Technical Manual

4. What costs were incurred in downtime, parts, tools and labor?

5. Could the problem have been prevented by prior action?

SAFETY

GENERAL

The importance of overall safety in the maintenance of mining equipment should always be emphasized; excavating operations may involve a variety of hazardous conditions. Many critical components are subject to wear and other deterioration which limits their useful life; thus they are expendable. When new, all such parts have a built-in reserve strength against unknown factors and reasonable loss of durability from gradual wear. If, however, inspection and adjustment are neglected, these parts eventually reach a condition where they become a safety problem. Similarly, failure to replace various mechanisms to insure proper performance of the machine also constitutes a safety problem. Study this manual carefully and follow all recommended procedures to avoid unsafe conditions. Review the manual periodically to refresh your knowledge of these procedures. Supervisor, operators and maintenance men should continously follow safe practices.

IN-OPERATION MAINTENANCE

Safety requirements dictate that all machines in active service be inspected at regular intervals for proper adjustment of operating mechanism, excessive wear of components, system cleanliness and any other defects. In-operation deficiencies should be carefully investigated. It should be determined if a safety problem exists. Remember, maintenance is vital to safe operation. It should be performed systematically by competent personnel.

From an economic standpoint, it is advisable to perform as much of the upkeep as can be safely accomplished while the machine is running. Obviously, there are some maintenance procedures, such a gear tooth inspection and replacement, which require machine shut down. However, many support duties can be safely and effectively handled at shift change when the machine is still activated.

Automatic lubrication systems function throughout the operational cycles of the machine. These systems release premeasured lubricant which lengthen the wear life of the machinery units. Other parts of the machinery may be manually lubricated in a safe manner through extended grease or oil fittings designed to keep the operator's hands at a safe distance. Where this is not possible, the machine must be shut down during the required lubrication.

A repair or maintenance job on equipment is not complete until guards, plates and other safety devices have been replaced before the equipment is restored to operation.

PRECAUTIONS BEFORE AND DURING MAINTENANCE WORK

The operator must be sure the equipment is in a safe position before repairs or adjustments are made. The machine should not be endangered by falling rock or a yielding support surface. Before beginning repair or adjustment, the operator shall:

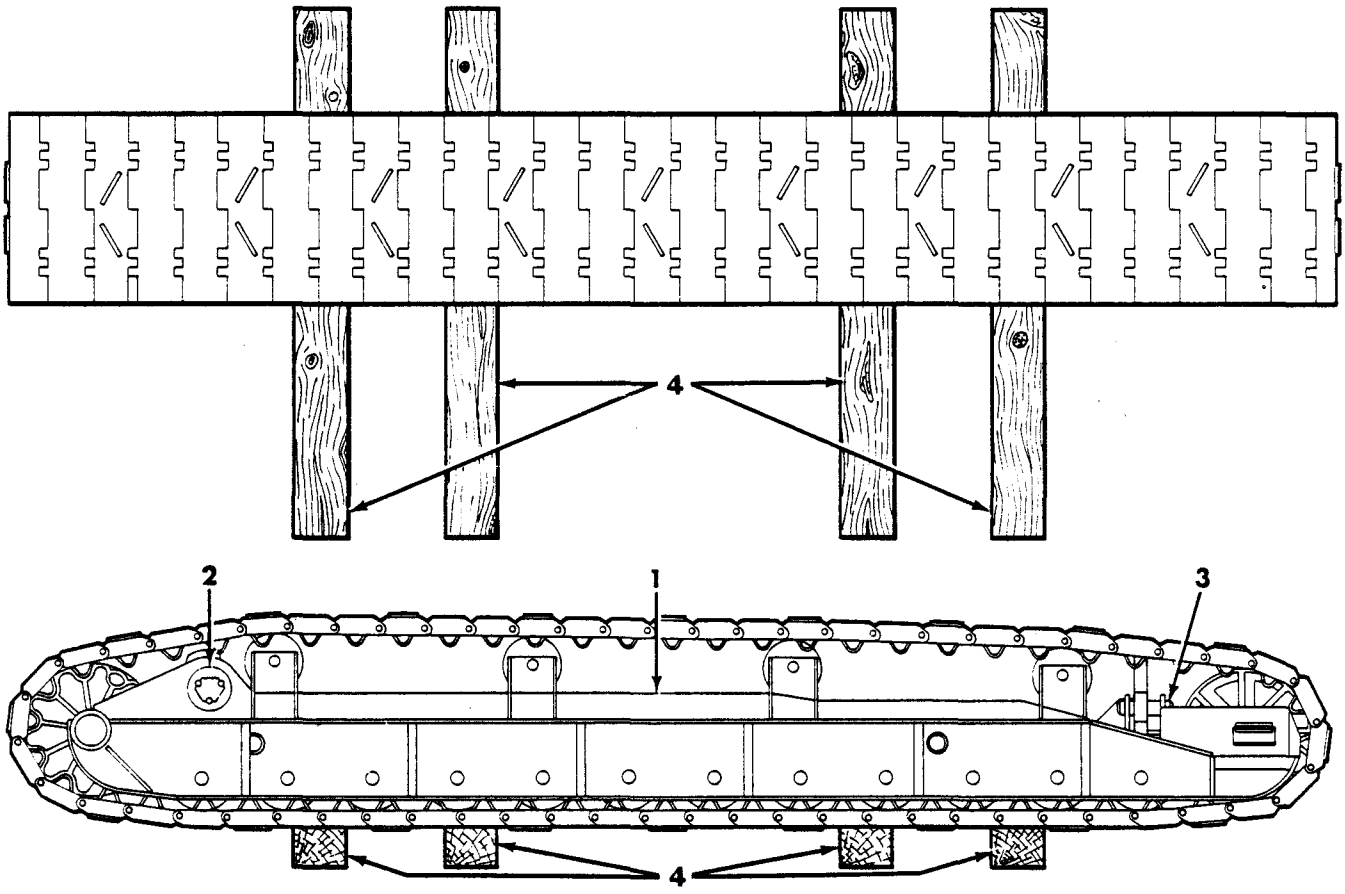
- Secure the rotary drive unit and tool string.
- Set all brakes.
- De-energize control functions and tag.
- Open circuit breakers and tag.
- Do whatever else is necessary to prevent accidental movement of the machine.

NOTE: If power is essential to the repair, it should only be energized when all personnel are clear of electrical and mechanical hazards. The power should only be energized during the required period and not when repair work is being done.

Prior to undertaking any work, maintenance personnel should notify the operator about the nature and location of the job. If work is to be done on or near moving parts, the starting controls should be locked in the "off" position and tagged. The lock and tag should be removed only by the maintenance people who installed them. During all phases of maintenance, use extreme caution when working near electrical equipment. Never work near exposed, energized high voltage connections.

Approved protection equipment such as gloves and insulated hooks or tongs should always be used when high voltage electrical cables are handled. Only qualified electricians are permitted to directly maintain electrical equipment such as motors, transformers, and switches.

While performing maintenance, the awkward positions assumed often increase injuries due to



1. CRAWLER FRAME
2. REAR AXLE RETAINER
3. EQUALIZER AXLE PIN
4. WOOD BLOCKING

CRAWLER FRAME

FIGURE 10

8. Using suitable rigging and suitable vehicle(s), pull the crawler frame straight away from the machine. Pull the crawler frame to a position to be repaired or handled with lifting equipment.

9. Repair the crawler frame and components as necessary.

10. To replace the crawler frame first position the crawler in-line with the rear and equalizer axles.

11. Lubricate the rear axle, axle bore, equalizer axle pin and bores.

12. Using suitable rigging and vehicle(s) pull the crawler frame toward the machine. Proceed slowly when attaching the crawler to the rear axle. Make sure the crawler is straight as it is being pulled onto the axle.

13. When the crawler is in position insert the equalizer axle pin and keeper.

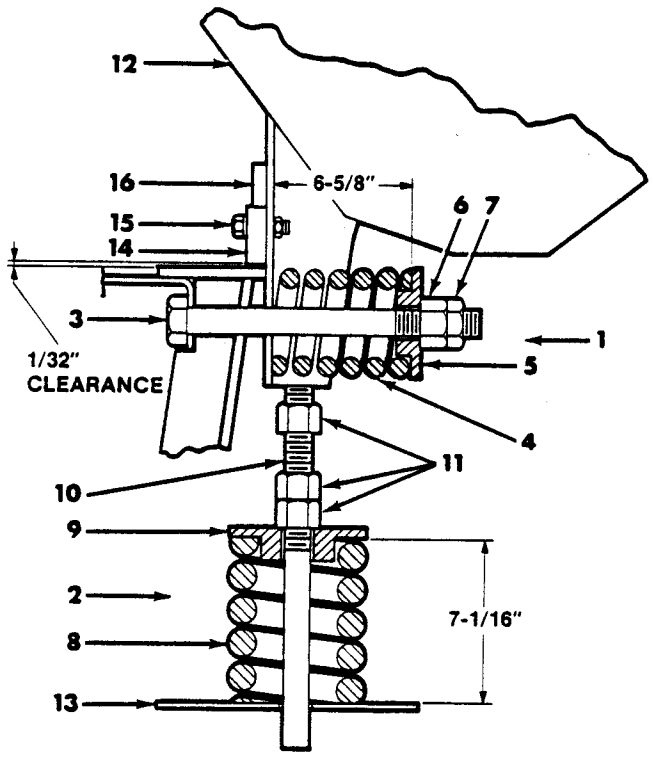
14. Install the rear axle retainer, retainer capscrews and lockwire.

15. Install and adjust the propel drive chain per topic PROPEL DRIVE CHAIN ADJUSTMENT.

16. Connect the automatic lubrication lines if equipped.

17. Raise the machine with the leveling jacks just enough to remove the blocking, then lower the machine.

18. Propel the machine to check the operation of the propel drive chains and crawler components.



1. HORIZONTAL SUSPENSION COMPONENTS
2. VERTICAL SUSPENSION COMPONENTS
3. SPRING GUIDE BOLT
4. HORIZONTAL SPRING
5. SPRING GUIDE
6. FULL NUT
7. JAM NUT
8. VERTICAL SPRING
9. SPRING GUIDE
10. GUIDE ROD
11. ROD FULL NUT
12. GEARCASE
13. MAINFRAME
14. STOP BAR
15. STOP BAR CAPSCREW
16. CHOCK

GEARCASE SUSPENSION

FIGURE 17

Adjustment

To adjust the gearcase suspension proceed as follows:

1. Assemble the components of the horizontal suspension assembly.

2. While holding the head of the spring guide bolt, compress the horizontal suspension spring to a total length of 6-5/8" as measured from the underside of the spring guide to the gearcase flange by tightening the full nut.

3. Tighten the jam nut against the full nut. Lubricate the assembly.

4. Assemble the vertical suspension components. Note that if the gearcase has not been removed it is possible to assemble the vertical suspension by inserting the spring guide rod from the bottom through the vertical suspension spring and spring guide. Be sure to install a full nut and two jam nuts. The upper end of the spring guide rod should fit into the socket in the underside of the gearcase.

5. To compress the vertical suspension spring, it will be necessary to restrain the spring g the lower nut while compressing the spring and the upper nut while loosening the spring. Compress guide rod. This can be accomplished by tightthe vertical suspension spring to a total length of 7-1/16" as measured from the underside of the spring guide to the top of the mainframe.

6. Tighten both full nuts against the adjustment nut. Lubricate the assembly.

If the stop bar and stop bar chock have been removed or are damaged it will be necessary to reinstall these components.

1. Loosely install the stop bar on the gearcases with the two 5/8" capscrews.

2. Place a 1/32" shim between the bottom of the stop bar and the top of the suspension support.

3. While holding the stop bar firmly against the shim tighten the stop bar attachment capscrews.

4. Place the stop bar chock firmly against the top of the stop bar and against the gearcase flange.

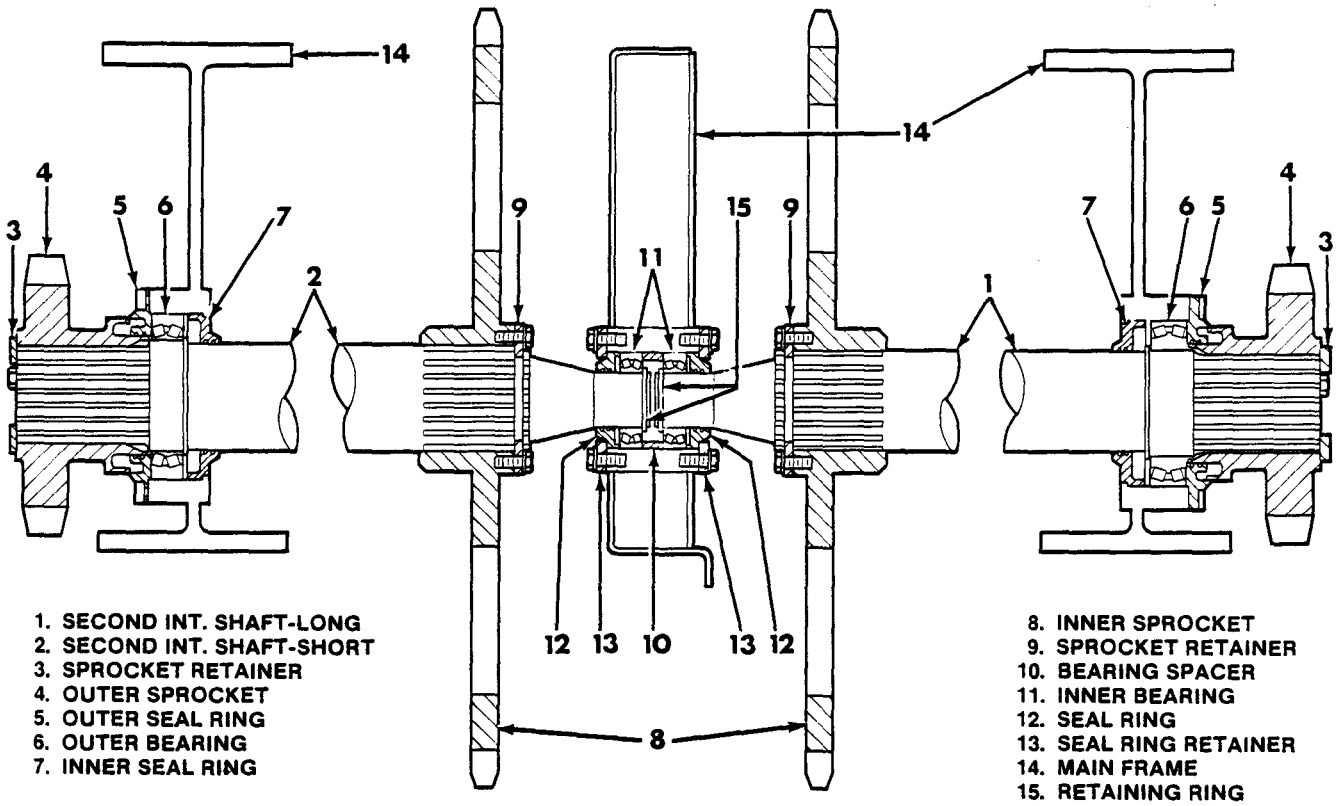
5. Using the repair welding techniques detailed in the appendix, weld the chock to the gearcase flange along the top and sides of the chock. Do not weld the chock to the stop bar. Verify that the chock is solidly against the stop bar.

6. Remove the shim between the stop bar and suspension support. Retighten the stop bar capscrews.

HOIST-PROPEL GEARCASE DISASSEMBLY AND ASSEMBLY

The hoist-propel gearcase (figure 15) is disassembled and assembled in the following manner:

1. To remove the gearcase from the machine refer to topic REMOVAL AND INSTALLATION OF GEARCASE. Drain and collect the oil from the gearcase. Securely block the



2ND INTERMEDIATE SHAFT

FIGURE 26

21. Tighten all hardware and lubricate the assembly. Replace all guards.

SECOND INTERMEDIATE SHAFT

Repair of the second intermediate shaft (figure 26) may include removal and reinstallation of either of the sprockets, removal and installation of the shaft or replacement of the shaft bearings.

Replacement of the outer sprockets may be accomplished without removal of the shafts. Replacement of the shafts, bearings or inner sprockets will require removal of the shafts.

There are two second intermediate shafts. Each of the assemblies is identical except for the shaft lengths. This topic describes the repair of one assembly. The opposite assembly is repaired in a similar manner.

To repair the second intermediate shaft assembly proceed as follows:

1. Separate the second intermediate and final drive chains.
2. Remove the outer sprocket retainer capscrews, and remove the retainer and sprocket.
3. Remove the outer bearing outer seal ring capscrews and remove the seal ring.
4. Remove the inner bearing seal ring retainer capscrews and remove the retainer.
5. Block under the inner sprockets and remove the sprocket retainer capscrews. Remove the retainers.
6. Using a suitable pulling device, pull the shaft out of the sprocket and mainframe. The inner and outer bearings will be removed with the shaft.
7. Remove the outer bearing from the shaft. Remove the inner bearing retaining ring, bearing, and seal ring from the shaft.
8. Remove the inner sprocket from the blocking. Remove the outer bearing inner seal ring from the mainframe.
9. Repair or replace components as necessary.

case the disassembly procedure is the same.

4. Support the cable reel with rigging and a crane. Unpin the base supports from the cable reel base and lower the base onto blocking of sufficient height so that the reel base will be level. Disconnect the supports from the mainframe.

5. Remove all chain guards.

6. To remove the drive chain from the reel to the reducer on the left side of the cable reel, loosen the sprocket bracket mounting bolts and back off on the sprocket bracket adjusting screw to their full limit to put as much slack in the chain as possible. Separate the chain at the connecting link and remove the chain.

7. To remove the drive chain from the hydraulic motor to the dual sprocket, loosen the motor bracket mounting bolts and back off on the motor bracket adjusting screws to their full limit to gain slack in the chain. Separate the chain at the connecting link and remove the chain.

8. To remove the reel drive chain on the right side of the cable reel, loosen the sprocket bracket mounting bolts and back off on the sprocket bracket adjusting screws to their full limit to gain slack in the chain. Separate the chain at the connecting link and remove the chain.

9. To remove the level wind drive chain, loosen the sprocket bracket mounting bolts and back off on the sprocket bracket adjusting screws fully. Separate the chain at the connecting link. Remove the chain clip tee slide from the slide block. Remove the chain from the sprockets. Remove the chain from the chain clip by removing the chain pin clips and pins.

10. Unbolt the hydraulic motor from the mounting bracket (figure 34) and remove the motor. Remove the gib key and sprocket from the motor. Remove the motor bracket adjusting screws and mounting bolts and remove the bracket.

11. Remove the dual sprocket bracket mounting bolts and remove the bracket (figure 34). To disassemble the dual sprocket proceed as follows:

    a. Remove the shaft retaining bolt and slide the shaft from the bracket.
    b. Remove the shaft retaining ring and slide the sprocket assembly from the shaft.
    c. Remove the bearing retaining rings, bearings and spacer from the sprocket.

12. Remove the idler sprocket bracket mounting bolts and adjusting screws and remove the bracket (figure 34). To disassemble the idler sprocket use the same procedure as listed in step 11 for the dual sprocket.

13. To remove the idler sprocket bracket on the left side of the cable reel, remove the bracket mounting bolts and adjusting screws and remove the bracket (figure 34). To disassemble the idler shaft use the same procedure as listed in step 11 for the dual sprocket.

14. Unbolt and remove the level wind gear reducer (figure 34). Remove the gib key and sprocket from the driven end of the reducer. Back off cthe setscrew and remove the sprocket and key from the drive end of the gear reducer.

15. Remove the level wind idler sprocket (figure 34) using the same procedure as listed in step 13 for the idler sprocket on the left side of the cable reel.

16. To remove the level wind mechanism (figure 34) proceed as follows:
    a. Remove the closing plate mounting bolts and closing plates.
    b. Remove the roller shaft lower nuts and lock washers and remove the cable guide assembly. The roller lower spacers will be removed with the assembly.
    c. Separate the rollers from the guide assembly by removing the roller shaft spring pins, then slide the shafts out of the rollers and frame. Separate the bearings from the rollers.
    d. Remove the roller shaft upper nuts and lock washers and lift the level wind bracket off the shafts. Secure the rollers so that they will not fall when the bracket is removed.
    e. Remove the roller assemblies and separate the spacers, shafts and bearings from the rollers.

17. Remove the reel bearing base bolts (figure 33) and with proper rigging and a crane lift the reel assembly from the base structure.

18. Remove the bearing base retaining pins and slide the bearing bases from the reel shaft.

NOTE: Steps 3 through 14 are for the removal of one motor pinion shaft and one intermediate shaft. If the unit is equipped with two rotary motors, steps 3 through 14 will have to be repeated for the second set of shafts.

15. Remove the capscrews securing the swivel house to the gearcase and remove the housing. Remove the seals, spacers, wave spring and O-ring from the housing.

16. Remove the upper bearing retaining nut and washer. Remove the bearing spacer.

NOTE: The upper bearing retaining nut has left hand threads.

17. Support the drive shaft with blocking under the rotary coupling.

18. Remove the lower bearing retainer capscrews.

19. Slowly lift the gearcase until the vertical shaft gear is resting on the intermediate gear. If the weight of the vertical shaft will not free itself from the upper bearing inner race, additional force will have to be placed on the top of the shaft to force the race off the shaft as the gearcase is raised.

NOTE: If only one set of intermediate and motor shaft gears is used, blocking the thickness of the intermediate gear will have to be installed in the gearcase opposite the intemediate gear prior to raising the gearcase to remove the vertial shaft.

20. When the upper race is removed from the shaft, continue raising the gearcase until it clears the shaft. Remove the shaft and lower the gearcase back onto its blocking.

21. Remove the upper bearing inner race, gear spacer and gear from the gearcase through the front opening.

22. Remove the upper bearing cage and oil seal from the top of the gearcase.

23. Remove the intermediate gears or gear and blocking from the gearcase.

24. Remove the thrust bearing springs.

25. Unbolt and remove the drive shaft clamp collars.

26. Unbolt and remove the rotary coupling or shock sub from the shaft lower section.

27. Use a torch to heat the hub of the shaft lower section and separate the two sections of the drive shaft. Remove the O-ring from the shaft upper section.

⚠ CAUTION: Be sure to use all safety precautions when using the torch. Take additional precautions when handling the heated parts to prevent serious burns.

28. Slide the lower bearing retainer assembly from the shaft upper section and disassemble as follows:
    a. Remove the O-ring and shims.
    b. Remove the seal retainer capscrews and retainer.
    c. Remove the seals and spacer.

29. With a puller remove seal sleeve from the shaft. With a bearing puller, remove the lower bearing and the upper lower bearing from the shaft.

30. Inspect all components. Repair or replace all components as necessary.

31. To reassemble the gear case first clean all components throughly. Inspect all bores and shaft surfaces, and remove any nicks or burrs. Lightly oil all parts. Apply Loctite #271 to all threads at assembly.

⚠ CAUTION: In the following procedure a number of the steps require heating of a unit prior to assembly. When handling these heated units take every precaution and use suitable protective equipment to prevent burn type injuries.

32. Install the lower bearings on the drive shaft upper section. These bearings are interference fit and will require heating in an oil bath to 250°F prior to assembly. Be sure the bearings are tight against the shoulders of the shaft.

33. Install the seal sleeve on the shaft. The sleeve is interference fit to the shaft and will require heating in an oil bath at 250°F prior to assembly.

34. Assemble the lower bearing retainer assembly as follows:
    a. Install the oil seals and spacer in the

29. Lubricate all points and verify correct operation of the rotary drive unit.

PULLDOWN CHAINS

The pulldown chains (figure 46) transmit power from the sprockets on the hoist shaft to the sprockets on the shipper shaft to drive the rotary drive unit either up or down the mast. There are two identical roller chains on the 65/67-R. Each chain has a section which is cotter keyed rather than riveted to allow the chains to be removed or installed.

Inspect the pulldown chains every shift for cracked or broken side bars, rollers or roller pins. Inspect the cotter pin connected sections and any cotter pin connected replacement links and verify that the cotter pins are in place and intact. Check the "timing" of the chains every shift and adjust as necessary. Check the lubrication of the chains, if used, making sure that the chains are being flushed of contaminants. Once every 21 operation shifts check the chain rollers, roller pins and side bars for wear. Replace both chains when worn to a point where their strength is substantially reduced.

ADJUSTMENT

No adjustments to the chains themselves are possible. Both chains must be of the same number of pitches and the same length. The chains must be "timed" to assure that the rotary drive unit is parallel to the mast to eliminate any side loading on the rotary drive shaft.

To time the pulldown chains proceed as follows:

1. Lower the rotary drive unit to its lowest position and rest it on the lower stops. Depress the control off pushbutton and set the hoist brake. Tag the controls to prevent unauthorized operation.

2. Count the number of chain links between one sprocket tooth on one shipper shaft sprocket (A) and one tooth on one hoist shaft sprocket (B). Count the number of links between the matching tooth on the opposite shipper shaft sprocket and the matching tooth on the opposite hoist shaft sprocket. The number of links counted should be the same.

3. If the number of links is not the same, part one chain at a point near the shipper shaft sprocket. Restrain both ends of the chain and jump the chain on the sprockets to equalize the number of chain links on both sides. Refer to the PULLDOWN CHAIN-REPAIR topic for exact procedure.

4. Once the number of links is equal, reattach the chain and hoist and lower the rotary drive unit to verify correct operation.

REPAIR

Repair of the pulldown chains is limited to replacement of damaged or broken links, replacement of the entire chain or removal of links to shorten the chains.

Replacement of damaged or broken links is accomplished by first reversing the stroke of the equalizer cylinder to gain the maximum slack in the chains. The remove any damaged links and replace with the same number of new links. Reverse the stroke of the equalizer cylinder to the normal condition to complete the procedure. Remember that when replacing links to make sure that the total number of links must be made the same in both chains and the chains must be timed properly.

As the chains are subjected to the pulldown and hoist loading, the pins and bushings of each link will wear. This wear in each link will lead to an increase in the length of the chain. This increase in length will be automatically taken up by the equalizer cylinder. The equalizer cylinder has only six inches of stroke and when the increase in length of the chain is greater than the maximum take-up of the equalizers, the cylinder will "bottom out" and the chains will become slack. To shorten the chains it will be necessary to remove the same number of links from each chain. Removal of 4-6 links from each chain will be sufficient. Remember to keep the total number of links in each chain the same and keep the chains timed properly.

To replace the pulldown chains proceed as follows:

1. Lower the rotary drive unit to its lowest position and rest it on the lower stops. Apply sufficient pulldown pressure to the rotary drive unit to compress the equalizer springs and move the lower equalizer sprocket to its highest position. Insert suitable blocking in the slot to hold the shaft in the raised position (figure 47). Depress the control off pushbutton and tag all controls to prevent unauthorized operation.

HOT OIL SHUTTLE RELIEF CHECK

1. Install a 0-1500 PSI gauge in the pulldwon motor top port, test port 2, and a 0-7500 PSI gauge in pulldown motor bottom port, test port 1 (figure 57). Operate the motor in pull-down direction at sufficient RPM to cause gauge at test port 1 to be 500 PSI greater in reading then gauge at test port 2.
2. With RPM maintained as in step 1, increase hot oil shuttle relief valve setting while observing gauge pressure at test port 2 until pressure doesn't rise any further. Record test port 2 gauge reading when pressure stops rising.
3. With RPM maintained as in step 2, lower the setting of the shuttle relief so it is 100 PSI less than the maximum observed and recorded in step 2. Record new setting. Hot oil shuttle relief test is complete.

Pulldown Pump Main Relief Check

1. Disconnect high pressure lines at pulldown pump and cap and plug all open ports (figure 57).
2. Connect a hose, of sufficient length to reach the operator's cab, to the pulldown pump port that the sequence (force control) valve supply line had been connected. To the opposite end of the hose connect a 0-7500 PSI gauge.
3. In the operator's cab, while observing the gauge start the pump. With the pump running, move the pulldown pump control to 50% of full stroke in the pulldown direction for no more than 2 or 3 seconds (long enough to observe 5400-5500 PSI on the gauge) and then return the control to neutral.

WARNING: Staying on relief for much longer periods could damage the pump due to very high heat generation.

4. If the pressure reading on the gauge falls outside the range of 5400-5500 PSI, adjust the high pressure relief valve immediately opposite the lower main port, to 5500 PSI using a 3mm allen wrench.
5. With the pulldown main relief set, shut down the pump. Using a suitable adapter fitting attach the hose and gauge from item 2 to the pump upper high pressure discharge port (hoist). Cap off the port the hose and gauge had been removed from.
6. Repeat step 3 except now the pump control will be position in the hoist mode. Also, note warning after step 3.
7. If pressure reading on the gauge falls outside the range of 5400-5500 PSI adjust the high pressure relief valve immediately opposite the upper main ports, to 5500 PSI using a 3mm allen wrench.

Sequence Valve (Force Limit Control) Check

1. With pulldown pump shut down, use a suitable tee that will allow the sequence valve (force limit control) supply hose to be reconnected to the pump along with a 0-7500 PSI gauge. Be sure the upper high pressure discharge port (hoist) is plugged (figure 57).
2. With the pulldown pump control at (0) and the force limit control at minimum, turn on the pump drive electric motor.
3. With the force control at minimum, rotate the pulldown speed control CCW to maximum. The pressure gauge reading should not show anything greater than charge pressure of 275 to 300 PSI.
4. Gradually increase the force control and observe the pressure gauge noting reading at maximum setting. Record maximum PSI.

NOTE: With force control at maximum setting pressure gauge reading should be 4800 PSI. Pressure should smoothly increase and decrease with changing force control positions.

Chain Equalizer Pump Relief Check

1. When the pulldown pump drive motor was started as noted in step 2 under Sequence valve check, the chain tensioner pump should also have started.
2. With the chain tensioner pump running and the pulldown pump control at (0), the chain tensioner pump pressure gauge should show 700-750 PSI (figure 57).
3. With step 1 and 2 under Sequence valve check still in effect and with the force control at minimum, rotate the pulldown speed control CCW to maximum. When the force control is noew turned to maximum 4800 PSI, the chain tensioner gauge should show 1600-1800 PSI. Record pressure.
4. Remove all test gauges, hoses and fitting

NOTE: After the cartridges have been assembled the rest of the pump can then be assembled. Immerse the seals and bearing in clean hydraulic oil to make the reassembly easier and to provide initial lubrication. Assemble the pump as follows:

10. Place the mounting cap (7) on a clean surface with the large open end facing up. Install the shaft seal (11) in the cap (7). Make certain the open side of the seal is toward the inside of the cap.

WARNING: To prevent damage to the seal during installation use a seal driver. See figure 64 for drawing to make driver.

11. Install outer retaining ring (15) in groove nearest drive end of shaft (12) by passing ring over the internal serrations. Do not install the ring over the drive end as this may damage the seal surface next to the groove.

12. Press ball bearing (14) over the internal end of the shaft until it seats against the outer snap ring and install inner snap ring (13). Be sure the snap ring is fully seated in the groove.

13. Apply hydraulic oil to the inside of the shaft seal and install the shaft assembly into the mounting cap.

WARNING: Use protective cone over the end of the shaft to prevent damaging the shaft seal. See figure 64 for drawing to make protective cone.

14. Install snap ring (10) in the mounting cap (7) and against ball bearing (14) to hold the shaft assembly in place. Be sure the snap ring is fully seated in the groove.

15. Install O-ring (9) on pilot of mounting cap.

16. Place the center housing (5) on a clean flat surface with the square end up.

17. Insert front cartridge (8) into the center housing. Make certain that pin (8b) in the end of the cartridge enters the drilled hole in the housing.

NOTE: Apply hydraulic oil to the two seals on the cartridge and seal on the housing, to lessen the chance of damaging the seals when installing the mounting cap.

17. Install the mounting cap (7) with the attached shaft assembly by inserting the shaft through the cartridge and into the center housing (5). Rotate the shaft to engage the spline in the rotor.

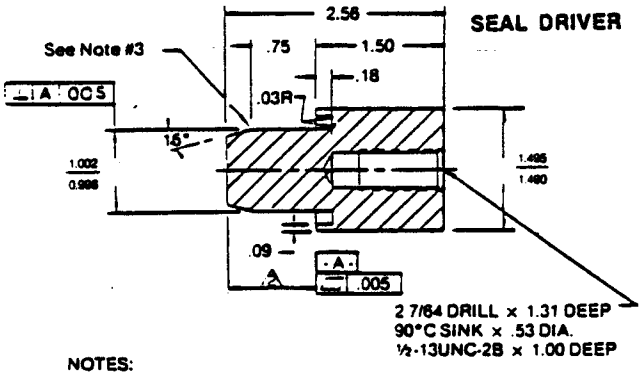
NOTE: Be sure the ports in the mounting cap and the center housing are orientated correctly.

18. Install the four screws (6) and alternately tighten to draw down cap. Torque the screws to 135 ft. lbs.

19. Place the center housing and mounting cap assembly in a vise with the shaft extended downward. Insert rear cartridge (4) into the small end of the center housing. Be sure that the pin (4b) in the end of the cartridge enters the drilled hole in the housing.

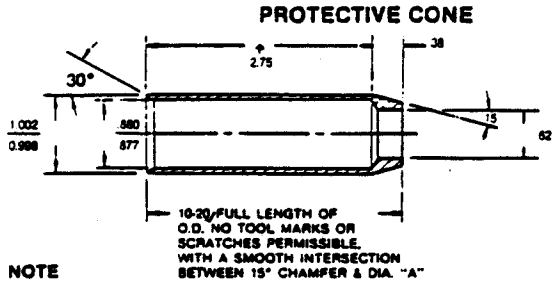
20. Install the rubber seal (3) on end cap (2). Apply hydraulic oil to the two seals on the cartridge and the seal on the end cap.

21. Locate end cap (2) over the exposed end of cartridge (4) and rotate until the outlet is in the desired position. Install the seven screws (1) and alternately tighten to draw down cap. Torque to 45 ft. lbs.



NOTES:
1. Remove all burrs and break sharp edges .010/.005R.
2. Length ⚠ to be heat treated to RC 50-55.
3. Length ⚠ to have a 10-20 √ full length, with a smooth intersection between chamfer and dia. "A".
4. Grease O.D. of length ⚠ before installing shaft seal onto tool to prevent damage to the seal.

Material 4140 or equivalent.

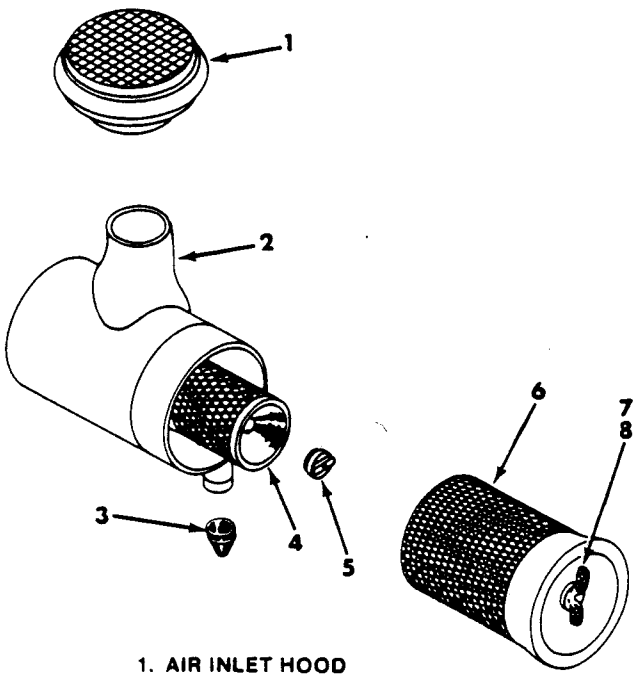


NOTE

1. Remove all burrs and break sharp edges .010/.005R.
2. Teflon preferred, alternate 4140 treated after machining to RC 50-55.
3. Install protective cone over shaft extension and grease O.D. to prevent damage to shaft seal.

SPECIAL TOOLS

FIGURE 64



1. AIR INLET HOOD
2. FILTER HOUSING
3. VACUATOR VALVE
4. SAFETY ELEMENT
5. SERVICE INDICATOR WING NUT
6. PRIMARY ELEMENT
7. WING NUT
8. GASKET WASHER

AIR FILTER

FIGURE 73

FILTER REPLACEMENT

The primary element should be cleaned, inspected and reinstalled or replaced as follows:

1. Loosen the wing nut. Remove the nut and gasket washer.
2. Carefully remove the primary element using care not to dent or damage it.
3. Wash the element by soaking it for 15 minutes or more in warm water with a mild detergent. Rinse the element thoroughly with clean water until the water is clear.
4. Allow the element to air dry completely. Warm flowing air (not to exceed 160°F) can also be used for drying the element. Do not use compressed air or a light bulb for drying.
5. Inspect the element for any ruptures, holes or cracks in the pleated media. This can be done by placing a bright light inside the element and rotating it slowly. Replace the element if any of the above situations are present. Also replace the element if the end gaskets are damaged.
6. Clean out the inside of the filter housing with a damp cloth. Before installing the primary element check the service indicator wing nut on the end of the safety element. Replace safety element if indicator has turned red. Carefully slide the cleaned or new element into the housing. Install the gasket washer and tighten the wing nut until the element is secure against the filter housing.

The safety element should be replaced as follows:

1. Loosen the wing nut. Remove the nut and gasket washer.
2. Carefully remove the primary element.
3. Remove the cotter pin and service indicator wing nut holding the safety element in place. Remove the element.
4. Carefully slide the new safety element inside the filter housing. Install the service indicator wing nut and tighten. Install the cotter pin.
5. Carefully slide the new or cleaned primary element into the filter housing. Install the gasket washer and tighten the wing nut until the element is secure against the filter housing.

COMPRESSOR RADIATOR

Every shift inspect the cooling system of the compressor. Check that the radiator is full and the fins clear. Inspect the radiator and piping for leaks. If the water pump is belt driven, check the condition and tension of the belt. While the compressor is running, verify that the coolant is moving by observing the movement in the flow indicator.

AUXILIARY AIR SYSTEM

The general maintenance of the auxiliary air system consists mainly of inspection of the system for proper operation, checking for leaks in the piping, etc.

AUXILIARY AIR COMPRESSOR

1. Daily inspect the compressor (figure 74) for belt slippage, vibration and unusual noises. Correct any problems found. Drain condensate from the tank.
2. Weekly inspect the air filter element and clean or replace as required. Check the compressor oil level and add oil if required.

and tighten the end cover bolts evenly. End cover gaskets or shims are furnished in three thicknesses. The proper combination must be selected so the crankshaft can be spun in the bearings without end play. If the oil seal needs replacing, slide the replacement seal on the pulley end of crankshaft and press into place in the base with the lip or seal side toward the pulley. Do not hammer the seal directly. Make sure the "V" ring is free and located between the base floor guides.

5. Connecting rod — cylinder — crankshaft: the lower connecting rod bearing consists of two identical inserts which are interchangeable in rod and cap. When installing the bearings, make sure that the bore and bearing insert are free of any foreign material. Install the inserts in the rod and cap, fitting the locating projections into the grooves provided. The ends of the inserts extend slightly above the parting line of the rod and cap.

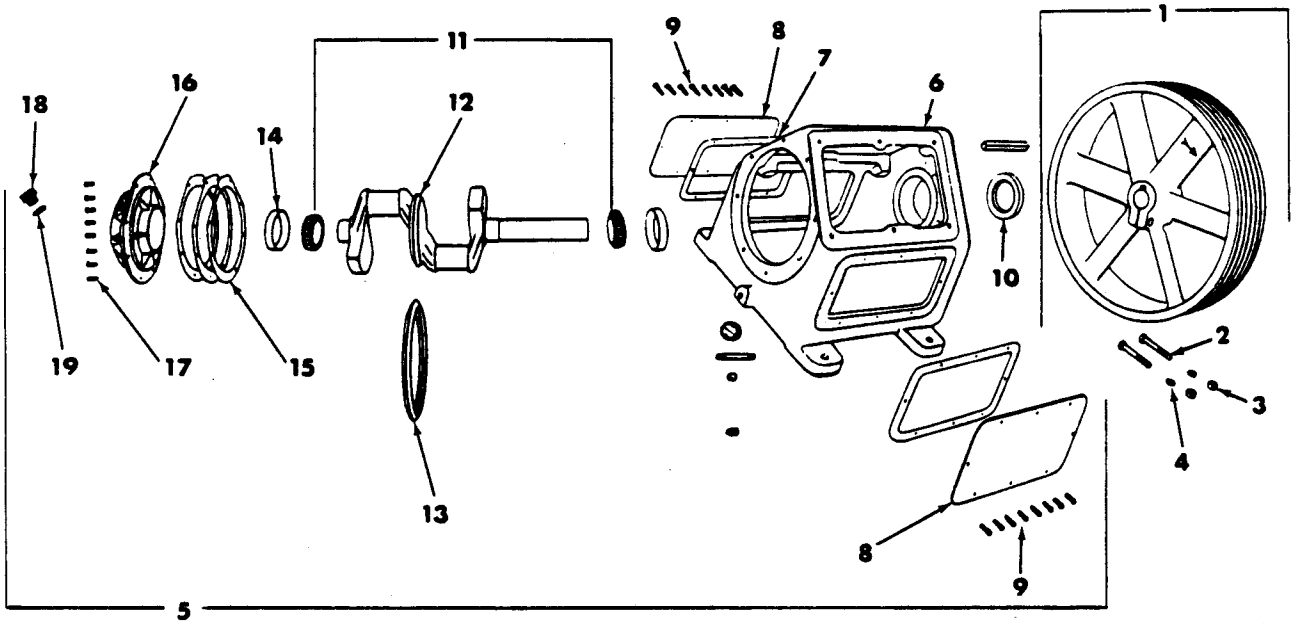
WARNING: Do not file these ends of the inserts.

Position rings on high pressure piston so the gaps are staggered around the piston. Insert the piston and rod assembly into the cylinder bore taking care to compress the rings so that the ends cannot catch and score the cylinder or break the ring. Assemble the cylinder to the base gasket. Assemble the cylinder and high pressure piston and the rod assembly to the base and crankshaft assembly. Tighten the base bolts with lock washers in place. Insert the low pressure rod assembly through the cylinder bore following previous precautions to compress the rings. Coat the bearing journals of the crankshaft with a heavy oil. With the crankshaft installed in the base, install the connecting rod and piston assemblies to the crankshaft. During installation, the connecting rod bolts, with lock washers in place, should be tightened until they just start to compress the lock washers. Then lightly tap the cap to help align the bearing. The bolts should be drawn up tight (torque 90 foot pounds). Never file the rod or cap and never use shims to adjust the bearing clearance.

NOTE: "Running in" for a few hours without the head is recommended if a pump has been completely overhauled — especially if new pistons and/or cylinders have been installed.

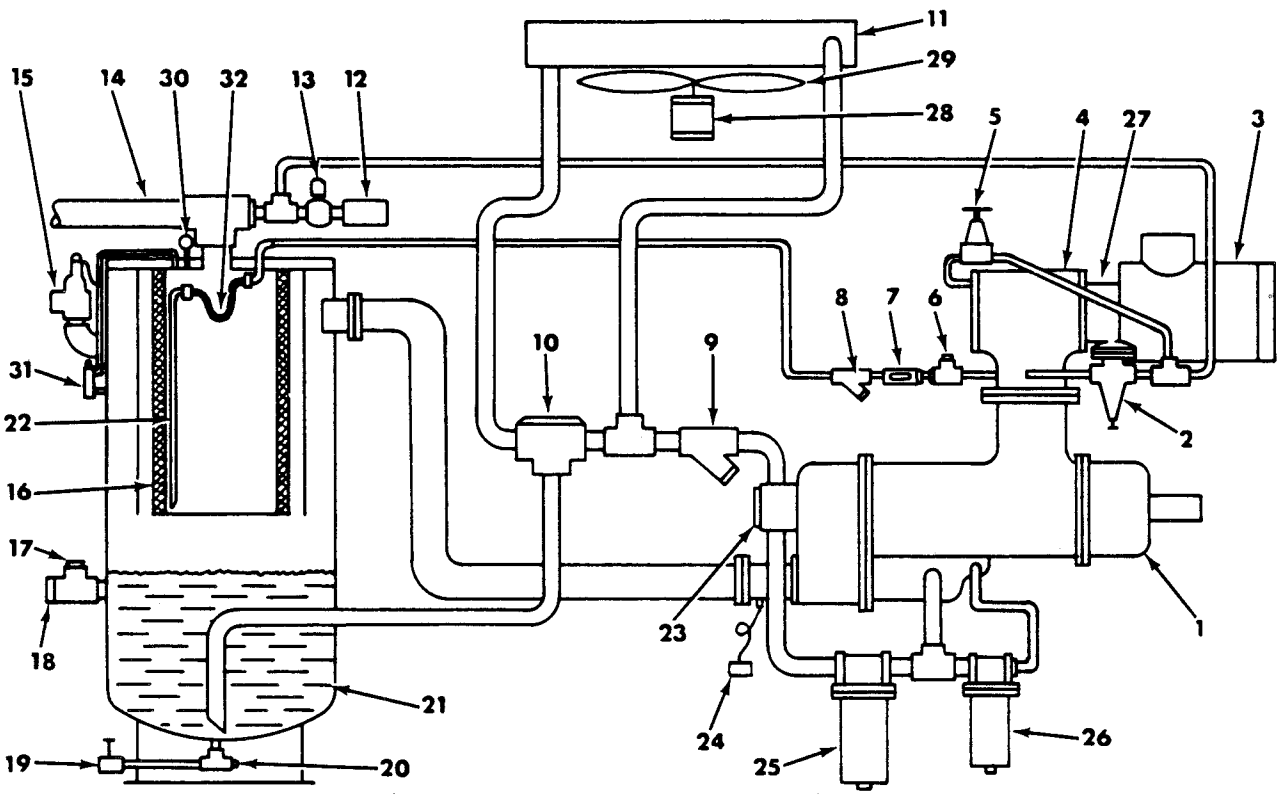
6. Oil: fill the base with oil to level on the oil gauge before operating or "running in."

7. Install the key and pulley after the head, intercooler and aftercooler are connected.



1. PULLEY
2. BOLTS
3. NUTS
4. LOCKWASHERS
5. BASE ASSEMBLY
6. BASE
7. GASKET
8. SIDE PLATE
9. SIDE PLATE BOLTS
10. OIL SEAL
11. CRANKSHAFT & CONE ASSEMBLY
12. CRANKSHAFT
13. OIL FEEDER RING
14. CUP
15. END COVER GASKETS
16. END COVER
17. END COVER BOLTS
18. OIL FILLER PLUG
19. PLUG GASKET

FIGURE 84



1. COMPRESSOR AIR END
2. VACUUM BREAKER (BY-PASS) VALVE
3. INLET AIR FILTER
4. INLET REGULATING VALVE
5. AIR PRESSURE CONTROL VALVE
6. OIL FILL PLUG
7. ORIFICE/SIGHT GLASS
8. STRAINER, SCAVENGING LINE
9. STRAINER, PUMP INLET
10. THERMOSTATIC CONTROL VALVE
11. RADIATOR OIL COOLER
12. BLOWDOWN MUFFLER
13. BLOWDOWN SOLENOID VALVE
14. MINIMUM PRESSURE ORIFICE
15. SAFETY RELIEF VALVE
16. OIL SEPARATOR
17. OIL FILL PLUG
18. OIL LEVEL GAUGE
19. DRAIN VALVE
20. MAGNETIC DRAIN PLUG
21. AIR/OIL RECEIVER
22. OIL SCAVENGING TUBE
23. OIL PUMP
24. HIGH AIR TEMP. LIMIT SWITCH
25. OIL FILTER, ROTOR
26. OIL FILTER, BEARINGS
27. RUBBER ELBOW, INLET
28. MOTOR, FAN
29. FAN, RADIATOR
30. GAUGE
31. MAINTENANCE INDICATOR
32. HOSE

COMPRESSOR PACKAGE COMPONENTS

FIGURE 91

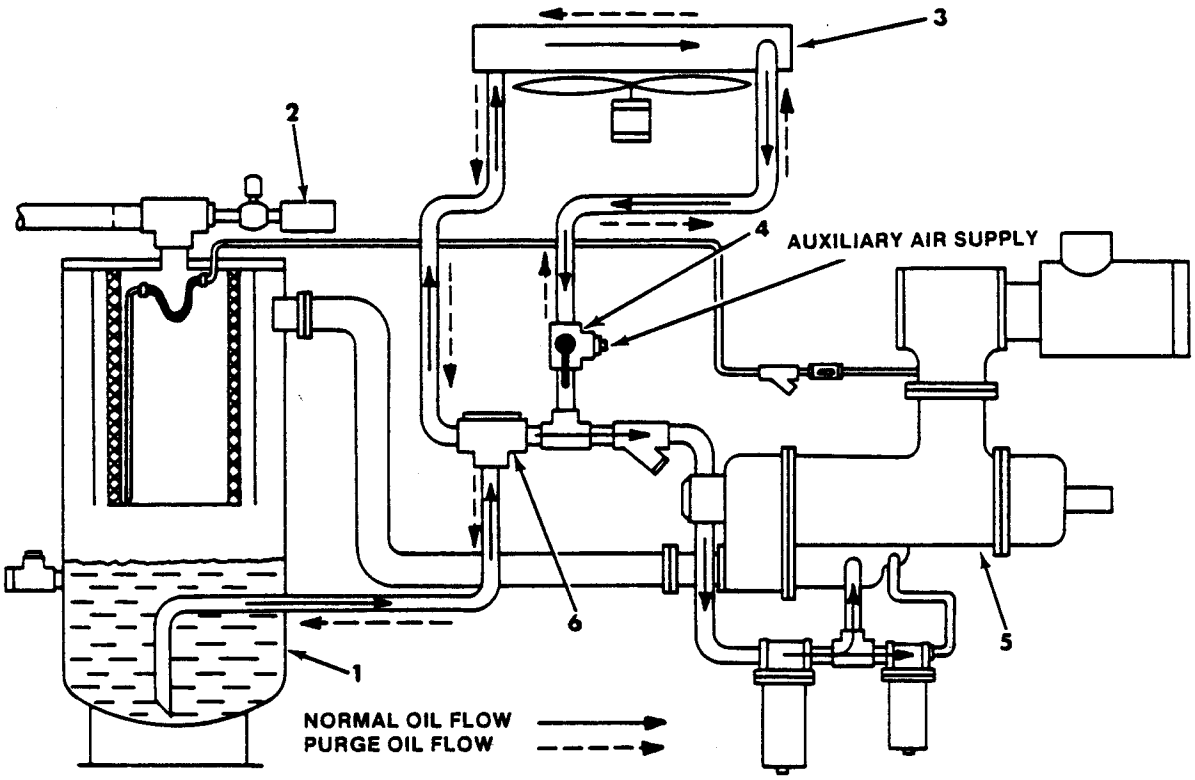
Inlet Regulating Valve

At start-up the rotation of the compressor rotors produces a vacuum downstream from the inlet regulating valve (figure 92). This drop in pressure causes the atmospheric pressure upstream of the valve to "push" the inlet valve completely open and thus provides full flow of air into the compressor. As explained above, the inlet valve is closed by the air pressure control valve admitting air to the diaphragm (figure 103). The orifice in the regulating valve is required to provide a continuous bleed of air through the air pressure control valve. This flow of air provides the necessary pressure differential across the control valve for it to operate properly.

In addition to regulating the inlet air volume, the inlet valve also acts as a check valve when the compressor shuts down. When the compressor shuts down, the regulating valve spring will rapidly close the inlet valve thus preventing the pressurized air and oil in the compressor and downstream system from flowing back through the inlet air filters.

Air Pressure Control Valve

As explained above, the purpose of the air pressure control valve is to control the receiver pressure by opening or closing the inlet regulating valve. If the receiver air pressure is higher than 15 psig above the rating plate pressure when the inlet butterfly



1. AIR/OIL RECEIVER
2. BLOWDOWN MUFFLER
3. RADIATOR OIL COOLER
4. 3-WAY VALVE
5. SCREW COMPRESSOR
6. THERMOSTATIC CONTROL VALVE

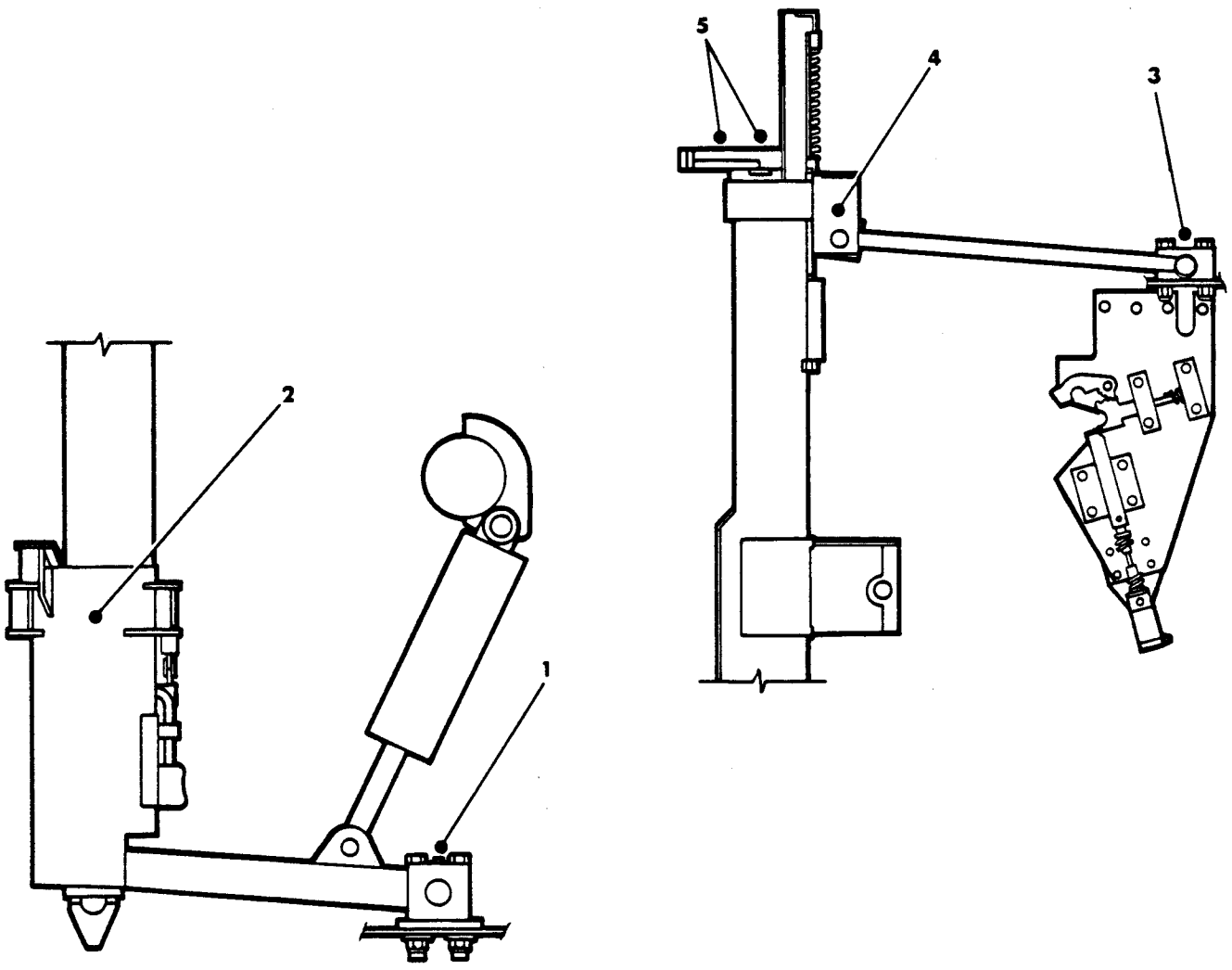
OIL PURGE SYSTEM FOR COLD WEATHER SHUTDOWN (PATENT PENDING)

FIGURE 99

Whenever the screw compressor will be shut down for more than one hour and the ambient temperature is below 0°F (-17°C), perform the following oil purge procedure immediately after shut down:

1. Close the main air discharge butterfly valve.
2. Stop the compressor and wait until the receiver tank pressure is at zero.
3. Check to make sure that the auxiliary air compressor is on and the air pressure is between 110-125 psig.
4. Rotate the handle on the three-way valve 90 degrees clockwise and hold it in this position until air can be heard venting through the blowdown muffler located on top of the air/oil receiver tank. This purge cycle should take less than 30 seconds, however the time required may vary slightly depending on jobsite conditions.
5. After step 4 has been completed, release the spring return handle and make sure that it returns fully to the original position over the "B" port on the valve.

WARNING: Automatic transmission fluid must be used in sub-freezing temperatures. If the above oil purge procedure is not completed immediately after shut down, the oil will cool down to the temperature where the thermostatic control valve "C" port will close. Once this happens, the purge oil flow path back to the receiver tank will be closed thus preventing the flow of oil when the three-way valve is manually actuated. If this occurs, restart the compressor and run unloaded at 75 psig until the thermostatic valve "C" port opens. Shut down the compressor and manually actuate the purge valve. If the compressor shuts down on high temperature, the oil in the cooler and lines is too thick to flow. Cover the cooler and blow heated air through its core to thin out the oil prior to starting. Also, if possible, heat the oil lines to the cooler.



LUBE POINT	NO. OF POINTS LUBRICATED	TYPE LUBRICANT	HOURS 8	40	160	1000	AS REQ.	(OPTIONAL) AUTOMATED	COMPONENTS
1	*2	MPG		X					LOWER ARM BEARING BLOCK BUSHINGS
2	*1	MPG		X					LOWER ARM BUSHING
3	*2	MPG		X					UPPER ARM BEARING BLOCK BUSHINGS
4	*1	MPG		X					UPPER ARM BUSHING
5	*2	MPG		X					PIPE RACK UPPER GATE BUSHINGS

NOTE: THE ABOVE FREQUENCIES FOR MANUAL LUBRICATION, IF THE MACHINE IS EQUIPPED WITH AUTOMATIC LUBE SYSTEMS THE FREQUENCIES ARE SET AT THE LUBE CONTROL STATION.

ON AUTOMATIC LUBE SYSTEMS THE INJECTORS SHOULD BE SET AT FULL OPENING AT STARTUP OF A NEW MACHINE AND THEN READJUSTED AS REQUIRED.

* NUMBER LIST FOR ONE PIPE RACK.

MAST LUBRICATION - PART 3

FIGURE 118

PROBLEM	CAUSE	CORRECTIVE ACTION
Drilling (cont.)		
Poor penetration rate.	1. Down pressure too low for given material.	1. Consult with mine engineering dept. and obtain compressive strength of rock to insure that down pressure exceeds it.
	2. RPM too low.	2. Increase RPM in increments until an acceptable bit life/-penetration rate combination is reached.
	3. Incorrect bit.	3. Obtain correct bit.
Poor bit life.	1. Excessive down pressure.	1. Decrease down pressure in increments until an acceptable bit life/penetration rate combination is reached.
	2. Excessive RPM for given material.	2. Decrease RPM in increments until an acceptable bit life/penetration rate combination is reached.
	3. Downfeed too fast, burying bit. This forces cuttings inside bit cones, locking bearings.	3. Decrease speed of downfeed.
	4. Too much water injection.	4. Decrease flow of injection water. Use just enough to settle dust.
	5. Low amount of bailing air flow.	5. Watch main air pressure. Decrease speed of downfeed if necessary, to maintain pressure at 30 to 45 psi.
	6. Dirt in drill pipe, obstructing air passage to bearing.	6. Disassemble tool string and clean out any dirt. Use care in making and breaking connections in the future to keep dirt out.
	7. Dropping bit against bottom.	7. Use care in operation.
	8. Bent drill pipe.	8. Replace drill pipe.
Excessive vibration during drilling.	1. Misalignment of rotary machinery.	1. Check alignment and make necessary adjustments or repairs.
	2. Bent drill pipe.	2. Replace drill pipe.
	3. Poor setup (machine not level, too high off ground).	3. Use correct setup procedures.
	4. Excessive wear on deck bushing.	4. Replace deck bushing.

PROBLEM	CAUSE	CORRECTIVE ACTION
Auxiliary Air Compressor (cont.)		
	6. End play in crankshaft.	6. Remove end cover, take out one end cover gasket or shim and replace. Do not remove too many gaskets or binding may result.
	7. Loose or worn internal parts (piston, connecting rods, wrist pins, insert bearing, etc.)	7. Overhaul pump.
Excessive oil consumption.	1. Wrong oil or inferior grade of oil.	1. Use correct oil.
HYDRAULIC SYSTEM		
Insufficient pressure or sluggish action.	1. Low oil level.	1. Keep tank filled to proper level.
	2. Leaking suction line allowing air intake.	2. Repair or replace line.
	3. Pump problem.	3. Check pumps.
	4. Oil overheated.	4. Check oil cooler.
	5. Control valve problem.	5. Check control valve.
	6. Motor problem (in the case of pulldown system).	6. Check hydraulic pulldown motor.
	7. Cylinder problem (in the case of cylinder actuated components).	7. Check cylinder.
	8. Wrong oil for operating conditions (oil too thin).	8. Use heavier viscosity oil.
Sluggish operation but sufficient pressure.	1. Oil viscosity too heavy for operating conditions. Extreme cold stiffens oil in outside portions of hydraulic system.	1. Use lighter viscosity oil.
Dirt or abrasives in oil.	1. Carelessness in filling.	1. Use only clean oil, from clean containers.
	2. Oil is beyond change interval.	2. Test samples of oil periodically and change at correct interval, or sooner if necessary.
	3. Defective or saturated filter element.	3. Replace element.
	4. Pressure vacuum relief not in place on reservoir.	4. Replace pressure vacuum relief.

TURN OF THE NUT METHOD

WARNING: This tightening procedure is good only for bolt grades 5 and 8 with UNC threads. For bolts with other than UNC threads contact the Bucyrus Erie Service Department.

Also, when using this procedure the bolt threads and the surfaces under the bolt head and nut must be lubricated.
This procedure is applicable only if the joint and under head surfaces for bolt and nut are machined for parallelism.

1. The bolts shall be brought to a "snug tight" condition to insure that the parts of the joint have good contact with each other. "Snug Tight" is defined as the tightness attained by torquing a bolt to the value specified in Table 3 below. Snug tightening should progress systematically from the most rigid part of the joint to its free edges, alternating from bolt to bolt to assure gradual even pull up of the mating parts. After all bolts have been snugged, the first bolts tightened at the most rigid part of the joint should be rechecked for proper torque. If these bolts are loose due to pull up of the joint, the snug tightening sequence should be repeated for all bolts in the connection. This rechecking and re-torquing procedure should be repeated as many times as is required until the joint is completely pulled up and all bolts are at the specified "snug tight" torque. Tightness of the mating surfaces of the joint should then be verified by using feeler gauges.

TABLE 3
"SNUG TIGHT" TORQUE VALUES

Bolt Dia.		Torque Values (1)	
In.	Cm.	Ft. Lbs.	Nm.
.500	1.27	15	20
.625	1.58	30	40
.750	1.90	53	71
.875	2.22	86	116
1.000	2.54	128	173
1.250	3.17	224	303
1.500	3.81	390	528
1.750	4.44	457	619
2.000	5.08	688	932
2.250	5.71	1005	1362
2.500	6.35	1375	1864
2.750	6.98	1864	2527
3.000	7.62	2462	3337

(1) Tighten to values listed ∓ 10%. The torque values listed are calculated for 20% × proof load with lubricated threads and under the head surfaces of the bolt and nut.

2. The nuts and bolts should then be matched marked by center punching the bolt end and nut. On rod bolts match mark both rod ends and nuts. The bolts and nuts should then be tightened additionally by the applicable amount of nut rotation as specified in Table 4. It is not necessary to follow any particular bolt to bolt sequence during this portion of the "turn of the nut" tightening.

NOTE: Nut rotation is read between punch mark on the bolt and punch mark on the nut. For rod bolts, nut rotation is the cumulative total rotation between punch marks on both ends of the rod bolt.

TABLE 4

Part No.	Nut Rotation	Bolt Length (1)
747773-01	1/3 Turn of ± 10%	Up to and including 4 diameters.
747773-02	1/2 Turn of ± 10%	Over 4 diameters but not exceeding 8 diameters
747773-03	2/3 Turn ± 10%	Over 8 diameters but not exceeding 12 diameters

(1) In case part number or nut rotation designation is not given, the nut rotation can be determined by the bolt length (Grip length + 1/2 bolt diameter). For bolt lengths exceeding 12 diameters contact the Bucyrus-Erie Service Department.

MPO — MULTI-PURPOSE OIL

SCOPE

Lubricant performance requirements for Multi-Purpose Oil.

APPLICATION

The addition of a lubricant to the compressed air system, hand oil cans, etc.

GENERAL REQUIREMENTS

1. Must be fluid at temperature applied.
2. Should contain rust inhibitor.
3. Motor oil - API service classification "MS".

VISCOSITY RECOMMENDATIONS

1. Air Line Lubricant

AMBIENT TEMPERATURE	SAE NUMBER
Below 10°F	5W
Above 10°F	10W

2. Hand Oil Can - Viscosity to be suitable for application and temperature.

These performance requirements are benchmarks and not a specification. Therefore, meeting these limits as described above does not relieve the supplier of the responsibility associated with brand name products.

OGL — OPEN GEAR LUBRICANT

SCOPE

Lubricant performance requirements for the lubrication of open gearing.

APPLICATION

Lubrication between mating teeth in an open gear drive.

METHODS OF APPLICATION

1. Heated and either poured or hand sprayed on the gear teeth.
2. Sprayed or dripped on the gear teeth by means of an automatic lubrication system.
3. Applied by means of a cartridge gun.

General Requirements

The following are the requirements of the lubricant at the ambient temperature of the open gear drive.

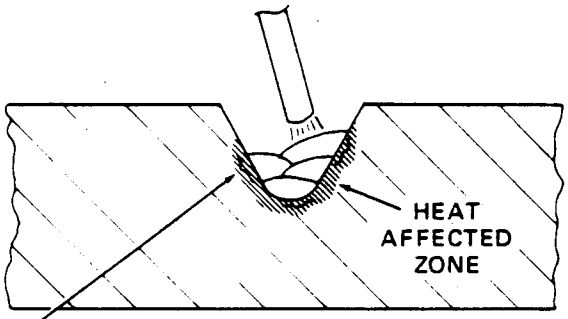
1. ADHESIVE - Maintain film lubricity and be highly resistant to squeeze at contact points of mating surfaces.
2. FLEXIBILITY - The coating on the surface of the gear teeth must remain pliable.
3. EXTREME PRESSURE - Must withstand the high rolling and sliding contact pressures and have the ability to flow under loads.

WELDING ELECTRODES

Weld repairs on the various structures of blast hole drills can be made with three basic classifications of shielded metal arc electrodes, namely E7018, E8018-C1 and E11018-M. These are low hydrogen electrodes which deposit weld metal having excellent properties at strength levels from 70,000 to 110,000 pounds per square inch, and impact properties from -20 to -75°F. These are all position electrodes which produce high quality welds for repairing the structural components of blast hole drills.

NOTE: Electrode handling procedures must be followed to obtain maximum weld strength. Low hydrogen electrodes are highly susceptible to moisture pick-up from the atmosphere after removal from sealed containers. To maintain low hydrogen that is, crack resistant properties, they must be stored in electrode ovens at 250 to 350°F up to the time of use.

Cracks caused by hydrogen are extremely fine and occur invisibly below the surface in the weld heat affected zone of the base metal (figure 134). Therefore, they are not detectable at the time of welding. These cracks can propagate in service and lead to ultimate failure of part. It is necessary to adhere strictly to recognized good welding practice re-



UNDERBEAD CRACKING IN THE WELD HEAT AFFECTED ZONE RESULTS FROM INSUFFICIENT PREHEAT, WELD SHRINKAGE STRESS AND HYDROGEN IN THE WELD METAL.

FIGURE 134

TABLE 1

PRINCIPAL BLAST HOLE DRILL STRUCTURAL MATERIALS
BUCYRUS-ERIE MATERIALS SPECIFICATIONS — REFERRED TO AS SD NUMBERS

	MACHINE MODEL				
MATERIAL LOCATION	40R	45R/47R	55R	60R/61R	65R/67R
Crawler Frames					
Plate	3116	3155	3155	3156	3156
Crawler Links	3515G	3520H	3520H	3520FS	3520FS
Hubs	3510B	3710	3710	3710	3710
Equalizer Axle					
Plates	3116	3150	3150	3150	3150
Bars	3116	3116	3010A	3116	3116
Mainframe					
Beams	3116	3155	3155	3155	3155
Plates	3116	3155	3155	3155	3155
Bars	3116	3155	3155	3155	3155
Hubs	3010A	3710	3710	3010A	3010A
Level Jack Housings					
Plates	3116	3116	3116	3116	3116
Bars	3116	3116	3116	3116	3116
Mast Support					
Beams	3116	3155	3155	3155	3155
Plates	3116	3155	3155	3155	3155
Bars	3116	3155	3155	3155	3155
Hubs	3010A	3710	3010A	3010A	3010A
Mast					
Beams	3116	3155	3116	3155	3155
Angles	3116	3155	3116	3155	3155
Plates	3116	3155	3116	3155	3155
Bars	3116	3155	3116	3155	3155
Hubs	3710	3010A	—	3010A	3010A
Racking	AISI C-1030	AISI A-8630	AISI C-1030	AISI C-1030	AISI C-1030

In any repair welding application for which E7018 electrodes are specified in Table 3, E8018-C1 electrodes can be readily substituted if desired.