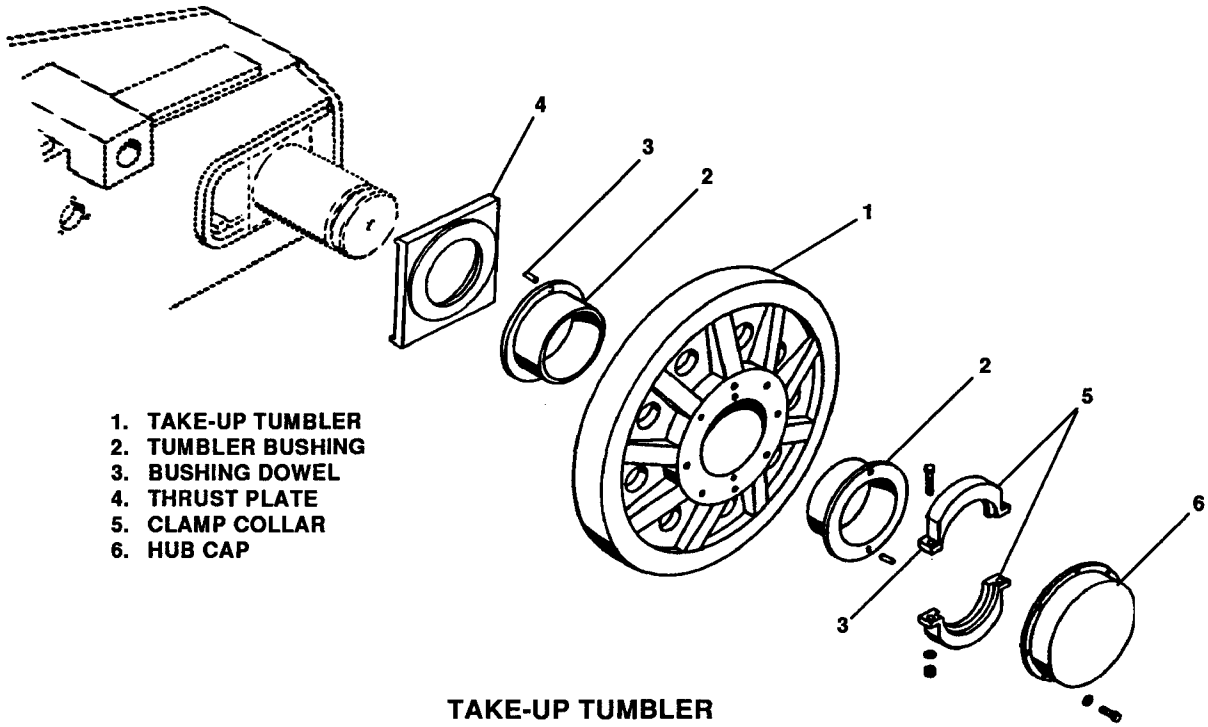
BUCYRUS®

Technical Manual

APPENDICES



TAKE-UP TUMBLER
FIGURE 1-2-8

9. Insert new dowels and drive them in. Dowel ends should be flush with flange surface of the bushing.
10. Lubricate the bushing bore and the axle mating surface. Use a hoist and slide the take-up tumbler onto the axle. Install the tumbler clamp and hub cap.
11. Join the crawler belt links and adjust belt tension as described in topics BELT REPLACEMENT and BELT ADJUSTMENT. Thoroughly lubricate the take-up tumbler bushings. Propel the machine carefully and remove the blocks. If other method was used, carefully back up machine until tumbler is out of depression and join the belts.
12. Propel the machine backward and forward a few times to distribute the lubricant evenly in the bushing.

UPPER ROLLERS

INSPECTION

Inspect the upper rollers for cracks and damage that can impair normal tracking of the crawler belts.

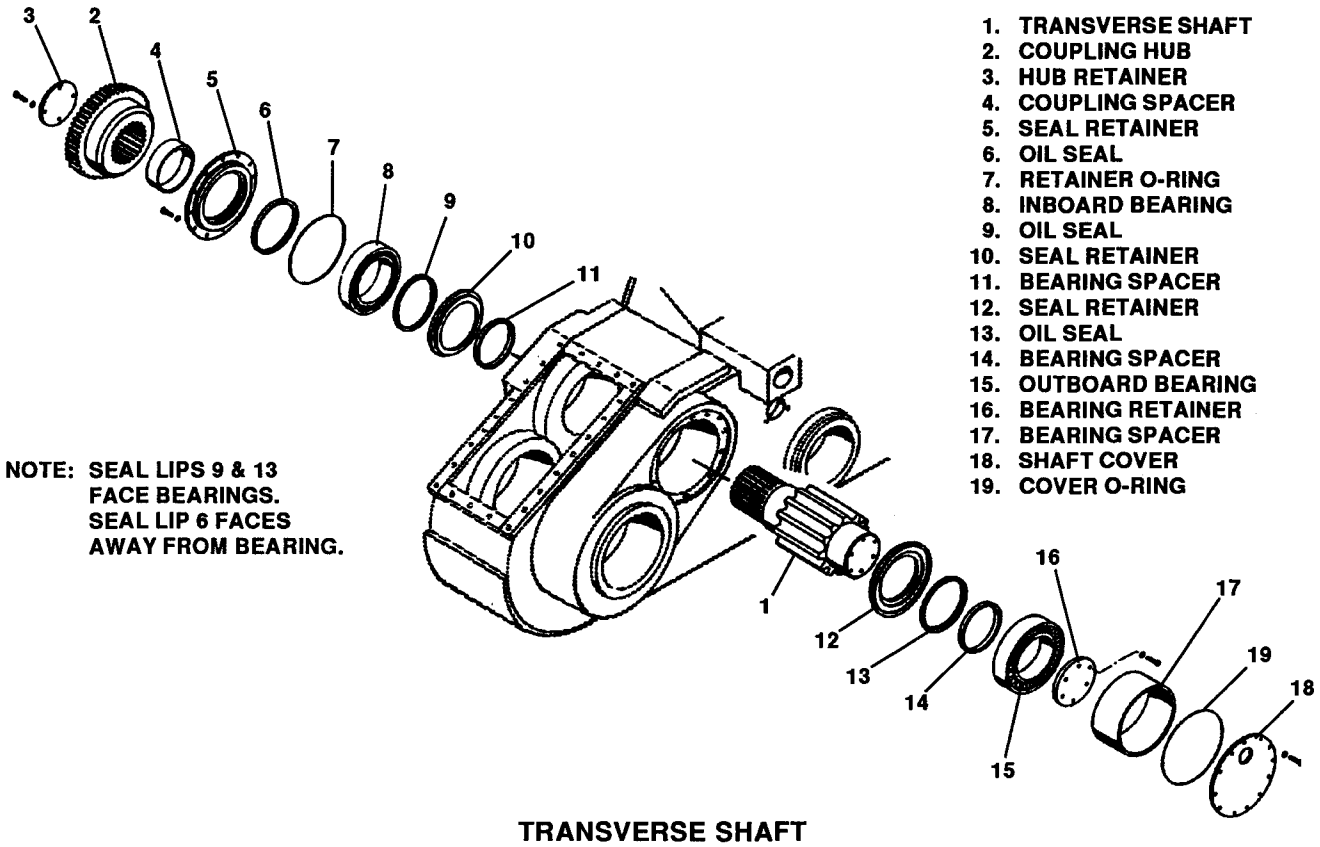
Every six months remove the upper roller collar and check the roller bushing for bore elongation and wear. Replace the bushing if badly worn.

REPAIR

The upper rollers are not subjected to high load conditions. The most common problem encountered is bushing wear.

If bushing replacement is necessary, the upper roller must be removed from the machine. To remove the roller:

1. Relieve crawler belt tension as described in the topic BELT ADJUSTMENT.
2. Raise the belt with a suitable lifting device until it clears the upper portion of the roller. Block belt in raised position.
3. Remove the cotter pin and retaining pin securing the roller collar and remove the collar (figure 1-2-9). Slide the roller from the shaft.
4. Remove the bushing from the roller. Check the roller bore and the shaft for defects. Remove burrs with a file. Check the roller bore for out-of-round condition. Replace the roller if the bore is out-of-round. Check roller shaft for wear.
5. Install new bushing into the roller bore. Make sure bushing is flush with or slightly below the surface of the roller.
6. Lubricate the bushing bore and the shaft



TRANSVERSE SHAFT
FIGURE 1-2-12

6. Loosen the coupling hub retainer bolts. At the same time, with the puller cable that was attached in step 4, pull the shaft from the crawler frame. The outboard bearing, spacer, seal retainer and oil seal will be removed with the shaft.
7. Remove the inboard bearing retainer, retainer O-ring, retainer oil seal, outer spacer, bearing, inner spacer, seal retainer and oil seal.
8. Inspect the parts for wear or damage and repair or replace all damaged or worn parts.
9. The drive tumbler gear must be rotated so that the gear teeth mesh with the pinion teeth of the shaft.
10. Assemble the outboard bearing inner spacer, seal retainer, oil seal, bearing and bearing retainer onto the shaft.
11. Assemble the inboard bearing inner spacer and bearing inner race onto the shaft.
12. Assemble the inboard bearing, seal retainer, oil seal, bearing outer race with roller cage and guide flanges, retainer, O-ring and oil seal into the crawler frame housing.
13. Slide the shaft assembly into the crawler frame and inboard bearing. Install the spacer and coupling with retainer and secure in place.
14. After the assembly is completed, hand lubricate the bearings thoroughly prior to connecting to the auto-lube system.

PROPEL CLUTCHES

INSPECTION

The propel clutches are self-contained units mounted on the input shafts of the propel machinery. The clutch is air set and spring released, and does not require adjustment.

Frequently check the air line connections and the rotary seal for air leaks. Tighten loose connections. Repair the poppet seal or rotary seal if leakage at the rotary seal is detected. Every 2000 hours of operation check the clutch disc wear through the openings in the outer

16. Connect the air line to the air cylinder and apply air pressure to cylinder, which will hold shoes in the open position.
17. Remove the block between the spring guide and the spring guide yoke. Brake shoes will remain in open position.
18. Adjust the square setscrew to provide equal release of the shoes. Lock setscrews with jam nut.
19. Release air pressure to cylinder allowing brake shoes to close or set on brake drum. Be sure to adjust support link spacer plate setscrews to obtain 1/16" gap between them and spacer plate. This is required to restrict brake fore and aft movement when brake is released.
20. Position and secure brake guard.

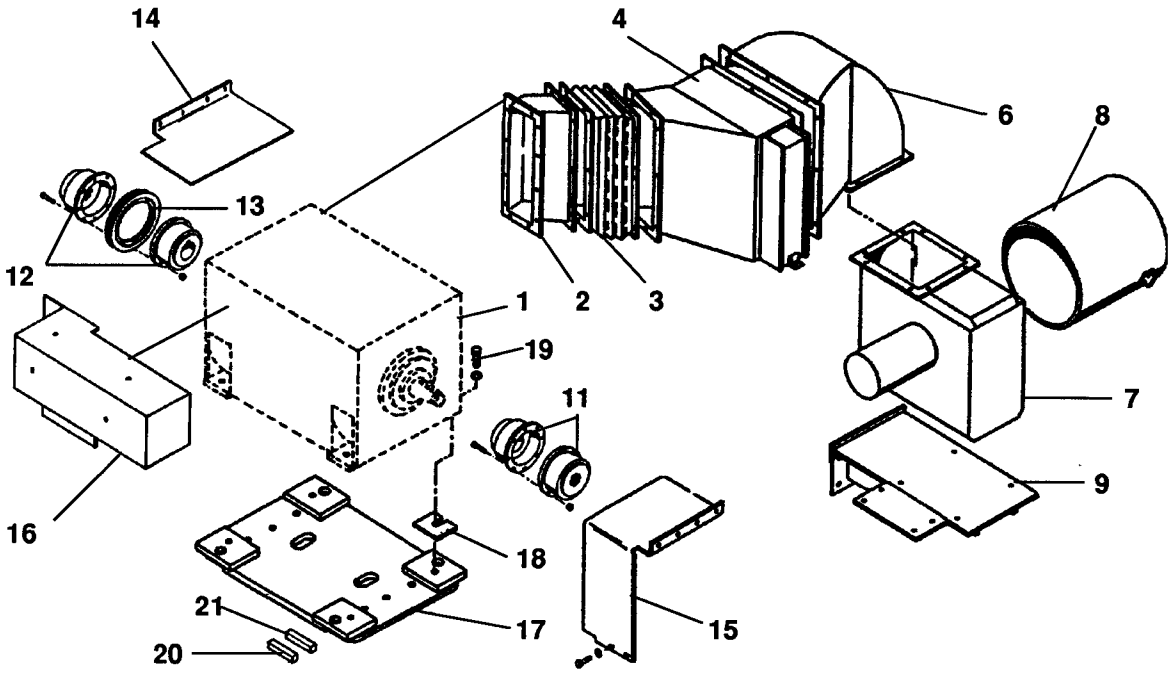
PROPEL MOTOR

Inspection, lubrication and maintenance instructions for the propel motor are described in the Motor Manufacturer's Manual. If removal of the propel motor is necessary, follow the instructions below.

REPAIR

1. Swing the machine so the boom foot is slightly beyond the center of the propel motor.

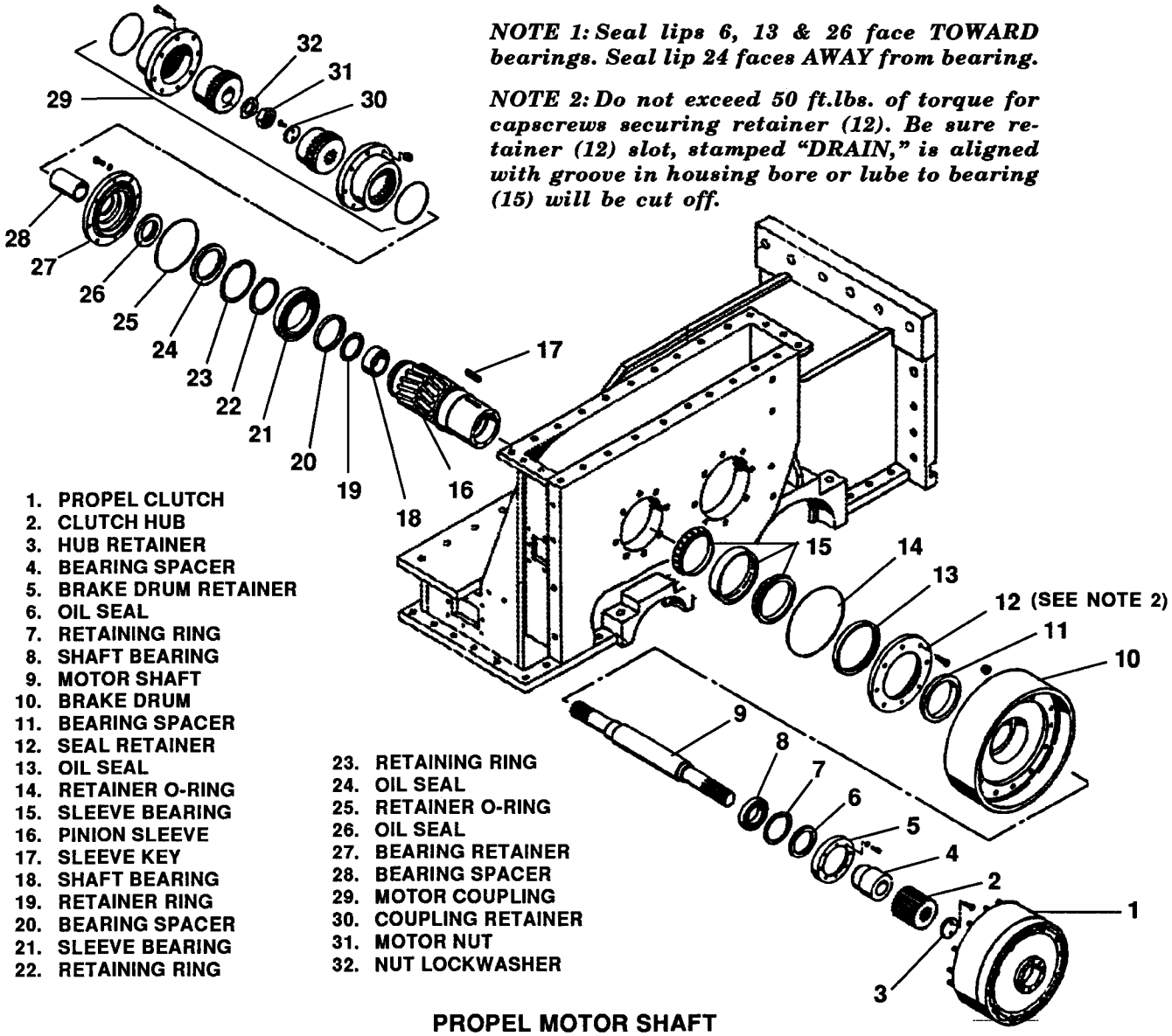
⚠ CAUTION: Press the main power off button and tag it to avoid inadvertent energizing before attempting to disconnect the propel motor leads. A voltage hazard is present and could cause electrocution resulting in death or serious injury. Do not attempt to disconnect any wires until the auxiliary power has been disconnected and the main power is OFF.



1. PROPEL MOTOR
2. BLOWER DUCT
3. CONVOLUTED DUCT
4. BLOWER DUCT
6. BLOWER DUCT
7. PROPEL MOTOR BLOWER
8. BLOWER DUCT
9. BLOWER SUPPORT
11. R.H. COUPLING
12. L.H. COUPLING
13. TACH DRIVE PULLEY
14. L.H. COUPLING GUARD
15. R.H. COUPLING GUARD
16. PROPEL TACH
17. MOTOR BASE
18. MOTOR SHIM
19. MOTOR MOUNTING BOLT
20. MOTOR CHOCK
21. CHOCK WEDGE

PROPEL MOTOR
FIGURE 1-2-16

8. Support the first intermediate shaft gear. Slide the shaft out the pinion side of the gear case. The bearing, seal, seal retainer and spacer will be removed with the shaft. Remove these items from the shaft.
9. Lift the first intermediate gear from the gear case.
10. Remove the bearing carrier and key, bearing seal, and seal retainer, from the gear case.
11. Remove the inner seal retainer, seal and gear spacer from the gearcase.
12. Remove the retainer from the coupling end of the motor shaft, and slide the coupling half off the shaft (figure 1-2-19).
13. Remove the oil seal retainer from the motor coupling side of the gearcase. Remove the coupling spacer.
14. Remove the shaft bearing inner retaining ring.
15. Remove the retainer securing the clutch hub to the propel motor shaft. Remove the clutch hub.
16. Remove the bearing spacer. Remove the brake drum retainer and bearing seal from the clutch end of the shaft. Inspect the seal and discard if it is damaged.
17. Remove the shaft ball bearing retaining ring and slide the shaft and bearing from the shaft sleeve. Remove the needle bearing from the sleeve and ball bearing from the shaft.



NOTE 1: Seal lips 6, 13 & 26 face TOWARD bearings. Seal lip 24 faces AWAY from bearing.

NOTE 2: Do not exceed 50 ft.lbs. of torque for capscrews securing retainer (12). Be sure retainer (12) slot, stamped "DRAIN," is aligned with groove in housing bore or lube to bearing (15) will be cut off.

1. PROPEL CLUTCH
2. CLUTCH HUB
3. HUB RETAINER
4. BEARING SPACER
5. BRAKE DRUM RETAINER
6. OIL SEAL
7. RETAINING RING
8. SHAFT BEARING
9. MOTOR SHAFT
10. BRAKE DRUM
11. BEARING SPACER
12. SEAL RETAINER
13. OIL SEAL
14. RETAINER O-RING
15. SLEEVE BEARING
16. PINION SLEEVE
17. SLEEVE KEY
18. SHAFT BEARING
19. RETAINER RING
20. BEARING SPACER
21. SLEEVE BEARING
22. RETAINING RING
23. RETAINING RING
24. OIL SEAL
25. RETAINER O-RING
26. OIL SEAL
27. BEARING RETAINER
28. BEARING SPACER
29. MOTOR COUPLING
30. COUPLING RETAINER
31. MOTOR NUT
32. NUT LOCKWASHER

PROPEL MOTOR SHAFT
FIGURE 1-2-19
(REV. 12/13/93)

fective rollers should not be between upper and lower rails.

2. Remove the splice plate bolts from each end of an outer frame section.
3. Remove the nuts securing the roller pins to the outer frame section, and remove the frame section (figure 1-2-24).
4. Remove the bolts from the roller pin and remove the defective roller with its pin.
5. If a lower rail segment must be replaced, remove both inner and outer frame splice joints. Remove the chocks, clamp bar, and hardware securing the rail to the rack. Install a new rail segment.
6. If an upper rail segment must be replaced, remove a frame and roller section and swing the machine until the upper rail is over the gap. Remove the rail segment and install a new segment.
7. Before replacing a new roller, see appendix for the procedure required to size the new roller to the old roller. See appendix A8 for procedure.
8. Install a new roller, roller pin or frame section as needed reversing the steps necessary for removal of the component. Be sure to lubricate the roller pins and bushings and the roller when installing them.

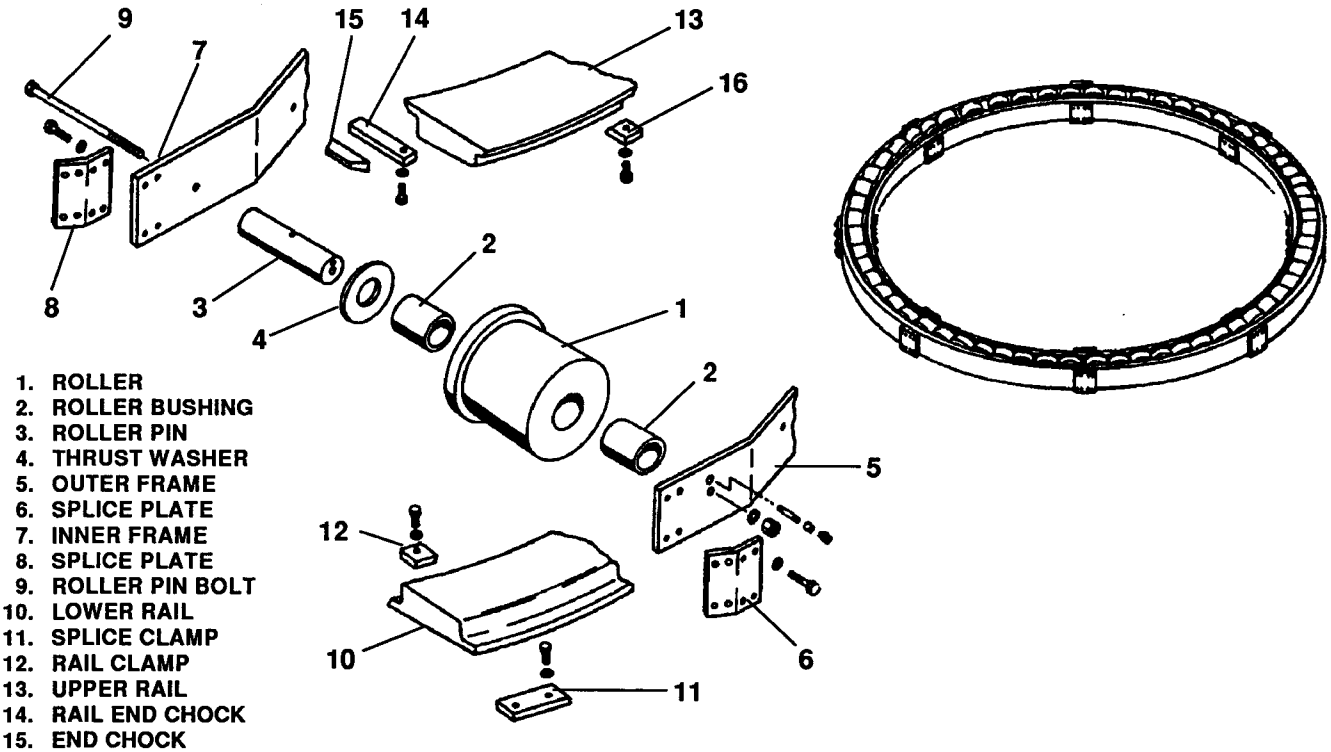
CENTER PINTLE

CAUTION: Extreme care must be exercised at all times when performing maintenance in the center pintle area due to the presence of electrical energy. High voltage can cause serious or fatal injury. Installation, operation and servicing of components should be performed only by qualified personnel. ALWAYS DISCONNECT THE ELECTRICAL POWER BEFORE TOUCHING ANY PART IN THE CENTER PINTLE.

INSPECTION

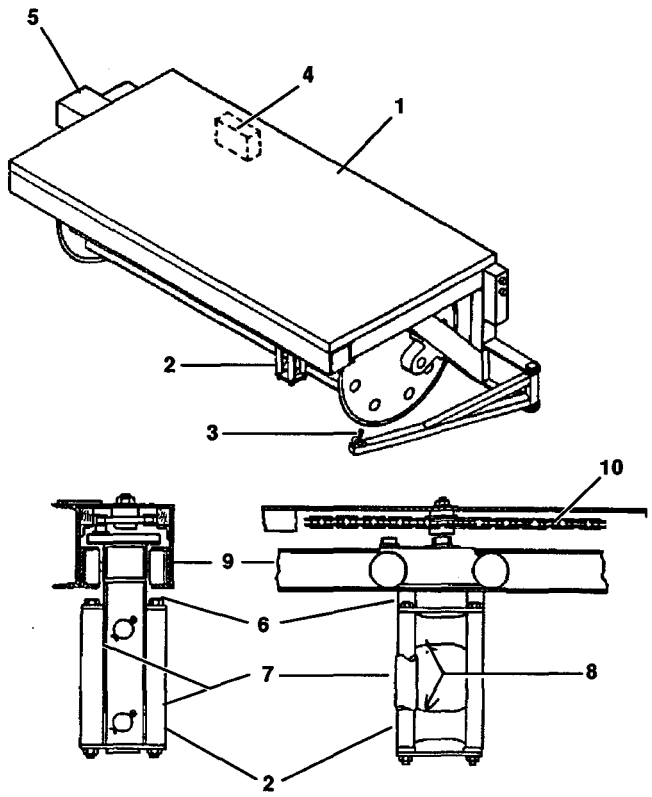
1. To inspect for worn thrust washers, rails, or rollers proceed as follows:

   Every 3 months, check the amount of lift of the revolving frame at the rear of the machine. Engage the dipper in the bank at near maximum reach and apply hoist power. Measure the distance between the upper and lower roller rails at the rear of the machine. Subtract from this measurement



1. ROLLER
2. ROLLER BUSHING
3. ROLLER PIN
4. THRUST WASHER
5. OUTER FRAME
6. SPLICE PLATE
7. INNER FRAME
8. SPLICE PLATE
9. ROLLER PIN BOLT
10. LOWER RAIL
11. SPLICE CLAMP
12. RAIL CLAMP
13. UPPER RAIL
14. RAIL END CHOCK
15. END CHOCK
16. RAIL CLAMP

ROLLER CIRCLE
FIGURE 1-2-24



LEVEL WIND ASSEMBLY

1. CABLE REEL
2. LEVEL WIND ASSEMBLY
3. CONTROL VALVE
4. HYDRAULIC RESERVOIR
5. COLLECTOR RINGS
6. TROLLEY
7. VERTICAL ROLLERS
8. HORIZONTAL ROLLERS
9. ROLLER GUIDE ANGLES
10. DRIVE CHAIN

CABLE REEL
FIGURE 1-2-28

Before winding trail cable on the reel, remove the chain between the reducer and level wind drive shaft and install the correct sprocket on the reducer. Refer to the LEVEL WIND SPROCKET TABLE for the correct sprocket.

LEVEL WIND SPROCKET TABLE
(1.53:1 spiral bevel gear reducer)

REDUCER SPROCKET	LEVEL WIND SPROCKET	TROLLEY TRAVEL Inch (mm)
80B9	80B34	2.00 (51)
80B9	80B33	2.06 (52)
80B9	80B32	2.13 (54)
80B10	80B34	2.22 (56)
80B10	80B33	2.29 (58)
80B10	80B32	2.36 (60)
80B11	80B34	2.44 (62)
80B11	80B33	2.52 (64)
80B11	80B32	2.60 (66)
80B12	80B34	2.67 (68)
80B12	80B33	2.75 (70)
80B12	80B32	2.83 (72)
80B13	80B34	2.89 (73)
80B13	80B33	2.98 (76)
80B13	80B32	3.07 (78)
80B14	80B34	3.11 (79)
80B14	80B33	3.21 (81)

When determining the correct sprocket, allow approximately 1/8" clearance between wraps for cable variables.

Start winding trail cable on reel drum opposite the collector ring end of the reel. After several wraps have been installed, position the trolley on the centerline of the cable and install the chain on the right-angle reducer.

Continue winding cable on reel slowly while checking trolley travel. If not correct, adjust trolley position and/or sprocket ratio.

HYDRAULIC ADJUSTMENTS

When properly adjusted, the cable reel will pick up cable when the shovel moves toward its power source. The reel will stall when the shovel is stationary and the reel drive will be over powered when the shovel moves away from the power source, allowing the cable to be unwound from the reel.

WARNING: The cable reel should not be used to pull the cable onto the reel but only wind the cable onto the reel as the shovel moves toward the cable. Attempting to pull 50 feet or more cable, layed in a straight line onto the reel without moving the shovel toward the cable, will damage or possibly break the cable.

Line pull is proportional to operating pressure. The correct line pull is when there is sufficient pull on the cable to wind it on the reel but not too great to put unnecessary strain on the cable.

Line speed is dependent on the volume of hydraulic oil flowing through the system. The correct line speed is slightly faster than the travel speed of the shovel.

Adjust the line pull and line speed as follows (figure 1-2-29).

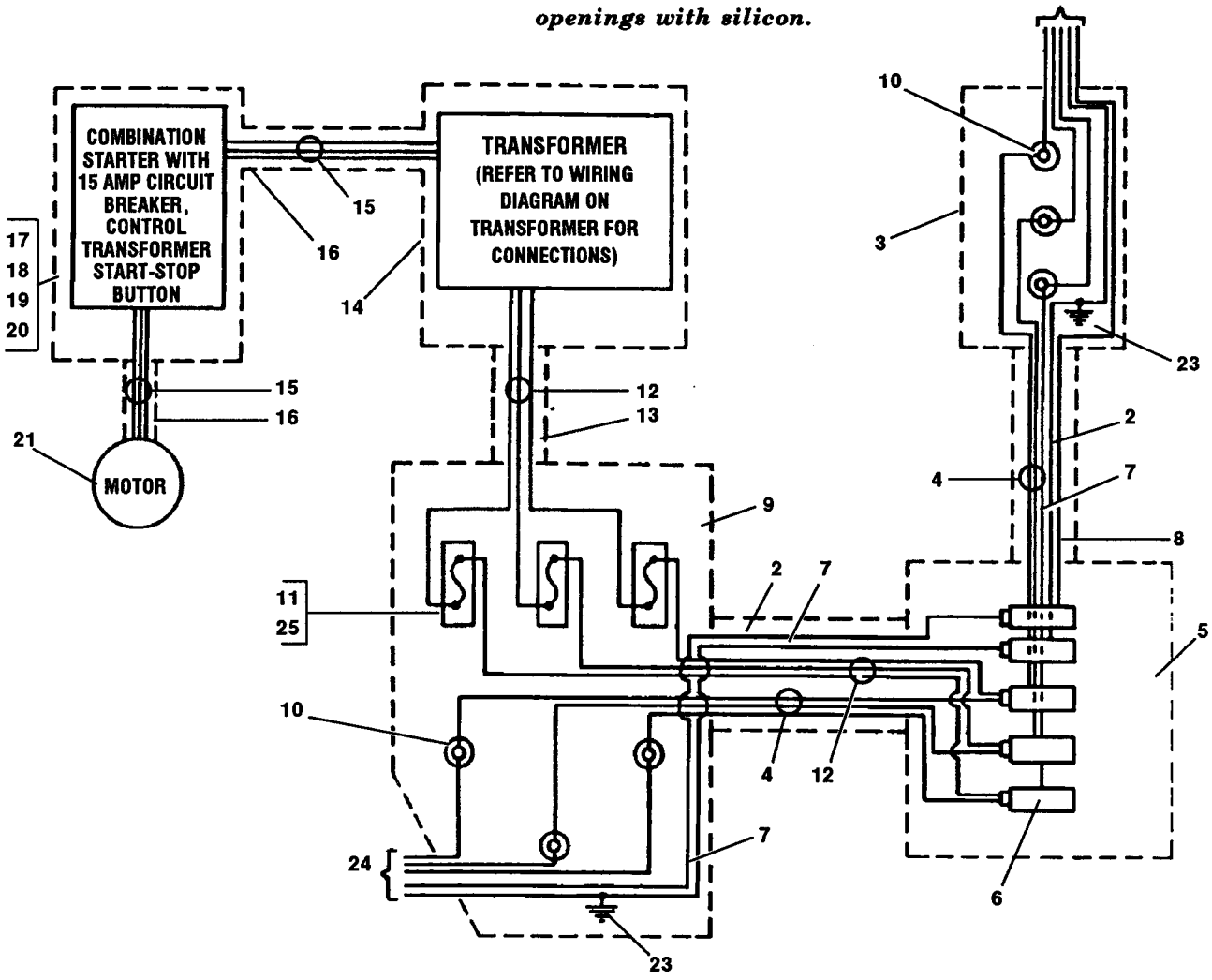
1. Verify that the hydraulic reservoir is full with the correct hydraulic fluid.
2. Place the manual control valve in the neutral (center) position.
3. Open the flow valve fully.

NOTE: This valve is used for setting operating pressure and system diagnostics only. All system flow adjustments are made on the hydraulic pump.

4. Adjust pump for maximum flow. The hydraulic pump is normally run at maximum

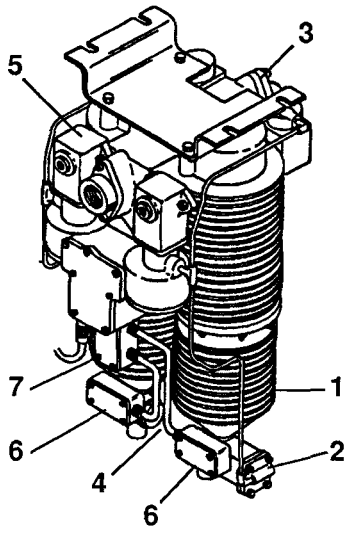
CAUTION: Cable reel electrical maintenance and repair should be maintained by qualified electricians only.

NOTE: Seal all cable openings with silicon.



1. TRAIL CABLE
2. #8 THW 600V WIRE
3. JUNCTION BOX
4. #2/0 8KV WIRE
5. COLLECTOR COVER
6. COLLECTOR RING ASSY.
7. #4 GROUND WIRE
8. REEL SHAFT
9. JUNCTION BOX
10. INSULATOR 8KV
11. FUSED DISCONNECTS
12. #14 8KV WIRE
13. 3/4 FLEXIBLE CONDUIT
14. TRANSFORMER
15. #12 600V WIRE
16. 3/4 FLEXIBLE CONCUIT
17. MOTOR STARTER
18. CIRCUIT BREAKER
19. START/STOP BUTTON
20. CONTROL TRANSFORMER
21. PUMP MOTOR
23. GROUND LUG
24. CONNECTING CABLE
25. FUSE LINKS 2 AMP TYPE K OR N

CABLE REEL ELECTRICAL SCHEMATIC
FIGURE 1-2-34



1. TWIN TOWER BODY & CANISTERS
2. PURGE VALVE
3. INLET CHECK VALVE W/PRE-COALESCER
4. DRAIN VALVE
5. OUTLET CHECK VALVE W/SOLENOIDS, TIMER AND CIRCUIT BOARD
6. HEATER/THERMOSTAT ASSEMBLY
7. JUNCTION BOX

AIR DRYER
FIGURE 2-1-5

Monthly Inspection

NOTE: This inspection requires the compressor to be operating and the air pressure equal to a minimum of 105 PSI.

Inspect the humidity indicators. A blue color represents proper operation, while white indicates unsatisfactory operation and requies further inspection. (See Repair and Maintenance of air dryer in Chapter 2 Section 2.)

Yearly Inspection
Repeat the monthly inspection plus the following:

1. Remove and inspect the coalescer element.
2. Inspect regenerating orifice/operation.

Two-year Inspection
Repeat the monthly inspection plus the following:

1. Inspect desiccant. If contaminated with oil and water replace with precharged canister.
2. Remove and inspect coalescer element. Replace if necessary.

Three-Year Inspection
Every three years the air dryer should be completely overhauled.

AIR/LUBE SWIVEL ASSEMBLY

The air/lube swivel assembly is the vehicle by which the compressed air and lubrication is supplied from the rotating deck to the lower works. The swivel assembly is located in the center pintle. The swivel is serviced from the propel collector ring housing.

⚠ CAUTION: Lock out and tag the AC and DC power to the collector rings before attempting to work on the swivel, to prevent injury or death.

After every one hundred sixty hours of operation, check for leaks or air in the auto-lube lines. You can make the check by removing the inspection plug (L3) figure 2-2-7 on the housing of the swivel. Presence of air or grease in the port indicates a leak between passages in the swivel. If leak exists, the O-rings and packing in the housing must be replaced.

PRESSURE SWITCHES

There are four pressure switches located in the air system. These switches should be checked regularly to see that they are operating correctly. If they do not function properly, readjust them or have them replaced by an electrician (figures 2-1-1 to 2-1-3.)

The pressure switch and their correct settings are as follows:

1. AIR COMPRESSOR LOAD-UNLOAD SWITCH. The switch should close and the compressor load when the air pressure in the air tank drops to 130 psi or below. The switch should open and unload the air compressor when the air tank reaches 150 psi. The compressor runs continuously.

2. MAIN AIR LINE PRESSURE SWITCH. This switch will open and shut down the machine if the line pressure drops below 90 psi. When air pressure reaches 100 psi, the switch will close and the controls of the machine can be operated.

3. PROPEL PRESSURE SWITCHES. These switches are set to open if the air pressure in the line to the propel brakes and clutches drops below 80 psi. At or above 95 psi the switches are closed and the propel controls operable.

SOLENOID VALVES

The brakes, clutches and air horn or the air system of the model 495-B shovel are controlled by electro-mechanical solenoid valves. The solenoid valves for the swing, and crowd brakes, the propel clutches and brakes, and house and control room fan vane control are located on a panel at the front right side of the machine (figure 2-1-2.) The hoist brake solenoid is located at the hoist brake.

The solenoid valves should be checked daily for correct operation and for air leaks.

System B supplies open gear lube to swing pinions, roller circle rollers and center pintle thrust washers of the lower works. On the upper works the system lubricates the hoist and crowd drum gears. On the front end equipment system B supplies open gear lubricant to the saddle block liners.

System C supplies grease lube to the bearings of the propel machinery in the lower works, the dipper trip bearings and gears of the front end equipment, and swing intermediate shaft upper bearings, hoist drum and intermediate shaft bearings, and crowd drum and second intermediate shaft bearings.

The lube room pumps are 50:1 ratio pumps. There are two 85 gallon reservoirs. One reservoir is for open gear lube which has two pumps, one each for systems A and B. The other reservoir is for grease lube and has one pump. There is a control panel on the wall at the end of the reservoirs. This panel is equipped with indicator light to tell when system power is on and when a system fault occurs. There is an on/off switch and manual lube push bottom for each system on the panel. Also, there is a signal horn which will sound when a system fault occurs.

The timer controls for the lube are part of the Programmable Control cabinet in the Electric Control Room.

Refer to Electrical Maintenance for operation and adjustment of lube systems.

AIR PUMP SERVICE

Inspect the air pump and its lower pumping unit (figure 3-2-2.) Look for foreign material that has lodged between the upper and lower ball check, or between the check and the check seat. Remove and inspect parts and clean them thoroughly. Replace worn or damaged parts.

LINES AND CONTROL SERVICE

Make sure all flexible and rigid lines are free from kinks and cracks. Bend tubing carefully to avoid flattering which restricts lubricant flow. Maintain tight joints to avoid leakage and see that the tubing extends through the ferrule at least one-eighth inch. Be sure all couplings, sockets, plugs, tees and nipples are free from defects which can impair the effectiveness of the lubrication systems. With equipment deenergized, examine all relays, limit switches, timing units, shut-off valves and disconnect switches to determine if they are functioning properly. Replacement units can be ordered from the vendor of the original control device. Verify all electrical connections in the control assembly and check the insulation of all electrical wiring.

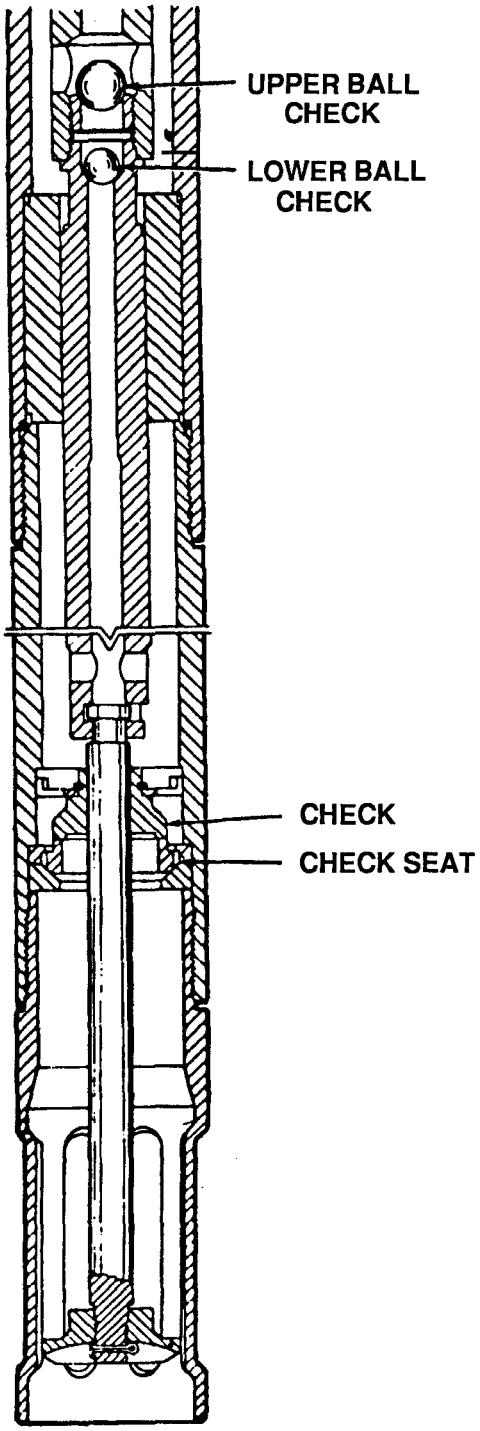


FIGURE 3-2-2

CHAPTER 4
TROUBLESHOOTING
SECTION 1 - LOWER WORKS

PROBLEM	CAUSE	CORRECTIVE ACTION
CRAWLER		
Crawler link pin retainer failure.	1. Link pins R.H. to L.H. of unequal diameters	1. Do not use link pins of different diameters as this causes one to thrust outward.
	2. Link pins being forced outward and shearing pin retainers. a. Tapered link pin holes	2. Remachine link pin holes. Remove tapered portion in loaded direction only. Replace link pins if tapered.
	3. Loss of retainer pin.	3. Replace worn and defective pin retainers on regularly scheduled maintenance shifts. a. Daily inspection while moving shovel is recommended to avoid unnecessary downtime.
Crawler link pin failure.	1. Excessively worn link pins.	1. Replace both pins to avoid uneven loading. a. Replace broken pin with one of same diameter as pin remaining in link.
	2. Tapered crawler link pin holes.	2. Remachine crawler link pin holes. Remove tapered portion in loaded direction only.
	3. Propelling when crawlers are jammed with loose material.	3. Remove loose material from crawlers before propelling thus avoiding expensive downtime.
	4. Improper propel motor electrical stall and/or motor field voltage adjustments causing excessive torque.	4. Reset electrical adjustments to conform to CEE143 standard sheet.
	5. Operating shovel on excessively rough pit floor.	5. Fill in the low spots and make sure crawlers are not bridging any holes.
	6. Link pins are too hard or too soft.	6. Replace only with BUCYRUS-ERIE® manufactured parts to assure pins of correct hardness.

PROBLEM	CAUSE	CORRECTIVE ACTION
Crawler frame to truck frame weld failure.	1. Truck frame does not completely set into bottom of crawler frame hook path in the front and/or rear.	1. The truck frame alignment hook must bottom in hook path in order to have top weld between crawler frame and truck frame hold. Cut out old weld, seat truck frame alignment hook into hook path and reweld as per drawing. ***NOTE: Do not install shims in hook path area. Contact Bucyrus-Erie Service Department.***
Swing rack breaks loose from truck frame.	1. Weld and body fit bolts holding swing rack to truck frame failed.	1. Relocate swing rack on truck in direct relation to the center of rotation. a. Check that there are no contaminants between the mating surfaces of the swing rack and truck frame. b. After relocating to the center of rotation, redrill body fit bolts and install. c. Reweld swing rack to truck frame per welding drawing. Do not weld to the top edges of man holes in top plate of truck frame.
Transverse shaft coupling damaged	1. Dry coupling.	1. Lubricate each coupling through both fittings on each until fresh grease shows around edges.

PROBLEM	CAUSE	CORRECTIVE ACTION
PROPEL CLUTCH		
Slipping clutch.	1. Sluggish operation, insufficient air pressure or air leak.	1. Clutches need 66 PSI minimum air pressure to operate properly. Check air pressure at clutch. Check quick release valves and propel brake cylinder. Check for clogged or restricted air lines. a. Check for grease in air lines. If grease is present, center of rotation air spindle is passing grease from automatic grease system into air system. Correct cause of contamination. Clean affected portions of air system by flushing. b. Correct air leaks. Check air pressure switches for operation. Check clutch for internal air leaks and correct. c. Dismantle and clean clutch and air system periodically, especially if Tanner gas is used for a de-icer. d. Check pressure regulator.
	2. Mechanical restriction of air cylinder.	2. Dismantle and clean the air cylinder. Check inline air swivels and lubricate parts upon reassembly.
	3. Worn discs.	3. Replace as required. a. Discs may distort due to overheating. Replace all distorted discs immediately.
	4. Restrictions on clutch hub or stud rods.	4. Periodic cleaning will prevent this problem. Clean once each year or as required.
	5. Distorted discs or pressure plates	5. Replace immediately to prevent permanent damage to other components.
Cracked or broken housing.	1. Failure the result of freezing due to lack of de-icer.	1. Improve de-icing procedures and equipment.
PROPEL BRAKE		
Not centered properly to clear housing when released.	1. Brake shoe pins not set properly to center brake shoe on drum.	1. Readjust brake shoe pins to center upper and lower shoes when brake is released.

PROBLEM	CAUSE	CORRECTIVE ACTION
Saddle block lubrication system hose failure.	1. The hose between the boom structure and the saddle block is either too long or too short. The hose can then be cut by the dipper stick in either the low or high point of the digging arc.	1. Be sure the correct length of hose is used.
	2. The wrong fittings on the saddle block or boom hoist line.	2. Be sure correct fitting is used. Do not substitute fittings.
	3. The crowd or retract ropes are cutting the hose.	3. Relocate hoses that lead from boom to saddle block over to central area of saddle block. This will position hoses away from under crowd or retract ropes.
DIPPER - PIN CONNECTED		
False tripping	1. Worn latch keeper insert.	1. Replace with a rebuilt latch keeper insert.
	2. Worn latch bar.	2. Rebuild latch bar. After welding, either grind the bottom of the latch bar or peen it to provide a smooth surface. A rough surface will prevent proper dipper door action.
	3. Improper latch bar adjustment.	3. Latch bar should be adjusted so it enters latch keeper pocket between 3/4 to 1 inch. If it enters more than 1 inch, latch will not trip properly. If it is less than 3/4 inch, false tripping will occur.
	4. Trip motor electrical.	4. Adjust trip motor electrical per instructions furnished with your machine. Check first for mechanical problems.
	5. Trip mechanism has trip rope fouled.	5. There is a remote possibility of the trip rope jumping off of the drum and getting into the gear or falling into the sheaves. If this should occur, the entire trip rope should be replaced.
	6. Trip gear lubrication.	6. Use standard bearing grease normally used in lubrication system on open trip gears. The use of open gear lubricant in not recommended due to rapid viscosity changes in cold weather.

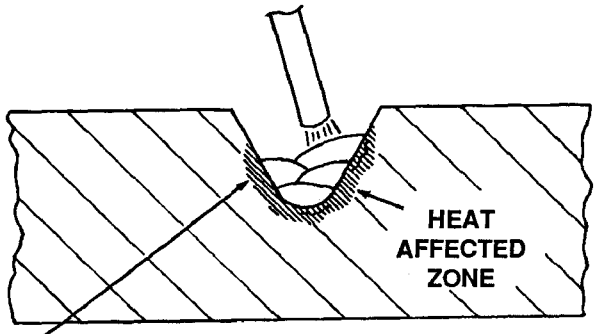
CHAPTER 4
TROUBLESHOOTING
SECTION 4 - AIR SYSTEM

PROBLEM	CAUSE	CORRECTIVE ACTION
QUINCY QSB 20 SCREW COMPRESSOR		
Failure to start.	1. Power not turned "ON."	1. Turn the power "ON" by closing the main disconnect switch or circuit breaker.
	2. Blown control circuit fuse.	2. Replace fuse. Find and correct cause.
	3. Safety circuit shutdown resulting from high discharge air temperature.	3. Correct the situation in accordance with the instructions in the "High Discharge Air Temperature and/or High Oil Injection Temperature" section of this troubleshooting guide. Restart the compressor.
	4. Thermal overload relays tripping.	4. Correct the cause of the overloaded condition and press the start button.
	5. Low voltage.	5. Ask the power company to make a voltage check at your entrance meter, then compare that reading to a reading taken at the motor terminals. Use these two readings as a basis for locating the source of low voltage.
	6. Faulty start switch.	6. Check the switch for malfunction or loose connections.
	7. Power failure.	7. Check power supply.
	8. Faulty control relay.	8. Replace relay.
	9. Loose wire connections.	9. Check all wiring terminals for contact and tightness.
	10. Faulty high air temperature switch.	10. Check HAT switch. Replace defective switch.
	11. Faulty transformer.	11. Check secondary voltage on transformer.

PROBLEM	CAUSE	CORRECTIVE ACTION
	9. Contaminated oil supply.	9. Check bulk storage for possible causes of contamination such as mixing oils, or rain, sleet, humidity, dust, sand, etc.
Oil coming out through the air cleaner at shutdown.	1. Inlet valve not closing completely.	1. Correct the situation in accordance with the instructions in "Inlet Valve Not Opening Or Closing In Relation To Air Demand" section of this troubleshooting guide. a. Inspect check valve. If necessary replace it.
Oil coming out through the flowdown valve.	1. Too high oil level in the receiver.	1. Bring oil level to recommended oil level by draining the receiver. Use the oil level gauge as a guide.
	2. Cycling too often between load and unload.	2. Correct the situation in accordance with the instructions in "To Rapid Cycling Between Load And Unload" section of this troubleshooting guide.
	3. Air/oil reservoir blows down too fast.	3. Check for proper blowdown valve size.
	4. Inlet valve not closing completely.	4. Correct the situation in accordance with the instructions in "Inlet Valve not Opening or Closing in Relation to Air Demand" section in this troubleshooting guide.
Frequent oil filter clogging	1. Faulty indicator.	1. Replace indicator assembly.
	2. Incorrect oil filter	2. Use original OEM replacement filters.
	3. Faulty, incorrect or inadequate air filter.	3. Replace air filter element. Use genuine OEM replacement elements.
	4. Oil breakdown.	4. See oil breakdown section of this troubleshooting guide.
	5. System contamination.	5. Check and clean system of all dirt, corrosion and varnish.
Frequent air cleaner clogging	1. Compressor operating in highly contaminated atmosphere.	1. Use remote air intake mounting.
	2. Air cleaner not adequate for conditions.	2. Use heavy duty air cleaner.

PROBLEM	CAUSE	CORRECTIVE ACTION
Inlet valve not operating or closing in relation to air demand.	1. Improper setting of air pressure switch or faulty switch.	1. Readjust air pressure switch to proper setting. If switch is faulty, replace it.
	2. Excessive moisture in the control air line at the air cylinder.	2. Service control air line filter daily.
	3. Improper functioning of air inlet valve piston.	3. Check piston and cylinder bore. Repair or replace as needed.
	4. Jammed air inlet valve assembly.	4. Check air inlet valve bushing or shaft. Check piston and cylinder bore. Repair or replace as necessary.
	5. Broken spring in air inlet valve.	5. Replace spring.
	6. Faulty solenoid valve.	6. Repair or replace as necessary.
	7. Faulty shuttle valve.	7. Repair or replace as necessary.
	8. Loose wiring connections at solenoid valve/pressure switch.	8. Check and tighten wiring terminals.
Compressor does not unload when there is no air demand	1. Air pressure switch not set correctly.	1. Readjust air pressure switch to proper setting.
	2. Faulty solenoid valve.	2. Repair of replace as necessary.
	3. Faulty air pressure switch.	3. Replace air pressure switch.
	4. Leaks in service lines.	4. Check plant air distribution system for leaks.
	5. Faulty blowdown valve.	5. Repair or replace as necessary.
	6. Leaks in control lines.	6. Check all control line fittings and tubing.
	7. Loose or broken wires.	7. Check all wire terminals for tightness. Replace any broken or pinched wires.
Compressor does not revert to load when service line pressure drops to low limit of modulation range.	1. Faulty pressure switch	1. Repair or replace as necessary.
	2. Loose wiring connection.	2. Check and tighten wiring terminals.

Therefore, they are not detectable at the time of welding. These cracks can propagate in service and lead to ultimate failure of the part. It is necessary to adhere strictly to recognized good welding practice regarding the handling, storage and use of low hydrogen electrodes. To avoid underbead cracks, remove all oil or grease or other contaminates from the surface and be sure the steel is dry. Preheat to the required temperature. Use only dry electrodes taken from the electrode oven. After exposure to the atmosphere, the electrodes must be returned to the oven. Time limit outside the oven[1] is four hours for E7018, two hours for E8018-C1 and 1/2 hour for E11018-M electrodes for normal conditions.



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

FIGURE A3-3

The selection of electrodes for repair welding steels employed in mining shovels is given in Table 3. All electrodes listed (except E308-16 stainless steel) are shielded metal arc low hydrogen classifications of the American Welding Society.

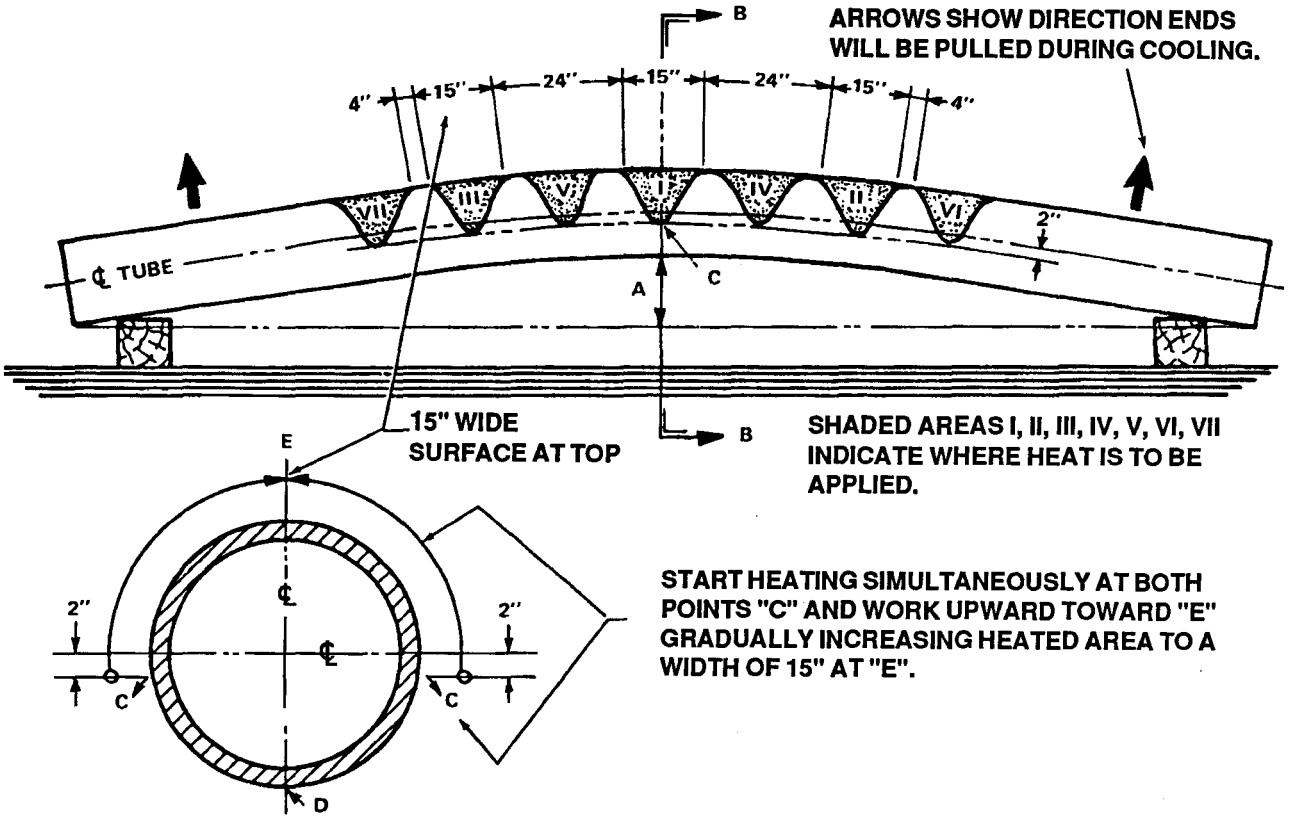
On occasion it may be desired to apply other types of electrodes, as for example, to hard face the dipper to improve wear resistance. Because of the variation in digging conditions from one machine to another, Bucyrus-Erie makes no specific recommendations concerning hard facing. In general hard facing can be satisfactorily applied using austenitic manganese or work hardening stainless steel electrodes. Welding should not be done on the dipper with non-low hydrogen electrodes other than the austenitic types which are not hydrogen sensitive.

As noted in Table 3, E8018-C1 electrodes are ordinarily used for repair of SD 3526 cast steel. E11018-M electrodes can also be used as a matter of convenience during repair of the dipper when welding is being done on the SD 3150 plate material requiring the use of E11018-M.

[1] The oven must be one that is designed for welding electrode drying and storage. Make shift arrangements, such as a light bulb in an old ice box, are inadequate for the purpose.

TABLE 2
MATERIAL IDENTIFICATION

SD NO.	SPECIFICATION	DESCRIPTION
3023	AISI C-1020	PLAIN CARBON BILLET STEEL
3116	ASTM A36	STRUCTURAL STEEL
3123	ASM A203	NICKEL ALLOY STEEL
3149	NONE	ABRASION RESISTANT ALLOY STEEL
3150	ASTM A514	QUENCHED & TEMPERED ALLOY STRUCTURAL STEEL
3155	ASTM A572	LOW ALLOY STRUCTURAL STEEL
3156	ASTM A633	LOW TEMPERATURE STRUCTURAL STEEL
3323	AISI A-8620	ALLOW BILLET STEEL
3510	NONE	MEDIUM CARBON CAST STEEL
3515	NONE	SPECIAL LOW ALLOY CAST STEEL
3520/3523	NONE	CR-MO ALLOY CAST STEEL
3526/3528	NONE	NI-CR-MO ALLOY CAST STEEL
3716	ASTM A618	SEAMLESS STRUCTURAL STEEL



STRAIGHTENING DIAGRAM
FIGURE A3-6

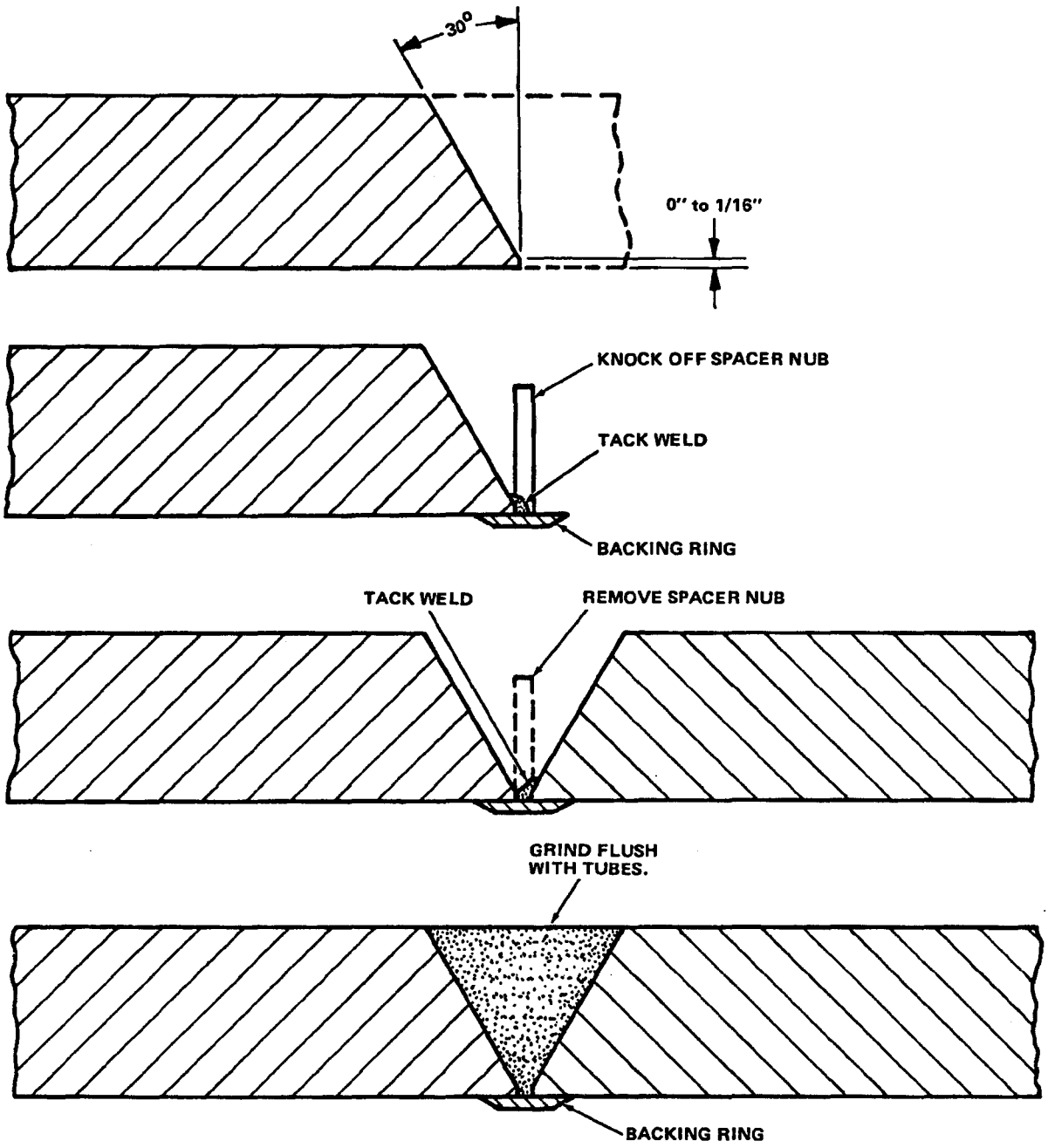
Regulator pressure and flow rates are as follows:

	Pressure Lbs./Sq. In.	Flow Rate Cu. Ft./Hr.
Oxygen	100	1200
Propane	28	300

Support the bent tube securely with the convex side on top. The number of vee heats required depends upon the amount of curvature. Should the bend be such that dimension "A" is about 2 inches, it is possible to straighten the tube by making only 3 heats, i.e., I, II and III. It is recommended that the 3 heats be allowed to cool for about 12 hours and the tube checked for straightness before making additional heats IV and V. If dimension "A" is about 3 inches, additional heats VI and VII may be required. These heats should be made after heats IV and V have cooled for about 12 hours.

Heat the surface in a diamond shape as shown in Figure A3-6. Start simultaneously with the two torches, one on each side 2 inches below the center line at "C" and gradually progress toward the top to a width of 15 inches. The manner in which the heat is applied is shown in Figure A3-7. Spot heat is applied at "C" until a temperature of 1200°F (measured by temperature indicating crayon) is reached. Movement of the torch in the pattern shown must be controlled at the correct rate of travel to maintain the 1200°F temperature at the torch location. Do not back track or go over previously heated area. The two torches on opposite sides of the tube must be controlled to provide balanced heating. Application of each vee heat should take about 20 minutes.

After completing each series of vee heats, (I, II, III) (IV, V), etc., the tube should be permitted to cool about 12 hours and checked for straightness. Continue the heating sequence or repeat as required. There may be some small depressions between heated areas. These can be blended by locally grinding the high spots. Also at "D" there may be a slight flat spot which is inherent in the flame straightening process and must be accepted.



BACKING RING JOINT WELD
FIGURE A3-15

HANDLE END CASTING REPLACEMENT

Replacement of the handle end casting requires cutting off the old casting and preparing the end of the tube to receive the new casting.

Consult Bucyrus-Erie to determine the proper location of the cut for removal of the casting. Prior to cutting is may be necessary to remove parts attached to the handle in the vacinity of the casting to tube weld joint. When this is done not the exact location of these parts and the size and location of attachment welds. If arc-air gouging is used to remove attachment welds use care to avoid cutting into the handle tube.

After cutting the casting from the handle prepare the end of the tube for re-welding according to instructions given for welding tube without backing ring. Dimension "D" of the finished tube end should equal the measured inside diameter of the replacement handle end casting.

SWING RACK TO TRUCK FRAME WELDING

1. Clean the two halves of the swing rack to remove all dirt, grease, oil, paint, etc., from the split line and bottom surfaces and from the weld grooves and faces to be welded. Similarly, clean the top surface of the truck frame in the area of the swing rack location (Figure A3-24.)

2. Assemble the two halves of the swing rack and bolt together. Locate the swing rack on the track frame and bolt down. Torque all bolts, first at the split line between the two halves, then between the swing rack and the truck frame.

3. The sequence of welding should be as shown in the referenced detail sketches. To help control possible distortion, it is recommended that the welding is done by at least two welders working simultaneously diametrically opposite from each other.

4. Preheating is required for welding the two halves of the swing rack together because of the harden-ability of the alloy cast steel used. The swing rack can be welded to the truck frame without preheat since the surfaces to be welded on the swing rack have been prepared with a butter weld layer in the factory to facilitate field welding. At temperatures below freezing, the application of preheat sufficient to remove the chill from the areas to be welded is recommended.

5. Refer to Figures I and II for the sequence of welding the two halves together. The two no. 1 weld locations should be welded simultaneously and these welds completed before starting the no. 2 welds. The same applied to the no. 2 and 3 welds.

6. A butter welding technique is recommended for the no. 1, 2 and 3 welds. The sequence of depositing weld beads in the butter welding technique is shown in section A. The entire length of the no. 1 welds should be butter welded, then the grooves filled as shown in section B. Repeat this sequence for the no. 2 welds, then the no. 3 welds.

7. The no. 4 welds should be as shown in Figure II, without butter welding (because the groove is too tight) but with the higher preheat temperature specified.

8. Refer to Figure III for the sequence of welding the swing rack to the truck frame. Diametrically opposite weld locations of the same sequence number should be welded simultaneously.

9. The sequence of depositing weld beads for the no. 5, 6, and 7 weld locations is shown in section D. The first weld bead is a starter bead, placed at the toe of the fillet so that subsequent weld beads will temper the heat affected zone of the starter bead.

10. The sequence of depositing weld beads for the no. 8 and 9 weld location as shown in section E. Again, the first weld bead is a starter bead, to be subsequently tempered by the following beads.

11. Retorque all bolts when swing rack is cold.

The foregoing welding procedure including shop applied butter weld layers, preheat for welding where specified, field butter welding technique and starter beads is designed to produce a sound, crack-free welded construction. In addition to carefully following the prescribed procedure, it is highly recommended that the low hydrogen electrodes specified are used directly from an electrode drying oven maintained at a temperature of 250°-350°F. Electrodes should be placed in the oven immediately after removal from hermetically sealed containers, and should be returned to the oven after 2 hours exposure to the atmosphere outside of the oven.

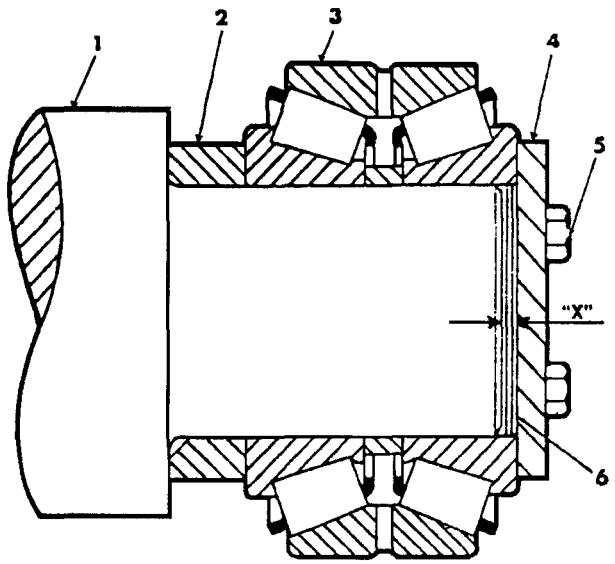
Shielded metal arc E8018-C1 electrodes are recommended. As an alternate for welding the swing rack to the truck frame, an E70TG flux cored arc electrode can be used. Lincoln Electric Company innershield NR-203M is suitable for welding between the truck frame and the butter welded casting. Do not apply directly to the cast steel.

APPENDIX A9 - SHIMMING INSTRUCTIONS

CAUTION: Use suitable protective equipment when handling the heated items.

Assembly the bearing as follow (Figure A9-1):

1. Dress end of shaft to remove all burrs.
2. Preheat the bearing and spacer in an oil bath.
2. Assemble preheated bearing components on shaft snug against locating shoulder and preload bearing components until the entire assembly has cooled.
4. Remove end plate and measure gap "X."
5. Assemble shim pack with total thickness equal to gap "X." "X" = -.002 to -.005".
6. Insert shim pack into gap "X." Install retainer with Grade 5 capscrews. Tighten capscrews to snug tight torque value (Figure A9-1) in a 180° apart sequence.
7. Continue to tighten capscrew in 180° apart sequence in steps of 1/3 the proof load torque value (bring all capscrews to same torque value before increasing toque level.)
8. Tighten all capscrews to torque value that gives 75% of proof loading on capscrews (Figure A9-1.)
9. If lockwire required be sure to install it.

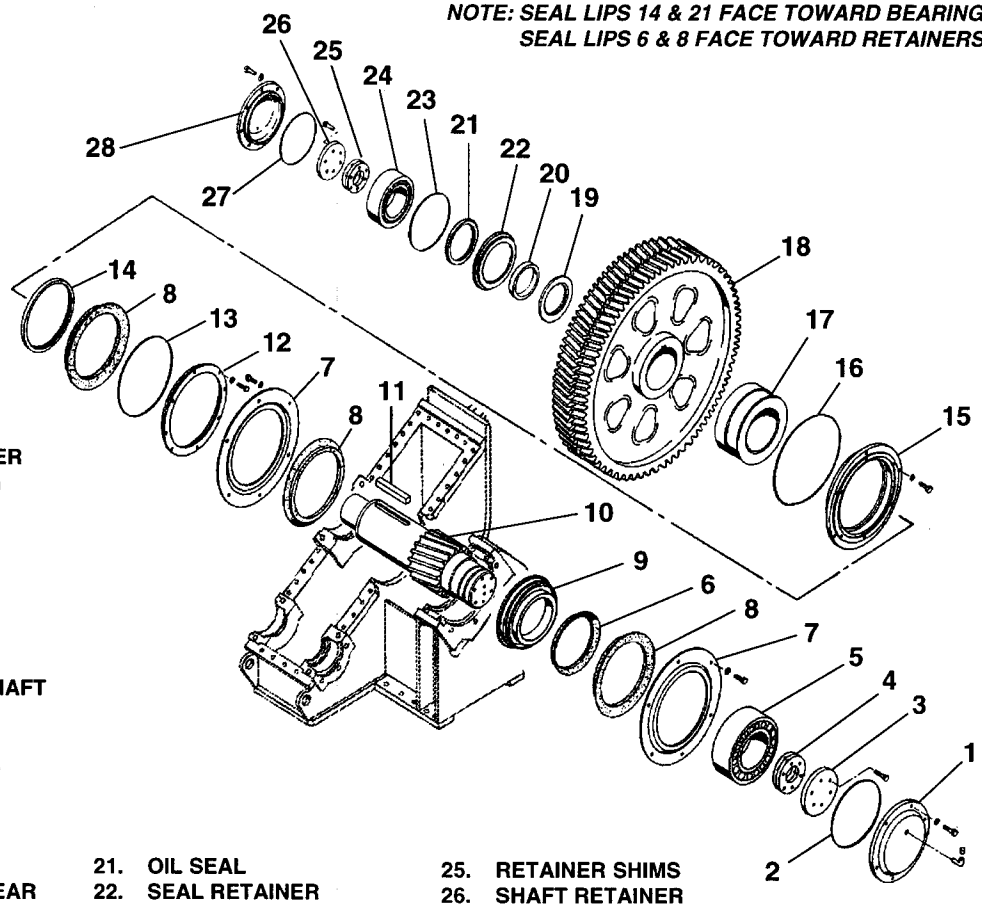


1. SHAFT
2. SPACER
3. BEARING
4. RETAINER
5. CAPSCREW
6. SHIM PACK

GRADE 5 CAPSCREW SIZE	SNUG TIGHT TORQUE	75% OF PROOF LOAD OF TORQUE*
1/2'	15. FT. LBS.	55 FT. LBS.
5/8"	30 FT. LBS.	110 FT. LBS.
3/4"	53 FT. LBS.	200 FT. LBS.
7/8"	86 FT. LBS.	320 FT. LBS.
1"	128 FT. LBS.	480 FT. LBS.
1-1/8"	160 FT. LBS.	600 FT. LBS.
1-1/4"	224 FT. LBS.	840 FT. LBS.
1-3/8"	293 FT. LBS.	1100 FT. LBS.
1-1/2"	390 FT. LBS.	1460 FT. LBS.

* With lubricated threads

RETAINER SHIMMING
FIGURE A9-1



1. BEARING RETAINER
2. RETAINER O-RING
3. SHAFT RETAINER
4. RETAINER SHIMS
5. SHAFT BEARING
6. V-RING SEAL
7. SEAL RETAINER
8. V-RING SEAL
9. SEAL CARRIER
10. INTERMEDIATE SHAFT
11. SHAFT KEY
12. SEAL RETAINER
13. RETAINER O-RING
14. OIL SEAL
15. SEAL RETAINER
16. RETAINER O-RING
17. GEAR SPACER
18. INTERMEDIATE GEAR
19. GEAR SPACER
20. BEARING SPACER
21. OIL SEAL
22. SEAL RETAINER
23. RETAINER O-RING
24. SHAFT BEARING
25. RETAINER SHIMS
26. SHAFT RETAINER
27. RETAINER O-RING
28. BEARING RETAINER

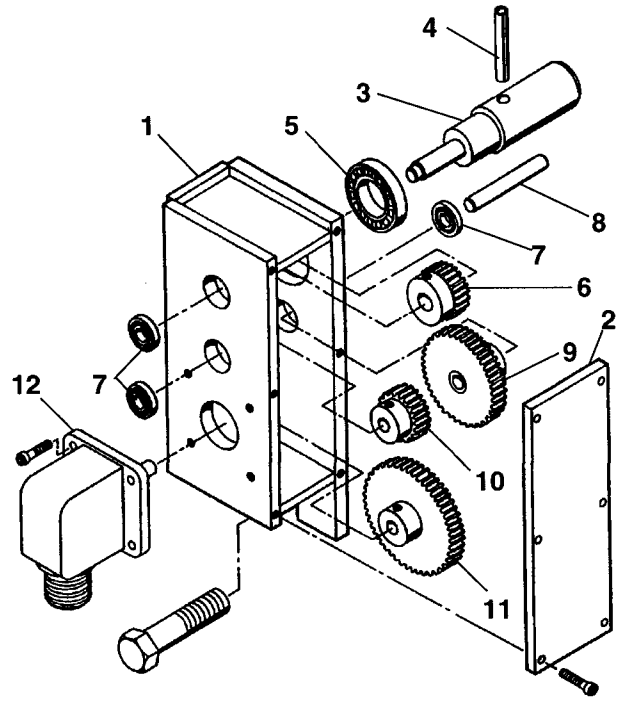
HOIST INTERMEDIATE SHAFT
FIGURE 1-3-3

Repair

Normal repair of the hoist gear train will only involve replacement parts. To disassemble the gear train:

NOTE: Removal of the appropriate roof panel is necessary to allow entry of a crane block and sling.

1. Shut off power and tag controls. Disconnect any lubrication lines attached to the gearcase covers.
2. Remove coupling guard.
3. Unbolt the coupling halves and separate the coupling (figure 1-3-2).
4. Remove the bolts securing the motor shaft retainer cap and retainer. Slide the retainer on the motor side toward the coupling. Remove the retainer cap on the opposite end of the shaft.
5. Remove the bolts securing the intermediate shaft cap, and remove the cap. Remove capscrews from retainer on right-hand side of first reduction gear (figure 1-3-3).
6. Attach a crane sling to the gearcase cover. Remove bolts securing the cover to the gearcase (figure 1-3-1) and lift the cover from gearcase.
7. Remove intermediate shaft right-hand bearing cap bolts and remove bearing cap.
8. Remove the capscrews which secure the drum gear guard seal retainers. Remove the bolts securing the rear half of the drum gear guard cover and remove the cover (figure 1-3-1).
9. The motor shaft and its bearings, and the intermediate gear, shaft and bearings (figures 1-3-2 and 1-3-3) can now be removed as units from the gearcase.



1. LIMIT SWITCH GEARCASE
2. GEARCASE COVER
3. INPUT SHAFT
4. SHAFT ROLL PIN
5. LARGE BEARING
6. INPUT SHAFT GEAR
7. SMALL BEARING
8. INTERMEDIATE SHAFT
9. INT. LARGE GEAR
10. INT. SMALL GEAR
11. ENCODER GEAR
12. OPTICAL ENCODER

HOIST LIMIT SWITCH
FIGURE 1-3-6

HOIST LIMIT SWITCH

The hoist limit switch, when used, prevents the padlocks on the dipper from being pulled into the boom point sheaves. It electrically cuts the reference signal and plugs the hoist-lower function. The limit switch is mechanically connected to the drum shaft which drives a gear reducer which drives an encoder (figure 1-3-6.) Setting the hoist limit switch is a function of the Panelview monitor in the operator's cab.

HOIST MOTOR

Inspection, lubrication and maintenance instructions for the hoist motor are described in the Motor Manufacturer's Manual. If removal of the hoist motor is necessary, follow the instruction below:

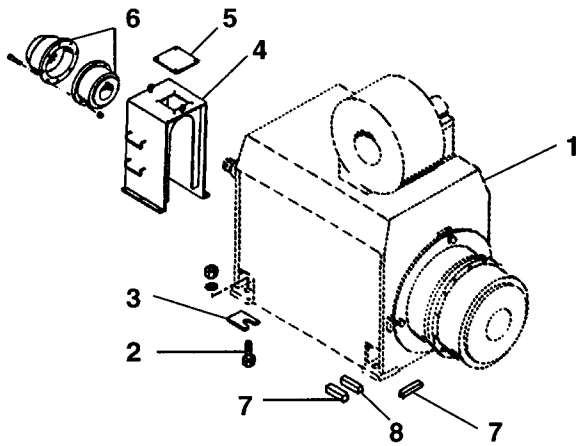
NOTE: Removal of the appropriate roof panel is necessary to facilitate this procedure.

1. Place the dipper on the ground.

⚠ CAUTION: Press the MAIN POWER OFF button and tag it to avoid inadvertent energizing before attempting to disconnect the hoist motor leads. A voltage hazard is present and could cause electrocution resulting in death or serious injury. Do not attempt to disconnect any wires until the auxiliary power has been disconnected and the main power is off.

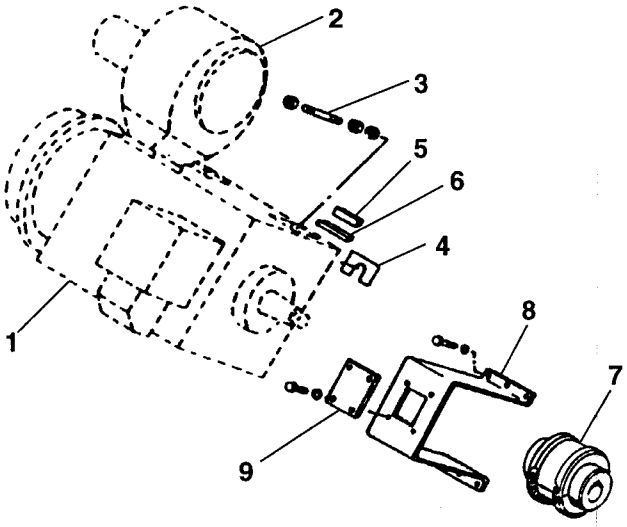
2. Disconnect and identify the electrical leads to the hoist blower motor and the hoist motor.
3. Remove the hoist blower motor and duct as a unit from the hoist motor (figure 1-3-7.)
4. Remove the brake from the motor. Refer to the topic HOIST BRAKE.
5. Separate the coupling on the gearcase end of the motor.
6. For repair of original motor: remove the two chocks and wedges located on the side of the motor towards the hoist drum. For replacement of original motor with a new motor: remove the four chocks and wedges located on both the front and rear sides.
7. Remove the motor mounting hardware. Attach the crane to the motor and lift it from the machine. Wire shims together, if used, and identify their location.
8. Install the motor by reversing the steps used to remove it. For installation of a new motor, mount the coupling hub on the motor as described in Appendix A4, then align the motor coupling per instructions in Appendix A12.

   Reinstall four chocks and wedges on both sides of the motor.



1. HOIST MOTOR
2. MOTOR MOUNTING BOLT
3. MOTOR SHIM
4. COUPLING GUARD
5. GUARD COVER
6. MOTOR COUPLING
7. MOTOR CHOCK
8. CHOCK WEDGE

HOIST MOTOR
FIGURE 1-3-7



1. CROWD MOTOR
2. MOTOR BLOWER
3. MOTOR MOUNTING STUD
4. MOTOR SHIM
5. MOTOR CHOCK
6. CHOCK WEDGE
7. MOTOR COUPLING
8. COUPLING GUARD
9. GUARD COVER

CROWD MOTOR
FIGURE 1-3-12

5. Remove the motor coupling guard and separate the coupling.
6. For repair of the original motor: remove the two chocks and wedges located on the side of the motor towards the boom.

   For replacement of the original motor or motor pinion, remove the four chocks and wedges located on both the front and rear side. Also remove the two chocks at the brake end of the motor.
7. Remove the bolts securing the crowd motor to the crowd machinery frame. Use a crane to lift the motor from the frame.
8. For reinstallation of the original motor and pinion: position the motor against the two inplace chocks and wedges. Reinstall the two chocks and wedges on the boom side of the motor. Recheck coupling alignment.

   For replacement of the original motor with a new motor refer to Appendix A4 for instructions for installing the coupling on the motor. Align the motor coupling per instructions in Appendix A12.

   Install the four chocks and wedges on both sides of the motor.
9. Install the motor by reversing the steps used to remove it.

CROWD BRAKE

The crowd brake is a disc type brake.

This brake has three inspection holes with covers (figure 1-3-13) These holes allow periodic inspection of the friction discs. If the friction discs are worn to the heads of the rivets or have become contaminated, they will require replacement. The wear of the friction discs can be measured by measuring the distance the piston protrudes out of the cylinder when the brake is set as shown in figure 1-3-13. When this measurement approaches .17" the discs must be replaced.

Adjustment

The disc type brake is spring set and air released and requires no adjustment.

To change friction discs, disassemble the brake as follows:

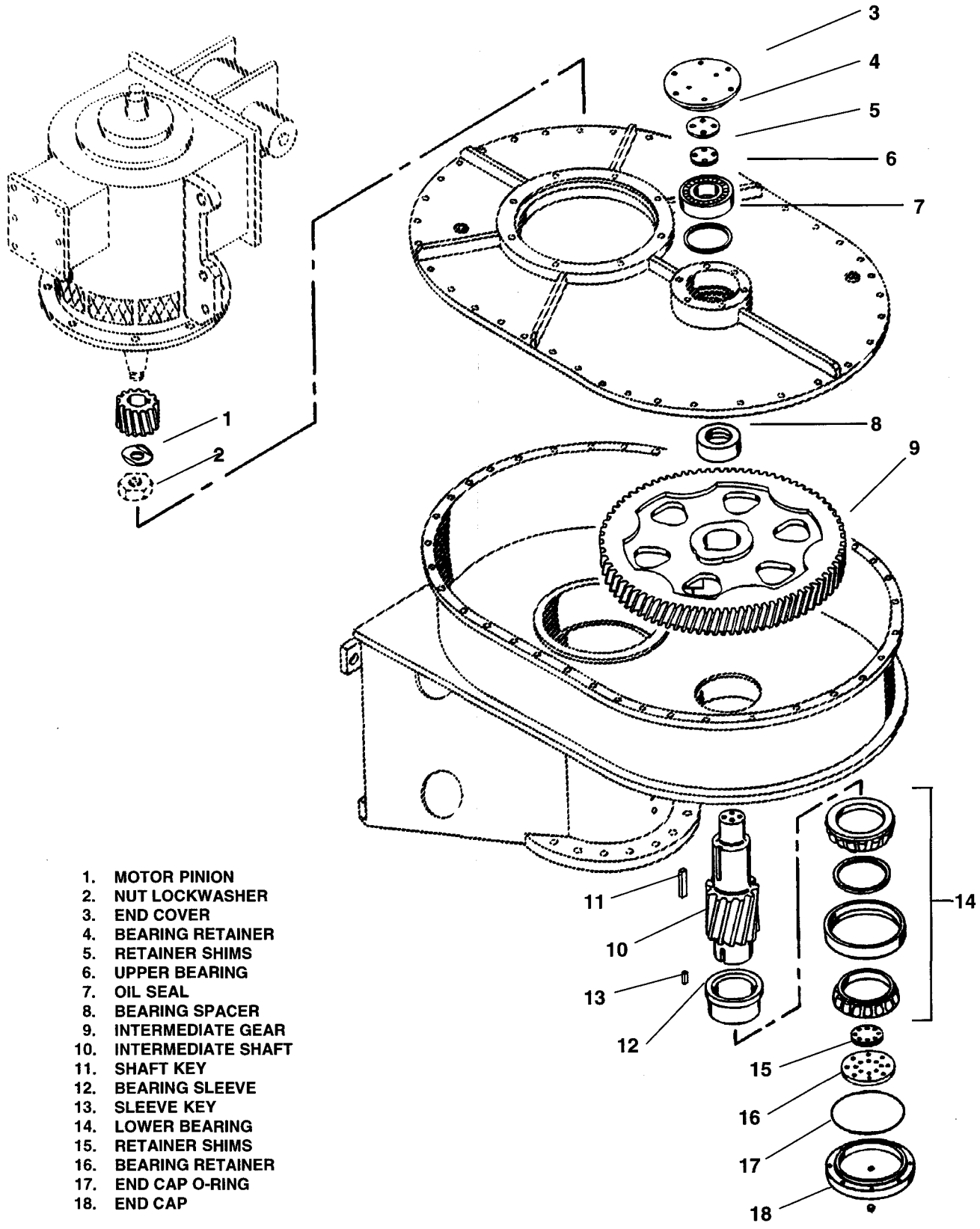
1. Shut off air to the brake at air tank shut-off valve and disconnect the coupling on cylinder. This will set the brake.
2. Remove the cylinder stud nuts and slide piston with cylinder and front plate from studs.

NOTE: Do not remove the socket head cap screws (12) securing piston (11) to front plate (14) as this will release the expansion springs and make reassembly difficult.

3. Slide friction disc assembly from the drive hub splines. Replace the friction disc linings if worn.
4. Wash the drive member and hub splines. Apply lubricant to all spline areas.

NOTE: The friction disc assembly is dynamically balanced and it is recommended the assembly be replaced and not relined.

5. Slide the friction disc assembly on drive hub. Be sure the assembly moves easily on the splines. Slide the piston, cylinder and front plate assembly on cylinder studs. Secure the assembly in place with the stud nuts. torque the nuts sequentially (every 5th nut) to 90-100 ft. lbs.



1. MOTOR PINION
2. NUT LOCKWASHER
3. END COVER
4. BEARING RETAINER
5. RETAINER SHIMS
6. UPPER BEARING
7. OIL SEAL
8. BEARING SPACER
9. INTERMEDIATE GEAR
10. INTERMEDIATE SHAFT
11. SHAFT KEY
12. BEARING SLEEVE
13. SLEEVE KEY
14. LOWER BEARING
15. RETAINER SHIMS
16. BEARING RETAINER
17. END CAP O-RING
18. END CAP

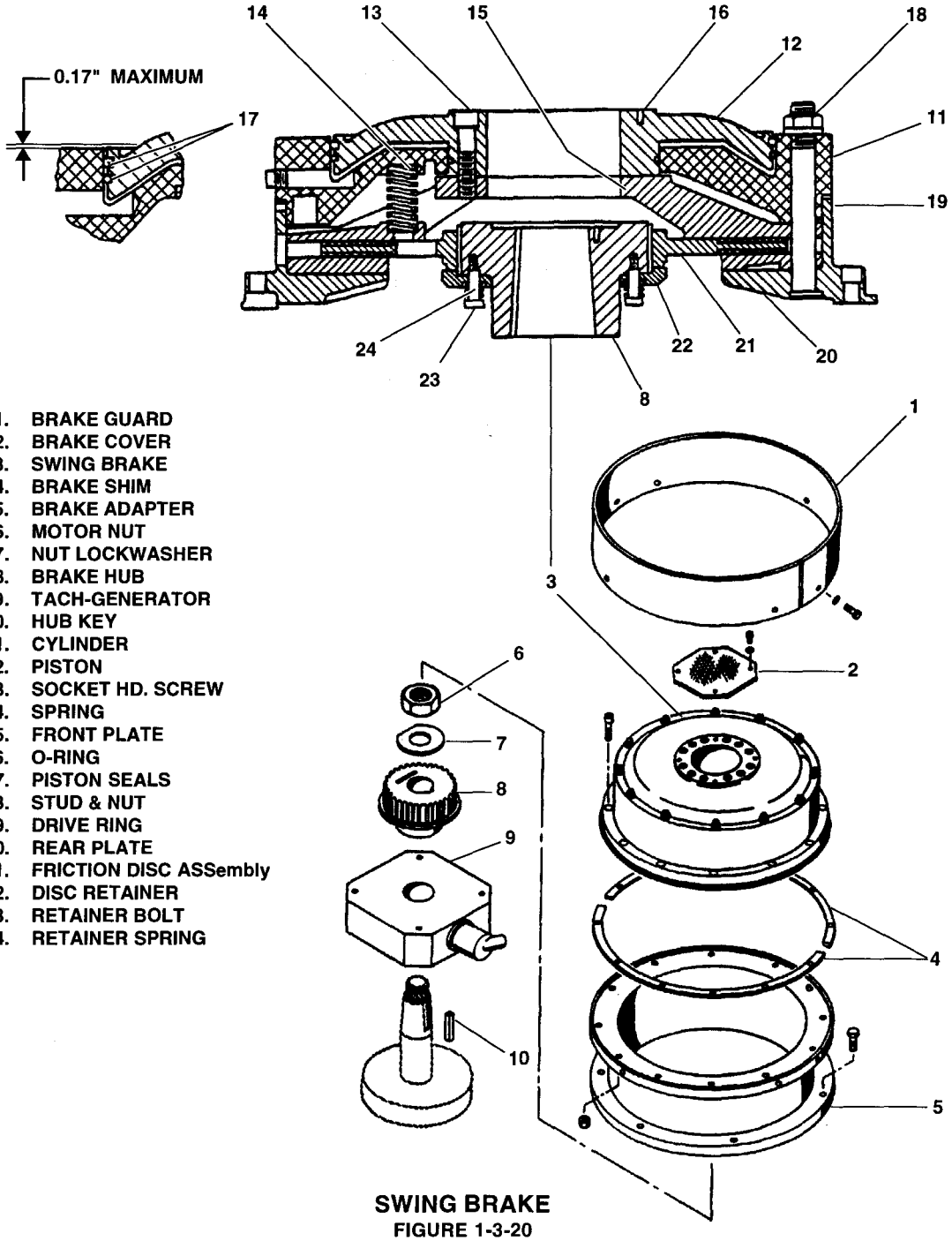
SWING MOTOR PINION AND INTERMEDIATE SHAFT
FIGURE 1-3-17

1. Have a qualified electrician disconnect and identify the electrical leads to the swing blower motor and swing motor.
2. Remove the swing blower motor and duct as a unit from the swing motor.
3. Remove the brake from the motor. Refer to the topic SWING BRAKE.
4. Remove the motor mounting hardware. Attach the crane to the motor lifting lugs and lift it from the machine.
5. Install the motor by reversing the steps used to remove it.

SWING BRAKE

The swing brakes are disc type brakes (figure 1-3-20).

This brake has three inspection holes with covers. These holes allow periodic inspection of the friction discs. If the friction discs are worn to the heads of the rivets or have become contaminated, they will require



SWING BRAKE
FIGURE 1-3-20