Technical Manual

PREVENTIVE MAINTENANCE – continued

DANGER: REMOVE ELECTRICAL POWER FROM MACHINE BEFORE PERFORMING ANY OF THE FOLLOWING INSPECTIONS:

- Inspect electrical cabinets; any discolored wires or components indicate overheating conditions have occured.
- Look for moisture, fungus or mildew in electrical cabinets. If found clean with approved solvents only, or compressed air.
- Check all electrical cabinets for messy or torn fasteners, cable armor or grommets, loose insulation
- Inspect electrical motors for discolored commutators or worn brushes.

These inspection points are representative of typical preventive maintenance routines. Use Section 10 as a detailed guide for all areas of machine inspection and suggested scheduled periods.

1. ANNUNCIATOR — A warning panel which relays vital equipment status information. A flashing light and buzzer indicate a problem. Some faults will result in machine function shutdown while others are a warning only. See Annunciator Panel on page 2—8 for more detail.

2. SPARE

3. HYD. PRESS. AUX. NO. 1 — Provides digital readout of pressure in auxiliary hydraulic system for valve banks numbers 1 and 2. With all these valves in neutral position pressure should be about 250 psi. (172 kPa. x 10).

4. HYD. PRESS. AUX. NO. 2 — Provides digital readout of pressure in auxiliary hydraulic system for hoist/pulldown brakes, propel brakes, and upper stem rack latches. With all brakes set and latches closed pressure will be about 400 psi. (275 k Pa. x 10).

5. CLOCK — Optional item.

6. AUXILIARY AIR PRESS. — This digital display shows pressure in auxiliary air compressor system. Normal readings displayed should be between 80 and 100 psi. (55 - 70 kPa. x 10). See section 6 of this manual for information about this system.

7. ROTATION SPEED — This digital display indicates drill stem speed in rpm.

8. HOLE DEPTH — Provides digital display of drilled hole depth in feet (meters). See also items 15, 16, 17, and 21.

9. DRILLING AIR PRESS. — Provides digital readout of pressure in output air line of main air compressor. With stem air switch (item 25) in ON position, air pressure should be between 25 and 35 psi. (17 - 24 kPa. x 10) during drilling operation. See Section 5 of this manual for drill air system detail.

10. ROTATION TORQUE — This digital display indicates percent (%) of torque exerted by D.C. motor mounted on rotary gear case in mast. Display will blink when 100% of rated motor torque is exceeded, provided that Alarm on/off switch (item 17) is in ON position. Beeper (item 21) will sound and display will continue to blink when motor torque reaches or exceeds 150% of rated for sustained period of 3 seconds, again provided that Alarm on/off switch (item 17) is in ON position. Audible alarm stops below 150% rated motor torque, and display ceases blinking below 100%.

36. HYDRAULIC FILTERS - NO. 2 PUMP — A red light for indicating status of main hydraulic system in-line filter that is located below Pump No. 2 in hydraulic room. When this light is lit, filter is clogged. Replace filter element.

37. HYDRAULIC FILTERS - AUX. SYSTEM — A red light for indicating status of auxiliary hydraulic system in-line filter that is located on deck in corner of hydraulic room below Valve Bank No. 1. When this light is lit, filter is clogged. Replace filter element.

38. DUST SUPPRESSION - FLOW CONTROL — On drills equipped with WET type dust suppression system, this dial is used to adjust water flow rate in system when operating (selector switch item 27). Dial is calibrated from 0 to 10, with 10 being maximum flow rate. On drills equipped with DRY type dust suppression system, this dial is **not** functional. There is a slight time lag between dial adjustment and flow rate response built into this system. Changing dial one unit requires 1.5 seconds before flow rate increases or decreases. Visual evidence of flow change is further delayed due to length of fluid stream from tank to drill bit.

39. HEATER — This off/on switch controls heater in operator's cab. Thermostat for heater is integral with heating unit. Some drills are not equipped with this heater.

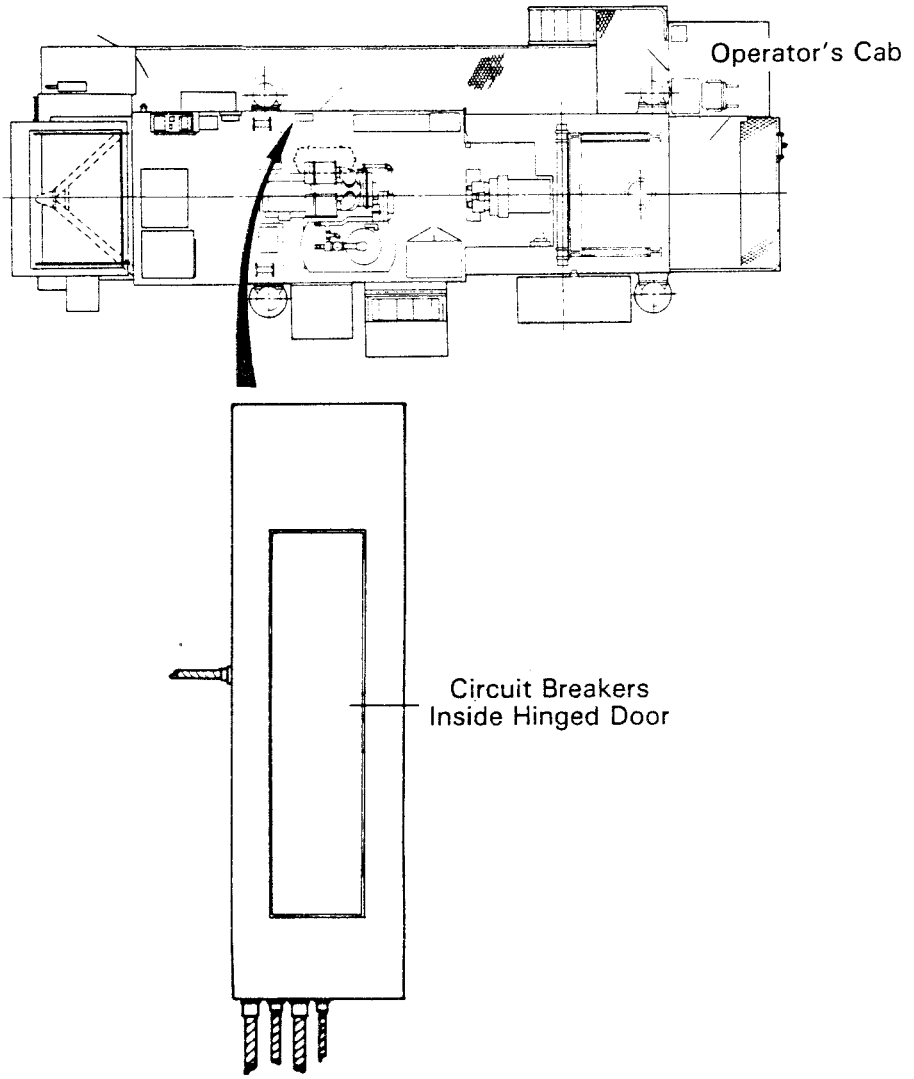
40. SHUTDOWN — This push/pull switch is wired into the ground check circuitry of the drill. Pushing switch in will shut off electrical power supply to machine at mine substation. This switch must be in its fully raised position (pulled out) for drill operation. This switch is optional.

41. (for Diesel-Electric machine only)

42. (for Diesel-Electric machine only)

NOTES:

ELECTRICAL DISTRIBUTION PANEL, located just inside the right access machinery house door, contains all the circuit breakers for the drill control, the lights, etc., except for those mounted on the face of the A.C. auxiliary cabinet.



The circuit breakers inside the panel are:

* Main Power	House Exterior Lights
Cab Interior Lights	House Interior Lights
Cab Exterior Lights	Mast Lights
Power Outlets	Cable Reel (optional)
Deck Washdown Pump (optional)	Aux. Gen. Anti-Condensation Heaters (optional)
* Auxiliary Air Compressor	* Drill Control

Those with an * must be closed (circuits energized) for machine operation. The Main Power breaker controls the supply of power to this panel.

TYPICAL SHUTDOWN — Start shutdown procedure in Operator's Cab. Check position of controls at Drilling Control Station and at Propel Control Station.

On Drilling Control Station,

- DRILL/STANDBY/PROPEL selector switch must be in **standby** position.
- all control levers should be in **neutral** (center) position.
- STEM ROTATION selector switch should be in **off** position.
- depress red **off** pushbutton for ROTATION and observe that green light in illuminated ON pushbutton above it goes **out**.
- DUST SUPPRESSION selector switch, if provided, should be in **off** position.
- STEM AIR selector switch should be in **off** position.

On Propel Control Station,

- both PROPEL control levers should be in **neutral** (center) position.
- PROPEL BRAKE selector switch should be in **set** position.
- PROPEL STATION selector switch should be in **local** position.

After controls are positioned, go to the machinery house and stand facing the A.C. Auxiliary Cabinet (Motor Control Center). Depress the STOP pushbutton for the HOUSE FILTER FAN; then for the HYDRAULIC DRIVE MOTOR; and finally for the MAIN AIR COMPRESSOR.

To Completely Shutdown the Machine, turn off the power supply from the mine distribution system by having the mine electricians shut off the power at the sub-station. On units powered by a diesel engine, proceed to the engine room from A.C. Auxiliary Cabinet and stop the engine.

Consider implementing following suggestions if machine is to be shutdown for extended period, such as a weekend or longer, but not to exceed one month.

Rack drill steel and lower rotary gear case to bottom of mast.

Propel machine away from edge of highwalls and place it where it will be safe from slides or falling rocks or other mine equipment.

Park machine in area that is not prone to flooding and is relatively level.

Park machine setting on crawler belts with leveling jacks extended so that their pads are in contact with ground.

Cycle the auto lube system, using the manual pushbutton on its electric panel, or the one on the Propel Control Station, at least once; lubricate all the points requiring application by hand; and fill all the reservoirs to their correct levels with the proper fluids.

SETTING MAST FOR ANGLE DRILLING (This is optional equipment) — The same two hydraulic cylinders and the handheld, portable control lever, that are used to raise or lower the mast, are used to perform this function. The mast can be set at any one of four positions for angle drilling—from vertical down to 15 degrees from vertical in 5 degree increments.

The hydraulic systems must be running to perform this operation. Be sure the control valving in the mast raising/lowering hydraulic circuit has been adjusted per the procedure given in Section 4 of this manual before proceeding further.

DANGER: Special precautions must be observed before the mast is lowered if any of the following conditions apply.

- **— mast raising/lowering cylinders have been removed for service.**
- **— hydraulic lines to the mast raising/lowering cylinders have been removed and replaced for any reason.**
- **— hydraulic system components for the mast raising/lowering cylinders control have been removed and replaced for any reason.**
- **— mast has been in its raised position for a period of 1 year or longer.**

If any one of these apply, disconnect both mast raising/lowering cylinders from the mast, rotate them on their bottom pins to clear the mast, and cycle the MAST control valve lever so that these cylinders retract and extend a full stroke a minimum of three (3) times. Now reconnect them to the mast and lower the mast as described in this section of the manual. Always make sure that the hydraulic fluid lines to the mast raising/lowering cylinders are fully bled of all air before raising or lowering the mast. Failure to comply with these precautions and instructions could result in the mast lowering without control about its pivot on the frame, possibly causing major damage to the machine as well as bodily injury or death to personnel.

Disassemble the drill string and rack the drill stem(s). Remove all loose items from the drill table, and secure the winch line and hook to its anchor on the drill table to prevent it from swinging. Arrange the rear deck area around the drill table for moving the mast. If applicable, make sure the left side door in the operator's cab is closed.

Lower the rotary gear case against the positive mechanical stops at the drill table using the hoist/pulldown control and carriage limit override. Move the rotary gear case SLOWLY and CAUTIOUSLY when bypassing the carriage travel limit to place it against the stops. See Drilling Operation in this section of the manual.

WARNING: The drill control has an interlock circuit that will NOT permit raising or lowering the mast unless the rotary gear case is positioned near the positive mechanical stops at the drill table. NEVER bypass or defeat the limit that controls this interlock in order to raise or

CAUTION: If threads do not release (unscrew) within three impacts, move Stem Rotation switch to OFF position and use the breakout tongs to provide loosening force. See Breakout Tong in this section for more detail. Repeated attempts to loosen a threaded joint using the rotary drive components can result in damage to the drive.

Raise the rotary gear case sufficiently to lubricate both sets of threads with a good quality drill pipe thread lubricant. Then hoist the rotary gear case high enough to prevent the stem in the rack from hitting it when the stem rack is lowered. Raise the stem rack containing a drill stem to release its lock and then lower it until the stem rack pot aligns with the drill string.

Now lower rotary gear case until the cross-over sub is near the top of the stem. Move the Stem Rotation switch to its FWD 1 position and engage the threads. When stem begins to rotate, return the Stem Rotation switch to its OFF position.

CAUTION: If machine is angle drilling, the steady guide must be lowered and the jaws engaged with the stem before it is removed from the stem rack pot.

This is done by moving the Steady Guide Jaws to the UP position to assure that the jaws are open. Then move the Steady Guide lever to the DOWN position. Hold it there until the jaws close about the stem completely.

Now, hoist the rotary gear case and drill stem. As the stem clears the stem pot, depress and hold the Stem Release button to open the upper stem latch. Lift the stem rack control lever to RAISE the rack into its FULLY raised position.

Lower the rotary gear case until the stem aligns with the threads of the stem held by the stem lock. Move the Stem Rotation switch to FWD 1 position and engage the threads. After the two stems are threaded together, release the stem lock.

CAUTION: ALWAYS release the steady guide jaws and raise the guide into its stored position when stem handling is finished.

Drill string and machine are now ready for the drilling operation.

REMOVE DRILL STEM FROM STRING by hoisting the rotary gear case until the milled slot, located at the top of the drill string component not being removed and just below the joint for separation, aligns with the stem lock on the drill table. Clamp the drill stem with the Stem Lock. The stem lock jaws should engage the slot about two inches (50 mm) below the collar at the top of the stem. This provides space for the threads to

MANUAL DRILL CONTROL — To place the machine in the manual drilling mode, move the MODE toggle switch to MANual. If applicable, lower the dust skirts.

CAUTION: Do not move drill mode toggle switch when main hydraulic pump(s) are stroked. Always place Hoist/Pulldown control lever in neutral (centered) position before making drill control mode change.

Press Rotation ON button and move Drill/Standby/Propel selector switch to DRILL. Next, set Stem Rotation pistol grip switch at FWD 2 position and set Stem Speed dial for low rpm.

Lower the rotary gear case and drill string until the bit is ready to enter the ground, then stop it. REMINDER: the amount the Hoist/Pulldown control lever is moved from the NEUTRAL (center) position regulates the speed of the drive.

Turn ON the Stem Air and the Dust Suppression system. If a Wet suppression system is used, adjust the liquid flow rate with the Dust Suppression dial control to suit the drilling conditions. Zero the counting program for the hole Depth counter by pushing the INITIAL button. Set the BITLOAD/PSI. toggle switch as desired to monitor the pulldown system. The BITLOAD setting is suggested for drilling.

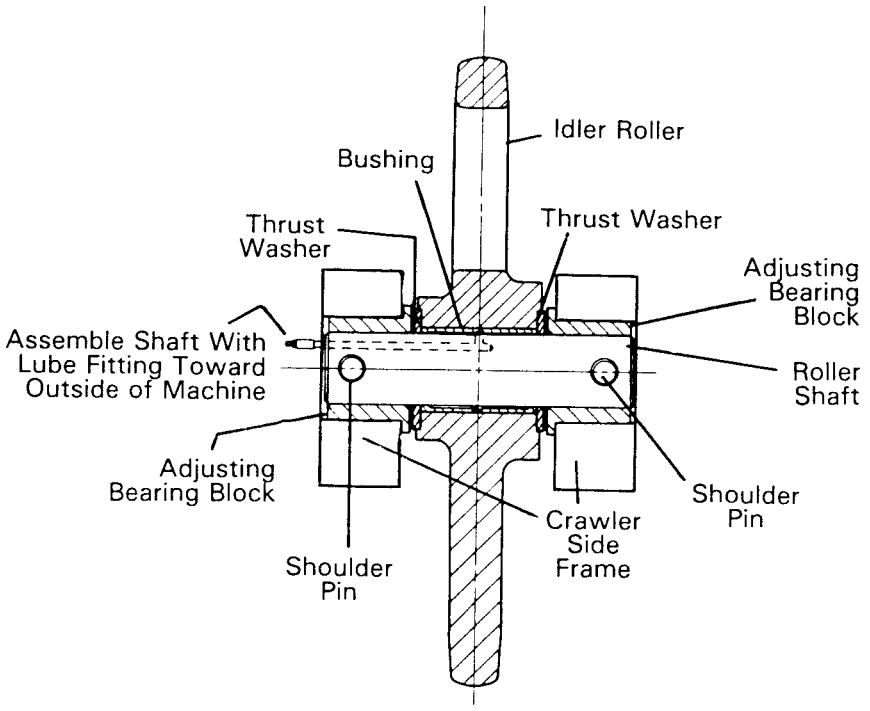
CAUTION: The operator must exercise extreme care when drilling with machine in MANual mode to avoid damaging components. In MANual mode, the operator is responsible to monitor the rotary motor load, the drilling air pressure, and the main hydraulic system pressure. He must operate the hoist/pulldown control lever to keep the drill working within the design range of the components. Automatic limits are NOT functional in MANual mode.

Slowly lower the drill string and start drilling the hole. When the bit stabilizer is below the surface, a depth that will vary with equipment used but generally between 4 and 6 ft. (1.2 and 1.8 m), increase the stem speed and the bit load to that recommended for the drill bit being used and suitable for the strata being drilled. REMEMBER - you have complete control of the drilling operation when the control is in the manual mode. The automatic (ADC) limits are **not** functional.

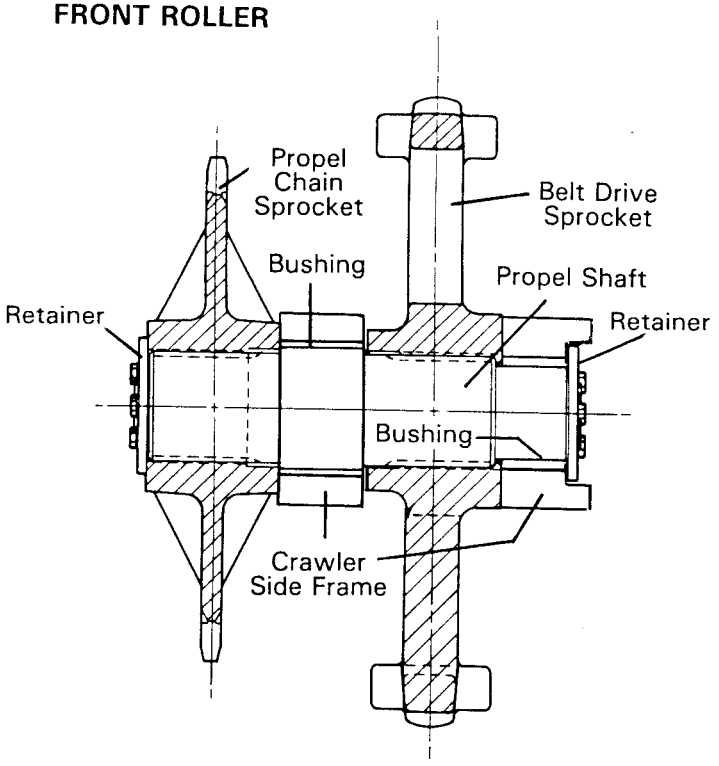
CAUTION: To prevent rotary motor(s) overheating, the motor(s) current should not exceed 100 percent (%) for any extended time period. Some overloading is permissible, but these instances must be limited. Following is a list of guidelines for motor(s) torque over100%:

120 % for 5 minutes
150 % for 1 minute
200 % for 10 seconds

DO NOT repeat overload more than once in 20 minutes.



FRONT ROLLER



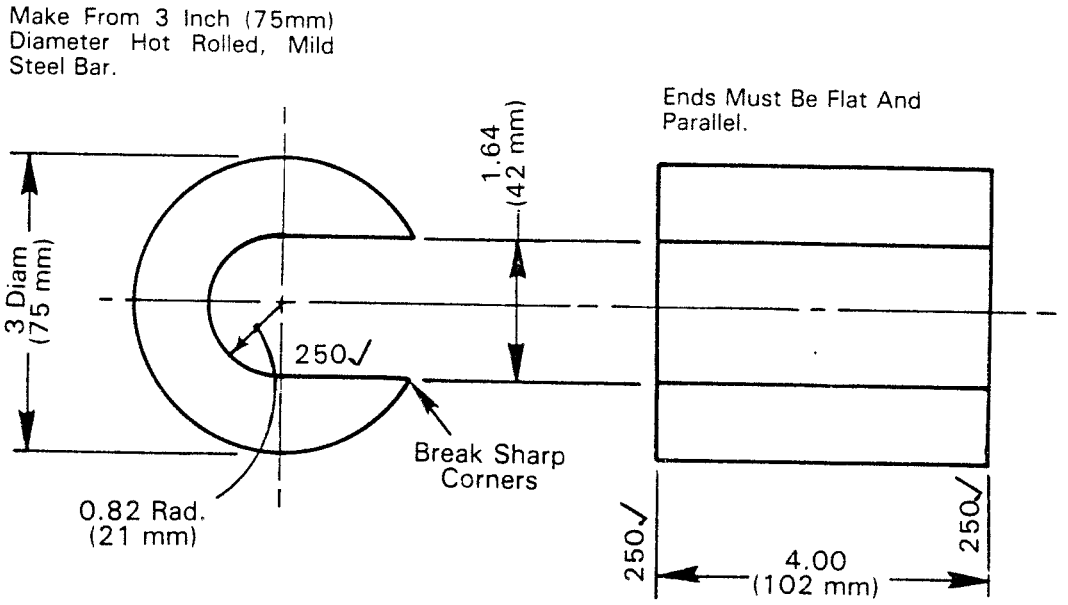
DRIVE SPROCKET SHAFT

Inspect the chains timing by counting the links from the anchor points under the gear case assembly to identical points on the two sprockets at each end of the hoist/pulldown shaft. This number should be the same on each side. If not, put the chains in time. Contact your MARION representative for assistance with this re-timing procedure.

Verify that the rotary gear case is level from side to side. If it is not level, bring it to level using a turnbuckle. If the gear case is out of level more than 1 inch (25 mm) across its width, do **not** use the turnbuckle for leveling it. Investigate for the cause of this excessive slant and correct it.

After the adjustment is complete, hoist the rotary gear case to the top of the mast and then lower it again to the lower travel limit. Recheck the tension, timing and levelness.

CHAIN ADJUSTMENT BY LINK REMOVAL — To remove chain links at the connection under the rotary gearbox, proceed as follows. Lower the gearbox until it is on its lower stops. Now exert enough pulldown effort to collapse the springs in the lower sprocket/take-up assemblies so that the six jig spacers (see sketches below) can be installed between the drill table and the bottom of the sprocket/ram bracket at each spring rod.



Approximate Weight Each — 3.6 Lbs. (1.62 kg.)

JIG SPACER
6 Req'd.

The **STEADY GUIDE** is furnished only on drills that have the optional feature of angle drilling. If the mast is set off vertical, the steady guide is used to support the lower portion of a drill stem in alignment with the drill string, when it is being added or removed from the drill string. The use and operation of the steady guide is fully explained in the article on Assembly of Drill String, Adding Additional Stem to String, Remove Drill Stem from String, and Drilling Operation that are in Section 2 of this manual.

IMPORTANT NOTE: The steady guide is **not to be used** to support the drill string during the drilling operation. The steady guide must be **disengaged** from the stem and **up** in its parked position when drilling to avoid being damaged.

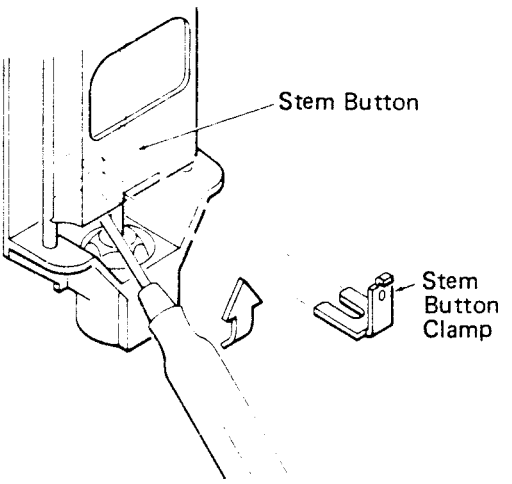
The steady guide is mounted to the rear chords each side in the mast structure just above the level of the mast pivot point in the A-frame structure on the machinery frame. It consists of a supporting framework that contains the guide jaws assembly. The supporting framework is pinned in place to the rear mast chords. It is designed so the left pin can be removed, and the whole steady guide assembly rotated away from the mast about the two hinge pins in the brackets on the right side. This movement can be accomplished without disconnecting the electric cable and hydraulic hoses to it.

The guide jaws assembly is mounted to the support framework on two (2) bushed pins and is connected to a double acting hydraulic cylinder. This cylinder rotates the jaws assembly forward from its parked position parallel to the mast into its drill stem support position perpendicular to the mast, and then back up to its parked position. The jaws themselves are closed about and opened from the drill stem by a lever system in the guide jaws assembly housing, that is operated by a double acting hydraulic cylinder pinned to it and the housing. The two (2) jaws each have a roller assembled into its outer extremity. These rollers contact the drill stem when the jaws are closed about it. The rollers have self contained roller bearings and rotate with the drill stem as needed.

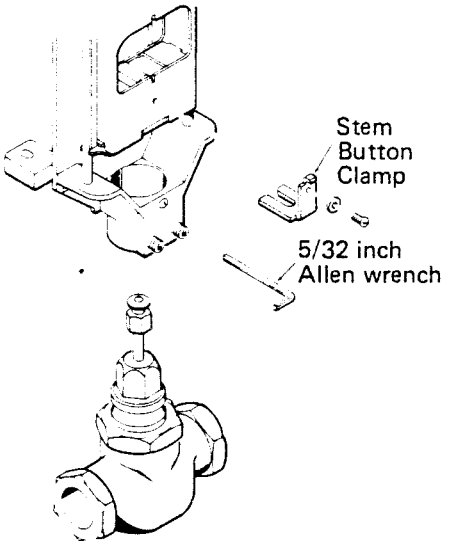
The two (2) hydraulic cylinders on the steady guide are in the auxiliary hydraulic system and are piped to operate in sequence. They are both controlled by a single control lever at the Drilling Control Station in the Operator's Cab. A dual sequence valve and some check valves in the circuit control the cylinders so the steady guide either lowers into position and then closes its jaws about the drill stem (control lever pushed down and held there) or opens its jaws from about the drill stem and then raises it into its parked position (control lever pushed forward and held there). For more on this hydraulic system, see the article on the Steady Guide Circuit in Section 4 of this manual.

WARNING: **To avoid personal injury when working on fluid pressurized systems, always remove pressure from the system, and loosen all connections slowly and carefully to guard against residual pressure conditions.**

To replace the motor or linkage on the flow control valve assembly, close the valve by returning the metering control in the operator's cab to 0 with the system operating. Wait 30 seconds, and then shut off the system. Isolate and lockout the power supply to it. Have a qualified electrician disconnect the electrical lead at the motor.

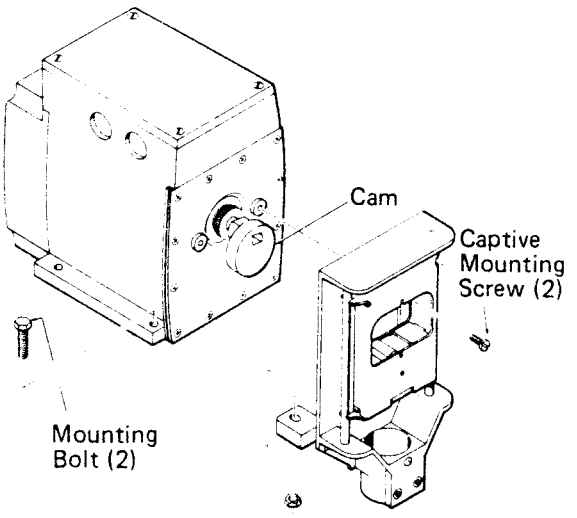


Remove the cover from the valve linkage. Place a heavy duty screwdriver under the linkage slide and into the slot in the back of the linkage housing. Use the screwdriver as a lever to force the slide mechanism up enough to relieve the pressure between the valve stem button and the stem buttom clamp. Remove the screw from the stem button clamp, and then take the stem button clamp out of the valve stem button and linkage assembly.



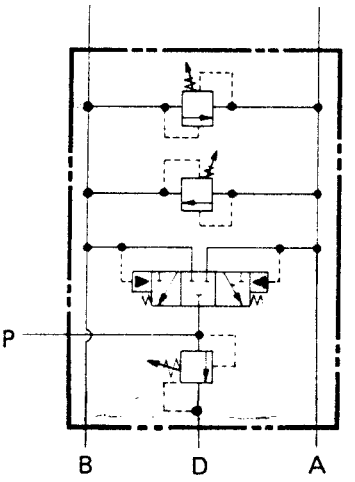
Use an Allen wrench to loosen the two (2) setscrews that secure the linkage/motor assembly to the valve. Remove the two (2) capscrews that hold the motor to the support bracket. Lift the linkage/motor assembly from the bracket and valve. This assembly weighs about 15 lbs. (6.8 kg).

Unbolt the linkage from the motor by removing the two mounting bolts and the two (2) captive mounting screws. Carefully separate the motor and its cam from linkage. Pull the cam from the motor drive shaft. The cam is key fit onto the shaft. Replace the faulty part(s) and reassemble the flow control valve assembly.



WARNING: To avoid unwarranted accidents involving personnel, do not disassemble the flow control valve from the delivery line unless the delivery line contents have been drained back into the water tank.

The two high pressure crossover relief valves monitor the main pump lines, one in Port A and one in Port B. These valves are each set to relieve at a fluid pressure of 4000 psi (27.6 MPa). These valves are safety valves in the hydrostatic loop. They should not function during normal system operation, since the pressure overrides will control the hydrostatic loop pressure to less than their relief setting.



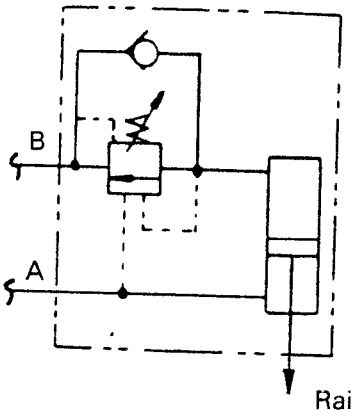
When a main pump is stroked, the shuttle valve shifts so that a portion of the fluid from the low pressure side (return line) of the hydrostatic loop flows thru it and the low pressure relief valve to the oil cooler and then to the reservoir. The remainder of the fluid in the return line flows to the suction port of the main pump that is stroked. The low pressure relief valve is in the charge pump circuit and is set to relieve at 200 psi (1380 kPa). Thus the shuttle valve and low pressure relief valve in each crossover manifold work together to remove hydraulic fluid from the hydrostatic loop for cooling.

Two **OIL COOLERS**, or heat exchangers, are piped in parallel into the main hydraulic system to cool the hydraulic fluid. They are the middle and bottom ones of the three located in the left rear corner of the machinery house wall just to the side of the pumps and reservoirs assembly. The fans on these two coolers operate when the temperature of the fluid in the main hydraulic tank reaches or exceeds 110 degrees F (42 degrees C). A separate circuit breaker on the A.C. auxiliary cabinet (motor control center) controls these cooling fans. Make sure this breaker is closed (circuit energized) whenever the pump drive is operating. If the oil coolers become clogged, a spring loaded check valve, rated at 20 psi (140 kPa), will open and permit the oil to bypass the two coolers and flow directly to the reservoir.

The fluid supply line to the charge pump on each main pump is equipped with a suction filter. These two filters are mounted in the top of the main reservoir, which is located just behind the pumps transmission. They each contain a 10 micron disposable element. An in-line filter is installed in the A line of the hydrostatic loop for each main pump. These two in-line filters are assembled to the top of the main manifold for the system, which is just below the two main pumps. They each contain a 10 micron disposable element also.

An **ACCUMULATOR** is piped into the charge pump circuit of each main pump in the main hydraulic system to stabilize hydraulic pressure. These two accumulators are mounted on the pumps and reservoirs assembly, one each side to the front supports of the base bracket. Each is a piston type and should be precharged with **dry nitrogen gas** to a pressure of 100 to 120 psi (690 to 830 kPa). This pressure is checked with a gauge at the valve located on top of the accumulator. Ambient and system operating temperature will cause this pressure to fluctuate. This effect must be given consideration when measuring the precharge. Check the accumulator charge once per month. If it is below the recommended range, recharge it with an accumulator charging assembly using only **dry nitrogen gas**. If the charge exceeds the rating of the accumulator, bleed some gas out of it until the charge is safely below the rating.

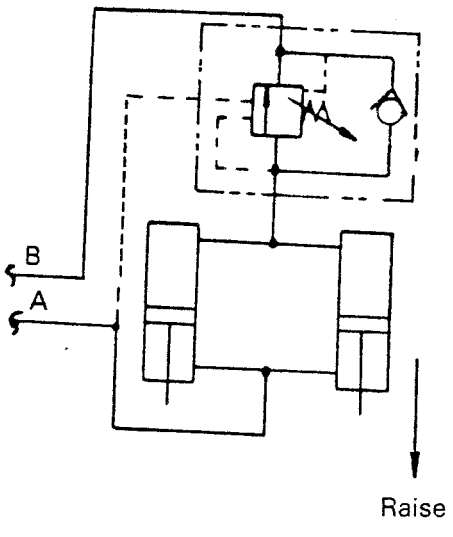
while the two front dual jacks, which work as one, are in a special circuit that is described in the article following.



In the single leveling jack circuit shown here, a counterbalance valve equipped with a check bypass is installed in the extend (raise) line with its pilot line connected to the retract (lower) line. This counterbalance valve is mounted directly into the head of the cylinder.

The counterbalance valve holds fluid in the cylinder until a pilot pressure from the lowering line activates it to allow fluid flow out of the top of the cylinder. In this manner the lowering function of the jack is controlled. The check in the counterbalance valve allows fluid flow to the head end of the cylinder when raising the machine and holds the cylinder rod in position when fluid flow ceases, even when the hydraulic system is shut down. This counterbalance valve has a built-in pressure relief connected to the extend (raise) line that protects the cylinder from being overloaded. This counterbalance valve should be adjusted so it operates at a pilot pressure from the lowering line of 275 psi (190 kPa x 10). This setting will cause the valve to relieve pressure in the cylinder head if it exceeds 2750 psi (18.95 MPa) since its pilot ratio is 10 to 1.

DUAL FRONT LEVELING JACKS CIRCUIT (optional) — The two front leveling jacks are each a double acting cylinder mounted in a housing and attached to each side of the machinery frame. They are controlled simultaneously by Valve 1 in Bank No. 1 thru a single control lever in the Drilling Control Station in the Operator's Cab.



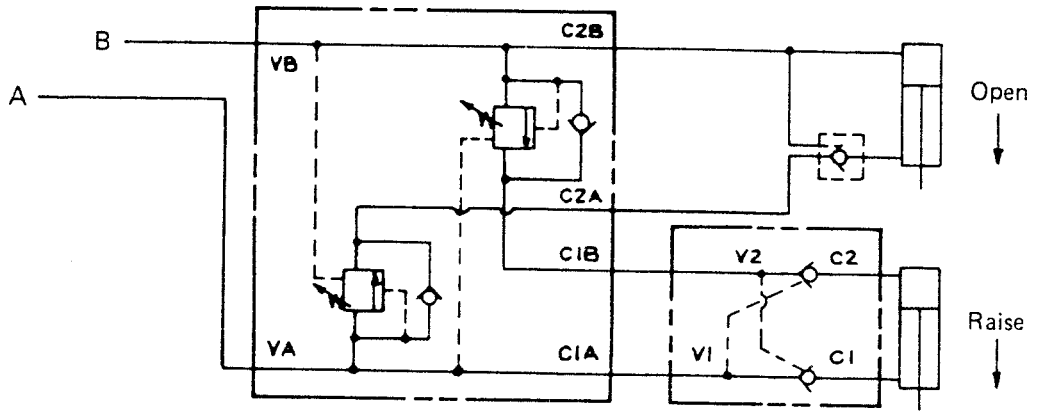
A counterbalance valve equipped with a check bypass is installed in the extend (raise) line with its pilot line connected to the retract (lower) line. This counterbalance valve is located in a compartment in the machinery frame between the two jacks.

The counterbalance valve holds fluid in the two cylinders until a pilot pressure from the lowering line activates it to allow fluid to flow out of the top of the cylinders. In this manner the lowering function of both jacks is controlled. The check in the counterbalance valve allows fluid flow to the head end of the two cylinders when raising the machine, and holds the cylinder rods in position

A dual sequence valve is in the extend (open and raise) and retract (lower and close) lines ahead of the cylinders. Check valves are between the sequence valve and the two cylinders. A nonadjustable, pilot operated check valve is in the retract line of the guide jaws open and close cylinder. It is mounted directly to the jaws cylinder. This check valve's pilot line connects to the extend (open) line for this cylinder. A nonadjustable, pilot operated dual check (lock) valve is in the extend and retract lines of the guide jaws raise and lower cylinder. The internal pilot lines in this check valve are crossported between the extend (raise) and retract (lower) lines for this cylinder.

The dual sequence valve controls fluid flow in the circuit so the guide jaws are either lowered into position and then closed about the drill stem, or opened and then raised up into the stored position for the angle drilling operation. The two adjustments on this dual sequence valve should each be set for fluid flow at 500 psi (3.4 MPa) below the circuit relief pressure. The relief pressure in this circuit should be 2600 psi (17.9 MPa).

The pilot operated check valves in the circuit control the opening motion of the steady guide jaws and the raising and lowering motions of the steady guide. They also hold the rods of the two cylinders in position when fluid flow ceases, even when the hydraulic system is shut down.



NOTES:

8. CHANGE HDF AT THESE TIMES:

   a. When filters frequently clog

   b. When fluid changes color or develops a strange odor

   c. When HDF becomes contaminated either chemically or with particulate matter

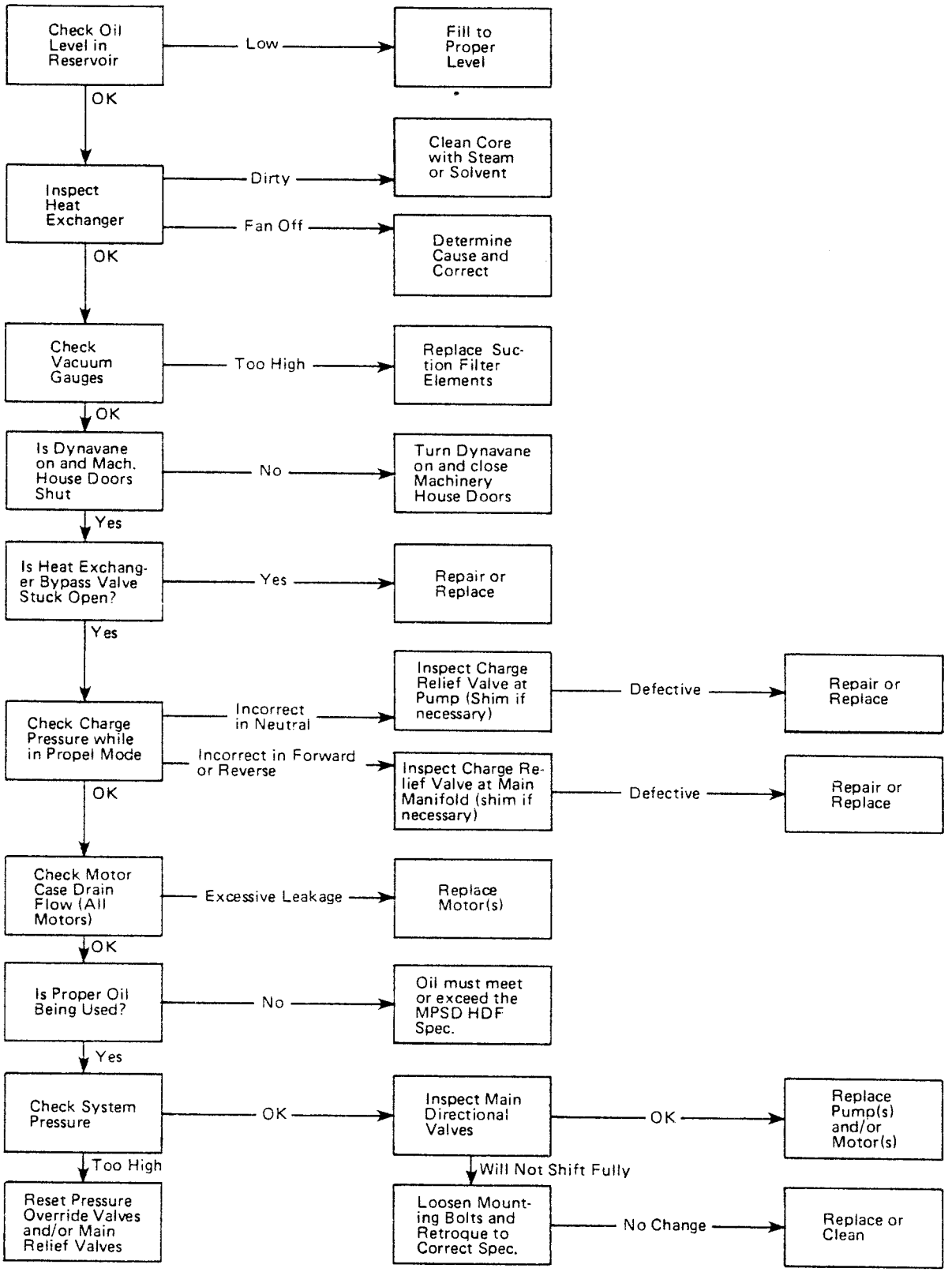
   d. With knowledge of a sizeable water content in system

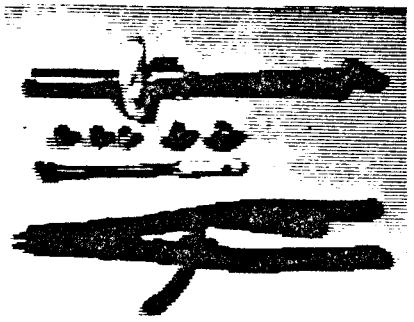
   e. If wrong HDF is added

   f. If viscosity ASTM D-445 drops over 10% in service, drain and replace HDF. A minimum viscosity of 90 SUS at HDF operating temperature in loop is essential to hydraulic motor life. (Oil suppliers generally run this test as a service to buyers.)

Normally (it's assumed) enough HDF is added to the system to eliminate concern about HDF oxidation life. However, if HDF goes 12 months without change for one of the above reasons, DRAIN AND REFILL the system. Prior to cold weather is the best time for a HDF change. If Summer and Winter fluids are used, drain and refill the system twice yearly.

MAIN SYSTEM OPERATING HOT



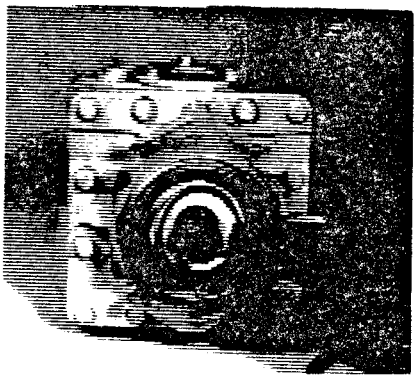


Special Tools

Certain tools are required that are not normally carried which are as follows:

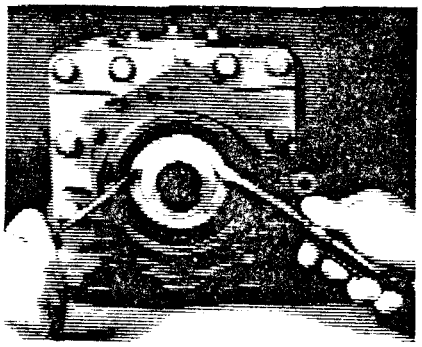
1. Waldes Truarc No.7 Retaining Ring Pliers
2. Drag Link Socket
3. Torque Wrench

REPLACEMENT OF PUMP SHAFT SEALS:

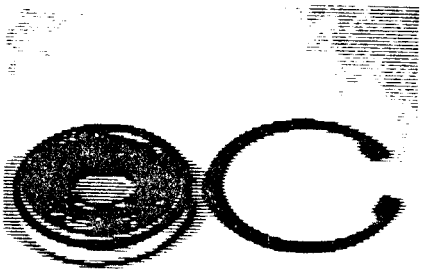


It is recommended that all shaft seal parts be replaced. If parts are to be reused, they must be protected from being damaged by the shaft during removal.

Remove the large retaining ring located on the shaft end of the pump. Remove the side opposite the tangs from the groove first.



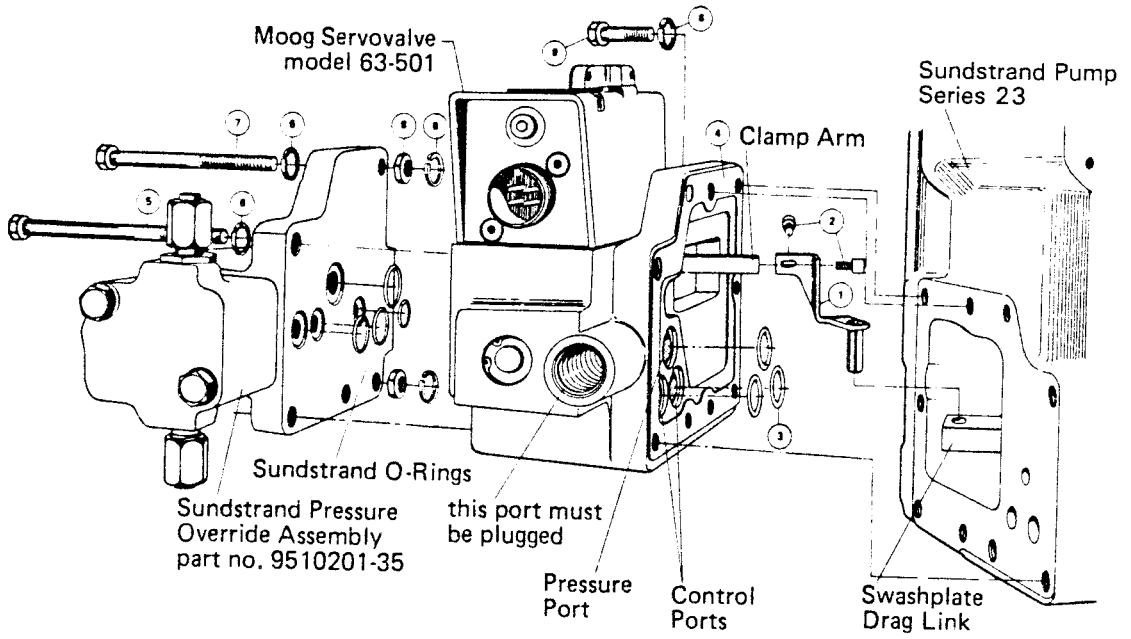
The aluminum housing is removed next. It is held in place by the friction of the O-ring on its O.D. Pry the housing toward the end of the shaft until the O-ring is free.



Remove the housing from the shaft. This part is actually an assembly that is being held together by the friction of an internal O-ring. It will normally remain assembled until physically separated.

CAUTION: Be extremely careful not to drop anything into the main pump opening while it is uncovered. Anything inadvertently entering the pump housing that could result in damage to the pump must be retrieved before starting the pump.

6. Position the controller opposite the opening in the main pump with the connecting link assembly toward the swashplate drag link. Engage the pin on the connecting link assembly (1) in the mating hole in the swashplate drag link. Slide the pin all the way into the swashplate drag link hole, and then swing the controller into place against the mounting surface on the main pump, assuring that the o-rings are in place.



MOUNTING KIT CONTENTS
for Main Pump Controller

Item	Part Name	Qty.
1	Connecting Link Assembly	1
2	Soc. Head Cap Screws 5/16 inch long, locking	2
3	O-Ring	3
4	Gasket	1
5	Hex Head Cap Screw 3-1/2 inch long	3
6	Lockwasher	10
7	Hex Head Cap Screw 3-1/2 inch long, long thread	2
8	Hex Nut	2
9	Hex Head Cap Screw 1 inch long	3

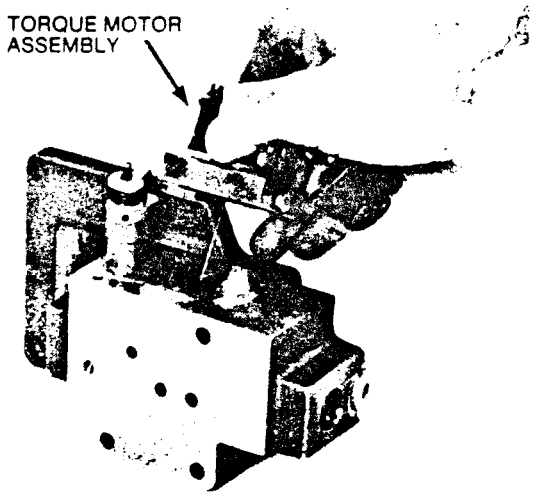
REQUIRED TOOLS for Controller Installation

- 1 Torque Wrench, 1/4 inch drive (0-30 in. lbs./ 0-3.4 Nm)
- 1 Torque Wrench, 1/4 inch drive (0-150 in. lbs./ 0-17 Nm)
- 1 Socket, 1/4 inch drive (7/16 inch)
- 1 Open End Wrench (7/16 inch)
- 1 Adaptor, 1/4 inch drive to 7/16 inch open end wrench
- 1 Allen Wrench, 1/8 inch hex
- 1 Adaptor, 1/4 inch drive to 7/64 inch, hex Allen

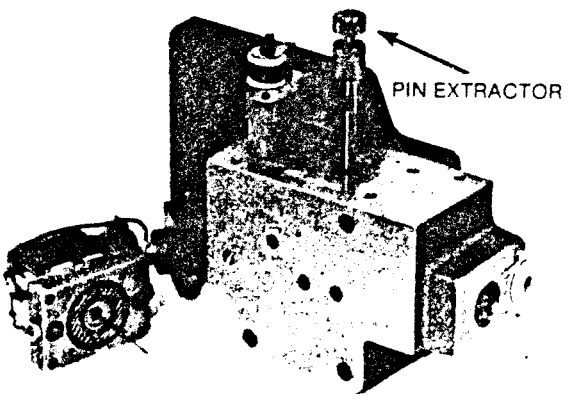
INSTALLATION OF CONTROLLER TO MAIN PUMP

CAUTION: The torque motor assembly is a precision built component and must be handled with care. Avoid any contact of objects with the feedback wire protruding from the base of the assembly. Do not let metal particles or objects come in contact with the magnets thereby not disturbing their charge and adjustment. Do not introduce metal filings or particles into the interior of the torque motor.

d. Disassemble the four socket head capscrews (10) from the base of the torque motor assembly (13) using a 3/32 inch Allen wrench. DO NOT let the screws or their washers rub the motor magnets.



View 2



View 3

e. **Carefully** lift the torque motor assembly (13) straight up until its feedback wire clears the controller body (25). See View 2. Do not remove the o-rings (14) and filter screens (15), or the filter assembly (16, 17, and 18), from the base of the torque motor assembly unless they are to be replaced with new ones.

CAUTION: Do not adjust the nozzles in the torque motor assembly. The only amplifier adjustments that need to be made can be accomplished with the null adjust adaptor screw. Refer to the article on Mechanical Null Adjustment in this section of the manual.

f. Insert the pin extractor (Moog part number AT24321) into the bushing locator pin (19). Tighten down the pin extractor thumbscrews to grip the inside diameter of the pin. See View 3.

g. Withdraw the bushing locating pin (19) from the controller body (25). See View 4.

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 the ball end and piston spherical seat do not show signs of wear.

Keep the restrictor in the connecting rod thru hole clear. The restrictor hole diameter is very critical and no enlarging can be tolerated.

Be sure the tracks for retaining rings are smooth.

BEARING INSPECTION is a must for damage to cup, cone and rollers. Take fretting or small fatigue crack as a sign of failure, but ignore discoloration by fluid additives.

Take excessive wear on roller edges as indication to replace bearing, even if no other failure signs appear.

When cones are removed from crankshaft, replace bearings as a matter of fact, as removal process invariably causes damage. Neglecting bearing renewal causes premature failure.

Bearings press fit on shaft and in housing. If bearings exceed normal life when motor is disassembled, replace in any case.

PISTON AND VALVE SEAL RINGS need inspection for excessive wear in plastic and when assembled as a pair in proper groove, no excessive gap may exist. Rings must be free to rotate. Metal rings, when fitted in proper groove, require gap check. Axial clearance between rings – .004 to .010 inch (.10 to .25 mm); ring gap in bore – .000 to .010 inch (.000 to .25 mm).

All **O-RINGS** need replaced as matter of fact. If spares are not available, reuse old rings only when free of cuts or other damage and are of circular cross section. Overheating causes some section set and this is unacceptable.

SHAFT SEAL is generally replaced, but reuse original if seal lips are free of cuts or excessive wear and garter spring is intact. Front cover and motor case fit together with a light interference fit and running surfaces for retaining rings must be smooth. Motor face mounting case fret marks are caused by incorrect fitting on installation or loose mounting bolts. This causes front cover screw failure.

Check **RETAINING RINGS** smooth and free from metallic particles.

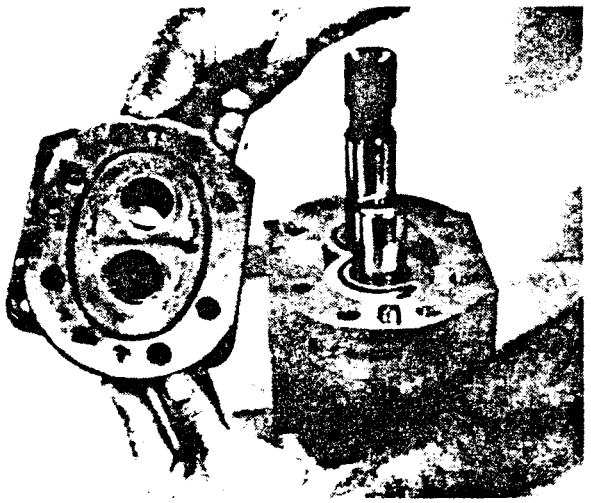


Fig. 3

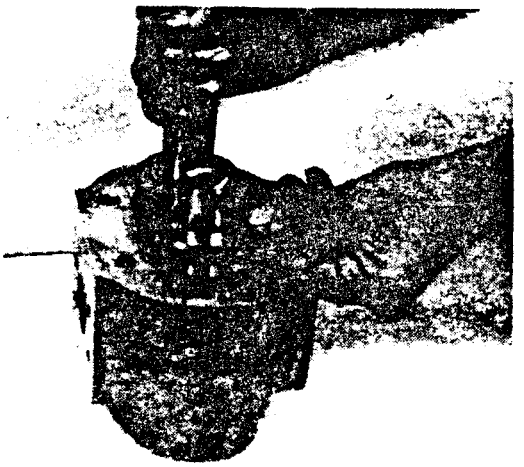


Fig. 4

9. Lift the drive gear and idler gear straight up out of pump case.

10. Examine gear bores in pump body. During initial break-in, (at factory), the gears cut into the body. The nominal depth of this cut is .008 inch (.203 mm) and should not exceed .015 inch (.381 mm). As gears cut into body, metal is rolled against edges of the pressure plates. Using a knife or sharp scraper, remove the metal that was rolled against top pressure plate. See Fig. 5. Use the point of scraper, go around the outer

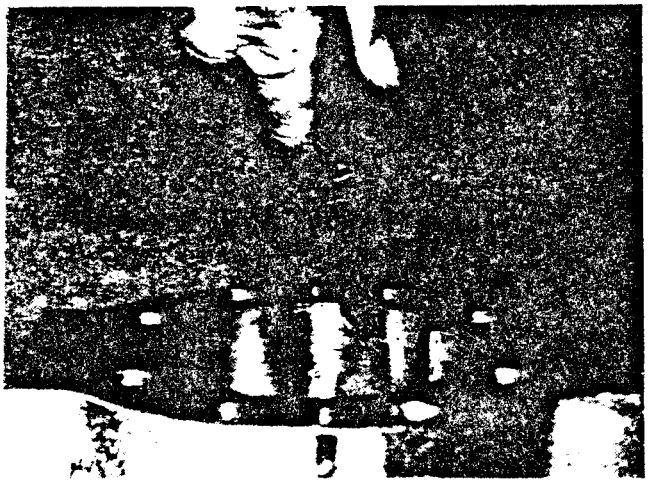


Fig. 5

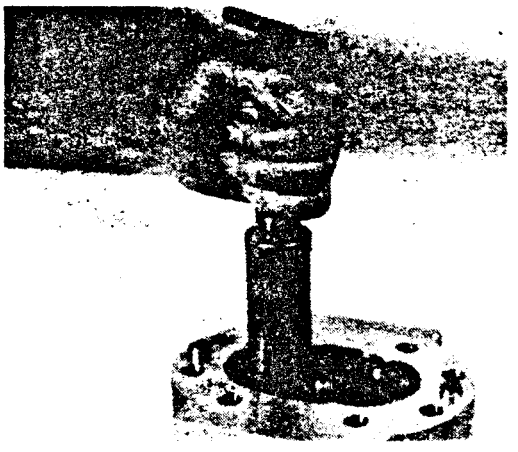
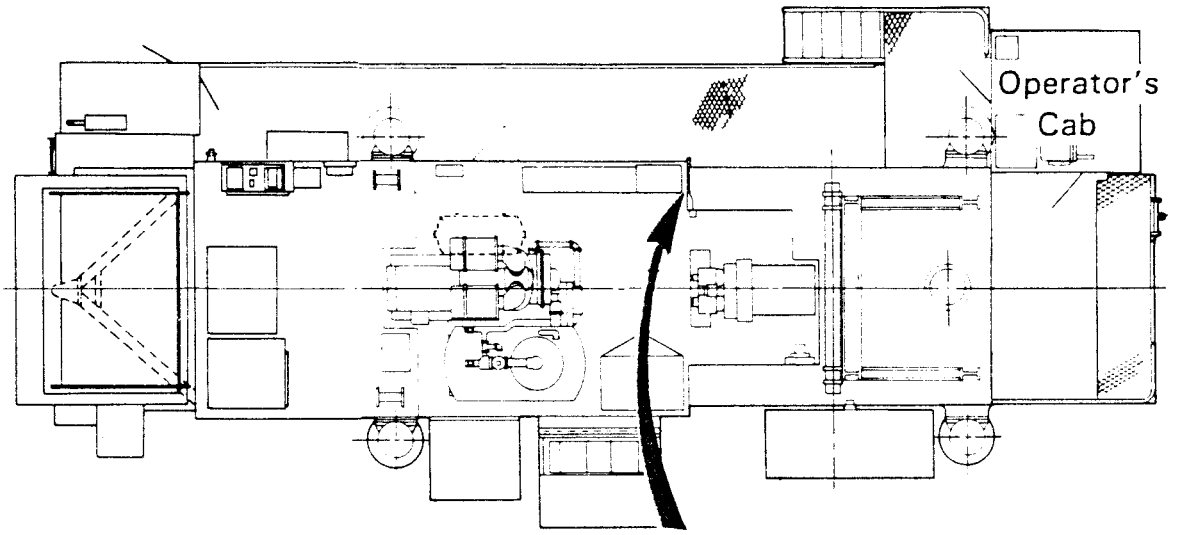
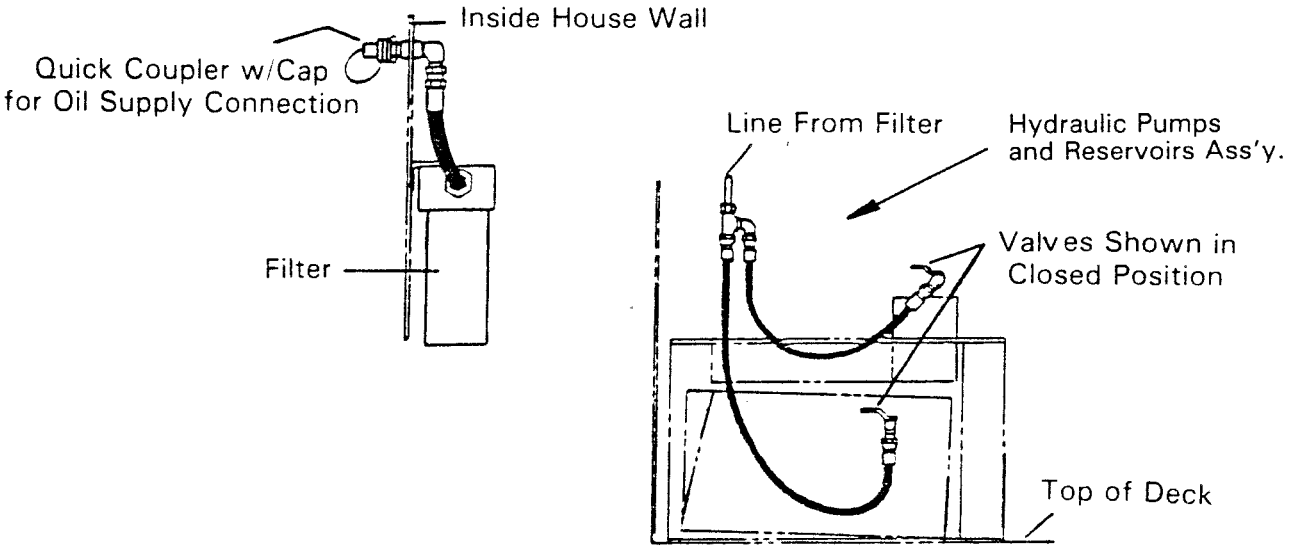


Fig. 6

edge of the pressure plate in bottom of body. Use air to blow out any loose chips. This keeps the plate from hanging as it is lifted from the bottom of gear bore. DO NOT attempt to remove the track-in grooves.





RESERVOIR FILL SYSTEM

separator element causing the oil to collect on the surface of the element. Return lines (or scavenge tubes) lead from the bottom of the separator element to the inlet region of the compressor unit. Oil collecting on the bottom of the separator is returned to the compressor by the pressure difference between the receiver and the compressor inlet. A sight glass is located in the return line to observe this oil flow. There are also orifices in the return lines (protected by strainers) to assure proper flow.

The sump tank is ASME Code rated at 150 PSIG (1034 kPa) working pressure. A minimum pressure valve, located downstream from the separator, assures a minimum receiver pressure of 40 PSIG (276 kPa) during all conditions. This pressure is necessary for proper air/oil separation and to assure proper oil circulation.

A terminal check valve at the outlet of the receiver prevents compressed air in the drill stem from bleeding back into the separator tank on shutdown and during operation of the compressor in an unloaded condition.

A high discharge pressure shutdown switch is provided to shutdown the compressor when discharge pressure rises to 80 PSI (552 kPa). This feature is provided to avoid excessive drill stem pressure.

A pressure relief valve (located on the wet side of the separator) is set to open if the sump pressure exceeds **90 PSIG (621 kPa).** A fast-acting temperature switch, located at the discharge port of the compressor, will shut down the compressor if the discharge temperature reaches 240°F (116°C).

WARNING: DO NOT attempt to open the oil filler cap when the compressor is pressurized. Shut down the machine and bleed the receiver to 0 PSIG before removing cap.

Oil is added to the sump via a capped oil filler opening, placed low on the tank to prevent overfilling the sump. A sight glass enables the operator to visually monitor the sump oil level. **The blast hole drill must be fully leveled for an accurate reading of the sump oil level in the compressor.**

A separator maintenance gauge located on the instrument panel is provided to monitor pressure drop on air flow across the separator elements. A reading of 10 PSI (69 kPa) differential is an indication that separator element changing is required.

CONTROL SYSTEM, FUNCTIONAL DESCRIPTION – Refer to Figure 5-4. The purpose of the control system is to regulate the compressor air intake to match the amount of compressed air being used. Within the full operating range of the compressor, the control system will automatically blow down the drill air system, and greatly reduce the power consumption of the compressor unit. The Sullimatic Control system consists of a Sullicon Control, a butterfly valve (located on the compressor air inlet), two (2) pressure regulators, a running blowdown and a shutdown blowdown valve. The functional description of the control system is described below in four distinct phases of compressor operation. **The compressor is operating within a pressure range of 60-70 PSI (414-483 kPa).**

INITIAL START-UP PROCEDURE—The following procedure is to be used to make the initial start-up of the compressor:

1. Read the preceding pages of the manual thoroughly.
2. Be sure that all preparations and checks described in the Installation article have been made.
3. Open the drilling air discharge butterfly valve to your drill stem.
4. The oil line to and from the cooler must be bled of air and full of oil prior to start-up.
5. Start the compressor.
6. Check for possible leaks in piping.
7. Slowly close the drilling air discharge butterfly valve and check that the setting of the unload pressure regulator is correct. If set correctly, the compressor will unload at your desired unload pressure. If adjustments are necessary, see Control System Adjustments in the Maintenance portion of this section.
8. Observe the operating temperature. If the operating temperature exceeds 210°F (99°C), your cooling system or installation environment should be checked.
9. Observe return line sight glass and maintenance indicators.
10. Open shut-off valve to drill stem.
11. Reinspect the compressor for temperature and leaks the following day.
12. To start a new compressor with a remote or to restart a compressor that has had an oil change, fill the oil cooler from the top. Restart as normal. The oil pre-heater line should establish cooler flow quickly enough to preclude a high temperature shutdown.

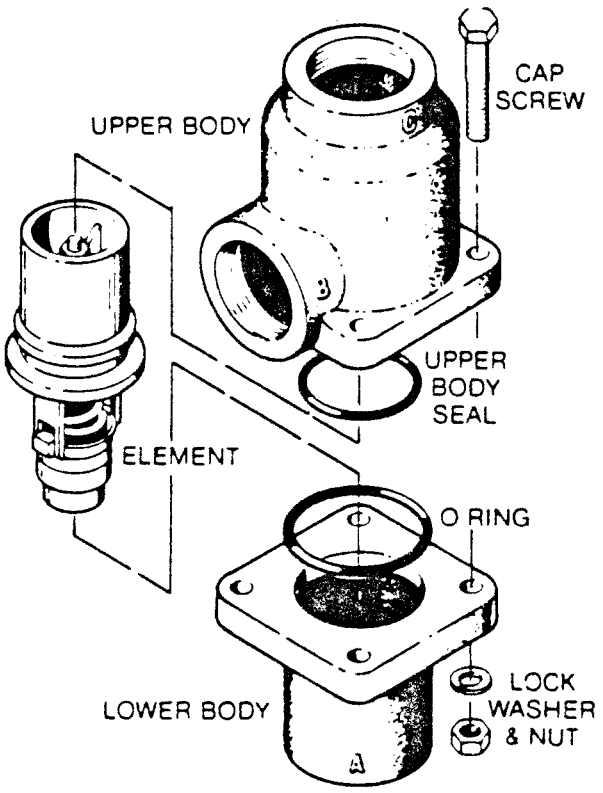
SUBSEQUENT START-UP PROCEDURE—On subsequent start-ups, check that the proper oil level is visible in the oil level sight glass and simply press the START button. When the compressor is running, observe the instrument panel and maintenance gauges.

SHUTDOWN PROCEDURE—To shut the compressor down, simply press the STOP button.

MAINTENANCE

GENERAL—The use of the service indicators provided for the bearing filter, air filter and oil separator, will alert you when service maintenance is required. See instructions for each item in the article Parts Replacement and Adjustment Procedures following.

FIGURE 5-14 THERMAL VALVE



2. Remove cover and O-ring.
3. Remove the spring.
4. Remove the piston rod.
5. Remove quad ring.
6. Remove the cover plate and sleeve.
7. Discard the stop and cover plate O-ring.
8. Clean all parts thoroughly including the cover bore, housing bore and sleeve.
9. Replace the piston rod quad ring.
10. Coat the piston rod, core bore, housing bore and sleeve with Parker Super "O" lube or an equivalent quality grease.
11. Replace cover plate O-ring.
12. Install stop and sleeve.
13. Replace cover plate.
14. Replace piston rod.
15. Install spring.
16. Replace cover O-ring and cover (tighten bolts evenly).

THERMAL VALVE MAINTENANCE—Refer to Figure 5-14. For thermal valve maintenance, use repair kit No. 001084. Follow the procedure explained below for repair kit installation.

1. Remove appropriate piping for disassembly of the thermal valve housing.
2. Remove the four (4) capscrews which hold the housing together and pull the upper housing away from the lower housing.
3. Remove element.

TROUBLESHOOTING (cont.)

SYMPTOM	PROBABLE CAUSE AND REMEDY
2. Compressor shuts down with the air demand present. (continued)	e. Clogged filter; change the oil filter element and change the bearing filter element, if the maintenance gauge indicates a dirty filter. f. Defective discharge temperature switch; replace
3. Compressor will not build up full discharge pressure.	1. Air demand too great; check service lines for leaks or open valves. 2. Dirty air filter; check filter maintenance gauge and change or clean element if required. 3. Pressure regulator out of adjustment; adjust regulator according to control adjustment instructions in the Maintenance section. 4. Defective pressure regulator; check diaphragms and replace if necessary (kit available). 5. Defective blowdown valve; repair.
4. Line pressure rises above cut-out pressure regulator setting.	1. Leak in control system causing loss of pressure signals; check for leaks. 2. Defective regulator; check diaphragms and replace if necessary (kit available). 3. Defective blowdown valve; check that sump pressure is exhausted to the atmosphere when the pressure regulator valve opens. Repair or replace if necessary (kit available). 4. High pressure shutdown switch is defective or adjustment is incorrect; readjust or replace.
5. Excessive oil consumption.	1. Clogged return line strainers or orifices. a. Clean strainers (screen and O-ring replacement kit available.) b. Clean orifices. 2. Separator elements damaged or not functioning properly; change separators. 3. Leak in lubrication system; check all pipes, connections, and components.
6. Pressure relief valve opens repeatedly.	1. High pressure shutdown switch is defective or out of adjustment; readjust below pressure relief valve setting or replace. 2. Defective pressure relief valve; replace pressure relief valve.

SECTION 7

LUBRICATION

Application of the CORRECT lubricant in the CORRECT amount thru a CORRECT program is required for the successful operation of any machine. Proper lubrication reduces maintenance and increases component life. The absence of proper lubrication causes moving parts to wear quickly, and failure results.

LUBRICATION FITTINGS on plain and anti-friction bearings, not served by the automatic lubrication system, are hydraulic type, push on fittings, size 1/8 inch or 1/4 inch as per DRESSER standard. When contamination creates a problem, as in slow speed bearings using labyrinth seals, new grease should be added until clean grease seeps out around the seal. When a bearing runs excessively warm due to overfilling, remove the pressure fitting, and allow the excess lube to escape. Allow the bearing to operate and purge excess lube from it for 10-15 minutes, then replace the fitting.

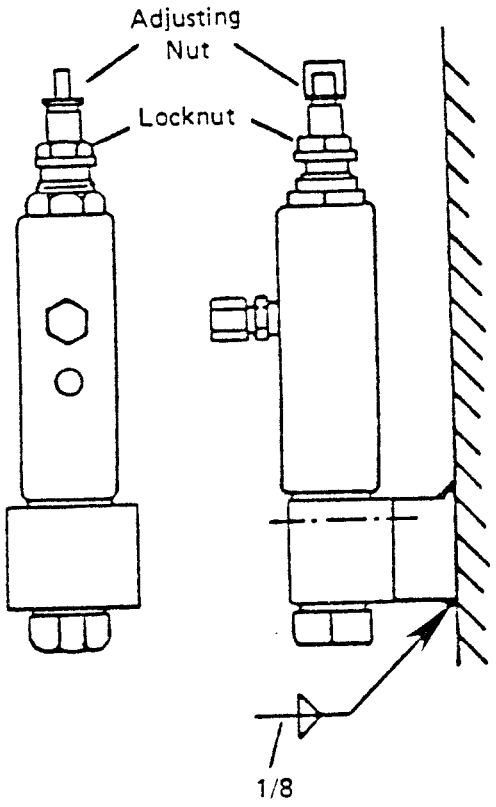
ANTI-FRICTION BEARINGS, lubed with grease, require the full quantity of lube as specified in the Lubrication Specifications. Ball and roller bearings require only a relatively small amount of lube, and relube intervals are generally long if good seals are used. Accurate predetermination of when to add new grease is impossible. Grease in a bearing generally deteriorates gradually, not suddenly. Thus only a small amount of lube needs to be added. A small amount of lube applied every 500 operating hours, unless otherwise specified, maintains adequate lubricating properties.

ENCLOSED GEAR CASES must have have their recommended lubricant level maintained. Check the dipstick or level plug at regular intervals. When you perform the seasonal change of lube, pump the used oil into a drum for final disposal. Drain all the remaining oil from the case thru its drain plug opening. Flush the gear case with fuel oil or light lube oil after draining it. Refill it with the proper lube.

EXTREME TEMPERATURE OPERATION — Operation of this machine in ambient temperatures below -20 degrees F. (-29 degrees C.) or above 110 degrees F. (44 degrees C.) requires the application of special lubrication. Contact your local supplier or DRESSER for these special lubrication specifications. Give the full particulars concerning the specific conditions of your operation.

NAME OF PART	TYPE	NO. OF POINTS	LOCATION	LUB. SYM.	METHOD & FREQUENCY
LUBRICATION OF 2 STEM RACKS					
Lower Rack Assembly Pivot	Oilite	4	Apply to Part	HL	Manual, 1800 Hours
Lower Stem Holder Pivot	Oilite	4	Apply to Part	HL	Manual, 1800 Hours
Stem Rack Lock Lever Pivot	Oilite	4	Apply to Part	HL	Manual, 1800 Hours
Upper Rack Assembly Pivot	Oilite	4	Apply to Part	HL	Manual, 1800 Hours
Upper Stem Holder Pivot	Oilite	4	Apply to Part	HL	Manual, 1800 Hours
Upper Rack Connecting Bars	Plain	8	Apply to Part	HL	Manual, 1800 Hours
Upper Stem Latch Lever	Plain	4	In Shaft Housing on Stem Holder	MPG	Manual, 1800 Hours
Links and Pins	—	38	Apply to Part	HL	Manual, As Required (Keep Coated)
LUBRICATION, MISCELLANEOUS					
Leveling Jack Housing	Plain	12 or 16	4 on Side of Each Cylinder Housing	MPG	Automatic
Jack Foot Pad Pivot	Plain	3 or 4	Pour on Pin	GL	Manual, Keep Coated

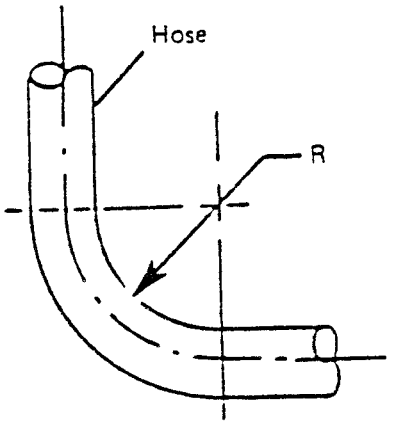
ADJUSTING AND MOUNTING OF LINCOLN INJECTOR



A new injector should be preset for maximum discharge. Maximum adjustment is set by loosening locknut and turning adjusting screw until daylight (space) appears between indicator pin and adjusting screw. Turn adjusting screw back down until it touches the indicator pin, then lock in place with the locknut.

To reduce discharge, start at maximum setting. With locknut loosened, turn adjusting nut clockwise until desired discharge is reached. Set locknut. DO NOT adjust more than six full turns (from maximum) of the adjusting screw. Check discharge for 3 to 4 lube cycles for operation of injector.

MINIMUM HOSE BEND RADIUS



MPSD NO.	Min. Radius (R)
Hose R5-5	3-3/8
Hose R2-8	7
Hose R2-12	9-1/2
Hose R2-16	11

DISASSEMBLY

Cured splines disassemble by breaking the bond with a puller, press, or hydraulic jack, and then removing. Temperatures of at least 400 degrees F. (240 degrees C.) (NOT over 650 degrees F. or 343 degrees C.) weaken the bond also. Apply pressure, and remove while hot.

Anti-friction bearings, requiring an interference fit onto a shaft, assemble BEST by shrinking the inner race onto the shaft. This means creating a difference in temperature between the shaft and the inner race. Heating the bearing is easier than cooling the shaft. Heat the bearing in a suitable oven or other means of dry heat.

NOTE: DO NOT APPLY HEAT DIRECTLY TO THE BEARING.

WARNING: Do not use a water or oil bath to heat bearings. DO NOT HEAT THE BEARING ABOVE 250 degrees F. (121 degrees C.).

GEAR BACKLASH

All backlash values are given in the normal plane. Therefore, backlash checked with a dial indicator requires this device to be set perpendicular to the helix of the teeth.

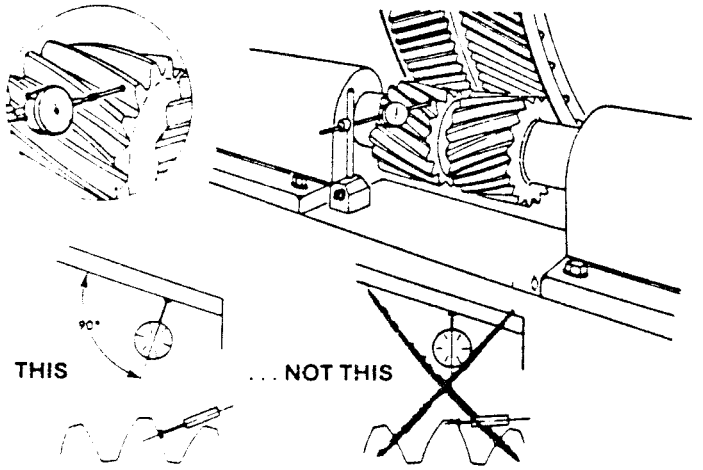


Figure 3

NOTE: Backlash is the amount by which a tooth space exceeds the thickness of an engaging tooth measured on pitch circles.

Required backlash for gears used on mining machines varies depending on value of diametral pitch. Table 2 gives assembled backlash values. These are measured in the plane of rotation.

NOTE: Plane of Rotating Backlash is the actual clearance measured with a dial indicator between teeth on an assembled gear set after rotating to the point of closest engagement.

REPAIR WELDING PROCEDURES

When weld repair is required, it is extremely important that it be done correctly because weld repairs can cause damage to an entire structure if performed incorrectly. Since several difficult to control variables can ruin a weld repair, such as impurities in raw materials, defective welding equipment, and state of normal wear, it is recommended that you request a factory weld procedure.

The Weld Engineering Department at Dresser issues repair procedures when a request is received from a customer. It is always better to see the repair problem; however, this is not always possible. Therefore, information received must be accurate. For example, it is important to know the exact size of the defect, its exact location, available welding equipment, and whether the repair will be done on the machine or in a building. Machine information, its serial number, along with the name and identification of the part, should also be sent to the Service Department. Pictures and sketches are also helpful to develop a good repair procedure.

Each step of a welding procdure must be followed. Years of experience in the manufacture of mining equipment have indicated to us that major failures will occur due to inadequate field repair of certain structures.

Weld repair jobs should not be rushed. The worn or fractured area must be evaluated carefully to determine how the repair should be accomplished. It is good practice to listen to experienced welders and ask for their input, if available.

Here is a ten-step outline to follow when developing any weld repair procedure.

1. Clean the worn or fractured part or area to be repaired.
2. Analyze and inspect the fractured or worn component for proper reporting.
3. Determine the type of material you will be repairing or rebuilding.
4. Prepare the part to be repaired or rebuilt.
5. Determine the electrode and process to be used.
6. Preheat before welding, if required.
7. Weld by using good welding techniques.
8. Post heat, if required.
9. Slow cool.
10. Inspect the repair.

STEP 8 – Postheating

The best practice is to thermally stress relieve a part that is highly stressed or requires machining. This is not always possible since parts of mining equipment are large and too complicated to stress relieve. Many times electric resistant heaters can be used for preheating and postheating of the weld area.

The preheat and interpass temperatures for weld repairs in alloy steels, where it is not possible to stress relieve, but must be used as welded because of the size and configuration of the part, should be held for one hour after welding. The objective is to permit the weld to transform from Austenite to softer microconstituents rather than to martensite, and, thereby, to minimize the possibility of cracking without undue sacrifice in mechanical properties. Postheating will also help in releasing entrapped hydrogen. Every precaution is important when making weld repairs.

STEP 9 – Slow Cooling

It is very important to keep any cool drafts away from parts which have been preheated, welded, and postheated. All parts should be covered by insulating blankets, returned to a furnace, covered with insulation, or covered with sand for slow cooling. Cooling rates should be controlled so the temperature decreases about $50^{o}F$ ($28^{o}C$) per hour until reaching $150^{o}F$ ($66^{o}C$).

Many times welders will set a repair job on beams and will cover the top of part, but forget about the area between the floor and the part. Unfortunately, the greatest draft occurs along the floor. This could cool the part unevenly and cracking could occur. Therefore, it is important to slow cool the whole part evenly.

STEP 10 – Inspection of Repair

The last important step is to inspect the completed weld after it has cooled to the ambient temperature. Make sure there are no notches which could become a stress riser. Grind welds so they blend in with the parent material.

Nondestructively inspect the repaired welds with dye penetrant or magnetic particle inspection discussed earlier. If it is important to examine the whole weld, then a technician with ultrasonics or x-ray expertise should be contacted.

If any questionable weld should appear, it should be examined and repaired before the part is put back into service, or it will not be long until the part will again have to be removed and repaired.

Make a final measurement of all important dimensions. This will show your success of staying within the dimension or tolerances. If the repair is successful, record the procedure for future reference.

TYPE T10 STEELFLEX COUPLING

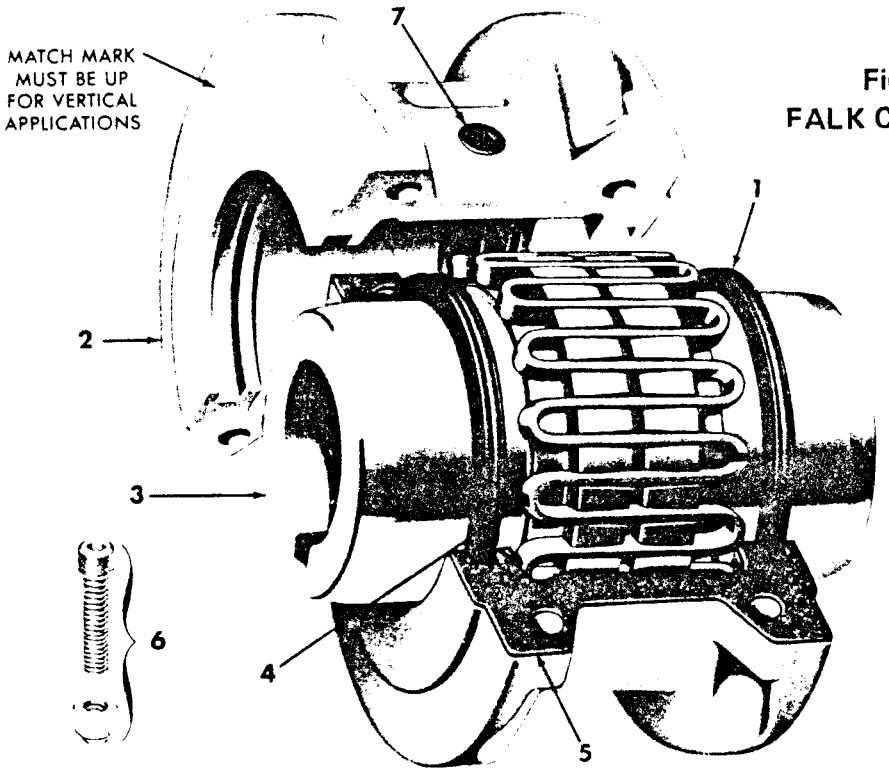


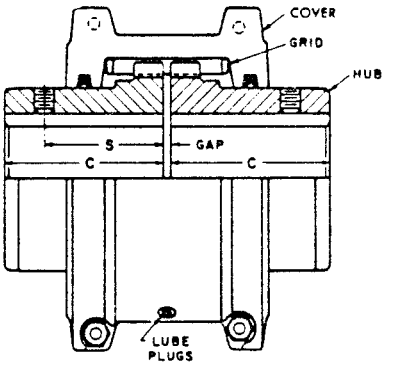
Figure 9
FALK COUPLINGS

PART NUMBERS

1. Seal
2. Cover
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket
6. Fasteners
7. Lube Plug

TABLE 9
INSTALLATION DATA

Size	Dimensions – inches (mm)					Cover Bolt Torque lb-in (N·m)	Max Speed rpm	Lube Wt lb (grams)
	Gap			Operating Alignment Limits				
	Min	Normal	Max	Offset (Max)	Angular (Max)			
70T	.062 (1.587)	.125 (3.175)	.188 (4.775)	.010 (.254)	.010 (.254)	200 (22.6)	4125	.19 (86)
80T	.062 (1.587)	.125 (3.175)	.250 (6.350)	.010 (.254)	.010 (.254)	200 (22.6)	3600	.38 (172)
90T	.062 (1.587)	.125 (3.175)	.250 (6.350)	.012 (.305)	.012 (.305)	200 (22.6)	3600	.56 (254)



THE SOLIDLY COUPLED SETS PROCEDURE IS:

1. Loosen ALL coupling bolts to point they do not hold valves together.

2. Start at coupling at two bearing unit (usually the motor) or near middle of a long set. Two diametrically opposed bolts need careful adjustment to be loose and YET NOT ALLOW coupling rabbet to disengage. Spread coupling about .005 inch to .015 inch (.127 mm to .381 mm) using two jacking screws or with a fiber mallet, rap the flange.

3. Measure gap between coupling faces at four points (90 degrees around coupling rim) with feeler gauge to nearest .001 inch (.025 mm).. Maximum variation may not exceed .002 inch (.050 mm) between any two readings.

4. Rotate coupling 90, 180, 270, 360 degrees and take similar readings. Maximum variation may not exceed .002 inch (.050 mm).

5. Correct horizontal misalignment by loosening foot bolts, removing dowel pins and bumping frame into position. Correct vertical misalignment by shimming under feet. Check and maintain ALL internal clearances (air gaps, bearing covers, fans, baffle clearances) equally around circumference. Abuse in shipping and handling often causes misalignment, even distort dowel pins to point of needing redoweled.

6. Repeat steps 2, 3, 4, 5 for each coupling while working away from two bearing unit.

7. Recheck couplings of long sets after completing previously mentioned checks, due to possibility that shimming on previous units effects units already checked. After aligning set within specified limits, carefully tighten ALL coupling bolts.

TORQUE VALUES

Recommended torque values for tightening coupling bolts:

3/4 inch bolts – 500 ft/lbs. (680 N·m) and for 1 inch bolts – 770 ft/lbs. (1047 N·m).

NOTES:

Accurate, properly maintained test equipment, suitable for the quantities for measurement is needed also.

a D.C. voltmeter for 125 - 600 volts,

a D.C. millivoltmeter for 600 millivolts,

zero center meters preferred,

a volt-ohm-milliamp meter or

a multi-meter (example, Simpson 260),

an A.C. voltmeter, unless multi-meter is accurate,

a quality tachometer is often handy, and

a 500 volt, D.C. megger tests insulation quickly.

Knowing the capabilities and limitations of each instrument helps keep repair and replacement costs reduced, since most test equipment suffers from the wrong connection rather than damage from dropping.

Now – get set to find the trouble.

INVESTIGATION: When trouble occurs, the operator is the "Expert Witness", so contact him first for answers to the following important questions:

How many motions are effected?

Is motion dead or sluggish?

Is it intermittent or continuous?

Did trouble develop slowly or suddenly?

What happened just before the failure?

A complaint concerning POWER means different things to different people, so try to get specific answers to the following:

Will machine drill under as heavy a load as before?

SECTION 10

INSPECTION REPORTS

Preventive Maintenance Programs may be defined as a systematic series of operations performed periodically on equipment to prevent breakdowns.

Breakdown WILL reduce productivity and increase overhead expense. Machinery is only new at one point of time. From that moment, machinery begins to deteriorate thru use and aging processes. A well organized program will avoid unexpected high cost breakdowns and increase component life.

A systematic approach to the program should be followed, and detailed records of all findings kept, to detect potential problem areas. Valuable time and effort can be saved if defects are corrected before they lead to a major breakdown. The records should be reviewed often and kept on file for future reference.

Personnel involved in the program should go thru an established training program, to know WHAT to check and HOW to rectify any potential problem area. Dresser can provide, at minimal charge, several tape/slide/workbook training presentations to be used as our guidelines. When personnel are able to do routine maintenance and normal repairs efficiently, downtime is reduced and machine productivity increased. Also, to keep your machine in good running condition, the necessary part, tools and current information should be kept on hand.

Equipment maintenance is a science and its practice an art. This art can be divided into six types of operations; they are:

INSPECTION is probably the most important operation. Careful observation is required of all parts of the equipment. Slight abnormalities may not interfere with the equipment performance BUT those that are a deviation from the normal should be discovered early. When inspecting, notice placement, state of cleanliness, color, etc. of part(s). Example: discoloration indicates overheating; all guards, bolts in place and good housekeeping.

CLEANING, and kept clean, is essential for good operation. Periodic cleaning should be more frequent on exposed parts than those which are contained within cabinets. Parts, connections and joints should be free of dust, corrosion and other foreign matter.

FEELING operation is used more often to check guarded rotating machinery for vibration due to worn parts, lack of lubrication, overheating, etc.

Feeling operation on electrical items should be performed as soon as possible AFTER power

DAILY ELECTRICAL INSPECTION

1. Check following bearings:
   Rotary motor bearings
   Hydraulic drive motor bearings
   Main air compressor drive motor bearings
   Fan blower bearings

2. Are all contactors operating properly?

3. Are all lights operating properly?

4. Are all motors commutating properly?

5. Is the air conditioner operating properly?

6. Is the air filtering system operating O.K.?

7. Visually examine operator controls:
   Are the main controllers working O.K.?

8. Are the auxiliary controls working O.K.?

9. Is all electrical equipment clean and dry?

10. Are all generators commutating properly? (if applicable)

11. Main transformer oil temperature