SERVICE MANUAL HP-9400 AND HP-10500 MARINE TRANSMISSIONS

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

CAUTION

DO NOT OPERATE IN REVERSE MODE TO MOVE VESSEL FORWARD

DO NOT OPERATE CONTINUOUSLY IN REVERSE MODE FOR MORE THAN 30 MINUTES AT 75% OF AVAILABLE HORSEPOWER.

DO NOT OPERATE UNIT OVER 180°F (82°C).

DO NOT OPERATE UNIT WITH HIGH OR LOW OIL PRESSURE **DO NOT** 'WINDMILL' UNIT IN EVENT OF ENGINE FAILURE (PROP SHAFT SHOULD BE LOCKED TO PREVENT 'WINDMILLING').

DO NOT ATTEMPT FINAL ALIGNMENT OF OUTPUT FLANGE AND PROP SHAFT COUPLING WHEN VESSEL IS IN DRY DOCK. **DO NOT** SHIFT TRANSMISSION UNLESS ENGINE IS AT IDLE SPEED.

DO NOT USE TRANSMISSION TO SUPPORT REAR OF ENGINE.

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Figure 1. Cross Section Showing Components and Design Features (HP-9400 shown)

SECTION 1. INTRODUCTION

The purpose of this manual is to provide assistance to operation and maintenance personnel to reduce downtime and obtain consistent performance from the Capitol HP-9400 or HP-10500 Reverse and Reduction Transmission.

This service manual contains thorough installation and operation procedures, steps for proper maintenance and repair, a trouble shooting guide for assessing difficulties promptly, an illustrated parts information section, and engineering drawings for fabricating special tools. It should be made readily available to all those responsible for the operation or servicing of the reverse gear.

Performance characteristics and other details may be obtained from the engineering department of Capitol Gears, Inc., St. Paul, Minnesota, U.S.A.

1.1 DESCRIPTION

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

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

1.2 OPTIONAL EQUIPMENT

OIL COOLER

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

HOSE AND FIT TING PACKAGE

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

PROP COUPLING KIT

A prop shaft coupling kit is available to meet most requirements.

POWER TAKE-OFF

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

INDEPENDENT MOUNT

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

TORSIONAL COUPLING

A rubber element input coupling is available (HPI Series)

SECTION 2. PRINCIPLES OF OPERATION

2.1 OUTPUT OPERATION

The Capitol marine gear in forward mode provides output rotation in the opposite direction as engine rotation. The marine gear unit is normally supplied for a right hand engine (when viewed from the front). This produces a right hand rotation output of the prop shaft in forward (when viewed from the rear of the transmission). For twin screw installations, where two right hand engines are used, the port unit is furnished with an idler gear. The idler gear produces, in forward, an output rotation the same as engine rotation.* Thus the two propellers can be turning opposite each other in outboard direction (see diagram below). *Note: Engine rotation transmissions are installed on right hand engines only.



2.2 REDUCTION RATIO

The reduction ratio is the number of teeth in the reduction gear compared to the number of teeth in the pinion, for example, 144 teeth compared to 36, or 4 to 1. Output speed then is a product of engine r.p.m. X $\frac{1}{4}$ = 500 r.p.m. output speed. The HP-9400 features four reduction ratios available in anti-engine or engine rotation output. They are nominally 1:1, 1.5:1, 2:1 and 3:1. The HP 10500 is available in three ratios: nominally 4:1, 5:1 and 6:1 also in anti-engine rotation output.

2.3 POWER FLOW

The flywheel adapter, being directly fastened to the engine flywheel continually rotates the drive flange assembly, clutch driving drum and forward clutch discs at engine speed.

NEUTRAL

In neutral no direct torque is applied to clutch and pinion. Consequently reduction gear and output flange do not rotate.

FORWARD (see Figure 2.)

When forward is selected the entire clutch becomes locked with the driving drum and rotates at engine speed. The clutch drives the pinion in reduction gear and output flange in anti-engine direction at a speed determined by the reduction ratio.



7

REVERSE

When reverse is chosen the clutch is held stationary to the housing. Engine power is transferred through the clutch bevel gears and the pinion is driven in anti-engine rotation at engine speed. This causes reduction gear and output flange to rotate in engine direction (reverse).

2.4 CLUTCH

The clutch assembly is a multiple disc type clutch activated by a hydraulic mechanism. This mechanism is formed by a carriers bolted together which act as the clutch pistons. The movement of the cylinders is regulated by the selector valve, which directs pressurized oil to the proper cylinder depending on the mode selected. The bevel gears inside the carrier transmit power flow to the pinion.





FORWARD MODE

At all times, stub shaft 1, clutch driving drum 2 and driving gear 8 are turning in engine rotation direction at engine speed. Forward is achieved when selector valve is shifted to allow oil to pressurize forward half of cylinder 3. Cylinder then slides on bevel gear carrier 4 clamping clutch discs 5 together. Half of discs are splined to forward driving drum and half are splined to end flange 8. Because end flange is bolted to gear carrier with bevel gears 7 now rotates at engine speed along with driving gear. Rotating bevel gears cause driven gear 9 to turn with them and this causes rotation of output shaft in forward rotation.



NEUTRAL MODE

Both halves of clutch cylinder 1 are filled with pressurized oil. Cylinder cannot press against either forward 2 or reverse clutch discs 3. Discs splined to driving drum 4 and reverse drum 5 remain separate from discs splined to end flanges 6 & 7. Consequently no direct torque is applied to gear carrier 8 or driven gear and output shaft 9 & 10. Bevel gears may revolve on their own shafts and gear carrier orbits at half engine speed.

REVERSE MODE

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

2.5 HYDRAULIC SYSTEM

Pressurized oil is provided by a gear type oil pump that is externally mounted and engine driven by means of a splined shaft. The pump includes a pressure relief valve to maintain the correct operating pressure relief valve to maintain the correct operating pressure. Oil is drawn from the sump through a suction hose and then sent under pressure to a filter and oil cooler and then to the sector valve. The selector valve is used to obtain forward, neutral or reverse by routing the high pressure oil through internal passages to the clutch. Low pressure oil is channeled to cool bearings, gears and clutch discs. An oil dam keeps the transmission oil within the transmission housing. In neutral the ports to both the forward and reverse sides of the clutch cylinder are opened and the balanced pressure that results keeps the clutch cylinder centered between the forward and reverse clutch discs. Oil is distributed through the lubrication system.

When the selector valve is shifted to either forward or reverse mode high pressure oil is allowed to flow only to one half of the clutch cylinder to engage the selected pack. Oil in the other half of the cylinder is exhausted to sump. In forward or reverse, oil is also distributed through the lubrication system.



High Pressure Oil 🔳

NEUTRAL

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



Lubrication Oil 🗏

FORWARD

Exhaust Oil 🔳

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



REVERSE The reverse half of the cluster cylinder is opened to high pressure of while oil in the howard half is exhecuted to sump.



LUBRICATION Positive creasure off is provided to all goard, bearings, cluster class and moving parts.

SECTION 3. INSTALLATION AND OPERATION

LUBRICATION

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

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

3.1 UNCRATING AND HANDLING

Tapped holes have been provided for insertion of eye bolts to aid in handling the unit. Average weight of HP-9400 is 1900 lbs.; HP-10500 is 3100 lbs. These weights vary with adaptation and clutch.

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

3.2 INSTALLATION PREPARATION

SPECIAL TOOLS REQUIRED

- 1.Chain Hoist or equivalent
- 2. Straight Edge
- 3. Feeler Gauge
- 4. Thousandths Dial Indicator

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

1. (Fig. 3A) Dial indicate the bolt face of the engine flywheel housing flange. Rotate engine flywheel. Record reading. Face deviation must not exceed a total indicator reading of .007 inch.

2. (Fig. 3B) Mount indicator with stem riding on flywheel housing bore as shown. Rotate flywheel and record reading. The bore eccentricity must not exceed a total indicator reading of .007 inch.

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

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

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

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

5.Remove the clutch assembly from the clutch driving drum and drive flange assembly (drive flange and flywheel adapter).

6.Remove clutch driving drum from flywheel adapter to engine flywheel mating surfaces and secure flywheel adapter (and drive flange attached to flywheel adapter).

7.Thoroughly clean flywheel adapter to engine flywheel mating surfaces and secure flywheel with cap screws and lock washers.

8.Locate oil dam adapter on engine flywheel housing with drain slots down. Secure oil dam tentatively with cap screws and lock washers.



Figure 3. Dial Indicating Flywhool Housing and Engine Flywheel



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

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



Figure 5. Dial Indicating Oil Dam Adapter Bolt Face

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



Figure 6. Dial Indicating Stub Shaft

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

The sum total of readings in step 4, 5 and 6 must not exceed .007 in.

12. Install clutch driving drum on flywheel adapter with hex head cap screws sealing with no.2 Permatex. Check clearance between clutch driving drum O.D. and oil dam adapter I.D. with feeler gauge. Minimum clearance must be at least .006 in. Tighten cap screws to 65 lbs.-ft. torque.

13.Reassemble slinger shield to oil dam adapter and tighten cap screws. Secure with locking wire.

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



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

9. Replace oil pump drive shaft, gasket and oil pump. Secure pump with capscrews and lockwashers and torque to 42 lbs. Ft.

3.3 INSTALLATION OF TRANSMISSION

1. Apply a small amount of grease to oil dam adapter and locate gasket.

2. Remove side inspection covers to facilitate installation.

3. Remove oil pump and oil pump shaft.

4. Using an adequate hoist and hoist guide (special tool no. 1-90021-0000) lift transmission into position behind engine. Ease unit forward over clutch assembly gently twisting transmission housing so that discs enter reverse drum properly without damaging teeth. A screwdriver may be used through the side inspection hole to align disc teeth with the reverse drum.

5. Secure transmission housing to oil dam adapter with cap screws and lock washers. Tighten to 28 foot pounds torque.

6. Check clutch end Float: Insert screwdriver through side inspection hole and pry clutch fore and aft. See fig. 20, page 22. End float should be 1/16" to 3/32".

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

8. Replace gaskets and inspection covers.



Figure 8. Locating Transmission Housing on Oll Dam Adapter



Figure 9. Alignment of Output Flange and Propeller Shaft Coupling

3.4 ALIGNMENT OF OUTPUT COUPLING

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

Mounting feet on housing permit unit to be bolted to bed rails, power plant frame, keelsons, etc.

The distance of the first shaft bearing from the mating surface of the reverse gear output coupling is extremely important. To avoid undue force on the reverse gear bearings, the propeller shaft bearing should be located at least twelve and preferably twenty shaft diameters from the reverse gear output coupling.

Note: The same alignment procedures should be followed even if a flexible coupling is used. The most accurate method is to use a non-flexible spacer of the same size first. Flexible couplings are used only to dampenNow align shaft coupling to reverse gear coupling. Lay a straight edge across the edges at top and sides to line up couplings. **Do not burr or mar mating surfaces.** Insert feeler gauge between couplings and run it all around the flange. Clearance should not be more than .006" at any point. Shim engine and reverse gear as necessary. Mounting feet have threaded holes for jacking screws.

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

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

Be sure transmission is connected to oil cooler.

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

3.5 WATER PIPING

To assure proper cooling of Capital's reverse gear units, connect the cooling system as indicated on one of the three diagrams shown. It is extremely important that the marine gear oil be cooled properly; the oil cooler must receive an ample supply of cold water.



Figure 10. Separate pump system



Figure 11. Heat exchange system



Figure 12. Keel cooler system



CAUTION: ALWAYS USE BACKUP WRENCH ON COOLER FITTINGS

3.6 START-UP PROCEDURE

 Remove oil breather or top inspection cover and add recommended oil level is up to full mark on dipstick (see lube chart, p. 12). Replace but do not secure.

2. Install pressure gauge of 300 pound capacity directly on top of gear or on bulkhead. Connect gauge to control valve with hydraulic hose. (Note: Electric type oil pressure gauges are not recommended.)

Reverse gear is now ready for start up:

3. Engage starter for approximately 30 seconds, but DO NOT START ENGINE. This activates pressure pump which prelubricates reverse gear, preventing premature gear before, preventing premature wear before load is applied.

4.Start engine and check all connections for leaks.

5.Oil pressure is adjustable at factory for testing purposes only and it may be necessary to readjust pressure to the correct level (200-210 PSI). This should be set for normal operating speed and temperatures (see fig. 12 below).

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

6. After unit has been operated a few minutes, stop engine, check oil level and add sufficient oil to bring level to full mark on dipstick. (See lube chart for capacities). Secure oil breather or inspection cover. 7.Shift several times to insure that all cylinders, hoses and cooler are full of oil.

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

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

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

MAXIMUM INPUT SPEED... 2500 RPM

3.7 OPERATING PRACTICES

CAUTION:

1.A Capitol reverse gear should normally not be shifted unless engine is at idle speed.

2. Reverse gear cannot be operated continuously in reverse mode for more that 30 minutes at 75% of available horsepower.

3. In marine application 'Windmilling" (freewheeling) is strictly prohibited as extensive internal damage may result. In the case of a twin screw application where only one engine may be installed. (As an alternative an auxiliary lube system may be installed).

4.Do not operate init with high or low oil pressure or if oil temperature exceeds 180 deg F.



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



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

SECTION 4. PREVENTIVE MAINTENANCE

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

4.1 LUBRICANTS

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

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

Where high ambient temperatures are encountered, over 85 deg. F (29 deg. C), it may be necessary to use SAE 40 motor oil.

Where high ambient temperatures are encountered, under 30 deg. F (-1 deg. C), it may be necessary to use SAE 20 motor oil.

CAUTION:

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

Oil Capacity (approximate, depending on cooler, hoses, etc.)

HP 9400: 10 gallons (38 liters) HP 10500: 12.5 gallons (47.5 liters)

Bring oil up to full mark on dipstick. Operate unit in forward and reverse for several minutes. This will fill cooler, clutch cylinders, pump hoses, etc. Stop engine and add required oil to return level to "Full" mark on dipstick.

Oil Pressure

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

Pressure Adjustment see fig. 13 p.11

Oil Temperature

Ideal operating oil temperature range is 140-160 deg. F (60-70 deg. C) at selector valve. Unit will tolerate higher temperatures but clutch life may be shortened considerably.

4.2 ROUTINE MAINTENANCE

Oil cooler assembly

Check zinc pencils in oil cooler and change if badly eroded. Check zinc pencils at approximately every 400 hours of operation.

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

Oil Filter

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

Oil Breather

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

Visual Inspection

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

Wear Analysis

At periodic interval record pressure readings at idle speed. A gradual decline is normal. Readjust pressure relief valve to maintain proper operating pressures. See fig. 13, p. 11

Inspection /Overhaul Interval

A complete inspection of the Capitol marine gear should be made at least as often as the engine is overhauled. Part such as commutator bushings, oil seals, o-rings, clutch discs, bearing, etc. showing any fatigue or wear should be replaced. It may be desirable to completely rebuild the marine gear at this time (See section 7.)

4.3 MAINTENANCE SCHEDULE AND CHECK SHEET

Engineer_____ Reverse Gear serial no._____ Date service began_____

INTERVAL Normal Operation	Maintenance Description	Record
Daily	-Check oil level -Check oil pressure	
After first 100 hours	-Change oil and flush sump	
Every 400 hours	 Check Zinc pencils Change oil if contaminated Remove and clean oil breather and suction tube Replace filter element 	
Every 2000 hours	 Check gear backlash (seep.34) Check water tubes in cooler 	
At engine overhaul	 Inspect clutch and all gearing and replace as necessary Inspect and or overhaul entire transmission 	
Frequently	-Check all oil lines and connections - Check all external components -Check all mounting bolts - Check alignment	

SECTION 5. TROUBLE SHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
A. Low oil pressure (at full operating speed and temperature)	1. Faulty pressure gauge	1. Check gauge against one of known accuracy
	2. Low oil level	2. Inspect gaskets, seals, hoses and fittings for leakage. Pressure test oil cooler- tubes may leak
	3. Clogged filter element	3. Replace filter element
	4. Clogged suction tube	4. Remove tube and clean with solvent. Blow dry
	5. Clogged parts in selector valve, baseplate or housing	5. Flush clean with solvent and blow dry
	6. Dirt or sludge in transmission	6. Remove drain plugs, flush gear with commercial solvent or diesel fuel. Start engine: at idle shift gear several times, full forward to full reverse for 3-5 mins max. Shut down engine and drain gearbox thoroughly. Refill gear with proper oil and run for 25 to 50 hours. Drain sump and refill with new oil. This will remove any residual solvent.
	7. Worn pump assembly	 7. Refer to oil pump section or fig. 13.
	8. Incorrectly adjusted pressure relief valve	8. See fig. 13.
	9. Oil too hot	9. Check heat exchanger system for clogged oil cooler or hoses
	10. Worn commutator bushings	10. See wear limits chart
	11. Incorrect lubricant	11. See lube chart
	12. Scratched clutch cylinders or hard O-rings in clutch cylinders.	12. Replace as necessary
B. High oil pressure (at full operating speed and temperature)	1. Incorrectly adjusted pressure relief valve	1. Refer to fig.13
	2. Inoperable relief plunger in base plate	2. Refer to p.17
	3. Incorrect oil	3. See lube chart
	4. Cold oil	4. Check heat exchanger system
	5. Cold oil at start up	5. Transmission should be pre- heated see p.11

C. No oil pressure	1. Faulty pressure gauge	1. Check pressure with gauge of known accuracy
	2. Broken hose	2. Replace hose. Inspect all hoses
	3. No oil in transmission	3. Fill with proper oil
D. Overheating	1. Insufficient oil cooler capacity	1. Install adequate oil cooler
	2. Insufficient flow of cooling water	2. Increase water lines sizes
	3. Clutch slipping	3. Refer to Symptom A
	4. Water temperature too high at cooler	4. Decrease water temperature to cooler or relocate heat exchanger in cooling system
E. Excessive noise in transmission	1.bearings worn or broken	1. Inspect bearings for scored races, broken roller, flat spots etc.
	2. Gears worn or broken	2. Inspect gears and replace if necessary
	3. Noise in forward only	3. Reverse position may be mistakenly used for forward. Selector valve lever must point forward when boat is in forward motion
	4. Noise in reverse only	4. This is normal because more gears are in operation in reverse mode.
	5. Improper alignment	5. Refer to section 5.
F. Noisy Pump	1. Dirt or sludge in oil	1. Remove oil pump and hoses. Clean thoroughly and reinstall
	2. Clogged hoses	2. Clean and replace as required
	3. Pump cavitation	3. Oil level may be too low
	4. Defective oil pump assembly	4. Refer to oil pump section
G. Clutch does not release	1. transmission is misaligned	1. Refer to installation section
	2. Improper oil in sump	2. Refer to lube chart
	3. Clutch discs warped	3. Replace as necessary
	4. Forward and reverse clutch cylinders dirty or distorted	4. Clean or replace as necessary
	5. Rear commutator bushing is worn	5. Replace as necessary. See replacement wear limits chart
	6. Incorrect linkage adjustment to selector valve assembly	6. Adjust linkage
	7. clutch discs fused due to slippage and overheating	7. Replace as necessary

H. Clutch slipping	1. Low oil pressure	1. See symptom A
	2. Transmission is misaligned	2. Refer to installation section
	3. Oil temperature too high	3. Temperature should be 140° to 160°F (60 to 71°C) at selector valve. Check heat exchanger system
	4. Worn clutch discs	4. Replace as necessary. See replacement wear limits chart
	5. Incorrect linkage adjustment to selector valve assembly	5. Adjust linkage
	6. Improper oil	6. See lube chart
I. Clutch burned out	1. Low oil pressure	1. See symptom A
	2. Clutch is shifted at other than engine speed	2. Install interlock shift control
	3. Transmission misaligned	3. check installation and alignment as described in installation section.
	4. Excessive heat	4. Check cooling system
J. No neutral	1. Transmission is misaligned	1. Refer to installation section
	2. Warped clutch discs	2. Replace as necessary
	3. Scored clutch cylinders	3. Replace as necessary
	4. Damaged clutch o-rings	4. Replace all 4 o-rings
	5. Worn or damaged commutator bushings (forward or rear)	5. Replace as necessary. See replacement wear limits chart
	6. Worn selector valve	 Replace if necessary. Note: selector valve is the least likely source of trouble
K. Clutch engages too slow	1. Cylinder timing screw out of adjustment	1. Remove dome nut and adjust screw (counter-clockwise) to speed up reaction see fig. 14.
L. Clutch engages too fast	1. Cylinder timing screw out of adjustment	1. Remove dome nut and adjust screw in (clockwise) to delay reaction see fig. 14.

SECTION 6. REPAIR OF EXTERNAL SUBASSEMBLES

CAUTION

Avoid contact with rotating output coupling and always shut down engine when doing even minor inspection or repair. Avoid contact with metal surfaces as operating temperature may exceed 200 deg.



Fig. 15. Oil Pump Assembly (Pump no. 1-13041-1000 shown)

6.1 OIL PUMP

A. PRESSURE RELIEF ASSSEMBLY

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

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

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

4.Generously lubricate relief plunger with oil or Vaseline. Insert plunger, cup end last. Check plunger for free movement. 5. Insert pressure relief spring into cup of plunger.

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

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

8.Cap and lock pressure relief screw with dome nut and washer.

B. OIL PUMP DISASSEMBLY

1. Remove oil pump assembly and filter from main housing cover by removing cap screws and hoses.

2. Remove cap screws and lock washer securing pump cover, pump body and pump adapter.

3. Using a soft hammer, separate cover, body and adapter from spring pins, NOTE: FOR REASSEMBLY, PUNCH MARK ALONG SIDE OF COVER, BODY AND ADAPTER.

4. Remove pump gears resting in adapter.

5. Remove dome nut and relief valve insert. NOTE: PRESSURE RELIEF SPRING IS UNDER TENSION.

6.Unscrew and separate pressure relief screw from relief valve insert. Remove pressure relief spring and plunger.

C. CLEAN AND INSPECTION

1. Remove all permatex and clean all parts with good grade cleaning solvent or diesel fuel. Blow dry with compressed air.

2. Inspect gears and oil pump for damage or excess wear. See replacement wear limits chart.

3. Inspect cover and adapter for wear cause by gears. Note: If grooving does not exceed .030, both surfaces can be repaired by grinding smooth (.030" max cut).

4. Inspect bushings in cover for wear (see wear limits p. 23), out of round condition or burrs. If they are worn, damaged or loose, replace and ream to size (see p. 23).

5. Inspect bushings (2) in adapter for wear, out-of –round condition or burrs. If bushings are damaged, replace as necessary, and ream to size (see p. 23)

6. Check relief plunger for free movement in adapter bore. Replace if necessary.

7. Inspect all mating surfaces for smoothness.

8. Check to see that each oil passage is free from obstruction.

D. ASSEMBLY

1.Generously lubricate pump gears with lubriplate, Vaseline, or engine weight oil and position them in adapter. NOTE: BE SURE

SPLINED ENDS (INSIDE DIAMETER OF PUMP GEARS) ARE TOWARD COVER.

2. To both mating surface of body, sparingly apply a very thin coat of 'SUPER 300' permatex or equivalent. Too much sealer can prevent pump from functioning.

3. Place body on adapter and cover on body following punch marks. Note: If new body is used make sure sharp inside corners are filled smooth.

4. Secure cover and body to adapter with cap screws and lock washers, -finger tight.

5. Drive spring pins (2) down through cover into body and adapter until they bottom in adapter. Drive 2 more spring pins into body until flush with top cover.

6. Insert pump shaft through adapter into pump gear and revolve shaft to check ease of operation.

7. Tighten all six cap screws to 16 footpounds torque.

8. Remove any excess permatex from seams with solvent.

9. Recheck for ease of operation.

10. Generously lubricate relief plunger with Vaseline or lubriplate and position cup end last in bore of adapter. Check to make sure plunger slides freely.

11. Insert pressure relief spring into cup of plunger.

12. Screw pressure relief spring into cup relief valve insert just enough to start threads.

13. Install washer and relief valve insert with pressure screw in place.

14. Tighten relief valve insert. Do not tighten relief screw.

15. Cap and lock pressure relief screw with dome nut and washer.

16. Recheck for ease or operation.



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



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

E. RE-INSTALLATION

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

1. Flush canister and install new filter element in filter.

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

3. Apply grease to bearing container and locate new oil pump gasket on container.

4. Install oil pump (and filter) on bearing container. Secure pump with cap screws and lock washers and torque to 42 lb. Ft.

5. Install suction hose to tee and oil pump.

6. On units with idler gear, connect hose from oil pump to idler shaft.

7. Be sure to re-adjust oil pressure to correct operating level when engine is started up. See Fig. 17.

F. PUMP ROTATION

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



Fig. 18 Selector Valve Assembly

6.2 SELECTOR VALVE AND RELATED PARTS

A. REMOVAL

1. Disconnect hoses and control linkage from lever on selector valve.

2. Remove cap screws and lock washers and lift off selector valve and baseplate being very careful to keep gaskets in proper configuration for replacement. (They may be fixed in position with wire, etc.)

B.DISASSEMBLY

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

2. Remove key from rotor shaft.

3. (Note position of cover). Remove cover, cover gasket, and rotor from block.

4. Remove safety relief adjustment screw, washer, spring and plunger. NOTE: SPRING IS UNDER TENSION.

C. CLEANING AND INSPECTION

1. Clean all parts thoroughly with oil and clean all ports. Blow dry with compressed air.

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

3. Inspect oil seal in cover. If it is worn or shows evidence of leaking, replace it.

D. ASSEMBLY

NOTE: On all fittings use Permatex 'Super 300' sealant graphite paste, or equivalent. Caution: Do not use No. 1 Permatex or Teflon tape.

1. If necessary install new seal in cover. Press seal in until it bottoms in bore (rubber face out). Apply lubricant to seal.

2. Insert rotor shaft through oil seal in cover.

3. Set key in rotor shaft and install lever with indexing ball and spring. Make sure that keyway in rotor shaft remains toward bottom of cover.

4. Tap control lever into position with a soft hammer and secure with retaining ring.

5. Position new cover gasket on pilot face of cover.

6. Install rotor with cover into selector valve body. Secure cover with four cap screws. Tighten to 4 pounds-foot torque.

7. Install safety relief adjustment parts in rear of valve body.

8. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on main housing. See fig. 19.



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

8.3 SELECTOR VALVE

8.3 SELECTOR VALVE



Fig. 42. Selector Valve Assembly, no. 1-09427-2000

ITEM	DESCRIPTION	PART NO	QTY
REF	ASSEMBLY, SELECTOR VALVE	1-09427-2000	1
1	BODY	1-01141-3500	1
2	PIPE PLUG. HEX SOCKET ¹ / ₄ NP	1-11279-0300	1
3	PIPE PLUG, HEX SOCKET: 1/8 N.P	1-11279-0200	1
4	VALVE ROTOR	1-01144-1000	1
5	GASKET, VALVE COVER	1-01156-3700	1
6	COVER	1-01142-3400	1
7	CAPSCREW, SOCKET HD ¹ ⁄4-20 X	1-09432-0800	4
½LG			
8	LEVER	1-01143-4200	1
9	RETAINING RING, EXTERNAL	1-13125-0000	1
10	KEY, 3/32 X 1/2" DIA	1-01164-3200	1
11	SPRING PIN, 1/4 DIA X 1/2" LG	1-12097-0800	1
12	OIL SEAL	1-01152-3200	1
13	SPRING, INDEXING	1-01132-1500	1
14	BALL, INDEXING 1/4" DIA	1-11200-0000	1
15	ADJUSTMENT SCREW RELIEF	1-12617-0000	1
16	WASHER, .030" THICK	1-12619-0000	5
17	WASHER, 1/16" THICK	1-10288-0700	1
18	SPRING, RELIEF VALVE	1-12618-0000	1
19	PLUNGER, SAFETY RELIEF	1-12616-0000	1

8.4 OIL PUMP

A. Pump No. 1-13041-1000 (standard duty)



Fig. 43 Oil Pump no. 1-13041-1000

ITEM DESCRIPTION

IIEM	DESCRIPTION	PART NUMBER	QTY
REF 1 2 REGU 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	OIL PUMP ASSEMBLY PLUNGER SPRING PRESSURE LATING WASHER, COPPER INSERT, RELIEF VALVE WASHER, COPPER SCREW, PRESSURE RELIEF NUT, DOME ADAPTER, OIL PUMP PIPE PLUG PIPE PLUG PIPE SPRING BUSHING, SPLIT BODY, OIL PUMP GEAR DRIVE DISC FLAT COVER, OIL PUMP PIPE PLUG	1-13041-1000 1-07725-0800 1-12602-0000 1-12901-0000 1-12902-0000 1-06660-0800 1-06667-0800 1-13045-0000 1-11279-0300 1-11279-0200 1-11279-0200 1-11380-0000 1-07856-3100 1-09688-3100 1-13731-0000 1-07723-1100 1-11279-0100	QIY 1 1 1 1 1 1 1 1 2 4 4 1 2 1 1 1 1 7
18 19	LOCKWASHER CAPSCREW, HEX HEAD	1-12692-0000	7

8.4 OIL PUMP

B. PUMP NO. 138500-4000: Used only with engines not exceeding 1300 max R.P.M



Fig. 44. 'Heavy Duty' Oil Pump no. 1-13850-4000

ITEM	DESCRIPTION	PART NUMBER	QTY
REF	OIL PUMP ASSEMBLY	1-13850-4000	1
1	CAPSCREW, HEX HEAD	1-13856-0000	5
2	LOCKWASHER	1-09460-0800	5
3	COVER, PUMP	1-13853-0000	1
4	PIN, SPRING ¼" DIA X 1"LG	1-12097-1600	4
5	DISC, FLAT: 7/8" dia. X .074"	1-13731-0000	1
6	PIPE PLUG: 1/16 NPTF	1-11279-0100	1
7	BUSHING	1-11330-0000	4
8	BODY PUMP	1-13852-0000	1
9	PLATE, PUMP NUMBER	1-11209-0000	1
10	DRIVE SCREW, ROUND HEAD	1-13275-0000	2
11	GEAR PUMP	1-13854-0000	2
12	PIPE PLUG: 3/8 NPTF	1-11279-0400	1
13	ADAPTER PUMP	1-13851-0000	1
14	PIPE PLUG: 1/8 NPTF	1-11279-0200	2
15	SPOOL, RELIEF	1-13855-0000	1
16	SPRING, PRESSURE REGULATING	1-12602-0000	1
17	SCREW, PRESSURE ADJUSTMENT	1-06660-0800	1
18	WASHER, COPPER	1-12901-0000	1
19	INSERT, RELIEF	1-12603-0000	1
20	WASHER, COPPER	1-12903-0000	1
21	NUT, DOME	1-06667-0800	1



Fig. 45. Clutch Assembly No. 1-00100-2419

8.5 CLUTCH

A. No. 1-00100-2419

ITEM	DESCRIPTION	PART NUMBER	QTY
REF 1	CLUTCH ASSEMBLY CAPSCREW, SOCKET HD3/8-24 X8¼"	1-00100-2419 1-12973-0000	1 8
2 3 4 5 6 7	SNAP RING END FLANGE BALL BEARING BEVEL GEAR (DRIVING AND DRIVEN) CLUTCH DISC, DRIVING CLUTCH DISC, DRIVEN	1-00222-3200 1-00210-2600 1-00211-5400 1-00216-2400 1-00230-2800 1-00233-2400	2 2 2 15 15
8 9	NUT, FLEX-LOC ¼-20 CAPSCREW, SOCKET HD ¼-20 X 2"	1-07846-0800 1-12028-0000	4 4
10 11 12 13	SHAFT, BEVEL PINION BEARING, PINION GEAR BEVEL PINION CLYINDER (FORWARD & REVERSE)	1-00220-2400 1-00218-2500 1-00217-1800 1-00234-2400	4 4 2
14 15 16 17 18 19 20 21 22	NUT, FLEX LOC O-RING O-RING CARRIER, BEVEL GEAR PIPE PLUG, HEX SOCKET COMMUTATOR BUSHING SPRING PIN 3/16 DIA X 5/8" NAMEPLATE CAPSCREW, SOCKET HD5/16-18 X ³ / ₄ "	1-11399-0000 1-12784-0000 1-12785-0000 1-00219-2400 1-11279-0300 1-00247-3200 1-12096-1000 1-12397-0000 1-07546-0800	28 2 1 2 1 3 1 12
23	CAPSCREW, SOCKET HD 5/16-18 X 2"	1-09439-0800	16
24 25 26	RETAINER, RETURN SPRING SPRING, RETURN LOCKWASHER, HIGH COLLAR 3/8dia	1-00243-2400 1-00239-3700 1-08755-0800	16 16 8
21	ALLEINUT 3/8-24	1-12999-0000	8

Fig. 46. Clutch Assembly No. 1-00100-2420

8.5 CLUTCH B. No. 1-00100-2420

ITEM	DESCRIPTION	PART NUMBER	QTY
		1-00100-2420	1
REF		1-12973-0000	8
1	CAPSCREW, SUCKET HD3/8-		•
2		1-00222-3200	2
2		1-00210-2800	2
3		1-00211-5400	2
4 5		1-00216-2400	2
5	DEVEL GEAR (DRIVING &		
6		1-00230-2800	19
0		1-00233-2400	19
/ Q		1-07846-0800	4
0		1-12028-0000	4
9	2 2"		
10	SHAFT BEVEL DINION	1-00220-2400	4
10		1-00218-2500	4
12	GEAR BEVEL PINION	1-00217-1800	4
12		1-00234-2400	2
10	&REVERSE)		
14		1-11399-0000	28
15	O-RING	1-12784-0000	2
16	O-RING	1-12785-0000	2
17	CARRIER BEVEL GEAR	1-00219-2400	1
18		1-11279-0300	2
19	COMMUTATOR BUSHING	1-00247-3200	1
20	SPRING PIN 3/16 dia X 5/8"	1-12096-1000	3
21	NAMEPI ATE	1-12397-0000	1
22	CAPSCREW SOCKET HD 5/16-	1-07546-0800	12
	18X ³ ⁄⁄′″		
23	CAPSCREW SOCKET HD 5/16-	1-09439-0800	16
	18 X 2"		
24	RETAINER. RETURN SPRING	1-00243-2400	16
25	SPRING RETURN	1-00239-3700	16
26	LOCKWASHER, HIGH COLLAR	1-08755-0800	8
	3/8 dia		_
27	ALLENUT 3/8-24	1-12999-0000	8

Fig. 47. Clutch Assembly No. 1-00100-4300 PTO With Brake.

8.5 CLUTCH C. No. 1-00100-4300 Power take off with Brake

ITEM	DESCRIPTION	PART NUMBER		QTY
REF		1-00100-4300	1	
I	8 ¼"	1-12973-0000	8	
2	BEARING SUPPORT	1-13905-0000	1	
3	SNAP RING	1-00222-3200	2	
4	END FLANGE CLUTCH	1-13907-0000	1	
5	BALL BEARING	1-00211-3200	1	
6	SNAP RING	1-13906-0000	1	
7	CLUTCH DISC DRIVING	1-00230-2800	12	
8	CLUTCH DISC DRIVEN	1-00233-2400	12	
9	CYLINDER	1-00234-2400	2	
10	NUT FLEX-LOC 5/16-18	1-11399-0000	28	
11	O-RING	1-12784-0000	2	
12	O-RING	1-12785-0000	2	
13	CAPSCREW, SOC HD 5/16-18	1-09439-0800	16	
	X 2"			
14	RETAINER, RETURN SPRING	1-00243-2400	16	
15	SPRING, RETURN	1-00239-3700	16	
16	CARRIER BEVEL GEAR	1-00219-2400	1	
17	NUT, FLEX LOC ¹ / ₄ -20	1-07846-0800	12	
18	SHAFT BEVEL PINION	1-00220-2400	4	
19	2"	1-12028-0000	4	
20	COMMUTATOR BUSHING	1-00247-3200	1	
21	SPRING PIN, 3/16 DIA X 5/8"	1-12096-1000	3	
22	PIPE PLUG HEX SOCKET ¼-18 NPT	1-11279-0300	2	
23	NAMEPLATE	1-12397-0000	1	
24	CAPSCREW, SOC HD 5/16-18 X ¾"	1-07546-0800	12	
25	END FLANGE, CLUTCH	1-13904-0000	1	
26	LOCKWASHER, HIGH COLLAR 3/8"dia	1-08755-0800	8	
27	ALLENUT, 3/8-24	1-12999-0000	8	


Fig. 48. HP-9400 Housing and External Parts

8.6 HP-9400 HOUSING AND EXTERNAL PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	HOUSING (ALL RATIOS WITHOUT IDLER)	1-13002-0000	1
	HOUSING 1:1 WITH IDLER	1-13002-0100	1
	HOUSING 1 1/2:1 WITH IDLER	1-13002-0200	1
	HOUSING 2:1 WITH IDLER	1-13002-0300	1
0		1-13002-0400	1
2		1-01102-3600	1
3		1-13077-0000	3
- 5	CAPSCREW FLAT SOCKET HD: 1/2-13 X 1"	1-13610-0000	1
U	SELE LOCKING	1 11210 0000	12
6	NAME PLATE	1-13275-0000	2
7	DRIVE SCREW; #2 X 3/16" LONG	1-13088-0000	1
8	OIIL BREATHER	1-09461-0800	1
9	DOME NUT	1-09471-0800	3
10	GASKET	1-09464-0800	1
11	NUT, LIGHT; 5/16-18	1-09466-0800	1
12	SCREW CLUTCH TIMING 5/16-18X 1 ¹ / ₂ "	1-09458-0800	5
13	LOCKWASHER, 5/16 LIGH I	1-10964-0000	4
14		1-09669-0900	1
15		1-09427-2000	1
10	CASKET SELECTOR VALVE	1-13861-0000	1
18	PLATE BASE	1-13065-0000	1
19	GASKET BASE PLATE	1-13068-0000	1
20	PLATE SUPPORT	1 12115 0000	1
21	GASKET. SUPPORT PLATE	1-09460-0800	32
22	LOCKWASHER, 3/8 LIGHT	1-09662-0800	12
23	CAPSCREW HEX HD: 3/8-16 X 2"	1-06751-0800	4
24	CAPSCREW HEX HD 3/8-16 X 1/14"	1-10334-0000	1
25	CAPSCREW HEX HD: 5/16-18 X 3/4"	1-11259-0100	1
26	NIPPLE PIPE 3/8 DIA X 2"	1-11260-0200	1
27	TEE REDUCING; 1/2 X 3/8 X 3/8"	1-08873-0900	1
28	HOSE (VALVE TO PUMP)	1-12435-0000	1
29		1-10965-0000	16
3U 31		1-13005-0000	1
32	GASKET INSEPCTION COVER (TOP)	1-13006-0000	1
33	ELBOW 90 DEG. MALE 1" NPT	1-11221-2400	1
34	REDUCER: 1-11 ½ TO ¾-14 NPT	1-11224-1100	2
35	NIPPLE ¾ X 4"	1-13049-0000	1
36	GASKET, OIL PUMP	1-13041-1000	1
37	OIL PUMP (STANDARD) SEE PG 38	1-11220-1100	1
38	ELBOW 45 MALE	1-13811-0000	1
39	FILTER OIL SEE PAGE 64	1-09462-0800	8
40	LOCKWASHER, 7/16 LIGHT	1-07106-0800	8
41		1-12145-0000	1
42		1-07915-0900	1
43 44	HOSE (SUMP TO PUMP)	1-13623-0000	1
45	PIPE PLUG HEX SOCKET 1/2 NPT	1-11279-0500	1
46	PIPE PLUG SQUARE HEAD 1 ¼ NPTF	1 11231-0700	∠ 1
47	NUT 45 DEG FLARE	1-12438-0000	2
48	GASKET, INSPECTION COVER (SIDE)	1-12405-0000	2
49	COVER, INSPECTION (SIDE)	1-13056-0000	1
50	TUBE, DIPSTICK	1-11255-0700	1
51	TEE 1 ¼ X 1 ¼ X 1 1/4	1-13802-0000	1
52	TUBE, SUCTION	1-11238-0700	1
53	ELBOW 90 DEG FEMALE	1-11259-0200	1
54 55		1-13576-0000	1
33 56		1-13850-4000	1
50 57		1-11260-1400	1
58		1-11214-2100	1
59	HOSE (VALVE TO PUMP)	1-13859-0000	1
		1-11240-0700	1

60 61 62 63	ELBOW 90 DEG. FEMALE CONNECTOR MALE 1 ¼ NP X 1 5/8-12 NIPPLE 1 ¼ X 5" ELBOW 45 DEG. ST	1-11246-0700 1-11214-2700 1-11259-4000	1 1 1
63	ELBOW 45 DEG. ST	1-11249-0500	1
64	BUSHING, PIPE 1 ¼ X ¾"	1-11253-1300	1



Fig. 49 HP-10500 Transmission Housing and External Parts

8 7 HP-1(500 HOUSING AND EXTERNAL PARTS		
ITEM	DESCRIPTION	PART NUMBER	ΟΤΥ
1		1-13102-0000	1
i	HOUSING 4-1 RATIO WITH IDLER	1-13102-0100	1
	HOUSING 5:1 RATIO WITH IDLER	1-13102-0200	1
	HOUSING 6:1 RATIO WITH IDLER	1-13102-0300	1
2	DOWEL PIN. 1/2 DIA X 3/4"	1-13077-0000	3
3	DRUM REVERSE CLUTCH	1-13610-0000	1
4	CAPSCREW FLAT SOCKET HD. 1/2 –13X	1-09741-0800	12
•	1 SELE LOCKING		
5	GASKET HOUSING	1-01102-3600	1
6	NAME PLATE	1-11210-0000	1
7	DRIVE SCREW: #2 X 3/16" LONG	1-13275-0000	2
8	OIL BREATHER	1-13088-0000	1
9	DOME NUT	1-09461-0800	1
10	GASKET	1-09471-0800	3
11	NUT. LIGHT 5/16-18	1-09464-0800	1
12	SCREW. CLUTCH TIMING 5/16-18 X 1 ¹ / ₂ "	1-09466-0800	1
13	LOCKWASHER, 5/16 LIGHT	1-09458-0800	8
14	CAPSCREW HEX HD: 5/16-18 X 2 1/2"	1-10946-0000	4
15	GAUGE PRESSURE	1-09669-0900	1
16	ASSEMBLY, SELECTOR VALVE, PG 37	1-09427-2000	1
17	GASKET. SELECTOR VALVE	1-13861-0000	1
18	PLATE, BASE	1-13065-0000	1
19	BASKET, BASE PLATE	1-13068-0000	1
20	PLATE SUPPORT	1-13063-0000	1
21	GASKET, SUPPORT PLATE	1-13115-0000	1
22	LOCKWASHER 3/8 LIGHT	1-09460-0800	32
23	CAPSCREW HEX HD 3/8-16X 2"	1-09662-0800	12
24	CAPSCREW HEX HD 3/8-16 X 1 1/4"	1-06751-0800	4
25	CAPSCREW HEX HD 5/16-18 X 3/4"	1-10334-0000	3
26	NIPPLE. PIPE 3/8 DIA X 2"	1-11259-0100	1
27	TEE REDUCING ½ X 3/8 X 3/8"	1-11260-0200	1
28	HOSE (VALVE TO PUMP)	1-08873-0900	1
29	DIPSTICK, OIL	1-15088-0000	1
30	CAPSCREW HEX HD. 3/8-16 X ³ / ₄ "	1-10965-0000	16
31	COVER, INPSECTION (TOP)	1-13005-0000	1
32	GASKET, INSPECTION COVER (TOP)	1-13006-0000	1
33	ELBOW 90 DEG. MALE 1" NPT	1-11221-2400	1
34	REDUCER 1-11 1/2 TO 3/4 -14 NPT	1-11224-1100	1
35	NIPPLE 3/4X 4"	1-11259-1700	2
36	GASKET, OIL PUMP	1-13049-0000	1
37	OIL PUMP (STANDARD) PG 38	1-13041-1000	1
38	ELBOW 45 DEG MALE	1-11220-1100	1
39	FILTER, OIL; SEE PG 64	1-13811-0000	1
40	LOCKWASHER; 7/16 LIGHT	1-09462-0800	8
41	CAPSCREW HEX HD. 7/16-14 X 1 1/4"	1-07106-0800	8
42	BRACKET, DIPSTICK	1-07915-0900	1
43	NUT, 45 DEG. FLARE	1-11243-0800	1
44	HOSE (SUMP TO PUMP)	1-13625-0000	1
45	GASKET, INSPECTION COVER (SIDE)	1-12438-0000	2
46	COVER, INSPECTION (SIDE)	1-12405-0000	2
47	PIPE PLUG, HEX SOCKET; 1/2 NPT	1-11279-0500	1
48	PIPE PLUG, SQUARE HD. 1 ¼ NPTF	1-11251-0700	2
49	TUBE, DIPSTICK	1-13094-0000	1
50	TEE 1 ¼ X 1 ¼ X 1 ¼"	1-11255-0700	1
51	TUBE, SUCTION	1-13802-0000	1
52	ELBOW 90 DEG FEMALE	1-11238-0700	1
53	NIPPLE; 1/2-3"	1-11259-3700	1
54	KIT, MOUNTING FOOT	1-13576-0000	1
55	OIL PUMP (HEAVY DUTY) SEE PG 39	1-13850-4000	1
56	1 EE, REDUCTING ³ / ₄ X 3/8 X ³ / ₄ "	1-11260-1400	1
57	CONNECTOR, MALE ³ / ₄ NP X 1 1/16-12	1-11214-2100	1
58	HOSE (VALVE TO PUMP)	1-13859-0000	1
59	CONNECTOR MALE, 1 ¼ NP X 1 5/8-12	1-11214-2700	1
60	ELBOW 90 DEG. FEMALE	1-11246-0700	1
б1 00		1-11259-4000	1
62	ELBOW 45 DEG STREET	1-11249-0500	1
63	BUSHING, PIPE; 1 ¼ X ¾"	1-11253-1300	1



Fig. 51. Idler Gear and Related Parts

8.8 PINION SHAFT AND RELATED PARTS

HP-9400 AND HP-10500

ITEM	DESCRIPTION	PART NUMBER	QTY
1	RING, RETAINING	1-10534-0000	2
2	BEARING, OUTER RING AND ROLLERS	1-12795-0000	1
3	SNAP RING	1-13074-0000	1
4	SPACER	1-13813-0000	1
5	RING, INNER BEARING	1-12795-2000	1
6	COMMUTATOR, REAR	1-13050-0000	1
7	TUBE, COMMUTATOR	1-13114-0000	2
8	O-RING	1-13076-0000	4
9	CAPSCREW, SOCKET HD 3/8-24 X 6"	1-13067-0000	1
10	ASSEMBLY, PINION AND SHAFT		
	(INCLUDES PIPE PLUGS, SNAP RING,		
	SPACER AND INNER BEARING RING)	SEE CHART P.56	1
11	BEARING, TWO ROW (4 PIECES)	1-12790-0000	1
12	O-RING	1-13078-0000	1
13	CONTAINER, BEARING	1-13007-0000	1
14	LOCKWASHER, 7/16 DIA	1-09462-0800	1
15	CAPSCREW, HEX HD 7/16-14 X 1 ¼"	1-07106-0800	1
16	WASHER, BEARING	1-13079-0000	1
17	LOCKWASHER, BEARING	1-13080-0000	1
18	LOCKNUT, BEARING	1-00335-2100	1
19	SHAFT, PUMP DRIVE (PUMP 1-10341-	1-13812-0000	1
20	SHAFT, PUMP DRIVE (PUMP 1-13850- 4000)	1-13857-0000	1

8.9 IDLER GEAR AND RELATED

PARTS

HP-9400 AND HP-10500

ITEM	DESCRIPTION	PART NUMBER	QTY
1	RING, RETAINING	1-13035-0000	2
2	BEARING, IDLER	1-13037-0000	4
3	RING, RETAINING	1-13036-0000	2
4	SHAFT, IDLER	1-13034-0000	1
5	GEAR, IDLER	1-13028-2000	1
6	ADAPTER, PIPE	1-12320-0000	1
7	WASHER; 21/64 I.D X 1" O.D	1-10338-0000	1
8	LOCKWASHER; 5/16' DIA	1-09458-0800	1
9	CAPSCREW, HEX HD; 5/16-18 X ¾"	1-10334-0000	1
10	HOSE, PUMP TO IDLER	1-07875-1000	1
11	ELBOW, 90 DEG. MALE	1-11221-0300	2



Fig. 52. HP-9400; Output Gear and Related Parts

8.10 HP-9400 OUTPUT GEAR AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	BEARING ROLLER (TWO PIECE)	1-10811-0000	1
2	OIL PAN	1-13051-0000	1
3	RETAINER, BEARING	1-10640-0000	1
4	CAPSCREW. HEX HD. 3/8-16 X ³ / ₄ "	1-13768-0000	4
5	LOCKNUT, BEARING	1-06830-0800	1
6	LOCKWASHER, BEARING	1-06846-0800	1
7	SPACER, BEARING	1-13031-0000	1
8	GEAR, OUTPUT	SEE CHART P.56	1
9	SHAFT, OUTPUT	1-13030-0000	1
10	KEY, OUTPUT GEAR	1-13029-0000	1
11	SPRING PIN; 3/16 DIA X 1"	1-12096-1600	1
12	GASKET, REAR COVER	1 12008 1200	1
13	SPRING PIN; 3/8 X DIA X ¾"	1 11082 0000	4
14	LOCKWASHER; ½" DIA	1 00141 0000	19
15	CAPSCREW, HEX HD 1/2-13 X 1 1/2"	1 12211 0000	19
16	DOWEL PIN; 1/2 X DIA. X 1 1/4"	1 12003 0000	4
17	COVER, REAR-ALL RATIOS	1-13003-0000	I
	WITHOUT IDLER	1 13003 0100	1
18	COVER, REAR- 1:1 RATIO WITH	1-13003-0100	1
	IDLER	1-13003-0200	1
19	COVER, REAR- 1 1.2:1 RATIO	1-13003-0200	1
	WITH IDLER	1-13003-0300	1
20	COVER, REAR-2:1 RATIO WITH	1-10000-0000	1
	IDLER	1-13003-0400	1
21	COVER, REAR-3:1 RATIO WITH	1 10000 0400	
	IDLER	1-13053-0000	1
22	GASKET, OUTPUT BEARING		•
	CONTAINER	1-13039-0000	1
23	CONTAINER, OUTPUT BEARING	1-13070-0000	1
24	BEARING, TWO ROW OUTPUT	1-13194-0000	1 or 2
25	GASKET, RETAINER	1-13043-0000	1
26	RETAINER, BEARING	1-06074-0800	6
27	LOCKWASHER, 5/8" DIA	1-13217-0000	6
28	CAPSCREW, HEX HD. 5/8-11X4 ½	1-13197-0000	1
29	OIL SEAL	1-13825-0000	1
30	FLANGE, OUTPUT	1-10637-0000	1
31		1-10638-0000	1
32		1-13628-0000	4
33	CAPSCREW, HEX HD. %-10 X 2 ¼"	1-06022-0800	1
34	RING, PILOT		



Fig. 53. HP-10500 Output Gear and Related Parts

8.11 HP-10500 OUTPUT GEAR AND RELATED PARTS

ITEM	DESCRIPTION	PART NUMBER	QTY
1	BEARING, ROLLER	1 12150 0000	4
2	LOCKNUT, BEARING	1-13150-0000	1
3	LOCKWASHER, BEARING	1-09511-0800	1
4	WASHER, BEARING	1-13190-0000	1
5	SPACER, BEARING	1-13189-0000	1
6	GEAR, OUTPUT	1-13112-0000	1
7	ASSEMBLY, SHAFT AND OUTPUT	SEE CHART P.56	1
	COUPLINGS	1-13616-0000	1
8	KEY, OUTPUT SHAFT		
9	SPRING PIN, 3/16 DIA. X 1 1/4"	1-13113-0000	1
10	GASKET, REAR COVER	1-12096-2000	1
11	COVER, REAR-ALL RATIOS	1-13106-0000	1
	WITHOUT IDLER	1-13103-0000	1
12	COVER. REAR- 4:1 RATIO W/		
	IDLER	1-13103-0100	1
13	COVER, REAR-5:1 RATIO WITH		
	IDLER	1-13103-0200	1
14	COVER, REAR-6:1 RATIO WITH		
	IDLER	1-13103-0300	1
15	LOCKWASHER, 1/2" LIGHT		
16	CAPSCREW, HEX HD. 1/2-13 X 1 3/4"	1-11083-0000	28
17	DOWEL PIN: 1/2 DIA. X 1 1/2"	1-10058-0000	28
18	SPRING PIN: 3/8 DIA, X 1"	1-11142-0000	4
19	CAPSCREW, HEX HD, ¹ / ₂ -13 X 1"	1-12098-1600	4
	SELF-LOCKING	1-13805-0000	3
20	OIL PAN		
21	BEARING, OUTPUT (5 PIECES)	1-13109-0000	1
22	GASKET BEARING RETAINER	1-13117-0000	1
23	REATINER BEARING	1-13195-0000	1
24	I OCKWASHER 3/7 LIGHT	1-13198-0000	1
25	CAPSCREW HEX HD 3/-10 X 2 1/2"	1-11516-0000	8
26		1-09649-0800	8
27	O-RING	1-13087-0000	1
28	PLATE RETAINER	1-13093-0000	1
20	CAPSCREW HEX HD $\frac{3}{-10} \times 2^{\frac{1}{2}}$	1-13108-0000	1
23	SELELOCKING	1-13628-0000	1
30			
00		1-10547-0000	1

8.12 REDUCTION GEAR SELECTION CHART

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

A. LOCATE THE NAMEPLATE (ON TOP OF HOUSING) AND DETERMINE THE TWO REDUCTION RATIO OPTION CODE NUMBERS (CIRCLED IN SAMPLE BELOW) AND THE RATIO. THE NUMBER OF TEETH MAY BE CHECKED ALSO.

B. MATCH THIS INFORMATION WITH THE CHART BELOW TO DETERMINE THE CORRECT PART NUMBER(s).

			MOD OPTI SE RA EN	EL ON CODE RIAL NO. ITIO IG. MFG. N APITOL G	MARINE GEAR xx-xxxxx x-xxxxx-(xx)xx-xxxxx xxxx-xxxxx (x xx:1 x.x.) xxxxxx (x xx:1 x.x.) 0. xxxxxx EARS, INC. ST. PAUL, MINN. MADE IN U.S.A.	C
		RATIO	PART	NO. OF TEETH	PART NUMBER	
-9400	01	1.037: 1 AER	PINION GEAR	54 56	1-13014-1000 1-13024-2000	
	02	1.500:1 AER	PINION GEAR	44 66	1-13008-1000 1-13018-2000	
	03	2.056:1 AER	PINION GEAR	38 74	1+13009-1000 1+13019-2000	
	04	3.074:1 AER	PINION GEAR	27 83	1-13010-1000 1-10320-2000	
	05	1.024:1 ER	PINION GEAR	44 45	1-13011-1000 1-13025-2000	
	06	1.500:1 ER	PINION GEAR	36 54	1-13121-1000 1-13021-2000	
	07	2.032:1 ER	PINION GEAR	31 63	1-13012-1000 1-13022-2000	
	08	3.038:1 ER	PINION GEAB	28 79	1-13013-1000 1-13023-2000	
	09	1.340:1 AEB	PINION GEAR	47 63	1-13026-1000 1-13022-2000	
	OPTION CODE	RATIO	PART	NO. OF TEETH	PART NUMBER	
-10500	01	4.00: 1 AER	PINION GEAR	37 148	1-13118-1000 1-13128-0000	
	02	4.96:1 AER	PINION	31 154	1-13119-1000	
	03	6.11:1 AEB	PINION	28	1-13120-1000	
	04	4.00:1 EB	PINION	36	1-13121-1000	
	1 1		a con		1101010000	

PINION

GEAR

PINION

GEAR

4.96:1 ER

6.12:1 ER

05

06

30

149

25

153

1-13122-1000

1-13132-0000

1-13123-1000

1-13133-0000

HP

HP

8.13 HP-9400 AND HP-10500 ADAPTER PARTS



Fig. 54. HP-9400 and HP-10500 Adapter Parts

ITEM	DESCRIPTION	PART NUMBER	QTY
1	CAPSCREW, HEX HD. 3/4-10 X 2"	1-12793-0000	6
2	FLYWHEEL ADAPTER (SEE		1
	APPROPRIATE INSTALLATION DRAWING)		
3	DRIVE FLANGE ASS'Y	1-13711-1000	1
4	NUT; SELF-LOCKING ¾-10 NC	1-13095-0000	6
5	OIL DAM ADAPTER (SEE APPROPRIATE		1
	INSTALLATION DRAWING)		
6	CAPSCREW, HEX HD. ¼-20 X ¾"	1-11101-0000	2
7	LOCKWASHER; ¼" DIA	1-05309-0800	2
8	COVER, AIR VENT (TOP)	1-10528-0000	1
9	COVER, AIR VENT (SIDE)	1-01118-2700	1
10	LOCKWASHER, 5/16" DIA	1-09458-0800	1
11	CAPSCREW, HEX HEAD 5/16"-18 X 5/8"	1-06987-0800	2
12	DRUM, CLUTCH DRIVING	1-01116-6800	1
13	CAPSCREW, HEX HEAD; ½ X 1 ¼" SELF	1-13134-0000	8
	LOCKING		
14	SLINGER SHIELD	1-01119-2700	1
15	CAPSCREW, DRILLED SOCKET HD. 5/16-	1-08035-0800	10

18 X ¾"



Fig. 53. HP-10500 Output Gear and Related Parts

8.14 COUPLING AND ADAPTER KIT

HP 9400/ HP 10500

ITEM	DESCRIPTION	PART NUMBER	QTY
REF	INDEPENDENT MOUNT WITH TORSIONAL COUPLING	1-13841-0000	1
1	ADAPTER, FLYWHEEL	1-13818-0000	1
2	CAPSCREW, HEX HD. ½-13 X 1 ¼ SELF LOCKING	1-13134-0000	21
3	PLATE, RETAINER	1-13817-0000	1
4	ASSEMBLY, FLEXIBLE COUPLING	1-13819-0000	1
5	BLOCK, FLEXIBLE COUPLING (INCLUDED WITH ITEM #4)	1-13819-1000	10
6	SPRING PIN, 3/16 X DIA. X ¾"	1-12096-1200	1
7	KEY, SQUARE 5/8 X 5/8 X 4 ¼"	1-11421-0000	1
8	HOUSING, ALIGNMENT	1-13821-0000	1
9	LOCKWASHER, ¼" DIA, LIGHT	1-05309-0800	10
10	CAPSCREW, HEX HD. 1/4-20 X 1/2"	1-08087-0800	10
11	COVER, ALIGNMENT, HOUSING	1-13827-0000	2
12	CAPSCREW, HEX HD. 3/8-16 X 1"	1-07432-0800	6
13	LOCKWASHER, 3/8" LIGHT	1-09460-0800	6
14	OIL SEAL	1-13713-0000	1
15	RETAINER, OIL SEAL	1-13741-0000	1
16	GASKET, RETAINER	1-13740-0000	1
1/		1-00507-0400	1
18	LOCKWASHER, BEARING	1-13823-0000	1
19	WASHER, BEARING	1-13822-0000	1
20	CUNE, BEARING	1-11627-0100	2
21	CUP, BEARING	1-11627-0200	2
22	CONTAINER, BEARING	1-13830-0000	1
23		1-11279-0300	1
24	LUCKWASHER, 7/16 LIGHT	1-09462-0800	12
25		1-13829-0000	12
20	CAPSCREVV, SOCKET HD;7/16-14X1 %	1-10152-0000	4
21		1-13828-0000	1
20 20		1-13815-0000	1
29	DRUM, CLUTCH DRIVING	1-01116-4000	1

8.14 B. INDEPENDENT MOUNT FOR HP-9400 AND HP-10500 TRANSMISSIONS



Fig. 54. HP-9400 and HP-10500 Adapter Parts

ITEM	DESCRIPTION	PART NUMBER	QTY
ITEM REF. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	DESCRIPTION INDEPENDENT MOUNT CAPSCREW, HEX HD. 3/8-16 X 1" LOCKWASHER, 3/8" OIL SEAL RETAINER, OIL SEAL GASKET, RETAINER LOCKNUT, BEARING LOCKWASHER, BEARING LOCKWASHER, BEARING CONE, BEARING CUP, BEARING CUP, BEARING CUP, BEARING CUP, BEARING CUP, BEARING FITTING, METERING BUSHING, ½ X ¼" TEE NIPPLE CAPSCREW, HEX HD. 3/8-16 X 2" ASSEMBLY, DRIVE SHAFT AND FLANGE	PART NUMBER 1-13772-0000 1-07432-0800 1-09460-0800 1-13713-0000 1-13741-0000 1-13740-0000 1-13823-0000 1-13822-0000 1-13822-0000 1-11627-0100 1-11627-0100 1-11627-0100 1-11627-0100 1-11627-0100 1-11259-0000 1-12989-2600 1-11255-0400 1-11233-0400 1-09662-0800 1-13738-0000	1 6 18 1 1 1 1 1 2 2 2 1 1 1 1 1 1 1 1 1 2 2 1
20 21	DRUM, CLUTCH DRIVING CAPSCREW, HEX HD; ½-13 X 1 ¼" (SELF	1-13134-0000	8

LOCKING)

8.15 PROPELLER COUPLING KITS



Fig. 57. HP-9400 Propeller Coupling Kit

ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	PROPELLER COUPLING KIT	1-13577-1000	1
1	NUT, SELF LOCKING ¾-10 NC	1-13095-0000	12
2	COUPLING, PROP SHAFT	1-13826-0000	1
3	CAPSCREW, HEX HD. ¾-10 NC X 3 ¼"	1-08793-0800	12





ITEM	DESCRIPTION	PART NUMBER	QTY
REF.	PROP COUPLING KIT	1-13575-0000	1
1	NUT, SELF LOCKING	1-13096-0000	8
2	PROP SHAFT COUPLING	1-10320-2000	1
3	CAPSCREW, HEX HEAD 7/8 X 3 ¾"	1-13212-0000	8

8.16 OIL COOLERS



Fig. 59. Oil Coolers

ITEM	DESCRIPTION	PART NUMBER	QTY
OIL C 1 2 3 4	OOLERS SEA WATER COOLER 1. (17" X 5 1/8 dia.) FRESH WATER COOLER (19 ½" X 6 1/8" dia.) FRESH WATER COOLER (30 ¾" X 6 1/8" dia.) ZINC PENCILS	1-13769-0000 1-13795-0000 1-13814-0000 1-12445-0400	1 1 1 2

8.17 HOSE AND FITTING KIT



Figure 60. Hose and Fitting Kit (oil cooler not included in kit)

Hose and fitting kit no. 1-13960-0000 is available for use with the oil coolers listed on page 62.

ITEM	DESCRIPTION	PART NUMBER	QTY
REFERENCE 1 2 3 4 5	HOSE AND FITTING KIT BUSHING 1" X ¾" 90 DEG. ELBOW (JIC) FEMALE FITTING HOSE 5/8" I.D X 12 FT MALE ELBOW, 45 DEG.	1-13960-0000 1-11253-1200 1-11221-1800 1-11282-0700 1-11835-0000 1-11220-1700	1 2 3 4 1

8.18 OIL FILTER



Fig. 61. Oil Filter No. 1-13811-0000

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

SECTION 9. SPECIAL TOOLS

Special tools that may be used in repair work for HP-9400 and HP-10500. Transmissions are shown on the following pages. All pertinent information for fabrication is included. These tools are not normally available from Capitol Gears, Inc.





HP - 10500 Puller Plate for Output Coupling and Cover Special Tool no. 1-90023-0000

SECTION 6. REPAIR OF EXTERNAL SUBASSEMBLES

CAUTION

Avoid contact with rotating output coupling and always shut down engine when doing even minor inspection or repair. Avoid contact with metal surfaces as operating temperature may exceed 200 deg.



Fig. 15. Oll Pump Assembly (Pump no. 1-13041-1000 shown)

6.1 OIL PUMP

A. PRESSURE RELIEF ASSSEMBLY

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

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

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

4.Generously lubricate relief plunger with oil or Vaseline. Insert plunger, cup end last. Check plunger for free movement. 5. Insert pressure relief spring into cup of plunger.

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

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

8.Cap and lock pressure relief screw with dome nut and washer.

B. OIL PUMP DISASSEMBLY

1. Remove oil pump assembly and filter from main housing cover by removing cap screws and hoses.

2. Remove cap screws and lock washer securing pump cover, pump body and pump adapter.

3. Using a soft hammer, separate cover, body and adapter from spring pins, NOTE: FOR REASSEMBLY, PUNCH MARK ALONG SIDE OF COVER, BODY AND ADAPTER.

4. Remove pump gears resting in adapter.

5. Remove dome nut and relief valve insert. NOTE: PRESSURE RELIEF SPRING IS UNDER TENSION.

6.Unscrew and separate pressure relief screw from relief valve insert. Remove pressure relief spring and plunger.

C. CLEAN AND INSPECTION

1. Remove all permatex and clean all parts with good grade cleaning solvent or diesel fuel. Blow dry with compressed air.

2. Inspect gears and oil pump for damage or excess wear. See replacement wear limits chart.

3. Inspect cover and adapter for wear cause by gears. Note: If grooving does not exceed .030, both surfaces can be repaired by grinding smooth (.030" max cut).

4. Inspect bushings in cover for wear (see wear limits p. 23), out of round condition or burrs. If they are worn, damaged or loose, replace and ream to size (see p. 23).

5. Inspect bushings (2) in adapter for wear, out-of –round condition or burrs. If bushings are damaged, replace as necessary, and ream to size (see p. 23)

6. Check relief plunger for free movement in adapter bore. Replace if necessary.

7. Inspect all mating surfaces for smoothness.

8. Check to see that each oil passage is free from obstruction.

D. ASSEMBLY

1.Generously lubricate pump gears with lubriplate, Vaseline, or engine weight oil and position them in adapter. NOTE: BE SURE

SPLINED ENDS (INSIDE DIAMETER OF PUMP GEARS) ARE TOWARD COVER.

2. To both mating surface of body, sparingly apply a very thin coat of 'SUPER 300' permatex or equivalent. Too much sealer can prevent pump from functioning.

3. Place body on adapter and cover on body following punch marks. Note: If new body is used make sure sharp inside corners are filled smooth.

4. Secure cover and body to adapter with cap screws and lock washers, -finger tight.

5. Drive spring pins (2) down through cover into body and adapter until they bottom in adapter. Drive 2 more spring pins into body until flush with top cover.

6. Insert pump shaft through adapter into pump gear and revolve shaft to check ease of operation.

7. Tighten all six cap screws to 16 footpounds torque.

8. Remove any excess permatex from seams with solvent.

9. Recheck for ease of operation.

10. Generously lubricate relief plunger with Vaseline or lubriplate and position cup end last in bore of adapter. Check to make sure plunger slides freely.

11. Insert pressure relief spring into cup of plunger.

12. Screw pressure relief spring into cup relief valve insert just enough to start threads.

13. Install washer and relief valve insert with pressure screw in place.

14. Tighten relief valve insert. Do not tighten relief screw.

15. Cap and lock pressure relief screw with dome nut and washer.

16. Recheck for ease or operation.



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



Should Be 200-210 P.S.I.

E. RE-INSTALLATION

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

1. Flush canister and install new filter element in filter.

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

3. Apply grease to bearing container and locate new oil pump gasket on container.

4. Install oil pump (and filter) on bearing container. Secure pump with cap screws and lock washers and torque to 42 lb. Ft.

5. Install suction hose to tee and oil pump.

6. On units with idler gear, connect hose from oil pump to idler shaft.

7. Be sure to re-adjust oil pressure to correct operating level when engine is started up. See Fig. 17.

F. PUMP ROTATION

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



Fig. 18 Selector Valve Assembly

6.2 SELECTOR VALVE AND RELATED PARTS

A. REMOVAL

1. Disconnect hoses and control linkage from lever on selector valve.

2. Remove cap screws and lock washers and lift off selector valve and baseplate being very careful to keep gaskets in proper configuration for replacement. (They may be fixed in position with wire, etc.)

B.DISASSEMBLY

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

2. Remove key from rotor shaft.

3. (Note position of cover). Remove cover, cover gasket, and rotor from block.

4. Remove safety relief adjustment screw, washer, spring and plunger. NOTE: SPRING IS UNDER TENSION.

C. CLEANING AND INSPECTION

1. Clean all parts thoroughly with oil and clean all ports. Blow dry with compressed air.

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

3. Inspect oil seal in cover. If it is worn or shows evidence of leaking, replace it.

D. ASSEMBLY

NOTE: On all fittings use Permatex 'Super 300' sealant graphite paste, or equivalent. Caution: Do not use No. 1 Permatex or Teflon tape.

1. If necessary install new seal in cover. Press seal in until it bottoms in bore (rubber face out). Apply lubricant to seal.

2. Insert rotor shaft through oil seal in cover.

3. Set key in rotor shaft and install lever with indexing ball and spring. Make sure that keyway in rotor shaft remains toward bottom of cover.

4. Tap control lever into position with a soft hammer and secure with retaining ring.

5. Position new cover gasket on pilot face of cover.

6. Install rotor with cover into selector valve body. Secure cover with four cap screws. Tighten to 4 pounds-foot torque.

7. Install safety relief adjustment parts in rear of valve body.

8. Check for correct assembly by moving lever back and forth. Selector valve is now ready to be installed on main housing. See fig. 19.



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

SECTION 7. REPAIR OF INTERNAL SUBASSEMBLIES

CAUTION

Avoid contact with rotating output coupling and always shut down engine when doing even minor inspection or repair. Avoid contact with metal surfaces as operating temperatures may exceed 200°F

7.1 REMOVAL OF REVERSE GEAR

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

2. Disconnect all plumbing and wiring and disconnect control linkage

3. Remove inspection covers

4. Scribe alignment mark across outside diameter of flanges on output coupling for exact refit. Disconnect coupling

5. Remove or push back propeller coupling member to obtain maximum clearance and remove pilot ring resting between couplings. NOTE: Protect mating faces of couplings and pilot ring to insure proper refit and alignment.

6. Screw two $\frac{3}{4}$ "-10 eye bolts into lifting holes on top of housing and connect hoist so it supports the weight of the transmission.

7. Remove cap screws and lock washers holding housing to oil dam

8. Insert screwdriver or similar object through side inspection hole to hold clutch assembly inside forward drum. Slowly move housing aft and away from oil dam. See fig 20.

9. Remove clutch from forward driving drum.

NOTE: See page 35 for adapter group repair



Capitol Gasket and Seal kit no. 1-10190-0000 (HP-9400) and No. 1-10192-0000 (HP-10500) includes all gaskets, seals and orings needed for repairs.

The o-rings required for the bevel gear carrier must be purchased separately.

7.2 TABLE: REPLACEMENT WEAR LIMITS

HP-9400 And HP 10500

	NEW	NEW DIMENSION	REPLACEMENT
ITEM	DIMENSION	MAXIMUM	WEAR LIMIT
	MINIMUM		
Reduction Gears backlash	0.004	0.008	020
PINION SHAFT	0.001	0.000	.020
O.D at Forward Commutator	2.2450	2.2455	2,2440
O.D at Forward Bearing	3.1504	3.1511	3.1490
O.D at Rear Commutator	3.872	3.873	3.871
O.D At Rear Bearing	2.5010	2.5015	2.5000
Forward Commutator bushing I.D.	2.250	2.251	2.253
Rear Commutator bushing I.D.	3.876	3.877	3.881
Clutch Disc Thickness			
Driving (external teeth)	.184	.189	.174
Driven (Internal teeth)	.085	.095	.075
Clutch Pack Thickness-Clutch			
no. 1-00100-2419			
Forward pack (Compressed)	2.152	2.272	1.992
Reverse pack (compressed)	1.883	1.946	1.743
Clutch pack thickness-Clutch			
no. 1-00100-2420			
Forward pack (Compressed)	2.690	2.840	2.490
Reverse pack (Compressed)	2.421	2.556	2.241
Clutch pack thickness-clutch			
Forward Pack (compressed)	2 600	2 840	2 490
Brake (Compressed)	538	568	108
	.550	.500	
			PRESENT OR MORE THAN
			006" CLEARANCE EXISTS
			BETWEEN PLIMP GEARS
			AND BODY
OIL PUMP BUSHINGS. I.D	.751	.752	.754
SELECTOR VALVE			IF DEEP GROOVES ARE
			PRESENT (.025" DEEP).
DRIVING DRUM SPLINES			IF DEEP GROOVES ARE
CLUTCH END FLANGE			PRESENT (.025" DEEP)
SPLINES			
ALL SPLINED PARTS			REPLACE IF FIT IS NOT
			SNUG.



Fig. 21.Clutch Assembly (no. 1-00100-2420 is shown).

7.3 CLUTCH

A. DISASSEMBLY

1. Remove socket head cap screws, lock washers and Allen nuts securing both clutch flanges to bevel gear carrier.

2. Lift off clutch flanges and clutch discs.

3. Press and Remove bearing and driving gear from both forward and reverse clutch flanges.

4. Remove locknuts, clutch identification tag and cap screws from outer perimeter of cylinders.

5. Separate and remove cylinders

6. Remove and discard o-ring from bevel gear carrier. (Always replace with new o-rings to avoid internal leaks).



Fig. 22. Removing Sevel Pinion Shaft with Puller.

7. Remove cap screws and locknuts securing pinion shafts in bevel gear carrier and remove bevel pinion shaft with puller. See figure 22.

B. CLEANING AND INSPECTION

1. Inspect bevel pinions for wear, chips, and breaks or out of round condition. If there is any damage, we recommend replacing all of them as a set.

2. Check all pinion bearings and washers for distortion or rough operation

 Clean all parts with a good grade cleaning solvent or diesel fuel. Blow dry with compressed air, coating bearings with light oil.
Inspect all oil passages in bevel gear carrier to see that they are free from obstruction.

5. Inspect bevel gear carrier for cracks, chips or worn mounting surfaces. Pay special attention to seal ring grooves. Discard carrier if damaged.

6. Inspect forward commutator bushing for chips, heat scores, scratches, distortion or wear (see Wear Limits p.23). Repair or replace as necessary.

7. Inspect all hardware and springs for wear or distortion. Repair or replace as necessary.

8. Remove clutch discs from flanges and inspect discs for broken teeth, heat scores warp age or wear (see wear limits, page 23). Replace as necessary.

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

10. Check both clutch flange ball bearings for wear, distortion, or rough operation. Replace if necessary.

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

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

C. ASSEMBLY

1. In order to install a new commutator bushing either that bushing should be frozen or the bevel gear carrier heated. This will allow ease of fit and will help prevent scoring of the gear carrier bore. An anti-seize compound should be used on the bushing also.

2. Line up holes in flanged end of bushing with roll pins in bevel gear carrier. Press in new bushing on side of carrier stamped "REV'. Until it seats in bore. The roll pins will lock the bushing in place and insure lineup of oil holes in the bushing and bevel gear carrier. 3. Installation of pinion shafts: (see fig. 23).

A. Lay gear carrier flat on table

B. Apply lubricant on shafts and bores to ease fit and prevent damage.

C. Insert protective cap screw in top of pinion shaft and tap shaft into carrier bore just enough to protrude slightly into inner recess. Make sure holes will match.

D. Place bevel pinion with bearing on shaft. Tap shaft into bearing until holes in shaft and carrier match.

E. Insert socket head cap screw and nut, Torque to 8 lbs ft.

4. Replacement of return springs and retainers (if necessary): Insert return spring retainers into return springs and secure in gear carrier using cap screws. Tighten cap screws tentatively until top of spring retainer protrudes the specified distance from the face of the bevel gear carrier hub as shown in fig 24.

5. Without installing o-rings, place cylinders on bevel gear carrier by hand. There must be a uniform gap between cylinders of .015 to .025". See figure 24. Check with a feeler gauge. If necessary readjust return spring height and install locknuts.

6. Apply lube in o-ring grooves in bevel gear carrier and slip on four new o-rings avoiding twists in the ring.



Fig. 23. Installation of Bevel Pinion Shaft Using Protective Capscrew (%-20 NF).



Fig. 24. Clutch Return Spring Height Adjustment.



7. To install cylinders:

a). Apply a light coat of lubricant on inner walls of each clutch cylinder as well as o-rings.

b). With forward side of gear carrier up, press cylinder on by hand. (See fig.25)



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

d). Insert cap screws and locknuts and tighten to fifteen pounds-foot torque.

8. Press ball bearing into forward clutch flange. Press bevel gear into ball bearing. See fig. 26. Be sure to replace snap ring in innermost groove of forward flange.



ig. 27. Roverse Clutch Flange, Roller Bearing and Bovel Gear

9. Likewide press the other ball bearing into reverse clutch flange. Be sure to install snap ring in outermost groove of reverse flange (see fig.27). Then press bevel gear into ball bearing. Check that ball bearings on both flanges are well seated.

10. Arrange the driving friction discs (external tooth) with the steel driven discs (internal tooth). Against the forward and reverse clutch flanges. Refer to the appropriate illustration in the parts information section.

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

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

Clutch assembly is now ready for installation

NOTE: Clutch cylinder timing adjustment is illustrated on p.11

7.4 PINION SHAFT AND RELATED PARTS

A. <u>REMOVAL</u>

1. With adequate hoist tip unit to rest on engine end. Support sump housing properly (HP-10500 only).

2. Remove cap screws securing oil pump and remove oil pump and oil pump shaft.

3. Remove cap screws securing bearing container and remove bearing container (pinion shaft will accompany bearing container). Rear commutator should be held so that pinion shaft slides out freely. See fig 28.



Fig. 20. Removing (or Installing) Pinion Shaft Assembly.

B. DISASSEMBLY

1. Release bearing locknut on pinion shaft by bending bearing lock washer. Remove bearing locknut with spanner wrench.

2. Remove keyed flat washer.

3. With suitable press extract pinion shaft out of bearing container. See figure 29.



C. <u>CLEANING, INSPECTION AND</u> <u>REPAIR</u>

1. Inspect pinion bearings for roughness of rotation, corrosion, scoring, scratches, burrs, cracks, pitted or chipped races, and wear of rollers. If one of these conditions is found replace the entire bearing set (3 pieces) see fig. 30. Clean bearings thoroughly with solvent. CAUTION: Because of close tolerance between shoulder of gear and bearing cone, the use of a puller will destroy the bearing.

2. Inspect pinion threads and splines for damage. Inspect both commutator surfaces and inspect bearing surfaces for grooved, burred or galled conditions. If damage cannot be repaired with crocus clutch, pinion shaft must be replaced.

3. Remove plugs in the end of pinion shaft and flush oil ports clean with solvent.

4. Inspect roller bearing mounted in housing bore for conditions mentioned in step 1. Clean bearing with solvent or replace if necessary.

5. Inspect rear commutator for damage or wear (see wear limits chart p.23). Replace if necessary. Clean commutator and commutator tubes and discard o-rings.

6. Remove oil filter cover and discard filter element. Flush canister clean with solvent.



Fig. 30. Pulling Bearing Cone from Pinion Shaft.

D. RE-ASSEMBLY PINION SHAFT AND RELATED PARTS

1. Heat bearing cones in hot oil (or water) (200 deg F max).

2. Apply lubricant to bearing surface on threaded end of pinion shaft.

3. See fig 31. Install bearing cup (A) into bearing container (B).



Fig. 31. Cross Section Showing Sequence of Assembly for Pinion Bearings.

4. Install heated bearing cone (C) onto pinion shaft and immediately install bearing container (B) onto bearing cone (C).

5. Bearing spacer (D) and heated cone (E) are now installed and cone is tapped snug.

6. Locate bearing washer and bearing lock washer on shaft.

7. Apply loctite 242 or equivalent on threads of pinion shaft.

8. Install bearing locknut on shaft and secure with lock washer.

9. Apply lubricant to o-ring groove in outside diameter of bearing container and install new o-ring.

10. Apply lubricant to o-ring grooves in rear commutator and install new o-rings. Install anti-rotation stud.

11. If new commutator or pinion is being used, check to see that fit between them is not too tight. Clearance must be .006", otherwise assembly will be very difficult and commutator may freeze on shaft.

IF PINION ONLY IS BEING REPAIRED OR REPLACED AND NOT OUTPUT GEAR PARTS THEN REFER TO E. INSTALLATION ON P.33.

7.5 OUTPUT GEAR AND RELATED PARTS

A. REMOVAL AND DISASSEMBLY

Transmission should be resting engine end down (See fig 33). Support housing if necessary. Pinion shaft should be removed prior to removal of output gear.

1.Remove cap screws securing retainer plate and remove retainer plate.

2. Remove and discard o-ring.

3. With suitable puller pull output coupling from output shaft (see fig.32).



Fig. 32. Removing Output Coupling from Shaft.



Fig. 33. Removing Cover from Housing.

4. Remove cap screws securing bearing retainer. Remove bearing retainer. Discard oil seal and bearing retainer gasket.

5. Remove housing cover cap screws and pull housing cover from housing (see fig.33).

HP-9400 Models: Do not remove bearing container before pulling cover.

6. Remove bearing container from cover and tap bearings from container.

7. Remove idler gear assembly from housing (or cover) if present.

8. Install lifting eyes and hoist output shaft and gear from housing (see fig.34).



Fig. 34. Removing Output Gear and Shaft.

B. CLEANING, INSPECTION AND REPAIR

1. Inspect tapered roller bearings for rough rotation, corrosion, scoring, scratches, burrs, cracks, pitted or chipped races and wear of rollers. If one of these is found replace entire matched bearing set. Otherwise, clean bearings thoroughly with solvent.

2. Inspect roller bearing at threaded end of output shaft (HP-9400: Roller assembly is on shaft. HP-10500: Roller assembly is in housing). And bearing race for any of the conditions mentioned in step 1. Replace if necessary by removing bearing locknut, bearing lock washer and bearing washer (HP-10500 only). Otherwise clean bearing thoroughly.
3. Inspect output gear for nicks, burrs, scratches, damage or wear of any kind. Teeth may be repaired with a flat file or grinding wheel, otherwise gear must be replaced. Clean gear with solvent.

4. Inspect output shaft splines for grooves or excess wear. Inspect bearing surfaces and shoulder (on splined end of shaft) for grooved, burred or galled conditions. If damage cannot be repaired with crocus clutch, shaft must be replaced. Otherwise clean shaft with solvent.

5. Inspect idler gear for nicks, burrs, damage or wear. Check bearings for smooth rotation. If wear is suspected remove snap ring(s) and replace as necessary. Clean all parts including idler hose with solvent.

6. Inspect output flange at bearing mating surface for nicks or burrs. File smooth or replace flange if necessary.

7. Inspect mating surfaces of output flange and propeller coupling and file smooth.

8. Inspect housing cover bores and front and rear mating surfaces for nicks and burrs. Repair if possible with file or crocus cloth. Clean cover with solvent.

HOUSING PARTS

Housing should now be tipped upright:

1. Flush clean and inspect main housing. Inspect front and rear mating surfaces and repair with file or crocus cloth.

2. Inspect reverse clutch drum for deep scratches or wear. Repair or replace as necessary. Clean with solvent.

3. Flush clean oil breather.

4. Clean oil suction tube and suction hose (sump to pump).

C.RE-ASSEMBLY OF OUTPUT PARTS 1. If output shaft or gear are new:

a). To create a better fit, gear and shaft must be lapped with lapping compound. Parts must then be thoroughly cleaned with solvent.

b). Key must have a slip fit in output gear. There must be at least .020" clearance between top of key and gear. File or grind key if necessary. Secure key to shaft with spring pin.

c). Heat gear in hot oil or water at 200F (93C) maximum.

d). Drop shaft in gear

2. Install bearing spacer on threaded end of output shaft.

3. (HP 9400 only) to install new roller bearing on threaded end of output shaft, roller assembly must be heated. Roller assembly is then tapped gently onto shaft snug against spacer. Tip housing to rest on engine end. Support housing if necessary. Install outer race so it seats firmly in housing bore. Install oil pan and bearing retainer and secure with capscrew.

4. (HP 10500 only) To install new roller bearing at threaded end of output shaft, inner race must be heated and tapped gently onto shaft snug against spacer. Install roller assembly so it seats firmly in housing bore. Install oil pan and secure with cap screws.

5. Place bearing lock washer on shaft

6. Apply lubrication to threads and install bearing locknut. Tighten locknut so that bearing spacer becomes tight against gear.

7. Using a punch, bend tang of lock washer into slot of locknut.

CAUTION: DO NOT ATTEMPT TO ASSEMBLE OUTPUT GEAR PARTS IN HOUSING. CREATE THE ASSEMBLY SHOWN IN FIGURE 35 BEFORE INSTALLATION IN HOUSING.

8. (HP-9400 only) see fig.35. Locate new bearing container gasket on cover and install bearing container in cover bore.

9. Heat output shaft bearing cones in hot oil (200 maximum).

10. See figure 35. Tap bearing cup (A) evenly into cover bore (HP 10500) or bearing container (HP-9400) make sure cup seats properly.

11. With threaded end of output shaft resting on table, lower cover on output shaft.

NOTE: BEARINGS ARE A MATCHED SET, DO NOT MIX PARTS.



Fig. 35. Sequence of Assembly: Output Bearings

12. Apply lubricant to bearing surface on shaft and install heated bearing cone (B) on shaft and snug against shoulder.

13. Install bearing spacer (C) and install second heated bearing cone (D) on shaft. Install bearing cup (E).

14. Heat output flange in hot oil or water at 200F (93C) maximum.

15. Press new oil seal evenly into bearing retainer.

16. Locate bearing retainer gasket and install bearing retainer. Secure retainer to cover assembly by alternately tightening cap screws. Torque to 130 lb-ft. (HP-9400) and 225 lb-ft (HP-10500).

17. Install hated output flange on splines of output shaft using match marks (10500 only). Flange may need securing with soft hammer.

With transmission housing engine side down:

18. Install forward pinion roller bearing in housing. Secure with snap ring.

D.INSTALLATION OF OUTPUT PARTS IN HOUSING

1.Install idler assembly, if present, in housing bore. Apply lubricant to o-ring groove on idler shaft. Install new o-ring and apply lubricant to oring.

2. If a new idler gear and or a new output gear are being installed apply marking compound to idler gear.

3. Secure new cover gasket in place with grease.

4. Using adequate hoist, carefully lower the cover/output gear assembly into place, see fig.36 or fig 37. A slow twisting of the output flange can aid in proper location of roller bearing. Secure cover in place with cap screws and lock washers. Tightening torque is 65-lb-ft.

5. TRANSMISSIONS WITH IDLER GEAR ONLY If a new idler gear and or output gear have been installed they must be checked for backlash as follows:

a.) Tip housing to rest in upright position

b.) Locate thousandths dial indicator on housing with tip resting on side of idler tooth (similar to figure 40).

c.) Stabilize output gear and twist idler back and forth

BACKLASH between idler gear teeth and output gear teeth must be NO LESS THAN .003" AND NO MORE THAN .010".

6. TRANSMISSIONS WITH IDLER GEAR ONLY if a new idler gear and or output gear have been installed check for proper tooth contact with marketing compound.



Fig. 36 Installing Output Gear and Cover: HP-9400



Fig. 37. Installing Output Gear and Cover: HP-10500.

7.4 (continued) PINION SHAFT AND RELATED PARTS

E. INSTALLATION

1. If new pinion, output gear or idler are being installed, apply marking compound to pinion.

2. Apply lubricant to bearing container outside surface to ease fit in cover bore.

3. Apply lube to commutator I.D and rest commutator in place with stud protruding through selector valve opening in top of housing.

4. Attach suitable hoist to bearing container and lower pinion shaft assembly through cover bore gently into commutator, seating bearing container in cover bore (see fig. 28).

NOTE: Commutator may have be jiggled with shaft assembly is tapped into it.

5. Apply cap screws and lock washers to bearing container. Torque to 42 lb ft.

F. INSTALLATION OF OIL PUMP AND RELATED PARTS

1. Install oil pump shaft into pinion shaft.

2. Apply joint compound to threads and install pipe nipples, bushing and oil filter to oil pump. CAUTION: FLOW ARROW ON FILTER MUST POINT AWAY FROM PUMP SEE FIG.16. 3. Apply grease to bearing container and locate new oil pump gasket on container.

4. Install oil pump (and filter) on bearing container. Secure pump with cap screws and lock washers and torque to 42 lb ft.

apply joint compound on all threaded fittings:

5. Install cleaned suction tube and tee at bottom of housing (see installation drawing for correct location).

6. Install suction hose to tee and oil pump. Connect hose from selector valve to oil pump.

7. On units with idler gear, connect hose from oil pump to idler shaft.

Transmission housing should now be tipped up right with the aid of a hoist.

7.6 POST ASSEMBLY PROCEDURE

A. CHECK OUTPUT FLANGE FOR TRUENESS

Check output flange rotation as follows:

a). With a thousandths dial indicator check the run out of the output flange pilot ring groove as shown in fig.38. Variation must not exceed .003" max.

b). Dial indicates the output flange mounting face as shown in fig.39. Variation must not exceed .003" maximum.



Fig. 38. Dial Indicating Output Flange Pilot Ring Groove



Fig. 39. Dial Indicating Output Flange Mounting Face



Fig. 40. Checking 'Backlash' with Thousandths Dial Indicator.

B. CHECKING BACKLASH

Transmissions requiring new pinion, idler or output gear must be checked for 'BACKLASH' or play between gear teeth as follows:

TRANSMISSIONS WITHOUT IDLER (A.E.R)

If a new pinion and or output gear have been installed, mount a thousandths dial indicator as shown so the tip is resting on the side of a pinion tooth. Stabilize the output gear and twist pinion back and forth. Backlash must be no less than .004" and no more than .016".

TRANSMISSIONS WITH IDLER (E.R):

IF a new pinion and or idler have been installed, mount a thousandths dial indicator as shown so the tip is resting on the side of a pinion tooth. Stabilize the idler gear and twist pinion back and forth. Backlash must be no less than .003" and no more than .010".

C. CHECKING TOOTH CONTACT (ALL MODELS) If a new pinion and or idler are installed check for proper tooth contact with marking compound (applied to pinion).

D.MISCELLANEOUS ASSEMBLY

1.Install oil breather

2.Install oil drain plug

3.Install new o-rings in commutator and selector valve support plate and install tubes in commutator bushing.

4. Install selector valve parts including support plate, base plate and gaskets. Use fig. 19 as a reference.



Fig. 41. Adapter Parts

7.7 ADAPTER PARTS

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

2. Remove oil dam adapter and inspect labyrinth oil seal on inside diameter. Repair or replace as necessary (wear or damage to seal indicates misalignment, check further.) 3. While oil dam is removed, inspect flywheel adapter and drive flange for distortion or rough mounting surfaces. Repair or replace as necessary.

NOTE: Independent mounts are shown in exploded view on pages 58 and 60.