Technical Manual

(Section 4 – Drill Air Components cont.) Page

The machine "leveling" hydraulic circuit is part of the auxiliary hydraulic system. This system powers the support functions on the machine. The various circuits in the auxiliary system are listed in following:

Circuit	Function
Stem Lock	Holds the drill stem or bit when connecting or unconnecting the threaded joints.
Winch	Provides power for heavy lifting requirements.
Stem Racks	Position stem for threading into rotary gearbox and provides storage for additional drill stems.
Mast Cylinders	Raises or lowers the mast as required.
Dust Skirt Cylinders	Lowers the dust skirts into position before drilling.
Break Out Tongs	Helps to loosen threaded joints.
Leveling Cylinders	Levels the machine before drilling.
Steady Guide Cylinders	Position Steady Guide for stem support while drilling.

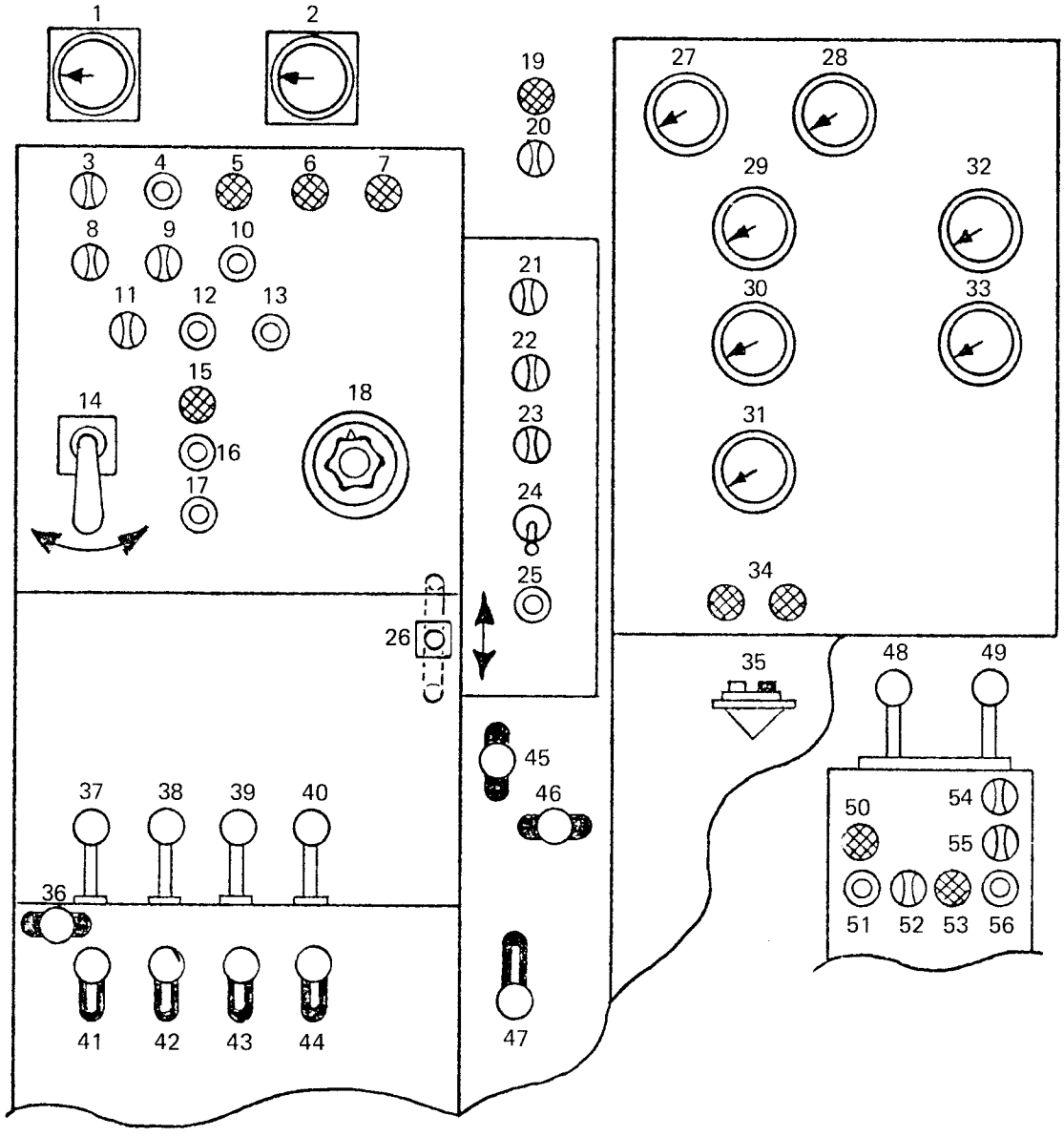
A house air filtering system provides clean air to the machinery house to cool the enclosed components and provide a slight pressurization to keep dust and dirt from entering.

The auxiliary air compressor provides pressurized air to operate the brakes, air valves and lubrication air pump. An additional discharge port is provided for attachment and use of air tools or hose for cleaning components or machinery house.

The AMERpulse (Bag House) air filtering system entraps airborne dust during the drilling operation to keep the air free of dust and help maintain a clean drilling area.

The motor generator set converts alternating current (A.C.) power to direct current (D.C.) power for use by the D.C. motor on the Rotary Gearbox.

The semi-automatic lubrication system provides lubrication to critical parts of the machine when the system is energized.



CONTROL PANEL

ADDING DRILL STEM TO STRING:

1. HOIST Drill Stem until milled slot aligns with Drill Table Lock. The Ram should engage the slot under 2 inches BELOW the slot in top flange. This provides sufficient space to allow the thread to back out of the Sub Saver.

2. MOVE Stem Lock Lever (36) to LEFT. The Hydraulic Cylinder moves the Stem Lock Ram against the Stem.
   If the Stem Lock Ram IS NOT 2 inches BELOW the Flange when engaged, HOIST Drill String the required 2 inches OR until Stem Lock Ram lifts OFF the pad for required distance to RUN the thread.

3. MOVE Selector Switch (14) to REVERSE Position 2. As Stem turns LEFT, a spring loaded pawl engages the milled shoulder of the Stem, causing the thread to release (unscrew) on impact.

WARNING: IF THREAD DOES NOT RELEASE (UNSCREW) IN LESS THAN 10 SECONDS, MOVE SELECTOR SWITCH (14) TO OFF POSITION AND USE THE BREAK-OUT TONGS. RUN OUT THREAD USING POSITION 2 ON SELECTOR SWITCH (14).

4. HOIST the Rotary Gearbox high enough to prevent Stem from hitting the gearbox when Stem Rack is lowered. Gearbox height is determined by reading the depth indicator.

5. PUSH Lever for Stem Rack selected (37, 38, 39) to raise rack to FULL UP position and take the load OFF the Stem Rack Lock. Then PULL Lever (37, 38, 39) to LOWER Rack until Stem Rack Cup aligns with the Drill String.

6. LOWER Gearbox until the Sub Saver contacts the Stem top. Move Selector Switch (14) to forward position 1 to engage the thread. When Drill Stem begins to rotate, MOVE Lever (14) to NEUTRAL position.

CAUTION: IF MACHINE IS ANGLE DRILLING, THE STEADY GUIDE MUST BE ACTIVATED AND ENGAGE THE STEM BEFORE IT IS REMOVED FROM THE STEM RACK CUP.

This is done by moving the lower Steady Guide Lever to the right to assure that jaws are OPEN, then LOWER the Steady Guide by moving the Upper Steady Guide Lever to the DOWN position. The Lower Lever is then moved to the LEFT to close the Jaws.

7. HOIST Gearbox and Stem. As Stem clears Rack Cup, the Lock Lugs release the Stem top. PUSH Stem Rack Lever (37, 38, 39) to return the Stem Rack to the UP position. The Stem Rack Lock snaps into position when reaching this position.

REMEMBER

PAYS

MAST AND MAST MACHINERY –

MAST RAISING uses two (2) hydraulic cylinders, one (1) on each side of the Mast. Before starting this procedure, take the following steps:

1. Make sure the Mast Brace Sections are pinned together. If raising Mast to a VERTICAL position, PLACE/POSITION Anchor caps to the UP position.

2. PLACE Rotary Gear box in the LOWERED position on the Mast.

3. LOWER Leveling Jacks to the ground to provide greater stability. LEVEL MACHINE USING REAR JACKS ONLY.

CAUTION: DO NOT LIFT MACHINE WITH FRONT JACKS WITH MAST IN LOWERED POSITION.

4. SECURE the Winch line.

5. CLOSE Left Hand Operator's Cab door.

With Auxiliary Hydraulic System operating, MOVE Control Lever (located in Operator's Cab at Machinery House side) to RIGHT.
SLOWLY MOVE Lever to FULL ON position.
When raising, Variable Restrictors control the oil flow to insure a safe raising speed.
SLOWLY MOVE Lever at STOP and START to prevent Mast whipping.

The Rotary Gear Box provides a counterbalance weight while raising the Mast. The Counterbalance valves in the Hydraulic System automatically hold the Mast at any angle, when necessary to interrupt the raising process. These valves also prevent uncontrolled Mast action if the Mast goes "over center" during raising.

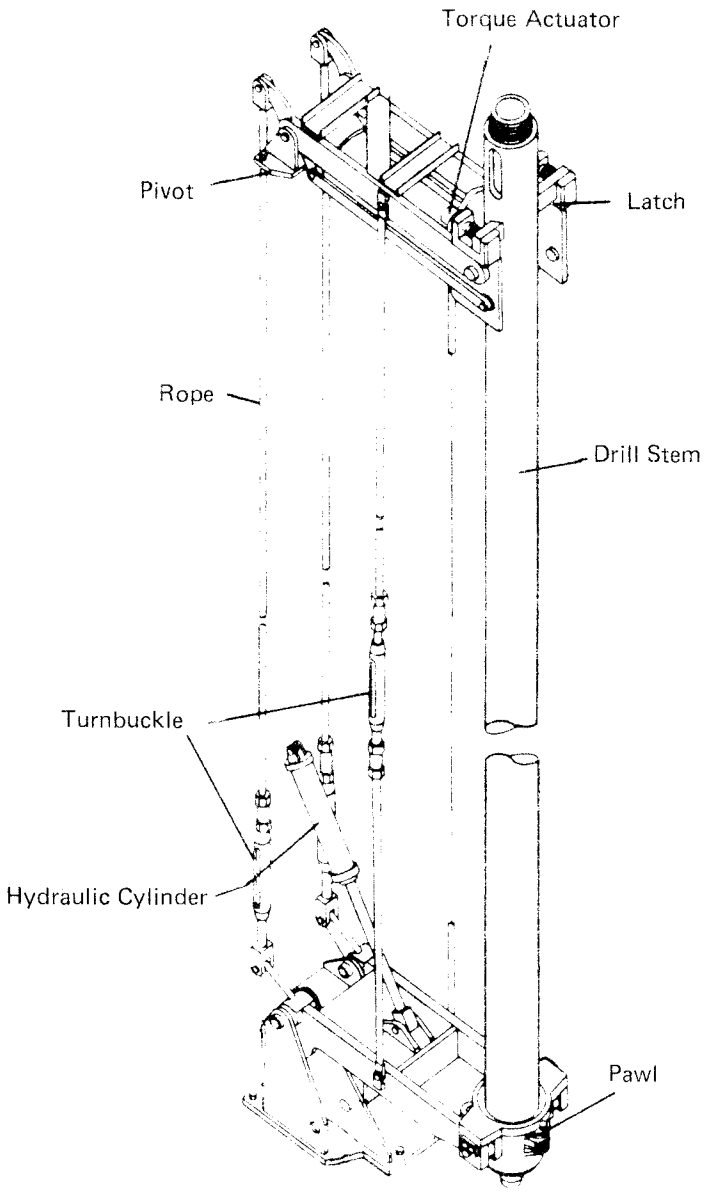
When the bore in the Lower End of the Mast Braces aligns with the bore in the Mast Brace Support Structure, INSERT PIN to maintain position.

If Mast Braces are not on the Machine, RAISE MAST TO VERTICAL POSITION: then LOWER the Hold down Anchor Caps over the Mast Anchor Pin and BOLT TIGHTLY.

If Mast is raised to Vertical position with the Mast Braces on the Machine; the Hold down Anchor Caps should still be used.

MAST LOWERING:

1. LOCK the Drill Stem in Rack



DRILL STEM RACK

The **STEM RACK** stores extra drill stems when not used and aligns the stem for assembly into drill string. Three separate and independent operation racks are used.

Each rack consists of a top and bottom bracket, pivoted to drill mast. The top and bottom bracket move in parallel by a quadrilateral linkage.

The stem rack lowers and raises by a hydraulic cylinder and locks in up position by a spring set, hydraulic release lock. In lowered position this lock acts as a stop.

The stem is supported by a cup on the bottom bracket and locks in place with two rotating locking latches on the top bracket.

When the stem is being lowered into bottom bracket cup, it strikes a position switch to actuate the rotary locking lugs at top bracket.

When stem is lifted from the cup, the lock lugs release.

A spring loaded pawl in this cup prevents stem from turning when separating threads at stem top.

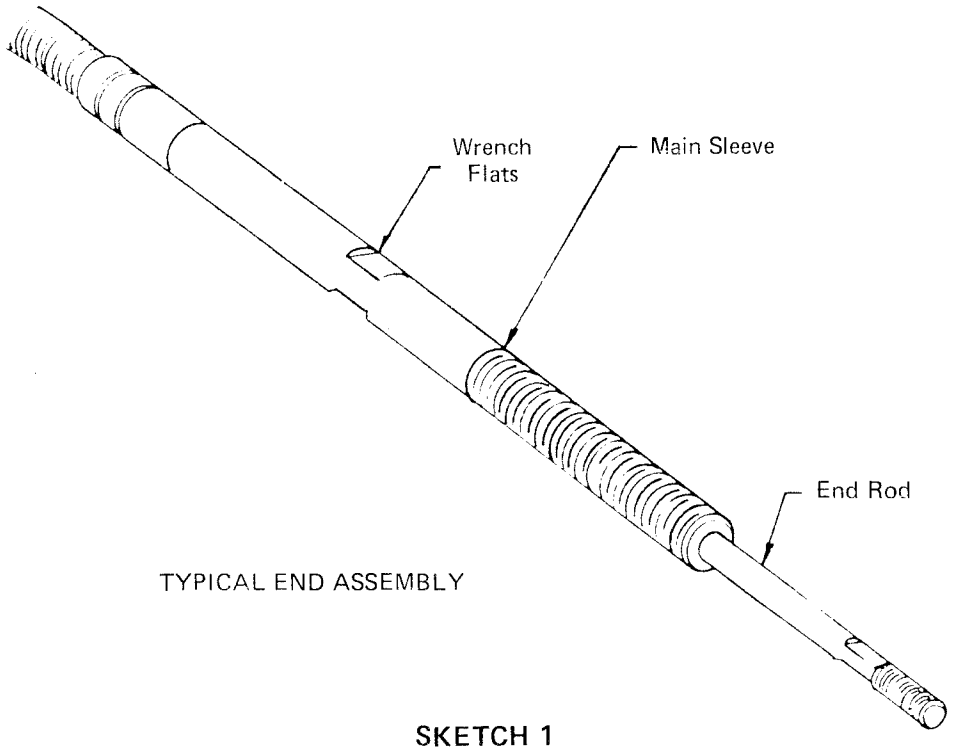
The **PROPEL CONTROL CABLE** is a direct link to the pumps for control of crawlers during the propel mode.

INSTALLATION PROCEDURE FOR PROPEL CONTROL CABLE – First, (before uncoiling the control) check that propel control number and identification appears in the control. All controls are marked.

Uncoil the control as shown in sketch 1. Once control is laid out straight, straighten the ribbon as shown in sketch 2. This is important to insure control is not helixed prior to installation.

Visually check the entire control, look at parts for cracks, abrasions, gauges, wear or other damage. Check also for excessive radial clearance and end play.

With a completely straightened control, stroke the end rod by hand. Check both the load and required stroke. The end rod should stroke freely without binding through out the full length of travel. The stroke length should be as required for the control in a straight position. If loads appear excessively high and above the stated ones on table I or if during stroking any erratic or increased loading occurs, recheck control for straightness and damage over the entire length. If this check shows control straight and undamaged, but erratic or increased loads remain, do not install this control.



TYPICAL END ASSEMBLY

SKETCH 1

The **AMERPULSE DUST COLLECTOR** (Bag House) is shipped to the Erection Site as one unit. Filter bags to be installed in the field.

OPERATING PRINCIPLES: Dust laden air enters top of collector housing and is deflected and distributed by a baffle plate. Dusty air flows down and thru the unit. Air passes thru the fabric tubes (bags) leaving the dust on the tube's outside, so clean air passes down thru the tube's, inside.

The filter tubes mount over spring-like expanders that prevent tube collapse due to air pressure. These expanders are in a coiled form for shipment to save space. The top end fastens to the diffuser and the bottom end connects to the tube sheet.

The control panel is a solid state printed circuit controller that energizes air valves to send compressed air flow over the diffusers to clean the fabric tubes. The electric controller is field adjustable for BOTH pulse duration and interval.

As compressed air ejects thru a pipe orifice to the diffuser, air moves down the tube. The tube deflects to quickly accelerate the media; first outward, then inward. This in, and out action causes collected dust caking to break away and fall into the hopper.

Because dust ladden air enters at unit top and discharges at bottom, air flows downward. This downward flow adds to the downward dust flow at the tubes to offer more cleaning.

Hopper capacity is mostly to receive dust and not intended for storage. The dust exits the hopper thru a "trickle valve" that automatically opens and slowly releases the dust.

The fabric tubes require careful handling. One end snaps into the tube sheet and the other fastens to the diffuser at unit top with a tube clamp. The fabric tube easily adjusts to provide the proper tension.

The collected dust falls into the hopper after pulsing. Dust is carried away automatically by the "trickle valve."

Occasionally, check the differential pressure across the fabric tubes during normal operation. After Start-Up, the pressure drop gradually rises to its normal operating level range of 3-6 inches.

Install a manometer and static tips with one connection on clean air side and one on dirty air side. See Sketch. Locate this device conveniently to outlet plunum.

Control the air volume entering collector so that NO condensation takes place until stream passes thru collector. Moisture causes a gradual binding of tubes and this is detected by a

KEEP BEARINGS AND SHAFT CLEAN and free of burrs, nicks, etc. Under no condition should bearing outer race and reservoir be hotter than 200 degrees F.

MAINTENANCE: Inspect Exhauster rotating parts and insure that proper lube be selected with a schedule depending on air temperature, amount of dust and moisture in locale.

Use proper lubrication from Lube Section.

Never over-lube or high temperature results.

If using a pressure lube gun, Do Not damage bearing seals.

INSPECT HOUSING AND WHEEL for wear and dust accumulation to prevent unbalanced conditions.

Cleaning may be manual wire brushing, scraping or steam, water, high pressure air; as best suited to locale.

Protect motor and bearings as needed, depending on method chosen.

Chcke for loose bolts and retighten.

Check V-belt drives often to insure proper alignment and tension.

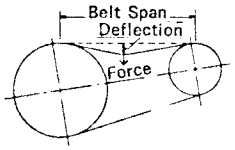
Replace belts in matched pairs, when necessary.

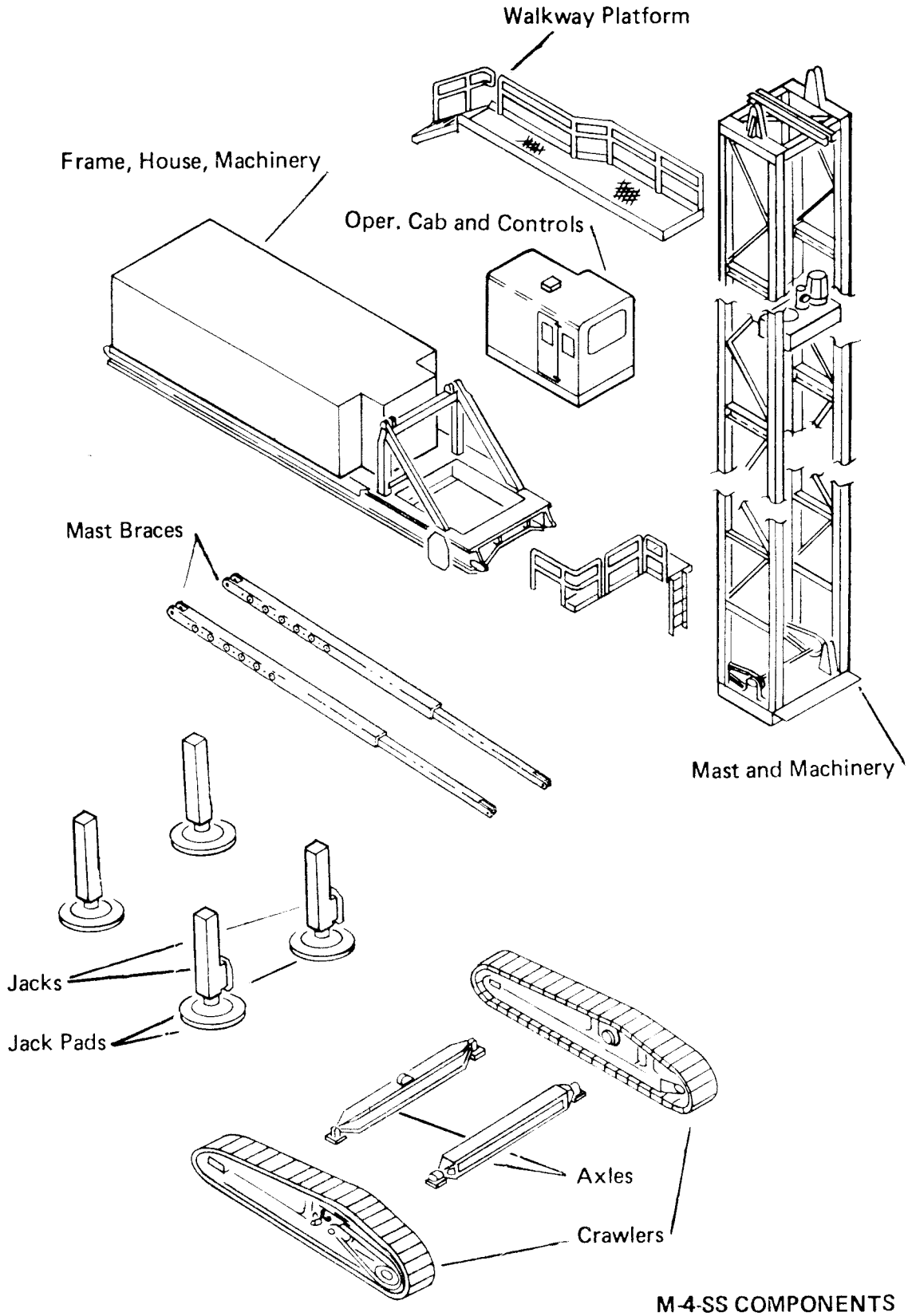
V-BELT DRIVE INSTALLATION: After placing matched set of belts in sheave grooves, take up belt slack and start drive.

Tension the drive until belts have only a slight bow in slack side of drive while operating under load.

Stop drive and measure belt span. Using a spring scale, apply force to one belt in center span. Keep force perpendicular to span and toward drive center. Measure force required to deflect anyone belt 1/64 inch for every inch of span length. For example, deflection of a 32 inch span equals 1/64 inch times 32 or 1/2 inch.

After a day or two of running, recheck.





M-4-SS COMPONENTS

NOTES

MOTOR RESPONDS SLOWLY TO CHANGES OF INPUT IN EITHER DIRECTION–

Remove the valve filter and check for cleanliness. If dirty, replace with a new filter (Kit No. 136567A). ***Change system oil and replace the 10 micron system filter.*** (The internal filter of the valve will not clog under normal operating conditions with a 10-micron filter in the system.)

Check the orifice to be sure that it is free of obstructions. If the orifice is clean and the valve continues to respond slowly, the air gaps may be clogged and the valve will require replacement. If these checks do not reveal the trouble source, the problem may be in the transmission.

MOTOR RUNS CONTINUOUSLY, AND TOGGLES TO OPPOSITE DIRECTION WHEN VOLTAGE IS APPLIED–

In this case, the motor may snap from one direction to the other when voltage is applied. Such a condition may be caused by a broken torque motor suspension or worn torque motor stops and will require replacement of the valve.

INCOMPLETE DRIVE IN ONE DIRECTION–

Check the valve centering adjust screw, spool, and valve linkage to see that each is properly adjusted, allowing equal travel in both directions. Also check to be sure that the proper valve and/or linkages are being used.

TRANSMISSION CANNOT BE CONTROLLED–

A broken pushrod can cause the valve to function as though the command source was inoperative. The pushrod may be checked by moving the manual operator and observing spool movement. If the spool moves back and forth freely, and does not appear to be restrained or centered by the torque motor, then the pushrod is broken. If operation of the valve is jerky and unpredictable, check to see that the manual operator has clearance to the spool and is centered in the gap. Also examine the feedback linkage between valve and transmission, making sure it is not bent or binding. Linkage can be replaced if bent. Replace valve if one of the other problems is found.

MOTOR CREEPS IN EITHER DIRECTION; VALVE CENTERING DIFFICULT–

If the valve is not easily centered for full stop after operating in both directions, the spool may have worn porting edges and will require replacement. Dirty oil will cause abnormally rapid wear. A 10-micron filter or better is recommended for system filtration.

NOTES: _____

When replacing worn or damaged components with new valves, install new valve as received from manufacturer, without initial setting change. Attach a hydraulic pressure gauge at a test point compatible to the pressure reading required. Operate machine and adjust valve as required to conform to the following table or until optimum performance is acquired.

CAUTION: Shut down system when turning adjusting screw on relief valves. The override pressure build up can cause system damage.

PRESSURE SETTING OF VALVES:

Name of Valve	No.	psi Setting
Charge pump relief, in main pump	2	240
Main pump relief, at manifold	4	3,500
Shuttle valve pilot, at manifold	2	200
Auxiliary pump relief, large control valve stack	1	2,500
Auxiliary pump relief, small control valve stack	1	2,600
Auxiliary pump relief, direct mounted relief	1	2,600
Leveling jack retract line, relief at control valve	3	1,500
Breakout tong retract line, relief at control valve	1	1,500
Stem rack cylinder lowering relief at control rack	1,2 or 3	1,500
Counterbalance valve, stem rack in raising line, pilot	1,2 or 3	1,000
Counterbalance valve, mast raising pilot	3	1,000
Steady guide cylinders, reliefs at control valve	4	600
Stem rack latch actuator, pressure reducing valve	1	290
Stem rack latch actuator, relief valve	1	300

Keep in mind: Dust is one of the meanest abrasives, mostly since it is hard to see.

Ozone, oxygen and moisture; over a long period of time act on O-rings also. Most manufacturers now add chemicals to slow or eliminate the effects; but correct storage is still needed.

Excessive heat is a problem, so storing O-rings on the top shelf near the tin roof is not good. Besides that, sunlight and flourescent light tends to age rings earlier. Use Polyethylene or brown glass jars to keep light out.

Contact between rings lying together in bulk or on hooks or pegs damages seal surfaces. When stored in the open, they collect dust and dirt. Also, bulk shipments often cannot be numbered. Keep rings away from steam pipes, heater conduits and areas where contact with water, oils, grease, solvents and other damaging fluids seems likely. Add replacement O-rings to the bottom or back of a bin as older parts move to the top or front to assure issue before a brand new one.

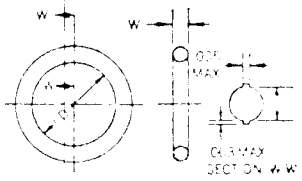
Individually packaged rings seem to have unlimited shelf life. Some maintenance shops use peg boards for individual packages of shop stock used daily. These are arranged by size on each board, but with ONLY ONE compound type per board.

O-rings are almost always dimensioned in terms of cross-section diameter and inside diameter either in decimals or fractions.

Example:

Standard Size Cross Sections

Nominal	*Actual*
1/16	0.070 ± 0.003
3/32	0.103 ± 0.003
1/8	0.139 ± 0.004
3/16	0.210 ± 0.005
1/4	0.275 ± 0.006



Standard inside diameters for these various cross sections range anywhere from 1/32 to 26 inches.

All in all, there are slightly more than 300 standard O-ring sizes.

BASIC THINGS TO REMEMBER:

Select the proper O-ring ONLY by part number.

Keep all parts clean.

Use compatible fluids and rings.

Use either individual containers or provide LABELED, clean, low light storage.

DO NOT USE hardened steel tools when removing or installing rings.

Be sure new rings are not mixed or contaminated when put into labeled storage.

DO NOT INSTALL a dry O-ring on a dry shaft.

REPLACEMENT OF DISPLACEMENT CONTROL VALVE

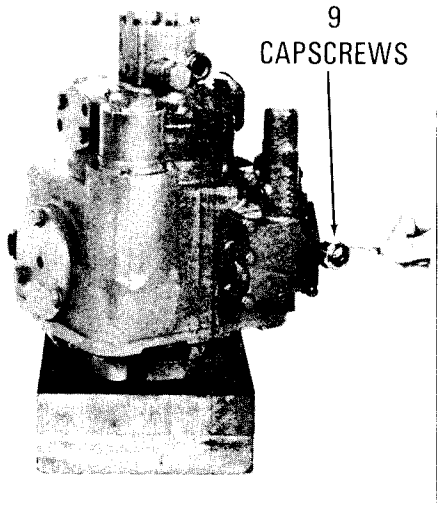


FIG U

A. REMOVAL

1. Remove control linkage from Displacement Control Valve Assembly.

2. Remove the nine (9) capscrews holding valve to pump housing. See Figure U.

3. Lift Valve away from housing and remove cotter pin and washer. See Figure V. Remove pin from link in pump.

NOTE: *Caution must be exercised to prevent these parts from falling into pump.*

4. Remove orifice and "O" rings from control valve.

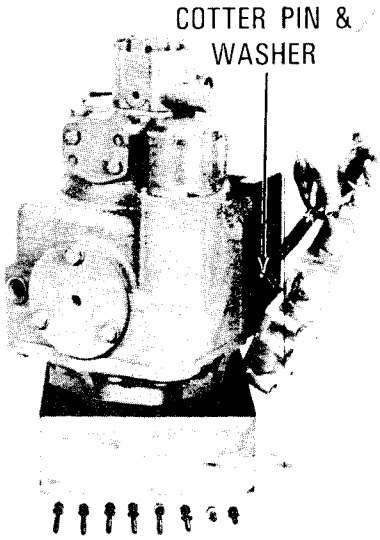


FIG. V

B. INSTALLATION

1. Install orifice, tip down, and new "O" rings in Control Valve.

2. Install new gasket on control valve dry.

3. Install pin in control valve links and pump link.

4. Place washer in pin, install cotter pin and spread.

NOTE: *Caution should be exercised during installation of these parts to prevent them falling into unit. Lightly coating parts with petroleum jelly (not grease) is advised.*

5. Install valve to pump and torque the nine (9) bolts 10-11 ft. lbs.

Place one retaining ring onto motor face back case. Lower crankshaft into position. Take care here that TDC mark on shaft matches position on valve (if assembled in opposite position, i.e. 180 degrees out, motor rotates in opposite direction and no other harm is done). Do not allow crankshaft to damage the bearing surfaces of con-rod slippers. Pull and lift con-rods next to shaft bottom dead center over the ring. Very carefully rotate shaft to center ring with the throw before placing remaining con-rods into position. Top retaining ring now fits easily over the slippers.

Grease crankshaft at point where shaft seal runs. Grease O-ring and fit to front cover. Then place front cover over shaft onto motor case. Align screw holes, then gently tap cover squarely into case until all hold down screws start into threads. Screw cover down evenly and tighten screws with torque wrench properly.

SETTING CRANKSHAFT END FLOAT offers two different shimming methods.

If motor has steel shim(s), place shim(s) between valve housing spigot and rear bearing. The procedure follows:

Firmly tap shaft down with soft drift to ensure the rear bearing cap seats squarely on valve housing. Measure shaft axial end float with dial indicator and select proper shim(s) to reduce end float to proper valve. Remove valve housing and insert shim(s) behind rear bearing. Refit valve housing and recheck shaft end float. Adjust and repeat as needed.

If motor has separate shim plate, shim(s) are plastic, place between shim plate and front cover. The process follows:

Firmly tap down crankshaft with soft drift to ensure rear bearing cup seats squarely on valve housing. Place shim plate over front bearing and evenly tighten down shim plate screws until crankshaft end float reduces to about .002 inch. Measure gap between shim plate and front cover, then select proper shim(s) to give needed shaft end float. Take off shim plate, fit shim(s). Grease and fit the O-ring over the bearing. Fill recess between lips of shaft seal with grease and lightly smear O.D. of seal with loctite hydraulic seal. Carefully press seal into shim plate. Fit shim plate and tighten screws to proper torque. Finally, recheck shaft end float and correct as needed. (Shaft axial end float .001 to .004 inch.)

CYLINDER HEAD REFIT, if removed, means refit O-ring and evenly tighten screws with torque wrench.

Cover all ports and drains until placed back in service with lines connected. Store in protected area.

13. Replace flange o-ring into oval recess in flange face. (Photo 23) Use a small quantity of clean cup grease to hold o-ring in groove.

Photo 23

14. When replacing flange, pay particular attention in placement of shaft in seal hole. Apply light amount of cup grease to seal lips before inserting over shaft. CAREFULLY slip seal over shaft and slide flange into the pump body over two dowels. Insert two cap screws (opposite each other) and pull down tight. (Photo 24, 25 and 26)

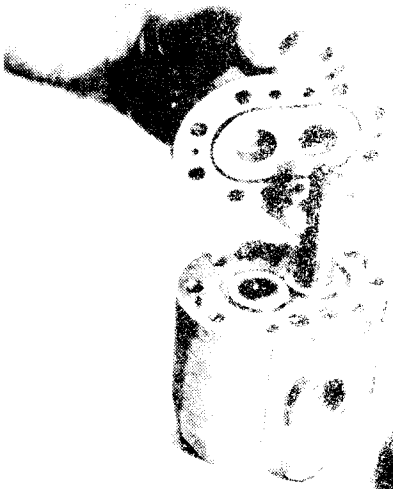


Photo 24

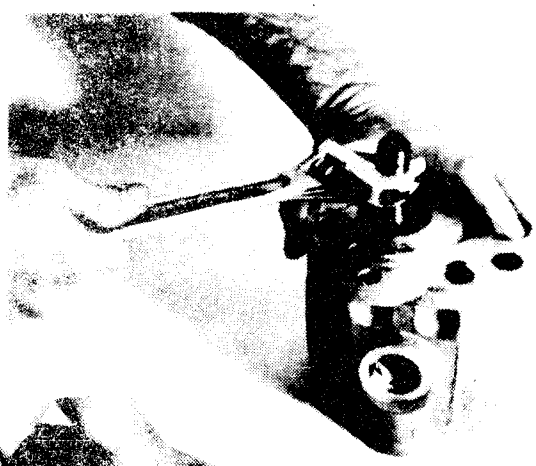


Photo 26

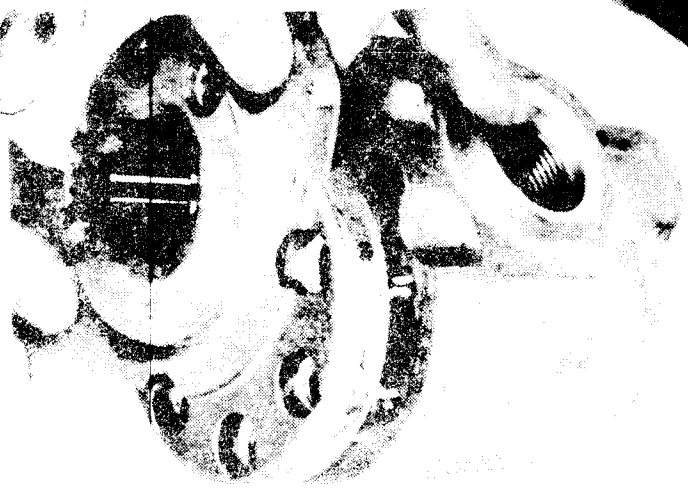
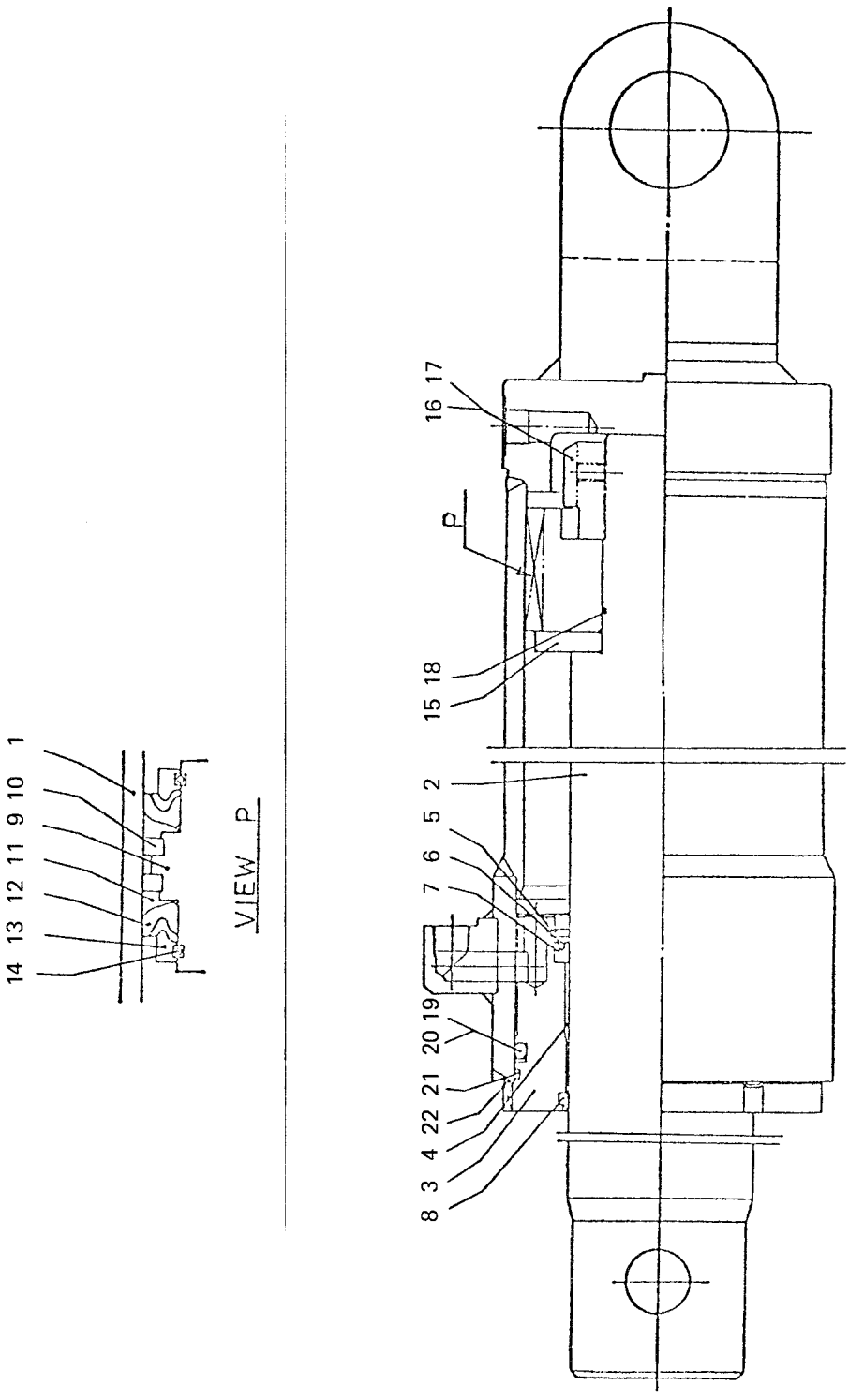


Photo 25

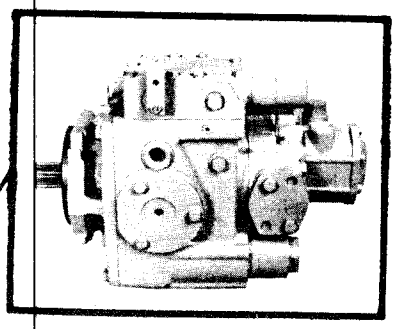
15. Replace remaining cap screws and torque to 30-35 foot pounds.

Seal off inlet and outlet from contamination. Remove from vice.



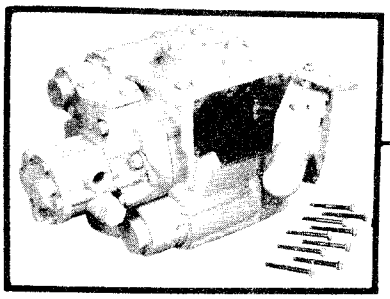
CROSS SECTION OF HYDRAULIC LEVELING JACK CYLINDER

INSPECT CONTROL VALVE

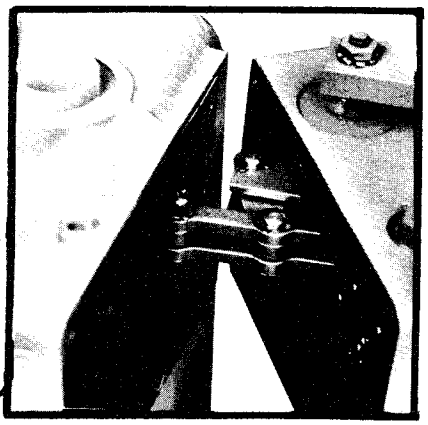


Disconnect machine linkage, check for neutral & spring centering @ pump control. Operate machine @ pump control if possible.

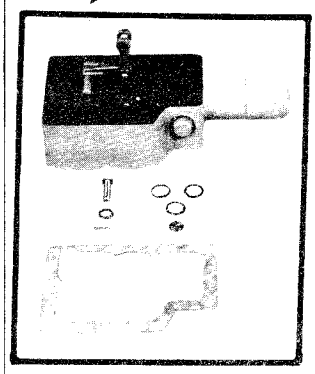
Remove cap screws & pull control away from pump housing.



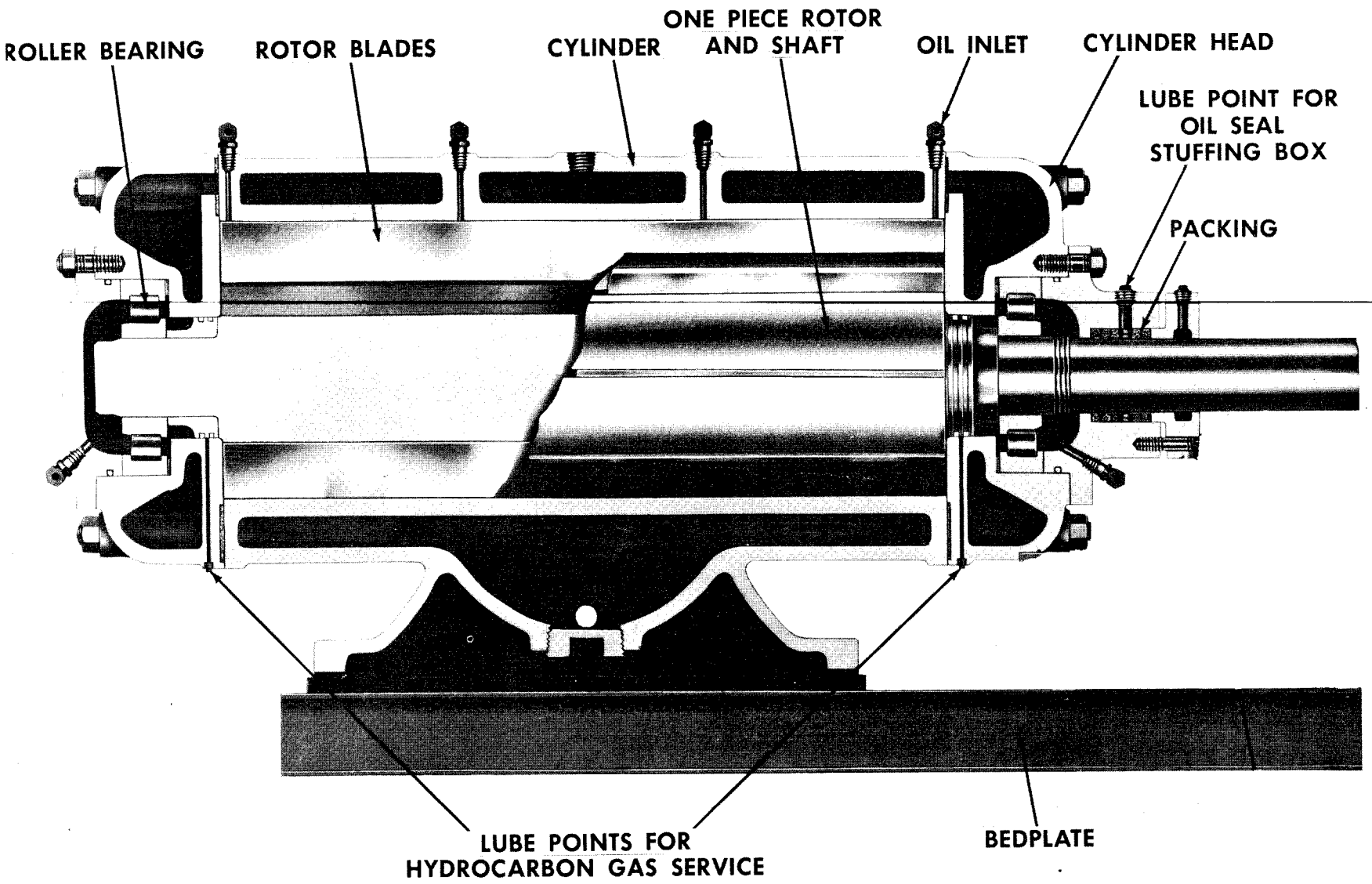
Inspect linkage, pins & retaining rings for proper assembly. Inspect for broken spring or plugged orifice.



Remove control from pump and replace.



Further disassembly of control is not recommended.


ROLLER BEARING
ROTOR BLADES
CYLINDER
ONE PIECE ROTOR AND SHAFT
OIL INLET
CYLINDER HEAD
LUBE POINT FOR OIL SEAL STUFFING BOX
PACKING
LUBE POINTS FOR HYDROCARBON GAS SERVICE
BEDPLATE

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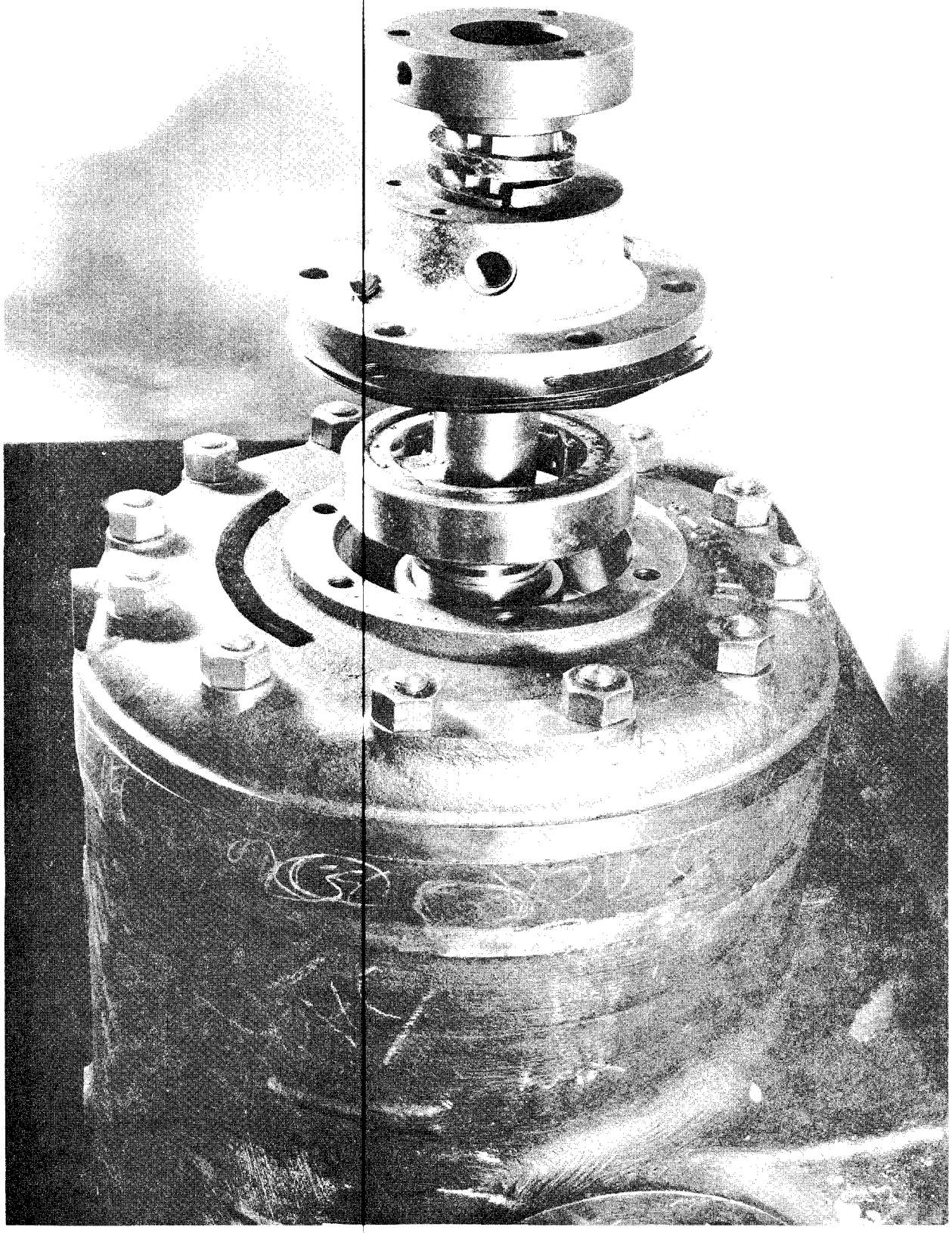
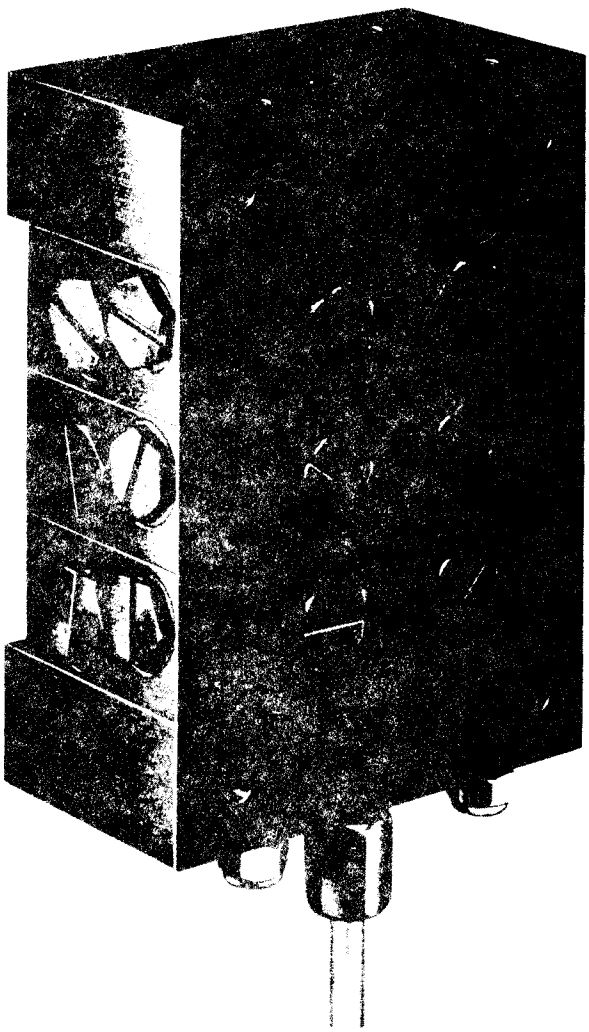


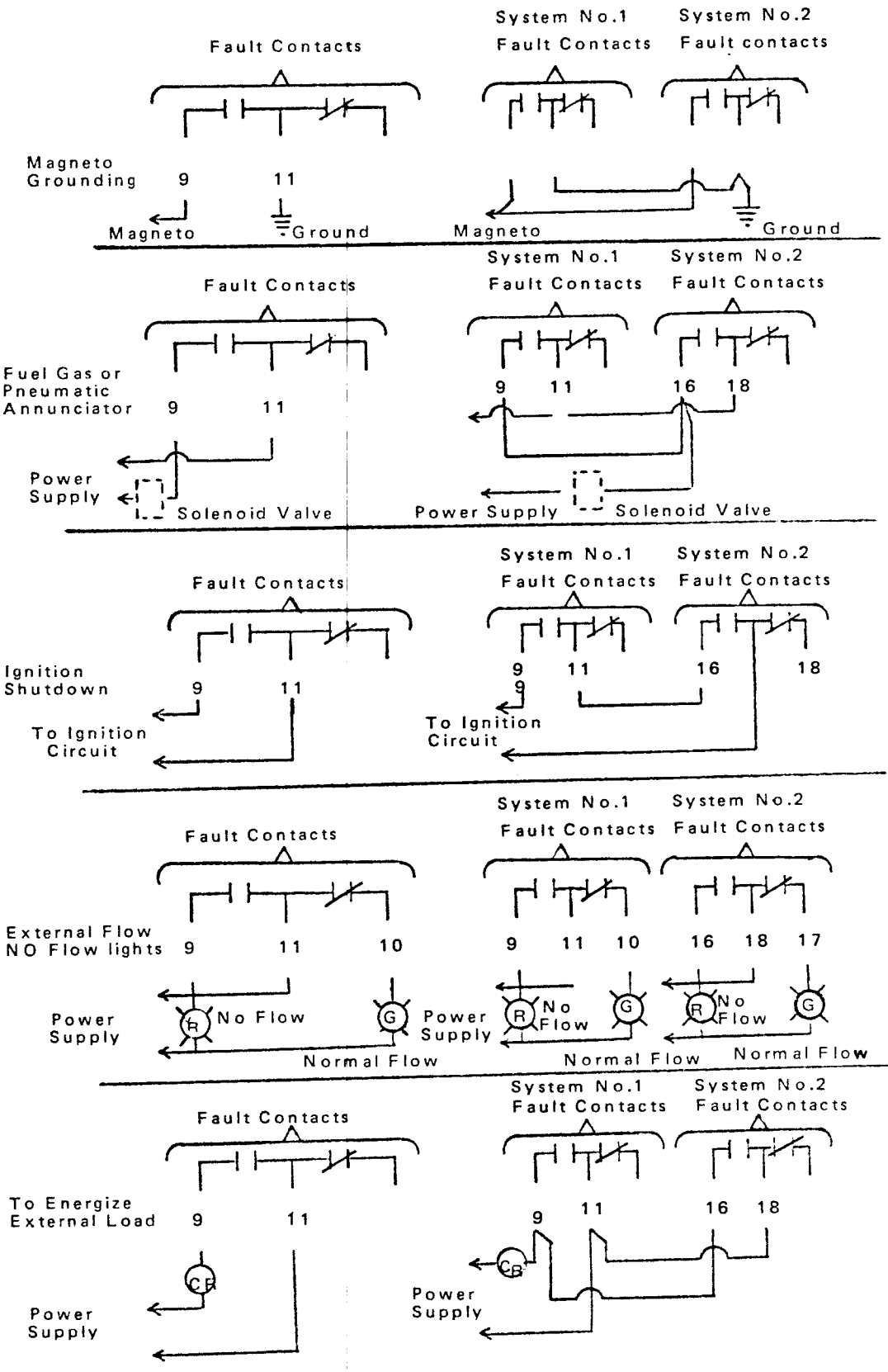
UNI-BLOCK LUBEMATION SYSTEM

L-SERIES DIVIDER ASSEMBLIES

The Manzel Lubemation System has been developed to provide accurate, trouble-free, automatic fluid lubrication for engines, compressors and related equipment.



Highly versatile, the Lubemation System centers around the Uni-Block or L-Series divider assembly for single line, cyclic progressive lubricant distribution. The divider assembly consists of a series of individual metering blocks each containing a piston and passageways for the flow of oil. Each of the divider blocks are identical in external physical size however a range of piston or plunger sizes are available to provide different lubricant displacements. The sections are stacked according to required displacement from three to eight individual parts thus providing up to 16 separate outlets. The blocks are such that their discharges are controlled by hydraulic circuitry to cause plungers to cycle endlessly; lubricant emerges successively from all outlets so long as pressure is applied to the inlet port. Since divider assemblies are as the name implies, flow-split depends upon the number of outlets and relative plunger size in each block.


Fault Contacts
System No.1
Fault Contacts
System No.2
Fault contacts
Magneto
Grounding
9
11
Magneto
Ground
Magneto
Ground
Fault Contacts
System No.1
Fault Contacts
System No.2
Fault Contacts
Fuel Gas or
Pneumatic
Annunciator
9
11
9
11
16
18
Power
Supply
Solenoid Valve
Power Supply
Solenoid Valve
Fault Contacts
System No.1
Fault Contacts
System No.2
Fault Contacts
Ignition
Shutdown
9
11
9
11
16
18
9
To Ignition
Circuit
To Ignition
Circuit
Fault Contacts
System No.1
Fault Contacts
System No.2
Fault Contacts
External Flow
NO Flow lights
9
11
10
9
11
10
16
18
17
Power
Supply
R
No Flow
G
Power
Supply
R
No
Flow
G
R
No
Flow
G
Normal Flow
Normal Flow
Normal Flow
Fault Contacts
System No.1
Fault Contacts
System No.2
Fault Contacts
To Energize
External Load
9
11
9
11
16
18
CR
CR
Power
Supply
Power
Supply

MONTHLY

1. Add or change compressor crankcase oil. Under CLEAN operating conditions the oil should be changed at the end of 500 running hours or every 6 months, which ever occurs first.

   If operating conditions are NOT CLEAN, change oil more frequently.

2. Adjust the pressure switch cut-in and cut-out settings.

3. Check relief valve or CPP for exhausting head pressure each time the motor stops.

4. Tighten belts to prevent slippage. A heated motor pulley is a sign of loose belts. Overtightening of belts may cause motor overload or premature failure of motor and compressor bearings.

5. Check and align a loose motor pulley or compressor flywheel. It will be necessary to remove the front section of the enclosed belt guard.

6. Tighten all valve plugs and covers on the compressor head to insure that each valve does not become loose and damage the valve or piston.

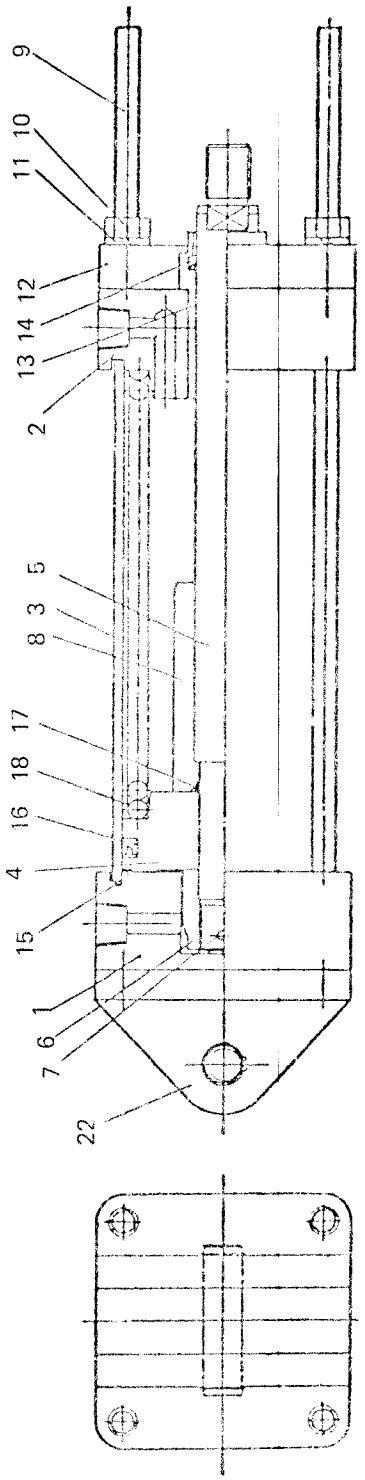
7. Check for air leaks on the compressor outfit and air piping system.

8. Check compressor pump up time when the air receiver outlet valve is closed.

9. Listen for unusual noises.

10. Check and correct oil leaks.

11. Perform weekly maintenance.



1. Head Cover
2. Rod Cover
3. Cylinder Tube
4. Piston
5. Cylinder Rod
6.
7. Split Pin
8. Ring
9. Tie Rod
10. Nut
11. Lockwasher
12. Gland
13. Bushing
14. Dust Seal
15. O-ring
16. Piston Seal
17. O-ring
18. Spring
22. Head Cover, clevis type mount

AIR CYLINDER

CODE	NAME	DESCRIPTION
continued. . . .		
GL	Enclosed Gear Case	3. Inside machinery house, where oil is not pumped, use GL-200 except where freezing temperatures rarely or never occur, use GL-250. On new machines, oil should be drained after first 60 days of operation and replaced with new oil. Thereafter, change oil once a year, or when determined necessary by oil supplier. Oil should be checked for contamination every 30 days.
PO	Pneumatic Oil	Petroleum oil especially compounded for use in air line oilers or built in lubricators having the correct viscosity, low pour point, emulsifying ability, film strength and free of deposit forming tendencies. It should not cause swelling or deterioration of rubber or leather seals and gaskets.
EMG	Electric Motor Grease	Electric motor bearing grease meeting the requirements of G.E. Specification D6A4.

This information taken from CI-929A.

SPECIAL HYDRAULIC DRIVE FLUID (HDF) SPECIFICATIONS for 50° Celcius (-58°F).

APPLICATION:

Main Hydraulic System:

This System MUST BE HEATED when ambient temperature drops BELOW +40°F (+5°C).

Mobil DTE-13 for WINTER operation when minimum temperature is expected to be BELOW 0°F (-18°C).

Mobil DTE-16 for SUMMER operation when minimum temperature is expected to be ABOVE 0°F (-18°C).

CHANGE FLUID twice yearly (seasonal) AND when fluid analysis indicates excessive contamination OR chemical deterioration.

CAPACITY: Initial System Fill – 65 U.S. Gallons.
System Refill – 45 U.S. Gallons.

Auxiliary Hydraulic System:

Mobil DTE-13 for summer use, Mobil HFA for winter use.

CHANGE FLUID twice yearly (seasonal) AND when fluid analysis indicates excessive contamination OR chemical deterioration.

CAPACITY: Initial Fill – 120 U.S. Gallons.
Refill – 80 U.S. Gallons.

Quantity Required – 5000 hours (one year maximum).

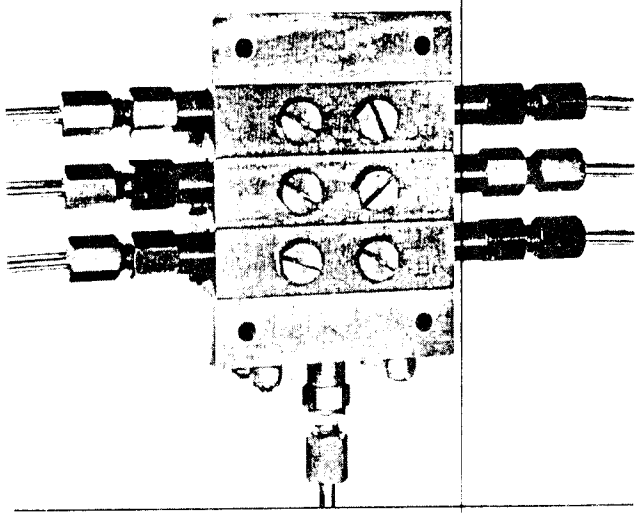
Mobil DTE-13: 500 U.S. Gallons (10 drums).

Mobil DTE-16: 250 U.S. Gallons (5 drums).

Mobil HFA' 250 U.S. Gallons (5 drums).

Specifications:	DTE-13	DTE-16	HFA
Gravity API	30.1	29.1	32
Flash Point – °F (°C)	329 (165)	329 (165)	209 (98)
Pour Point – °F (°C)	-50 (-45)	-50 (-45)	-85 (-65)
Viscosity, SUS @ 100°F (38°C)	150	300	73.8
SUS @ 210°F (99°C)	46	60	42
Viscosity Index	150	150	200

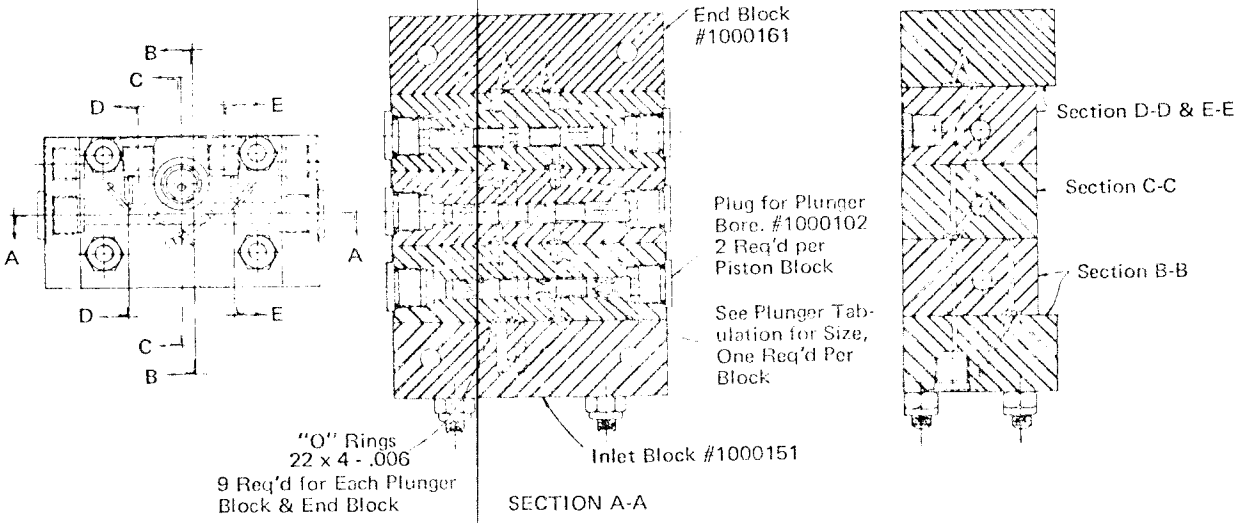
Marion Power Shovel Company Specification for Hydrostatic Drive Fluid (HDF) is part of this specification and applies with the exceptions noted before.



L3-321 Divider Assembly
Shown with inlet and discharge check valves

ABSOLUTELY LEAKPROOF – Divider assemblies are absolutely leakproof at 5,000 psi pressure. Individual sections of the assemblies feature heavy wall thicknesses and have internally drilled lubricant passages. All connecting passages are sealed by Viton "O" rings, permitting metal-to-metal assembly of adjacent sections without gaskets. Straight-threaded, "O" ring sealed ports assure leakfree assembly without the distortion characteristic with pipe threads. There are no external permanently plugged holes to develop leaks. Plungers are air gage tested 100% and are fitted to the same close tolerances (.0001"- .0003") high degree of accuracy found in Manzel's 50,000 psi pumps which have long represented the highest standards in the industry. Positive high pressure sealing is completed by the use of 4 studs to clamp the assembly rigidly together.

ASSEMBLY –



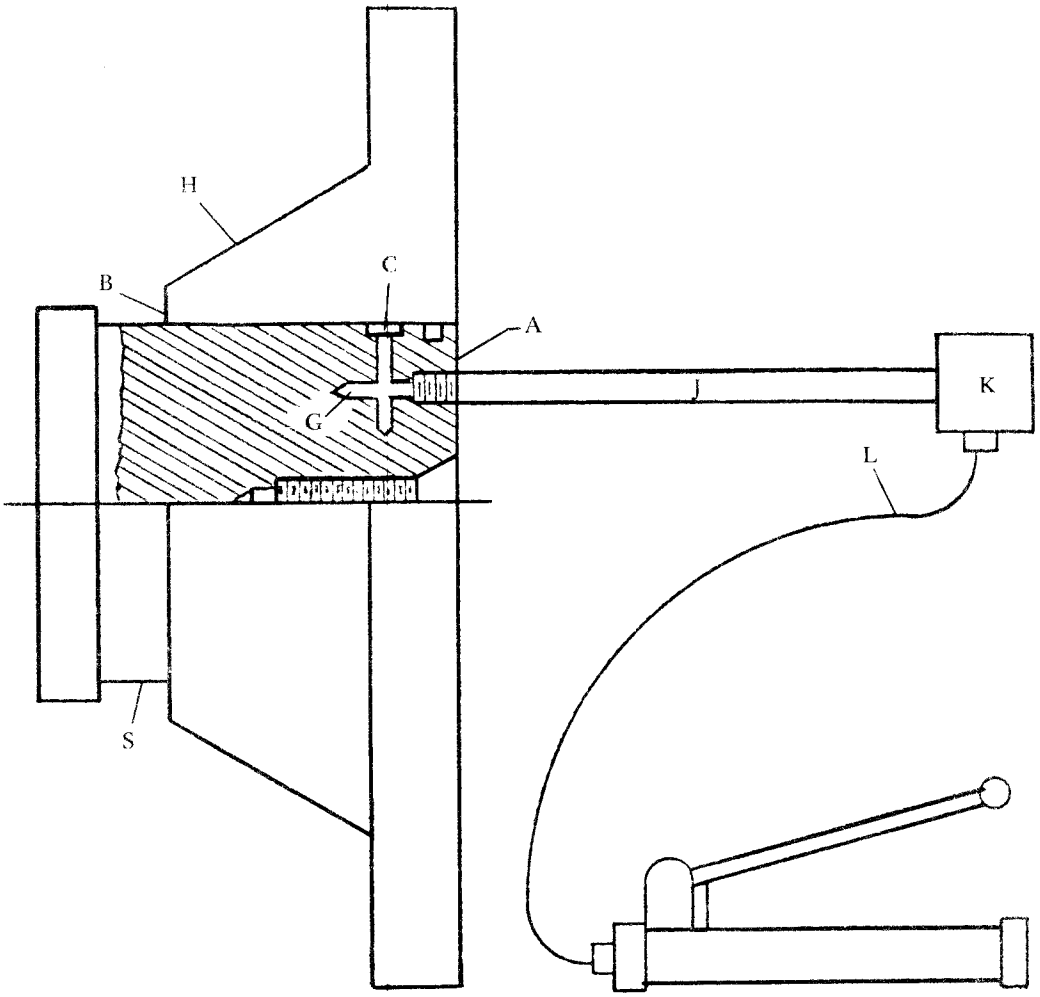
(Section 7 — Engineering Data cont.) Page

If coupling removal is difficult using this procedure (bores or shaft surfaces abused) the following tips may help.

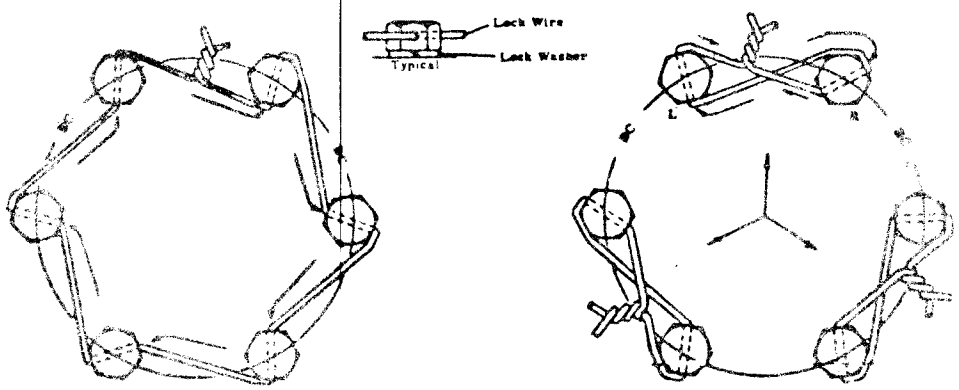
If oil does not appear on both hub ends due to insufficient pressure (excessive shaft end leaks), use heavier oil or grease. Slight, cautious peening around leak helps.

If pressure builds up, but no oil appears at hub end opposite shaft end; heating hub helps. Apply torch carefully and evenly to hub as far back from shaft end as possible. This heat relieves the back area of fit and allows oil to appear at both hub ends.

PRESSURE EQUIPMENT, such as a Blackhawk pump, connects to groove C by high pressure flex hose L, high pressure elbow K and high pressure nipple J. This nipple J is long enough for hub to pull clear of shaft extension and not interfer with elbow or hose. The nipple J also supports coupling when it drops free. The nipple screws into a pipe tap in the shaft end which connects to groove C thru two drilled holes G.



ENGINEERING STANDARD 1101-2 for wire lock cap screws. This standard establishes two recommended methods for these fasteners. Use here is for designs where maximum locking assurance is required and periodic visual inspection is not possible. Check classification 121F for special fasteners with 1/8" holes for locking with 14 gauge soft annealed wire. RECOMMENDED WIRING METHODS: The following procedures will exert a tightening force on cap screws as the wire is twisted tight.



Single Wire: Insert wire thru fastener from inside bolt circle toward outside of bolt circle; advancing in clockwise direction.

Wired in Pairs: Establish left and right hand fasteners as viewed from center of bolt circle. Insert left end of wire thru left hand fastener from inside to outside of bolt circle. Insert right end of wire thru right hand fastener from outside to inside of bolt circle.

SECTION 8

ELECTRICAL

CARE OF D.C. MOTORS AND GENERATORS holds one watchguard – cleanliness. Keeping this equipment free of dirt, oil and grease is of prime concern. The operator generally recognizes and may correct the few common problems. Failure of this equipment is rare. Serious problems require a competent electrician. In the case of poor commutation, where simple remedies can not solve the problem, consult the electrical equipment manufacturer.

BRUSHES with an excessive amount of arcing between brush and commutator when operating under normal loads and speeds need checked for the following:

Are brushes sticking in holders?
Are brushes making full contact on commutator?
Are contact surfaces of the brushes clean?

NOTE: Determine this by removing the brush and looking at it's surface. The surface is smooth and polished where the brush rubs. Any portion not in contact has a rough, dark appearance. Loose brush holder studs throw brushes out of line and cause excessive arcing. Here the brush rides on heel or toe out of normal commutating plane. Tighten brush holder into correct position to solve the problem. Loose brush holder yoke set screws permit the yoke to rotate and shift all the brushes. So they are. Reposition the holder yoke and tighten. Another problem solved. Keep even spring pressure on ALL brushes. The exact pressure varies with unit type. Call the factory for specific information on your unit. The brush springs are set originally at one point. One may assume this pressure setting as correct and keep it exact when installing a new brush. This initial brush pressure should be the same for all brushes on any one motor or generator. Inspect all brushes regularly. Brushes worn beyond a point of good contact need replaced. Put in new one(s). Avoid allowing rapid brush wear. This results in improper brush pressure and causes severe arcing. Excessive brush wear may even cause the pigtail to wear into the commutator proper. Check the brush springs. Are they in their slots? When using fairly long brushes, it's a good practice to increase spring tension after brushes wear to make up for brush pressure loss. Use the same brush type as originally furnished with the unit when replacing. Serious problems occur when using an incorrect brush. A change in brushes sometimes improves a condition of poor commutation and severe arcing. First, consult manufacturer before making this change.

BRUSH INSTALLATION – Brush should properly fit holder or guide, to work up and down freely. Grind brush with 2/0 or 3/0 sandpaper until contact surface matches the commutator contour. Use the following procedure: Place brush in holder, release spring and insert sandpaper (wider than brush, rough side to brush) between brush and commutator. Exert full spring pressure on brush. Hold sandpaper close to commutator and draw it in direction

DAILY ELECTRICAL INSPECTION

	YES/NO Heat	YES/NO Vibration
1. Check following bearings for		
M.G. set bearings?	_____	_____
Rotary motor bearings?	_____	_____
Hydraulic drive motor bearings?	_____	_____
Exciter set bearings?	_____	_____
Oil pump bearings?	_____	_____
Fan blower bearings?	_____	_____

2. Are all contactors operating properly? _____
3. Are all lights operating properly? _____
4. Are all motors commutating properly? _____
5. Are all generators commutating properly? _____
6. Is the air conditioner operating properly? _____
7. Is the air filtering system operating O.K.? _____
8. Visually examine operator controls:

   Are the main controllers working O.K.? _____
9. Are the auxiliary controls working O.K.? _____
10. Is all electrical equipment clean and dry? _____

WEEKLY ELECTRICAL INSPECTION

	YES/NO Sticking	YES/NO Wear
1. Check all brushes for:		
Rotary motor brushes?	_____	_____
Hydraulic drive motor brushes?	_____	_____
M.G. set brushes?	_____	_____
Exciter generator brushes?	_____	_____
2. Are all motor connections good?		_____
3. Are all generator connections good?		_____
4. Are all D.C. contacts in good condition?		_____
5. Have all motors and generators been cleaned?		_____
6. Are the cabinets clean?		_____
7. Are all warning systems working?		_____
8. Are all limit switches working?		_____
9. Are all cable runs in good conditions?		_____
10. Are all M.G. set hold down bolts tight?		_____

WEEKLY MECHANICAL INSPECTION (Continued)

YES/NO

HOUSES:

1. Are all panels in place and undamaged? _____
2. Are roof arches in good condition? _____
3. Any leaks in the house? _____
4. Are all house bolts in place and tight? _____

SECTION 11

AUXILIARY GENERATOR

I. OPERATION MANUAL

A. Specification

a. AC generator

Type:	Drip-proof, self-ventilated cooling, revolving-field type.
No. of phase:	3 phase, 4 wires
Rated output:	15 KW (18.75 KVA)
Rated voltage:	380/220 V
Rated ampere	28.5 A
Rated revolution:	1500 RPM
Rated frequency:	50 Hz
Rated power factor:	80%
No. of poles:	4
Rating:	Continuous
Excitation.	Static self-exciting system

b. Diesel Engine

Model:	Mitsui Deutz Diesel engine F3L-912
Type:	4-cycle forced air cooling direct injection type
No. of cylinders :	3
Dia. x Stroke:	100 x 120 mm
Gross stroke volume:	2827 CC
Compression ratio:	17:1
Rated output:	28.5 PS/1500 RPM
Rated revolution:	1500 RPM
Fuel:	BS2896:1957 class A. ASTMD 97553 T. No. 1-D
Injection pump:	Bosch type plunger straight type
Speed governor:	Bosch RSV centrifugal mechanical all speed type
Fuel supply pump:	Bosch KS plunger type
Injection nozzle:	Bosch DLL type hole
Fuel filter:	Filter paper element type (integral with cartridge case)
Lubrication:	Forced circulation of wet sump system
Lubrication pump:	Gear driven trocoid pump
Lubrication oil filter:	Filter paper element type (integral with cartridge case)
Lubrication oil: (recommendable oil)	Oils satisfying MIL-L-2104C
Cooling system:	Forced air cooling
Cooling blower:	Axial type

Viscosity of lube oil	Allowable working temperature of lube oil
10W/30	$-10^{o}C - +105^{o}C$
5W/20	$-40^{o}C - + 80^{o}C$

E. Use of AC power source:
   a. With engine warm up operation finished, adjust RPM to approx. 1550 RPM
   b. Turn field switch on operation panel to "ON", so voltage is generated and increased in AC generator. (AC generator pilot lamp on operation panel will light.
   c. Adjust AC voltage meter to indicate 380 V by turning AC generator voltage regulator clockwise.
   d. For power supply connect generator to load, switch "ON" the circuit breaker on control panel after careful inspection of electric circuit.
   e. Any load connection should be ADJUSTED CAREFUL. Watch indication of AC ammeter on operation panel so current does not exceed rated amperes (28.5A).
   f. Adjust load to rated amperes (28.5A) and engine to 1500 RPM by means of RPM control knob.
   g. With the generator voltage load made and set but showing bad voltage regulation, fluctuating from the rated voltage, (380 V), that is set during no-load (becoming lower than 360 V or higher than 400 V, adjust that variation in the following procedures:
      1. Adjust to 1550 RPM a little higher than the rated one with no-load running of generator, and adjust the voltage to the rated voltage (380 V) by voltage regulator (FR).
      2. Apply the rated load to generator and adjust frequency to 1500 RPM. If generator voltage drops below 360 V once set, shift lines x, y and z leading from the 3-phase current transformer (CT) to the voltage setting resistor (R) as shown by B in Fig. 9. Also if generator voltage rises higher than 400 V once set, shift lines x, y and ze as shown by A in Fig. 9 to adjust generator voltage to 380 V. In this case, such adjustment should be carried out ONLY by (R) without operating the voltage regulator. Also adjust frequency to 1500 RPM.
      3. Next, run the generator with no-load. Adjust generator voltage to 380 V by the voltage regulator (FR), leaving the RPM frequency as is.

flows in, and then restore the oil level check screw and oil refill screw completely and firmly as before.
Examine if overflow pipe (3) of fuel injection pump is blocked by inserting wire into it.

6. Wash fuel feed pump strainer:
Fuel feed pump strainer is a pipe joint with screen incorporated, and should be washed with fuel oil every 14 days (120 hours).
For reinstallation after washing, clamp it firmly to prevent oil leakage.

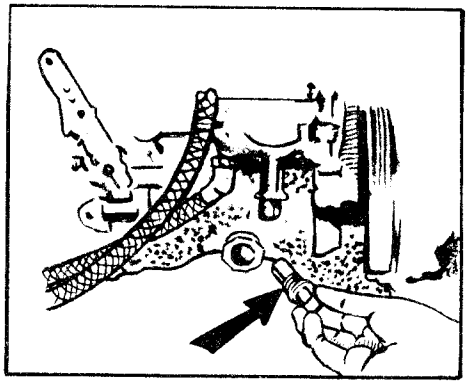


Fig. 18

7. Replacement of engine lubricating oil:
Replacement of lubrication oil every 14 days (120 hours) using specified lubricating oil. Refer to item (6) for specified lubri-oil.
Even if engine is left unused, replace with new every 6 months.
Regarding new engine (or engine immediately after overhaul), replace lubricating oil as follows:

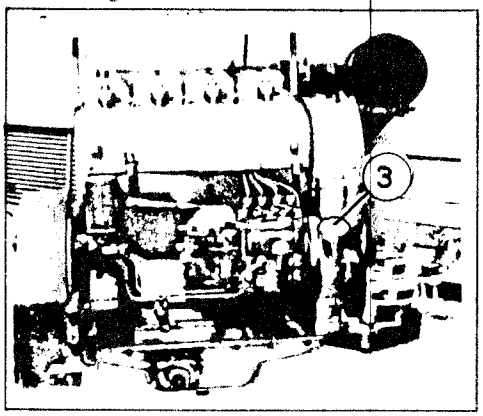


Fig. 19

First replacement is conducted after 20 hours. Second replacement is conducted 40 hours after first replacement. (First replacement has already been finished before delivery).
Replace oil by opening drain plug while engine is still warm.
After oil is drained completely, clamp the drain plug securely to eliminate oil leakage.
After drain plug is clamped, take out refill port (3) by hand, and refill new oil up to mark (2) on the oil level measuring rod.
Replace cap securely after refilling.
After refilling, further, perform trial operation of engine, and re-examine oil volume to confirm at normal volume Oil required at replacement time is about 9.5 liters.

8. Cleaning of cooling fin:
Clean cooling fin every 30 days (240 hours). Clean it more frequently in dusty atmosphere.
Keep fin clean at all times, because dust attaches with fuel and oil to cooling fin (1) and oil cooler (2) of cylinder and cylinder head. Carefully, clean vertical

Trouble	Main Cause	Method of Repair
J. Controller become red-hot too fast	Disconnection of coil in intake valve	Replace part
	Sharp bend or twist of fuel piping	Repair
	Oil leakage from, or stuffing of joint part	Replace packing and wash
	Shortcircuit within intake air heater (Frame type)	Replace part
	Earthing of wire harness	Interrupt earthing
	Earthing of connector	"
	Shortcircuit or wrong insulation in preheat circuit	Interrupt earthing and repair or replace

		Tolerance
Oversize No. 1 m/m	$100.5^{+0.022}_{+0}$	
Wear-off limit m/m	(Starting performance should be considered)	0.3
Outer dia. of piston		
Standard size m/m	99.910 ± 0.01	
Oversize No. 1 m/m	100.410 ± 0.01	
Piston cylinder clearance m/m	0.08 - 0.122	
Piston top clearance m/m	1.0 - 1.2	
Height of No. 1 ring groove (Both side key stone) m/m	$2.5^{+0.05}_{+0.03}$	
(Oversize groove) m/m	$3^{+0.05}_{+0.03}$	
Height of No.2 & No. 3 grooves m/m	$2.5^{+0.100}_{+0.080}$	
Height of oil ring groove m/m	$5^{+0.050}_{+0.030}$	
Ring clearance		
No. 1 ring m/m	0.20 - 0.24	0.3
No. 2 and No. 3 rings m/m	0.09 - 0.122	0.3
Oil ring m/m	0.040 - 0.072	0.2
Piston ring		
Compression rings	3	
Oil rings	1	
Ring size HxWxD		
Compression ring		
Standard m/m	2.5x4.3x100	
Oversize No. 1 m/m	2.5x4.3x100.5	
Top oversize No. 1 m/m	3x4x100	
Top oversize No. 2 m/m	3x4.3x100.5	
Oil ring		
Standard m/m	5x4.55x100	
Oversize No. 1 m/m	5.4.55x100.5	
Compression ring section clearance (m/m)	$0.35^{+0.2}_{+0}$	4

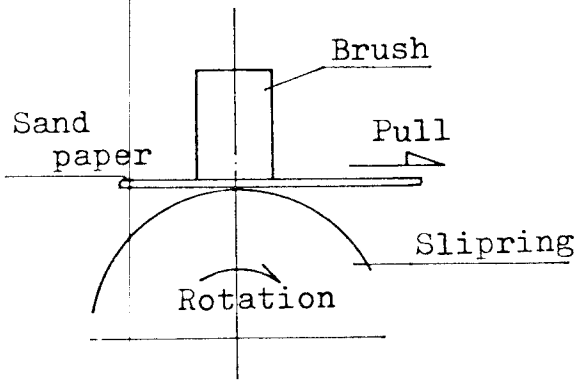


Fig. 38

When a new brush made from different material is replaced, it hinders electrical performance of generator. Always use spare part for replacement, and replenish spare parts.

f: Brush holder and stud:
Brush holder also has a large effect on electric performance. When brush holder and brush are so tight that the brush can not move smoothly, this condition causes incorrect electric performance. Further, when side surface of brush is worn off it causes play between it and brush holder, and must be replaced.

When brush holder and stud has slackened due to vibration, and parts in contact with commutator or slide link spark and cause unexpected trouble. Occasional inspection is necessary.

g: Bearing:
This generator has adopted a radial ball bearing at the slip ring side.

Ball bearing requires a supply of grease cup (use Toray silicone SH33M) once in 3 or 4 months, (800 hours). Take caution not to over grease. Pay attention to temperature of, and abnormal noise from bearings during operation. Immediately stop the operation when any abnormality arises, and take proper preventative steps.

h: Replacement of bearing → use the following procedures:
1. Move a transmitter for the dynamo tachometer.
2. Remove cover of ventilation window for the yoke.
3. Dislocate the brush connecting wire, and remove brush from brush holder.
4. Remove bearing nut and washer.
5. Pull out the ball bearing using a bearing puller. Take care, not to damage

d: Maximum current charging:
External problems resulting from max. current charging are:

Sealing compound may flow out.

Electrolytic cell, lid and vent plug deformed, accompanied by color change or fading on this part.

Trouble shows when battery overheats at end of charging, lid deforms on cell, etc. and corrosion of positive plate lattice and separator.

e: Insufficient charge:
Battery looses charge when compared to the previous charge, or when battery is left uncharged for a long time, and results in troubles below.

When battery is continuously used for a long time without charging, or left unused for a long period, white crystals form on plates and gradually increase in size, (Sulfation). Sulfation occurs also in pores of separator and promotes reduction charge capacity and lowering of discharge voltage and short circuit.

A discharged battery left unused for many hours will not fully recharge, also electrolyte may freeze in cold.

When battery discharged, specific weight of electrolyte is reduced.

f: Volume of electrolyte:

1. Oversupplied electrolyte causes troubles as liquid overflows from exhaust port during use, corroding vehicle body and other instruments. Also inducing reduction of capacity due to leak of electricity or loss of sulphur content.
2. Troubles caused by shortage of electrolyte are: air exposed parts of separator and plates are bleached and hardened, reduction in capacity as in case of sulfation due to less charge and recovery of such a battery by charging is difficult.

g: Wrong installation:
Several problems occur due to serious vibration that shorten battery life.

Damage to electrolytic cell and early flaking of substances from plates.

Cracks at sealed portion, causing battery contents to leak out. Leaked electrolyte corrodes cable terminal and lead wire, resulting in discharge.

Clamped terminals loosen due to vibration, and generate sparks which fire gas evolved