



Technical Manual

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Lower bucket/dipper to ground and shut down machine. Inspect bucket/dipper for cracks and breaks. Do not permit tooth base exposure. Teeth may be reversed. Remove bucket/dipper from service and rebuild in shop before breakdown. Check main rotating gear hold down bolts. Use impact wrench if needed. Test ALL hold down bolts on rotating frame. Especially swing gear case, motor mounting, machinery pedestal and base bolts. Check also motor generator and air compressor mount and base bolts. Tighten rod bolts on bearing housing.

Examine and readjust, if needed, hoist and drag brakes and drag clutch. Look at the condition of brake and clutch lining. Remove inspection plate from swing gear case. Look at condition of gears. Use pry bar to detect any side motion of shaft indicating worn bearings. Examine condition of rotating brakes and their adjustment. Adjust, if needed. Inspect air compressor "V" belt tension, replace if needed. Fill the anti-freezer but don't drink that stuff. Check auto-lube system for loose or broken fittings or injectors.

Check center journal thrust washer and bearing. Secure ALL guards and safety features in place. DISCONNECT POWER SOURCE with machine shut down so electrical crew may adequately clean and inspect motor generators and electrical cabinets. NOTE any discolored electrical parts, it's a sign of overheating. In humid areas, look for fungus and mildew. Dry compressed air at LOW pressure works well for dust removal. Clean corrosion from parts, joints and connections. Retighten, where needed, any loose connections and terminals. Use of proper tool here eliminates broken terminals and terminal blocks. Replace missing or damaged tags and labels. Bundle loose wiring. Fasten ALL components and wiring in cabinets. Check the cable armor tight in the fixture. Look closely where wires and cables pass thru openings and grommets. Insulation damage generally occurs here. Replace grommets if needed. Arcing of motors and generators causes discolored commutators. Look at brushes and brush holder condition. Correct brush spring tension where needed. Collector rings need cleaning and checking also. Use a hand grease gun at each injector. Fill ALL grease lines and purge EACH bearing with MPG. Remember to replace ALL plugs, covers and inspection plates.

This may seem like a lot of running around checking, looking, inspecting, cleaning and then greasing; but this is the machine that makes the payroll possible. Keeping it running is very important.

Passing equipment condition reports along the line is important also. Wear patterns show up at varying degrees in time. Recording and checking these reports at a future date allows comparison and planned shutdowns. Planned repairs, part orders and crews for a scheduled shutdown eliminates idle downtime.

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-
5. Place seal on the shaft with lip turned toward the pressure and install garter spring in the slot with the hook and eye, 90 degrees from split. Butt seal ends together. If desired, apply to the split a small amount of Loctite #404 or Eastman #910 adhesive; but be very careful to keep adhesive AWAY from shaft, bore and seal edge. START seal into bore with the split at top of shaft. Tap seal into bore with hammer and wood block. Alternate from side to side until seal firmly seats in the bore. (Might be an idea to read the solid seal installation).

INSTALL OIL AND GREASE SEALS with the following procedure:

1. Carefully inspect seal for cuts, nicks or breaks. Rub a finger over lip and edges to feel roughness or pits that might cause a leak. A damaged seal is not worth installing. A properly sized seal is.
2. Check shaft for scratches, burrs or roughness that may cut or score the lip of seal. Look closely at area over which seal installs. Keyway and splines need a thimble or protective tape to safeguard seal.
3. Inspect bore for roughness or burrs that might cut or scrape seal when pressed into place. The bore and shaft need 1/16" chamfer. If not, carefully break the corner of seal.
4. Determine proper position of lip. (Ask the question: Is seal used to retain fluid or grease IN or rather to keep other material OUT). Position seal with lip turned to INSIDE when retaining oil or grease. Place seal with lip to OUTSIDE when other material OUT of bearing or case.
5. Lube the seal with light coat of oil or grease on ALL surfaces, particularly the lip and O.D. Lube shaft and bore also.
6. CAUTIOUSLY install seal on shaft. Be sure garter spring is IN SLOT and lip is TURNED correctly. Move seal from the shaft end to bore with a spiral motion.
7. Align seal in bore and tap LIGHTLY with hammer on wood block. Change from side to side around the seal until firmly seated in bore. No retainer plate is needed.

TWO SEALS INSTALLED back to back retain grease or oil and keep out other material at the same time. Where this practice exists, fill the space between the two with MPG.

GEAR CASE SEAL used for ALL oil tight gear cases requires a coat on one surface of the gear case cover with aviation Form-a-Gasket #3 (Permatex Co.). Apply 1/100" thick. Is using a paper gasket at cover, ALWAYS replace with a NEW manila paper gasket .010" thick. Apply aviation Form-a-Gasket #3 to BOTH sides of the gasket. Tighten the gear case cover bolts until the seal material extrudes from the joint.

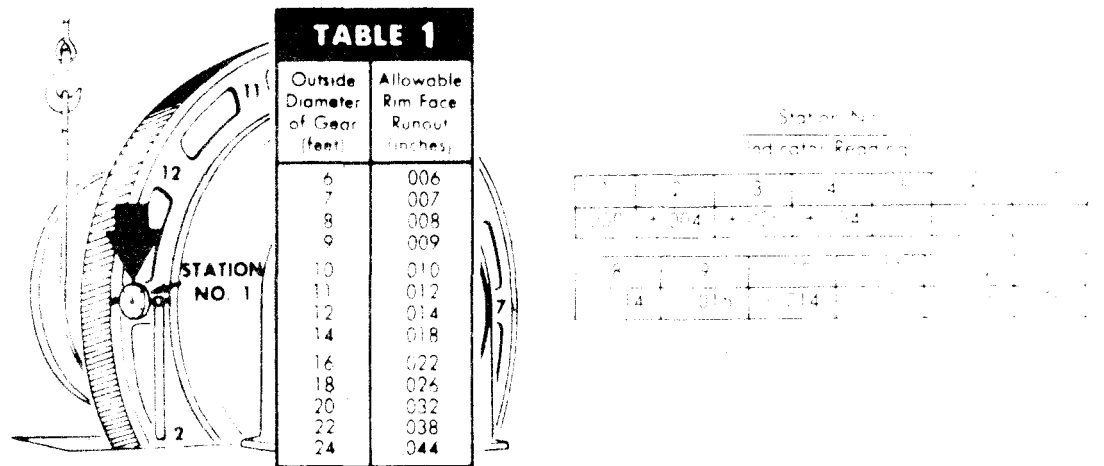
GEAR INSPECTION PROCEDURES

METHOD OF CHECKING RIM FACE RUNOUT OF GEAR. If gear can be rotated without end float, place dial indicator squarely against the rim face stamped (000), at station stamped (1) and set to zero.

Revolve gear slowly. Record reading at each station. After one complete revolution, indicator should read within (plus or minus) .002". If not, recheck. Allowable rim face runout is shown in table 1. Total rim face runout is the algebraic difference between maximum plus and maximum minus readings.

EXAMPLE: Readings for a 16 foot diameter gear are listed in a chart below.

Total rim runout is .020" is obtained between station 3 with a maximum plus reading of .005" and station 9 with a maximum minus reading of .015". This is within allowable .022" shown in table 1.



CHECKING RADIAL RUNOUT OF GEAR: Mount a dial indicator so it can be set against one of four machined surfaces. See sketch. Place indicator square with the machined surfaces at one of the stations stamped on the gear rim face. Revolve gear slowly and record readings at each station under the corresponding station number. After one complete revolution, indicator should read within (plus or minus) .002" of initial reading at starting station.

ALLOWABLE RADIAL RUNOUT is shown in table 2. The total radial runout is the algebraic difference between maximum plus and maximum minus readings. If radial runout ex-



Another method requires hand pouring of lube onto rope after brush or air jet cleaning. In either method, the rope must remain coated at all times.

Inaccessible boom supports and bridge strands need lubricant applied at and around boom hoist sheaves, as well as, the dead end anchor area. Spray can lube helps here.

Proper Methods of Seizing



Sketch of Method No. 1 for applying seizings. At A the turns of the seizing wire are spread apart to illustrate method of applying them. Completed seizing is shown at B.



Sketch of Method No. 2 for applying seizings. At A the turns of the seizing wire are spread apart to show method of applying them. Completed seizing is shown at B.

Seize rope BEFORE cutting. Tighten wrap, (a soft, annealed wire), about strand size wire; around rope. Pull wrap tight. Twist wire end secure. Use 1/4 inch wrap length on all rope up to 1/4 inch. On all other rope, measure wrap length at least one rope diameter in length. Place the first wrap about 1 to 1-1/2 inches from the intended cut. Then place a second wrap or seizing about 4 to 6 inches from the first.

Properly seizing a wire rope end prevents the strands from slipping. Any strand movement causes uneven load distribution in the strands and reduces rope life.

Seize rope BEFORE cutting. Tighten wrap, (a soft, annealed wire), about strand size wire; around rope. Pull wrap tight. Twist wire end secure. Use 1/4 inch wrap length on all rope up to 1/4 inch. On all other rope, measure wrap length at least one rope diameter in length. Place the first

Use a portable cable cutter whenever possible. Often a flame cutting torch is used and generally fuses the strand and wires together. Do not use a melting tip here.

Space wire rope clips about 6 rope diameters apart. Tighten clip on rope BEFORE placing rope in tension. Then retighten after rope is in use. Any rope diameter loss caused by pulling on rope, loosens clips. Retighten clips.

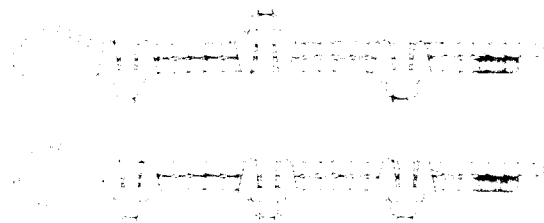
Only one correct method of attaching U bolt clips on wire rope exists. The clip base must bear on the live end of rope. The U of the bolt bears on the rope dead end (see sketch). Otherwise, the U-bolt kinks or cuts the anchor live end and causes failure.

Wire rope adjacent to the dragline bucket is subject to the greatest abrasive wear. This is true of the shovel dipper ropes too. When this rope section shows excessive wear, remove the rope socket, seize the worn area and cut off.

APPLYING WIRE ROPE CLIPS



The Right Way to Clip Wire Rope

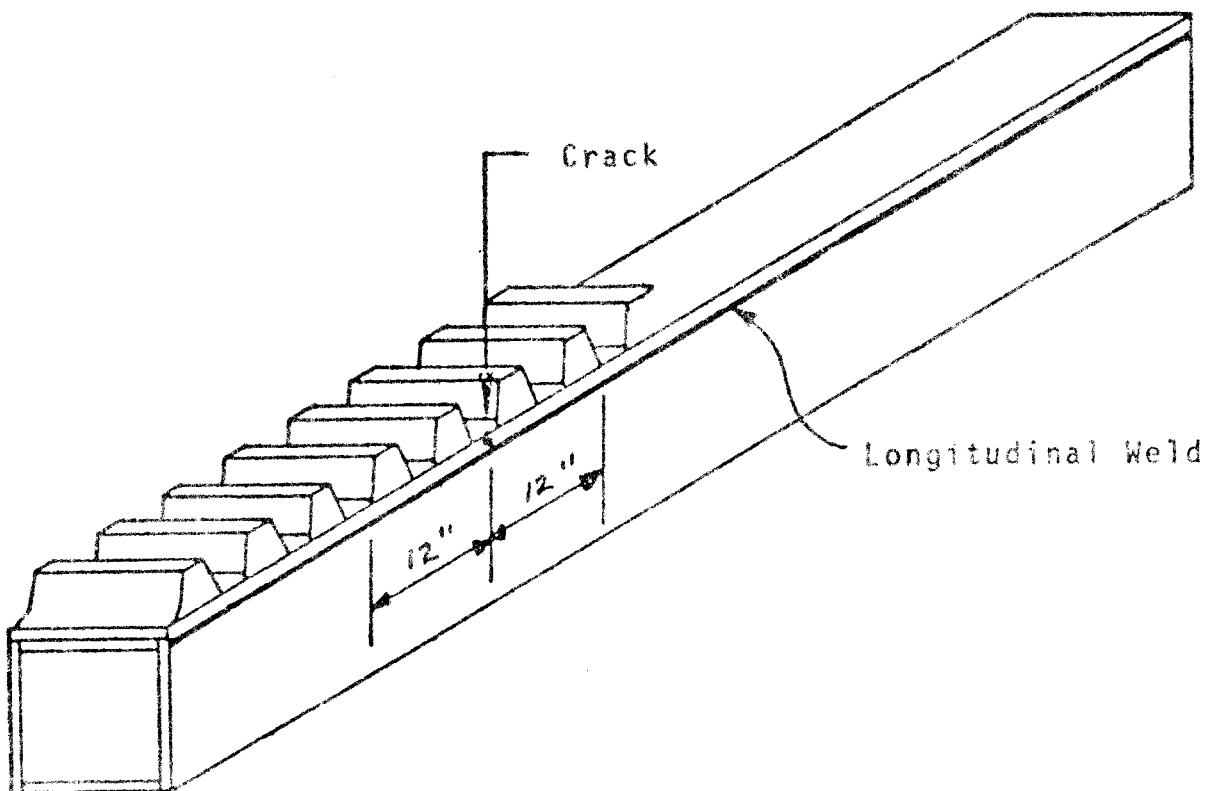


The Wrong Way to Clip Wire Rope



crack in the handle member; TAKE CARE that the root (base) bead DOES NOT penetrate into the handle member in the transverse joint. To accomplish this use LOW amperage and bridge across by placing a thin strip of copper in the root (base) of the joint or perhaps a thin, steel bar. Electrode selection for compatibility to material specifications see the Welding Specifications.

Deposit the weld passes the FULL length of the joint, reversing direction at each pass.

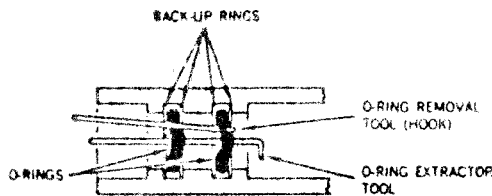
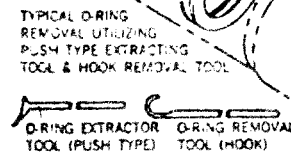
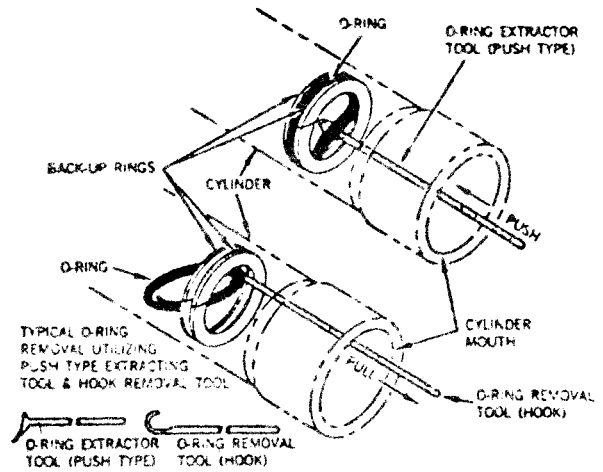
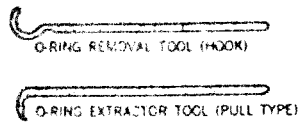
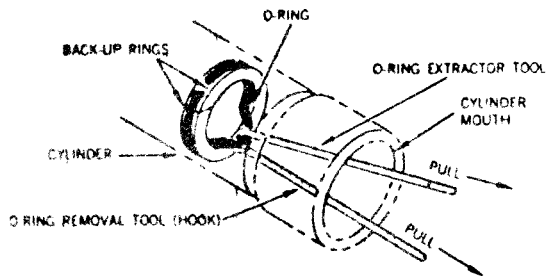




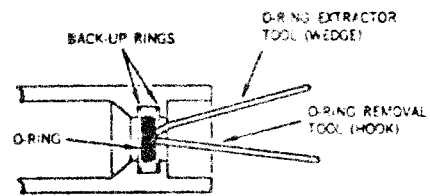
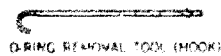
DO NOT USE pointed, sharp-edged or hardened steel tools (screwdrivers, church keys or knives) for removal or installation of backup rings or seals. Soft-metal tools of brass or aluminum, plastic, wood or phenolic rod when formed into desired shape save the critical surfaces.

Tool surfaces need to be well rounded, polished and no burrs on working end. This obviously prevents scratches.

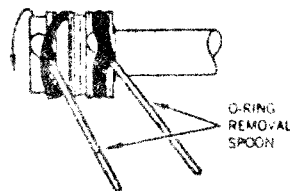
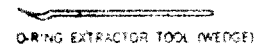
Removal from cylinders and pistons means every effort is needed to avoid contact with machined surfaces.



TYPICAL DUAL O-RING INTERNAL EXTRACTION AND SIMULTANEOUS REMOVAL

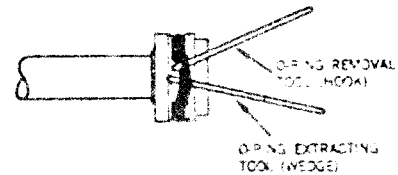


TYPICAL SINGLE O-RING INTERNAL EXTRACTION UTILIZING WEDGE TYPE EXTRACTING TOOL AND HOOK REMOVAL TOOL



TYPICAL EXTERNAL O-RING REMOVAL UTILIZING O-RING REMOVAL SPOON

CAUTION: DO NOT PERMIT UNNECESSARY CONTACT OF TOOLS WITH BEARING AND CYLINDER WALL SURFACES AND/DROPPING TOOLS INTO CYLINDERS.



TYPICAL SINGLE O-RING REMOVAL UTILIZING WEDGE TYPE EXTRACTING TOOL AND HOOK TYPE REMOVAL TOOL

NOTE: AFTER O-RING IS DISLODGED FROM GROOVE, HOLD SPOON TOOL STATIONARY, SIMULTANEOUSLY ROTATE AND WITHDRAW PISTON FROM RING.



KEYLESS COUPLINGS

ASSEMBLY OF KEYLESS COUPLINGS requires heating coupling uniformly in an oil bath or controlled oven (DO NOT unevenly heat with any torch type) to a temperature of 392 degrees F. or 200 degrees C., and shrinking onto a cylindrical shaft extension with no key or keyway. The amount of interference fit sufficiently gives adequate driving torque with adequate safety factor, using no key.

When reinstalling a removed coupling half, locate it in the original axial and angular position. Generally, axial position is when the hub end is flush with the shaft end. Space the pressure hole in the shaft as far as possible from the pull-off holes. Check the face of a solid coupling and insure it is perpendicular to the shaft. Check the periphery of the coupling and insure it is concentric with the shaft. If necessary, true up these surfaces. Perform these checking and truing operations with shaft accurately aligned in a lathe.

REMOVAL OF KEYLESS COUPLING uses hydraulic pressure applied to the circumference of groove C in shaft extension S. (See sketch for cutaway of section for removal.) When this pressure exceeds initial radial stress, due to interference fit, coupling hub H expands a small amount and allows oil to seep into the fit in both directions from groove C. Although the distance from groove C to coupling face A is much less than distance to coupling face B, the end effect at corner maintains hydraulic pressure until entire bore length expands and oil appears at face B.

Upon reaching this condition (3 or 4 minutes after applying pressure) the coupling floats on a high pressure oil film and may be removed with a hand puller and wrench. When coupling face B uncovers groove C, oil pressure is instantly lost. The coupling now pulls harder to shaft end. However, this area is small enough that finishing with same wrench and puller adding a little more force does the job.

Protect the shaft center from damage with a small brass or copper shim under puller driving point.

WARNING: DO NOT USE ORDINARY PIPE FITTINGS. PRESSURES INVOLVED ARE WELL ABOVE RUPTURING STRENGTH OF ORDINARY PIPE AND FITTINGS.

Use threaded holes near shaft for pulling coupling. Distortion of coupling is possible when pulling near the outer rim.



Pushing **ALARM RESET** button silences the alarm and resets system for continued service. **CHECK OUT** the causes previously mentioned before continuing.

When installing, servicing or repairing auto-lube equipment: **KEEP IT CLEAN**. Keep **ALL** lines free of dirt. Bleed **ALL** air and pre-fill lines with lube before placing into operation.

To pre-fill, disconnect lines at bearing **ONLY**. Remove cap on each injector face and expose grease fitting. Fill line from injector to bearing with hand pump until lube flows from the tube. Connect tube to bearing and fill bearing. (The auto-lube system is not designed to provide initial filling of bearing, only to provide replenishing supply.)

Remove **ALL** plugs on main supply line, one at a time, including injector block end plugs. Pump lube into system until **ALL** air bleeds out and lube flows from opening. Proceed until **ALL** plugs have been removed; **ALL** lines filled and **ALL** plugs **REPLACED**. With these steps complete, the system is ready for automatic operation.

USE ONLY CLEAN AND PROPER LUBRICANT – KEEP IT CLEAN

Selection of proper lubricant remains of the utmost importance. Improperly lubricated bearings, gears, couplings, and other precision parts quickly fail. For this reason, lubricants selected in accord with the ASTM Standards are recommended. These standards were compiled in cooperation with major petroleum suppliers to insure the consumer of exact supply to specific requirements regardless of source.

We recommend you avail your petroleum supplier of the following information to assist him in selecting the proper product for each application on this machine.

Final acceptance of all lubricants supplied to this standard will be based upon satisfactory performance in its intended application and does not relieve the supplier of performance responsibility of brand name products.



MPS CO. SPECIFICATION – HDF HYDROSTATIC DRIVE FLUID

	<u>HDF All Season</u>	<u>HDF Summer</u>	<u>HDF Winter</u>
Pour Point	-25	0	-40
Flash Point °F Min.	400	400	390
Temp. @ 1000 SUS °F Max.	55	70	40
Temp. @ 5000 SUS °F. Max.	10	30	0
Temp. @ 90 SUS °F Min.	165	165	140
Viscosity @ 100°F SUS Min.	300	300+	190
Ambient Temperature Range (°F)	-10/+110	+40/+110	-40/+80
Viscosity @ 210 °F SUS Min.	64	64	50
Operating Oil Temp. Range (°F)	*40/165	*70/165	*40/140
Viscosity Index Min. ASTM 2270	180	100	140
E.P. Timken Min. O.K. Load (Lbs.)	30	30	30
R & O Additive	Yes	Yes	Yes
Copper Corrosion ASTM D-130	1A	1A	1A
Anti-wear Additive	Yes	Yes	Yes
Oxidation Life (Hours) ASTM D-943	2500	2500	2500
Analine Point Min. °F.	190	190	190
Anti-rust	Yes	Yes	Yes
Vickers Pump Wear Test 2000 PSI – 100 Hours	Pass	Pass	Pass

*With Heated Reservoir

NOTE:

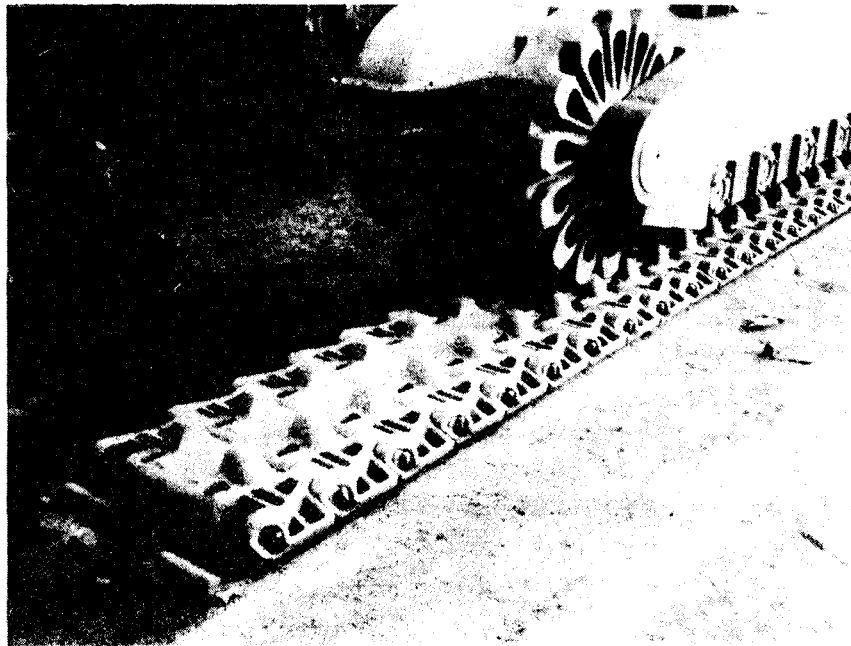
1. Anti-Wear Additives must be compatible with bronze and copper alloys.
2. Automatic Transmission Fluids and Engine Oils are not acceptable.
3. Fluid must have petroleum base (no synthetic base).
4. Fluid must not combine with water to form emulsions.



SECTION 4

MECHANICAL ADJUSTMENTS

CRAWLER BELT assembles on the side frame with the bottom strand male connecting lugs turned toward the front. Both belts are identical. Each belt consists of 45 separate shoes, connected at each joint by two hardened steel pins. Each pin locks in place by a bolt thru the shoe web. Each bolt uses two lock washers; one under the bolt head, another under the nut. **DO NOT TRAVEL** with lock bolt missing. Pins work out and the belt separates.



The belt disconnects at ANY joint by removing the lock bolts and driving the pins out. Use a spike maul and sledge here. If pins are bent or deformed, burn them out.

The crawler belt adjusts by moving the front roller shaft assembly. Moving the shaft forward tightens the belt; moving to rear, toward sprocket shaft, loosens the belt. The proper belt adjustment is 3 inches of sag in the top strand between the slides. Adjusting belt too loose causes shoes to climb the sprocket and serious damage may result. Adjusting too tight causes unnecessary wear and loss of power.

The front roller shaft mounts in two bearing blocks fitted into rectangular openings at each side of the crawler side frame. The roller pin is held in place by a shoulder pin which fits thru the slide block and roller pin. This pin also extends thru the rear wall and provides a base for the jack when adjusting belt tension. With roller in place and the proper belt adjustment, place shims on each side of the bearing block to completely fill the rectangular opening.


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DISASSEMBLY OF ROTATING GEAR CASE (once removed from machine): Remove the four tapered pins, the eighteen 1 inch bolts and top case section. Remove the bearing retainer from the intermediate shaft, the 1st intermediate gear, inner bearing retainer and pinion shaft. The top and bottom bearings come out with the shaft. Remove the retainer from the main rotating shaft and remove the gear.

Clean inside case and flush with a light oil.

REASSEMBLY OF ROTATING GEAR CASE:

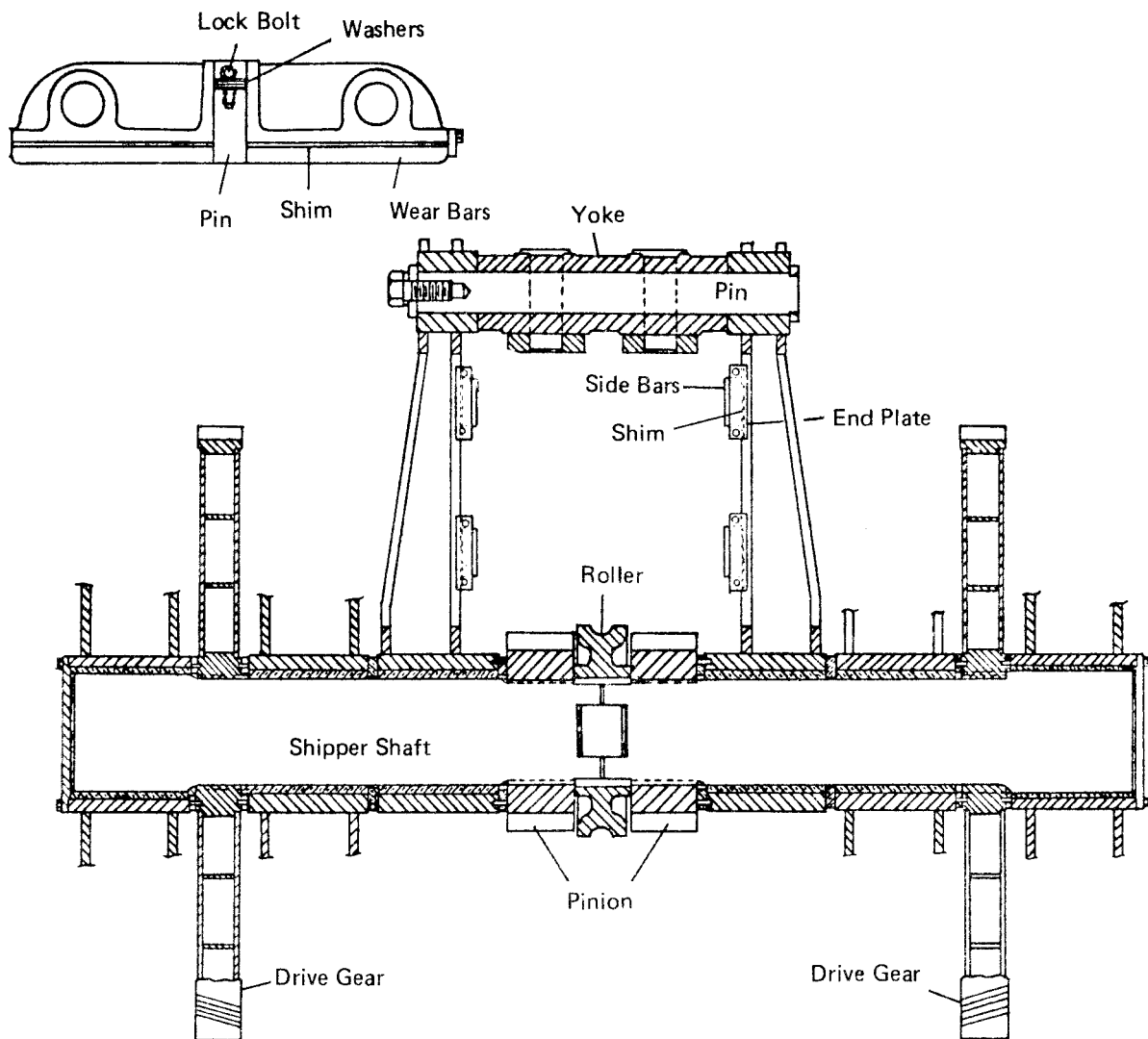
1st intermediate shaft—position the lower anti-friction bearing on shaft and lower the unit into gear case. (NOTE: shaft pinion has left hand, helical cut teeth.)

2nd intermediate shaft—position the lower anti-friction bearing on gear and lower into gear case. (NOTE: gear has right hand, helical cut teeth.) Rotate gear to mesh with it's mating pinion. This is important. Place center section of case on the lower section, align and install the temporary hold down bolts. Assemble top bearing on the 1st intermediate shaft. Pull down bearing retainer ring without shims. Turn capscrews progressively until the bearing binds slightly when shaft is turned. Back off on retainer until shaft turns freely. Measure space between retainer and top of bearing housing at three places, 120 degrees apart. Average these measurements and install proper shim(s) under retainer ring. Retighten capscrews and lock with lock wire (see Engineering Data). Assemble top bearing on 2nd intermediate gear. Adjust bearing the same as for the 1st intermediate gear. Remove temporary bolts and assemble gear base cover, replace tapered pins and tighten ALL bolts. Before rotating case is returned to machine, replace O-ring on the underside of case.

Reverse removal procedure to install gear case and motor on machine.

REASSEMBLY OF MAIN ROTATING SHAFT: Replace bearing retainer on underside of upper frame and it's gasket. Assemble double row bearing on main rotating shaft. Lower the shaft thru opening in gear case cover. Install bottom gasket bearing retainer and oil seal (with lip up). Replace O-ring in swing pinion and spray swing pinion top end with Molycote, M3402 on lip seal area. Jack pinion onto swing shaft and secure with retainer and bolts. Replace pipe plug in bearing housing and install pinion guard. Replace drain pipe, fill swing case with 190 gallons of GL and check oil level.

A **MAIN ROTATING BRAKE** mounts atop each swing motor. The brake housing keys to vertical motor extended shaft. This brake is NOT intended to retard or stop swing motion, except in **EMERGENCY:** but acts as a holding brake only. Rotation is stopped by "plugging" or reversing the motors. (See Operation Section.)



To measure clearance at handle top; place handle in horizontal position with dipper slightly retracted so handle weight rests squarely on the center roller of the shipper shaft. Pry up on each wear bar end until bar is snug against shims. Measure space between wear bar and dipper handle. Maximum allowable clearance is 1/4 inch.

Side wear bar clearance adjusts by removing end plate from shim end and inserting new shims between wear bar and yoke. If more than 1/4 inch of shims is required to reduce clearance to 1/4 inch; install new wear bar.

To replace top yoke block bars, remove the two lock plates. This exposes wear bars and top shims. Replace new wear bars and shims, replace lock plates and tighten capscrews.

To remove front wear bars, one each side; disconnect auto lube lines and remove front lock plates. The wear bar removes by pulling it toward the dipper.



SECTION 5

ELECTRICAL MAINTENANCE

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Rectifier failure detection using ohmmeter works, but the low voltage batteries in the meter do not always give a good test. Best results show up using the high resistance scale, but even this may not be conclusive.

The best test for rectifiers uses D.C. voltage at least 1/4th its rating. Connect a resistor in series with rectifier to limit current to a safe value. Connect resistor and rectifier across D.C. voltage, then read voltage across resistor. Reverse rectifier and measure resistor voltage. A good rectifier gives voltage across resistor with only one polarity.

Many other failures occur and often good intuition and ingenuity is needed to find them.

The trouble discussed thus far usually results in complete and permanent malfunction.

Perhaps more common and more difficult to find are intermittent failures resulting in only partial power loss. These trouble types distinguish a good troubleshooter from an average one.

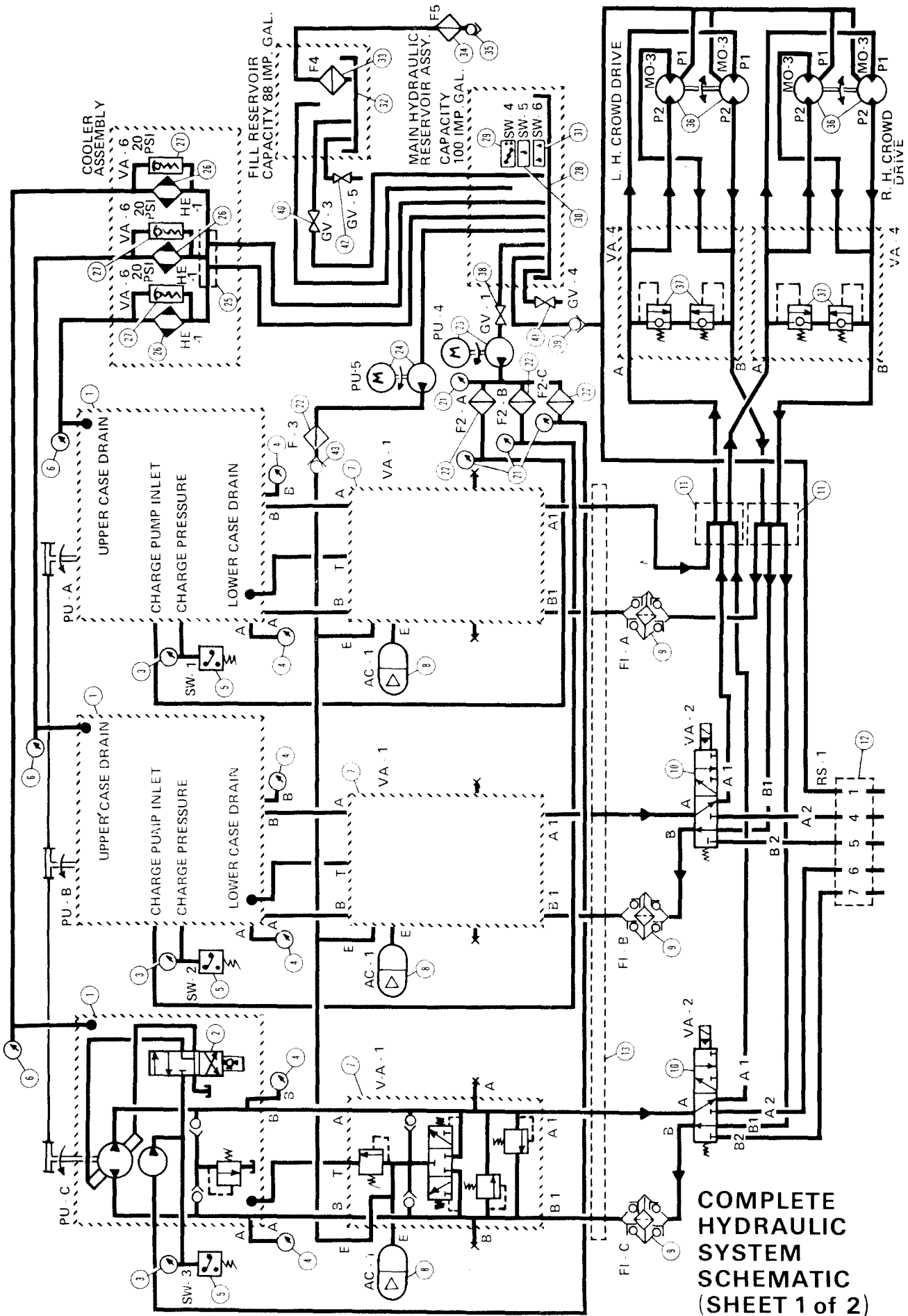
Start as before, interviewing operator, oiler and witnesses. Try in questioning to determine the exact nature of trouble. When complaint indicates partial power loss, find the effect under various load conditions and determine the cause of this effect.

Often a cause for weakening may be determined in a similar manner as locating complete failure. Select a starting point and compare measurements taken against recorded data. Compare honestly. A slight difference shows due to aging, temperature or an inaccurate instrument along with failure. Tests under one condition might not give a true problem indication. For example, tests at stall do not indicate no-load voltage is incorrect. Likewise, test for proper motor field voltage ONLY with controller (master switch) in proper position. In addition, check that stall current or no-load voltage varies properly with master switch position, since trouble could be failure of master switch.

In locating trouble of the weakening kind, one needs to know the various devices functions used to augment or increase power under certain conditions. Master switch contacts fall in this device class. Motor field contactors increase field strength under certain conditions. Conversely, current or voltage feedback circuits limit certain quantities to acceptable values. Failures resulting in decreased or increased outputs generally come from failure in these supplementary circuits.

Help here comes from knowing the effects certain changes have on performance. Naturally, reducing stall current reduces motor torque so an equally heavy load cannot be lifted as before. A reduction in no-load voltage causes decreased speeds.

A change in motor field strength offers various effects. A lower field voltage provides higher speed for light loads, but lower speed for heavy loads. Complete field loss gives very high



**COMPLETE
HYDRAULIC
SYSTEM
SCHEMATIC
(SHEET 1 of 2)**

Control of the variable displacement, axial piston pumps is the key to controlling the shovel. The M-G set motor horsepower is transmitted thru the gear box to the pump. When the operator moves the control lever, the swashplate in the pump is tilted from neutral. The position of the control lever will determine the angle of the swashplate and therefore, the volume of fluid displaced by the pump. The control lever is stepless, therefore the direction and speed of operation is infinitely variable from zero to maximum.

The pump swashplate is controlled and positioned by a servo system. The control lever can be moved rapidly to a predetermined position with the servo follow-up system moving the pump swashplate to this predetermined point/position. The use of a servo system on the pump controls allows a minimum force to move the control handle.

MAIN PUMP SPEED AND DIRECTION CONTROL — As the swashplate of the variable pump is tilted in one direction, fluid is pumped thru one line to the motor/motors resulting in rotation of the output shaft in one direction. The fluid is returned to the pump thru the other line and the cycle repeated. The amount of flow (speed) varies with the swashplate angle. Load (working pressure) is determined by the external conditions (grade, ground conditions, etc.) and this establishes the demand on the system.

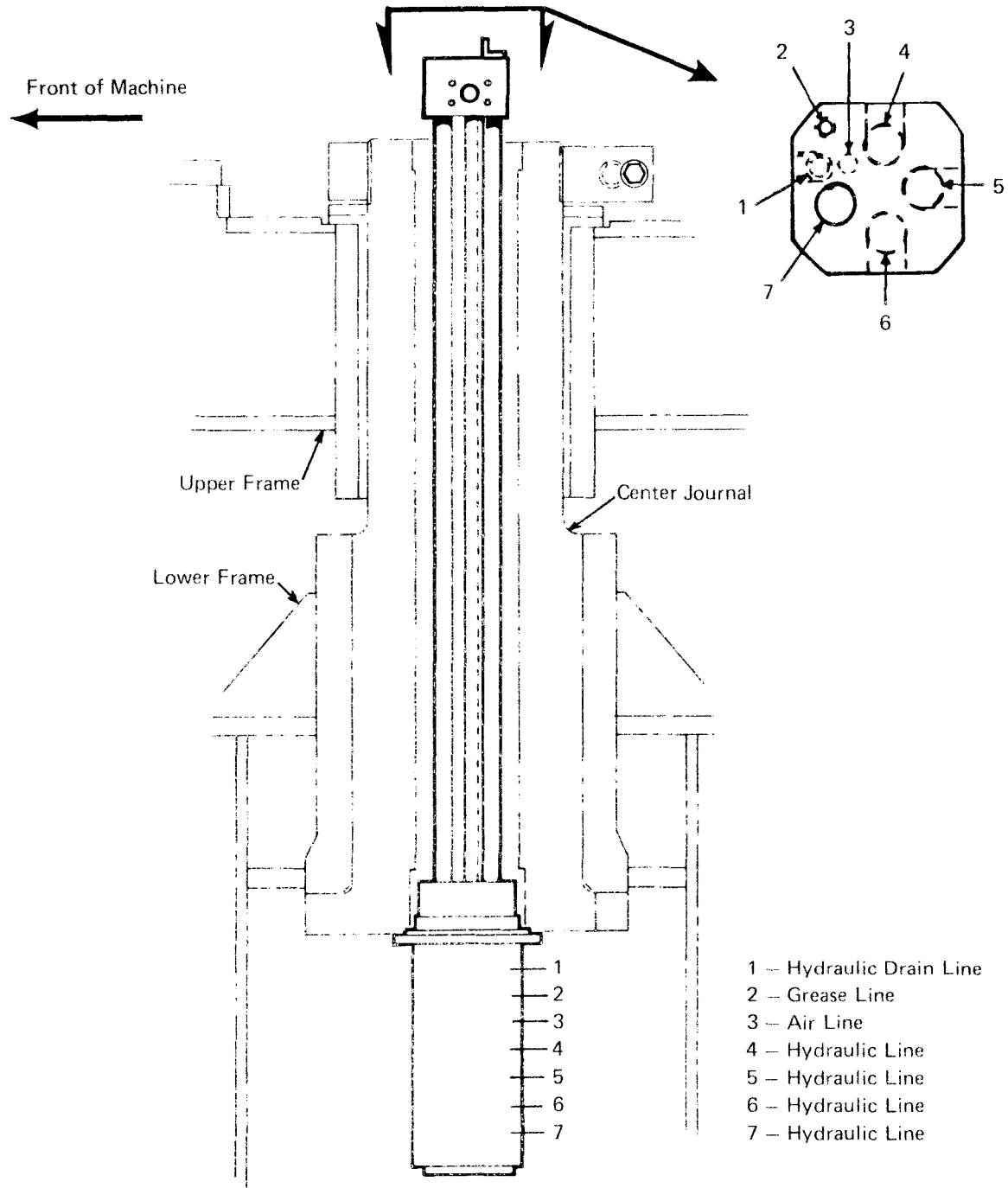
When the swashplate is tilted in the opposite direction, fluid is pumped to the motor/motors thru the opposite line, causing output shaft rotation in the opposite direction.

When the swashplate is in neutral, (zero angle), the axial pistons do not stroke, therefore, there is no fluid flow and no output shaft rotation.

The hydrostatic drive system has three main conditions which are NEUTRAL, FORWARD, and REVERSE. The output shaft speed is infinitely variable within the three conditions.

A small amount of fluid is used internally for the hydrostatic lubrication of critical wear surfaces. There is also a small amount of leakage past pistons, valve spools, etc. This leakage is removed from the circuit to prevent excessive heat. It is routed from the motor case directly back to the reservoir or from the pump case, thru the heat exchanger, then back to the reservoir.

CHARGE PUMP CIRCUIT — In the circuit described to this point, the system would soon be starved because leakage fluid is continuously taken out of the closed loop and returned to the reservoir. Therefore, it is necessary to replenish the circuit with fluid to keep it fully charged. To accomplish this, fluid flows from the reservoir thru a Precharge Centrifugal Pump, Inline Precharge Pressure Filter, then to the inlet of the Charge Pump mounted on the main pump. The charge pump is driven at main pump shaft speed. The purpose of the Charge Pump is to provide a flow of fluid thru the system for cooling, to supply fluid under pressure to maintain a positive pressure on the low side of the Main Pump Motor circuit, to provide sufficient fluid under pressure for control, and to make up for internal leakage.



ROTOSEAL ASSEMBLY

CAUSE D: Faulty low level switch.

INDICATED BY: Audible alarm and warning light in cab and at hydraulic/electrical control panel despite a fluid level ABOVE low level mark on reservoir sightglass.

REMEDY: Drain fluid from reservoir.

Check float action on switch assembly for correct vertical movement. Replace switch, if faulty.

Refill reservoir to proper level.

CAUSE E: Low charge pressure.

INDICATED BY: Audible alarm and warning light in cab and at hydraulic/electrical control panel location, PLUS charge pressure reading at one pump NOT attaining 280 psi.

REMEDY: Refer to "Troubleshooting" problem of "Low Charge Pressure" in this section.

NOTE: Charge Pressure Switches are set to actuate at 250 psi, falling.

CAUSE F: Faulty charge pressure switch.

INDICATED BY: Audible alarm and warning light in cab and at hydraulic/electrical control panel location, PLUS charge pressure above 280 psi on gauge.

REMEDY: Reset pressure switch at 280 psi and/or replace faulty switch.

NOTE: Charge Pressure Switches are set to actuate at 250 psi, falling.

CAUSE G: Clogged pre-charge filter.

INDICATED BY: Audible alarm and warning light in cab and at hydraulic/electrical control panel console. Low or unstable charge pressure in neutral or pump in "stroke" and A. Contamination indication at the filters.

REMEDY: Replace filters. If conditions persists, repair/replace filter head assembly.

TROUBLESHOOTING

PROBLEM: NEUTRAL DIFFICULT OR IMPOSSIBLE TO FIND.

CAUSE: Pump Moog controller NOT centered in neutral.

INDICATED BY: Charge pressure reading 300-320 psi and higher than charge pressure as read on respective A or B gauges, plus possible Crowd or Propel system movement, or pressure rise (above 400 psi) on A or B gauge.

REMEDY: Remove electrical connector from pump control or TURN OFF electronic control inside box. If pump returns to neutral, check electronic control system and repair electrical system, as required, to eliminate a Moog control from getting an electrical signal in neutral.

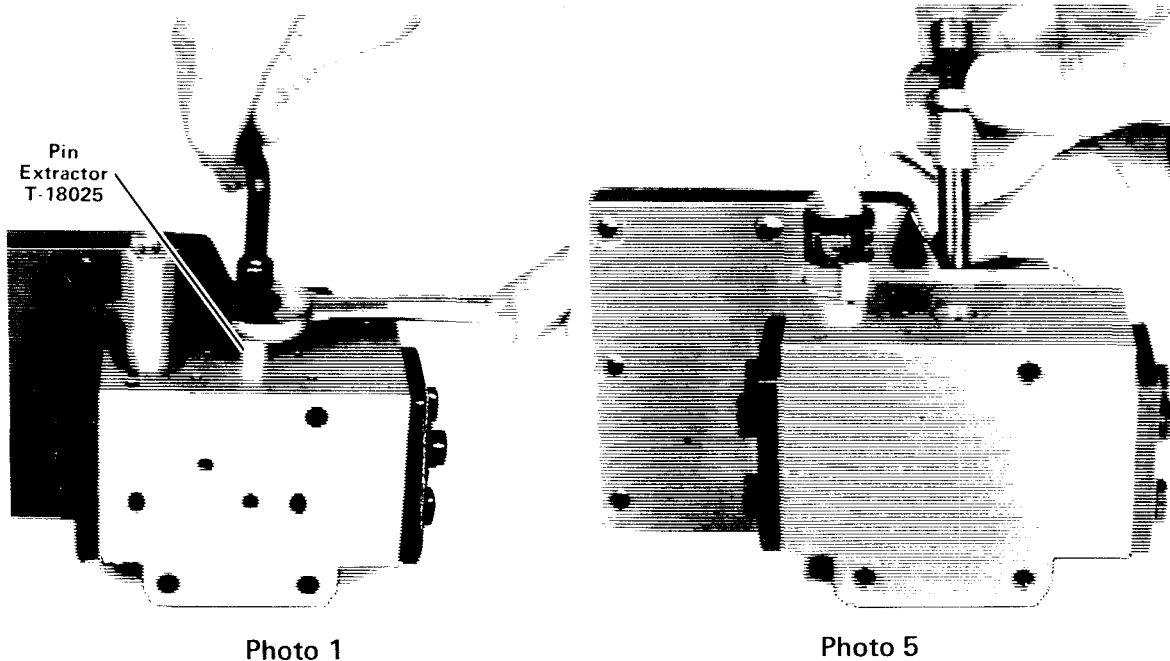
If removing electrical signal, pump remains uncentered; center pump Moog control, utilizing mechanical centering adjustment. If unable to recenter with this procedure, remove and replace Moog control.

NOTE: Place selector switch in PROPEL mode. EXCITATION ON.

NOTES:

Lubricate spool (28) with clean, filtered hydraulic fluid. Install spool in bushing (29) with spool slot end positioned toward right side of body (31). **PERFORM THIS OPERATION WITH EXTREME CARE.** Any misalignment causes spool to "hang up" and not slide fully or easily into bushing.

Thread a 5/16 – 18 x 2 inch socket head cap screw into bushing locating pin (19). With RETURN HOLE (in the side of bushing locating pin) pointing away from mechanic, insert bushing locating pin into large center hole in top of body (31). Remove socket head cap screw from bushing locating pin.



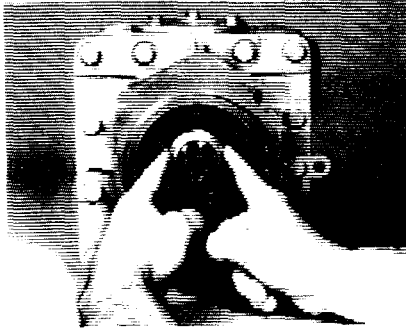
Install retaining screw (18) in top of controller body (31). Torque retaining screw to 15 – 17 inch pounds.

CAUTION: FAILURE TO INSERT BUSHING LOCATING PIN (19) AND RETAINING SCREW (18) TO SUFFICIENT DEPTH IN CONTROLLER BODY (31) PREVENTS PROPER INSTALLATION OF HYDRAULIC AMPLIFIER ASSEMBLY (14). THIS RESULTS IN EXTERNAL LEAKAGE AND PROBABLE DAMAGE TO HYDRAULIC AMPLIFIER ASSEMBLY.

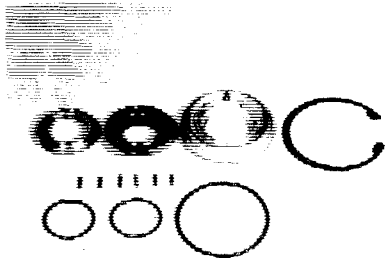
Install o-rings (15) and (17) in base of hydraulic amplifier assembly (14). If old hydraulic amplifier filters (16) were removed, install new ones by pressing filters thru o-rings, coarse side first.

Install left side seal plate (23) and end plate (22) and secure with hex head screws (20) and lockwashers (21).

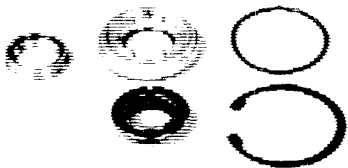
MINOR REPAIRS, VARIABLE DISPLACEMENT PUMP



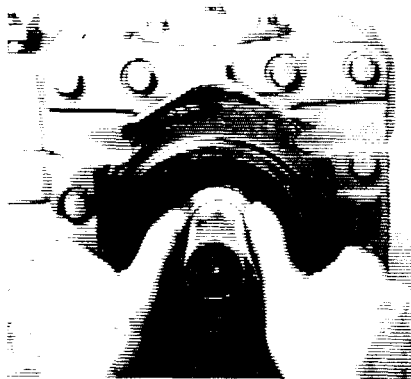
The bronze sealing ring is also held in place by internal o-ring friction. Work this part free and carefully slide over the shaft.



All of the shaft seal parts, which are included in the Shaft Seal Kit, have now been removed. Each part should be inspected separately if the seal is to be re-used. It is recommended that this entire shaft seal be replaced.



Prior to assembly, place one o-ring in the I.D. of the bronze sealing ring and one o-ring in the I.D. of the aluminum housing. Place the six (6) springs in the cavities in the housing. Care must be used to protect the parts from damage by the shaft during assembly.



Slide the sealing ring over the shaft and onto the shaft pilot diameter with the o-ring facing the pump. Work the ring into place using hand force only.

REMOVE BEARINGS FROM MOTOR: First push out rear bearing cup from motor case, using a press, or by tapping with a tubular drift toward motor center.

If bearing plate is a single unit, take out bearing extractor hole seal screws. Then extract front bearing cup, using two jacking screws in these holes.

If a composite bearing plate (consisting of front cover and shimplate) is fitted to motor, remove shimplate and shim(s). Now press out front bearing cup from front cover.

Remove shaft seal by pressing toward motor center.

Remove bearing cones from crankshaft, using suitable extractor placed over bearing rollers.

NOTE: This operation damages bearing so replacement is necessary. Take care not to damage the crank throw surface or surface on which shaft seal runs.

CYLINDER HEAD REMOVAL is usually not done unless O-ring or motor case needs replaced. Withdraw heads, with O-ring, after removing cap screws.

CRANKCASE RELIEF VALVE DISASSEMBLY begins by unscrewing valve from motor case. Remove circle clip. Now remove internal valve parts.

COMPONENT INSPECTION ---

VALVES, PISTONS AND BORES. Valves and pistons, without sealing rings, should slide fit into bore. Slightly scored components are generally reusable (except on motors where high volume efficiency is needed), provided that all sharp edges are removed by light stoning.

CONNECTING ROD AND CRANKSHAFT surface scoring is not acceptable, although a slight crankshaft roughness may be polished. Remove all running surface high spots. Be sure that ball end and piston spherical seat do not show signs of pick-up.

Keep the restrictor in the con-rod thru hole clear, and filter clean and undamaged. Restrictor hole diameter is very critical and no enlarging can be tolerated.

Be sure tracks for retaining rings are smooth.

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