hex-head capscrews. The bearing support is installed around the input shaft, and bearing support shims are used to adjust the end play of the input shaft tapered roller bearings. LOCTITE plastic gasket material is used to prevent leakage around the bearing support. The bearing support oil seal is installed in the bearing support to prevent oil leakage past the input shaft.

OUTPUT GROUP OF PARTS.

1. **Output Shaft.** The larger diameter area of the output shaft is tapered for the installation of the output gear. The output shaft tapered roller bearings are installed on the shaft on both sides of the output gear. One bearing cup is installed in the bearing bore of an integral web of the main housing, and the other bearing cup is installed in a bearing bore in the rear cover of the main housing assembly. The output end of the output shaft is splined for installation of the output flange.

2. **Output Gear.** The output gear is installed on the tapered area of the output shaft between the output shaft tapered roller bearings. The output gear is in constant mesh with the forward clutch hub pinion assembly and the reverse clutch hub pinion assembly.

3. **Output Flange.** The output flange is spline-connected on the output shaft, and secured to the shaft by the lathe-cut rubber seal ring, the retainer washer, the roll pin, and either one or three hex-head capscrews, depending on ratio. The seal ring prevents oil leakage past the splined areas of the output shaft and the output flange. The output flange also provides for the installation of a six-bolt companion flange.

PUMP MOUNT GROUP OF PARTS.

The pump mount is installed on the rear cover with three hex-head capscrews at the reverse clutch group of parts location. The pump mount shims between the pump mount and the rear cover permit the proper end play adjustment to be made for the reverse clutch shaft tapered roller bearings. The pump mount also provides a mounting pad for the oil pump assembly. Two holes in the pump mount permit the connection of the lube oil connector tube and. the main oil connector tube to be made to the main regulator valve body.

OIL PUMP ASSEMBLY.

1. **Oil Pump Assembly.** The oil pump assembly is a positive-displacement, gear-type pump that is tang driven by

OIL FLOW.

1. **Neutral (Figure 3-4).** Oil is drawn from the sump through the filter screen and suction tube to the oil pump assembly. From the oil pump assembly the oil is conveyed by a flexible hose to the remotely-located heat exchanger where the oil is cooled. The cooled oil returns from the heat exchanger through a flexible hose (and the oil filter assembly if installed) to the oil inlet port of the selector valve assembly. Oil is pressurized by the main regulator valve in the regulator body to approximately 300 psi. Overage oil from the valve chamber of the regulator valve enters the lube oil passages and a connecting tube conveys lube oil to the pump mount. The lubricating oil is supplied to both clutch shafts for cooling and lubricating functions in the marine transmission. Since neither clutch is engaged, the remainder of the oil in the chamber not required for cooling and lubrication is returned to sump.

2. **Forward Clutch Applied (Figure 3-5).** Oil is drawn from the sump through the filter screen and suction tube to the oil pump assembly. From the oil pump assembly the oil is conveyed by the flexible hose to the remotely-located heat exchanger where the oil is cooled. The cooled oil returns from the heat exchanger through a flexible hose (and the oil filter assembly, if installed) to the oil inlet port of the selector valve assembly. Oil is pressurized by the main regulator valve in the regulator valve body to approximately 300 psi. Oil is routed by the selector valve spool in the valve body to an annular groove and cross-drilled hole in the forward clutch shaft. An annular chamber formed in the rear of the clutch shaft is sealed on both sides by piston rings. The cross-drilled hole in the clutch shaft intersects a horizontally-drilled hole in the shaft that is terminated by a ball plug installed in the end of the shaft. A second cross-drilled hole, that also intersects the horizontally-drilled hole, permits the oil to enter the chamber between the forward clutch housing gear and the clutch piston. The oil pressure moves the clutch piston against the clutch plates, and the forward clutch is engaged. Any oil that exists in the reverse clutch is returned to sump by the position of the selector valve and the force exerted by the clutch piston spring. Overage oil in the regulator valve body chamber passes by the regulator valve and enters the lube oil tube for cooling and lubricating functions as described in Neutral.

3. **Reverse Clutch Applied (Figure 3-6).** Oil is drawn from the sump through the filter screen and suction tube to the oil pump assembly. From the oil pump assembly the oil is conveyed by a flexible hose to the remotely-located heat exhanger where the oil is cooled. The cooled oil returns from the heat exchanger through a flexible hose (and the oil filter assembly if installed) to the inlet port of the selector valve assembly. Oil is pressurized by the main regulator valve in the regulator valve body to approximately 300 psi. Oil is routed by the selector valve in the valve body to the annular groove and cross-drilled hole in the reverse clutch shaft. An annular chamber formed in the rear of the clutch shaft is sealed on both sides by piston rings. The cross-drilled hole in the clutch shaft intersects a horizontally-drilled hole in the shaft that is terminated by a ball plug installed in the end of the shaft. A second cross-drilled hole that also intersects the horizontally-drilled hole permits the oil pressure to enter the chamber between the reverse clutch housing gear and the clutch piston. The oil pressure moves the clutch piston against the clutch plates, and the reverse clutch is engaged. Any oil that exists in the forward clutch is returned to sump by the position of the selector valve and the force exerted by the clutch piston spring. Overage oil in

the reverse clutch shaft. The oil pump assembly is secured to the pump mount by a gasket and four hex-head capscrews. The oil pump assembly is driven at engine speed and has a rated capacity of 2.65 gpm at 2000 rpm.

2. **Suction Tube.** The suction tube connects the filter screen and the inlet port of the oil pump assembly.

SELECTOR VALVE ASSEMBLY.

1. **General.** The selector valve assembly is installed on the rear cover of the marine transmission with three hex-head capscrews at the forward clutch group of parts location. The regulator valve body shims, between the selector valve assembly and the rear cover, permit the proper end play adjustment to be made for the forward clutch shaft tapered roller bearings. The selector valve assembly consists to the selector valve group of parts and the main regulator valve group of parts assembled in a a common valve bore in the main regulator valve body. The selector valve hydraulically functions by the mechanical movement of the shaft lever, and the main regulator valve controls main and lube oil pressure in the hydraulic system.

2. **Selector Valve Group of Parts.** The selector valve group of parts basically consists of the valve body, valve body center bore cover, cover gasket, shift lever, regulator piston, detent assembly plate, thrust race, valve spool and spring set (inner and outer). The rotary-type selector valve contains milled slots that direct oil flow to the forward clutch, neutral or reverse clutch selections through integral passages in the valve body bore. Rotary mechanical movement of the selector valve is accomplished by movement of the shift lever. From the detented neutral position the lever is moved 51 degrees to either forward or reverse clutch positions. The detent ball in the detent plate retains each selected position (neutral, forward, reverse) of the valve spool in the valve body. An O-ring seals the valve spool in the valve body from external leakage along the spool.

3. **Main Regulator Valve Group of Parts.** The main regulator valve group of parts consists of the piston, and a pair of springs. Shims, one or two usually, are placed behing the springs to increase the oil pressure rating to desired range. The piston fits in the drilled end of the selector valve spool. A large flange on the bottom of the piston operates against the springs when oil pressure is exerted on the top of the piston. As the piston moves downward toward its regulating point, it uncovers a port to the lubrication circuit. This overage oil from the regulating piston supplies the needed lube pressure for the unit.

HOSE-AND-HEAT EXCHANGER KIT. (See Table 2-1).

1. **Heat Exchanger.** The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing coolant from the engine through the heat exchanger. Consequently, the heat exchanger should be installed in a location convenient to both engine coolant and marine transmission oil.

2. Heat exchangers furnished by Twin Disc, to be used for salt water applications, have zinc rods installed at the inlet and outlet heads. See Figure 2-4. These rods must be checked every 90 days. If over 50 % of the rod is disintegrated, it should be replaced to provide effective protection.

3. Excessive corrosion of the zinc rod indicates electrolytic action. A careful

inspection should be made to determine if this action is caused by a short citcuit or external grounded electric current. These conditions must be eliminated to avoid the necessity of frequent replacement of the zinc rods. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign material, they should be cleaned with a wire brush.

4. **Flexible Hose and Fittings.** Sufficient flexible hose and fittings are provided with the kit to accommodate a normal installation.

GENERAL INFORMATION CHART.

Table 2-2 provides general information relative to marine transmission operation. These specifications must be observed to obtain proper operation of the marine transmission.

Table 2-1.

Marine Transmission Model	**MG 506A**
Heat Exchanger	**M-1959-F**
Quantity	**1**
Part n° of Zinc Electrode	**M-1988**

TABLE 2-2. GENERAL INFORMATION

OIL PRESSURE *

Normal : 300-320 psi at 1800 rpm and 180° F (82° C).
(Minimum 270 psi at cruising speed).

Cooling and lube : 4,5 psi at 1800 rpm and 180° F (82° C).

* Some applications require boost pressure to 350-370 psi. Check nameplate on unit for correct operating pressures.

Normal : 350-370 psi at 1800 rpm and 180° F (82° C) (minimum at cruising speed).

Cooling and lube : 4,5 psi at 1800 rpm and 180° F (82° C).

OIL CAPACITY

1,3 US Gallons (4,9 liters), or fill to "FULL" mark on gauge.

OIL RECOMMENDATION

Use only SAE-API service class CD engine oil certified to meet TO-2 transmission oil specification or type C-3 transmission fluid. Also approved is SAE-API service class CC engine oil and MIL-L-2104B.

Multi-viscosity oils (i.e. 10W-40, etc.) should not be used in Twin Disc Marine Transmissions.

OIL VISCOSITY

Sump temperature, also oil temperature into heat exchanger		Recommended oil viscosity
During start-up	Steady operating conditions	
	Below 66° C (150° F)	This operating condition is **not** approved.
0° C mini (32° F)	66° - 85° C (150° - 185° F)	**SAE** viscosity number **30** engine oil.
0° C mini (32° F)	79° - 99° C (175° - 210° F)	**SAE** viscosity number **40** engine oil.
	Above 99° C (210° F)	This operating condition is **not** approved.

OIL CHANGE INTERVAL

Replace every 1000 hours of operation, or 6 months, whichever occurs first.

FILTER SCREEN

Remove and clean every 1000 hours of operation, or 6 months, whichever occurs first.

OIL PUMP CAPACITY

2.65 gpm (10 L/min) at 2000 rpm.
2.5 gpm (9,45 L/min) at 2000 rpm.

MAXIMUM INPUT SPEED

3000 rpm.

SHIFTING LIMITS

"Neutral" to "Forward" or "Reverse" - under 80 % governed engine rpm.

Shifting across "Neutral" - under 50 % governed engine rpm.

DRY WEIGHT

Approximately 275 / 291 lbs (125 / 134 Kg) (depending on ratio).

Table 2-3. HEAT EXCHANGER (H.E.) REQUIREMENTS.

Permissible oil temperature into H.E.	210° F. MAX. - 150° F. MIN. / 99° C. MAX. - 66° C. MIN.
Min. heat transfer capacity	BTU per min. per engine RTD. H.P. :
(Multiply by 1.25 for fresh water) (Multiply by 2.00 for raw water)	Continuous duty : 1.484/.026 kW P.C. & Int. duty : 1.272/.022 kW
Approximate oil flow to H.E.	.132 GPM per 100 engine RPM / 0,50 L/min
Peak oil pressure at H.E. (Proof test H.E. at 1.5 x PSI)	445 psi/3070 KPA
Max. allowable oil pressure drop across H.E. with 300 SUS oil at rated engine RPM	30 psi/207 KPA
Water flow to H.E.	Use 1.5 to 3.0 times oil gpm
H.E. water pressure rating, min.	= 1.5 x H.E. inlet water psi

DATA H.E. PURCHASER MUST ALSO TELL VENDOR

State if raw (open channel & sea) or fresh (closed engine jacket & keel cooler) water will cool heat exchanger.

State max. water temperature into heat exchanger

Typical : Raw water - 85° F./29° C.
Keel cooler water - 140° F./60° C.
Engine jacket water - 180° F./82° C.

State min., also max. gpm of water flow to heat exchanger.

H.E. INSTALLATION & SERVICE REQUIREMENTS.

Oil lines, transmission to H.E. and return -

(1) Max velocity in fittings, pipe, hose and tubes - 25 FT./Sec. or 7.6 m/sec.
(2) Burst pressure, min., = 10 x peak oil pressure at H.E.
(3) Hose - SAE J517 100R1 metting USCG 46CFR 56.60-25(C), 275° F./135° C. temp. rating.
(4) Protect lines from mechanical damage.
Zinc anodes protect H.E. raw water passages from corrosion.
Check and replace them frequently.

SECTION 3 - OPERATION.

GENERAL.

1. Description. The model MG 506 A Marine Transmission 10° down angle configuration provided for near level installation is a reverse and reduction transmission available in five ratios : 1.09:1, 1.50:1, 1.97:1, 2.50:1 and 2.96:1. Within their rated capacities, all ratios may be operated continuously in the forward and reverse propulsion directions. The marine transmission is completely hydraulic in all phases - all bearings are oil lubricated, both clutches are engaged by high pressure oil, and both clutches are oil lubricated.

2. Direction of Drive. The input shaft always turns in engine direction, and the forward clutch shaft always turns in anti-engine direction. Therefore, when the marine transmission is engaged in the forward position, the output shaft will turn in engine direction as the clutch hub pinion assembly installed on the forward clutch shaft is meshed with the output gear. When the marine transmission is engaged in the reverse position, the output shaft will turn in anti-engine direction.

POWER FLOW.

1. Neutral. See Figure 3-1. When in neutral, all parts that rotate in the marine transmission while in this position, turn at engine speed. The connecting member between the engine and the marine transmission is the driving ring that is bolted to the engine flywheel. The rubber blocks that are installed on the drive spider are meshed in the driving ring. The drive spider is keyed to the input shaft the input gear being in one piece with the input shaft. Therefore, the input gear turns at engine speed and in engine direction. The input gear is in constant mesh with the forward clutch housing gear, and turns the gear, the clutch shaft, and the sintered metal clutch plates at engine speed and in anti-engine direction. The forward clutch housing gear is in constant mesh with the reverse clutch housing gear, and the gear, the clutch shaft, and the sintered metal clutch plates rotate at engine speed and in engine direction. The oil pump assembly which is connected to the end of the reverse clutch shaft, also rotates at engine speed and in engine direction. Since neither forward nor reverse clutch is engaged, there is no further power flow within the gear.

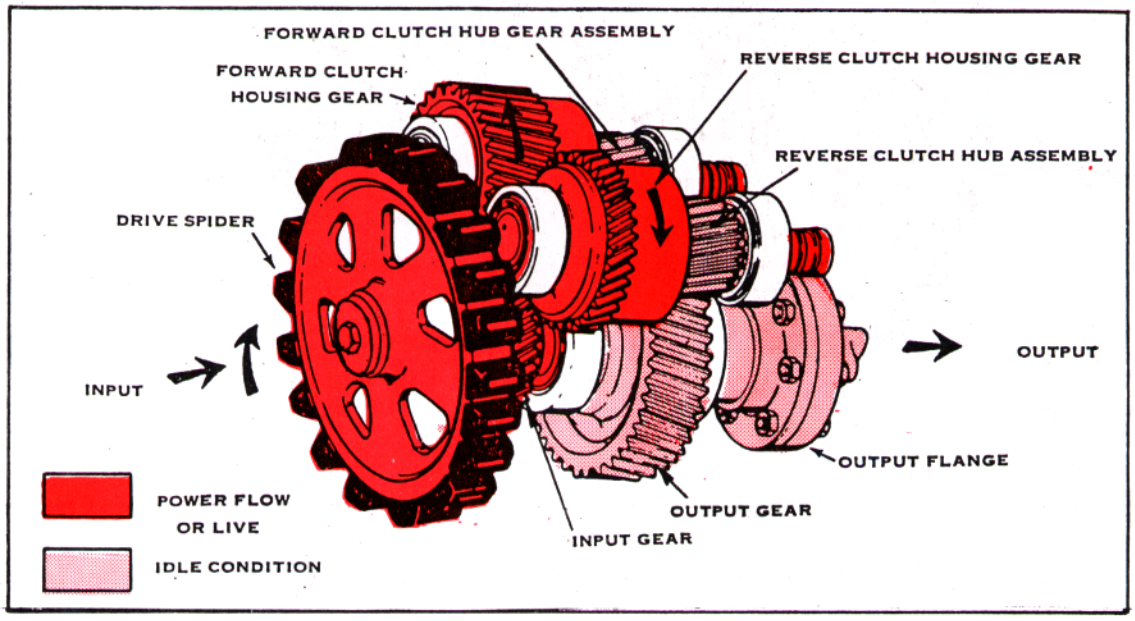


Figure 3-1. MG 506 A Marine Transmission Power Flow - Neutral - Schematic view.

2. Forward. See Figure 3-2. When forward clutch is selected, all the marine transmission parts which were turning during neutral selection are still turning. However, when forward is selected, the forward clutch faced and metal plates are clamped together by the clutch piston and back plate. The internal teeth of the steel clutch plates are meshed with the smaller diameter external teeth of the clutch hub pinion assembly and turn the pinion gear at engine speed and in anti-engine direction. The larger external gear teeth of the pinion gear are in constant mesh with the output gear which is high press fit on the output shaft. The output flange is spline-connected to the output shaft and, therefore, the flange rotates in engine direction when in forward. The output shaft and flange rotate at a speed that is reduced from the engine speed due to the ratio between the pinion gear and the output gear.

3. Reverse. See Figure 3-3. When in reverse, all the marine transmission parts that rotated in neutral are still turning. However, when reverse clutch is selected, the reverse clutch steel and faced plates are clamped together by the clutch piston and back plate. The internal teeth of the steel clutch plates are meshed with the smaller diameter external teeth of the clutch hub pinion assembly, and turn the pinion gear at engine speed and in engine direction. The larger diameter external gear teeth of the pinion gear are in constant mesh with the output gear which is high press fit on the output shaft. The output flange is spline-connected to the output shaft and, therefore, the flange rotates in anti-engine direction when in the reverse clutch position. The output shaft and the output flange rotate at a speed that is reduced from the engine speed due to the ratio between the pinion gear and the output gear.

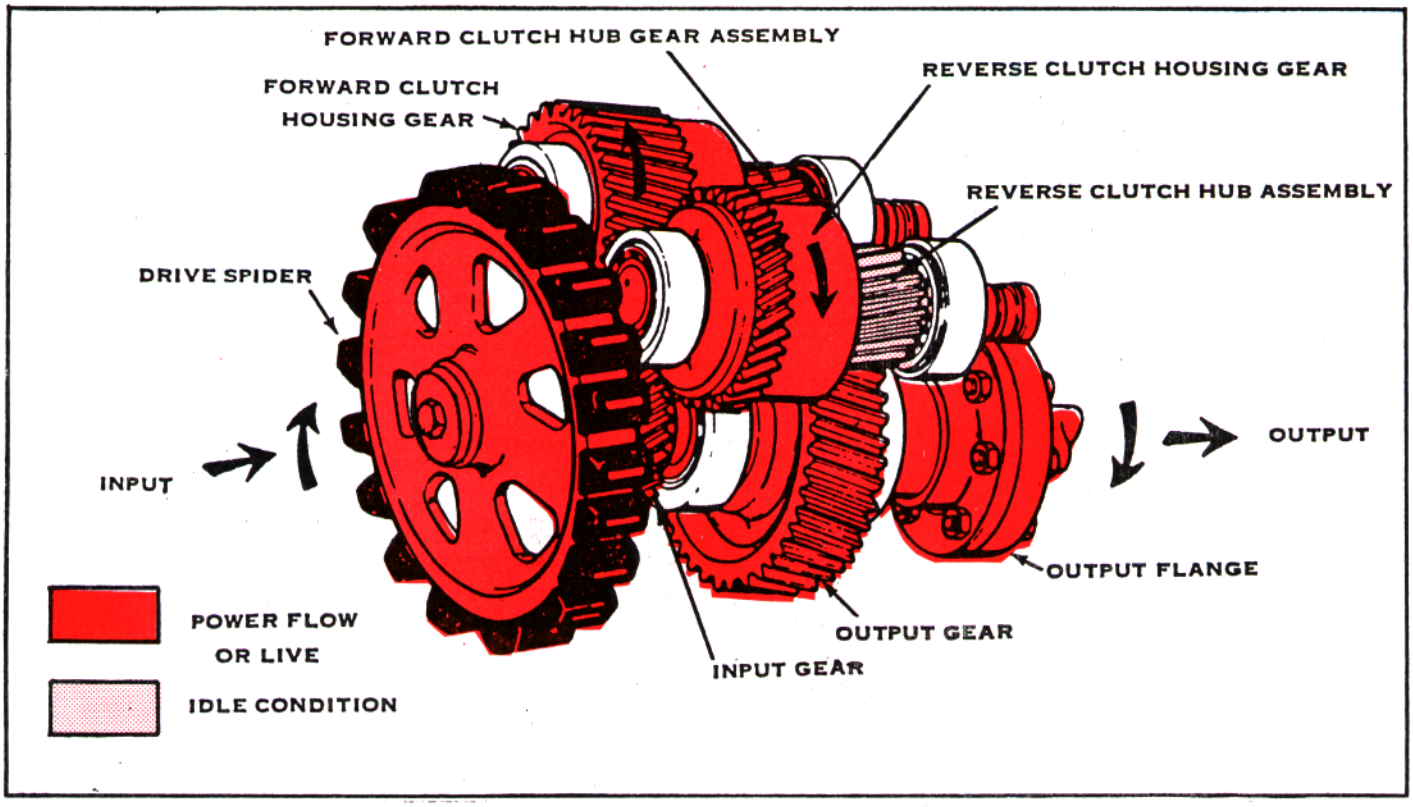


Figure 3-2. Model MG 506 A Marine Transmission Power Flow - Forward - Schematic view.

HYDRAULIC SYSTEM.

General.

1. **Description.** The hydraulic system delivers oil pressure for clutch engagement, clutch cooling, and lubrication functions. The sump, which is located in the bottom of the main housing, contains and adequate amount of oil for all functions of the system. The oil pump assembly pressurizes the oil for pressure requirements. The selector valve assembly functions as both a regulator and distributor for the hydraulic system. The selector valve assembly directs the oil to engage either the forward or reverse clutch depending on the position of the selector valve. The selector valve assembly also directs oil to the lube system. Piston rings on the ends of the clutch shafts separate the lube and clutch pressure oil.

2. **Oil Circuit.** Oil is drawn from the sump through the filter screen and suction tube to the oil pump assembly. From the oil pump assembly the oil is conveyed by a flexible hose to the remotely-located heat exchanger where the oil is cooled. The cooled oil returns from the heat exchanger through a flexible hose (and the oil filter assembly if installed) to the oil inlet port of the selector valve assembly. Oil is conveyed from the selector valve assembly to the pump mount by the oil connecting tubes. The oil tubes connecting the selector valve assembly to the pump mount convey oil to the reverse clutch shaft for clutch engagement and lubrication.

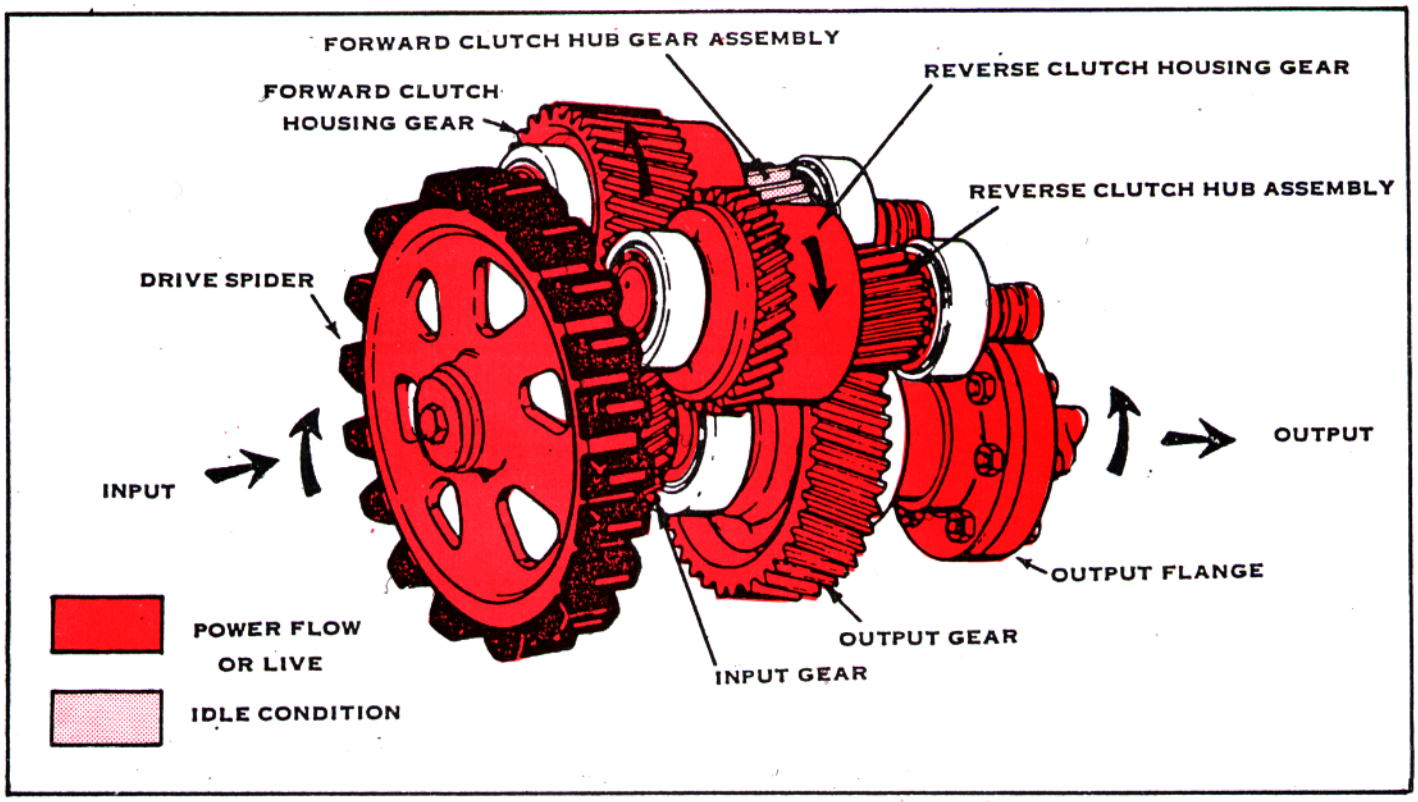


Figure 3-3. Model MG 506 A Marine Transmission Power Flow - Reverse - Schematic View.

the regulator valve body chamber passes by the regulator valve and enters the lube oil connecting tube for cooling and lubricating functions as described in Neutral.

BACK DRIVING.

All current Twin Disc production marine transmissions can be back driven (propeller windmilling with dead engine) for the following conditions provided that the vessel speed when back driving the marine transmission, does not exceed the normal maximum speed of the vessel.

Intermittent Back Driving.

Examples :

Sail boat auxiliary - short trips, less than one day.

Towing purse boats in seining operations.

Twin Screw vessel with operation of only one engine for part of the day.

Towing home a boat with engine trouble, short trip, less than one day.

1. Start the engine and operate the marine transmission in neutral at normal fluid pressures for a minimum of four minutes, doing this once every 12 hours for model MG 506-A.

2. Maintain the back driven marine transmission's oil level as for normal propulsion, or use above full oil level.

Continuous Back Driving.

Examples :

Towing to deliver a boat.

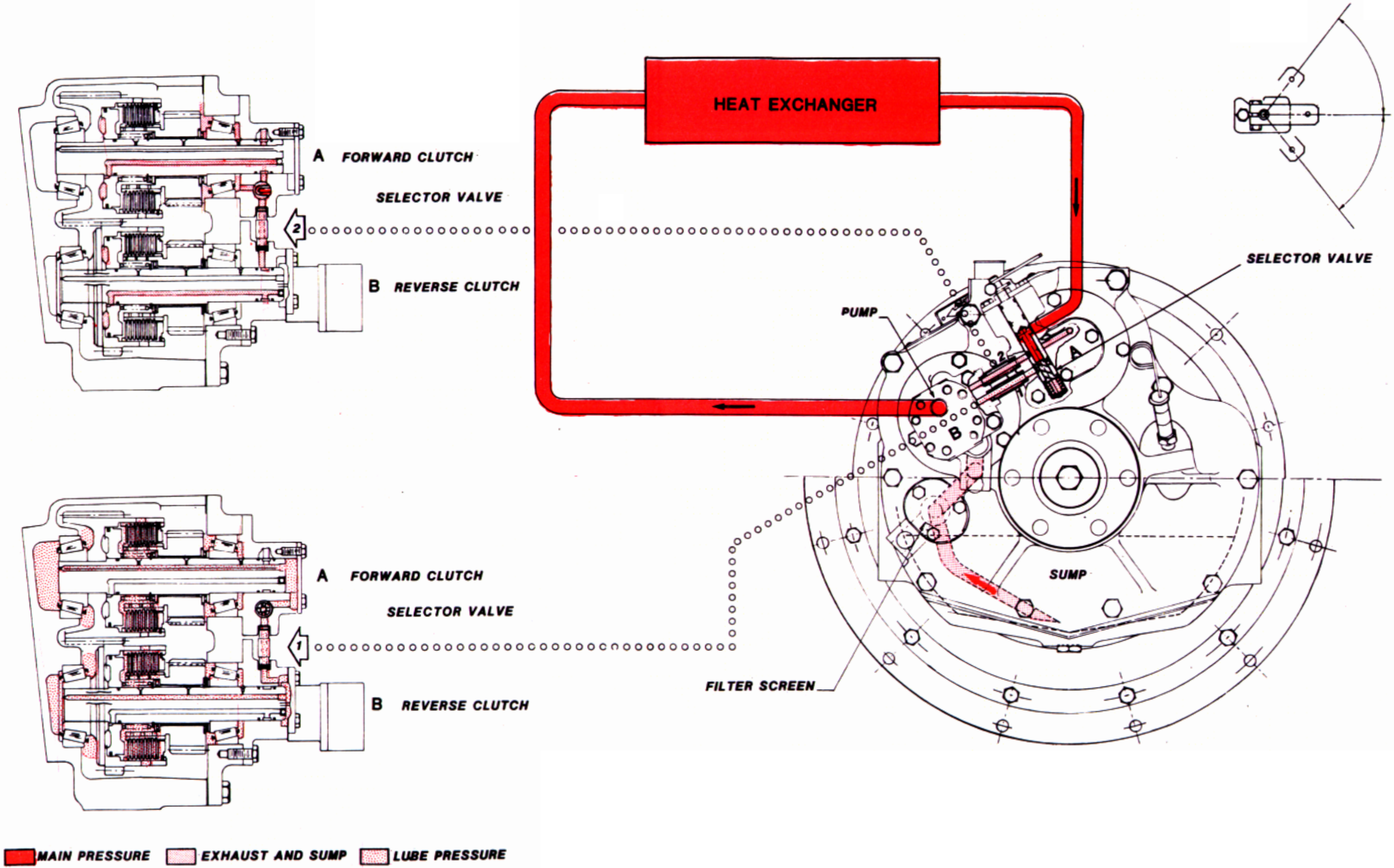
Towing home a boat with engine trouble, long trip.

Sail boat auxiliary - long trips.

1. Start the engine and operate the marine transmission in neutral at normal fluid pressures for a minimum of four minutes every 8 hours for model MG 506 A. Maintain oil level as above.

2. An alternate would be to lock the propeller shaft to prevent rotation.

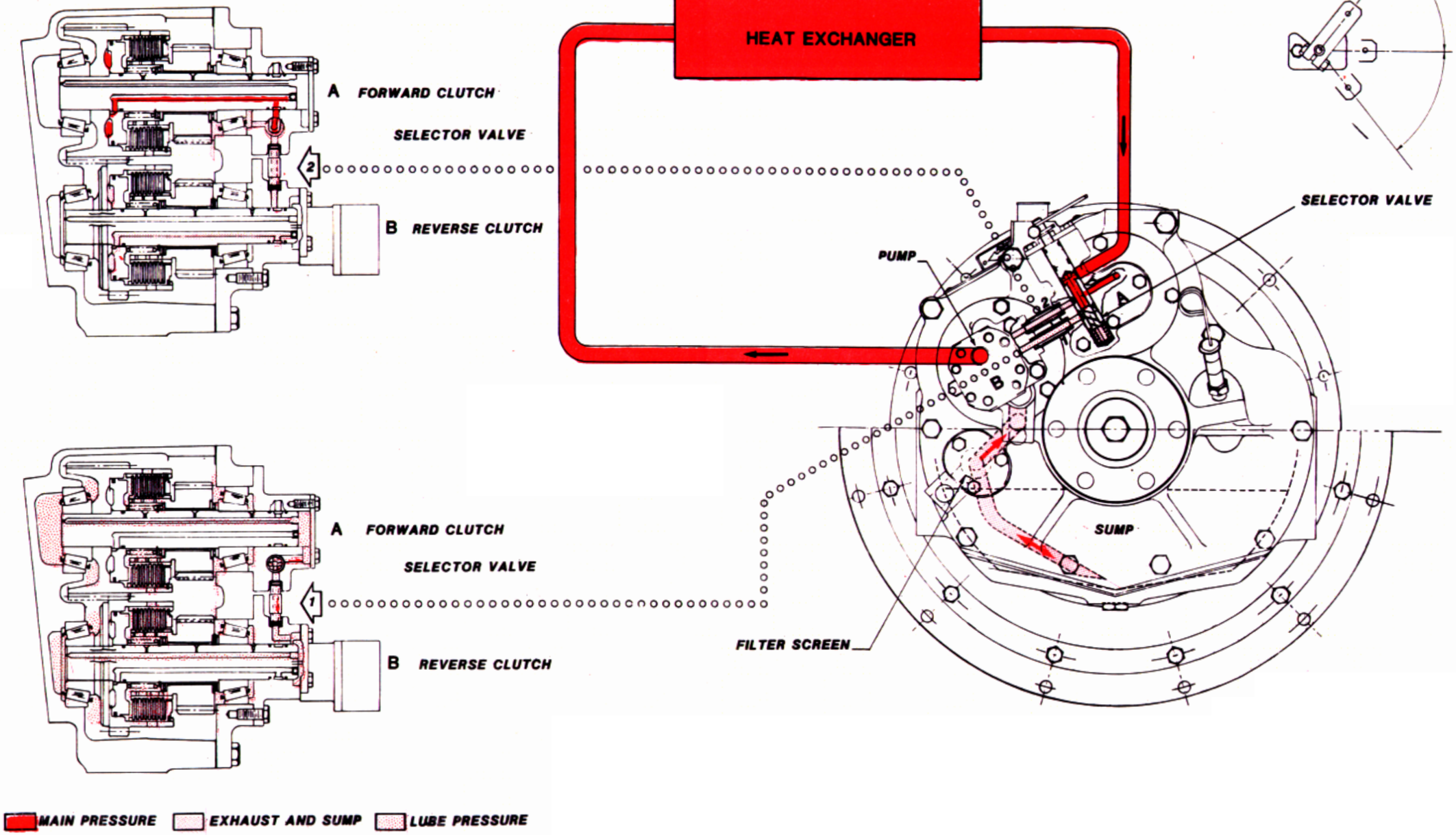
3. Prior to backdriving, plug dipstick tube, fill unit with oil then pump oil out of unit down to recommended level. Repeat this as described above.



20A

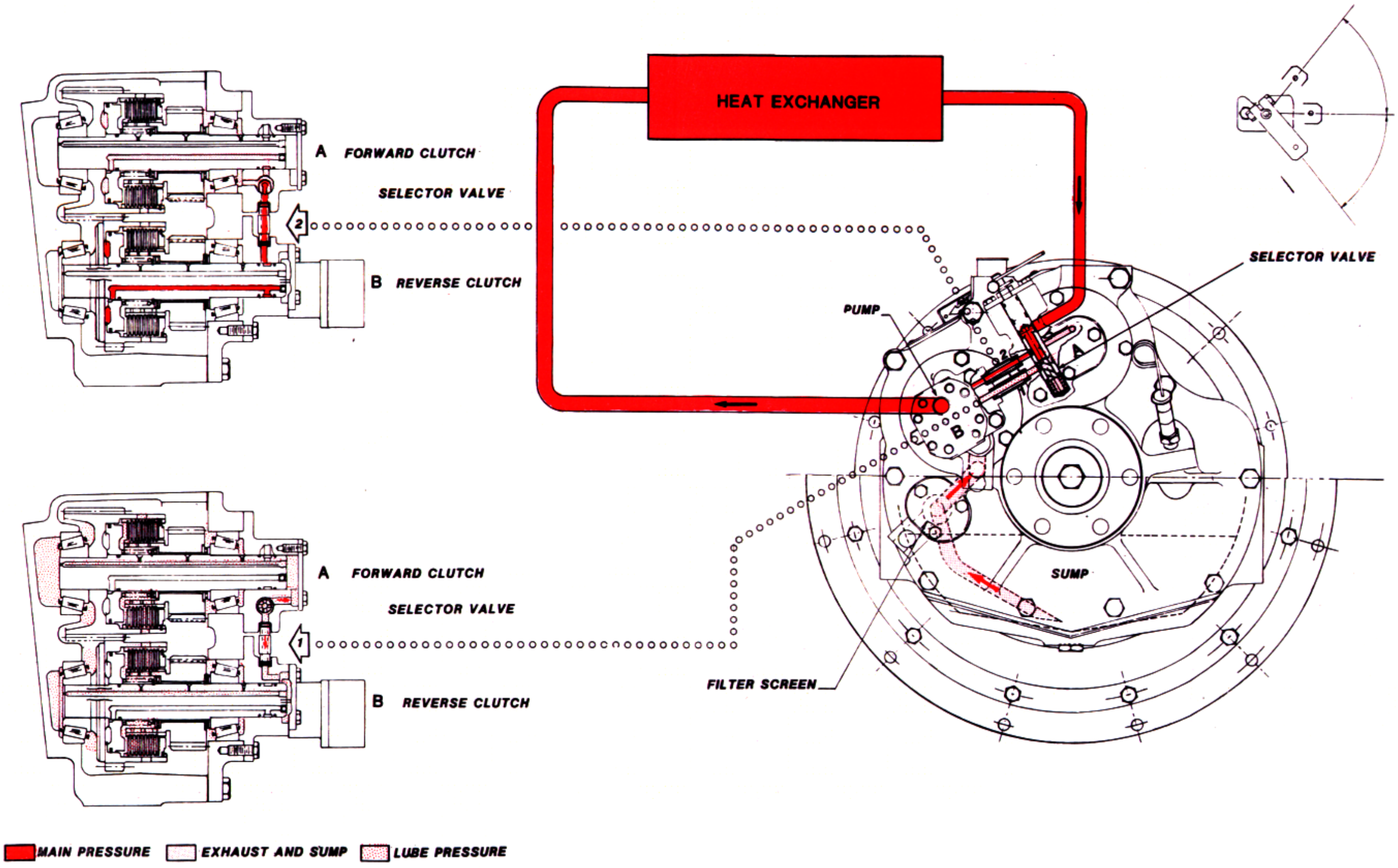
Model MG-506-A Marine Transmission Oil Flow- Neutral-Schematic View

Figure 3-4



Model MG-506-A Marine Transmission Oil Flow-Forward Schematic View

Figure 3-5



Model MG-506-A Marine Transmission Oil Flow-Reverse Schematic View

Figure 3-6

SECTION 4 - PREVENTIVE MAINTENANCE.

GENERAL.

1. **Lubrication.** All moving parts of the **MG 506 A** Marine Transmission are lubricated by the oil within the sump as it travels throughout the hydraulic system. The preventive maintenance required to keep the transmission functioning properly is slight; however, it is very important that the following directions be complied with.

2. **Overhaul interval.** A complete overhaul of the model **MG 506 A** Marine Transmission should be made at the same time the engine is overhauled. All parts showing signs of wear, fatigue, etc. should be replaced at that time.

HYDRAULIC SYSTEM.

1. **Oil capacity.** The oil capacity of the model **MG 506 A** Marine transmission is 1,3 US Gallons (4,9 liters) or to the 'FULL' mark on the oil level gauge. The oil used in the marine transmission should be of the same quality and type recommended by the engine manufacturer for use in the engine. Use SAE 40 HD when the inlet water temperature to the heat exchanger is above 85° F. (29° C), and SAE 30 HD when the inlet water temperature to the heat exchanger is below 85° F. (29° C).

2. **Oil level.** The oil level should be checked daily using the oil level gauge in the marine transmission. Check the oil level with the engine at idle speed and the marine transmissions in "Neutral". The oil level must be maintained at the "full" mark on the oil level gauge.

3. **Oil Change Interval.** The oil must be changed every 1000 hours of operation, or 6 months, whichever occurs first. Boats that are placed in dry dock or storage for periods of three months or more, should have the oil changed in the marine transmission prior to return to active use.

4. **Draining.** When a complete oil change of the hydraulic system is required, it is necessary to drain the oil from the heat exchanger and connecting hoses as well as the marine transmission sump. In addition, if an oil filter assembly is installed, the filter and connecting hoses must be drained and the filter element replaced. Alternate methods of draining the marine transmission sump of oil are possible as described below :

a. **Gravity Drain.** Remove the hex-head plug from the bottom of the main housing. Allow sufficient time for the marine transmission oil to drain from the sump, and then install the plug securely in place.

b. **Suction Drain.** A suction pump can be used to drain the marine transmission sump. The oil level gauge tube is serrated to accommodate a suction hose. Remove the oil level gauge, and install a suction hose on the oil level gauge tube. Operate the suction pump until the marine transmission oil has been removed from the sump. After suction draining, remove the pump and hose, and install the oil level gauge in the tube.

5. **Filling.** Make certain the drain plug is tight. Remove the breather cap from the breather cap nipple assembly. Use the recommended quality, type and weight oil and fill the marine transmission sump with 1.3 US Gallons (4,9 liters) of oil. Pour the oil into the breather cap nipple. After filling, start the engine and shift the unit from "Forward" to "Reverse" several times permitting the oil lube lines and heat exchanger to fill with oil. Check the oil level. With the engine at idle speed and the

marine transmission in "Neutral", the oil level must be to the "full" mark on the oil level gauge. Install the breather cap after proper oil fill has been attained. Operate the marine transmission to raise the oil temperature to operating range and recheck the oil level, filling to the "full" mark as required.

COMPONENTS PARTS.

1. **Oil and Filter Screen cleaning interval (maximum).** The oil must be changed and the filter screen cleaned every 1000 hours of operation or more often if conditions warrant. Boats that are placed in dry dock or storage for periods of three months or more, should have the oil changed in the marine transmission prior to return to active use.

2. **Heat Exchanger and Hoses.** Disconnect the hoses from the heat exchanger every 1000 hours of operation at the same time that the oil is changed. Drain the hoses and the heat exchanger of all oil. After draining, connect the hoses to the heat exchanger.

3. **Oil Filter Assembly.** If an oil filter assembly is used in the hydraulic system, the filter and connecting hoses must be drained every 1000 hours of operation and the filter element must be replaced. Accomplish these procedures at the same time that the oil is changed.

PERIODIC VISUAL INSPECTION.

1. **General.** Frequently inspect the mounting parts of the marine transmission. Replace any damaged parts.

2. **Heat Exchanger and Oil Filter Connection Lines.** Inspect the heat exchanger and oil filter connecting lines for leaks, sponginess, or other damage. Replace damaged lines.

3. **Pressure and Temperature Gauge Assemblies.** Periodically inspect the pressure and temperature gauge assemblies for damage. Replace a damaged gauge. If a gauge is suspected of being inaccurate, replace the gauge with one of proven accuracy to determine the extent of malfunction.

NOTE

Zinc anodes are installed in the heat exchanger to help protect it from corrosion. Remove and inspect the anodes frequently because they are consumed as they provide protection. Replace the anodes as necessary. See figure 4-1.

OIL SEAL REPLACEMENT.

Prior to replacement.

1. **General.** If it becomes necessary to replace the bearing retainer oil seal (Figure 1262, 24) because of leakage, this procedure can be accomplished without removing the marine transmission from the engine. Follow the description below to accomplish this replacement.

2. **Draining.** In most installations, it will be necessary to drain the marine transmission sump of oil in order to accomplish the oil seal replacement. Drain the marine transmissin sump of oil.

3. **Output Flange Clearance.** Scribe an aligning mark across the outside diameter of the output flange (26) and the companion flange for installation

purposes. Remove the bolts, and nuts that secure the companion flange to the output flange. Slide the propeller shaft rearward until sufficient clearance is apparent for the removal of the output flange.

Oil Seal Replacement.

1. **Removal.** Remove the capscrew (Figure 12-2, 28), retainer washer (28), and the seal ring (26) from the output flange and the output shaft (18). Discard the seal ring. Remove the spline-connected output flange from the output shaft. It may be necessary to use a gear puller to accomplish this removal. Remove the bearing retainer oil seal (24) from the bearing retainer (22). Discard the oil seal.

2. **Installation.** Install a new bearing retainer oil seal (24) in the bearing retainer (22). The oil seal must be installed flush with the rear face of the bearing retainer, and the lip of the seal must point towards the output gear (19). Carefully install the output flange (25) on the splines of the output shaft (18). Do not damage the lip of the oil seal during this procedure. Secure the output flange on the output shaft with a new lathe-cut rubber seal ring (26), retainer washer (27), and the 1/2 20 x 1 hex-head capscrews (28). Tighten the capscrews to 65 $\pm$ 5 lbs. ft. torque.

AFTER REPLACEMENT.

1. **General.** After replacement of the bearing retainer oil seal (Figure 12-2, 24) has been accomplished, and the output shaft end play has been verified as being correct, the following procedures of driveline connection and oil filling of the marine transmission sump can be completed.

2. **Drive Line Connection.** Slide the propeller shaft and the companion flange forward against the output flange (25). Align the scribed marks on the companion flange and the output flange. Secure the flanges together with the bolts and nuts previously removed.

3. **Filling.** Fill the marine transmission sump with oil.

SECTION 5 - TROUBLE SHOOTING.

GENERAL.

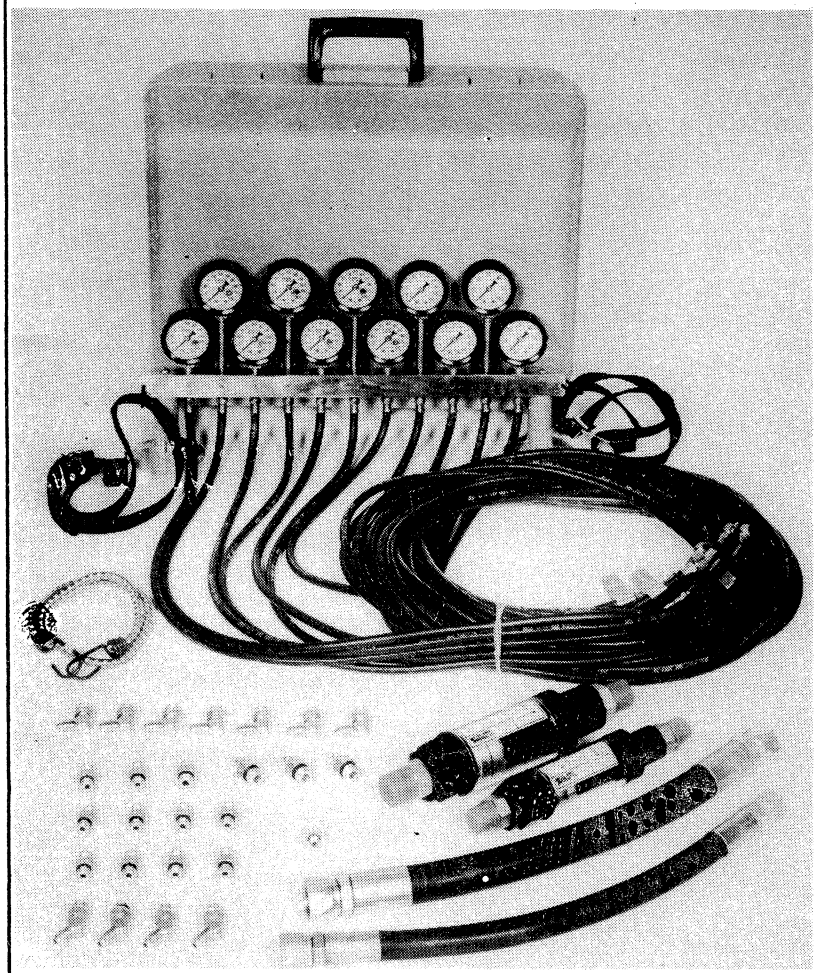
This section of the maintenance manual has been prepared to assist maintenance personnel in trouble shooting equipment discussed in the manual. When trouble shooting the equipment, always remember to consider the entire power package.

PRESSURE AND FLOW TEST KIT.

A portable pressure and flow test kit 2451 is available and contains the necessary equipment to accurately test and trouble shoot the hydraulic system of this Twin Disc unit. The kit is ruggedly constructed for field use and contains pressure gauges, hoses, adapters, flow meters, straps, clips, etc. Contact the TWIN DISC Service Department, Nivelles/Belgium or Racine, WISCONSIN, U.S.A. 53403 for specific information concerning this test kit. See figure 5-1.

TROUBLE SHOOTING CHART.

The trouble shooting chart (Table 5-1) is organized in three columns. Proper use of the chart will aid in the rapid determination and repair of functional difficulties that may occur.



CONTENTS OF KIT 2451

Part No.	Qty.	Description
6652	1	Gauge Bar
6653	7	Gauge 400 psi
6234	2	Gauge 100 psi
6258	1	Gauge 60 psi
6654	1	Gauge 30 psi
6094	11	Hose 10 ft. Long
0799	2	"D" Clip
0800	2	Strap
0801	2	Coated Clips
0802	1	Stretch Cord
0803	2	Suction Cup
6311	5	Nipples NPT-2
0076	5	Coupler NPT-2
0804	2	Screw 1/4-20 x 2-3/4 lg.
0831	7	90° Elbow 4 SAE x 4 JIC M
0039	10	Adapter 4 SAE x 4 JIC M
0721	1	Adapter 3 SAE x 4 JIC M
0013	3	Adapter 6 SAE x 4 JIC M
0752	1	Adapter 5 SAE x 4 JIC M
6655	1	Flow Meter 30 GPM
6656	1	Flow Meter 10 GPM
6657	1	Hose 10 – 100R1 18 inches Long
6658	1	Hose 12 – 100R1 18 inches Long
6660	2	Adapter 10 SAE MX 10 JIC M
6659	2	Adapter 12 SAE MX 12 JIC M
6641	4	Adapter 45° 4 SAE x 4 JIC M
6299	1	Box Storage with fills

NOTE: Twin Disc will not stock or sell this kit.

Manufactured for Twin Disc, Incorporated by The Nuday Co. 14615 Wyoming, Detroit MI. 48238

Figure 5-1 : Pressure and Flow Test Kit 2451.

Table 5-1 - Trouble Shooting.

SYMPTOM	CAUSE	REMEDY
1. Low oil pressure.	1.1. Partially clogged filter screen.	1.1. Remove and clean filter screen.
	1.2. Stuck main regulator piston.	1.2. Remove main regulator valve parts from valve body, and clean parts.
	1.3. Broken or worn piston rings on clutch shaft(s).	1.3. Remove pump mount and selector valve assembly from rear cover. Remove piston rings from clutch shafts. Install new piston rings on clutch shafts.
	1.4. Damaged or worn oil pump assembly.	1.4. Remove and replace the oil pump assembly.
	1.5. Damaged or worn clutch piston rings.	1.5. Remove marine transmission. Disassemble clutches, and replace damaged or worn parts.
	1.6. Scored valve bore in selector valve assembly.	1.6. Remove selector valve assembly. Disassemble selector valve assembly and inspect valve bore.
	1.7. Reverse clutch housing gear turning on shaft.	1.7. Remove and replace reverse clutch shaft and gear assembly
2. No oil pressure.	2.1. Low oil level or empty sump.	2.1. Check gaskets, hoses, and seals for oil leakage. Replace parts causing leakage and fill marine transmission sump.
	2.2. Fully clogged filter screen.	2.2. Remove and clean filter screen.

SYMPTOM	CAUSE	REMEDY
	2.3. Damaged suction tube.	2.3. Disassemble and inspect suction tube. Replace parts as required.
	2.4. Damaged or worn oil pump assembly.	2.4. Remove and replace oil pump assembly.
	2.5. Broken clutch shaft.	2.5. Refer to remedy 1.5.
3. High oil pressure.	3.1. Stuck main regulator piston.	3.1. Refer to remedy 1.2.
4. Overheating.	4.1. Insufficient heat exchanger capacity.	4.1. Replace present heat exchanger with heat exchanger of sufficient capacity.
	4.2. Insufficient cooling water flow.	4.2. Replace lines and/or hoses with larger inside diameter lines and/or hoses.
	4.3. Slipping clutch.	4.3. Low oil pressure (symptom 1). Remove marine transmission disassemble, and inspect for worn clutch plates.
	4.4. Oil level too high.	4.4. Correct oil level.
	4.5. Improper oil in sump.	4.5. Drain marine transmission, and fill with proper oil.
	4.6. Clutch piston spring broken.	4.6. Refer to remedy 1.5.
	4.7. Clutch plates warped.	4.7. Refer to remedy 1.5.
	4.8. Improper bearing adjustment with shims (especially after overhaul).	4.8. Check end play of shafts, and make proper shim adjustments.

SYMPTOM	CAUSE	REMEDY
5. Excessive noise.	5.1. Air leak in suction side of system.	5.1. Tighten all fittings and/or replace a damaged tube. * (* Special rolling tools are required).
	5.2. Worn gear teeth or splines on marine transmission parts.	5.2. Overhaul marine transmission. Replace worn parts.
	5.3. Bearing failure.	5.1. Overhaul marine transmission. Replace damaged or worn parts.
	5.4. Worn or damaged rubber blocks.	5.4. Remove marine transmission. Replace worn or damaged rubber blocks.
	5.5. Excessive bearing end play.	5.5. Check and reset end play.
6. No neutral.	6.1. Clutch plates warped.	6.1. Refer to remedy 1.5.
	6.2. Clutch piston spring broken and jammed.	6.2. Refer to remedy 1.5.
	6.3. Selector valve linkage incorrect.	6.3. Check linkage and adjust.
	6.4. Scored bore in valve body of selector valve assembly.	6.4. Refer to remedy 1.6.
7. Harsh engagement.	7.1. Air in oil.	7.1. Correct air leaks in suction side of system. Change oil to proper oil.
	7.2. Binding clutch piston.	7.2. Refer to remedy 1.5.
8. Leakage between main housing and rear cover.	8.1. Main housing gasket failure.	8.1. Remove marine transmission. Disassemble and replace main housing gasket.

SYMPTOM	CAUSE	REMEDY
9. No pressure and no output power.	9.1. Input shaft broken.	9.1. Overhaul marine transmission. Replace broken or damaged parts.
	9.2. Drive spider broken.	9.2. Refer to remedy 9.1.
	9.3. Drive spider or input gear keys sheared.	9.3. Refer to remedy 9.1.

SECTION 6 - REMOVAL AND UNIT DISASSEMBLY.

PRIOR TO REMOVAL.

1. **Hydraulic System.** Drain the hydraulic system of oil.

2. **Connecting linkage.** Disconnect all connecting linkage and lines to the marine transmission.

3. **Support.** Support the marine transmission with a hoist, or other suitable equipment, prior to the removal of any mounting parts.

REMOVAL.

1. **Output Flange Connection.** Scribe an alignment mark across the outside diameter of the output flange and the companion flange for installation purposes. Remove the bolts and nuts that secure the output flange and companion flange together. After the removal of attaching parts, move the propeller shaft rearward until sufficient clearance is apparent for marine transmission removal.

2. **Engine Bedrail Connections.** Disconnect the mounting brackets installed on the engine bedrails from the mounting pads of the marine transmission or from the engine bedrails.

3. **Engine Connection.** Remove the 12 hex-head capscrews that secure the main housing of the marine transmission to the engine flywheel housing. Slide the marine transmission rearward until the rubber blocks on the drive spider are clear of the driving ring installed on the engine flywheel. Remove the marine transmission. Remove the driving ring from the engine flywheel only if replacement of parts is necessary.

DISASSEMBLY.

Miscellaneous External Parts.

1. Remove the oil level gauge (Figure 12-1, 13) from the oil level gauge tube (14). Remove the tube (14) from the rear housing (11).

2. Remove the drain plug (50) and O-ring (51).

3. Remove breather cap (10) only if parts are being replaced.

4. If replacement of the name plate (7) is necessary, remove the four drive screws (6) that secure the name plate to the main housing. Remove the name plate from the main housing, and transfer the data stamped on the old plate to the new plate.

5. If replacement of the rotation indicator plates (4) is necessary, remove the four drive screws (5) that secure the rotation indicator plate to the main housing. Remove the rotation indicator plate from the main housing.

6. Remove capscrew (Figure 12-2, 1) and retainer washer (2).

7. Use a puller to remove drive spider (5). See Figure 6-1.

8. Remove capscrews (Figure 12-2, 12) and use two of the capscrews as pushers in the threaded holes in bearing support (7) to remove the bearing support. See Figure 6-2.

9. Remove the input shaft and gear assembly. See figure 6-3.

10. Turn the transmission over so that the output shaft is up.

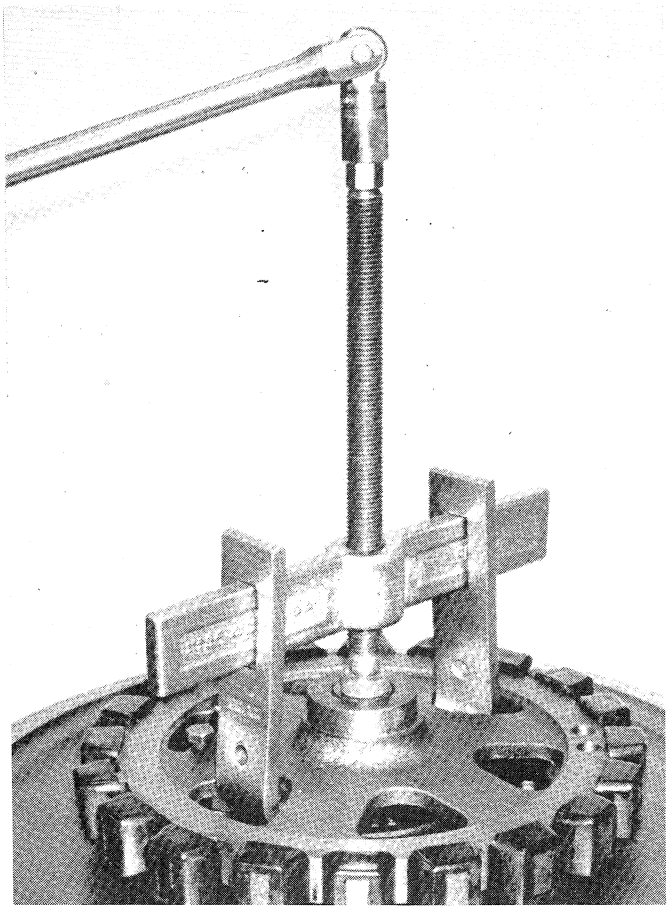


Figure 6-1. Removing Input Drive Spider.

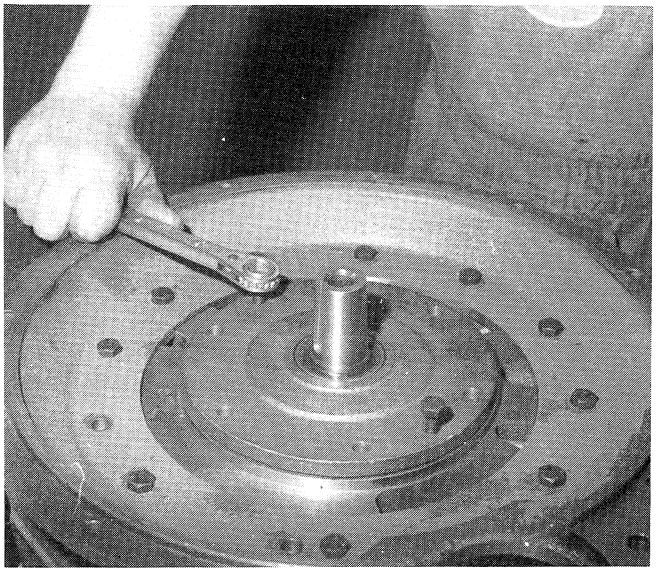


Figure 6-2. Using Pusher Screws to remove Input Bearing Support.

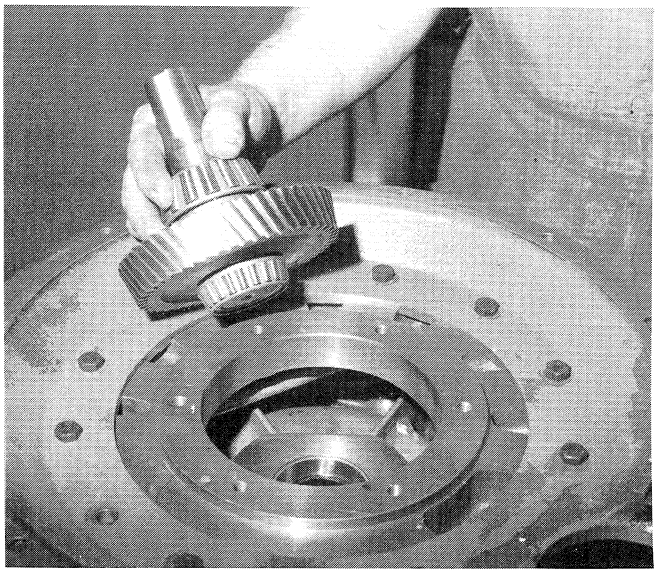


Figure 6-3. Removing the Input Shaft & Gear Assembly from Main Housing.

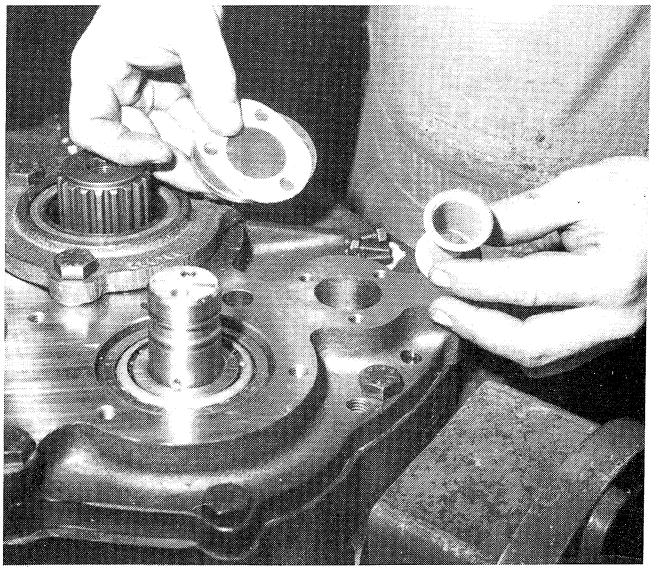


Figure 6-4. Pump Suction Filter Screen and Cover Plate Removal.

11. Remove the three capscrews (Figure 12-1, 43), filter screen cover (44), gasket (45) and screen (46) from the rear cover (11). See Figure 6-4.

12. Remove the four hex-head capscrews (Figure 12-1, 42) that secure the oil pump assembly (41) to the pump mount. Remove the oil pump assembly and the oil pump gasket (40) from the pump mount. Discard the gasket. Disassemble the parts only if replacement of parts is necessary.

13. Remove the hex-head capscrew (Figure 12-2, 28) and the retainer washer (27) that secure the output flange (25) on the output shaft (18). See Figure 6-5. Some ratios have three capscrews on the output shaft. Use a standard gear puller and remove the output flange (Figure 12-2, 25) from the output shaft (18). Remove the lathe cut ring (26) from the output flange (25). Discard the seal ring.

14. Loosen the hex-head capscrews (Figure 12-1, 18), and nut (19), and remove selector lever (20). Remove the three hex-head capscrews (34) and (30) that secure the selector valve assembly (28) to the rear cover (11). Simultaneously, remove the pump mount and selector valve assembly from the rear cover. See Figure 6-6. Remove the two jumper tubes (Figure 12-1, 36), and four O-ring seals (35) from between the pump mount and selector valve assembly. Remove the pump mount shims (37) and O-ring (48), and valve body shims (16) from the rear cover.

15. Remove the three hex-head capscrews (Figure 12-2, 23) that secure the bearing retainer (22) to the rear cover. Remove the bearing retainer and the bearing retainer shims (21) from the rear cover. See Figure 6-7. Remove the bearing retainer oil seal (Figure 12-2, 24) from the bearing retainer. Discard the oil seal.

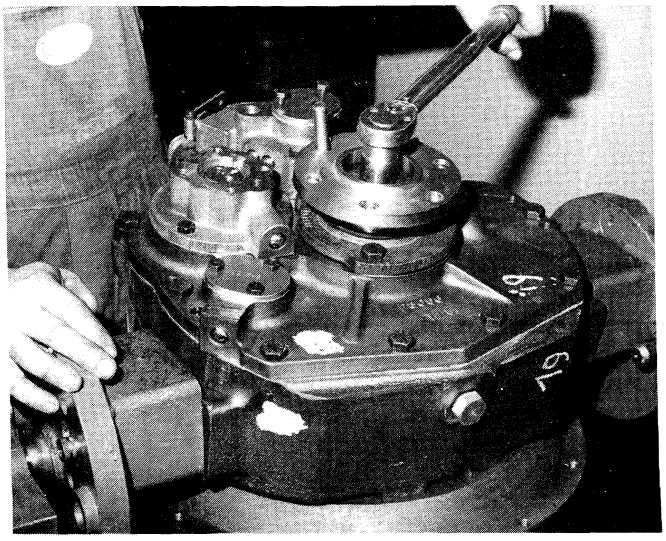


Figure 6-5. Removing Output Flange.

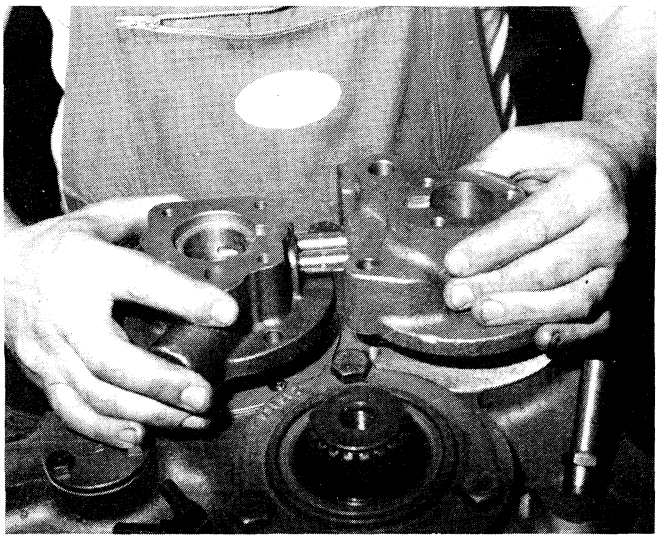


Figure 6-6. Removing or Installing Pump Mount and Valve Body together.

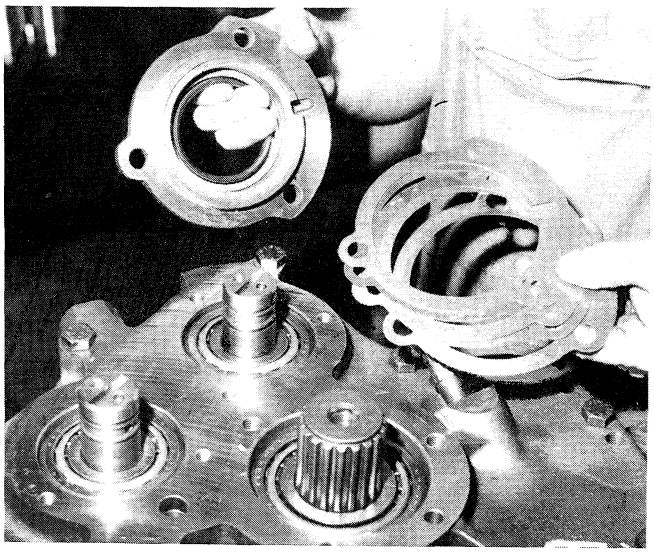


Figure 6-7. Output Bearing Retainer and Shims removed.

16. Remove the ten hex-head capscrews (Figure 12-1, 12, 15 and 49) that secure the rear cover (14) to the main housing (8). See Figure 6-8. use two 1/2-13 pusher screws and remove the rear cover and the main housing gasket (Figure 12-1, 13) from the main housing. Do not remove the two dowel pins (49) from the rear cover or main housing. Remove the bearing cups of the output shaft tapered roller bearing (Figure 12-2, 20), the forward clutch shaft tapered roller bearings (Figure 12-3, 21), and the reverse clutch shaft tapered roller bearing (Figure 12-4, 21) from the rear cover only if replacement of parts is necessary.

17. Remove the output shaft and gear assembly. See Figure 6-9.

18. Remove the reverse clutch assembly. See Figure 6-10.

19. Remove the forward clutch assembly. See Figure 6-11.

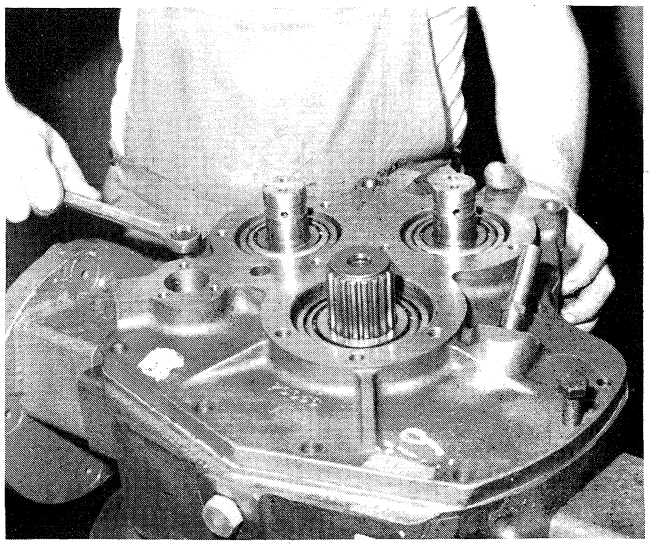


Figure 6-8. Using Pusher Screws to remove Rear Cover.

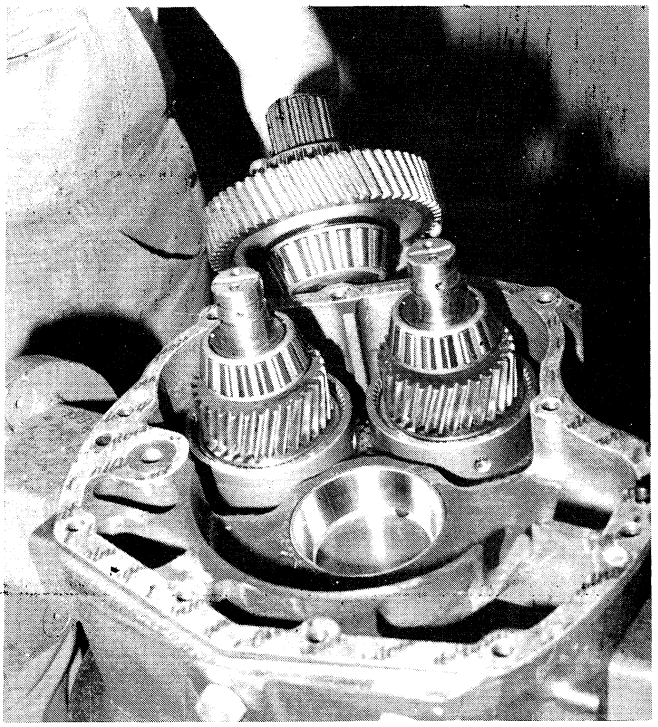


Figure 6-9. Removing or Installing Output Shaft and Gear Assembly.

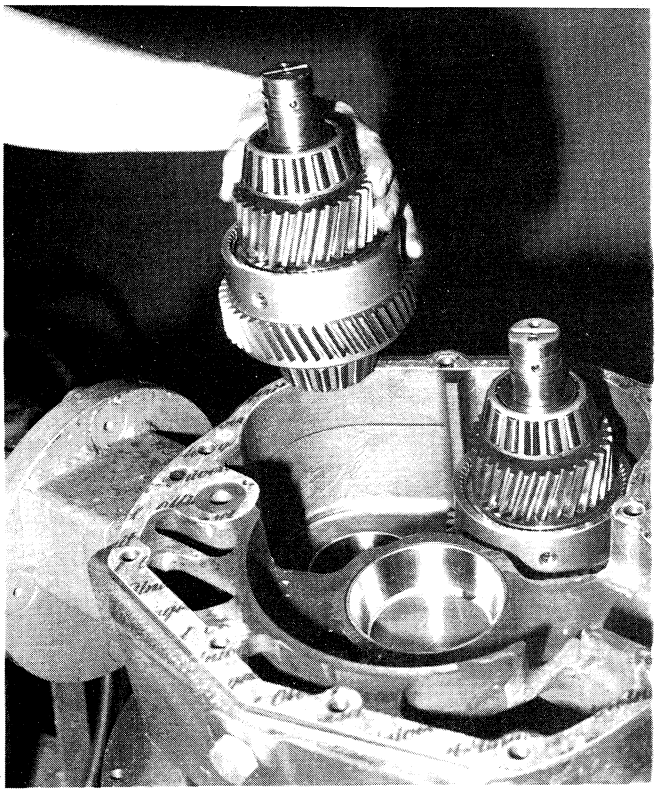


Figure 6-10. Removing or Installing the Reverse Clutch Assembly.

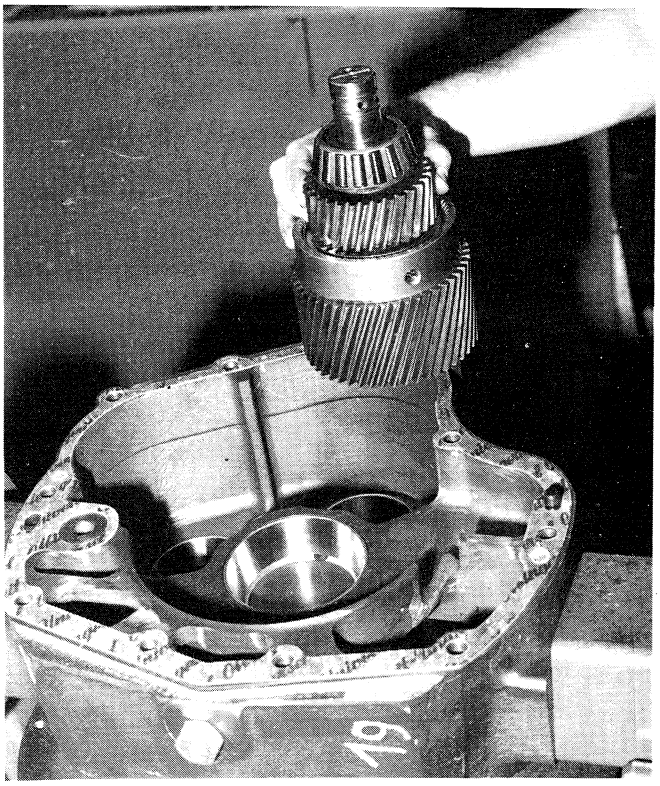


Figure 6-11. Removing or Installing the Forward Clutch Assembly.

SECTION 7 - CLEANING AND INSPECTION.

CLEANING.

General.

NOTE

Replace all oil seals, gaskets, O-rings, lock plates, piston rings, seal rings, snap rings, etc., as a part of any maintenance or overhaul procedure. Shims which could be damaged or destroyed in disassembly should also be replaced.

1. Using Stoddard solvent, or equivalent or steam cleaning, clean all parts. Parts cleaned with solvent or steam cleaned must be dried and oiled immediately.

2. Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.

3. Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.

4. Use clean solvent to flush oil pumps, valves, etc.

5. Flush all hoses, tubing, coolers, etc., particularly if the unit is being disassembled due to an internal failure.

Cleaning bearings.

Do not remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service, in clean solvent. Soak bearing in solvent if they are particularly dirty or filled with hardened grease.

CAUTION

Never dry bearing with compressed air. Do not spin bearings while they are not lubricated. Oil bearings with SAE 30 engine oil immediately after cleaning. Be sure bearings are oiled before inspection.

Preventing entrance of dirt into bearings.

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are to be installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lintfree cloth or paper to keep out dust.

Previously sealed joints.

1. For previously sealed joints, scrape surfaces to remove old gasket material. Gel-type paint removers containing methylene chloride can be used to wipe off cured sealant.

2. Clean surfaces with 1, 1, 1-trichloroethane to remove oil and grease residue.

3. Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface of the part in a film. If the water puddles or forms beads, use fresh solvent and reclean.

INSPECTION.

Housings, Cast parts, and Machined surfaces.

NOTE

Units with matched housings require replacement of both halves. These must be kept in matched halves.

1. Replace cast parts or housings that are cracked.

2. Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace parts that are deeply grooved or scratched.

3. Inspect oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working a wire back and forth through the passage and flushing it with solvent.

4. Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If such defects cannot be removed with crocus cloth or a soft stone, replace the part.

5. Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.

6. Inspect studs for damaged threads and looseness. Replace defective studs.

7. Inspect dowel pins for wear or damage. Replace defective dowels. This applies where matched set of parts is not involved.

8. Inspect dowel pins holes for wear due to movement between mating parts. If a dowel pin hole is worn, rebore and sleeve the hole when possible. Otherwise, replace the parts. This applies where matched set of parts is not involved.

Valve seats.

Inspect valve seats for burrs, nicks and scratches. If these defects cannot be removed with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings.

1. Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.

2. Inspect bearings for corrosion, scored, scratched, cracked, pitted or chipped races, and for indication of excessive wear of balls or rollers. If one of these defects is found, replace the bearing.

3. Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate that the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired with a crocus cloth, replace the part.

Bushings and sleeves.

Inspect bushings for size and out-of-roundness, scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust washers and spacers.

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears.

1. Inspect gears for scuffed, nicked, burred or broken teeth. If the defect cannot be removed with a soft stone, replace the gear.

2. Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace the gear.

3. Inspect thrust faces of gears for scores, scraches and burrs. If these defects cannot be removed with a soft stone, replace the gear.

Splined parts.

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Snap ring.

Replace damaged or distorted snap rings.

Springs.

Inspect springs for broken or distorted coils. Replace the spring if either of these defects are found.

Flexible hoses.

Inspect flexible hoses for cracks and sponginess. Replace damaged hoses.

SECTION 8 - SUBASSEMBLIES.

ASSEMBLY NOTE

Place the inner race of all roller bearings in a 275° F. oven for 30 minutes maximum.

CAUTION

There is a possibility of clutch pack failure on initial start-up after rebuild, due to lack of lubrication until lube pressure builds up. All sintered metal clutch plates must be submerged in oil (use same oil as will be used in unit) for a minimum of one (1) hour prior to assembly. A longer soaking period would be even more beneficial. Covering the plates with oil from an oil can during assembly is NOT sufficient.

ASSEMBLY NOTE

Oil torque values are given for all screws; therefore, screws should be oiled before installing.

NOTE

In the discussion that follows, the input side of the transmission is the front and the output side is the rear.

FORWARD CLUTCH.

Disassembly.

1. Support the forward clutch assembly on a work surface with the output end up.

2. Remove two piston rings (Figure 12-3, 22) from the rear end of the clutch shaft.

3. Remove roller bearing (21) inner race using guillotine-type puller. See Figure 8-1.

CAUTION

Be sure the puller is under the inner cone of the race.

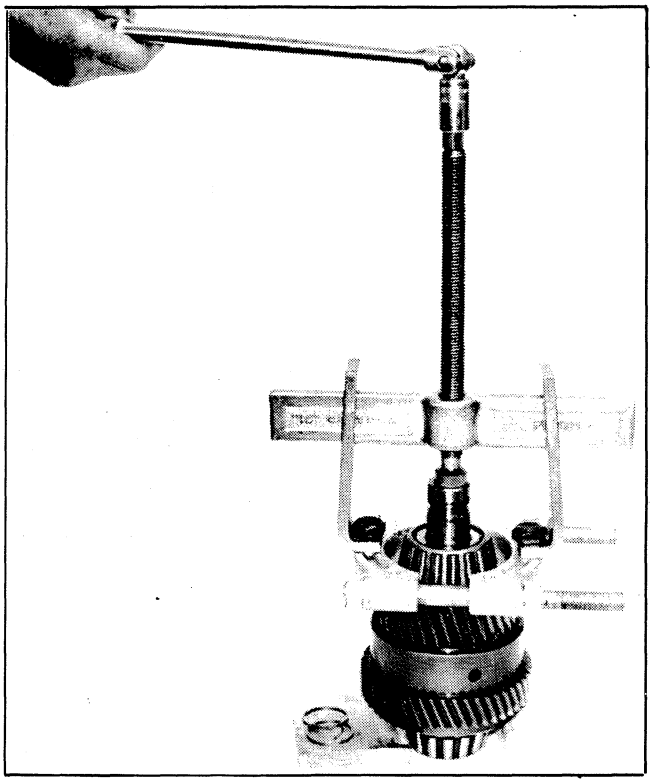


Figure 8-1. Pulling the Rear Bearing Cone from the Reverse Clutch Shaft.

4. Lift clutch hub and pinion assembly (Figure 12-3, 15) and remove steel thrust washers (18 and 20) and needle thrust bearing (19). See Figure 8-2.

5. Remove the clutch hub and pinion assembly. See Figure 8-3.

6. Remove steel thrust washers (Figure 12-3, 12 and 14) and needle thrust bearing (13). See Figure 8-4.

7. Remove internal snap ring (Figure 12-3, 9). See figure 8-5.

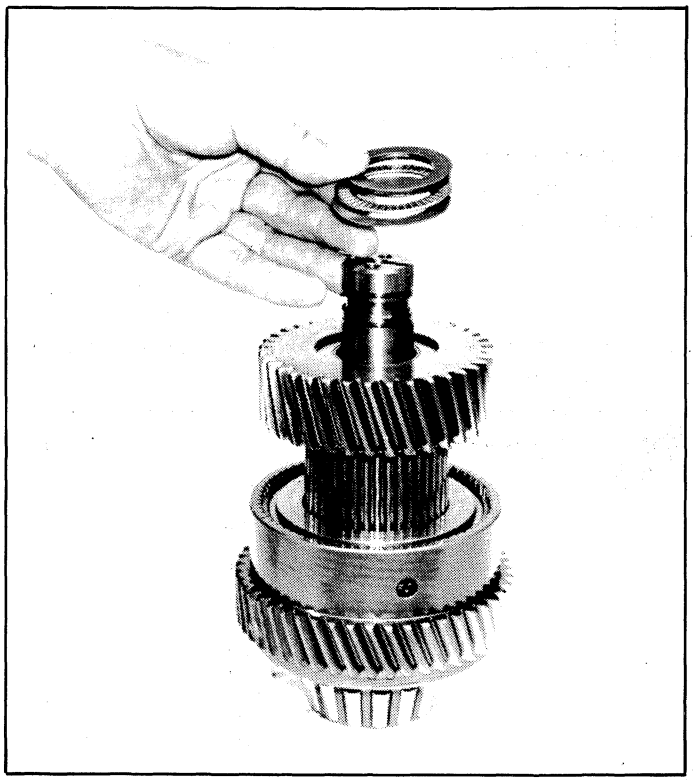


Figure 8-2. Removing or Installing the Rear Thrust Bearing, Spacer and Washer from the Reverse Clutch Shaft.

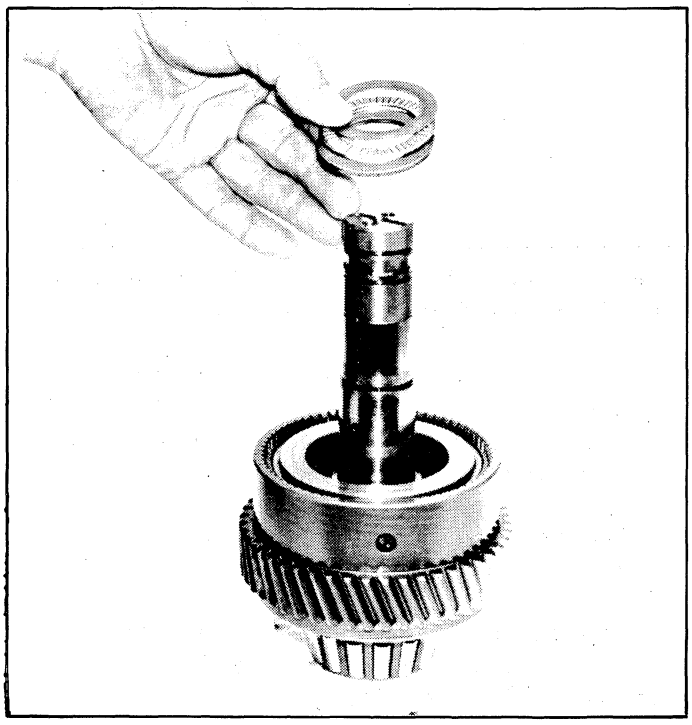


Figure 8-3. Removing or Installing the Clutch Hub and Pinion Assembly.

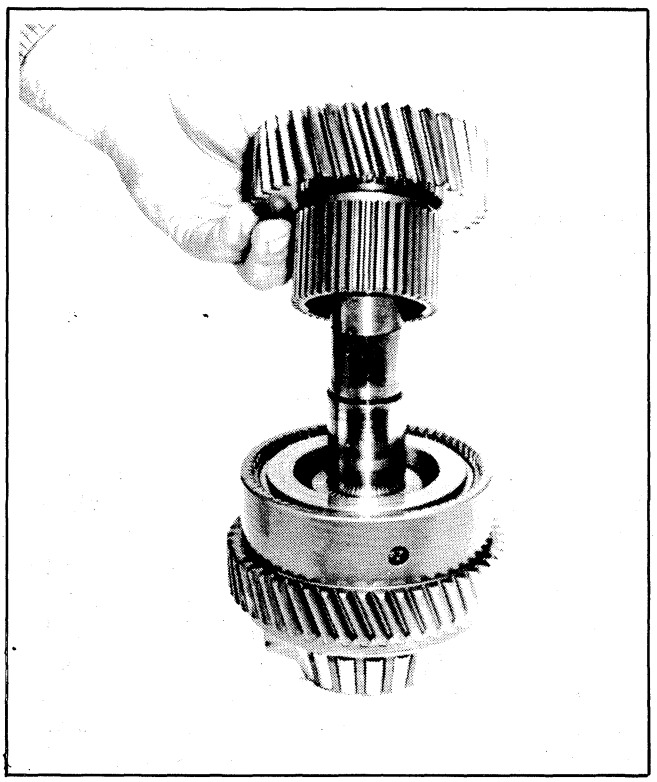


Figure 8-4. Removing or Installing the Front Thrust Bearing, Spacer and Washer from the Reverse Clutch Shaft.

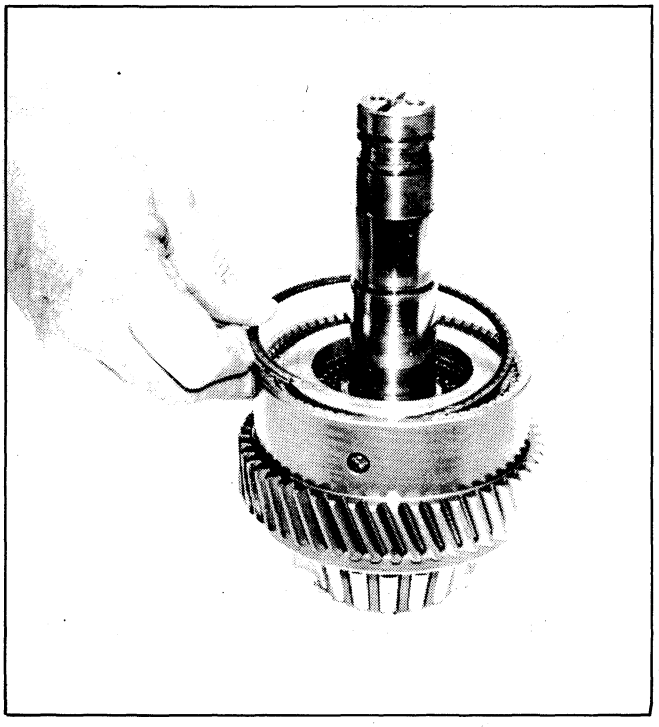


Figure 8-5. Removing or Installing the Internal Retaining Snap Ring on the Housing Gear.

8. Remove back plate (Figure 12-3, 8), faced clutch plates (7), and steel clutch plates (6). See Figure 8-6.

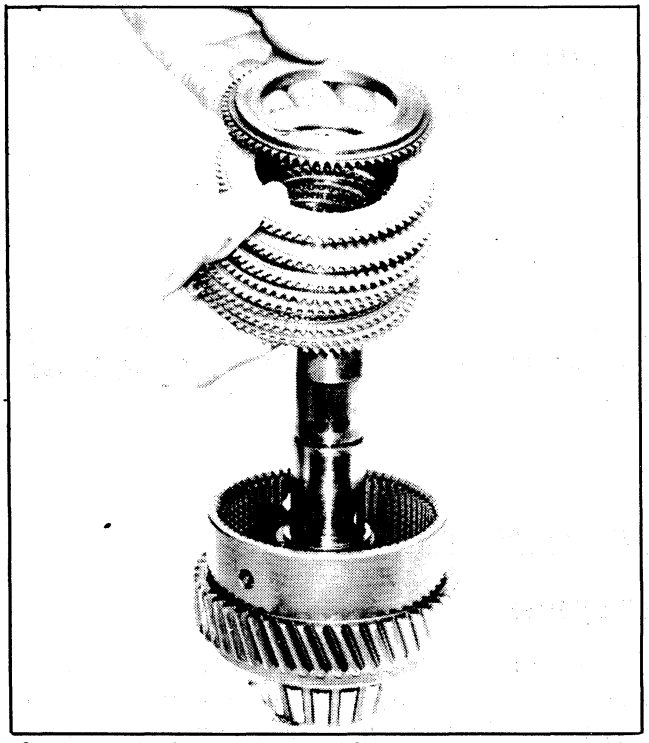


Figure 8-6. Removing or Installing Clutch Plates and Back Plate on Reverse Housing Gear.

9. Compress the clutch return spring (Figure 12-3, 10) with special tool T-16752 and remove external snap ring (11). See Figure 8-7.

10. Remove the clutch piston (Figure 12-3) and piston return spring (10). See Figure 8-8.

CAUTION

Do not remove front roller bearing (Figure 12-3, 1) inner race unless it is damaged or worn. The bearing is destroyed during removal.

11. If necessary, cut the bearing (1) cage and remove the cage and rollers.

12. Grip onto the lip on the inner race with a puller and remove the inner race.

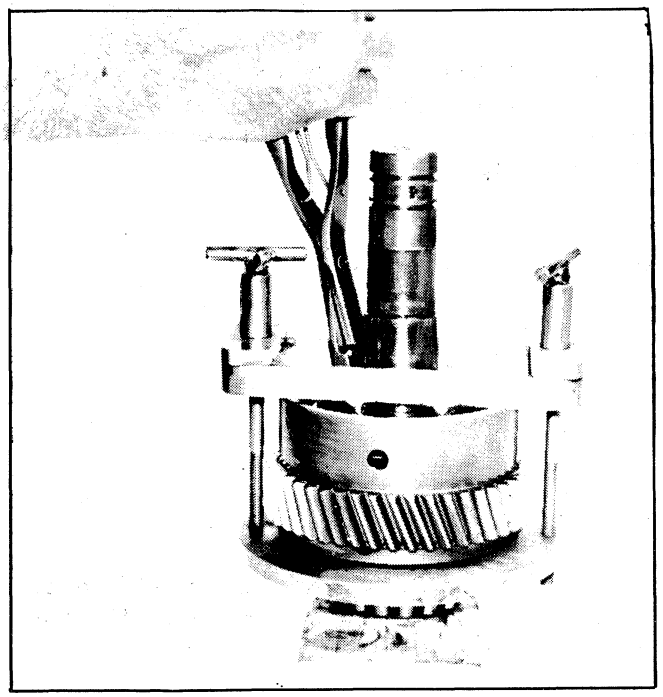


Figure 8-7. Compressing Clutch Piston Return Spring and Removing External Retaining Snap Ring.

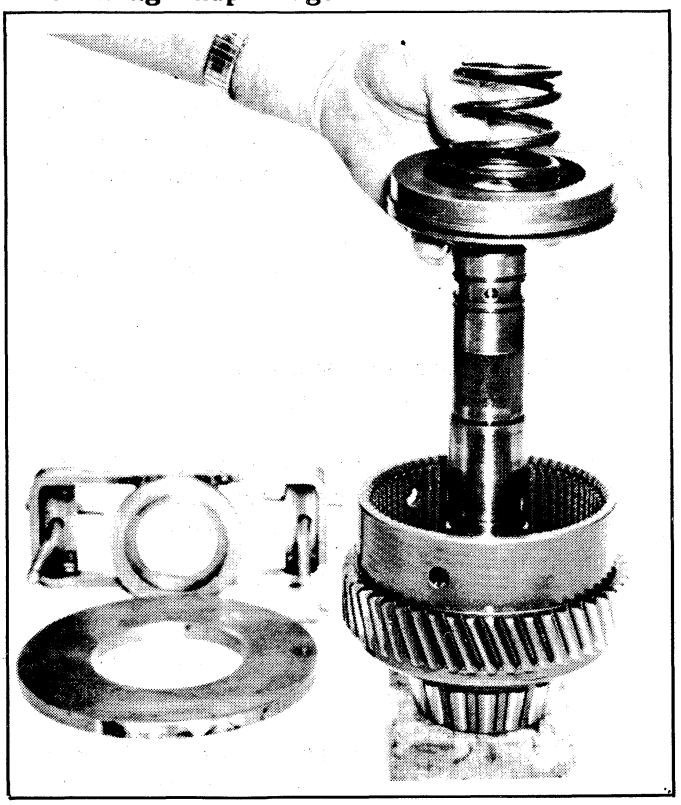


Figure 8-8. Removing or Installing Clutch Piston and Return Spring.

CAUTION

Do not attempt to remove the clutch housing gear (2) from clutch shaft assembly (17). These items are not serviced separately.

Cleaning and Inspection.

See Section 7.

Assembly.

1. Install a new piston ring (Figure 12-3, 5) on clutch shaft (17).

2. Install a new piston ring (4) onto the clutch piston (3) and install the clutch piston.

3. Install piston return spring (10). See Figure 8-8.

4. Use special tool T-16752 to compress the spring and install external snap ring (Figure 12-3, 11). See Figure 8-7.

5. Install clutch plates (Figure 12-3, 6 and 7). Begin with a driving (sintered) plate and alternate with a driven (steel) plate.

6. Install the back plate (8). See Figure 8-6.

7. Install internal snap ring (Figure 12-3, 9). See Figure 8-5.

8. Install thrust washer (Figure 12-3, 12), needle thrust bearing (13), and thrust washer (14) in that order. See Figure 8-4.

9. Install clutch hub and pinion assembly (Figure 12-3, 15). See Figure 8-3.

10. Install steel thrust washer (Figure 12-3, 18), needle thrust bearing (19), and steel thrust washer (20), in that order. See Figure 8-2.

11. Install heated inner races of tapered roller bearings (Figure 12-3, 1 and 21).

12. Install two piston rings (22) into the grooves provided on the rear of the clutch shaft (17).

REVERSE CLUTCH.

Repeat the above procedure to disassemble and assemble the reverse clutch.

OUTPUT GROUP OF PARTS.

Disassembly.

1. Support the output shaft and gear assembly in a press with the weight on the gear and the rear end of the shaft up.

WARNING

Due to the force required (30-60 tons) to remove the output gear from the output shaft, a protective shield should be placed around the press.
Also, the gear should be restrained so it will not fly up the shaft when it comes loose.

One way to restrain the gear is as follows :

a) Install the output flange (12-2, 24). See Figure 8-9.

b) Place a 1/8 inch thick dise that is slightly smaller in diameter than the rear of the output shaft, onto the rear of the output shaft.

c) Place the retainer washer (Figure 12-2, 26) over the disc.

d) Block up the output shaft so that it will not fall when it is pressed loose.

e) Press on the retainer washer until the gear pops loose.

f) Remove the output flange (Figure 12-2, 24). The output shaft can be pressed out of the bearing inner race (Figure 12-2, 19) and output gear.

2. Support the output group on the output gear (Figure 12-2, 18) in a press with the rear end of the output shaft up. Press the output shaft out of the output gear (18) and roller bearing (19) inner race.

NOTE

Do not remove front roller bearing (16) inner race on units with 2.96:1 and 2.50:1 ratios unless the bearing is worn or damaged. The bearing is destroyed in removal.

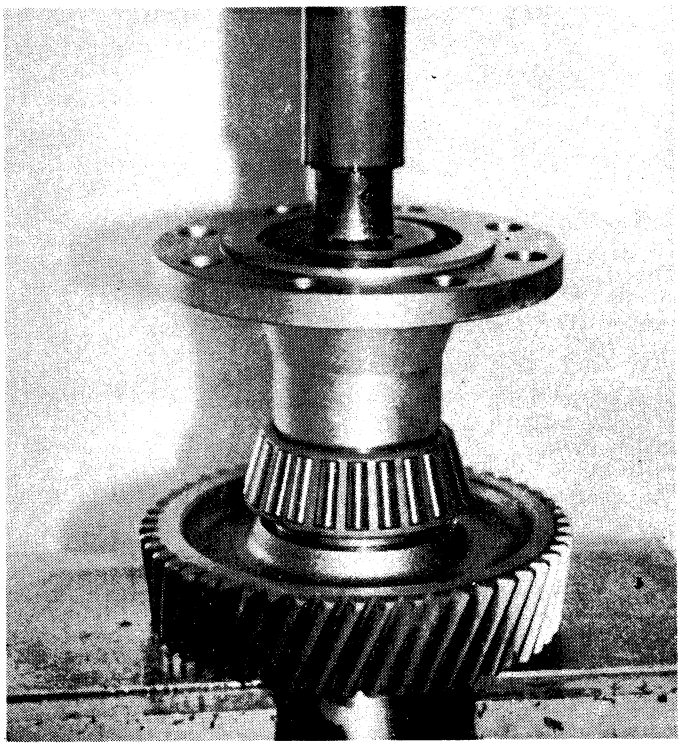


Figure 8-9. Pressing output shaft from rear bearing inner race and pinion.

3. To remove roller bearing (16) inner race, cut the cage and remove the rollers.

4. Grip onto the lip on the inner race with a puller and remove the inner race.

5. For units with ratios of 1.09:1, 1.50:1 and 1.97:1, use special tool T-12127 and an arbor press to press the shaft out of the bearing (16) inner race race.

Cleaning and inspection.

See section 7.

Assembly.

Output group keyless taper assembly.

1. Assembly instructions for tapered joints. Surface preparation :

a) Observe that the parts fit well as determined by brightness of fit on the full length of taper, when previously assembled or by use of a very thin red lead compound, powder or equivalent to ensure full length of taper contact. Remove any rust scales, badly worm spots, nicks, ridges or projections by suitable means. **DO NOT** use chrome, copper, zinc, cadmium, lead, tin, silver, nickel and other coatings.

b) Clean the surface properly. After washing, remove all remaining traces of grease and oil from the tapered surfaces, using approved solvents (*), then air dry or dry with paper towels. When assembling the mating part prevent any oil, dust or other contaminant from falling upon the tapered surfaces.

(*) I,I,I-trichloroethylene : (methylchloroform) meeting OSHA requirements is a recommended solvent. The oil content in the solvent is to be limited to 10 % maximum, by volume.

2. Seat the output gear on shaft using 200-300 lbs. force. Place the output package on an arbor press and using special tool TD-300392 or TD-300392-1, advance the gear flush to within .000-.002 inch of shaft shoulder at smal diameter end of taper. See Figure 8-10. A static press force of 30 to 45 tons (approximately) is required to achieve this advance. A nominal advance of .100 inch is expected and .080 inch is the minimum acceptable advance. Perform runout check from shaft centers to gear outer rim face at the small diameter end of the taper, .005 T.I.R. is a maximum acceptable runout. See Figure 8-11.

3. Install heated roller bearing (Figure 12-2, 16), inner race onto the front of output shaft (17) and seat it against the shoulder on the shaft.

4. Install heated bearing (19) inner race onto the rear of the output shaft.

NOTE

Installation of bearing (see Figure 12-16, 12-19) can also be achieve by pressing the bearings onto the shaft with special tools TD-300392 (or TD 300392-1) and TD 300391 (or TD-300391-1 depending on type of shaft used).

NOTE

Assembly of the rest of the output group is given in section 9.

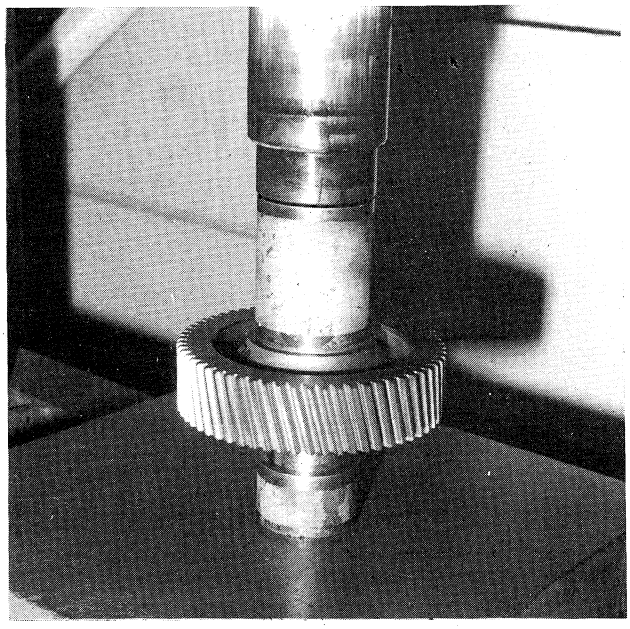


Figure 8-10. Assembly of gear output.

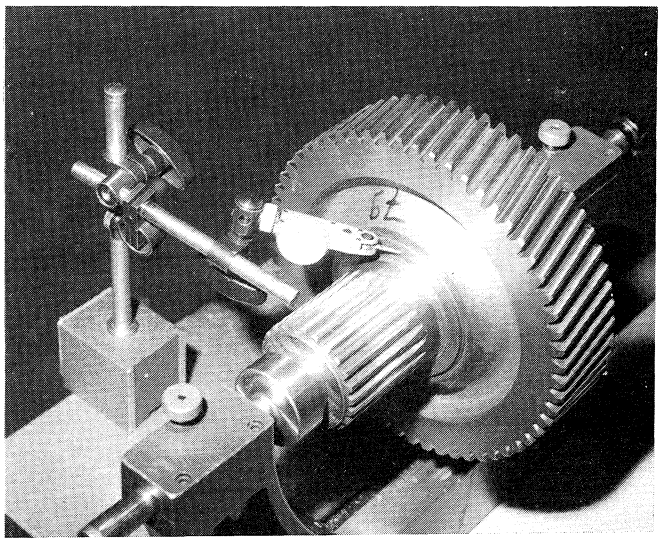


Figure 8-11. Runout check from shaft center.

INPUT SHAFT GROUP.

Disassembly.

NOTE

Do not remove rear roller bearing (8, 9) inner race unless the bearing is worn or damaged. The bearing is destroyed in removal.

1. To remove rear roller bearing inner race (Figure 12-2, 14), cut the cage and remove the rollers.

2. Grip onto the lip from the inner race with a guilloting type puller and remove the inner race.

3. Remove the front roller (Figure 12-2, 9) bearing inner race using the guillotine type puller.

Cleaning and inspection.

See section 7.

Assembly.

Install the heated inner races of roller bearing (9 and 14) and seat them against their shoulder on input shaft and pinion.

SELECTOR VALVE.

Disassembly.

1. Remove capscrews (Figure 12-1, 33), cover (32) and gasket (31).

2. Loosen hex-nut (19) and remove shift lever (20).

3. Remove capscrews (17) and detent plate (21).

4. Remove valve spool (23), regulator piston (24), outer spring (25), inner spring (26), and shim (27).

5. Remove O-ring (22) from valve spool (23).

6. Remove pipe plug (29).

Cleaning and inspection.

See section 7.

Assembly.

1. Install pipe plug (Figure 12-1, 29).

2. Install O-ring (22) onto valve spool (23).

3. Install valve spool (23), regulator piston (24), outer spring (25), inner spring (26), and shim (27) into the valve body (28).

4. Install detent plate (21) and secure it with capscrews (17). Torque the capscrews 15 $\pm$ 2 lbs. ft.

5. Install shift lever (20) and tighten hex nut (19) to 7 $\pm$ 1 lbs. ft.

SECTION 9 - UNIT ASSEMBLY AND INSTALLATION.

NOTE

In the discussion that follows, the input side of the transmission is the front, and the output side is the rear. Right and left sides are determined by facing the output end.

NOTE

Oiled torque values are used throughout; therefore, oil all capscrews before installing.

ASSEMBLY OF SUBASSEMBLIES.

Installing Forward and Reverse Clutches and Output Group.

1. Place the oil shield (Figure 12-2, 15) and install the outer races of roller bearings (Figure 12-2, 16; 12-3, 1 and 12-4, 1) into main housing (Figure 12-1, 8).

2. Install the forward and reverse clutch groups and output group. See Figures 6-9, 6-10 and 6-11.

3. Install outer races of roller bearings (Figure 12-2, 20; 12-3, 21 and 12-4, 21) into the rear cover (Figure 12-1, 11).

4. Install gasket (9) and rear cover (11) onto main housing (8).

NOTE

The main housing and rear cover are matched when machining and, therefore, not serviced separately.

5. Secure the rear cover with capscrews (Figure 12-1, 15 and 47). Figure 6-8 shows the cover being removed. Torque the capscrews 65 ± 5 lbs. ft.

Output Shaft Endplay Adjustment.

1. Intall bearing retainer (Figure 12-2, 21) and secure it with capscrews (22) tightened finger tight.

2. Apply forward pressure on the output shaft (17) and rotate the shaft several revolutions in each directions.

3. Tighten capscrews (22) finger tight again and then measure with a taper gauge the space between bearing retainer (21) and rear cover (Figure 12-1, 11). See Figure 9-1. Make up a shim pack (Figure 12-2, 20) equal to the measured space plus 0.005 inch.

4. Install the shim pack (22) and bearing retainer (21) (see Figure 6-7) and secure them with capscrews (Figure 12-2, 22). Torque the capscrews 65 ± 5 lbs. ft.

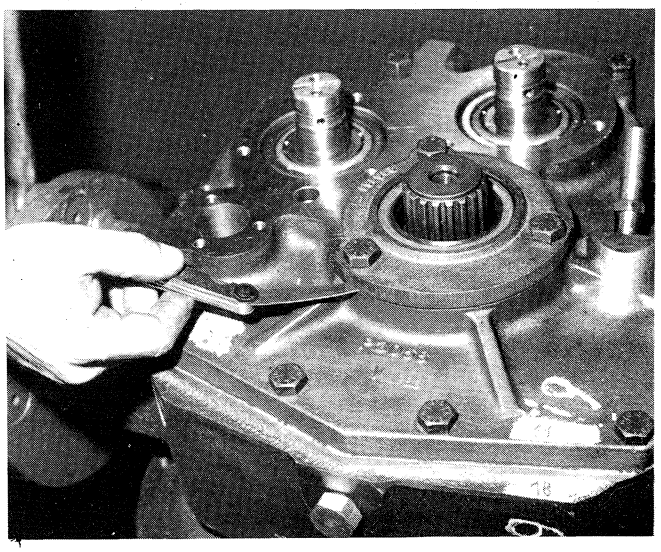


Figure 9-1. Measuring shim space between output bearing retainer and rear cover.

5. Install an eyebolt into the rear end of the output shaft.

6. Apply 60 to 100 lbs. downward pressure on the output shaft while rotating it several revolutions in each direction.

7. Install a dial indicator with the tip resting on the end of the output shaft. Mark with a felt marker the spot where the tip is resting. Zero the indicator.

8. Use a fish scale and hoist to apply 60 to 100 lbs. upward pressure on the output shaft and rotate it several revolutions in each direction. Stop with the indicator tip resting on the marked spot. The indicator reading is the end play.

9. Add or remove shims as necessary to adjust the endplay to 0.001 to 0.004 inch.

10. Use special tool T-11684 to install oil seal (Figure 12-2, 23) into the rear of bearing retainer (21) with the lip on the oil seal toward the oil being retained.

11. Apply anaerobic plastic sealant as follows :

a) For previously sealed joints, scrape surfaces to remove old plastic sealant. Gel-type paint remover containing methylene chloride may be used to wipe off cured sealant.

b) Clean surfaces of rear cover (Figure 12-1, 11), shims (Figure 12-2, 20) and bearing retainer (21) with 1,1,1,-trichloroethane to remove all oil and grease residue.

c) Use Twin Disc primer MA-579 (LOCQUIC T) or equivalent on both mating surfaces. Allow the primer to dry. This usually takes three to four minutes.

d) Keep surfaces clean and free of oil and grease from this point on.

e. Apply a thin layer of LOCTITE N° 49® on both sides of each shim (20).

12. Install shim pack (20) and bearing retainer (21) and secure with capscrews (22). Torque the capscrews 65 ± 5 lbs. ft.

Reverse Clutch Shaft End Play Adjustment.

1. Apply 60 to 100 lbs. downward (forward) pressure onto the reverse clutch shaft while rotating the shaft several revolutions in each direction.

2. Install pump mount (Figure 12-1, 39) without shims (37) and secure the mount with capscrews (38) tightened finger tight.

3. Use a taper gauge to measure the space between the pump mount (39) and the rear cover (11). See Figure 9-2.

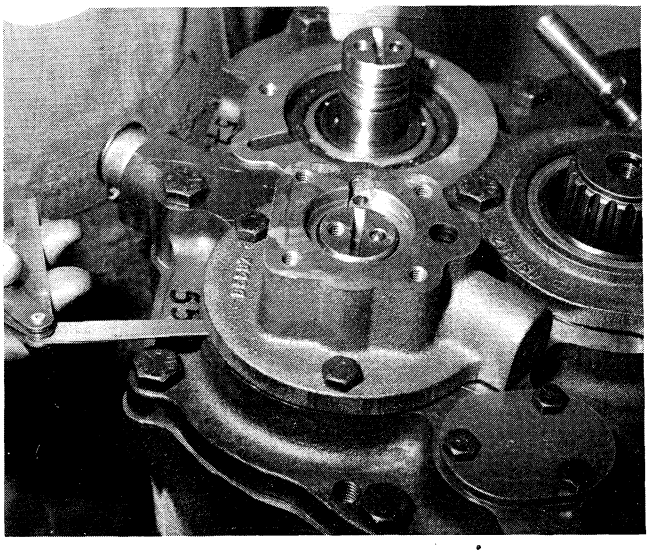


Figure 9-2. Measuring shim space between pump mount and the rear cover.

4. Make up a shim pack (see Figure 12-1, 16) equal to the measurement and ad .005.

5. Install the shim pack (see Figure 9-3) under the pump mount (Figure 12-1, 39) and secure with capscrews (38). Torque the capscrews 27 ± 2 lbs. ft.

6. Install an eyebolt into the threaded hole in the rear end of the reverse clutch shaft. See Figure 9-4.

7. Install an indicator with the tip resting on the clutch shaft. Mark with a felt marker the spot where the indicator tip is resting and zero the indicator.

8. Use a hoist and fish scale to apply 60 to 100 lbs. upward (rearward) pressure and rotate the reverse clutch shaft (by turning the output shaft) several revolutions in each direction. See Figure 9-5. Stop with the tip resting on the marked spot. The indicator reading is the end play.

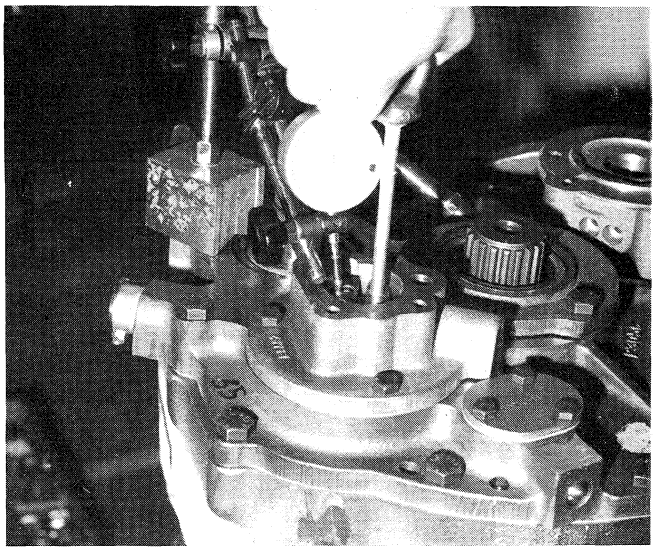


Figure 9-4. Applying pushing force while checking reverse clutch shaft end play.

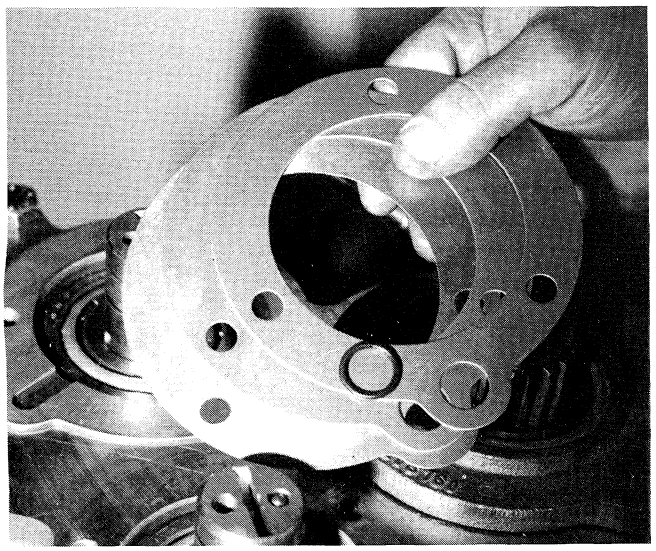


Figure 9-3. Pump mount shims and O-ring seal.

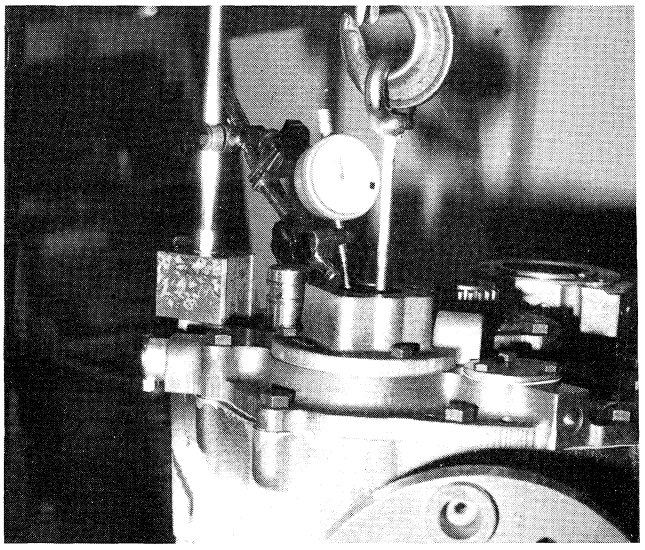


Figure 9-5. Applying pulling force while checking reverse clutch shaft end play.

9. Add or remove shims (Figure 12-1, 37) to adjust the endplay to 0.003 to 0.006 inch.

NOTE

Due to jumper tubes (36) the pump mount and the main regulator valve body (28, 39) must be installed at the same time. Therefore, the endplay of the forward clutch must be checked before the pump mount is installed.

Forward Clutch Shaft End Play Adjustment.

1. Follow the procedure given above for the reverse clutch with the following exceptions.

2. Shim under the main regulator valve body (Figure 12-1, 28) on the forward clutch shaft (Figure 12-3, 17).

3. Cover (32) must be removed to get access to the forward clutch to install the eyebolt.

4. After the shim pack size has been determined for the forward clutch shaft, clean all mating surfaces and apply anaerobic plastic sealant as described for the output shaft above.

5. With anaerobic plastic sealant applied to shims for both the forward and reverse clutch shafts, install the shim packs for both units.

6. Install O-rings (Figure 12-1, 35) onto jumper tubes (36).

7. Install jumper tubes (36) into their bores in pump mount (39) and main regulator valve body (28).

8. Install O-ring (48) over the protruding suction tube on the rear of the rear cover (11).

9. Install pump mount (39) and main regulator valve body (28) at the same time. See Figure 6-6.

10. Secure the pump mount (39) with capscrews (38) and the main regulator valve body with capscrews (30 and 34). Torque the capscrews 27 ± 2 lbs. ft.

11. Install filter screen (46), gasket (45), and cover (44). See Figure 6-4. Secure with capscrews (Figure 12-1, 43). Torque the capscrews 15 ± 2 lbs. ft.

Installing Input Shaft.

1. Turn the unit on the working surface so that the front (input) side is up.

2. Install the outer race of rear roller bearings (Figure 12-2, 14) into its bore in the housing.

3. Install the input shaft group. See Figure 6-3.

4. Install outer race of front roller bearing (Figure 12-2, 9) into its bore in the bearing support (7).

5. Install bearing support (7) without shims (8) or oil seal (6).

6. Secure bearing support (7) with capscrews (12) tightened finger tight.

Adjusting End Play of Input Shaft.

1. Measure with a taper gauge the space between the bearing support (7) and main housing (Figure 12-1, 8). See Figure 9-6.

2. Make up a shim pack (Figure 12-2, 8) (see Figure 9-7) equal to the space measured plus 0.005 inch.

3. Install the shim pack under the bearing support (Figure 12-2, 7) and secure with capscrews (12). Torque the capscrews 27 ± 2 lbs. ft.

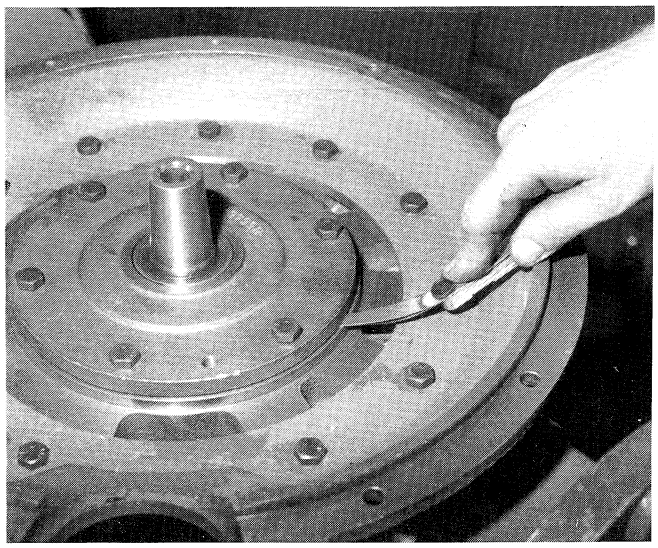


Figure 9-6. Measuring shim space between support and housing.

4. Install an eyebolt into the front of the input shaft and apply 60-100 lbs. downward pressure while rotating the input shaft several revolutions in each direction. See Figure 9-8.

5. Install a dial indicator with the tip resting on the front end of the input shaft.

6. Use a fish scale and hoist to apply 60-100 lbs. forward (upward) pressure on the input shaft. See Figure 9-9.

7. Zero the indicator and place a felt pen mark on the input shaft where the indicator is resting.

8. Rotate the input shaft several revolutions in each direction and stop with the indicator tip resting on the marked spot.

9. The indicator reading is the input shaft endplay.

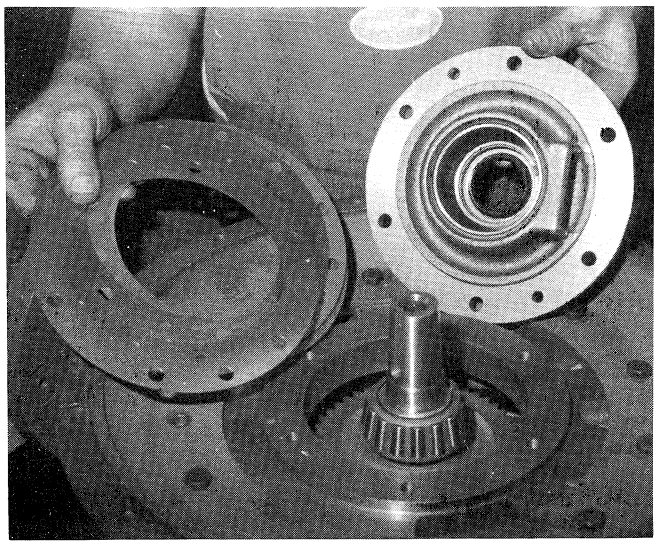


Figure 9-7. Installing shims and input bearing support.

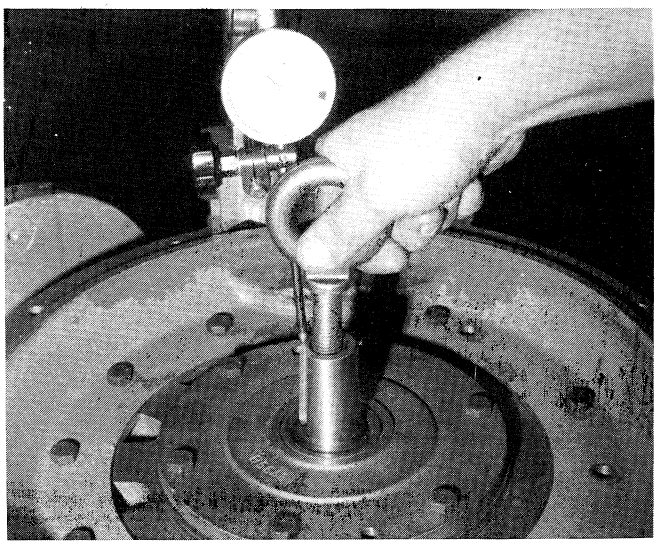


Figure 9-8. Applying pushing force while dial indicating end play of input shaft.

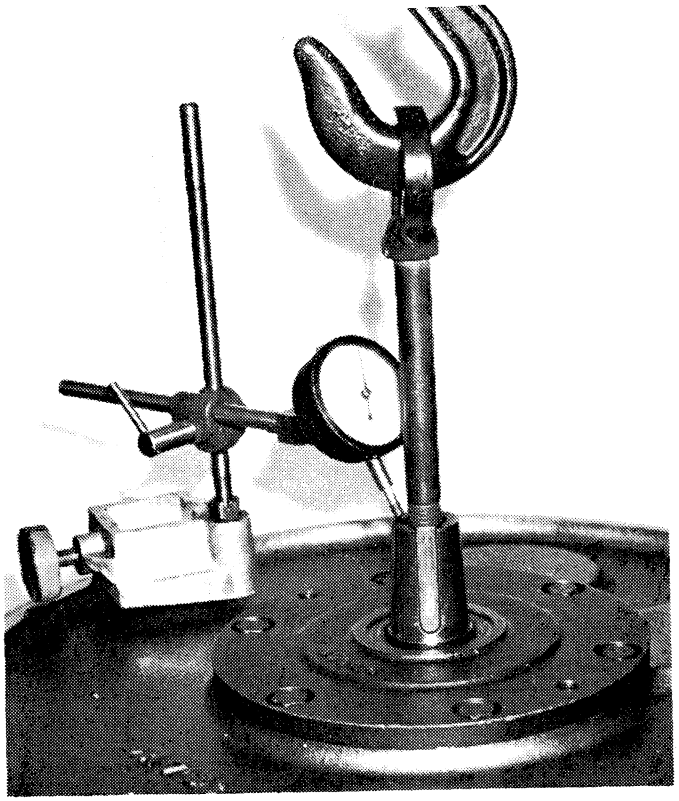


Figure 9-9. Applying pulling force while dial indicating end play of input shaft.

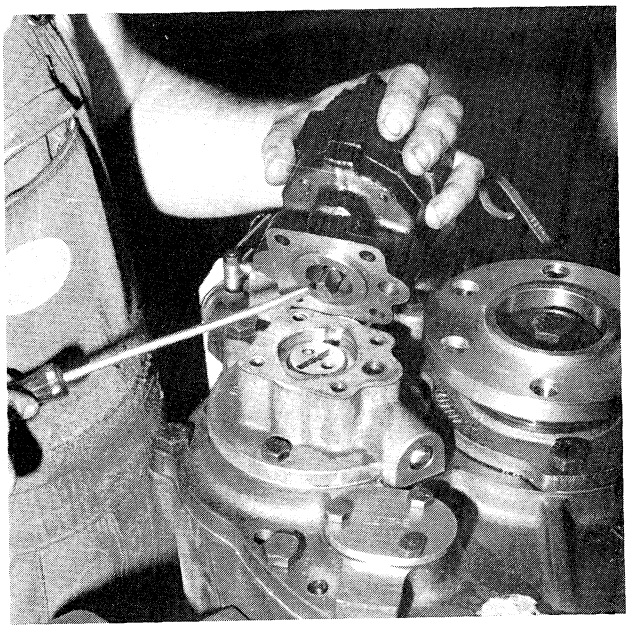


Figure 9-10. Installing oil pump with care to align drive tang.

10. Add or remove shims to adjust the end play to 0.001 to 0.004 inch.

11. Remove the bearing support (7) and shims (8).

12. Clean all shims and mating surfaces and apply anaerobic plastic sealant to shims and mating surfaces following the procedure given above for the output shaft shims.

13. Use special tool T-12126 to install oil seal (6) into bearing support (7) with the lip on the seal toward the oil being retained.

14. Install the shim pack and bearing support. Secure with capscrews (12). Torque the capscrews 27 ± 2 lbs. ft.

Miscellaneous External Parts.

1. Install drain plug (Figure 12-1, 50) and O-ring (51). Tighten snuggly.

2. Install oil level gauge tube (14) if removed, and oil level gauge (13).

3. Install oil filter and breather.

4. Install gasket (40) and oil pump assembly (41) aligning the tang on the pump shaft with the slot in the reverse clutch shaft. See Figure 9-10. Secure with capscrews (Figure 12-1, 42). Torque the capscrews 15 ± 2 lbs. ft.

5. Install the output flange (Figure 12-2, 24), lathe cut seal ring (25), and retainer washer (26). Secure with capscrew (27). Torque the capscrew 130 ± 10 lbs. ft., screw of 5/8-18 UNF 65 ± 10 lbs. ft. for screws of 1/2-20 UNF.

6. Install rubber blocks (4) onto drive spider (5).

7. Install input shaft key (10) and drive spider (5). Secure with retainer washer (2) and capscrew (1). Torque the capscrew 130 ± 10 lbs. ft.

PRIOR TO INSTALLATION.

CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine. Flywheel to driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, crankshaft endplay should be measured again. Endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin disc will not be responsible for system damage cause by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

General.

The transmission front housing flange and pilot, and the engine flywheel and flywheel housing must be checked for trueness. Make certain the engine flywheel and the flywheel housing are clean prior to making the tests.

Clean engine flywheel and housing thoroughly before check.

ALIGNMENT (Also reference SAE J-1033).

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange. See figure 9-11.

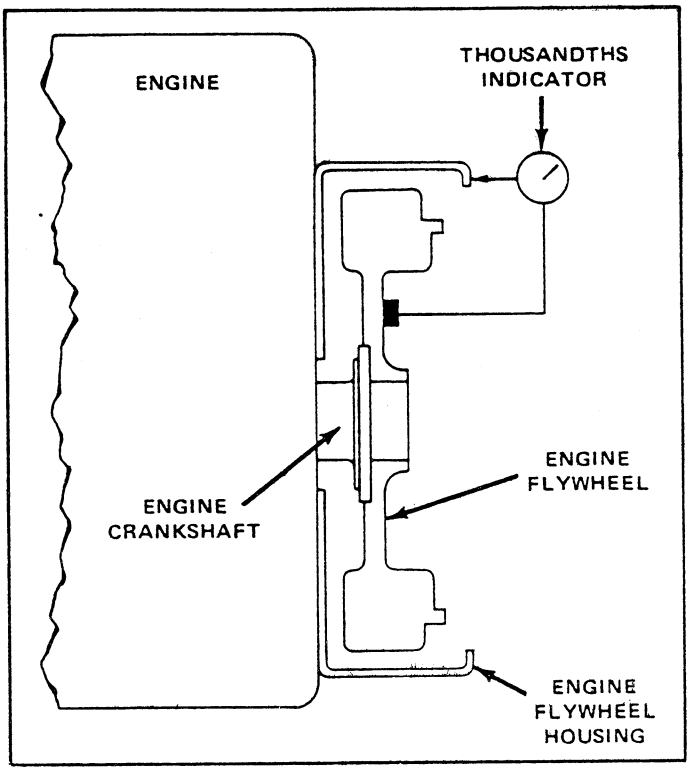


Figure 9-11. Checking the face of engine flywheel housing.

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel housing flange. The face deviation must not exceed the figures given in Table 9-1.

3. With the indicator mounted as in the above paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing. See figure 9-12.

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel housing bore. See Table 9-1 for allowable tolerances.

ALL FIGURES ARE TOTAL INDICATOR READINGS.

TABLE 9-1 - FLYWHEEL HOUSING TOLERANCES

SAE HOUSING N°	FACE DEVIATION		BORE ECCENTRICITY	
	Inch	mm	Inch	mm
00	0,012	0,3	0,012	0,3
0	0,010	0,25	0,010	0,25
1/2	0,010	0,25	0,010	0,25
1	0,008	0,20	0,008	0,20
2	0,008	0,20	0,008	0,20
3	0,008	0,20	0,008	0,20
4	0,006	0,15	0,006	0,15
5	0,006	0,15	0,006	0,15
6	0,006	0,15	0,006	0,15

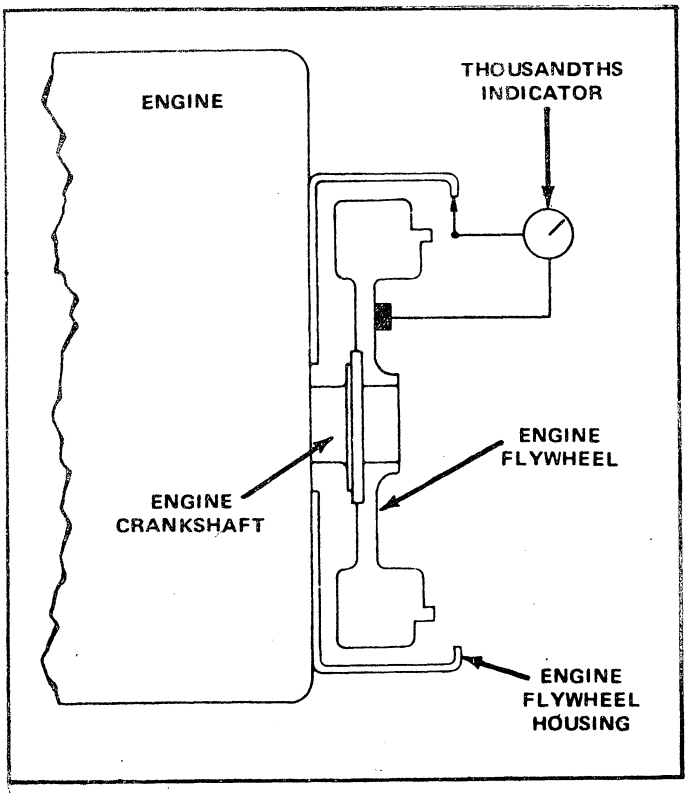


Figure 9-12. Checking the bore of engine flywheel housing.

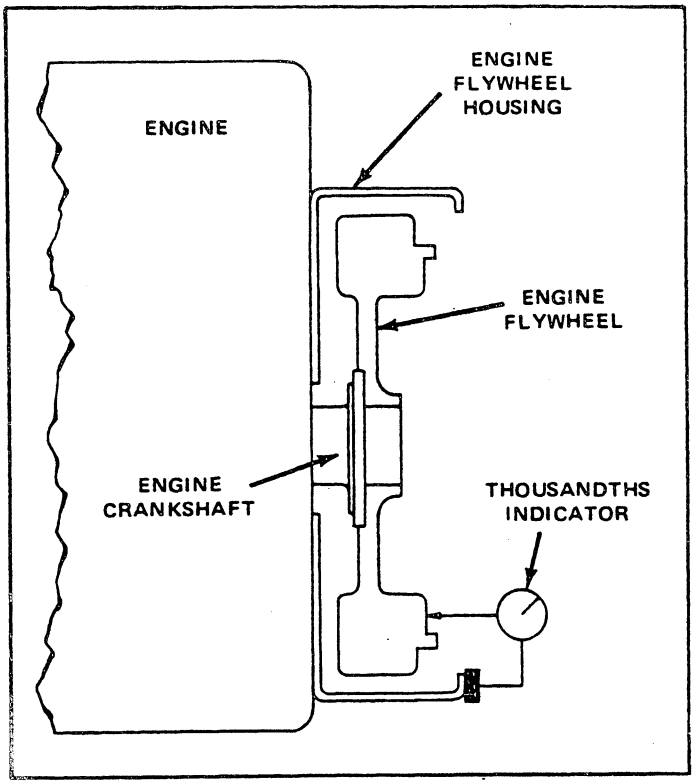


Figure 9-13. Checking the driving ring surface of engine flywheel.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator stem is riding on the inner face of the flywheel. See figure 9-13. Rotate the flywheel. The variation of the face runout of the surface to which the driving is bolted should not exceed 0.0005 per inch of diameter.

6. With the indicator mounted as in the paragraph above, adjust the indicator stem so that it will ride on the driving ring pilot bore of the engine flywheel. See figure 9-14. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.005 inch maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

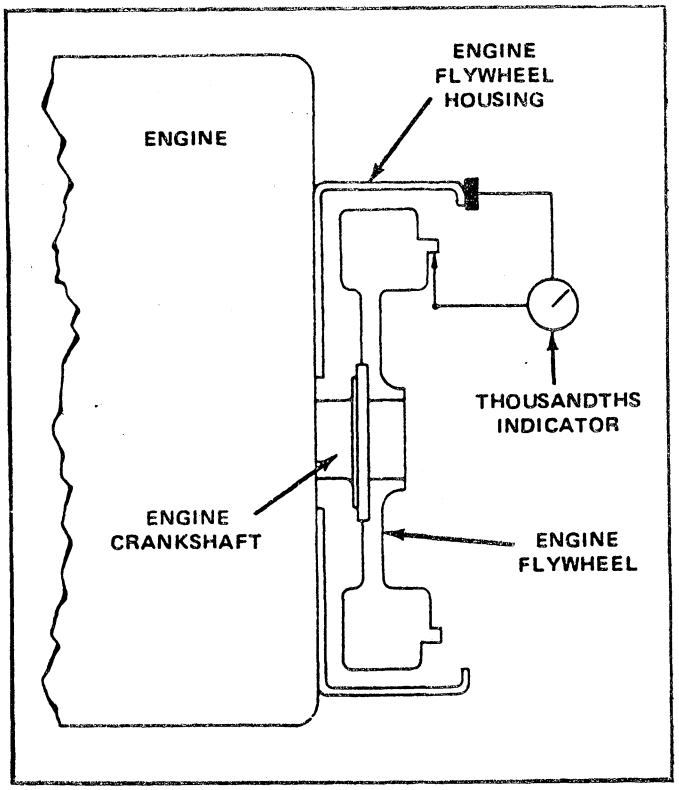


Figure 9-14. Checking the driving ring pilot bore of engine flywheel.

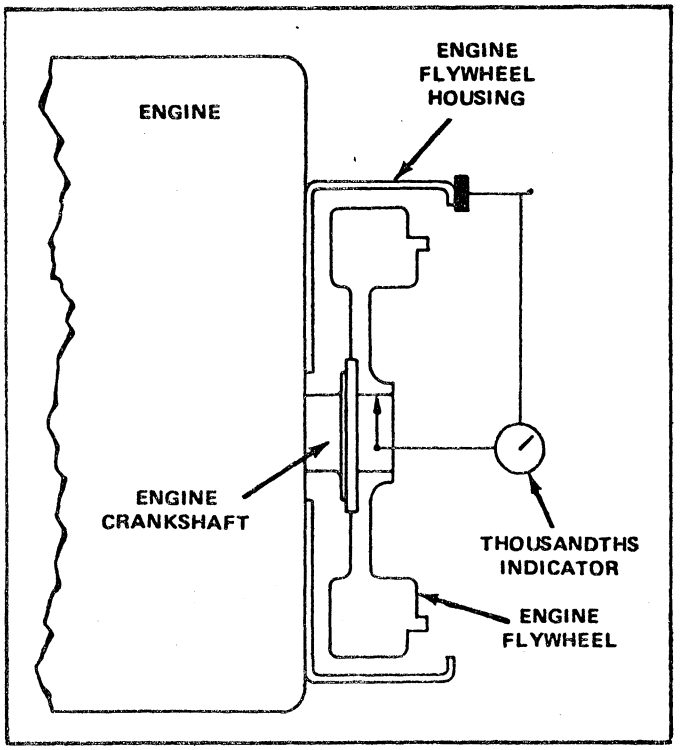


Figure 9-15. Checking pilot bearing bore of engine flywheel.

7. Readjust the indicator so that the stem will ride on the pilot bearing bore of the flywheel. See figure 9-15. Rotate the flywheel. The eccentricity of the pilot bearing bore should not exceed 0.005 maximum total indicator reading. Eccentricity between the driving ring pilot bore (figure 9-14) and pilot bearing bore (figure 9-15) should not exceed 0.008 inch total indicator reading.

INSTALLATION.

Alignment.

Proper alignment of an engine and marine unit is critical... both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. A bend is actually formed in the keel which changes the original engine and shaft alignment. The following steps may be taken to secure proper marine transmission alignment.

NOTE

The transmission output flange and companion flange are match reamed. Therefore, the index mark that was made on these flanges during disassembly must be aligned.

Propeller shaft installation.

1. A wire is run through the shaft log and secured to a brace near the engine bed, giving the wire a position equivalent to the shaft centerline.

2. The stern bearing and stuffing box are installed and bolted into position with the wire passing through each in the exact center of the bore. With the bearing and stuffing box in place, the wire is then removed.

3. The propeller shaft is then installed in its proper position.

4. If an intermediate shaft is used, it is blocked into position and its coupling is aligned with the propeller shaft coupling (see the following section - "Engine and Marine Transmission Alignment"). If there is an intermediate bearing in the line, this is installed and positioned with shims during the alignment process.

5. If a light shaft is used without an intermediate bearing, the shaft must be centered and supported to take out the droop while alignment of the flange couplings is being made.

Engine and Marine Transmission Alignment to propeller shaft. See figure 9-16.

1. It is important to align the engine and transmission, only when the boat is afloat, and NOT in drydock. During this alignment period, it is also advisable to fill the fuel tanks and add any other ballast that will be used when the boat is in service. With the engine and transmission in position on the engine bed, arrangemets must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off the desired amount. Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the used of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the whole problem, particularly for future realignment.

2. It will also be necessary to move the engine and transmission from one side or the other on the bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges. See figure 9-17.

3. As the engine and marine transmission comes into their aligned position, it will be possible to match the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mark this connection because the fit is very critical. Place a 0.002-inch feeler gauge between the flanges of the coupling. The feeler gauge is moved (slid) completely around the coupling.

4. Then the marine transmission flange coupling is rotated 90, 180 and 270 degrees with the feeler blade being moved around the flange again in each successive position. If the alignment is correct, the feeler gauge will fit snugly, with the same tension, all around the flange coupling.

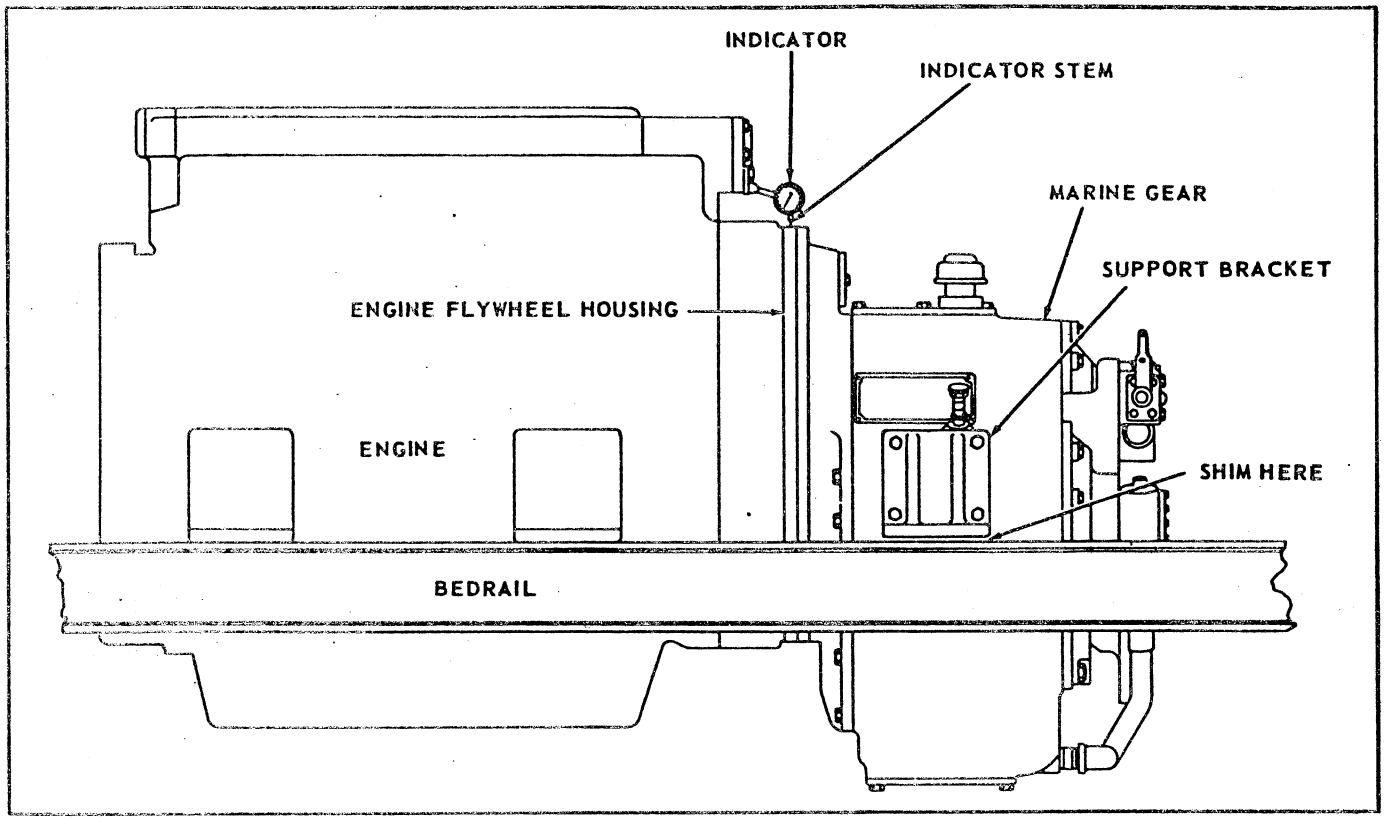


Figure 9-16. Alignment of engine and Marine Transmission - Schematic view.

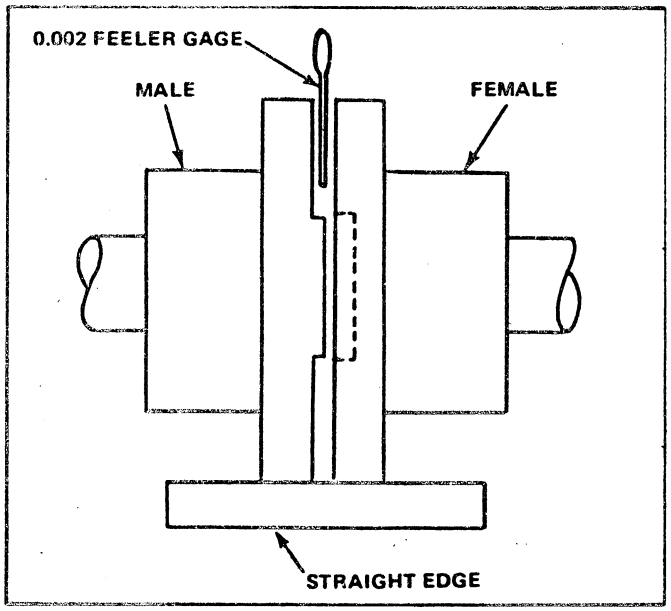


Figure 9-17. Checking alignment (parallelism) of coupling and propeller flanges.

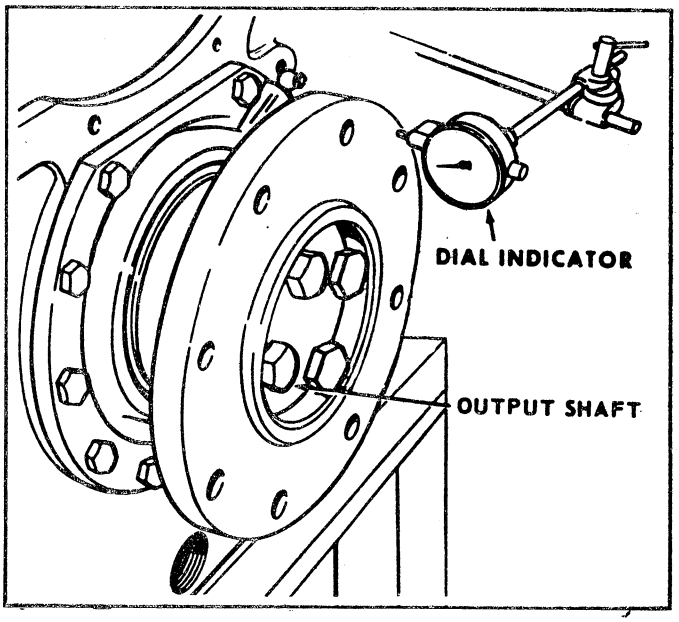


Figure 9-18. Checking race runout of output flange.

5. If the alignment varies during rotation, then further alignment is necessary, or the marine transmission and shaft couplings should be checked for improper face runout. See Figure 9 18 and 9-19. Runout must not exceed 0.004 inch. Face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline. Shaft coupling runout is usually due to inaccuracy of taper fit or key interference.

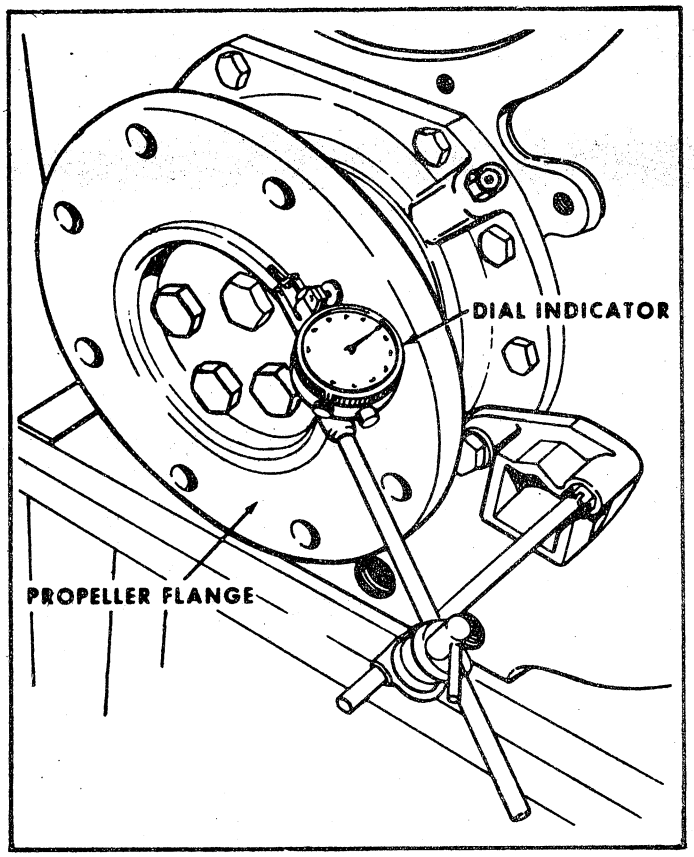


Figure 9-19. Checking pilot runout of output flange.

6. Some boats are not structurally rigid and some carry their load in such a way that they will 'hog' or go out of normal shape with every loading and unloading. Where this condition exists, it may be necessary to make a compromise between the top and bottom coupling clearance by leaving a greater clearance at the bottom of the marine transmission output flange and propeller coupling. This clearance might be 0.005 to 0.007-inch while the top would maintain the standard 0.002-inch.

7. During the process of securing final alignment, it may be necessary to shift the engine many times. When it becomes apparent that the alignment is reasonably close, the holes for the lag studs are marked and drilled. Then with final alignment secured, the necessary steel or hardwood shims are made up and the engine and transmission is fastened in place. The alignment is then rechecked, if satisfactory, the coupling is bolted together.

8. Although it is not necessary to align a flexible coupling as accurately as a solid coupling, the closer it is the initial alignment, the more vibration-free if will be. The most accurate method of alignment is to align the shaft onto the marine transmission with flexible coupling out of the system. This can be done with a spacer the same size as the coupling but not flexible in nature. Flexible couplings are used only for noise and vibration dampening... and not to correct inadequate alignment.

9. When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission coupling and prevent bending of the shaft.

CAUTION

Be sure the transmission is filled with oil before starting. See section 4 for proper oil and filling procedure.

WARNING

Transmission controls must be checked or proper function and alignment after any transmission installation or maintenance procedure to assure that the transmission selector valve is properly indexed in relation to the operator's control lever. Failure to do so could cause control system malfunction, resulting in personal injury and/or damage to equipment and property.

For mechanical controls : Movement of the Operator's selector lever to forward, neutral or reverse must position the transmission selector valve in the forward, neutral or reverse detents.

Power operated controls : Selector valve positioning devices must be installed so that full travel of the actuating cylinder places the transmission selector valve in the detent position for forward or reverse, as selected, without exerting pressure on the rotational stop collar on the selector valve stem. Selection of neutral must place the selector valve in the neutral detent position. Improper installation of power engaging devices could cause failure of the selector valve rotational stop collar permitting improper positioning of the selector valve with resultant control malfunction.

See specific marine transmission installation drawings for detail and dimentional information needed for proper installation of power engaging devices.

SECTION 10 - ACCESSORIES AND OPTIONAL EQUIPMENT.

CONTROL VALVE GROUP WITH PRESSURE RATE-OF-RISE AND TROLLING SPEED CONTROL.

GENERAL.

This control valve is offered as optional equipment. Also, an after sale and installation control valve kit is available for field installation. An oil filter (less hoses) is supplied with the control valve for field installation. The control valve groups are available for units with 300-320 psi or 350-370 psi application. See planograph PX-7205-C.

A correct sized transmission lube oil heat exchanger is required to ensure adequate cooling of the transmission oil.
Under certain conditions a heat exchanger that is suitable for transmission operation at the maximum governed engine speed with the propelling clutch fully engaged (locked-up), may be too large for the trolling mode transmission oil steady state operating temperatures may be below 150° F (66° C.). Under these conditions, the output shaft speed range may be reduced. This effect can be minimized by the installation of an appropriate thermostatic oil by-pass valve to the transmission oil side circuit.

The thermostatic by-pass valve reference available as optional equipment is B 3488 (see planograph).

HYDRAULIC SYSTEM.

The control valve functions are divided in two groups operating separately or together.

1. The control valve assembly containing passages and ports for the transmission and direction of pressurized oil within the hydraulic system. The rate-of-rise piston within the control valve assembly providing a rapid, yet smooth pressure rise for the hydraulic system during clutch engagement. Added to this function a lube main flow priority on the clutch engaged is provided through a shuttle valve device.

2. The trolling valve providing trolling speeds by varying the propeller speed with fixed engine speed.
The valve accomplishes this by mechanically changing the clutch apply pressure valve spring tensions through a cam movement. This will cause the applied clutch to slip a percentage selected to hold desired trolling speed.

Control and linkage to the trolling valve operating lever are to be furnished by the customer. See planograph of trolling valve, to determine distance travel of linkage. The trolling valve lever must be moved through a 79 degrees arc from detent to plate stop to control trolling operation.

NOTE

The operator must select the trolling mode with the control valve lever in neutral and set the engine speed at or below the recommended maximum trolling speed of 1100 rpm or 40 % of match point engine speed, whichever is smallest. Install the pilot house instruction plate B-2384 in an area near the trolling valve control head in pilot house where it may be easily read.

CAUTION

Do not operate marine transmission in the trolling mode at engine speeds above the maximum trolling rpm. Failure to obey this operating transmission components, which can cause an unsafe operation condition to occur. Unsafe operating condition could result in loss

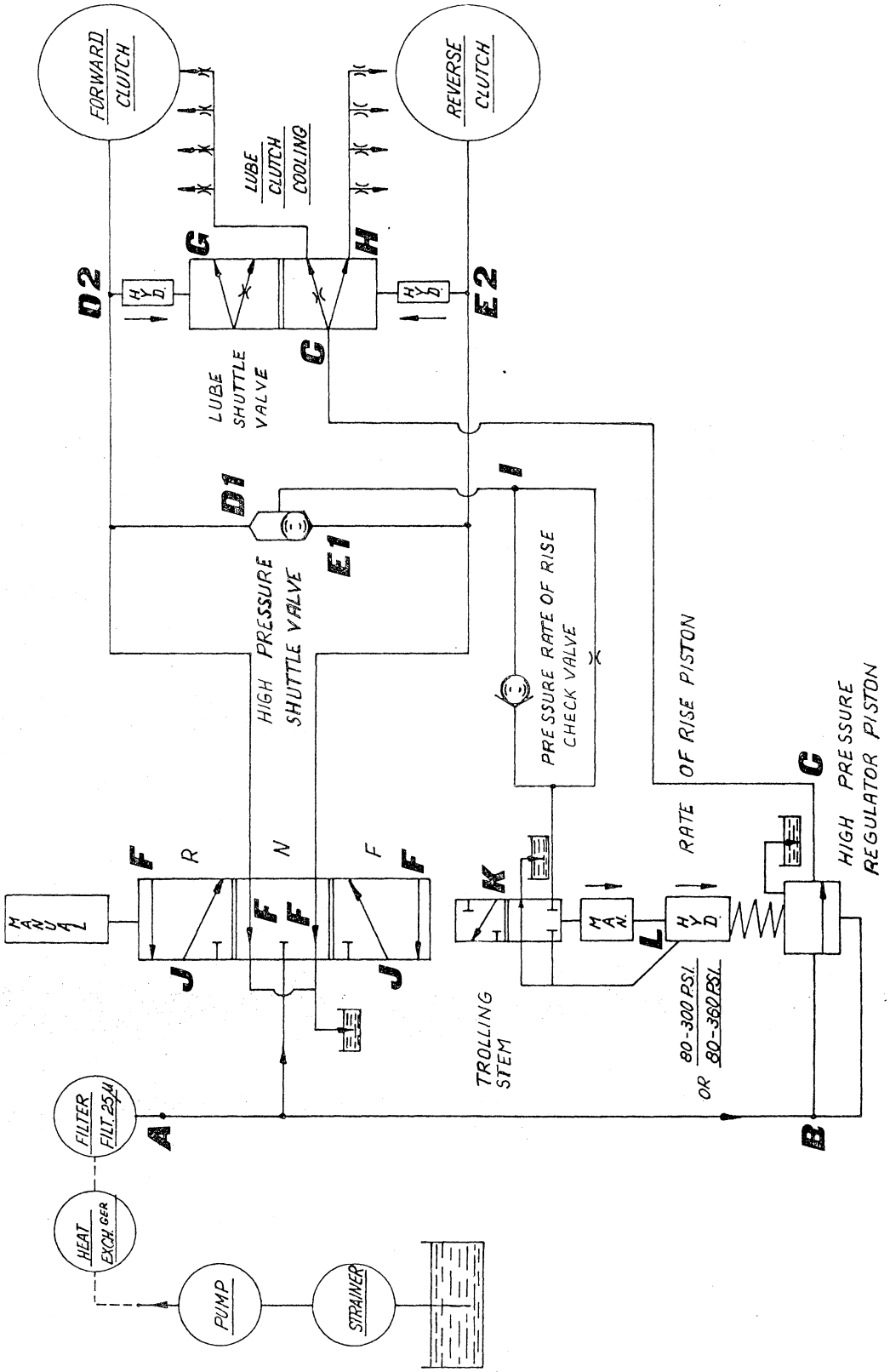


Figure 10-1. Hydraulic Circuit Diagram.

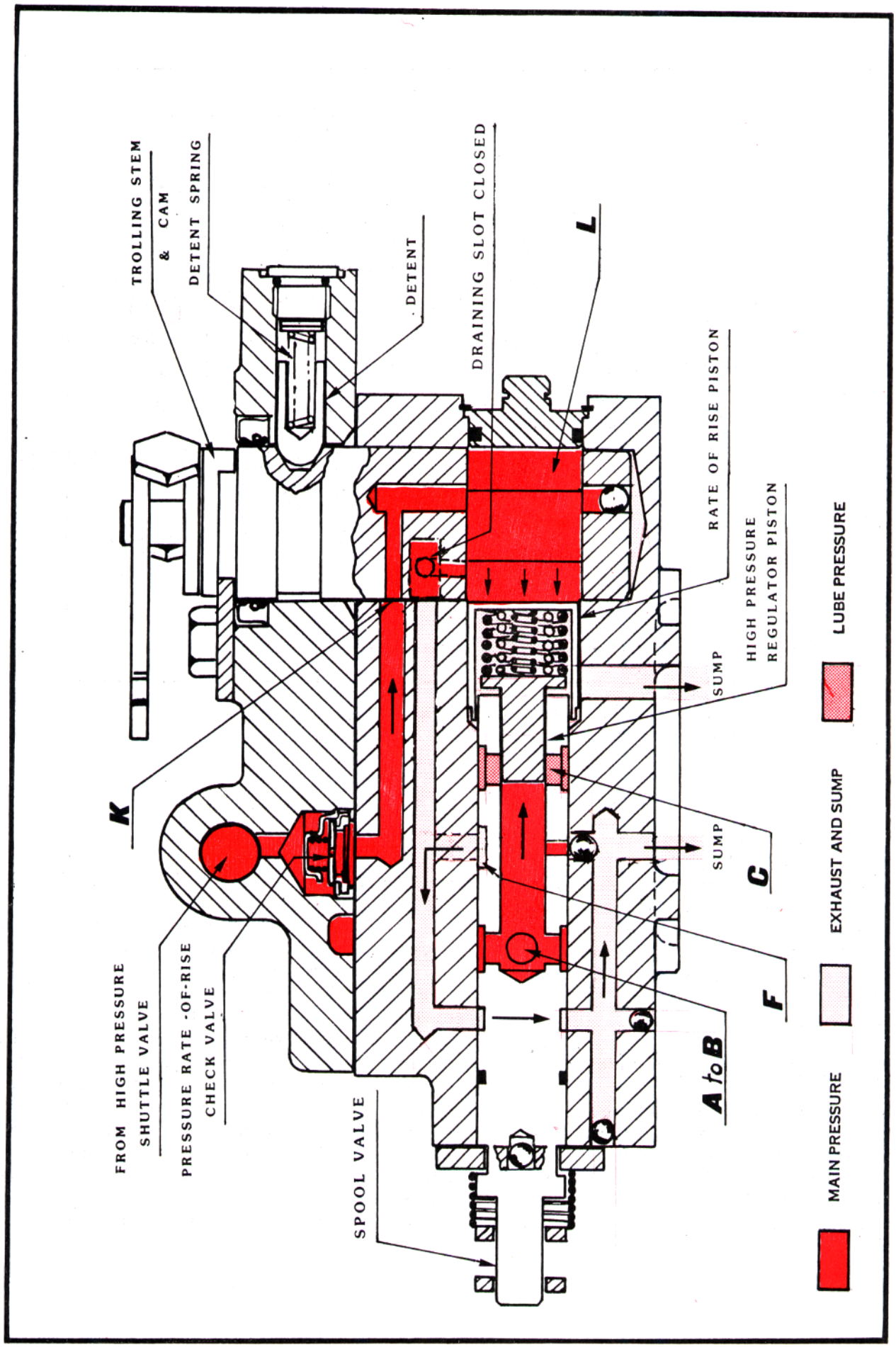


Figure 10-2. Control Valve and Trolling Valve - Cut-a-way View - Non Trolling.

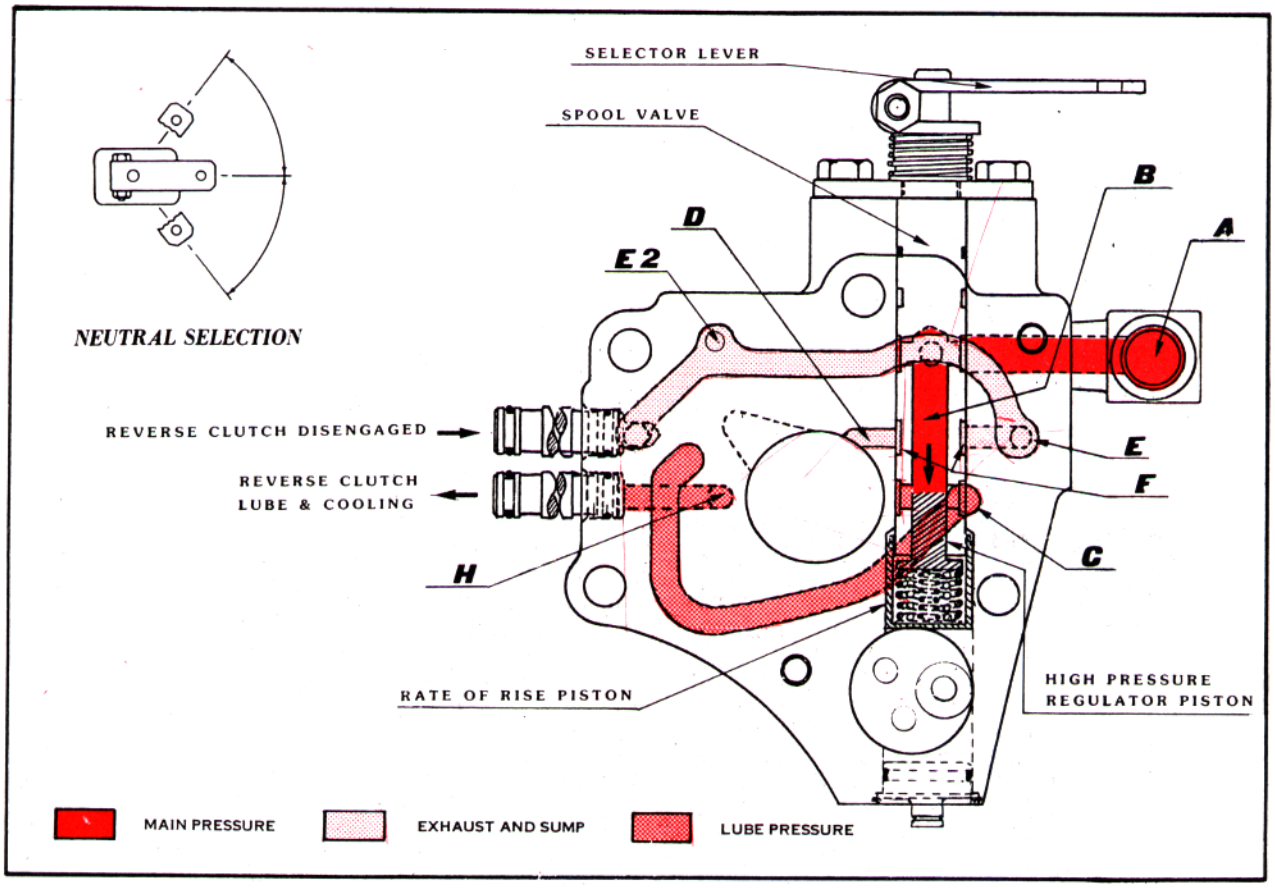


Figure 10-3. Control Valve - Neutral - Sectional View.

of vessel manoeuvering, control vessel damage, and/or loss of property and/or life. It should be noted that when the trolling mode is used when docking, the vessel may not develop sufficient stern trust. Therefore, it is recommended that docking only be attempted in the detended or no troll position.

Control Valve - NON - Trolling Mode.

The control valve is non-trolling, when the cam trolling lever is in the detent position. See Figure 10-2. The control valve with the cam/trolling lever in the non-trolling position allows the valve to operate as a standard control valve.

Control Valve - Neutral.

See Figures 10-2, 10-3, 10-4.

Oil is drawn from the sump through the filter screen and suction tube to the oil pump assembly.
From the oil pump assembly the oil is conveyed by suitable flexible hose to the heat exchanger, the cooled oil returns from heat exchanger through a 25 μ filter assembly and suitable flexible hose to the oil inlet port A of control valve assembly and fills chamber B. The oil causes the high pressure regulator piston to partially compress the piston springs and the rate-of-rise piston. This pressurizes the oil in

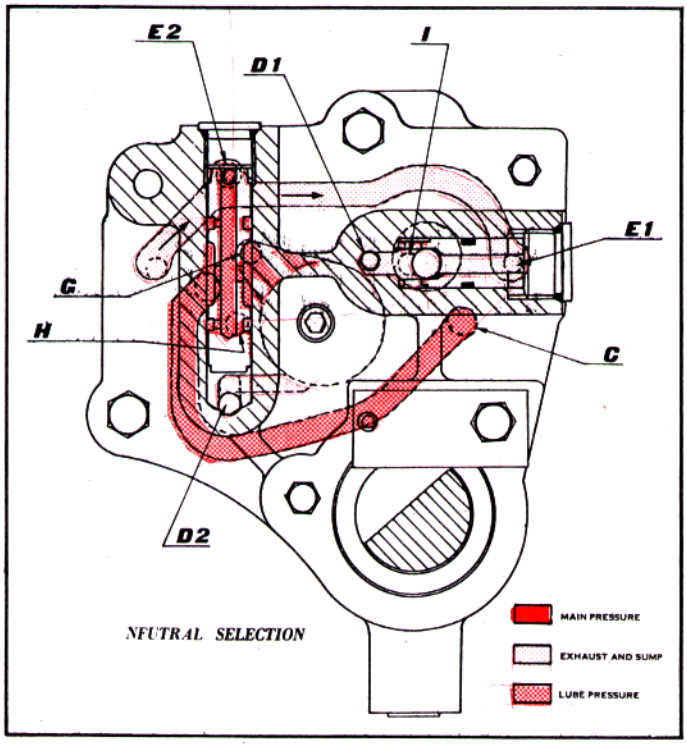


Figure 10-4. Control Valve - Neutral - Sectional View.

chamber B. This pressure varies with engine speed (see chart for pressure limits).

The movement of the high pressure regulator piston against the springs exposes port C in the valve body. Port C directs overage oil to lubrication and clutch cooling system through a flow divider called shuttle valve. This shuttle valve conveys to the clutch selected the main flow of lube for maximum cooling and lubrication. Passage D (which is the engaging pressure outlet to the forward clutch) and passage E (which is the engaging pressure outlet to the reverse clutch) are interconnected by slot F in the control valve stem when in neutral position. The slot is aligned with drilled holes on the front face of the valve body. These drilled holes are aligned with drilled holes to pass through the main housing to sump. Therefore, passages D and E are at atmospherice pressure at this time. Also passage F is at atmospheric pressure since ports E and D are interconnected with slot F. This area between the pistons and around the springs is vented to the sump and main housing. This area is at atmospheric pressure at all times permitting the return to sump of any leakage past the piston.

Control Valve - Forward.

See Figures 10-2, 10-5, 10-6.

When a shift to the forward position is desired the control valve lever is moved toward the engine. The shift causes the control valve stem to rotate and assume the position indicated in figure 10-5. The pressurized oil in chamber B is directed through port J to port D, which is interconnected with port D1 at high pressure shuttle valve, pushing the ball to the opposite seat provided in the shuttle valve closing the passage through port E. The pressurized oil travelling through port I reaches the rate-of-rise check valve; the rate-of-rise check valve meters the oil for a steady smooth pressure rise in chamber L through port K. As chamber L fills with oil, the rate-of-rise piston moves against the piston springs until the piston is stopped by a shoulder in the valve body. This causes the pressure in chamber B to rise to clutch engaging pressure while forward passage E remains at atmospheric pressure since slot F remains open to sump. The pressurized oil from port D travels also through port D2 causing shift of lube shuttle valve; this position of the lube shuttle valve allows main flow of lube oil to

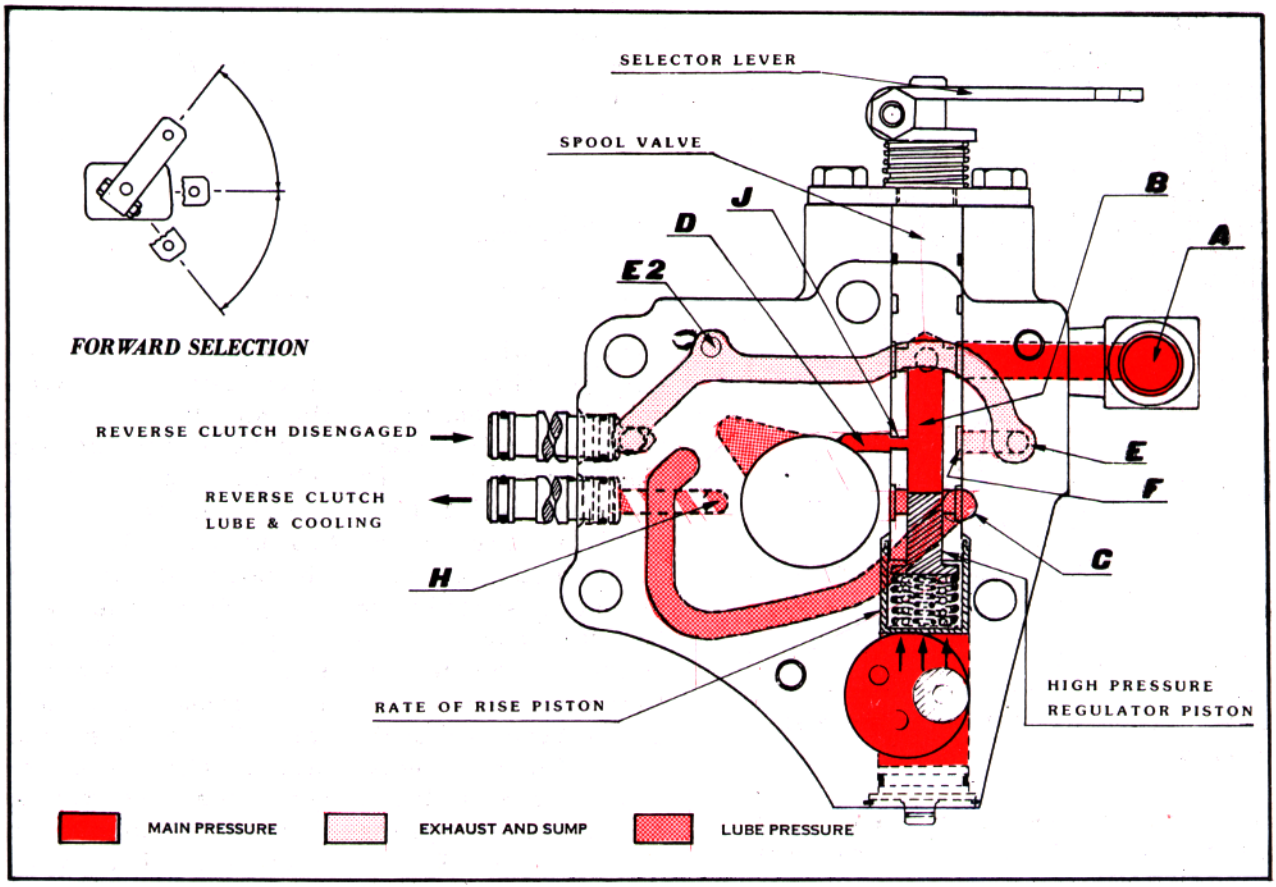


Figure 10-5. Control Valve - Forward - Sectional View.

travel through port G and partially through lube shuttle valve calibrated orifice to port H. When a shift is made from forward to neutral the valve stem is rotated to the position illustrated by Figure 10-3. Under these conditions, passage D being connected to sump by slot F, oil drains rapidly from the forward clutch to sump. Since passage I is now at atmospheric pressure the oil pressure in chamber L unseats the plate orifice of rate-of-rise check valve against the compression spring permitting a rapid oil drain from chamber L to sump and allowing the pressure rate control piston to move back against the cam device from trolling stem. The forward clutch is now disengaged and main system pressure reduced to neutral pressure.

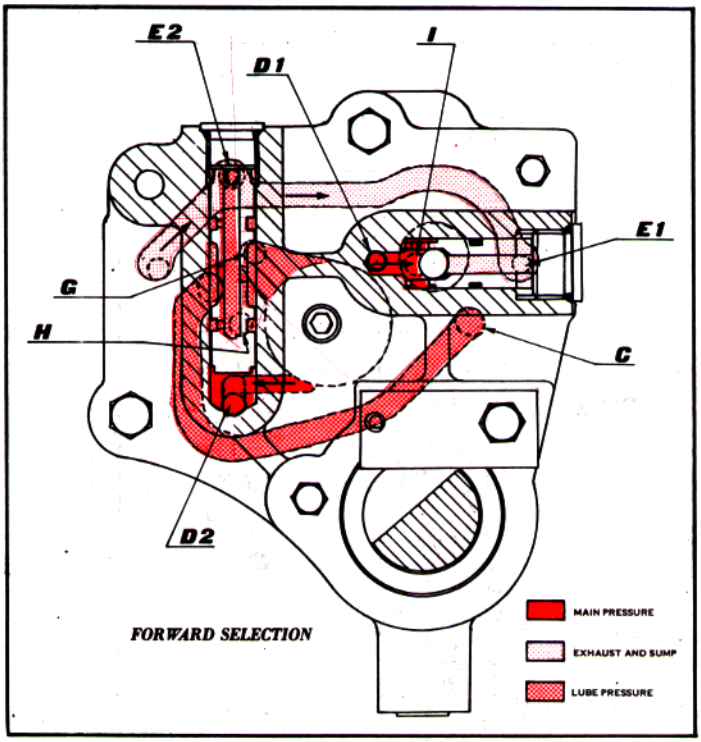


Figure 10-6. Control Valve - Forward - Sectional View.

Control Valve - Reverse.

See Figures 10-3, 10-7, 10-8.

When a shift to the reverse position is desired the control valve is moved away from the engine. The shift causes the control valve stem to rotate and assume the position indicated in Figure 10-7. The pressurized oil in chamber B is directed through port E which is interconnected with port E1 at high pressure shuttle valve, pushing the ball to opposite seat provided in valve body and closing the passage through port D. The pressurized oil travelling through port F reaches the rate-of-rise check valve; the rate-of-rise check valve meters the oil for a steady smooth pressure rise in chamber L through port K. As chamber L fills with oil, the rate of rise piston moves against the piston springs until the piston is stopped by a shoulder in the valve body. This causes the pressure in chamber B to rise to clutch engaging pressure. When in reverse passage D remains at atmospherice pressure since slot F remains open to sump. The pressurized oil from port E travels also through port E2 causing shift of lube shuttle valve : this position of lube shuttle valve allows main flow of lube oil to travel through port H and partially through lube shuttle valve calibrated orifice to port G. When in reverse, passage D remains at atmospherice pressure since slot F remain open to sump when a shift is made from reverse to neutral the valve stem is rotated to the position illustrated by Figure 10-3. Under these conditions passage E being connected to sump by slot F, oil drains rapidly from the reverse clutch to sump. Since passage I is now at atmospherice pressure the oil pressure in chamber L unseats the plate orifice of rate-of-rise check valve against the compression spring permitting a rapid oil drain from chamber L to sump and allowing the pressure rate control piston to move back against the cam device from trolling stem. The reverse clutch is now disengaged and main system pressure reduced to neutral pressure.

Trolling Valve - Forward or Reverse.

See Figure 10-9.

When the trolling valve is to be used for either forward or reverse the cam/trolling lever is moved out of the detent position and into the trolling range (see Figure 10-10). With the cam/trolling lever out of the detent, the port K closes and the slot I gradually opens position (depending on trolling lever position), the oil pressure present in chamber L is drained to sump. The rate-of-rise piston position can be manually adjusted by the trolling lever to decrease the compression of the outer middle and inner springs against the high pressure regulator piston (see Figure 10-11), decreasing the pressure in high pressure regulator chamber B by routing the excess oil through the lube circuit of the engaged clutch (port C). This will cause the applied clutch to slip a percentage to hold the desired trolling speed.

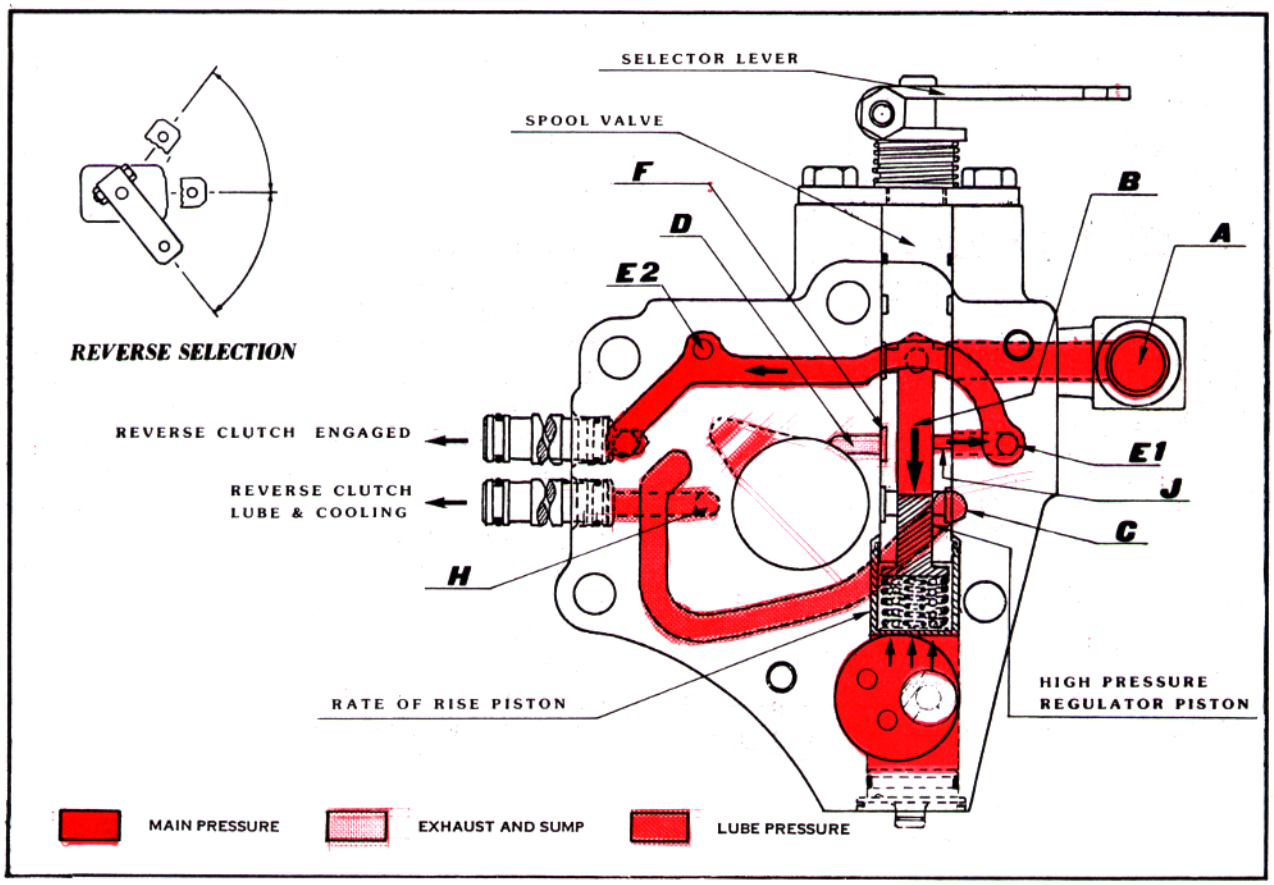


Figure 10-7. Control Valve - Reverse - Sectional View.

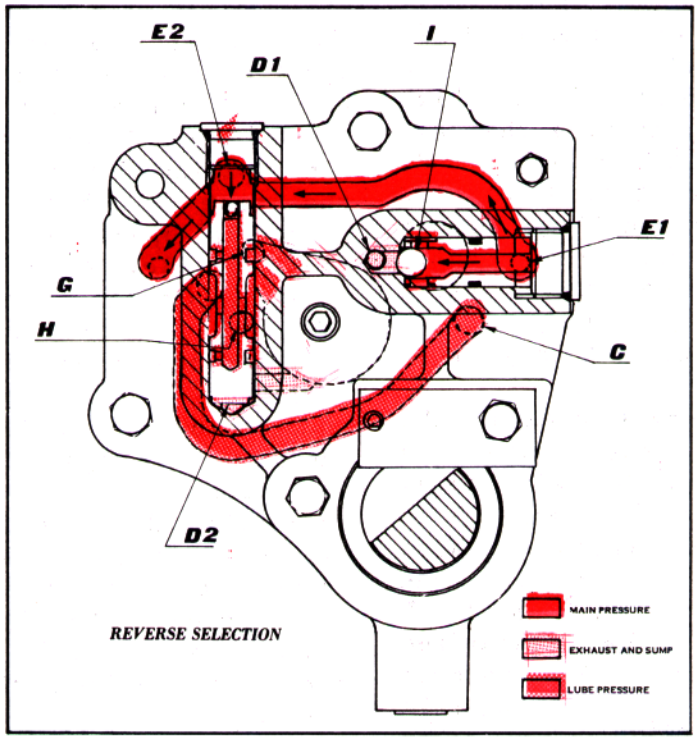


Figure 10-8. Control Valve - Reverse - Sectional View.

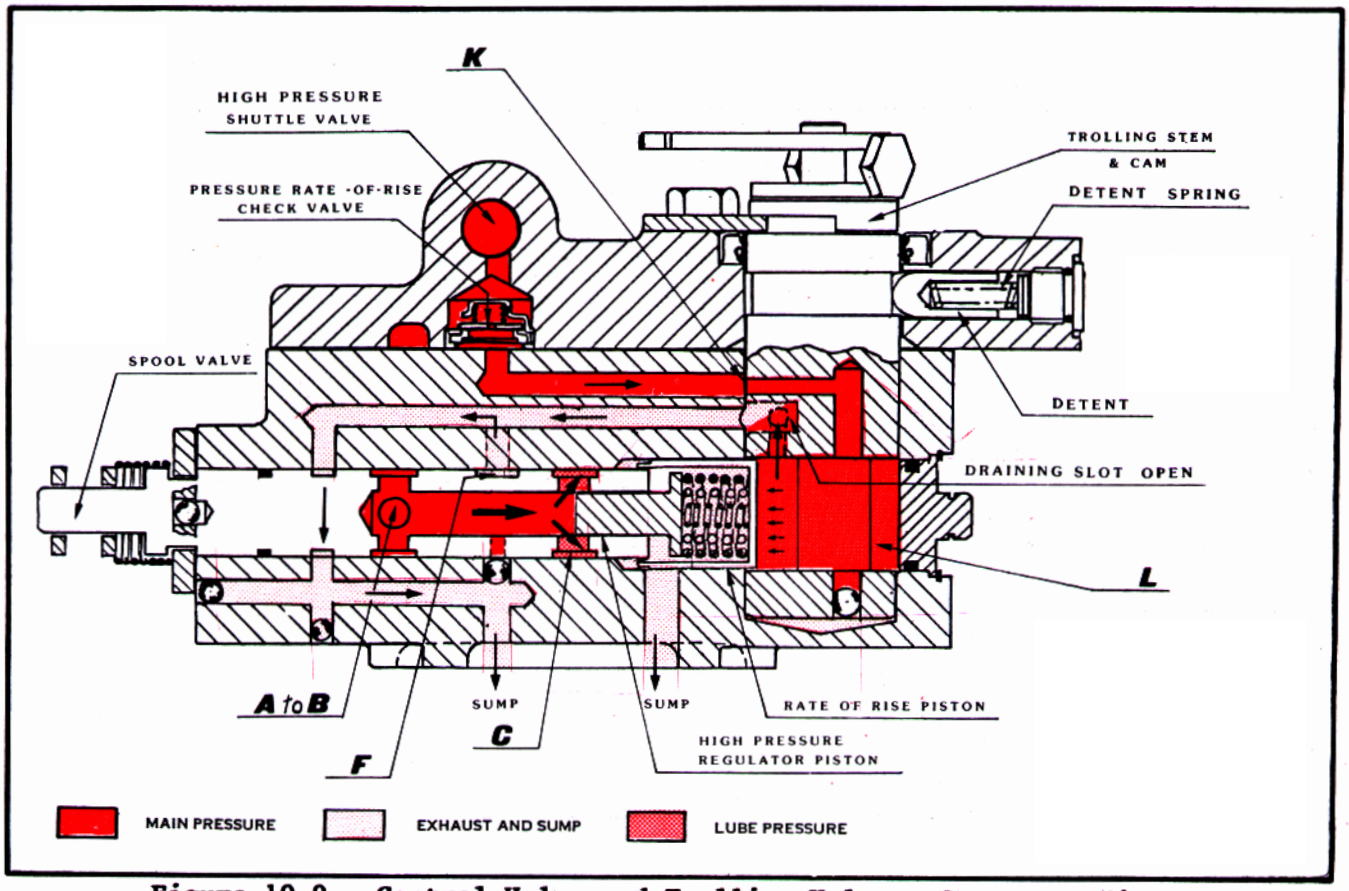


Figure 10-9. Control Valve and Trolling Valve - Cut-a-way View - Trolling Mode Function.

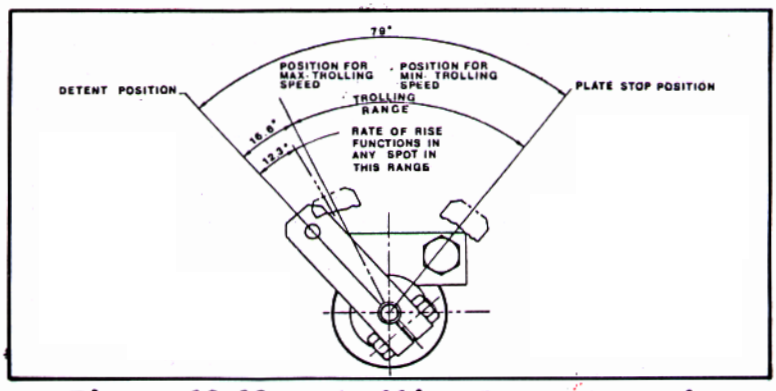


Figure 10-10. Trolling Lever Operating Range.

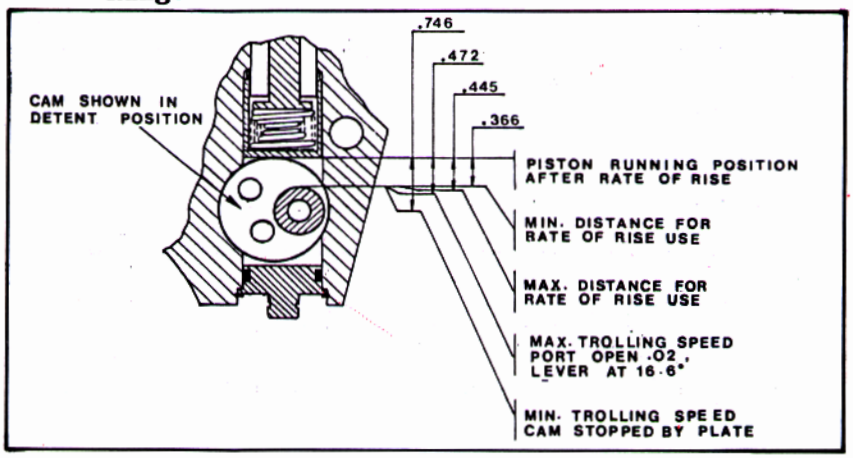


Figure 10-11. Trolling Cam Operating Range.

Limits with the standard 300 min. PSI springs.

TROLLING VALVE IN DETENTED POSITION					
INPUT RPM & SHIFT		Immediately Upstream of Shimmed Valve ⊗		At End of Fwd Shaft Lube Circuit	
		Min. PSI A	Max. PSI B	Min. PSI C	Max. PSI D
1800 RPM	Forward	300	320	7.5	16.5
	Neutral	80	120	2.0	16.5
	Reverse	300	320	2.0	4.0
600 RPM	Forward	280	315	0.8	4.0
	Neutral	70	110	0.2	4.0
	Reverse	280	315	0.2	1.0
Trolling valve with cam at minimum trolling stop position.					
1200 RPM	Forward	5	15	3.0	10
	Neutral			.8	10
	Reverse	5	15	.8	3

Limits with "special" 350 min. PSI springs.

TROLLING VALVE IN DETENTED POSITION					
INPUT RPM & SHIFT		Immediately Upstream of Shimmed Valve ⊗		At End of Fwd Shaft Lube Circuit	
		Min. PSI A	Max. PSI B	Min. PSI C	Max. PSI D
1800 RPM	Forward	350	370	7.5	16.5
	Neutral	80	130	2.0	16.5
	Reverse	350	370	2.0	4.0
600 RPM	Forward	330	365	0.8	4.0
	Neutral	70	120	0.2	4.0
	Reverse	330	365	0.2	1.0
Trolling valve with cam at minimum trolling stop position.					
735 RPM	Forward	5	15	1.5	6
	Neutral			.4	6
	Reverse	5	15	.4	1.5

A reading outside of limiting range could mean :

A wrong number of shims in valve, faulty valve springs, sticky valve, pump GPM too low, leakage, broken or forgotten seal rings.

CONTROL VALVE DISASSEMBLY.

1. Remove the control valve assembly (refer to Figure 12-6) and pump mount.

2. Loosen hex-nut (5) and remove shift lever (2) with spring compression (3) and washer (32).

3. Remove capscrews (30) and detent plate (6).

4. Remove valve spool (7), regulator piston (26), outer spring (24), inner spring (25).

5. Remove O-ring (8) from valve spool (7).

6. Loosen hex-nut (45) and remove lever shift (43).

7. Remove O-ring plug (46) with O-ring (47), detent spring (48), and detent (49) from the cover regulator (13).

8. Remove capscrews (14, 34, 35), cover (13) and gasket (12).

9. Remove the internal snap ring (20) and pull out the O-ring plug (21).

10. Remove the trolling stem (50) from the body valve (10) and the rate-of-rise piston (23).

11. Remove the O-ring plug (55, 19) with O-ring (54, 18) for removal of shuttle valve (52, 17) and ball (45) from the cover regulator.

12. Remove the check valve orifice (11) and discard the oil seal (41) from the cover regulator.

ASSEMBLY.

1. Install a new oil seal (41) on the cover regulator (13).

2. Install the shuttle valve (54) with a new O-ring (16) and ball (15) into cover regulator. Close with the O-ring plug (19) with O-ring (18).

3. Install the shuttle valve (52) and close with O-ring plug (55) and O-ring (54).

4. Install the rate-of-rise piston (23) with outer spring (24) into the valve body (10) and press on piston with a screw drive to introduce the trolling stem into body (10).

5. Install the O-ring plug (21) with a new O-ring (22) and secure with the snap ring (20).

6. Install the check valve orifice (11) onto cover regulator (13) before to install it with a new gasket on body valve (10) and secure it with capscrews (14, 34, 35). Torque the capscrews 15 lbs. ft.

7. Install O-ring (8) onto valve spool (7).

8. Install valve spool (7), regulator piston (26) and inner spring (25) into the valve body (10).

9. Install detent plate (6) and secure it with capscrew (30). Torque the capscrews 15 $\pm$ 2 lbs. ft.

10. Install shift lever (2) with spring compression (3) and washer (32) onto the valve spool (7) and secure with capscrews (1) and hex-nut (5) and washer (4).

11. Install the detent (49) into the threaded hole of the cover regulator (13) making certain that the detent fills into the detent recess of the trolling stem.

12. Install spring (48) and O-ring plug (46) with O-ring (47) into the threaded hole of the cover regulator (13).

13. Install the lock plate (39) into the slot of the trolling stem and onto the

roll pin (40). Fit and secure the shift lever (43) with capscrew (42), washer (44) and hex nut (45).

INSTALLATION. (Field)

Selector Valve.

1. Remove the selector valve (refer to Figure 6-6) assembly and pump mount. Remove the pump outlet to heat exchanger inlet oil line at the pump outlet only. Then remove heat exchanger outlet to valve inlet oil line from selector valve assembly, high pressure inlet only.

2. Remove hydraulic pump by removing the four screws which fasten it to the pump mount. These screws will be reused.

3. Remove three 3/8 hex-head capscrews from pump mount which **will be** reused.

4. Remove three 3/8 hex-head capscrews from main regulator valve body, which **will not** be reused.

5. Remove selector valve assembly, pump mount, and connector tubes by sliding them to the rear until they come off the forward and reverse clutch shaft simultaneously. It may be necessary to uncouple the marine transmission flange from the companion flange and move both flanges to the rear to permit this assembly to be removed.

TROLLING VALVE.

1. Install the trolling valve assembly. Assemble four new O-rings removed from 8-1/2 x 11 plastic bag, to the two jumper tubes.

2. With the old shim pack installed over the pilot diameter of the old selector valve assembly, measure the pilot face to top of shim distance, using a depth micrometer.

3. Remove three 3/8 hex nuts holding nine shims to the trolling valve assembly pilot face.

4. Select a combination of new shims to get the same pilot face to top of shim distance for the trolling valve assembly as for the old selector valve assembly. Recheck this distance with depth micrometer with the selected shim pack placed over the pilot diameter on the trolling valve. The pilot face to top of shim distance must be the same for the new trolling valve assembly as it was for the old selector valve assembly to assure the same forward clutch shaft bearing endplay.

5. Clean mating surfaces of the new trolling valve assembly, pump mount, shims, and rear cover and apply anaerobic sealant to the shims, the face of the pump mount and the trolling valve face.

6. Assemble pump mount with its shim pack, jumper tubes, and new trolling valve assembly with its shim pack. Then slide this assembly onto the forward and reverse clutch shafts, simultaneously.

7. Install three new 3/8 hex-head capscrews into the new trolling valve assembly and the rear cover, and install three **used** 3/8 hex-head screws into the pump mount and rear cover. Tighten these capscrews to 27-30 lbs. ft. torque.

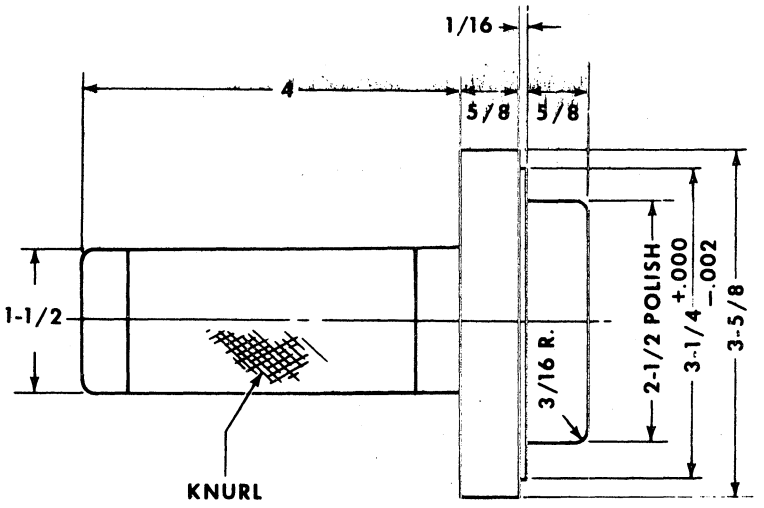
8. Reinstall the hydraulic pump making certain that the pump drive tang engages the shaft drive slot. Torque the screws to 15-17 lbs. ft.

9. Reinstall the oil line from the pump outlet to the heat exchanger inlet.

10. Mount the filter assembly supplied with the trolling valve parts. Two thinwall pipe plugs from filter inlet and outlet and one thinwall pipe plug from new trolling valve assembly high pressure oil inlet, 90 degree elbow must be removed and discarded.

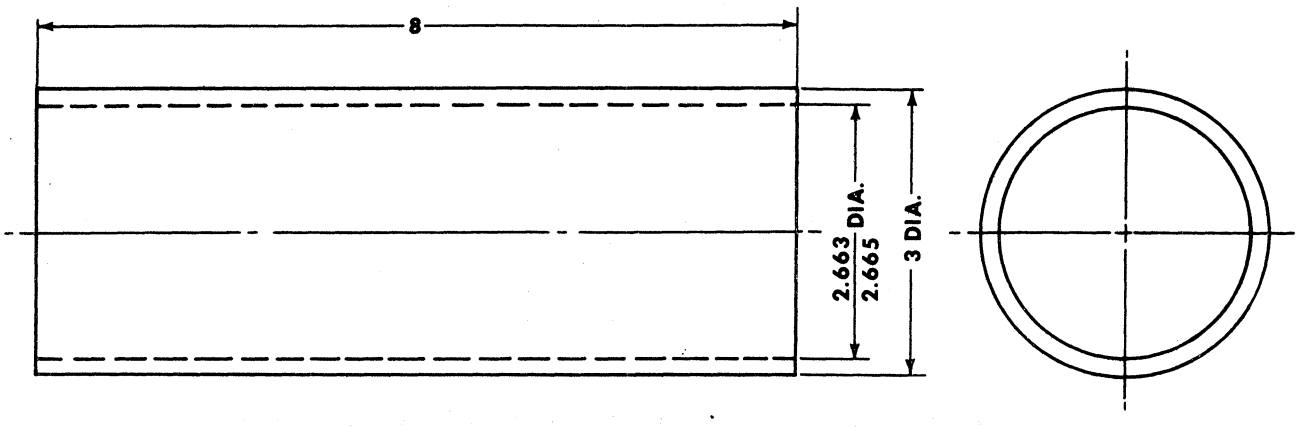
SECTION 11 - SPECIAL TOOLS.

Figures or illustrations used in this section identify the special tools by tool number. All pertinent information necessary for tool fabrication is shown on each drawing. These tools are intended primarily to make overhaul procedures easier. Twin Disc will not manufacture these tools for general use.



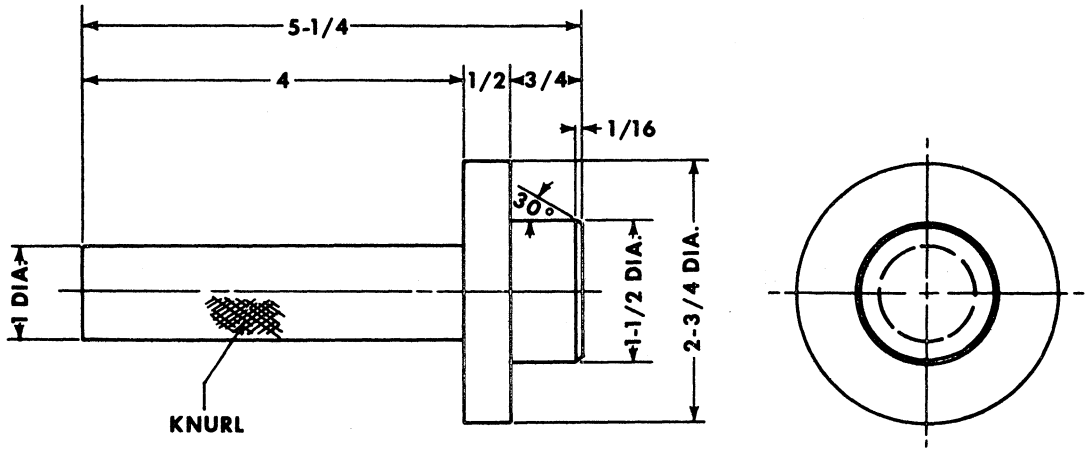
MATERIAL: STEEL-CARB. & HARDEN

Special Tool T-11684



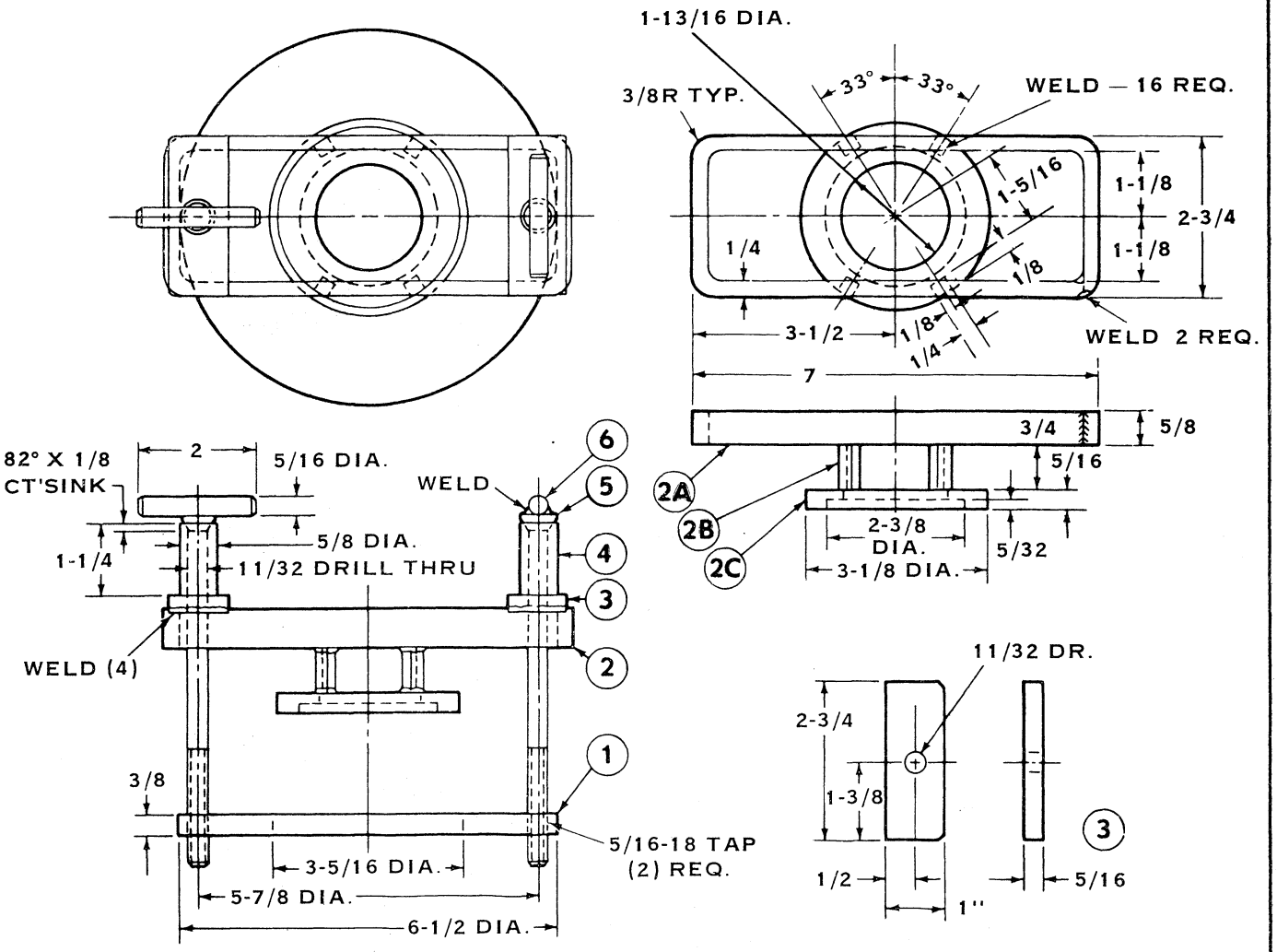
MATERIAL: 3" O.D. × 2-5/8 I.D. × 8-1/4 LG.SEAMLESS MECHANICAL TUBING

Figure 11-1. Special Tool T-12127.



MATERIAL: HEAT TREATED #4150—3 DIA.× 5-3/8

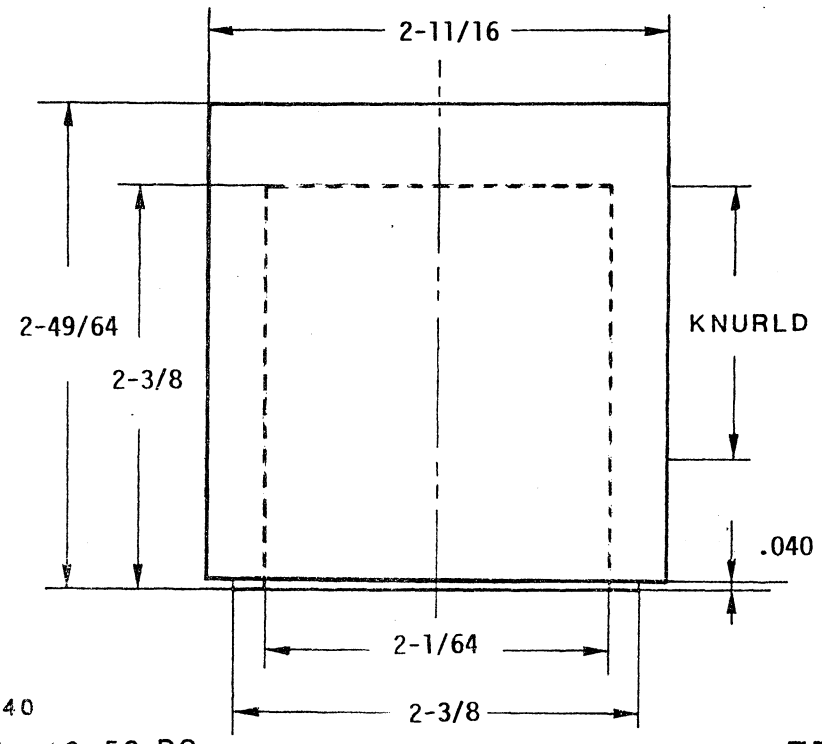
Figure 11-2. Special Tool T-12126.



DET	REQ	MAT	DESCRIPTION	STOCK SIZE		
6	2	CRS	BAR	5/16	DIA.	2-1/8
5	2	PUR	FLAT HD. SCR.	5/16-18 X 6		
4	2	CRS	SPACER	5/8	DIA.	1-3/8
3	2	CRS	CLAMP	1/2	1"	3-1/4
2C	1	MS	PLATE	3-1/4	DIA.	1/2
2B	4	CRS	SPACER	1/4	1/4	7/8
2A	1	CRS	SUPPORT	1/4	5/8	20
2	1		WELDMENT			
1	1	CRS	PLATE	6-1/2	DIA.	5/8

Special Tool T-16752

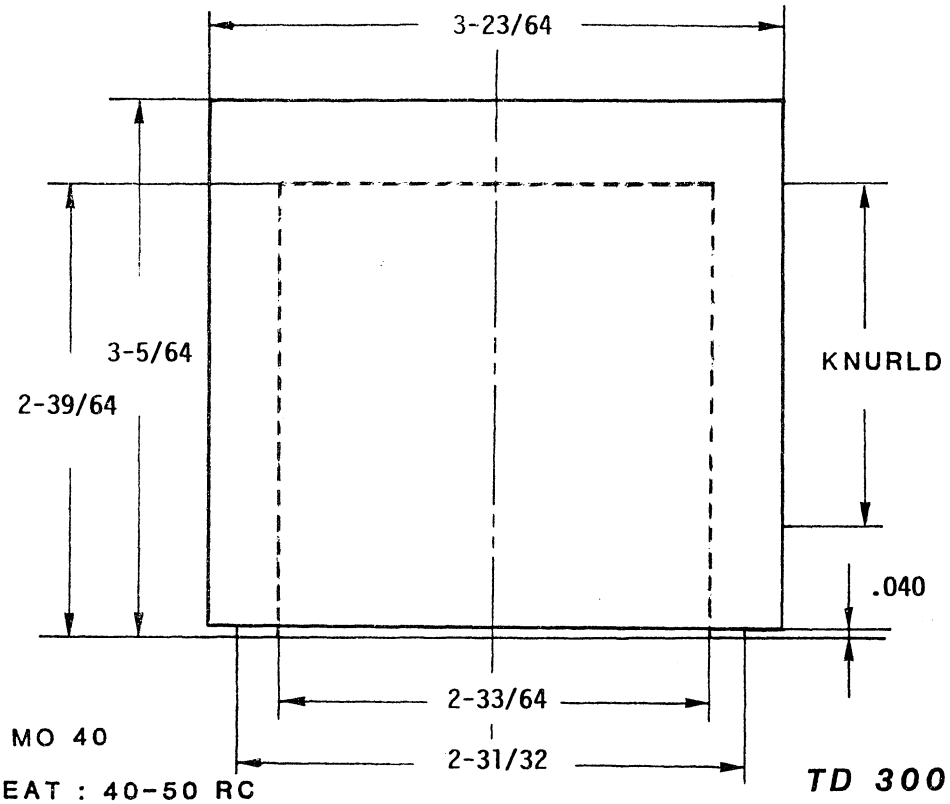
TO BE USED FOR OUTPUT SHAFT B 5154-B



MAT : MO 40
HT TREAT : 40-50 RC

TD 300391

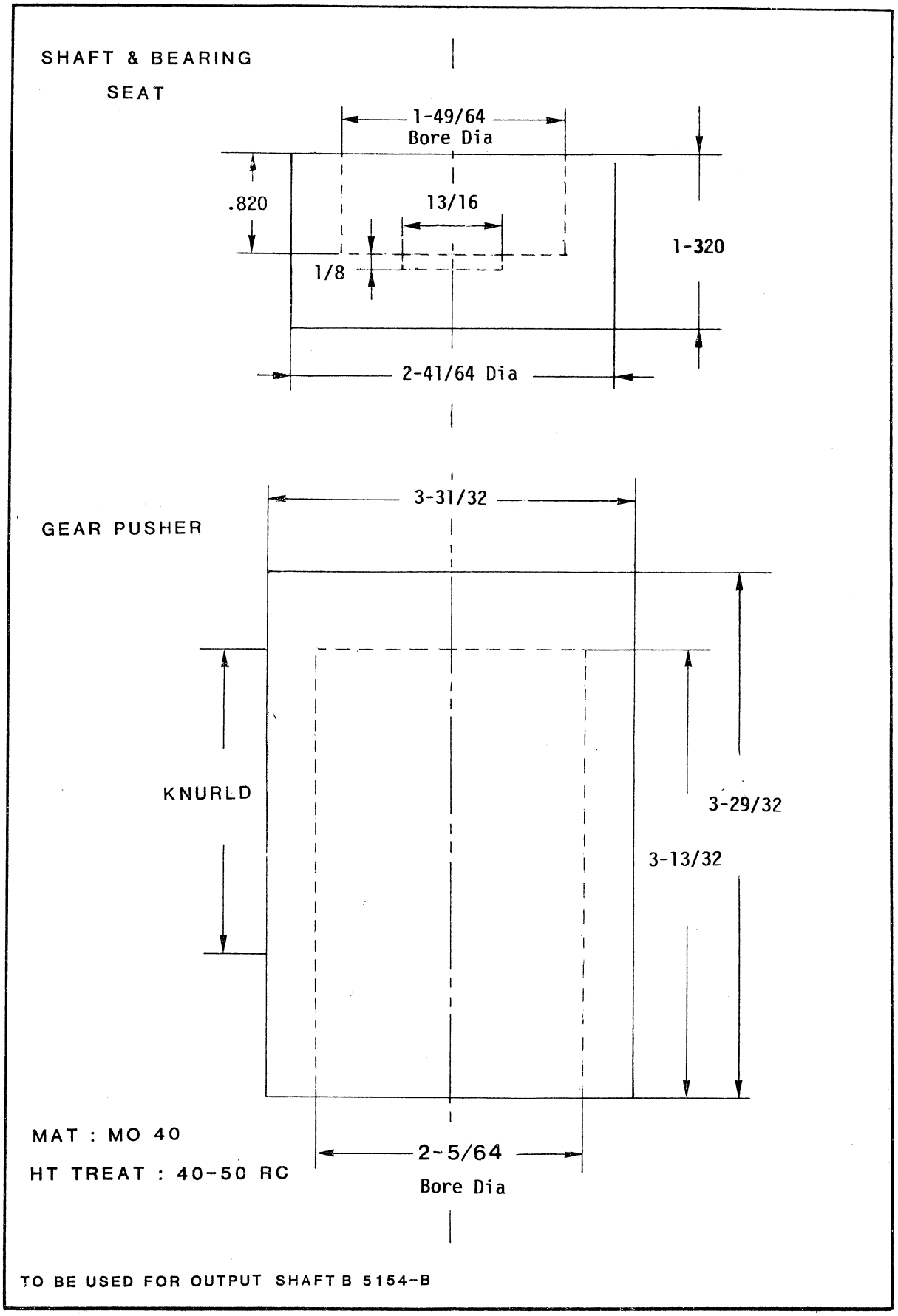
TO BE USED FOR OUTPUT SHAFT B5160-A



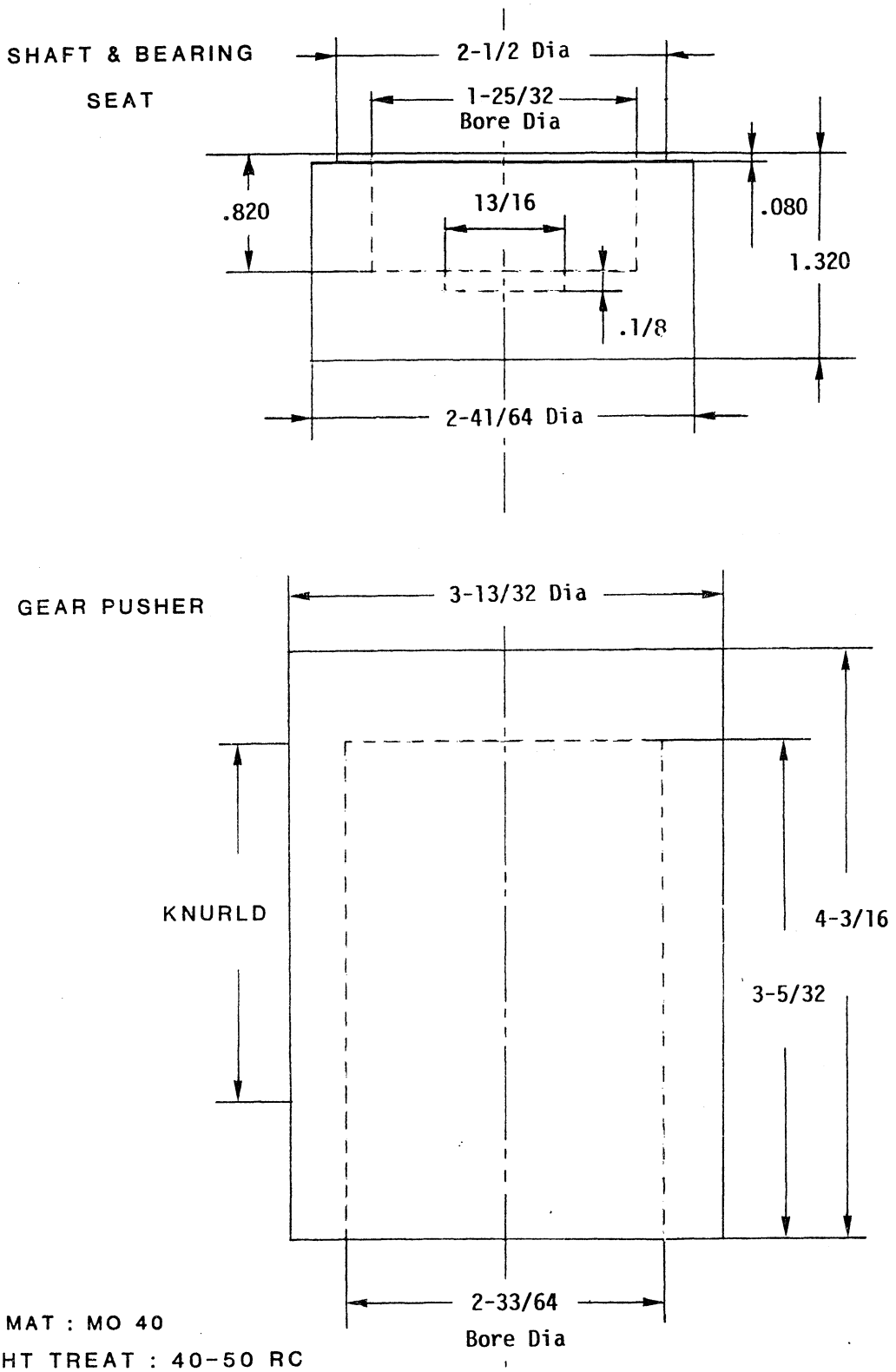
MAT : MO 40
HT TREAT : 40-50 RC

TD 300391-1

Special Tool ***TD 300391 / -1*** PRESS ADAPTOR



Special Tool TD 300392 OUTPUT GEAR PRESS ADAPTOR



Special Tool TD 300392-1 OUTPUT GEAR PRESS ADAPTOR

SECTION 12 - DRAWINGS AND DATA.

The following drawings and data pertain to the MG 506A Marine Transmission and are included for the convenience of the reader.

EXTERNAL PARTS GROUP.

ITEM	DESCRIPTION	QUANTITY
1	RING, ADAPTER SAE 3	1
1a	RING, ADAPTER SAE 2	1
1b	RING, ADAPTER SAE 1	1
2	CAPSCREW, hex-head (3/8-16x1)	12
3	CAPSCREW, hex-head (3/8-16x1)	6
4	PLATE, flywheel direction of rotation	1
5	SCREW, drive	2
6	SCREW, drive	2
7	PLATE, name	1
8	HOUSING, main (not serv. sep.)	1
9	GASKET, flat	1
10	FILLER & BREATHER, oil	1
11	COVER, rear (not serv. sep.)	2
12	CAPSCREW, hex-head (1/2-13x2-1/4)	1
13	GAUGE, oil level	1
14	TUBE, oil level gauge	1
15	CAPSCREW, hex-head (1/2-13x2-3/4)	1
16	SHIM (0.005, 0.007, 020 inch)	as req'd
17	CAPSCREW, hex-head (5/16-18x3/4)	2
18	CAPSCREW, hex-head (1/4-20x1)	1
19	NUT, hex (1/4-20)	1
20	LEVER, shift	1
21	PLATE, detent	1
22	O-RING	1
23	SPOOL, valve	1
24	PISTON, regulator	1
25	SPRING, outer	1
26	SPRING, inner	1
27	WASHER, pressure adjusting shim	as req'd
28	BODY, main regulator valve	1
29	PLUG, pipe (1/8-27)	1
30	CAPSCREW, hex-head (3/8-16x1)	2
31	GASKET, flat cover	1
32	COVER	1
33	CAPSCREW, hex-head (5/16-18x3/4)	3
34	CAPSCREW, hex-head (3/8-16x2)	1
35	O-RING	2
36	TUBE jumper	2
37	SHIM (0.005, 0.007, 0.020 inch)	as req'd
38	CAPSCREW, hex-head (3/8-16x1)	3
39	MOUNT, pump	1
40	GASKET, flat	1
41	PUMP ASSEMBLY, oil	1
42	CAPSCREW, hex-head (5/16-18x3/4)	4
43	CAPSCREW, hex-head (5/16-18x3/4)	3
44	COVER, filter screen	1
45	GASKET, flat cover	1
46	SCREEN, filter	1
47	CAPSCREW, hex-head (1/2-13x1-1/4)	8
48	O-RING	1
49	PIN, dowel (not serv. sep.)	2
50	PLUG, drain	1
51	O-RING	1
52	TUBE, suction	1

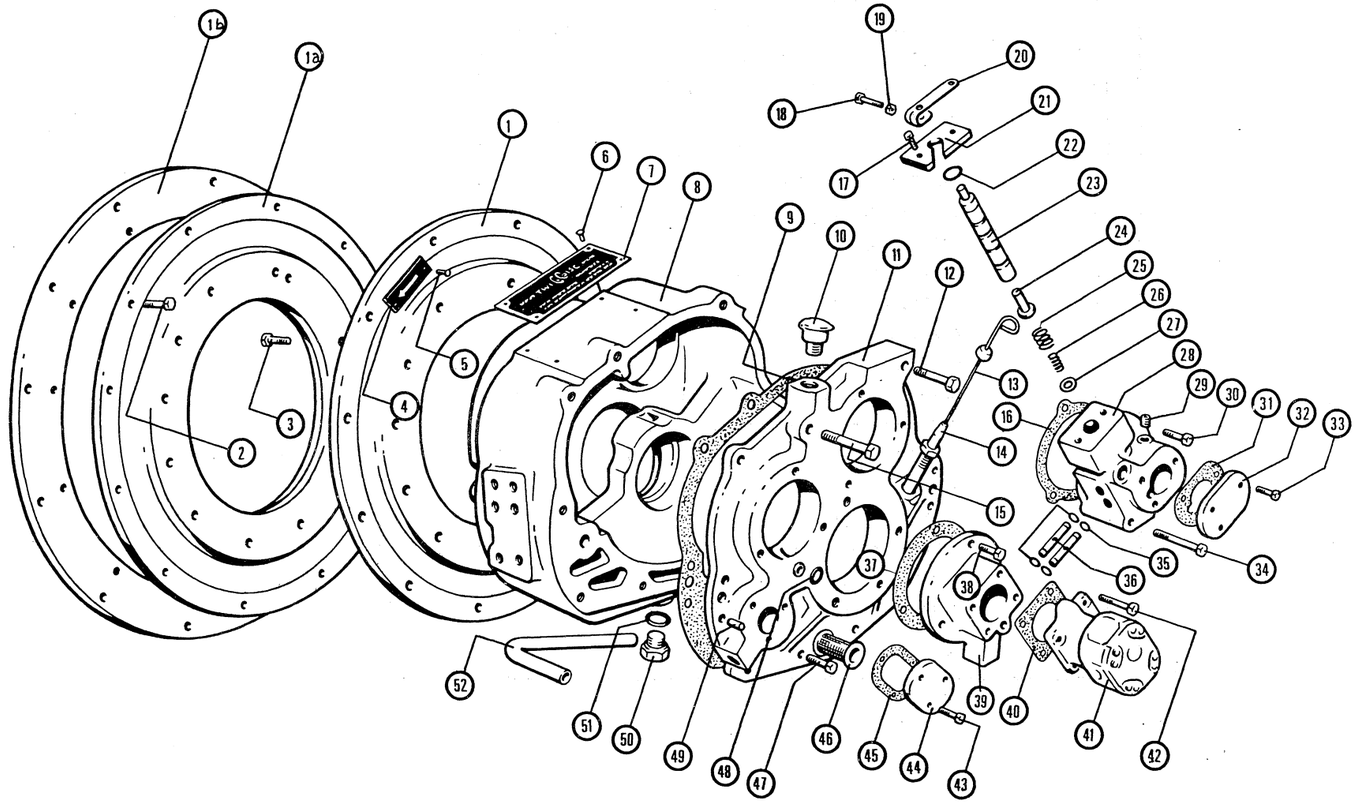


Figure 12-1. External Parts Group.

INPUT AND OUTPUT GROUP OF PARTS.

ITEM	DESCRIPTION	QUANTITY
1	CAPSCREW, hex-head (5/8-11x2)	1
2	WASHER, retainer	1
3	RING, drive	1
4	BLOCK, rubber	20
5	SPIDER, drive	1
6	SEAL, oil (input shaft)	1
7	SUPPORT, bearing	1
8	SHIM (0.005, 0.007, 020 inch)	as req'd
9	TAPERED ROLLER BEARING	1
10	KEY, input shaft (3/8x1/4x1-5/8)	1
11	SHAFT, input	1
12	CAPSCREW, hex-head (3/8-16x1)	6
13	CAPSCREW, hex-head	8
14	TAPERED ROLLER BEARING	1
15	OIL SHIELD	1
16	TAPERED ROLLER BEARING	1
17	SHAFT, output	1
18	GEAR, output	1
19	TAPERED ROLLER BEARING	1
20	SHIM (0.005, 0.007, 020 inch)	as req'd
21	RETAINER, bearing (output shaft)	1
22	CAPSCREW, hex-head (1/2-13x1-1/4)	3
23	SEAL, oil	1
24	FLANGE, output	1
25	RING, lathe cut seal	1
26	WASHER, retainer (output shaft)	1
27	CAPSCREW, hex-head (5/8-18x1-1/2)	1

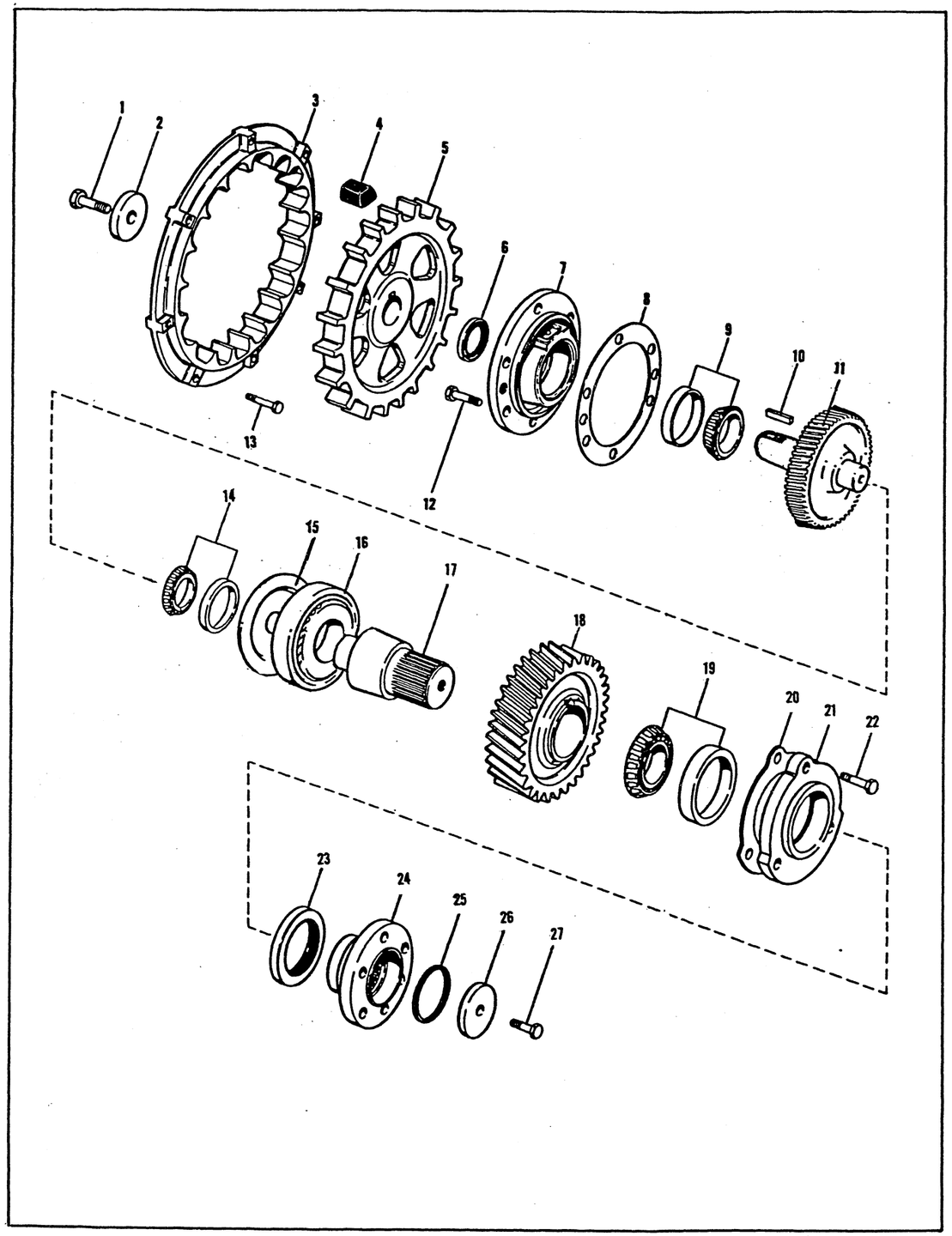


Figure 12-2. Input and Output Group of Parts.

Forward Clutch Group of Parts.

ITEM	DESCRIPTION	QUANTITY
1	TAPERED ROLLER BEARING	1
2	GEAR, clutch housing, forward * (not serv. sep.)	1
3	PISTON, clutch	1
4	RING, seal, piston	1
5	RING, seal, piston	1
6	PLATE, clutch, steel	8
7	PLATE, clutch, faced	9
8	PLATE, back	1
9	RING, snap, internal	1
10	SPRING, return, piston	1
11	RING, snap, external	1
12	WASHER, race, thrust, steel	1
13	NEEDLE THRUST BEARING	1
14	WASHER, race, thrust, steel	1
15	HUB, clutch pinion, assembly (not serv. sep.)	1
16	BUSHING, pinion (not serv. sep.)	1
17	SHAFT, clutch, assembly (not serv. sep.)	1
18	WASHER, race, thrust, steel	1
19	NEEDLE THRUST BEARING	1
20	WASHER, race, thrust, steel	1
21	TAPERED ROLLER BEARING	1
22	RING, seal, piston type	2

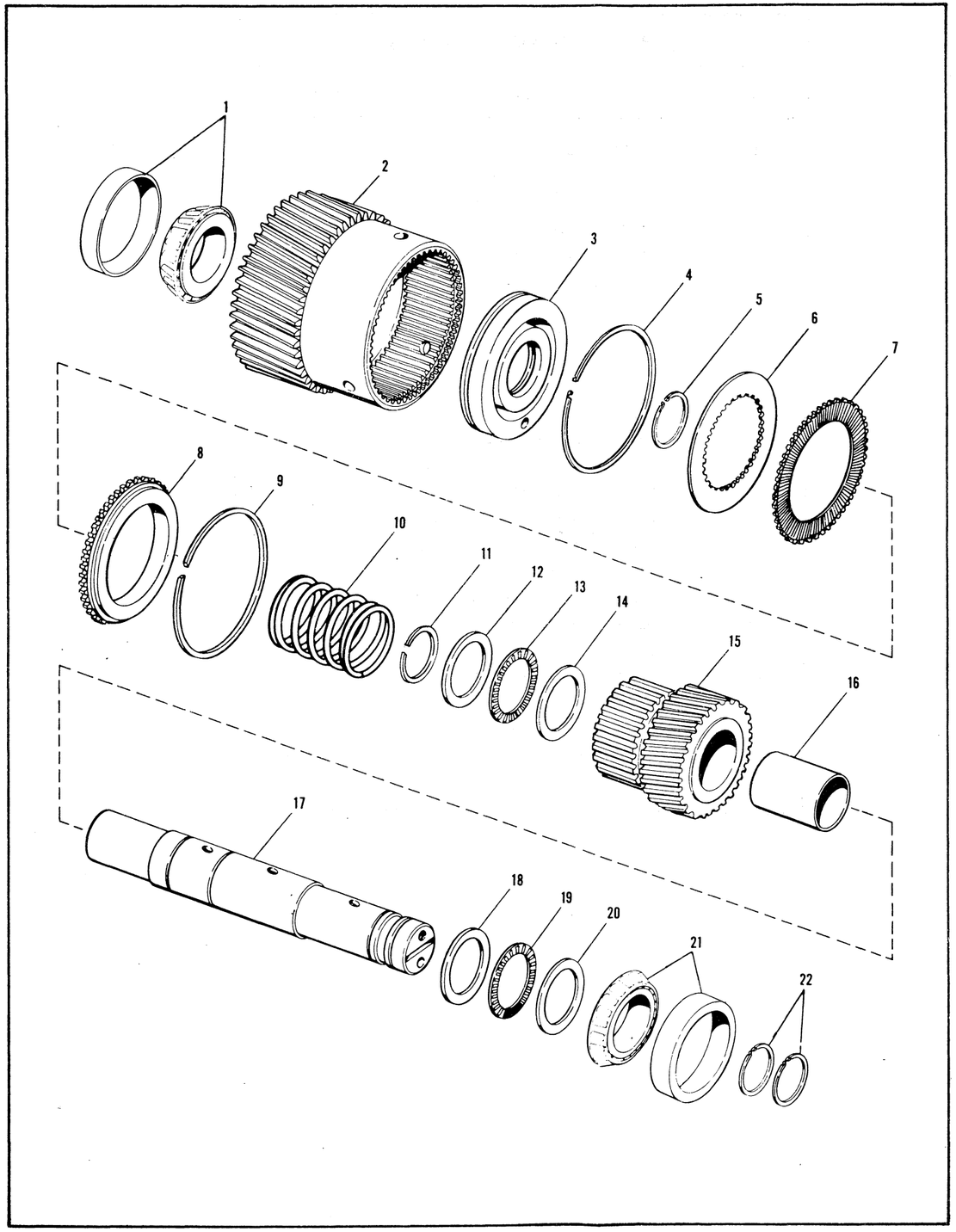


Figure 12-3. Forward Clutch Group of Parts.

Reverse Clutch group of Parts.

ITEM	DESCRIPTION	QUANTITY
1	TAPERED ROLLER BEARING	1
2	GEAR, clutch housing, reverse * (not serv. sep.)	1
3	PISTON, clutch	1
4	RING, seal, piston	1
5	RING, seal, piston	1
6	PLATE, clutch, steel	8
7	PLATE, clutch, faced	9
8	PLATE, back	1
9	RING, snap, internal	1
10	SPRING, return, piston	1
11	RING, snap, external	1
12	WASHER, race, thrust, steel	1
13	NEEDLE THRUST BEARING	1
14	WASHER, race, thrust, steel	1
15	HUB, clutch pinion, assembly (not serv. sep.)	1
16	BUSHING, pinion (not serv. sep.)	1
17	SHAFT, clutch, assembly (not serv. sep.)	1
18	WASHER, race, thrust, steel	1
19	NEEDLE THRUST BEARING	1
20	WASHER, race, thrust, steel	1
21	TAPERED ROLLER BEARING	1
22	RING, seal, piston type	2

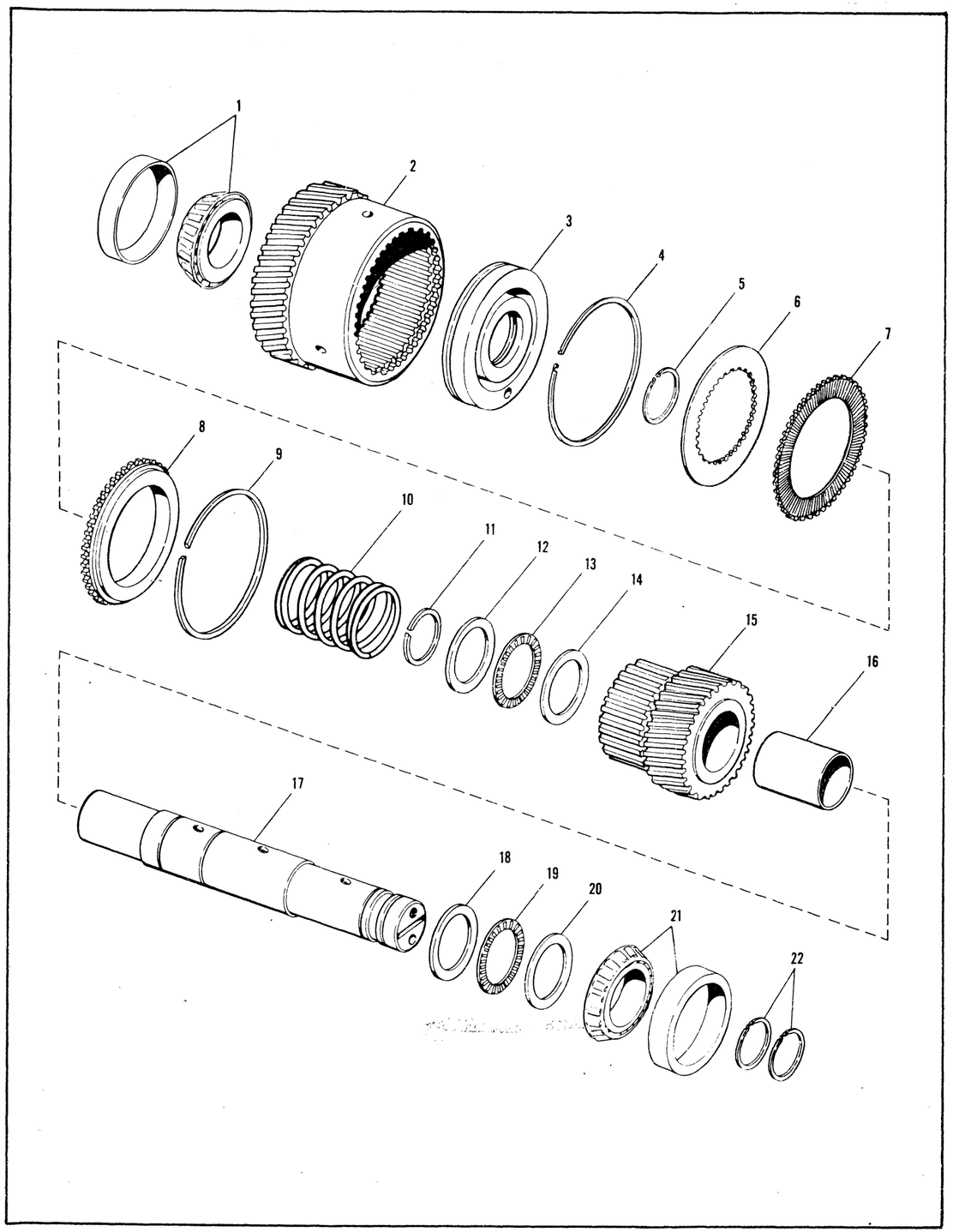
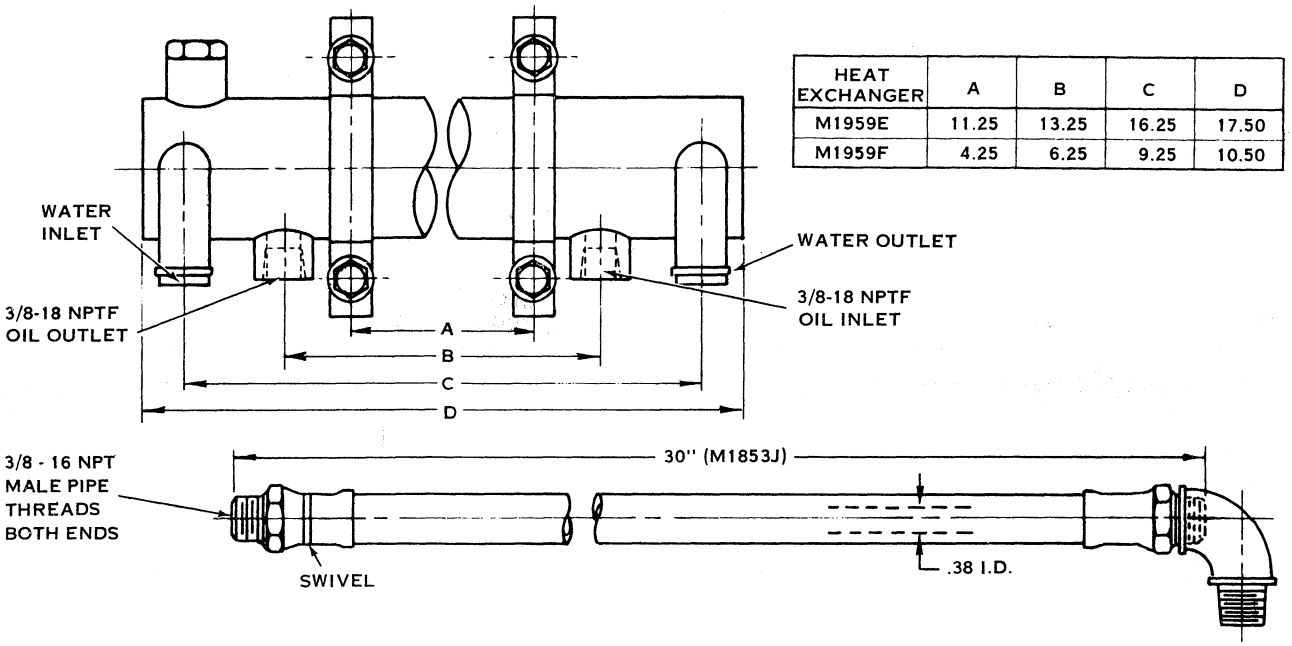


Figure 12-4. Reverse Clutch group of Parts.



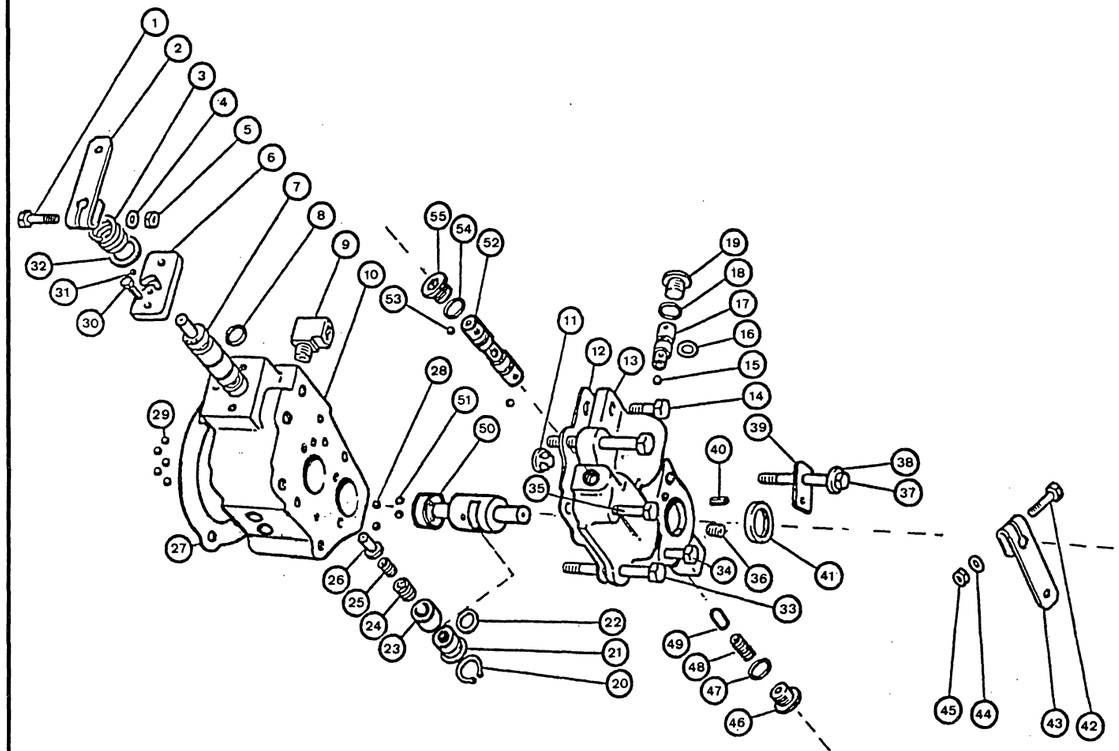
HEAT EXCHANGER	A	B	C	D
M1959E	11.25	13.25	16.25	17.50
M1959F	4.25	6.25	9.25	10.50

XB 1936 CONSISTS OF (SPEC. K-85)			XB1936A CONSISTS OF (SPEC. K-86)		
M1959E	1	HEAT EXCHANGER	M1959F	1	HEAT EXCHANGER
M1853J	2	FLEXIBLE HOSE (3/8 I.D.)	M1853J	2	FLEXIBLE HOSE (3/8 I.D.)
M2053BA	2	PIPE NIPPLE (3/8)	M2053BA	2	PIPE NIPPLE (3/8)
M2055AD	2	90° ELBOW (3/8)	M2055AD	2	90° ELBOW (3/8)
M2001F	4	HEX. HEAD CAPSCREW (5/16 x 5/8)	M2001F	4	HEX. HEAD CAPSCREW (5/16 x 5/8)
M2048F	4	PLAIN WASHER	M2048F	4	PLAIN WASHER
FOR RIGHT HAND ENGINE (FRESH WATER COOLING)			FOR RIGHT HAND ENGINE (SALT WATER COOLING).		

Figure 12-5. Heat Exchanger Kits — MG-506-A

SELECTOR VALVE, RATE OF RISE & TROLLING CONT.

ITEM	DESCRIPTION	QUANTITY
1	CAPSCREW, hex-head (1/4-20x1)	1
2	LEVER, shift	1
3	SPRING, compression	1
4	WASHER	1
5	NUT (1/4-20)	1
6	PLATE, detent (not serv. sep.)	1
7	STEM, valve	1
8	'O' RING	1
9	ELBOW, street 90°, 3/8-18	1
10	BODY, main regulator valve (not serv. sep.)	1
11	VALVE, check orifice	1
12	GASKET, valve cover	1
13	COVER, regulator valve	1
14	CAPSCREW, hex-head (5/16-18x1)	1
15	BALL, steel	1
16	'O' RING	1
17	VALVE, shuttle	1
18	'O' RING	1
19	PLUG (3/4-16)	1
20	RING, internal snap	1
21	PLUG	1
22	'O' RING	1
23	PISTON, pressure rise	1
24	SPRING, compression, outer	1
24 A	SHIM	as req'd
25	SPRING, compression, inner	1
26	PISTON, regulator	1
27	SHIM	as req'd
28	BALL, steel	2
29	BALL, steel	6
30	CAPSCREW, hex-head (5/16-18x3/4)	2
31	BALL, steel	1
32	WASHER, steel	1
33	CAPSCREW, hex head (M10x1.5x95)	2
34	CAPSCREW, hex head (5/16-18x1-1/2)	1
35	CAPSCREW, hex-head (5/16-18x1-3/4)	1
36	PLUG, pipe (1/8-27 NPTF)	1
37	CAPSCREW	1
38	WASHER, steel	1
39	PLATE, lock	1
40	PIN, roll	1
41	OIL SEAL	1
42	CAPSCREW, hex-head (1/4-20x1)	1
43	LEVER, shift	1
44	WASHER	1
45	NUT (1/4-20)	1
46	PLUG, pipe (1/4 inch)	1
47	'O' RING	1
48	SPRING, detent, indexing	1
48 A	SHIM	as req'd
49	DETENT, indexing	1
50	STEM, trolling (not serv. sep.)	1
51	BALL, steel	2
52	VALVE, shuttle	1
53	BALL (not serv. sep.)	2
54	'O' RING	1
55	PLUG	1



Control Valve and Trolling Valve — Exploded View. Figure 12-6

TORQUE VALUES : FOR TIGHTENING BOLTS AND NUTS.

LIMITING CONDITIONS.

DIN GRADE	6.9	8.8	10.9	12.9	DIN GRADE	6.9	8.8	10.9	12.9
FINE METRIC THREADS	TORQUE VALUES				NORMAL METRIC THREADS	TORQUE VALUES			
	Ft.lb	Ft.lb	Ft.lb	Ft.lb		Ft.lb	Ft.lb	Ft.lb	Ft.lb
	Kgm	Kgm	Kgm	Kgm		Kgm	Kgm	Kgm	Kgm
M5 x 0,5	4,5	5	7,3	8,7	M5 x 0,8	3,6	4,3	6,5	8
	0,6	0,7	1,0	1,2		0,5	0,6	0,9	1,1
M6 x 0,5	7,2	9,5	12,3	15,2	M6 x 1	3,6	8,0	10,8	14
	1,0	1,3	1,7	2,1		0,6	1,1	1,5	1,8
M8 x 1	9	25	27	32	M8 x 1,25	8,7	18	25	31
	1,3	2,7	3,8	4,5		1,2	2,5	3,4	4,3
M10 x 1	19	41	57	63	M10 x 1,5	19	38	54	60
	2,6	5,5	7,8	8,8		2,2	5,3	7,5	8,3
M12 x 1,5	32	65	90	108	M12 x 1,75	30	65	90	100
	4,4	9,0	12,5	15		4,2	9	12,5	14,0
M14 x 1,5	92	108	151	181	M14 x 2	48	100	144	166
	6,9	15	21	25		6,6	14	20	23

TORQUE VALUES : FOR TIGHTENING BOLTS AND NUTS.

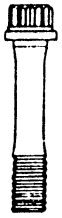
LIMITING CONDITIONS.

DIN GRADE	6.9	8.8	10.9	12.9	DIN GRADE	6.9	8.8	10.9	12.9
FINE METRIC THREADS	TORQUE VALUES				NORMAL METRIC THREADS	TORQUE VALUES			
	Ft.lb	Ft.lb	Ft.lb	Ft.lb		Ft.lb	Ft.lb	Ft.lb	Ft.lb
	Kgm	Kgm	Kgm	Kgm		Kgm	Kgm	Kgm	Kgm
M16 x 1,5	76	162	227	274	M16 x 2	72	155	216	256
	10,5	22,5	31,5	38		10	21,5	30	35,5
M18 x 1,5	105	235	332	397	M18 x 2,5	99	213	296	350
	14,4	32,5	46	55		13,8	29,5	41	48,5
M20 x 1,5	147	332	463	556	M20 x 2,5	140	300	426	498
	20,3	46	64	77		19,4	41,5	59	69
M22 x 1,5	208	441	621	759	M22 x 2,5	199	419	592	672
	28,8	61	86	105		27,5	58	82	93
M24 x 2	253	563	795	940	M24 x 3	240	513	723	867
	35	78	110	130		33,3	71	100	120

TORQUE VALUES

FOR TIGHTENING CAPSCREWS, BOLTS & PIPE PLUGS (1)

Torque (Lb.ft.) for course and fine threads

NOMINAL THREAD DIAMETER (EN POUCES)	SAE GRADE 5		SAE GRADE 8		SCREWS FOR UNIV. JOINT BEARING CAPS
	DRY (2)	OILED (3)	DRY (2)	OILED (3)	OILED (3)
1/4	9 ± 1	7 ± 1	14 ± 1	11 ± 1	
5/16	19 ± 2	15 ± 2	27 ± 2	22 ± 2	
3/8	33 ± 3	27 ± 2	46 ± 4	38 ± 3	
7/16	52 ± 4	40 ± 3	73 ± 6	60 ± 5	64 ± 4
1/2	80 ± 6	65 ± 5	112 ± 8	90 ± 7	100
9/16	112 ± 8	90 ± 8	158 ± 12	130 ± 10	
5/8	158 ± 12	130 ± 10	224 ± 16	180 ± 15	190 ± 10
3/4	280 ± 20	225 ± 20	390 ± 30	320 ± 25	330 ± 17
7/8	448 ± 32	360 ± 30	630 ± 50	510 ± 40	510 ± 25
1	680 ± 50	540 ± 45	960 ± 70	775 ± 60	
1 1/8	850 ± 60	675 ± 60	1360 ± 100	1110 ± 85	
1 1/4	1175 ± 85	925 ± 75	1850 ± 150	1500 ± 125	
	3 DASHES 120° APART 		6 DASHES 60° APART  (4)		 12 Pt. Head and Undercut Body
	SAE STANDARD HEX BOLT HEAD MARKINGS				

(1) Torque values for capscrews and bolts also apply to use in aluminium provided thread engagement is twice the nominal thread diameter and a hardened flat steel washer is used under the head. This table covers tightening torques for the majority of Twin Disc's use of capscrews and bolts in threaded steel, cast iron, aluminium and brass parts. Individual assembly drawings will show special requirements.

(2) Use for all capscrews, bolts and nuts when dry or coated only with a rust preventive which is dry to the touch.

(3) Use for all fasteners lubricated with moly-disulfide, when plated with zinc or cadmium, or when dipped in lubricating oil.

(4) Socket head screws and 12 point head screws with full body are also grade 8.

TORQUE VALUES FOR TAPERED PIPE PLUGS Recommended torque (Lb.ft.) *		
NPTF SIZE (INCHES)	LUBRICATED	
	IN CAST IRON OR STEEL	IN ALUMINIUM
1/16-27	8.5 ± 1.0	5.5 ± 0.7
1/8-27	10.5 ± 1.3	6.5 ± 0.8
1/4-18	25 ± 3	16 ± 2
3/8-18	27 ± 3	17 ± 2
1/2-14	50 ± 6	30 ± 4
3/4-14	54 ± 7	34 ± 4
1-11 1/2	80 ± 10	50 ± 6
1 1/4-11 1/2	85 ± 10	55 ± 7
1 1/2-11 1/2	85 ± 10	55 ± 7

* The lubricant is to be John Crane insolube plastic lead seal n° 2 or equivalent or Loctite n° 92 or equivalent and plugs are to be capable of removal without damage.
Overtightening may cause initial leakage plus potential removal damage. An option of a max. of two full turns after finger tightening the plug may be used if required and if removal conditions are met.

STRAIGHT THREADED TUBE FITTINGS, HOSE FITTINGS AND PLUGS WITH 'O' RINGS.

For 37°, 45° and inverted flared fittings per SAE standards J512, J514 and J516 (with latest suffix) (1)
For taper pipe threaded fittings use the pipe plug torque values shown

NOMINAL THREAD O. D.	NOMINAL TUBE SIZE	PLUG PART NUMBER (2)	TIGHTENING TORQUE, LB.FT. NUTS & PLUGS	TORQUE LB. IN EQUIV.
5/16	1/8	----	3.6 ± 0.5	43 ± 6
3/8	3/16	M-2080-G	8.6 ± 1.0	103 ± 12
7/16	1/4	M-2080-E	12 ± 1.5	144 ± 18
1/2	5/16	M-2080-C	15 ± 2	180 ± 24
9/16 & 5/8	3/8	M-2080-A	18 ± 2	216 ± 24
11/16	7/16	----	25 ± 3	
3/4	1/2	M-2080-K	30 ± 4	
7/8	5/8	M-2080-M	40 ± 5	
1-1/16	3/4	M-2080-F	55 ± 7	
1-3/16 & 1-1/4	7/8	M-2080-N	65 ± 8	
1-5/16 & 1-3/8	1	M-2080-B	80 ± 10	
1-5/8	1-1/4	M-2080-J	100 ± 12	
1-7/8	1-1/2	M-2080-D	120 ± 15	
2-1/2	2	M-2080-X	230 ± 30	

(1) This chart does not apply to ~~other than~~ the 3 flared designs quoted.
Thus do not use this data for sleeved compression type fittings.
Refrigeration tube fittings, ~~air line~~ tube fittings nor the many flareless fittings.

(2) This is a partial list. Use ~~thread~~ O. D. to determine the recommended assembly torque of the unlisted straight thread 'O' ring plugs.

The flareless fittings are best assembled with number of turns after some initial tightening or running to the stop provided and then tightening with an additional 5 to 50 pounds feet of torque. No standard data has been prepared for the flareless fittings.

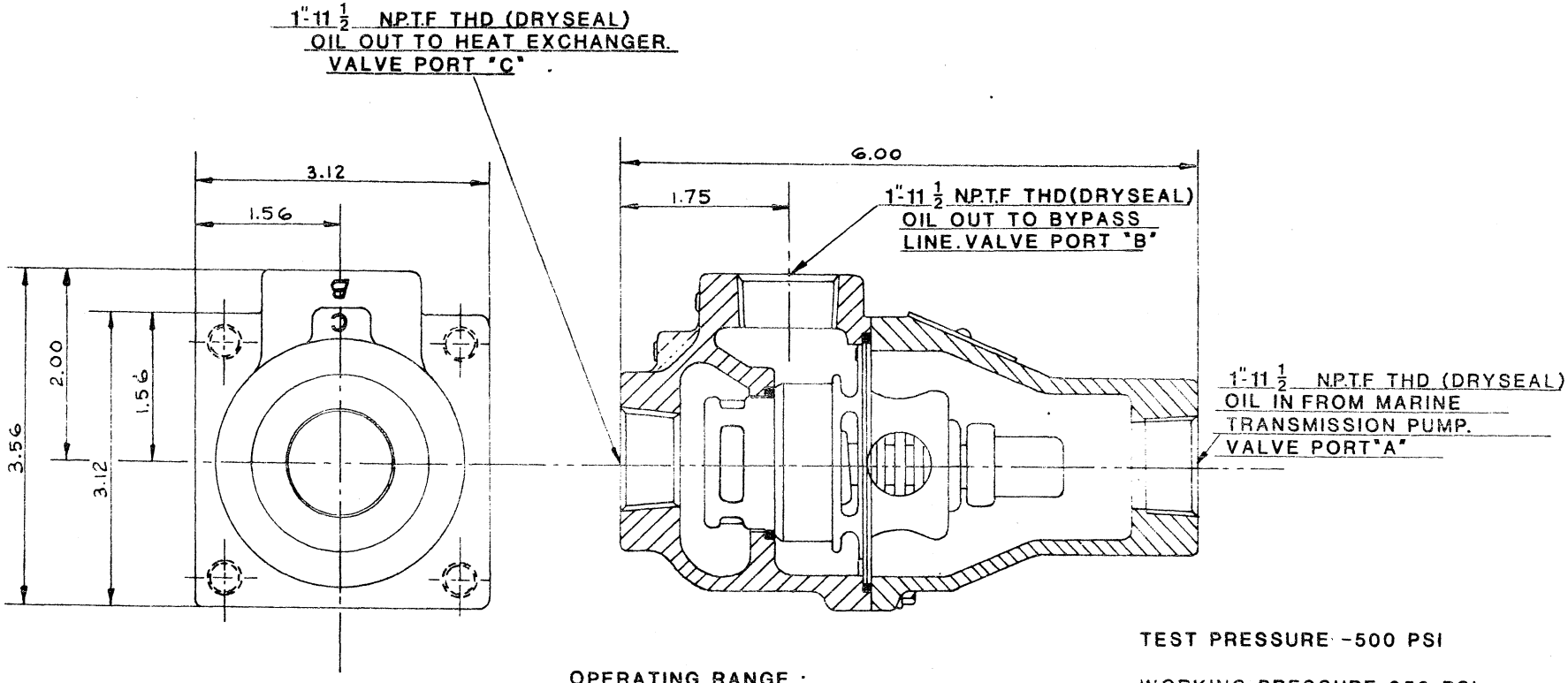
BEARING LOCKNUT TORQUE

DIMENSION	M-2012	M-2281	TORQUE Lb. Ft. (1)	M-2012	TORQUE Lb. Ft. (1)	M-2037	TORQUE Lb. Ft. (1)
01	BC		15 ± 2				
03	A		34 ± 5				
04	B		46 ± 6				
05	C	C	75 ± 10				
06	D		92 ± 12				
07	E		125 ± 16			E	150 ± 20
08	F	F	160 ± 20	AF	230 ± 30	(3) F	190 ± 25
09	G	G	200 ± 25	(2) AG	300 ± 40	G	240 ± 30
10	H	H	240 ± 30	AH	370 ± 50	H	290 ± 40
11	J	J	290 ± 40	AJ	440 ± 55	J	350 ± 45
12	K	K	350 ± 45	AK	530 ± 70	K	430 ± 55
13	L		400 ± 50	AL	600 ± 75	L	490 ± 65
14	M	M	460 ± 60	AM	710 ± 90	M	580 ± 75
15	N	AJ	550 ± 70	AN	830 ± 110	N & AN	680 ± 85
16	P	P	660 ± 85	AP	1000 ± 130	P	800 ± 100
17	Q		770 ± 100	AQ	1200 ± 150	Q	950 ± 120
18	R		900 ± 120	AR	1350 ± 170	R	1100 ± 140
19	S	S & AH	1000 ± 130	AS	1500 ± 190	S	1300 ± 170
20	T		1150 ± 150	AT	1700 ± 225	T	1400 ± 180
21	U		1300 ± 170	AU	2000 ± 250	U	1600 ± 200
22	V	V	1400 ± 180	AV	2200 ± 275	V	1800 ± 225
24	W		1800 ± 225	AW	2700 ± 350	W	2200 ± 275
26	X	X	2200 ± 275	AX	3300 ± 425	X	2700 ± 350
28	Y		2600 ± 325	AY	4000 ± 500	Y	3300 ± 425
30	Z		3100 ± 400	AZ	4800 ± 600	Z	4000 ± 500

(1) Torque values apply to solid shafts.
Torque values may or may not be satisfactory on thin-walled shafts.
Torque values apply to threads lubricated with SAE 20 or 30 oil.

(2) M-2281-AG is to have same assembly torque as M-2012-AG.

(3) M-2037-AA is to have 120 ± 15 Lb. Ft. assembly torque.



TEST PRESSURE -500 PSI

WORKING PRESSURE-350 PSI

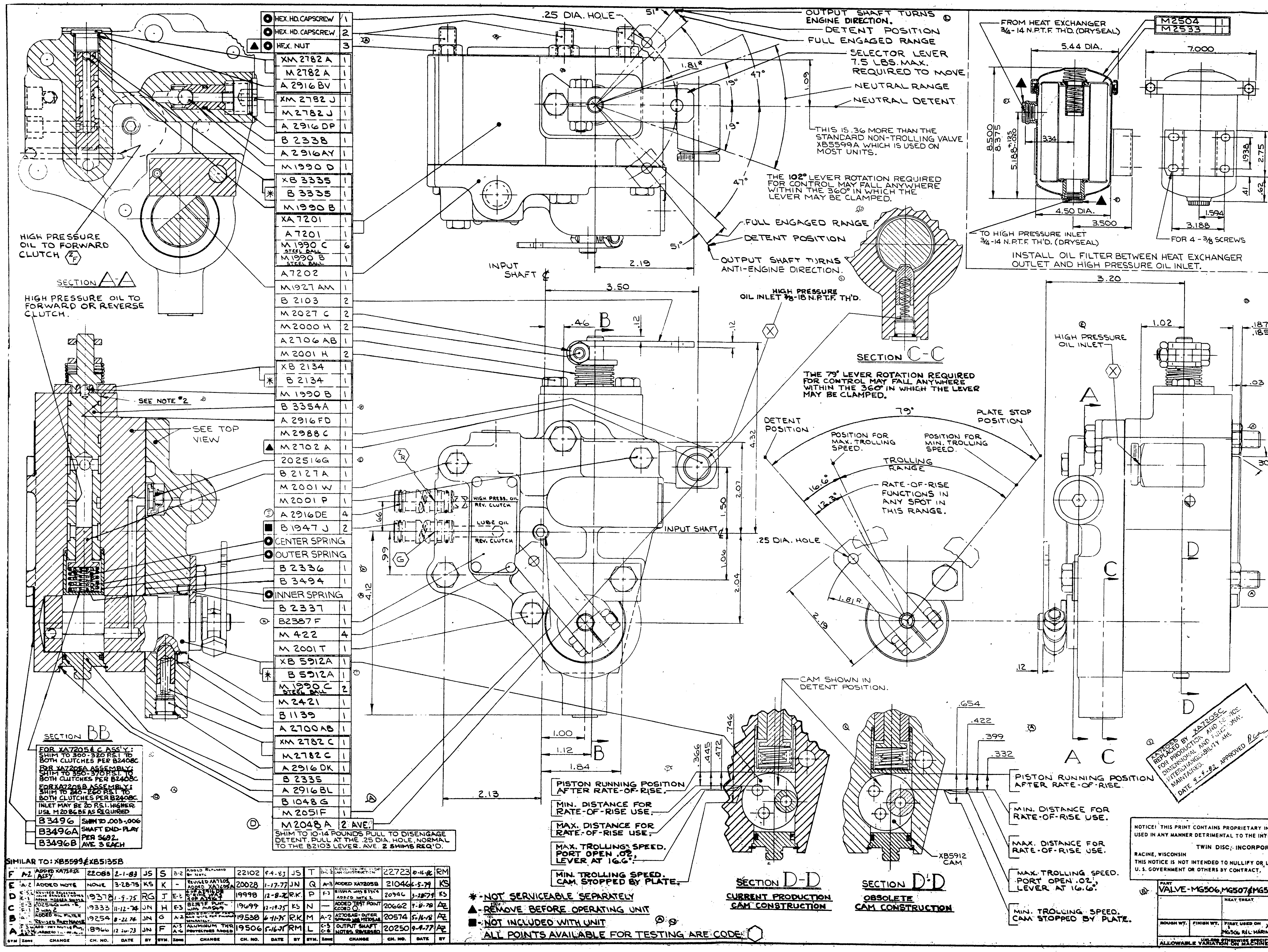
OPERATING RANGE :

BELOW 160°F MINIMUM FLOW TO HEAT EXCHANGER

ABOVE 180°F MAXIMUM FLOW TO HEAT EXCHANGER

SUITABLE FOR CONTINUOUS USE AT 215°F MAX

VALVE THERMOSTAT	DATE 12-6-71 SCALE NONE DRAWN RK CHECK HEB DS BCa	TWIN DISC INCORPORATED RACINE WI 53403 U.S.A. B 3488



HEX. HD. CAPSCREW 1
HEX. HD. CAPSCREW 2
HEX. NUT 3
XM 2782 A 1
M 2782 A 1
A 2916 BV 1
XM 2782 J 1
M 2782 J 1
A 2916 DP 1
B 2338 1
A 2916 AY 1
M 1990 D 1
XB 3335 1
B 3335 1
M 1990 B 1
XA 7201 1
A 7201 1
M 1990 C STEEL BALL 6
M 1990 B STEEL BALL 1
A 7202 1
M 1927 AM 1
B 2103 2
M 2027 C 2
M 2000 H 2
A 2706 AB 1
M 2001 H 2
XB 2134 1
B 2134 1
M 1990 B 1
B 3354 A 1
A 2916 FD 1
M 2988 C 1
M 2702 A 1
2025 16 G 1
B 2127 A 1
M 2001 W 1
M 2001 P 1
A 2916 DE 4
B 1947 J 2
CENTER SPRING
OUTER SPRING
B 2336 1
B 3494 1
INNER SPRING
B 2337 1
B 2387 F 1
M 422 4
M 2001 T 1
XB 5912 A 1
B 5912 A 1
M 1990 C STEEL BALL 2
M 2421 1
B 1139 1
A 2700 AB 1
XM 2782 C 1
M 2782 C 1
A 2916 DK 1
B 2335 1
A 2916 BL 1
B 1048 G 1
M 2051 F 1
M 2048 A 2 AVE.
SHIM TO 10-14 POUNDS PULL TO DISENGAGE DETENT. PULL AT THE .25 DIA. HOLE, NORMAL TO THE B2103 LEVER. AVE. 2 SHIMS REQ'D.
HIGH PRESSURE OIL TO FORWARD CLUTCH
SECTION A-A
HIGH PRESSURE OIL TO FORWARD OR REVERSE CLUTCH.
SEE NOTE #2
SEE TOP VIEW
SECTION B-B
FOR XA7205 & C ASS'Y: SHIM TO 300-320 P.S.I. TO BOTH CLUTCHES PER B2408C
FOR XA7205A ASSEMBLY: SHIM TO 350-370 P.S.I. TO BOTH CLUTCHES PER B2408C
FOR XA7205B ASSEMBLY: SHIM TO 240-260 P.S.I. TO BOTH CLUTCHES PER B2408C
INLET MAY BE 20 P.S.I. HIGHER. USE M2086BF AS REQUIRED
B3496 SHIM TO .003-.006
B3496A SHAFT END-PLAY PER S692.
B3496B AVE. 3 EACH
.25 DIA. HOLE
OUTPUT SHAFT TURNS ENGINE DIRECTION.
DETENT POSITION
FULL ENGAGED RANGE
SELECTOR LEVER 7.5 LBS. MAX. REQUIRED TO MOVE
NEUTRAL RANGE
NEUTRAL DETENT
THIS IS .36 MORE THAN THE STANDARD NON-TROLLING VALVE XB5599A WHICH IS USED ON MOST UNITS.
THE 102° LEVER ROTATION REQUIRED FOR CONTROL MAY FALL ANYWHERE WITHIN THE 360° IN WHICH THE LEVER MAY BE CLAMPED.
FULL ENGAGED RANGE
DETENT POSITION
OUTPUT SHAFT TURNS ANTI-ENGINE DIRECTION.
INPUT SHAFT ℄
HIGH PRESSURE OIL INLET 3/8-18 N.P.T.F. TH'D.
SECTION C-C
THE 79° LEVER ROTATION REQUIRED FOR CONTROL MAY FALL ANYWHERE WITHIN THE 360° IN WHICH THE LEVER MAY BE CLAMPED.
DETENT POSITION
POSITION FOR MAX. TROLLING SPEED.
POSITION FOR MIN. TROLLING SPEED.
PLATE STOP POSITION
TROLLING RANGE
RATE-OF-RISE FUNCTIONS IN ANY SPOT IN THIS RANGE.
HIGH PRESS. OIL REV. CLUTCH
LUBE OIL
REV. CLUTCH
INPUT SHAFT ℄
.25 DIA. HOLE
CAM SHOWN IN DETENT POSITION.
PISTON RUNNING POSITION AFTER RATE-OF-RISE.
MIN. DISTANCE FOR RATE-OF-RISE USE.
MAX. DISTANCE FOR RATE-OF-RISE USE.
MAX. TROLLING SPEED. PORT OPEN .02. LEVER AT 16.6°.
MIN. TROLLING SPEED. CAM STOPPED BY PLATE.
XB5912 CAM
SECTION D-D
CURRENT PRODUCTION CAM CONSTRUCTION
SECTION D'-D
OBSOLETE CAM CONSTRUCTION
FROM HEAT EXCHANGER 3/4-14 N.P.T.F. THD. (DRYSEAL)
M2504 1
M2533 1
TO HIGH PRESSURE INLET 3/4-14 N.P.T.F. TH'D. (DRYSEAL)
FOR 4 - 3/8 SCREWS
INSTALL OIL FILTER BETWEEN HEAT EXCHANGER OUTLET AND HIGH PRESSURE OIL INLET.
HIGH PRESSURE OIL INLET
XA7205C REPLACED BY XA7205C FOR PRODUCTION AND SERVICE. DIMENSIONAL AND FUNCTIONAL INTERCHANGEABILITY ARE MAINTAINED. DATE 5-5-83 APPROVED

ASSEMBLY INSTRUCTIONS:

1.) ASSEMBLE AND TEST PER B2408C & S692.

2.) GREASE APPLICATION PROCEDURE (CONTROL VALVE): BEFORE INSTALLING VALVE STEM INTO VALVE BODY, LIGHTLY APPLY GENERAL PURPOSE GREASE PER S364, ITEM 6 #1 NLGI, TO THE VALVE STEM FROM THE "O"-RING GROOVE TO NECKED DOWN DIAMETER AT LEVER END.

XA7205 (MG506) FOR 300-320 P.S.I. APPLICATION CONSISTS OF:

	PART NO.	QTY.	PART NAME
	XA7227	1	AS STOCKED VALVE ASS'Y. BUILT PER BOM 38193 FOR WHICH NO DRG. EXISTS
◉	B2384	1	INSTRUCTION PLATE
◉	B2385	1	VALVE INSTRUCTION PLATE FIELD INSTALL. INSTRUCTION
◉	B2386	1	VALVE FIELD INSTALLATION INSTRUCTIONS
◉	M2828	2	ANAEROBIC SEALANT
◉	S774	1	SEALANT APPLICATION INSTRUCTION
◉	M2504	1	FILTER ASSEMBLY
O	A2705AE	1	OUTER SPRING
O	A2703AW	1	INNER SPRING
O	M2002CK	1	HEX. HD. CAPSCREW
O	M2002CA	2	HEX. HD. CAPSCREW
O	M2027R	3	HEX. NUT

◉ THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.
O THESE PARTS ARE PICTORIALLY IDENTIFIED IN THE VALVE ASSEMBLY.

XA7205A (MG506) FOR 350-370 P.S.I. APPLICATION CONSISTS OF:

	PART NO.	QTY.	PART NAME
	XA7227A	1	AS STOCKED VALVE ASS'Y. BUILT PER BOM 38194 FOR WHICH NO DRG. EXISTS
◉	B2384	1	INSTRUCTION PLATE
◉	B2385	1	VALVE INSTRUCTION PLATE FIELD INSTALL. INSTRUCTION
◉	B2386	1	VALVE FIELD INSTALLATION INSTRUCTIONS
◉	M2828	2	ANAEROBIC SEALANT
◉	S774	1	SEALANT APPLICATION INSTRUCTION
◉	M2504	1	FILTER ASSEMBLY
O	A2705AE	1	OUTER SPRING
O	A2703AW	1	CENTER SPRING
O	A2702BK	1	INNER SPRING
O	M2002CK	1	HEX. HD. CAPSCREW
O	M2002CA	2	HEX. HD. CAPSCREW
O	M2027R	3	HEX. NUT

◉ THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.
O THESE PARTS ARE PICTORIALLY IDENTIFIED IN THE VALVE ASSEMBLY.

XA7205B (MG507) FOR 240-260 P.S.I. APPLICATION CONSISTS OF:

	PART NO.	QTY.	PART NAME
	XA7227B	1	AS STOCKED VALVE ASS'Y. BUILT PER BOM 36646 FOR WHICH NO DRG. EXISTS.
◉	B2384	1	INSTRUCTION PLATE
◉	B2385	1	VALVE INSTRUCTION PLATE FIELD INSTALL. INSTRUCTION
◉	B2386	1	VALVE FIELD INSTALLATION INSTRUCTION
◉	M2828	2	ANAEROBIC SEALANT
◉	S774	1	SEALANT APPLICATION INSTRUCTION
◉	M2504	1	FILTER ASSEMBLY
O	P5150	1	OUTER SPRING
O	P5149	1	INNER SPRING
O	PM1357H	1	HEX. HD. CAPSCREW
O	PM1357J	2	HEX. HD. CAPSCREW
O	PM1399A	3	HEX. NUT

◉ THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT:
O THESE PARTS ARE PICTORIALLY IDENTIFIED IN THE VALVE ASSEMBLY.

XA7205C (MG507 & MG507A) FOR 300-320 P.S.I. APPLICATION CONSISTS OF:

	PART NO	QTY.	PART NAME
	XA7227C	1	AS STOCKED VALVE ASS'Y. BUILT PER BOM 38195 FOR WHICH NO. DRG. EXISTS.
◉	B2384	1	INSTRUCTION PLATE
◉	B2385	1	VALVE INSTRUCTION PLATE FIELD INSTALL. INSTRUCTION
◉	B2386	1	VALVE FIELD INSTALLATION INSTRUCTION
◉	M2828	2	ANAEROBIC SEALANT
◉	S774	1	SEALANT APPLICATION INSTRUCTION
◉	M2504	1	FILTER ASSEMBLY
O	A2705AE	1	OUTER SPRING
O	A2703AW	1	INNER SPRING
O	PM1357H	1	HEX. HD. CAPSCREW
O	PM1357J	2	HEX. HD. CAPSCREW
O	PM1399A	3	HEX. NUT

◉ THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.
O THESE PARTS ARE PICTORIALLY IDENTIFIED IN THE VALVE ASSEMBLY.

SIMILAR TO: XB5599 & XB5135B

* - NOT SERVICEABLE SEPARATELY
▲ - REMOVE BEFORE OPERATING UNIT
■ - NOT INCLUDED WITH UNIT
ALL POINTS AVAILABLE FOR TESTING ARE CODED

VALVE - MG506, MG507 & MG507A TROLLING
DATE 11-16-73 · SCALE FULL · DRAWN R. GEISS · CHECK RM
FIRST USED ON XA 7022 MG506 REL MARINE TRANSMISSION
TWIN DISC INCORPORATED RACINE, WIS. 53403, U.S.A.
XA7205 THRU -C

PINION-CLUTCH HUB (2 REQUIRED)					GEAR-OUTPUT SHAFT (1 REQUIRED)			
ASSEMBLY NUMBER	CONSIST OF BUSHING H-3073-BT AND PINION Nº	Nº TEETH	RATIO	HELIX HAND	PART NUMBER	Nº TEETH	RATIO	HELIX HAND
XB-6251	B-6251	43	1.09:1	R.H	B-6249	47	1.09:1	L.H
XB-5659	B-5659	36	1.50:1	R.H	B-5672	54	1.50:1	L.H
XB-5661	B-5661	30	1.97:1	R.H	B-5651	59	1.97:1	L.H

SAE Nº	SHOSER Nº	DRIVING RING Nº	ADAPTOR Nº	SCREW Nº	RUBBER BLOCK Nº
1	P-4202	215041	P-4205 P-5063-B	12-M-2002-U	20-A-3905-B
2	B-5645-A	P-3331	P-5063-B	—	20-A-3905-B
3	B-5645-A	P-3331	P-5084-C	—	20-A-3905-B

B-3357	AS REQ'D	
B-3357-A		
B-3357-B		
SEE NOTES #1 & 2		

B-1842-V	2	
A-2916-BT	4	
B-2136	1	
XB-5592	1	
B-5592	1	
M-1990-J	1	STEEL BALL

XB-5595	1	
B-2109	1	
M-2002-K	1	
M-2003-C	1	
M-2001-H	2	

XB-2134	1	
B-2136	1	
B-1842-V	1	
B-3355	1	
A-2916-BT	1	
A-7013	1	
B-2130	1	
M-2001-H	1	
B-2127-A	1	
B-2126	1	
XA-2104-BS	1	
A-2760-BS	1	
A-2760-AP	1	
M-2006-BE	1	

SEE NOTE #2

SPOOL SHOWN IN FIVE NEUTRAL LEVER POSITION.

VIEW: G-G

SECTION: F-F

SECTION: E-E

SECTION: D-D

SEE NOTE #4

B-2135	1	
B-2133	1	
B-2130	1	
M-2001-H	3	
A-2916-AT	1	

SECTION: C-C

B-3356	AS REQ'D	
B-3356-A		
B-3356-B		
SEE NOTES #1 & 2		

XB-5649	1	
B-3593-A CLUTCH SHAFT	1	*
B-5649 REV. CL. H'SG GEAR	1	*
M-1990-C STEEL BALL	1	

XB-5648-C	1	
B-5593-A CLUTCH SHAFT	1	*
B-5648-A FW'D. CL. H'SG GEAR	1	*
M-1990-C STEEL BALL	1	

SECTION: B-B

NOTE: BE SURE TO ASSEMBLE SHORT O.D. HERE.

B-3060-B	18	
204097	18	
MA-302	1	
B-3061	2	
SEE CHART		
M-2086-0	4	
M-2087-B	4	

201513	1	
M-422	2	
204098-B	1	
M-422	4	

A-2708-AK	2	
A-2903-AS	2	
M-2617	4	
M-1904-CC	2	
M-2086-C	2	
206751	2	
M-2014-CW	2	
A-2669-DC	2	
B-6246-A	1	
M-2035-X	1	
M-2006-S	1	
B-1504-DR	1	
MA-355	1	
M-2622-A	1	
B-5646-A	1	
M-2618	1	
B-2499	1	
M-2002-U	6	
206792	AS REQ'D	
206792-A		
206792-B		
SEE CHART		

SEE NOTES #1 & 2

M-1904-BC	4	
M-2086-V	2	
THREAD PROTECTOR	1	▲
M-2035-AG	1	
XB-5595-A	1	
M-2002-U	3	
M-2620	1	
M-2006-K	1	
B-1504-AE	1	
M-2074-C	1	
B-5154-A	1	
206759	1	
M-2521-A	1	
M-2004-F	3	
206760	1	
206761	AS REQ'D	
206761-A		
206761-B		
M-2619-A	1	
SEE CHART		
M-2002-U	10	
SEE CHART		

SECTION: A-A

M-2067-C	1	▲
M-2002-U	2	
M-2051-CS	1	
M-2002-AV	1	

MA-656-A	1	
A-4989-BN	1	
A-2149-AA	1	
B-2412	1	
B-2411	1	

XA-7492-A	1	
XA-7492	1	H'SG FRONT ASS'Y
A-7492	1	H'SG FRONT *
A-2711-S	2	PIN-DOVEL
P-3057	1	GASKET
B-3355	1	TUBE-SUCTION
M-2080-M	1	PLUG
A-2916-BT	1	RING "O"
B-2132	1	TUBE. REAR COVER
M-1990-J	1	BALL
P-3056	1	COVER, REAR *
M-2004-F	8	SCREW, HEX. HD
■ M-2004-AB	2	SCREW, HEX. HD

XA-5225-AA CONSISTS OF:		
M-2027-AM	2	A-5225-AA 1
M-2047-AE	2	A-2030-A 1
M-2006-U	6	M-2006-AM 2
M-2026-Q	6	
OPTIONAL EXTRA-SUPPLIED ONLY WHEN SO SPECIFIED		

ASSEMBLY INSTRUCTIONS

1) SHIM SEALING: USE ANAEROBIC SEALANT MEETING M-2328 REQUIREMENTS ONLY IN THE CAVITY FORMED BY THE I.D. OF THE SHIMS, THE RETAINER AND ITS PILOT AND THE MATING PART.

2) ASSEMBLE AND TEST PER S-570-N.

3) THESE STANDARDS APPLY:
S-570 - FASTENER TORQUE REQUIREMENTS.
S-692 - THRUST BEARING SHIMING.
S-774 - ANAEROBIC SEALANT APPLICATION.

4) GREASE APPLICATION PROCEDURE (CONTROL VALVE): BEFORE INSTALLING VALVE STEM INTO VALVE BODY, LIGHTLY APPLY GENERAL PURPOSE GREASE PER S-384, ITEM 8, PAR. 1 & 6, TO THE VALVE STEM FROM THE "O" RING GROOVE TO NECKED DOWN DIAMETER AT LEVER END.

NOTE: THIS UNIT CANNOT BE USED WITH LEFT HAND ENGINE.

■ THESE PARTS ARE COMPONENTS OF XA7492A HOUSING ASSEMBLY, BUT MAY BE PURCHASED SEPARATELY.

* NOT SERVICEABLE AS A SEPARATE ITEM

▲ REMOVE BEFORE OPERATING UNIT

SIMILAR TO: XA-7022-A

SYM.	ZONE	CHANGE	CH. NO.	DATE	BY

MARINE TRANSMISSION

MODEL: MG-506-A

MAX. SPEED 3000 RPM
CONSULT SALE DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

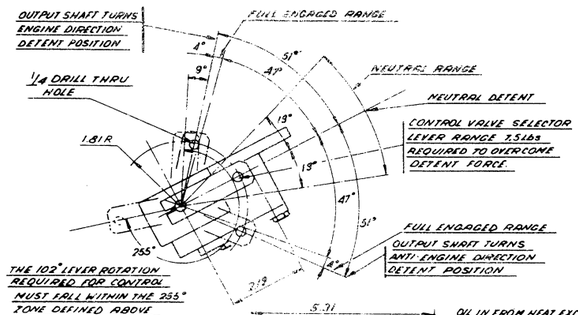
SHEET 1 OF 2	CROSS SECTION WITH PART NUMBERS
SHEET 2 OF 2	INSTALLATION DRAWING
A-6989-BN	HYDRAULIC SYSTEM
AL-9056	MASS ELASTIC SYSTEM

NAME: MG-506-A. MARINE TRANSMISSION
MATERIAL: —
RATIOS: 1.09:1 - 1.50:1 - 1.97:1
DRAWN: RJ
CHECKED:
APPROVED: RCA 11-9-66
ROUGH WT. —
FINISH WT. —
FIRST USED ON ASSEMBLY NO. —
MODEL NO —
UNLESS OTHERWISE SPECIFIED ALLOWABLE VARIATION ON MACHINED DIMENSIONS ±
DATE 28 MAY 64
SCALE 1/2 - 1"

TWIN DISC INCORPORATED RACINE, WISCONSIN U.S.A.

XA-7472
SHEET: 1 OF 2

SAE N°	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	21.75	20.875	20.125 20.120	18.375 18.371	17.250	–	.50	1.00	2.96	10.79	–	11.46	11.91	14.55 14.23	19.57	15.00 14.68	10.46	10.16	10.97	–	3.22	.25	.56
2	19.25	18.375	13.625 13.620	13.875 13.871	13.125	12.226 12.223	.75	1.56	2.38	10.23	.39 .38	10.90	11.35	13.99 13.67	19.01	14.44 14.12	9.90	9.60	10.41	2.43	3.40	.25	.38
3	17.75	16.875	16.125 16.120	13.875 13.871	13.125	12.226 12.223	.75	1.56	2.38	10.23	.39 .38	10.90	11.35	13.99 13.67	19.01	14.44 14.12	9.90	9.60	10.41	2.43	3.40	.25	.38



HEAT EXCHANGER (H.E.) REQUIREMENTS

PERMISSIBLE OIL TEMPERATURE INTO H.E.	200°F MAX	180°F MIN
MIN. HEAT TRANSFER CAPACITY (MULTIPLY BY 1.25 FOR FRESH AND 2.0 FOR RAW WATER H.E.)	1.5 BTU PER MIN PER ENGINE RTD. H.P. CONTINUOUS DUTY	PCS. INT. DUTY 1.875
APPROX. OIL FLOW TO H.E.	.132 G.P.M. PER 100 ENGINE R.P.M.	
PEAK OIL PRESSURE AT H.E. PROOF TEST (H.E. AT 1.5 × PSI.)	448 PSI	
MAX. ALLOWABLE OIL PRESSURE DROP ACROSS H.E. WITH 300 SUS OIL AT RATED ENGINE R.P.M.	30 PSI	
WATER FLOW TO H.E. - USE 1.5 TO 3.0 TIMES OIL G.P.M.		
H.E. WATER PRESSURE RATING, MIN. = 1.5 × H.E. INLET WATER P.S.I.		

DATA H.E. PURCHASER MUST ALSO TELL VENDOR

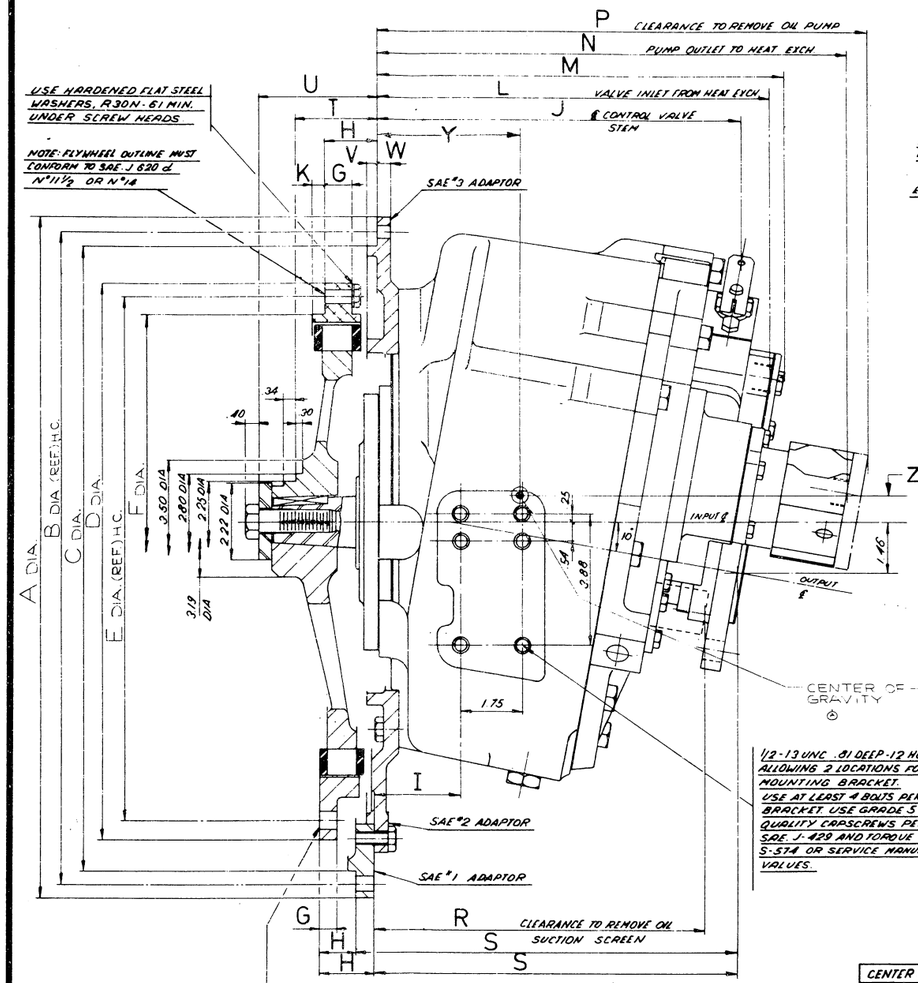
STATE IF RAW (OPEN CHANNEL & SEA) OR FRESH (CLOSED ENGINE JACKET & KEEL COOLER) WATER WILL COOL H.E.

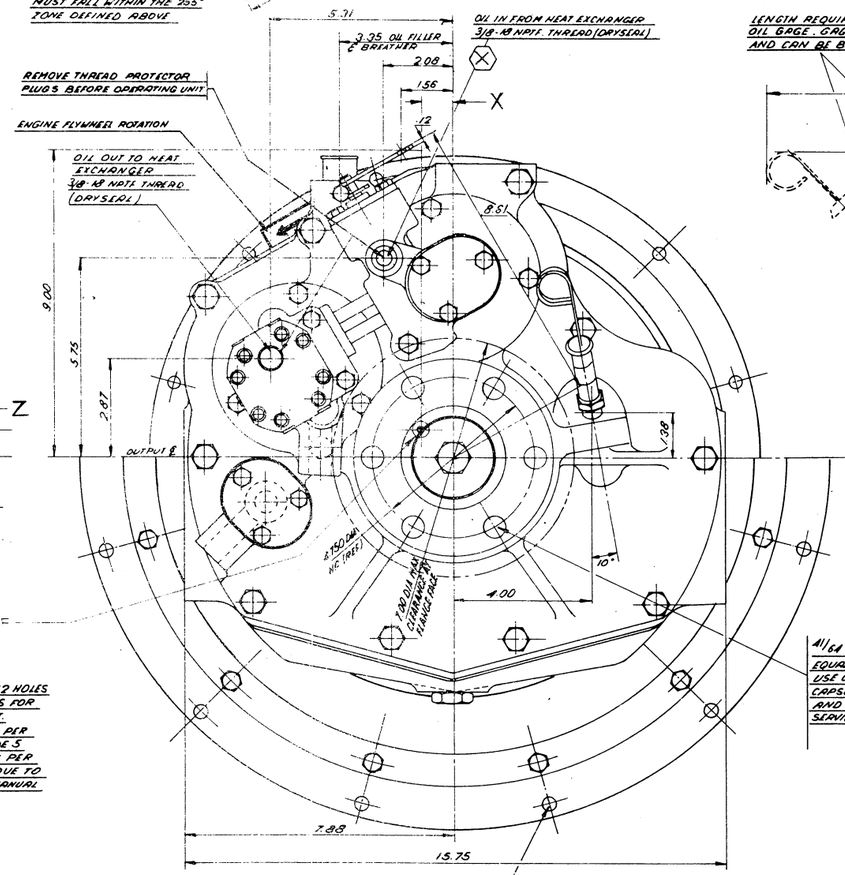
STATE MAX. WATER TEMP INTO H.E. -- TYPICAL -- RAW WATER 85°F, KEEL COOLER WATER 140°F ENGINE JACKET WATER 180°F

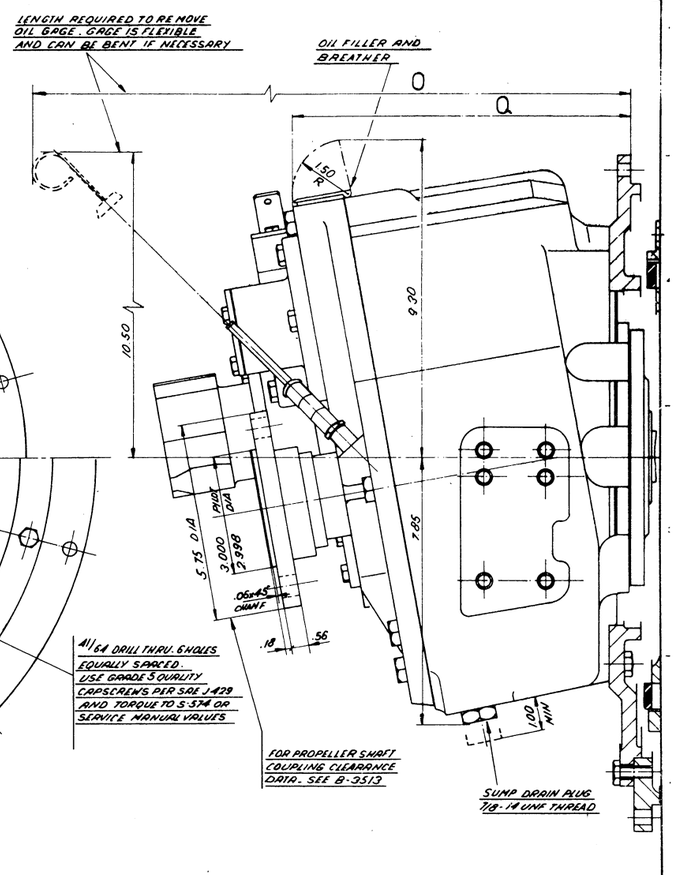
STATE MIN. ALSO MAX. G.P.M. OF WATER FLOW TO H.E.

H.E. INSTALLATION & SERVICE REQUIREMENTS

OIL LINES, TRANSMISSION TO H.E. AND RETURN.
1) MAX. VELOCITY IN FITTINGS, PIPE, HOSE AND TUBES 25 FT/SEC.
2) BURST PRESSURE, MIN. = 10 × PEAK OIL PRESSURE AT H.E.
3) HOSE SAE J517 100R1 MEETING USCG 46 CFR 56.60 25 (C), 275°F TEMPERATING
4) PROTECT LINES FROM MECHANICAL DAMAGE, ZINC ANODES PROTECT H.E. RAW WATER PASSAGES FROM CORROSION CHECK & REPLACE THEM FREQUENTLY







CENTER OF GRAVITY		
X	Y	Z
.91	4.14	.81

1/2-13 UNC .81 DEEP-12 HOLES ALLOWING 2 LOCATIONS FOR MOUNTING BRACKET. USE AT LEAST 4 BOLTS PER BRACKET. USE GRADE 5 QUALITY CAPSCREWS PER SAE J-429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES.

11/64 DRILL THRU. 6 HOLES EQUALLY SPACED. USE GRADE 5 QUALITY CAPSCREWS PER SAE J-429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES.

NOTE: ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡

DRIVING RING
SAE #1 - 17/32 DIA DRILL THRU - 8 HOLES EQUALLY SPACED AS SHOWN
SAE #2-#3 - 13/32 DIA DRILL THRU, 8 HOLES EQUALLY SPACED AS SHOWN
USE GRADE 5 (OR BETTER) QUALITY CAPSCREWS PER SAE J-429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES.

ADAPTORS
SAE #1 - 15/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
SAE #2 - 13/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
SAE #3 - 13/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
USE GRADE 5 (OR BETTER) QUALITY CAPSCREWS PER SAE J-429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES.

OIL CAPACITY
GALLONS PLUS VOLUME IN HOSES AND HEAT EXCHANGERS.

SIMILAR TO XA-7022-A

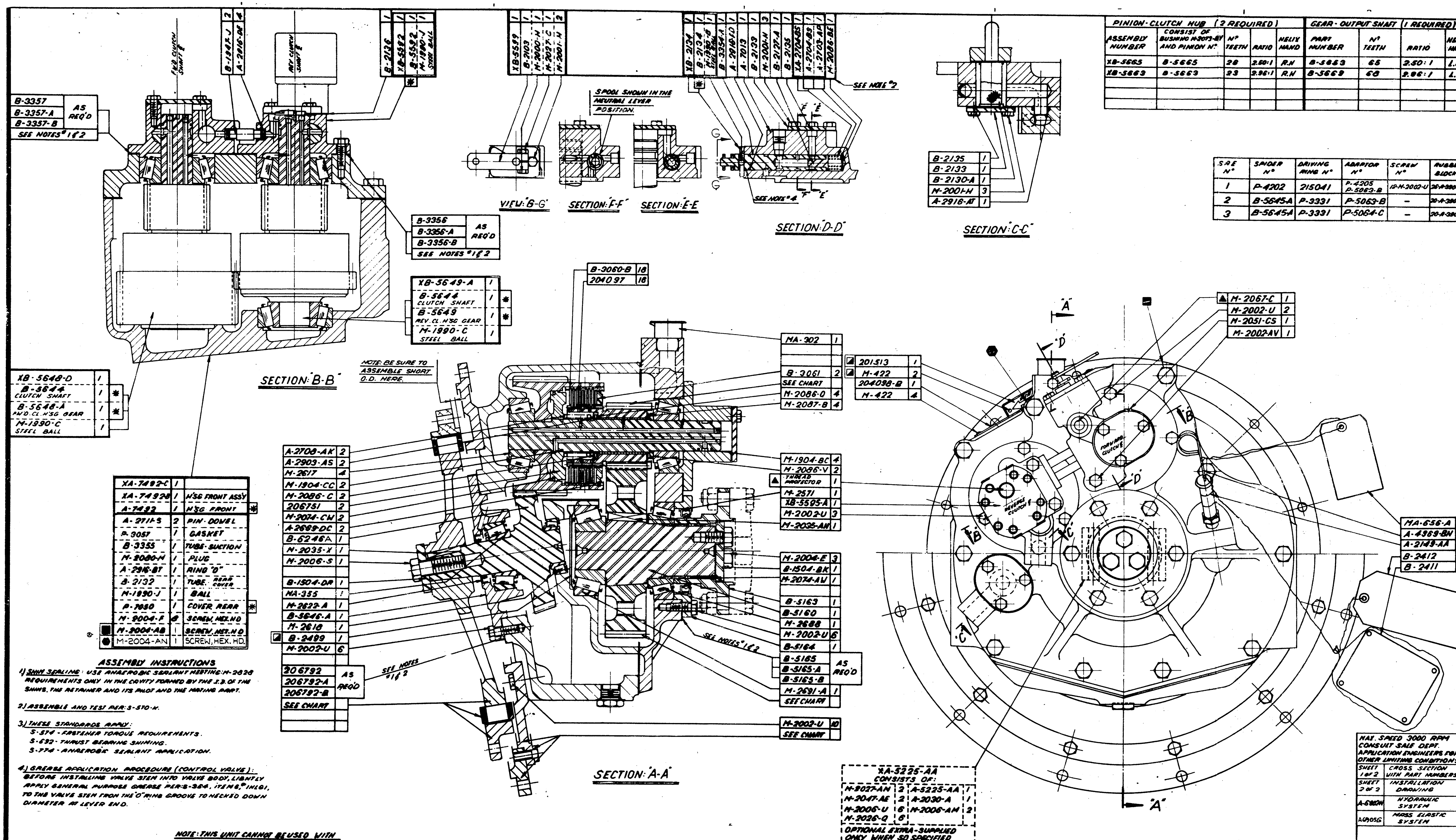
SYM	ZONE	CHANGE	CH NO	DATE	BY
A	C-3	ADDED CENTER E-3 OF GRAVITY	22562	3-28-85	KS

MARINE TRANSMISSION
MODEL: MG-506-A

NAME: MG-506-A, MARINE TRANSMISSION
MATERIAL: —
RATIOS: 1.09:1 - 1.50:1 - 1.97:1
ROUGH WT: —
FINISH WT DRY WT: 260#
FIRST USED ON ASSEMBLY NO: MODEL NO:
UNLESS OTHERWISE SPECIFIED ALLOWABLE VARIATION ON MACHINED DIMENSIONS ±
DATE: 4 JUN 84
SCALE: 1/2:1
DRAWN: RR
CHECKED:
APPROVED: C.A. J-P.P.

TWIN DISC INCORPORATED RACINE, WISCONSIN

XA-7472
SHEET: 2 OF 2


SECTION "B-B"
VIEW "G-G"
SECTION "F-F"
SECTION "E-E"
SECTION "D-D"
SECTION "C-C"
SECTION "A-A"
SPOOL SHOWN IN THE NEUTRAL LEVER POSITION.
SEE NOTE 4
SEE NOTE 2
NOTE: BE SURE TO ASSEMBLE SHORT O.D. HERE.
SEE NOTES 1 & 2
FORWARD CLUTCH
REVERSE CLUTCH
B-3357
B-3357-A
B-3357-B
AS REQ'D
SEE NOTES 1 & 2
B-3356
B-3356-A
B-3356-B
AS REQ'D
SEE NOTES 1 & 2
XB-5649-A 1
B-5644 CLUTCH SHAFT
B-5649 REV. CL. H'SG GEAR
M-1990-C STEEL BALL
XB-5648-D 1
B-5644 CLUTCH SHAFT
B-5648-A FWD. CL. H'SG GEAR
M-1990-C STEEL BALL
B-3060-B 18
204097 18
MA-302 1
B-3061 2
SEE CHART
M-2086-0 4
M-2087-B 4
201513 1
M-422 2
204098-B 1
M-422 4
M-1904-BC 4
M-2086-V 2
THREAD PROTECTOR 1
M-2571 1
XB-5595-A 1
M-2002-U 3
M-2035-AH 1
M-2004-E 3
B-1504-BK 1
M-2074-AV 1
B-5163 1
B-5160 1
M-2688 1
M-2002-U 6
B-5164 1
B-5165 1
B-5165-A 1
B-5165-B 1
AS REQ'D
M-2691-A 1
SEE CHART
M-2002-U 10
SEE CHART
A-2708-AK 2
A-2903-AS 2
M-2617 4
M-1904-CC 2
M-2086-C 2
206751 2
M-2074-CW 2
A-2669-DC 2
B-6246-A 1
M-2035-X 1
M-2006-S 1
B-1504-DR 1
MA-355 1
M-2622-A 1
B-5646-A 1
M-2618 1
B-2499 1
M-2002-U 6
206792
206792-A
206792-B
AS REQ'D
SEE CHART
M-2067-C 1
M-2002-U 2
M-2051-CS 1
M-2002-AV 1
MA-656-A 1
A-4369-BN 1
A-2149-AA 1
B-2412 1
B-2411 1
B-2135 1
B-2133 1
B-2130-A 1
M-2001-H 3
A-2918-AT 1
XA-7492-C 1
XA-7492-B 1 H'SG FRONT ASS'Y
A-7482 1 H'SG FRONT
A-2711-S 2 PIN-DOWEL
P-3057 1 GASKET
B-3355 1 TUBE-SUCTION
M-2080-H 1 PLUG
A-2916-BT 1 RING "O"
B-2132 1 TUBE-REAR COVER
M-1990-J 1 BALL
P-7050 1 COVER, REAR
M-2004-F 6 SCREW, HEX. HD
M-2004-AB 1 SCREW, HEX. HD
M-2004-AN 1 SCREW, HEX. HD.
XA-5225-AA CONSISTS OF:
M-2027-AN 2
M-2047-AE 2
M-2006-U 6
M-2026-Q 6
A-5225-AA 1
A-2030-A 1
M-2006-AM 2
OPTIONAL EXTRA-SUPPLIED ONLY WHEN SO SPECIFIED

PINION-CLUTCH HUB (2 REQUIRED)					GEAR-OUTPUT SHAFT (1 REQUIRED)			
ASSEMBLY NUMBER	CONSIST OF BUSHING M-2073-BY AND PINION Nº	Nº TEETH	RATIO	HELIX HAND	PART NUMBER	Nº TEETH	RATIO	HELIX HAND
XB-5665	B-5665	28	2.50:1	R.H	B-5653	65	2.50:1	L.H
XB-5663	B-5663	23	2.96:1	R.H	B-5669	68	2.96:1	L.H

SAE Nº	SPIDER Nº	DRIVING RING Nº	ADAPTOR Nº	SCREW Nº	RUBBER BLOCK Nº
1	P-4202	215041	P-4205 P-5063-B	12-M-2002-U	20-A-3905-B
2	B-5645-A	P-3331	P-5063-B	–	20-A-3905-B
3	B-5645-A	P-3331	P-5064-C	–	20-A-3905-B

ASSEMBLY INSTRUCTIONS

1) SHIM SEALING: USE ANAEROBIC SEALANT MEETING M-2828 REQUIREMENTS ONLY IN THE CAVITY FORMED BY THE I.D. OF THE SHIMS, THE RETAINER AND ITS PILOT AND THE MATING PART.

2) ASSEMBLE AND TEST PER: S-570-K.

3) THESE STANDARDS APPLY:
- S-574 - FASTENER TORQUE REQUIREMENTS.
- S-692 - THRUST BEARING SHIMING.
- S-774 - ANAEROBIC SEALANT APPLICATION.

4.) GREASE APPLICATION PROCEDURE (CONTROL VALVE): BEFORE INSTALLING VALVE STEM INTO VALVE BODY, LIGHTLY APPLY GENERAL PURPOSE GREASE PER: S-364, ITEM 6, INLGI, TO THE VALVE STEM FROM THE "O" RING GROOVE TO NECKED DOWN DIAMETER AT LEVER END.

NOTE: THIS UNIT CANNOT BE USED WITH LEFT HAND ENGINE

* NOT SERVICEABLE AS A SEPARATE ITEM

▲ REMOVE BEFORE OPERATING UNIT

◩ THESE PARTS ARE COMPONENTS OF XA7492C HSG. ASSY., BUT MAY BE PURCHASED SEPARATELY.

SIMILAR TO: XA-7046-A

MARINE TRANSMISSION

MODEL: MG-506-A

MAX. SPEED 3000 RPM CONSULT SALE DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

SHEET 1 of 2	CROSS SECTION WITH PART NUMBERS
SHEET 2 of 2	INSTALLATION DRAWING
A-6802N	HYDRAULIC SYSTEM
A-6905G	MASS ELASTIC SYSTEM

SYM.	ZONE	CHANGE	CH. NO.	DATE	BY
A	F-3	ADDED 1 OF M-2004-AN	22537	2-25-85	RZ

NAME	MG-506-A. MARINE TRANSMISSION
MATERIAL	—
RATIOS	2.50:1 - 2.96:1
ROUGH WT	—
FINISH WT	—
FIRST USED ON ASSEMBLY NO	—
MODEL NO	—
DATE	28 JUN 84
SCALE	1/2 = 1"
DRAWN	RZ
APPROVED	BCA J-P.P.

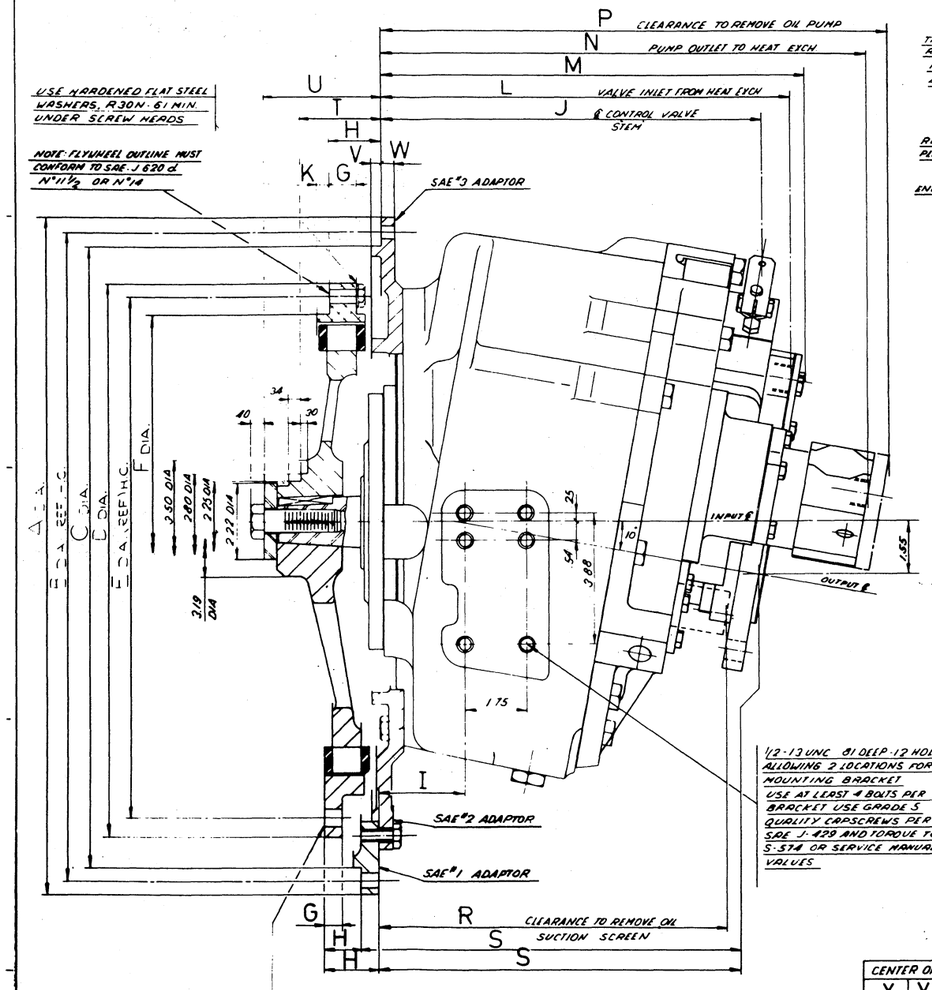
UNLESS OTHERWISE SPECIFIED ALLOWABLE VARIATION ON MACHINED DIMENSIONS ±

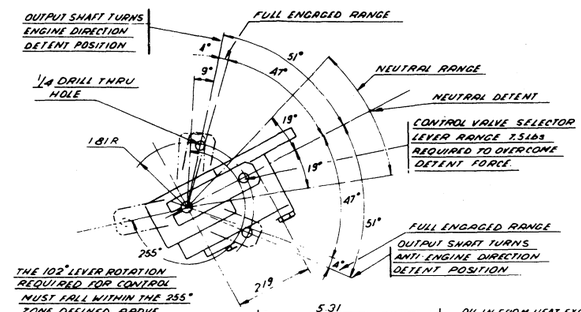
TWIN DISC INCORPORATED

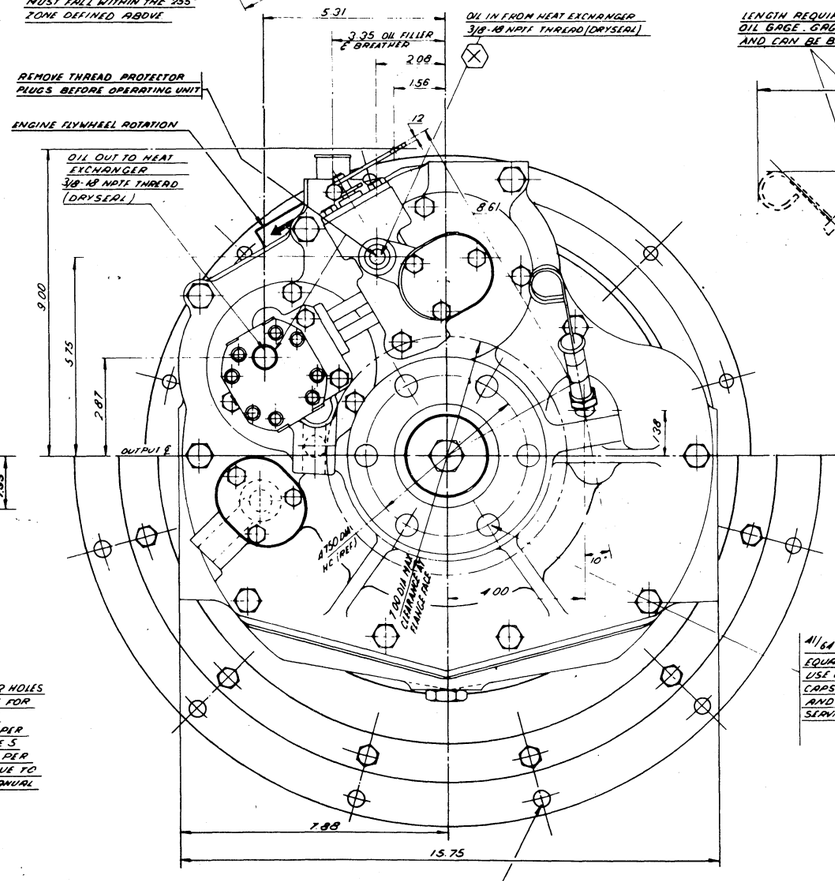
XA-7493

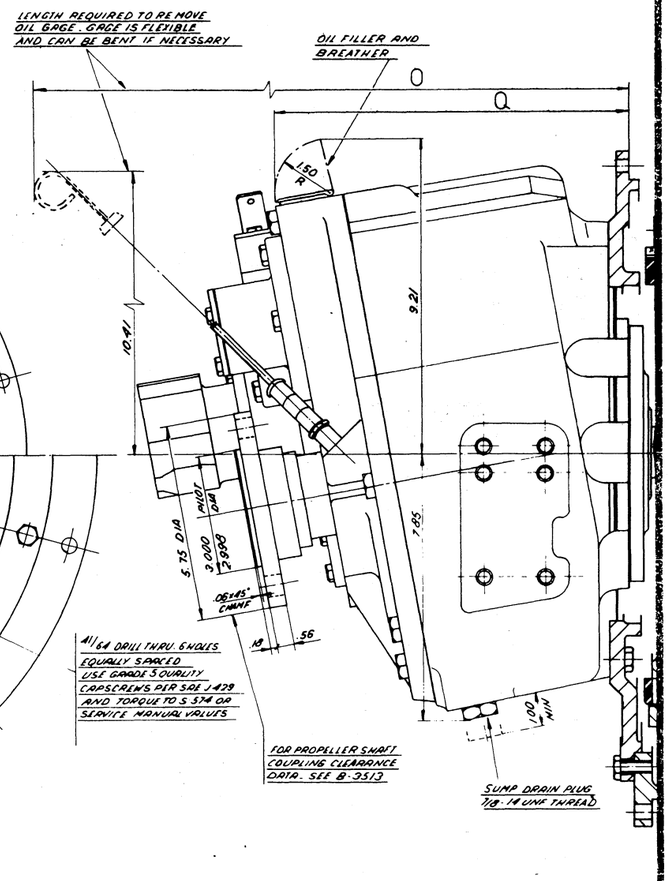
SHEET: 1 OF 2

SAE N°	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	21.75	20°-15'	20.126 20.120	MF.335 MF.371	7.50	–	.50	1.00	2.96	11.32	–	11.99	12.44	15.08 14.76	20.10	15.53 15.21	10.99	11.25	11.37	–	3.22	.25	.56
2	19.25	16° – 0'	17.825 17.820	13.875 13.871	3.25	12.226 12.223	.75	1.56	2.38	10.76	.39 .38	11.43	11.88	14.52 14.20	19.54	14.97 14.65	10.43	10.69	10.81	2.43	3.40	.25	.38
3	17.75	16°-8'-15"	16.125 16.120	13.875 13.871	3.25	12.226 12.223	.75	1.56	2.38	10.76	.39 .38	11.43	11.88	14.52 14.20	19.54	14.97 14.65	10.43	10.69	10.81	2.43	3.40	.25	.38









HEAT EXCHANGER (H.E.) REQUIREMENTS		
PERMISSIBLE OIL TEMPERATURE INTO H.E.	210°F MAX	160°F MIN
MIN. HEAT TRANSFER CAPACITY (MULTIPLY BY 1.25 FOR FRESH AND 2.0 FOR RAW WATER H.E.)	BTU PER MIN PER ENGINE R.T.D. H.P. CONTINUOUS DUTY	PC & INT. DUTY
	1.484	1.372
APPROX. OIL FLOW TO H.E.	132 G.P.M. PER 100 ENGINE R.P.M.	
PEAK OIL PRESSURE AT H.E. (PROF TEST H.E. AT 1.5 × PSI)	445 PSI	
MAX. ALLOWABLE OIL PRESSURE DROP ACROSS H.E. WITH 300 SUS OIL AT RATED ENGINE R.P.M.	30 PSI	
WATER FLOW TO H.E. - USE 1.5 TO 3.0 TIMES OIL G.P.M.		
H.E. WATER PRESSURE RATING, MIN. = 1.5 × H.E. INLET WATER P.S.I.		
DATA H.E. PURCHASER MUST ALSO TELL VENDOR		
STATE IF RAW (OPEN CHANNEL & SEA) OR FRESH (CLOSED ENGINE JACKET & KEEL COOLER) WATER WILL COOL H.E.		
STATE MAX. WATER TEMP. INTO H.E. -- TYPICAL -- RAW WATER -85°F, KEEL COOLER WATER -140°F, ENGINE JACKET WATER -180°F		
STATE MIN. ALSO MAX. G.P.M. OF WATER FLOW TO H.E.		
H.E. INSTALLATION & SERVICE REQUIREMENTS		
OIL LINES, TRANSMISSION TO H.E. AND RETURN ----- (1) MAX. VELOCITY IN FITTINGS, PIPE, HOSE AND TUBES 25 FT/SEC (2) BURST PRESSURE, MIN. = 10 × PEAK OIL PRESSURE AT H.E. (3) HOSE SAE J517 100R1 MEETING USCG 46 CFR 56.60-25(c), 275°F TEMPERATURE (4) PROTECT LINES FROM MECHANICAL DAMAGE. ZINC ANODES PROTECT H.E. RAW WATER PASSAGES FROM CORROSION CHECK & REPLACE THEM FREQUENTLY.		

CENTER OF GRAVITY		
X	Y	Z

DRIVING RING
SAE #1 - 17/32 DIA DRILL THRU - 8 HOLES EQUALLY SPACED AS SHOWN
SAE #2 - #3 - 13/32 DIA DRILL THRU - 8 HOLES EQUALLY SPACED AS SHOWN
USE GRADE 5 (OR BETTER) QUALITY CAPSCREWS PER SAE J 429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES

ADAPTORS
SAE #1 - 15/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
SAE #2 - 13/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
SAE #3 - 13/32 DIA DRILL THRU - 12 HOLES EQUALLY SPACED AS SHOWN
USE GRADE 5 (OR BETTER) QUALITY CAPSCREWS PER SAE J-429 AND TORQUE TO S-574 OR SERVICE MANUAL VALUES

NOTE ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡

OIL CAPACITY
GALLONS PLUS VOLUME IN HOSES AND HEAT EXCHANGERS

XB-7048-A

NO	DESCRIPTION	DATE	BY	SYM	ZONE	CHANGE	CH NO	DATE	BY

MARINE TRANSMISSION

MODEL: MG-506-A

NAME	MG-506-A, MARINE TRANSMISSION			DRAWN	4 NOV 64
MATERIAL		RATIOS 2.80:1 - 2.96:1		CHECKED	1/2 1
ROUGH WT	FINISH WT	FIRST USED ON ASSEMBLY NO	MODEL NO	APPROVED	dcg J-PP

UNLESS OTHERWISE SPECIFIED ALLOWABLE VARIATION ON MACHINED DIMENSIONS

TWIN DISC INCORPORATED

XA-7493

SHEET 2 OF 2

1015978

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