



Technical Manual

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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 handling heavy parts. As a precautionary measure, use mechanical handling equipment whenever possible. The mining foreman can facilitate safer and easier maintenance work by providing blocking materials. Service crews should have a fundamental knowledge of lifting practices so their knees and legs are used rather than their backs.



CAUTION: Many of the components of the 45-R drill are heavy, bulky items. Extreme caution should be used when lifting. Personnel should be certain of the weights of components before attempting to lift them, either manually or with some lifting device. Follow all applicable safety rules when using cranes or other lifting equipment. Be sure of the load, lifting height and radius, and capacity of the lifting device before lifting. Failure to follow all applicable safety rules when lifting can cause serious or fatal injury to personnel.

encountered is bushing wear. However, it is possible for the tumbler to develop cracks. When cracks do occur, they can be repaired by gouging out metal on both sides of the crack, and welding the crack. Follow welding instructions in appendix.

If bushing replacement is needed, the tumbler must be removed from the machine. To accomplish this:

1. Position the machine so that the take-up tumbler to be removed is over a slight depression (about 6" deep). This depth will be enough to relieve the weight of the machine from the tumbler.
2. Relieve crawler belt tension and separate the crawler belt as described in the topic CRAWLER BELT REPLACEMENT. Separation of the belt should take place at a point near the take-up tumbler, and the links laid back out of the way.
3. Remove the shim guards and lube lines if so equipped.
4. Remove the bearing block adjustment bolts and upper halves of the bearing blocks. Mark the upper halves of the bearing blocks so that they will be reinstalled in the same position.
5. Using a suitable lifting device, remove the take-up tumbler and shaft. Remove the shaft from the tumbler.
6. Inspect the tumbler bushings and thrust surfaces. Remove and replace the bushings if necessary.
7. The thrust surfaces of the tumbler may be rebuilt to original dimensions. Follow the welding procedures listed in the APPENDIX of this manual.
8. Inspect the tumbler shaft and replace if necessary.
9. Inspect and clean the bearing block halves. Replace if worn.
10. Inspect the crawler frame in the areas where the bearing block rests. Rebuild and grind flat if worn.
11. Lubricate the tumbler bore and shaft and install the shaft in the tumbler. Using a suitable lifting device position the tumbler and shaft in the crawler frame and lower halves of the bearing blocks.
12. Install the bearing block upper halves.

13. Install the bearing block adjustment bolts. Do not tighten the nuts at this time.
14. Reassemble the crawler belt.
15. Adjust the crawler belt tension as per topic CRAWLER BELT ADJUSTMENT. Tighten the bearing block adjustment bolts.
16. Replace the shim guards and lube lines if so equipped.
17. Propel the machine to distribute the grease evenly in the tumbler bushing and check operation of tumbler.

CRAWLER FRAMES

Inspect the crawler frames for cracks or damage (figure 10). Pay particular attention to the axle attachment points and the bottom flange plate. Any cracks, wear or damage should be repaired immediately, following the repair welding procedures listed in the APPENDIX of this manual.

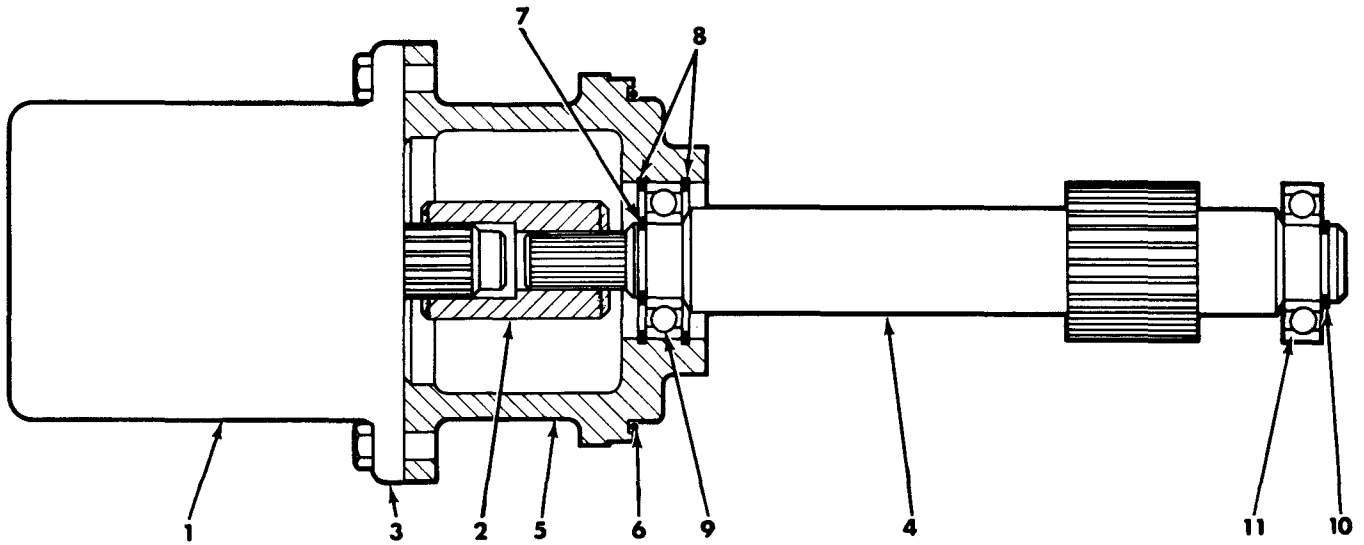
REPAIR

Repair of the crawler frames may be accomplished while the crawler frames are attached to the drill or the crawler frames may be removed to facilitate repair.

To remove the crawler frames from the machine proceed as follows:

1. Separate the propel drive chain. Remove the chain from the tumbler drive sprocket.
2. Disconnect all lubrication lines connecting crawler frame to mainframe, if so equipped.
3. Using the machine leveling jacks, raise the machine sufficiently to allow blocking to be placed under the crawler belts and extending 6 to 8 feet from the crawler frame. Blocking material should be selected to facilitate the sliding of the crawler frame away from the machine.
4. Slowly lower the machine until there is no weight on the rear axle or equalizer axle. Securely block the machine in this position.
5. From this point either one or both crawler frames may be removed from the machine.

NOTE: Steps 6 through 16 describe the procedure for removing and reinstalling one crawler frame. If both frames are to be removed, repeat steps 6 through 16 for the other crawler frame.



- | | | |
|--------------------|-------------------|--------------------|
| 1. HYDRAULIC MOTOR | 5. MOTOR ADAPTER | 9. BEARING |
| 2. MOTOR COUPLING | 6. ADAPTER O-RING | 10. RETAINING RING |
| 3. MOTOR GASKET | 7. RETAINING RING | 11. BEARING |
| 4. SHAFT | 8. RETAINING RING | |

HYDRAULIC MOTOR SHAFT

FIGURE 24

to damage the O-ring on the O.D. of the adapter when installing the shaft. Clean the mating surfaces of the adapter and motor and install a new gasket between these components when reassembling.

ELECTRIC HOIST-PROPEL MOTOR

Inspection, maintenance and repair of the hoist-propel motor are detailed in the motor manufacturer's service literature or in the **ELECTRICAL MAINTENANCE MANUAL**. Refer to these publications for detailed procedures regarding the hoist-propel motor.

REPAIR

To remove the hoist-propel motor (figure 16) from the machine proceed as follows:

1. Position the machine on firm level ground.
2. Lower the auxiliary reel line to place 10 feet of slack in the line. Secure the auxiliary reel line hook.
3. Set all brakes. Open all circuit breakers. Lock out and tag the maintenance lockout switch if the machine is so equipped. Tag the breakers and controls to prevent unauthorized operation.

4. Have a qualified electrician disconnect and identify all electrical leads to the motor. The cables should be removed from the junction box and suitably protected.
5. Using a suitable lifting device raise the sliding hood to a vertical position. Secure the hood in this position.
6. Using a suitable crane and rigging, rig the motor to be lifted from the machine.
7. Remove the capscrews securing the motor to the gearcase. Lift the motor from the machine. Discard the motor gasket.
8. Repair or replace the motor as required. Prior to installation, clean the gasket surfaces on the motor and gearcase.
9. Install the motor in reverse order of removal. Be sure to use a new gasket between the motor and gearcase. Be sure to align the motor pinion teeth with the hoist shaft gear and idler pinion when installing motor.

NOTE: If the pinion is to be removed from the motor, use the procedure as described under the topic **PINION AND COUPLING REMOVAL AND REPLACEMENT** in the appendix.

2. Using the hoist brake control fully release the hoist brake.
3. Remove the brake chamber yoke pin. Remove the brake chamber stud nuts and lower the brake chamber out of the support. If required, remove the yoke and jam nut from the chamber.
4. Back off on the brake chamber rod stop nuts. With the hoist brake released the brake chamber rod should retract into the brake chamber.
5. Turn the stop nuts until they contact the brake chamber body. Turn the stop nuts two full turns to lift the brake chamber piston off of the bottom of the brake chamber body. Lock the stop nuts in this position.
6. Install the brake chamber yoke jam nut and yoke. Turn the yoke onto the brake chamber rod until the center of the yoke pin is 3.75" from the brake chamber housing. Tighten the jam nut against the yoke.
7. Reinstall the brake chamber to the support and attach the yoke to the pivot arm. Secure the yoke pin with the cotter pin.
8. Remove the adjustment rod yoke pins. Remove the adjustment rod.
9. Adjust the yokes on the adjustment rod to give 7.25" between the yoke pin centers. Adjust the yokes so that they are both screwed onto the adjustment rod approximately the same distance. Secure the yokes with the jam nuts.
10. Reinstall the adjustment rod. Secure the yoke pins with the cotter pins.
11. Check the operation of the brake. If the brake does not hold properly, shorten the distance between the centers of the adjustment rod yoke pins. To do this remove one end of the rod from the brake band and turn the yoke further onto the rod. Tighten the jam nut against the yoke and reattach the yoke to the brake band.

REPAIR

Repair of the hoist brake is limited to replacement of worn or damage components and relining of the brake band. To repair the hoist brake proceed as follows:

1. Lower the rotary drive unit to its lowest position and secure against unwanted movement. Tag all controls to prevent unauthorized operation.
2. Release the hoist brake. Remove the brake chamber rod yoke pin. Remove the brake chamber stud nuts and lower the brake chamber from the support.
3. Turn off the auxiliary air compressor. Bleed the air from the auxiliary air system. Remove the air lines from the hoist brake chamber.



CAUTION: Keep hands away from the brake chamber piston rod when the air to the chamber is shut off. The piston rod is spring loaded and will extend upon loss of air pressure.

4. Remove the adjustment rod yoke pins and adjustment rod.
5. Remove the band anchor pin and band spacers and washers. Note the location of the spacers and washers if the old band is to be reinstalled.
6. Remove the band connection pins. Remove the upper band half.
7. Remove the band support. Remove the lower band half.
8. Remove the pivot arm pin retainer bolt. Remove the pivot arm pin, pivot arm and washers and spacers. Note the position of the washers and spacers if the old band is to be reinstalled.
9. Inspect all parts for wear or damage and replace or repair as necessary.
10. To reline the band, drill out the old rivets and remove the old lining. Install a new lining and rivets. Peen the rivets to hold the lining in place. Make sure the rivet heads are below the surface of the lining.
11. To reassemble the brake first install the pivot arm, pivot arm pin and washers and spacers. Install the washers and spacers in the same position as they were removed.
12. Install the lower band half. Install the band support.
13. Install the upper band half. Install the band connection pins.

2. Remove the rotochamber rod yoke pins. Detach the air lines to each rotochamber and remove the rotochambers.
3. Remove the spring rod yoke pin. Remove the yoke and jam nut from the spring rod.
4. Remove the spring guide retainer bolts and retainer. Remove the jam nuts from each end of the spring rod.
5. Loosen the full nuts on the spring rod to remove any spring preload. Once the preload has been removed remove the nuts and washers from the spring rod.
6. Remove the left spring rod guide. Remove the spring, spring rod and right spring rod guide.
7. Remove the shifter fork bearing block bolts. Remove the shift fork and bearing blocks as a unit. Note the position of the shims and washers on the lower bearing block.
8. Repair or replace components as necessary. The clutch sleeve shifter collar may be replaced at this time.
9. To reassemble the clutch lever assembly, first install the shifter collar. Then install the shifter fork assembly. Replace the shims and washers in the same position as removed. Make sure the shifter fork engages the shifter collar.
10. Check the alignment of the shifter fork. Center the fork radially on the shifter collar by adding or removing washers between the fork and the lower bearing block. Center the fork axially on the collar by removing the upper bearing block and adding or removing shims between the lower bearing block and the gearcase. Make sure to keep the clutch sleeve centered and the shifter fork bell crank straight when aligning the fork. When the fork is aligned, tighten the bearing block bolts.
11. Install the right spring rod guide. Install the spring rod in the rod guide. Install the washer and full nut on the right end of the spring rod. Position the nut to give 4.25" between the washer and the end of the spring rod. Lock the nut with the jam nut.
12. Install the spring, left spring guide and nut and washer on the left end of the spring rod.
13. Tighten the left spring rod nut to compress the spring. When the spring guide is flush with the gearcase flange install the guide retainer and secure with the guide keeper bolts.
14. Install the jam nut on the left end of the spring rod. Install the yoke jam nut on the right end of the rod. Position the nut .5" from the end of the rod.
15. Install the spring rod yoke. Tighten the yoke against the jam nut.
16. Attach the spring rod yoke to the shifter fork bellcrank.
17. Install both rotochambers. Attach the rotochamber yokes to the shifter fork bellcrank. Attach the air lines to the rotochambers.
18. Check the operation of the clutch lever assembly. The clutch sleeve should be centered between the splines on the hoist sleeve and the auxiliary reel when in neutral. At this point the shifter fork bellcrank should also be parallel to the rotochamber mounting plate. If this is not the case the shifter fork must be moved to one side or the other to center the clutch sleeve while keeping the bellcrank parallel to the rotochamber mounting plate. If this movement is necessary, the spring rod must also be moved so as to return the bellcrank to the neutral position.

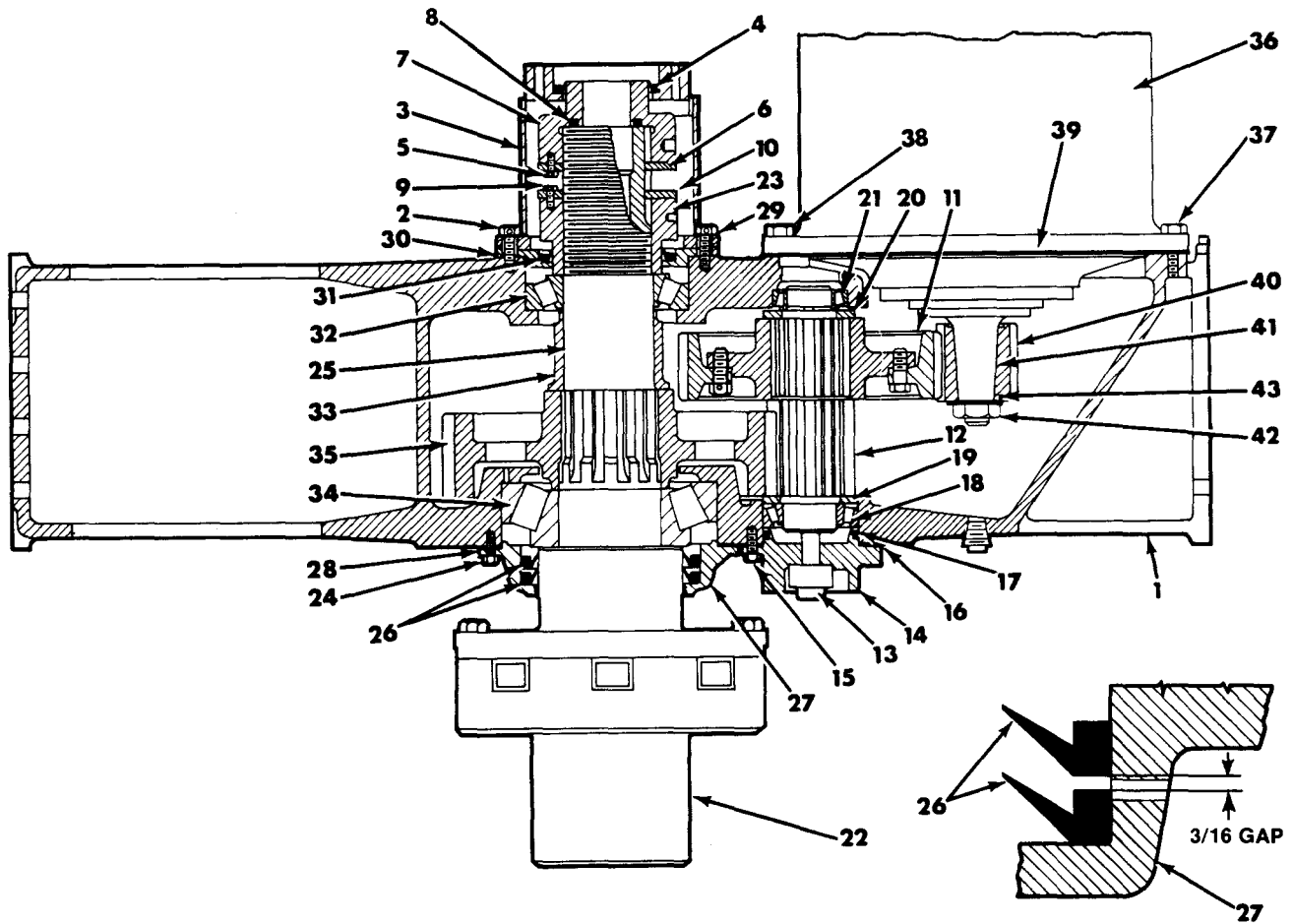
HYDRAULIC PULLDOWN MOTOR CLUTCH LEVER

The hydraulic pulldown motor clutch (figure 32) is a jaw type clutch which connects or disconnects the hydraulic pulldown motor to the hoist-propel gearcase. The clutch is operated by an air rotochamber and is returned to the neutral position by a compression spring.

ADJUSTMENT

The hydraulic pulldown motor clutch lever is adjusted at assembly and should not need any further adjustments during the lifetime of the assembly. The assembly is subject to wear or damage and must be readjusted whenever any of the components are replaced. To adjust the clutch proceed as follows:

1. Place the downfeed clutch control on the operator's console in the "off" position. Tag all controls to prevent unauthorized operation. Remove the inspection cover on the hoist-propel gearcase.



- | | | |
|----------------------------|-------------------------|--------------------------|
| 1. ROTARY GEARCASE | 16. RETAINER SHIM | 31. UPPER SEAL |
| 2. HOUSING CAPSCREW | 17. RETAINER O-RING | 32. UPPER BEARING |
| 3. SWIVEL HOUSING | 18. LOWER BEARING | 33. GEAR SPACER |
| 4. HOUSING OIL SEAL | 19. BEARING SPACER | 34. LOWER BEARING |
| 5. LOCK PLATE CAPSCREW | 20. BEARING SPACER | 35. DRIVE SHAFT GEAR |
| 6. LOCK PLATE | 21. UPPER BEARING | 36. MOTOR |
| 7. SEAL COLLAR | 22. ROTARY COUPLING | 37. MOTOR BOLT |
| 8. COLLAR O-RING | 23. ADJUSTING COLLAR | 38. SPECIAL LUBE BOLT |
| 9. LOCK PLATE CAPSCREW | 24. RETAINER CAPSCREW | 39. MOTOR GASKET |
| 10. LOCK PLATE | 25. DRIVE SHAFT | 40. MOTOR PINION |
| 11. INTERMEDIATE GEAR | 26. LOWER SEAL | 41. PINION KEY |
| 12. INTERMEDIATE SHAFT | 27. LOWER SEAL RETAINER | 42. PINION RETAINING NUT |
| 13. LUBE PUMP | 28. RETAINER GASKET | 43. NUT LOCK PLATE |
| 14. LOWER BEARING RETAINER | 29. UPPER SEAL FLANGE | |
| 15. RETAINING CAPSCREW | 30. FLANGE GASKET | |

ROTARY GEARCASE

FIGURE 35

Every 80 operating shifts partially drain the gearcase and remove the inspection cover. Inspect the gear teeth for wear or damage. Check the bearing preload on the intermediate shaft bearings by lifting the intermediate gear with a suitable pry bar.

If the gear moves more than .003" it will be necessary to shim the lower retainer. Check the rotary drive shaft bearing preload. If any clearance exists in the drive shaft bearings tighten the adjusting nut to give the appropriate preload.

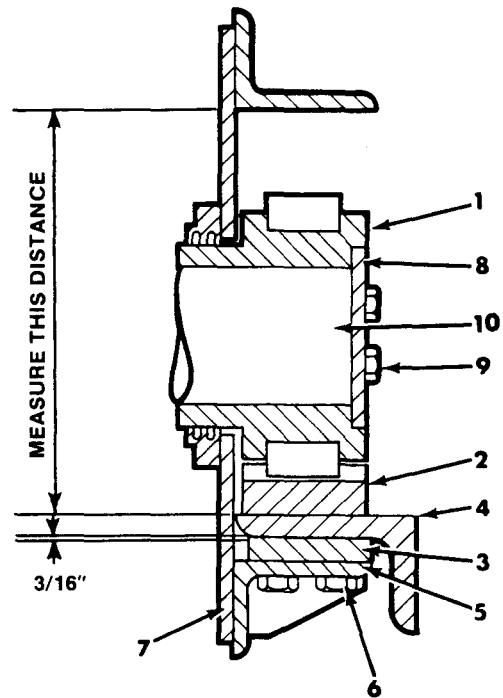
guide angles, drive sprockets and idler sprockets. The guide frame ties the shipper shaft and rack pinions to the rotary gearcase. Slide shoes on the guide angles align the guide frame to the mast and determine the backlash of the rack pinions.

Inspect the entire guide frame daily for loose or missing hardware. Inspect the bumper blocks for wear or damage and replace if necessary. Inspect the idler sprockets and drive sprockets for wear or damage. Verify that the gib keys securing the drive sprockets to the shipper shaft are tight and that the drive sprockets are aligned with the idler sprockets. Inspect the rack pinions for wear or damage. Check the adjustment of the slide shoes and adjust if necessary. Inspect the alignment of the guide frame in the mast. Check the main air pipe connections for leaks. Verify that the chock bars securing the rotary gearcase in place are intact and the welds securing the chock bars to the guide frame are intact. Check the lubrication of the shipper shaft and idler sprocket bearings. Check the lubrication of the rack pinions.

ADJUSTMENT

The slide shoes (figure 39 and 40) on the rotary guide frame align the assembly to the mast and keep the rack pinions in contact with the mast. As the slide shoes wear, it is necessary to periodically adjust the clearance between the shoes and the mast angles. To adjust the slide shoes proceed as follows:

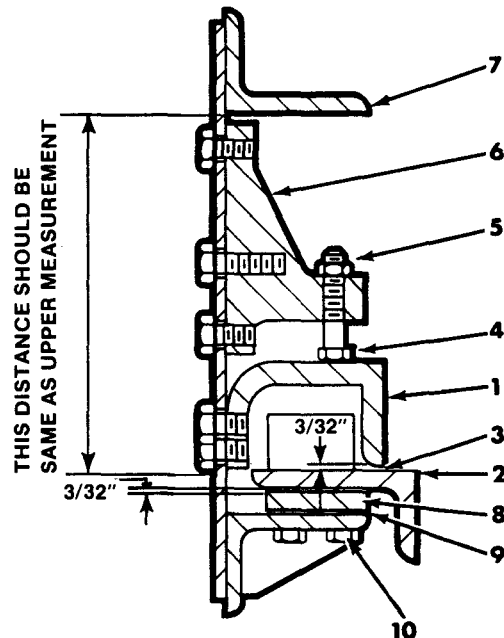
1. Position the rotary drive unit so that the upper slide shoes and rack pinions are accessible. Depress the control off pushbutton and tag all controls to prevent unauthorized operation.
2. Using a suitable jack or pulling device, pull or push the rack pinions tightly against the rack on both sides. This assures that the backlash of the pinion is correct.
3. Measure the clearance between the slide shoe and mast leg. If this clearance is greater than 3/16 inches, the slide shoes will have to be shimmed and the lower guides adjusted.
4. To shim the upper slide shoes remove the bolts securing the slide shoes to the guide frame and remove the shoes and shims. Add sufficient shims to the shim pack to reduce the clearance obtained in step 3 above to 3/16 inches.



- | | |
|-----------------|--------------------|
| 1. RACK PINION | 6. SHOE BOLT |
| 2. RACK | 7. GUIDE FRAME |
| 3. SLIDING SHOE | 8. PINION RETAINER |
| 4. MAST LEG | 9. RETAINER BOLT |
| 5. SHIMS | 10. SHIPPER SHAFT |

UPPER SLIDE SHOE

FIGURE 39



- | | |
|--------------------|--------------------|
| 1. GUIDE | 6. TAKE-UP BRACKET |
| 2. MAST ANGLE | 7. GUIDE FRAME |
| 3. SHIMS | 8. SLIDING SHOE |
| 4. ADJUSTMENT BOLT | 9. SHIMS |
| 5. LOCK NUT | 10. SHOE BOLT |

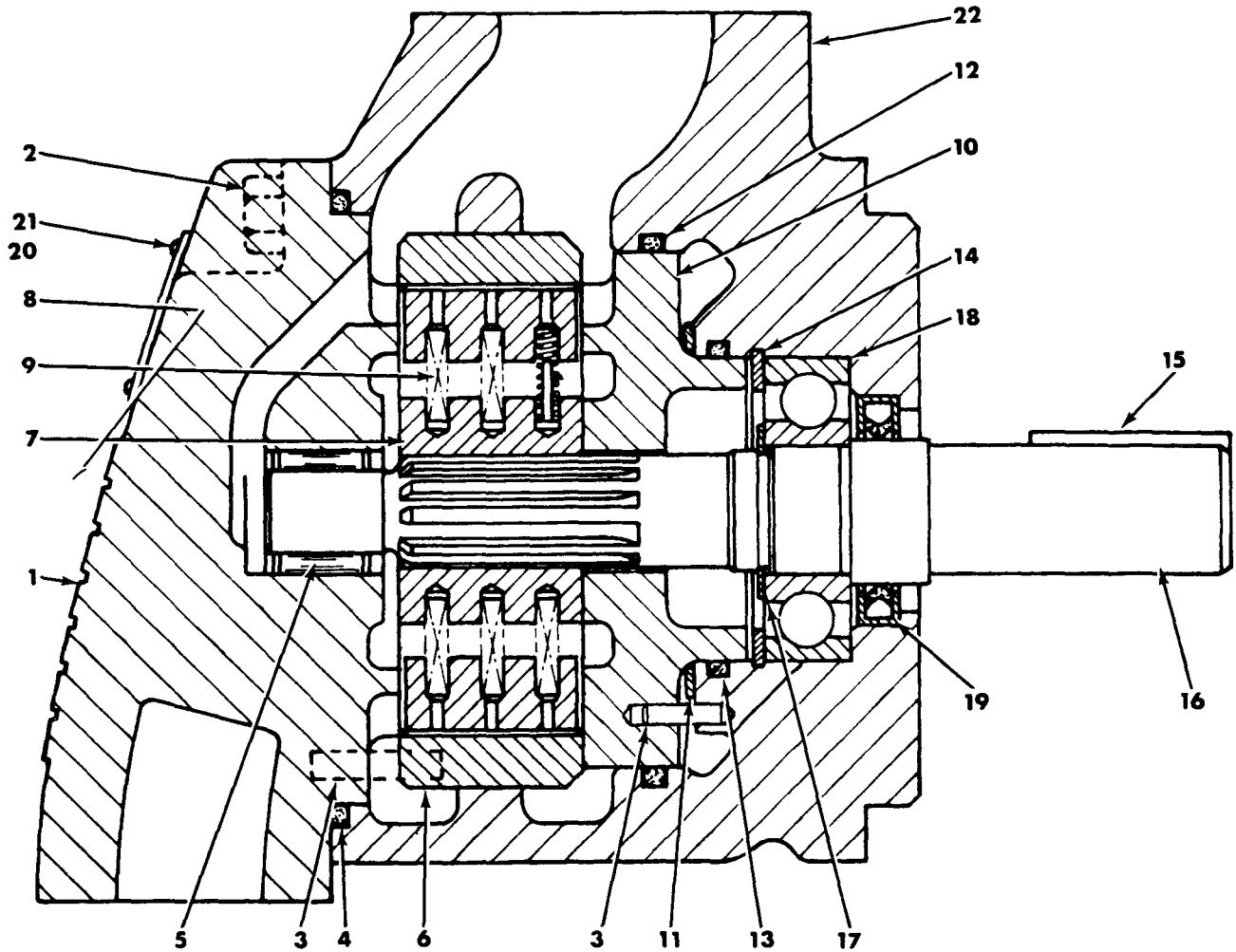
LOWER SLIDE SHOE

FIGURE 40

at the same elevation and that the mast is positioned vertically.

3. Loosen the adjustment screw lock nuts using the special wrench provided.
4. Using a suitable bar, turn the adjustment screws until the telescoping lock pins can be freely inserted. Install the telescoping lock pins and retaining pins.
5. Lock the adjustment screw in place with the lock nuts.

WARNING: Once the back braces are adjusted, it is not necessary to alter the adjustment unless the back brace is replaced. Difficulty in pinning the back braces usually results from the machine not being level or the mast not being vertical. Arbitrary adjustment of the back braces without accurately leveling the machine may cause serious damage to the mast and should be avoided.



- | | | |
|--------------|------------------------|--------------------|
| 1. END CAP | 9. SPRING | 17. RETAINING RING |
| 2. SCREW | 10. PORT PLATE | 18. BEARING |
| 3. DOWEL PIN | 11. WAVY WASHER SPRING | 19. SEAL |
| 4. O-RING | 12. O-RING | 20. DATA PLATE |
| 5. BEARING | 13. O-RING | 21. SCREW |
| 6. CAM RING | 14. SNAP RING | 22. HOUSING |
| 7. ROTOR | 15. KEY | |
| 8. VANE | 16. SHAFT | |

HYDRAULIC PUMP

FIGURE 56

6. Inspect the housing for cracks or other possible casting damage. Replace a damaged housing.

REASSEMBLY

1. Insert the dowel pin (3) in the housing (22).
2. Press the seal (19) in the housing.

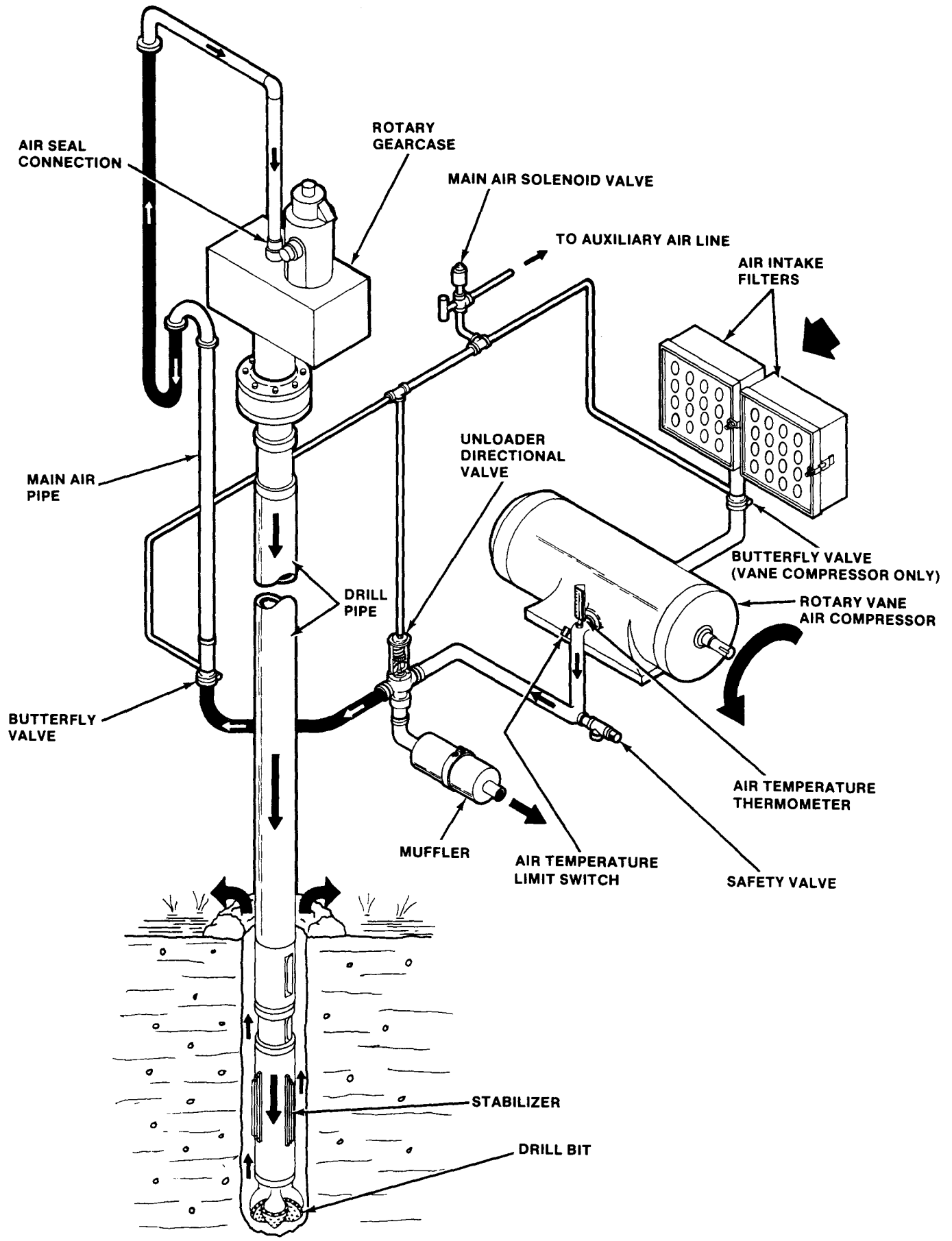
NOTE: *The open face of the seal must be facing the end cap.*

WARNING: Special care must be taken to keep foreign matter from the sealing lips of the seal to prevent cuts or abrasion of the edges.

3. Install the bearing (18) on the shaft (16) and secure the bearing with the snap ring (17).

WARNING: Do not press on the roller of the bearing.

4. Install the shaft assembly in the housing (22) and insert the key (15).



TYPICAL MAIN AIR SYSTEM

FIGURE 61

the next lower SAE number. For other ranges of discharge air temperatures, use the viscosity grade indicated by the SAE numbers below.

DISCHARGE AIR TEMPERATURES	SAE NUMBER
200 to 275°F	30
250 to 320°F	40
300 to 350°F	50

NOTE: For extreme cold weather starting (below -10°F), use 5W-30 under specification MIL-L-46152.

LUBRICATOR DAILY MAINTENANCE CHECK

Fill the lubricator with the correct oil. Use only clean oil.

LUBRICATOR WEEKLY MAINTENANCE CHECK

1. Check all connections to be sure they are tight.
2. Be sure all oil lines are securely supported to prevent vibration.
3. Be sure the lubricator mounting bolts are tight.

LUBRICATOR SERVICE

The lubricator injectors are the ball valve type. Use only clean oil and keep these valves clean. Flush the lubricator oil reservoir periodically. At the first indication of non-uniform delivery from an injector, remove it and clean it.

NOTE: Remove and clean only one injector pump at time. Each plunger is individually fit to a body and must be reassembled to that same body after cleaning.

Terminal check valves are located at the ends of the delivery lines. Each check valve consists of 2 ball valves. Keep these ball valves clean.

If a delivery line must be replaced, the new tubing must be seamless, clean, and free of scale. It must be free of kinks and the ends must be free of burrs. Cut it to a length which will allow the line to be as direct as possible. Bend tubing carefully to avoid flattening or kinks, which would restrict oil flow. All joints must be tight. Anchor the tubing securely to prevent vibration. Tubing connections are solderless compression 1/4 inch O.D. tubing size. When making the joint, let the tubing extend

through the ferrule into the connection at least 1/8 inch. Be sure to prime an empty line before connecting it to the compressor.

LUBRICATOR PRIMING

Several things can make it necessary to prime the lubrication system. Among these are: the oil reservoir has been allowed to run dry, the type of oil has been changed, a line has been changed, the compressor has been reassembled. To prime the system, use the following procedure:

1. Disconnect the oil lines at the compressor. Crank the lubricator until oil flows from each line. The oil must flow steadily with no air bubbles.
2. Reconnect the oil lines to the compressor. Crank the lubricator 25 times, then rotate the compressor sheave by hand 1/4 turn in the direction of rotation (indicated by the arrow embossed on the inboard end of the cylinder).
3. Crank the lubricator 25 times again, and turn the sheave another 1/4 of a turn. Repeat this procedure two more times.
4. Crank the lubricator a few more times while checking each sight feed chamber for oil flow.

COMPRESSOR RADIATOR (Figure 67)

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.

SAFETY VALVE SETTINGS

The chart below gives the safety valve settings for different elevations.

ELEVATION (feet above sea level)	SAFETY VALVE SETTING
0 to 3000	50 psi
3000 to 6000	46 psi
6000 to 8000	44 psi
8000 to 10000	40 psi

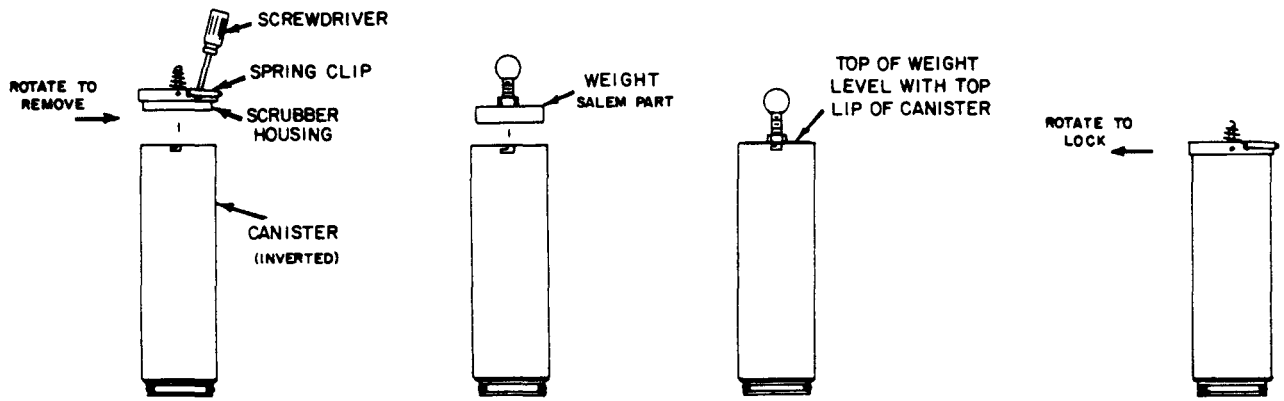


FIGURE 73

5. Reassemble sump cap with seal, lock washers and 5/16 hex nuts.
6. Reconnect actuating air line.

Procedure For Renewal of Desiccant Charge (Figure 73)

1. First, invert canister assembly.
2. To remove scrubber housing, insert screwdriver between spring clip and housing releasing spring clip from slot. Then rotate housing counterclockwise and pull up.
3. Dispose of old desiccant charge.
4. Slowly add contents of new desiccant charge into desiccant canister until level of charge is approximately 1/2" below top lip of canister.
5. Place weight (provided) on top of desiccant charge and lightly tap sides of canister while rotating to settle charge. If top weight should drop below top lip of canister, add more charge and repeat above procedure until lip of canister and top of weight are level.
6. Now scrubber housing can be replaced on top of canister assembly and rotated clockwise to lock. Make sure that spring clip snaps back into slot.

PURGE VALVE REMOVAL (Figure 74)

Disassembly

1. Remove purge valve from filter sump cap by unscrewing four 5/16" diameter bolts.
2. Spring cap assembly must be removed prior to disassembling the piston.
3. To remove the piston it is necessary to use a 1/4" diameter screw for a piston puller. The piston base is threaded, insert 1/4" screw and pull.

Cleaning and Repairing

1. Replace all rubber seals that are cracked, broken, cut, worn excessively, damaged, or in such a condition as would result in unsatisfactory operation.
2. Inspection should be made every 12 months.

Assembly

1. Lubricate all O-rings and piston body with a silicone grease equal to Dow Corning 55M.
2. Replace piston into purge valve body.
3. Attach spring cap to valve body with three capscrews.
4. Secure purge valve to filter sump with four 5/16" diameter bolts.
5. Connect actuating air line from solenoid valve to purge valve.

CHAPTER 3

SECTION 4 – MAIN AIR COMPRESSOR

ROTARY VANE COMPRESSOR (ALLIS-CHALMERS)

1000 HOUR MAINTENANCE CHECK

At this maintenance check, it is necessary to remove the outboard head (the head on the non-drive end). Use the following procedure:

1. Drain the compressor cooling system.
2. Wedge a block of wood between the inboard head (figure 79) and the V-drive pulley. This will prevent the rotor from sliding laterally when the outboard head is removed. If the rotor and shaft would slide laterally the inboard head seal ring would advance with the rotor and shaft, necessitating the removal of the inboard head as well.
3. Remove the outboard head nuts and jack the outboard head (using the outboard head jack-screws to remove it evenly) away from the cylinder until the gap is approximately 1 inch.

WARNING: Do not exceed 1 inch or the rotor shaft will fall from the cylinder head.

4. The rotor and shaft must be supported before removing the outboard head completely from the dowel pins. Support the rotor and shaft by inserting a 1/4 inch diameter cable, under the portion of the shaft exposed in the gap between the cylinder and outboard head and secure it to an overhead support (figure 80). Using an eyebolt, support the outboard head weight from above and remove the outboard head completely.

WARNING: If the rotor and shaft is not properly supported, it will drop toward the bottom of the cylinder bore. This will put a strain on the inboard bearing and cause possible damage to the inboard bearing, inboard head, and rotor and shaft.

5. After the outboard head is removed, check the rotor blades for wear (figure 81). Inspection of the rotor blades will indicate whether

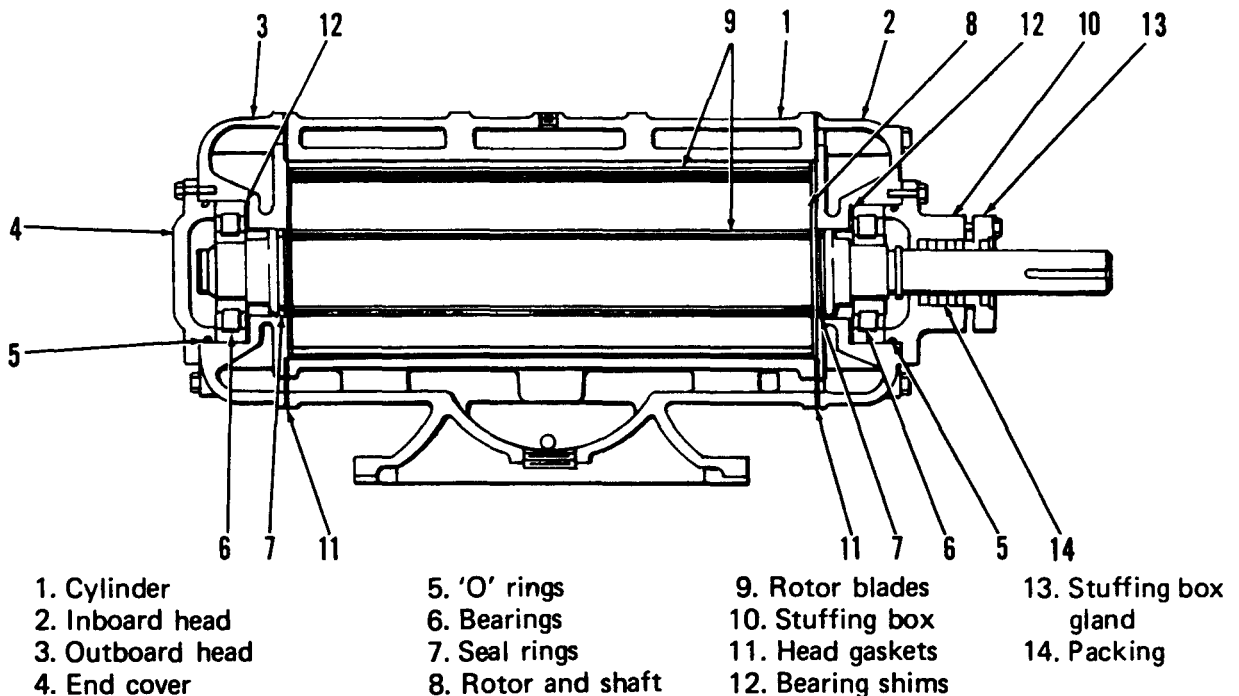


FIGURE 79

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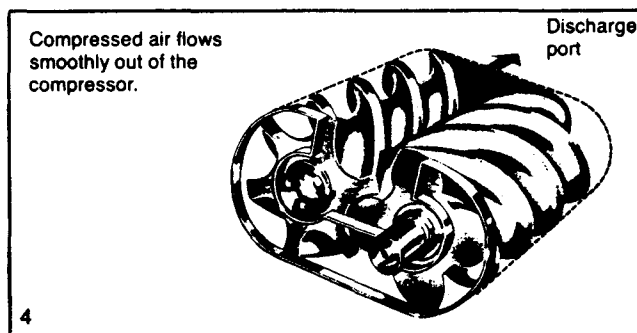
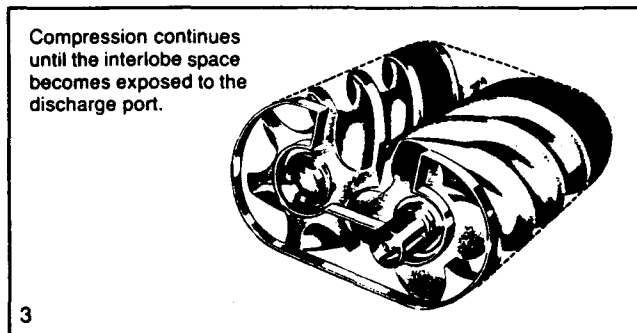
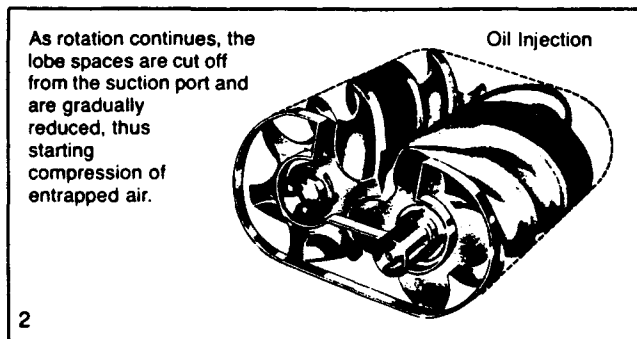
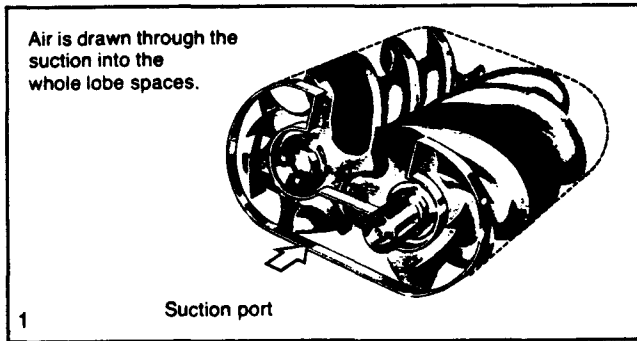


FIGURE 87

bottom, inlet end of the compressor, show how it works. The suction (inlet) port is located on the top, drive shaft (inboard) end of the compressor. The discharge port is located on the bottom, outboard end.

As the male rotor is turned counterclockwise (by the clockwise rotation of the gear shaft and gears — not shown), it drives the female rotor clockwise. This action causes air to be drawn through the suction port completely filling the uncovered channels or grooves between the spiral (helical) lobes in the male and female rotor. As the rotors continue to turn the lobes begin to intermesh at the bottom. This intermeshing causes the spiral grooves to become shorter thus resulting in the compression of the air entrapped in the grooves. Compression continues until the grooves are uncovered by the discharge port.

During the compression process, cool oil is injected into the entrapped air by a gear type oil pump direct driven by the outboard end of the male rotor. The oil is injected for the following reasons:

1. Cooling — The oil removes the heat of compression to maintain discharge air temperatures below 200°F.
2. Sealing — The oil seals the internal clearances between the rotor, cylinder and discharge end casing to prevent loss of air volume back to the inlet.
3. Lubrication — The oil lubricates the rotors, bearings, gears and mechanical shaft seal.

COUPLING ALIGNMENT

Final alignment of direct-driven units is made by moving or shimming the unit so that misalignment of the unit and drive shafts is within .002 inch. Misalignment can be either parallel or angular, or both, and in the vertical as well as the horizontal plane.

Although several methods of aligning machinery have evolved, the following recommended method will produce the required accuracy with minimum effort: A dial indicator mounted on one shaft with a bracket to indicate the turn of the other shaft will check parallel misalignment. An inside micrometer or dial indicator on the faces of the coupling will check angular misalignment. Readings taken 180 degrees apart will measure the runout in one plane. It is important to rotate both shafts simultaneously to avoid errors due to surface imperfections of the shafts or coupling.

Parallel Misalignment

Steps in checking parallel misalignment in the horizontal and vertical planes:

2. Open valve on oil reservoir (figure 90) and drain the oil. Close drain valve. Remove magnetic drain plug and clean plug. Replace plug and tighten.
3. Open drain connections on oil cooler and drain completely.

NOTE: Open fill plugs slightly to vent the cooler while draining. Replace plugs and tighten.

4. Remove plugs from oil drains on compressor air end sump and bearings, seal and gear cavities and drain oil completely.

NOTE: Place a large oil pan under drains before removing plugs. Replace and tighten plugs.

5. Remove plug from compressor discharge pipe oil drain (figure 92) and drain oil completely.

NOTE: Place a large oil pan under drain before removing plug. Replace plug and tighten.

6. Remove plugs from both oil filters and drain oil completely.

NOTE: Place oil pans under filters before removing plugs. Replace plugs and tighten.

Refilling Oil System

Refer to FILLING OIL SYSTEM (INITIALLY) procedure above. Follow steps 1 through 5 to fill the receiver and oil cooler. It will not be necessary to refill the compressor body with oil after the initial oil fill. After start-up, the oil pump will inject the required amount of oil into the compressor from the receiver. However, it will then be necessary to stop the compressor after approximately 15 minutes and refill the oil receiver to the top of the level gauge.

Compressor Oil Strainer and Filters

The compressor oil system contains the following strainer and filters:

1. Pump Inlet Strainer — This y-type strainer (figure 94) is installed at the pump inlet to prevent foreign material from entering the pump. The strainer basket should be removed, cleaned and inspected every time the oil is changed.
2. Oil Filter (Rotors) — This 25 micron filter (figure 94) is installed at the pump outlet and

filters the entire oil supply to the compressor. It is referred to as the rotors oil filter since most of the total oil supply is pumped to the rotors in the compressor.

3. Oil Filter (Bearings, Seal and Gears) — This 10 micron filter (figure 94) is installed to further filter the oil supply to the bearings, mechanical seal and gears where clean oil is especially desired for optimum life of these compressor components.

Both of the oil filters described above are constructed as shown in figure 96. Each has an internal by-pass valve set to open at a 20 psi differential. The filter maintenance indicators are set to indicate filter element replacement with a red flag at a 15 psi differential. The internal by-pass valve, therefore, ensures a continuous supply of oil to the compressor in the event the filter element is not changed in time.

It is important that the filter element be changed as soon as the red flag appears completely in the maintenance indicator window. As a preventative maintenance procedure, the user should consider changing the filter elements at least every oil change even though the red flag may not be showing completely. Clean oil is essential for maximum compressor life.

The elements in the oil filters are disposable, cartridge type. To change out the element follow this procedure:

1. Remove drain plug and drain oil from filter.
2. Loosen and remove the four capscrews on top of the filter.
3. Lower the filter bowl until the element is partially exposed. Grab the element and slide it down off of the internal mounting sleeve. Drop the element into the bowl and remove the bowl.
4. Dispose of the used element and clean the filter bowl.
5. Slide the new filter element up over the mounting sleeve.
6. Inspect the O-ring gasket in the filter bowl and replace if it is cut or cracked.
7. Slide the filter bowl up over the element while being careful to position the bowl spring so that it fits into the recess in the bottom of the element.
8. Draw up the capscrews evenly and tighten.

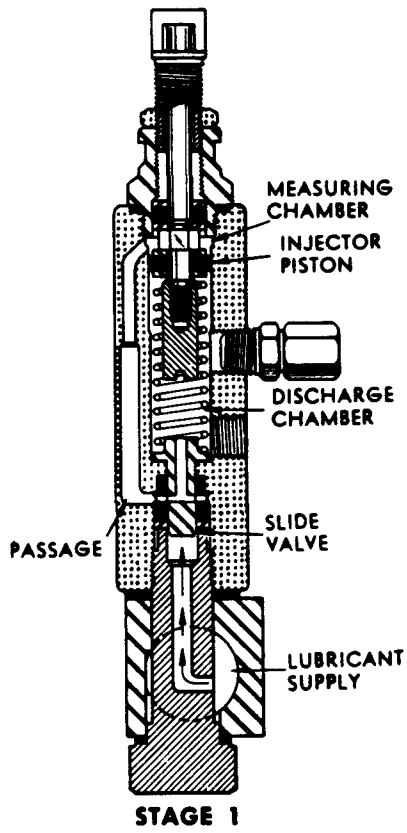


FIGURE 131

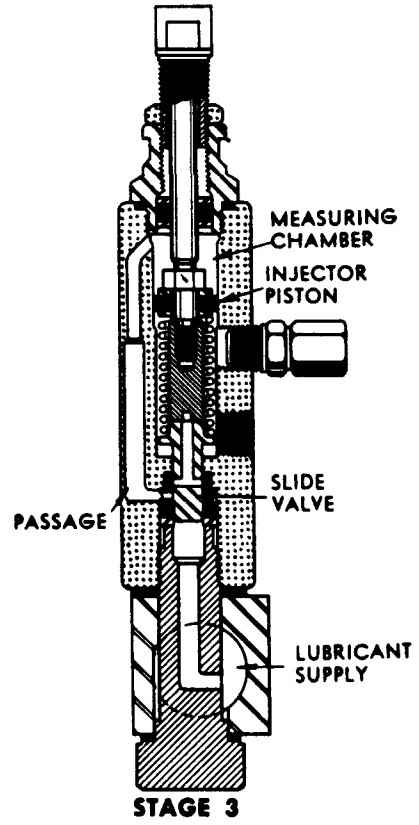


FIGURE 133

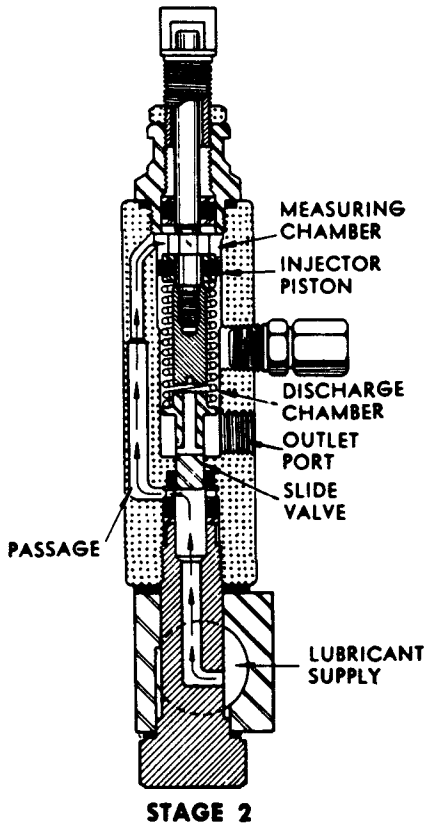


FIGURE 132

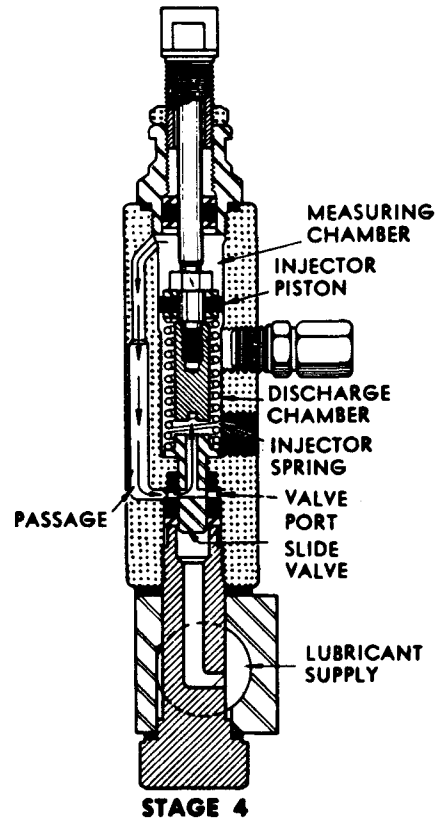


FIGURE 134

is indicated. This means that the oil has been squeezed from the grease, leaving the soap behind. All of the soap must be removed from the unit before reassembling. If no blocked bearings or crushed lines (which would cause abnormally high pressure in the system) have been found and the grease has separated at normal operating pressures, consult your lubricant supplier for his recommendations for a different grease.

After all sections have been cleaned, blown out, inspected and found to be in good condition, reassemble the distributor assembly by following your sketch. Important — Use the torque settings listed below. Test operation of the assembly on the bench by pumping lubricant (preferably oil) into the inlet of the distributor with a hand grease gun. If it now functions properly, replace it in the system and again test for proper operation. Remember — Dirt and foreign material are the worst enemies

of any lubricating system. All servicing should be carried out under the cleanest possible conditions.

TORQUE INFORMATION IN FOOT POUNDS

	MJ	M-MV	MX
Tie Rod Nuts	12	20	25
Alternate Outlets	10	10	24
Check Valves	10	15	19
End Plugs	15	15	45

In summary, remember the following:

1. Re-stack distributor according to your sketch.
2. Check proper assembly, including gaskets, etc.
3. Draw up assembly to proper torque settings.
4. Test distributor with light oil.

PROBLEM	CAUSE	CORRECTIVE ACTION
Control Valves (cont.)		
No relief valve action (high pressure).	<ol style="list-style-type: none"> 1. Small particle of dirt plugging orifice in relief valve sub-assembly. 2. Relief valve sub-assembly installed backwards. 	<ol style="list-style-type: none"> 1. Remove relief valve and check hole. If blocked, clear hole. 2. Install properly.
Cylinder will not hold.	<ol style="list-style-type: none"> 1. Oil by-passing between spool and body. 2. Oil by-passing piston in cylinder. 3. Spool not centered. 	<ol style="list-style-type: none"> 1. Replace valve. 2. Repair or replace cylinder. 3. Refer to above spool remedies.
Cylinder falters when spool is moved from neutral to a power position.	<ol style="list-style-type: none"> 1. Dirt or foreign particles lodged between check valve poppet and seat. 2. Scored or sticking check valve poppet. 	<ol style="list-style-type: none"> 1. Disassemble, clean and reassemble. 2. Replace poppet.
UNLOADER VALVES		
Erratic pressure.	<ol style="list-style-type: none"> 1. Foreign matter in the system. 2. Spool binding in the body bore. 	<ol style="list-style-type: none"> 1. Drain, flush and refill system with clean fluid. 2. Check spool for excessive wear or burrs. Remove burrs with India Stone. Check body bore for wear or out-of-round. RT and RCT series, check the connecting piping for excessive tightness distorting body.
Premature valve action (low pressure).	<ol style="list-style-type: none"> 1. Valve improperly adjusted. 2. Drain hole through main spool plugged. 3. Main spool stuck in open position. 4. Control piston binding in up position. 	<ol style="list-style-type: none"> 1. Readjust valve to proper setting. 2. Remove spool. Blow out hole with filtered compressed air. 3. Remove spool. Check for burrs, foreign matter, excessive wear, out-of-round body bore. RG and RCG series, inspect valve mounting surfaces for flatness. 4. Remove bottom cover. Check piston for burrs.
Delayed valve action (high pressure).	<ol style="list-style-type: none"> 1. Control piston binding in bottom position. 	<ol style="list-style-type: none"> 1. Check for burrs, foreign matter or excessive wear.

APPENDIX A4 – LUBE BENCHMARKS

MPG – MULTI-PURPOSE TYPE GREASE

SCOPE

Lubricant performance requirements for Multi-Purpose Type Grease.

APPLICATION

For heavy duty ball, roller and plain bearings.

GENERAL REQUIREMENTS

1. HEAT RESISTANCE - Shall be thermal stable.
2. RETENTION IN BEARINGS - Shall not exhibit high leakage.
3. MECHANICAL STABILITY - Shall work continuously with a minimum change in consistency.
4. WATER RESISTANCE - shall withstand water wash-out or leaching.
5. REVERSIBILITY - Shall be stable with repeated heating and cooling.
6. PRESSURE OIL SEPARATION - Shall resist oil-soap separation.
7. DISPENSABILITY - Shall have the ability to be pumped through automatic lubrication systems without the aid of heat tracing on the lube lines at the designated ambient temperatures.
8. EXTREME PRESSURE - Shall withstand heavy shock loading.
9. COMPATIBILITY - Low temperature greases shall be compatible with mineral oil base greases and their oil seal material.

COMPOUNDING

1. Suitable for producing the extreme pressure characteristics (without inert fillers) required for heavy duty ball, roller and plain bearing lubrication.

Specific Requirements

AMBIENT TEMPERATURE	NOTE #1	110° TO 30°F	40° TO 0°F	+10° TO -50°F
NLGI	ASTM. D-217	2	1	Note #2
Typical Penetration	ASTM. D-217	265-295	310-340	Note #2
Dropping Point °F, min.	ASTM. D-2265	325	325	Note #2
Timken O.K. Load, lbs., min.	ASTM. D-2509	40	40	40
Shell Four Ball EP	ASTM. D-2596			
Load Wear Index, kg., min.	ASTM. D-2596	40	40	35
Load Weld, kg., min.	ASTM. D-2596	200	200	200
Shell Four Ball Wear	ASTM. D-2266			
Wear Scar Diam., mm., max.	ASTM. D-2266	0.60	0.60	0.60
Copper Strip Corrosion	ASTM. D-130	Pass	Pass	Pass
Rust Test	ASTM. D-1743	Pass	Pass	Pass

NOTATIONS

1. AMBIENT TEMPERATURE - The ambient temperature shall be the temperature at the point of lubricant application.

CHAPTER 5

SECTION 1 — LUBRICATION PROCEDURES

GENERAL

Lubrication may well be the most important part of preventive maintenance. Do not allow anything to interfere with the lubrication of the machine. It may require some study to find out just how much lubricant to use at each servicing. However, the extra effort will result in a smooth running machine with less wear of parts.

NOTE: *On diesel powered machines, refer to the engine literature for engine lubrication instructions.*

There is no way to say definitely how much grease to add to any particular bearing. It depends on how hard the machine is being worked, how much the bearing is worn, and the grade of grease being used. Watch all the bearings closely until you are sure the grease added at one servicing is enough to last until the next servicing.

Most wearing parts need lubricants applied regularly in small quantities, instead of large amounts applied only occasionally. Make regular inspections of the machine and watch for signs of incorrect lubrication, such as accumulation of excess grease. Make sure that the grease has not come from a broken or disconnected line or grease pipe. Usually, it is a waste to pump grease into a plain bearing after the grease starts to come out. However, certain bearings which may collect dirt (such as the lower works bearings) should have extra grease added to force out all of the old grease. This old grease may have collected abrasive dirt.

New bushings sometimes overheat because they are too tight to allow normal distribution of grease. Old bushings may overheat because they are so worn that grease will not stay in until the next time of servicing. In the case of the new bearing, it may be necessary to give it more frequent greasing until it is worked in. It may be necessary to do the same for the old bearing, until it can be replaced. It is much better to lose a little time on a shift to give some extra grease to a point which needs it, instead of trying to run it to the end of the shift.

The most common cause of overheating of an anti-friction bearing is churning of the grease. This

happens when the bearing is packed too full. If grease leaks out of an anti-friction bearing it is almost a sure sign that too much grease was added to the bearing. Continue to grease it as often as before, but use less grease.

LUBRICANT CLEANLINESS

Even the best lubricant is useless in preventing wear if it has become dirty by careless handling and storage.

The manufacturer usually packs the lubricant in tight containers to keep it clean. It is the job of the operator (and the oiler, if one is assigned to the machine) to be sure that no dirt gets into the lubricant. Follow these points of good practice:

1. Keep all oil and grease in tightly covered containers.
2. Wipe off covers before opening containers.
3. Keep funnels, oil cans, grease guns, etc., in a clean place and wipe them off before using them.
4. Wipe off each grease fitting before attaching the grease gun.
5. Wipe off oil filler caps and the surrounding area before removing them.

LUBRICATION POINTS

The lubrication charts in this section show the principal points to be lubricated. Automatic lube systems should be checked daily to see that they are operating properly and that each lube point is receiving the correct amount of lubricant. The types of lubricants are explained under LUBRICANT BENCHMARKS in the appendix.

The frequency of lubrication given in each chart is intended as a guide. Under unusual operating conditions, some points may require more frequent lubrication or other special attention. Use good judgement in lubricating the machine. If a bearing is showing signs of trouble, such as overheating or unusual noise, give it immediate attention. Make sure the grease was not dirty or of the wrong grade. When the machine is operated for more than one shift each day, all crews must cooperate

AMBIENT TEMPERATURE		45° to -50°	75° to -20°F	105° to +10°F	130° to 30°F	150° 10°F
Viscosity SUS @ 100°F	ASTM D-445 D-2161	284-347	626-765	1919-2346	—	—
Viscosity SUS @ 210°F	ASTM D-445 D-2161	55-61	70-76	122-138	220-240	470-530
AGMA Lubricant Number, (See Note N1)		2EP	4EP	7EP	NONE Applicable	SHC*
Viscosity Index, Min.	ASTM D-2270	130	95	90	85	155
Pour Point °F, Max.	ASTM D-97	-50	-20	+10	30	—

**Synthesized Hydro-Carbon Gear Oil*

NOTATIONS

1. AGMA standard gear oil specification does not include pour point temperature pour point as specified is an additional Bucyrus-Erie Company requirement.
2. If ambient starting temperature approaches lubricant pour point, external heaters may be required to facilitate starting and insure proper lubrication.

WARNING: If oil recommendation requires special seal or packing material, oil supplier should inform the Bucyrus-Erie Company Engineering Department of the need in time to obtain suitable seals or packings.

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

LEVEL III CHECKLIST

(Suggested to be performed in the Spring and Fall - 2nd shifts)

ITEM TO BE CHECKED	✓ ONLY LIST PROBLEMS
1. Position the machine so that one drive tumbler, take-up tumbler, and lower roller can be removed for inspection of the bushings.	<hr/> <hr/> <hr/> <hr/>
2. Drain the hoist-propel gearcase and fill with new oil.	<hr/> <hr/> <hr/> <hr/>
3. While the gearcase is drained, remove the gearcase cover and inspect the gears, pinions, bearings and seals.	<hr/> <hr/> <hr/> <hr/>
4. Drain the rotary gearcase and fill with new oil.	<hr/> <hr/> <hr/> <hr/>
5. While the gearcase is drained, remove the motor and inspect the gears, pinions, bearings and seals.	<hr/> <hr/> <hr/> <hr/>
6. Repack the bearings in the masthead sheaves and sprockets.	<hr/> <hr/> <hr/> <hr/>
7. Repack the bearings in the auxiliary reel.	<hr/> <hr/> <hr/> <hr/>
8. Drain the hydraulic reservoir and fill with new oil.	<hr/> <hr/> <hr/> <hr/>
9. Change all oil filters.	<hr/> <hr/> <hr/> <hr/>
10. Correct any deficiencies found during Level I and Level II inspection which did not require immediate action.	<hr/> <hr/> <hr/> <hr/>
11. Clean up around the machine and touch-up paint any parts of the machine where paint is missing and rusting could occur.	<hr/> <hr/> <hr/> <hr/>

Maintenance Inspector: _____

Time Inspected: _____

Date Inspected: _____

Remarks: _____

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