



Technical Manual

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

SAFETY

GENERAL

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

IN-OPERATION MAINTENANCE

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

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

Automatic lubrication systems function throughout the operational cycles of the machine. These systems release premeasured lubricant which lengthen the wear life of the machinery units. Other parts of the machine may be manually lu-

bricated in a safe manner through extended grease or oil fittings designed to keep the operator's hands at a safe distance. Where this is not possible, the machine must be shut down during the required lubrication.

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

PRECAUTIONS BEFORE AND DURING MAINTENANCE WORK

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

- Set the dipper on the ground.
- Set all brakes.
- De-energize control functions.
- Do whatever else is necessary to prevent accidental movement of the machine.

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

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

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

While performing maintenance, the awkward positions assumed often increase injuries due to handling heavy parts. As a precautionary measure,

NOTE: When installing a new thrust washer be sure the dowels are flush with or below the face of the thrust washer.

9. Lubricate the bushing bore and the shaft mating surface. Slide the bogie onto the shaft. Install the clamp collar, lube lines and lube guards.
10. Lower the crawler assembly, and adjust belt tension as described in the topic BELT ADJUSTMENT.
11. Thoroughly lubricate the bogie bushing.

LOWER ROLLER

INSPECTION

Inspect the lower roller for cracks and damage that can impair normal tracking of the crawler belts.

REPAIR

The most common problem encountered is bushing wear. However, over a long period of time it is possible for the rollers to develop cracks and wear. If cracks do occur, they can be repaired by gouging out the metal on both sides of the crack and welding the crack. Follow welding instructions in appendix.

If bushing replacement is necessary the bogie must be removed from the machine to accomplish this (figure 10).

1. Relieve crawler belt tension as described in the topic BELT ADJUSTMENT.
2. Remove the bogie as described in the topic LOWER ROLLER BOGIES.
3. Remove the roller shaft clamp collar. Support the roller, then remove the roller shaft from the bogie and roller. Remove the roller from the bogie.
4. The lower roller bushings are flanged.
5. After removing the bushings, check the roller bushing bore and the shaft for defects. Remove any burrs with a file. Check the bore for out-of-round condition. Replace the roller if the bore is out-of-round.
6. Press new bushings in the roller. Lightly lubricate the bushing bore of the roller before inserting the bushings.

7. Lubricate the bushing bore and the shaft mating surface. Set the roller into the bogie so that the bores line up. Insert the roller shaft and secure it with the clamp collar.
8. Reinstall the bogie as described in the topic LOWER ROLLER BOGIES steps 8, 9, and 10.

DRIVE TUMBLER

There are two styles of drive tumblers used on the Model 195-BI shovel: offset lug style and sprocket style. In either style the inspection and repair procedures are the same.

INSPECTION

Inspect the drive tumblers (figure 11) for cracked or broken lugs and other defects which can impair tumbler function and belt tracking. Check the tumbler clamp collar bolts and tighten if loose. The clamp collar should be flush with or slightly inside the end of the tumbler shaft. Every six months remove the drive tumbler and shaft and check the bushings for bore out-of-round and wear. Replace the bushings if badly worn.

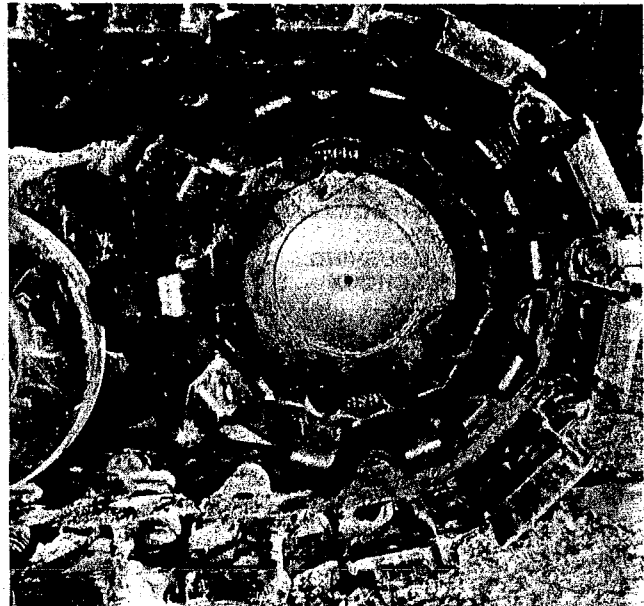
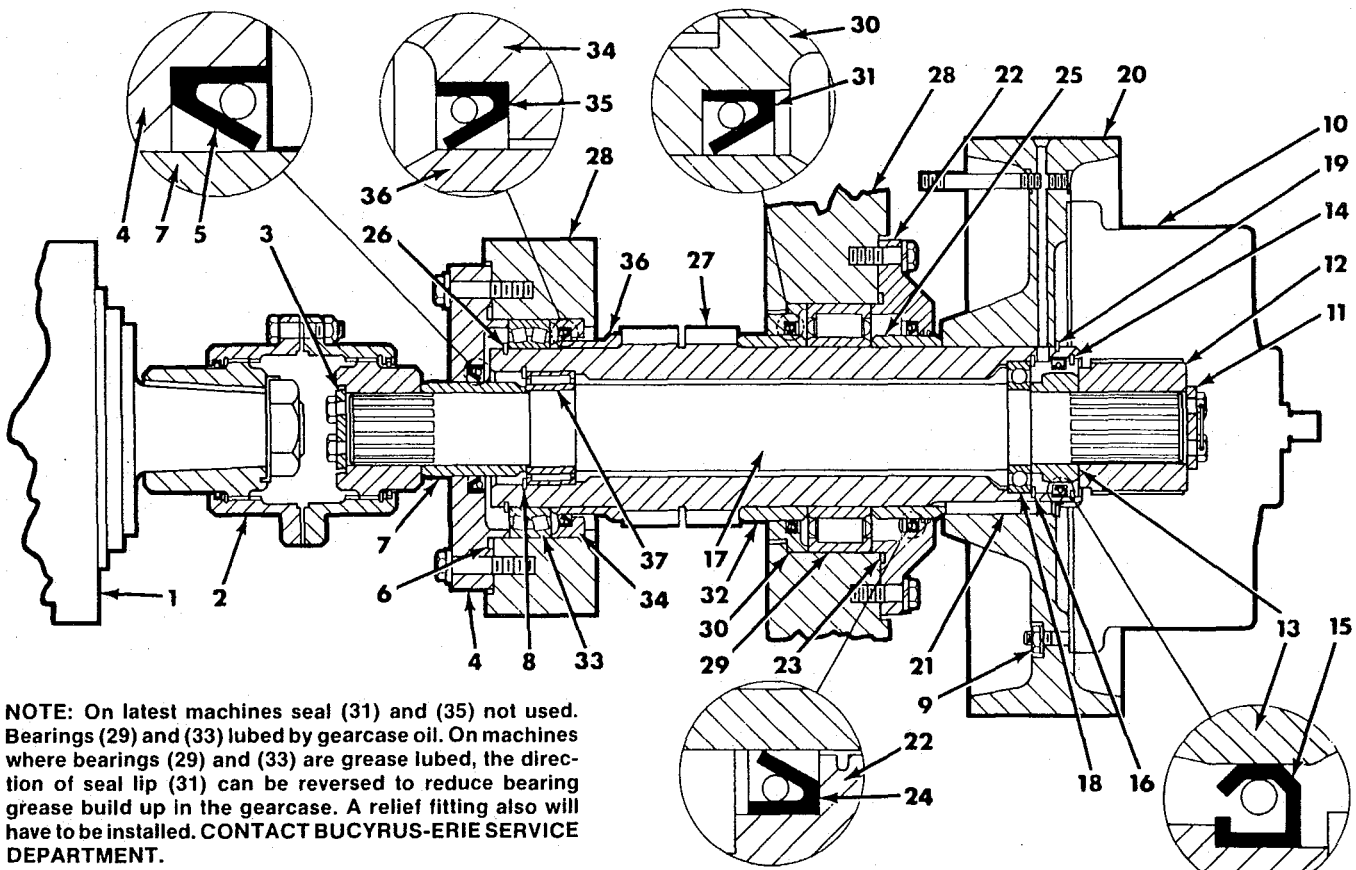


FIGURE 11

REPAIR

The drive tumbler is splined to the drive shaft and is held securely to the shaft with a clamp collar. If repair of the tumbler is deemed necessary, consult Bucyrus-Erie Company Service Department for repair instructions.



NOTE: On latest machines seal (31) and (35) not used. Bearings (29) and (33) lubed by gearcase oil. On machines where bearings (29) and (33) are grease lubed, the direction of seal lip (31) can be reversed to reduce bearing grease build up in the gearcase. A relief fitting also will have to be installed. CONTACT BUCYRUS-ERIE SERVICE DEPARTMENT.

- | | | |
|----------------------|----------------------|---------------------------|
| 1. PROPEL MOTOR | 14. RETAINING RING | 27. SHAFT SLEEVE |
| 2. MOTOR COUPLING | 15. OIL SEAL | 28. PROPEL GEARCASE COVER |
| 3. COUPLING RETAINER | 16. RETAINING RING | 29. BEARING-CLUTCH END |
| 4. OIL SEAL RETAINER | 17. MOTOR SHAFT | 30. SEAL RETAINER |
| 5. OIL SEAL | 18. BALL BEARING | 31. OIL SEAL |
| 6. RETAINER O-RING | 19. RETAINING RING | 32. BEARING SPACER |
| 7. COUPLING SPACER | 20. BRAKE DRUM | 33. BEARING-COUPLING END |
| 8. RETAINING RING | 21. DRUM KEY | 34. SEAL RETAINER |
| 9. CLUTCH BOLT NUT | 22. BEARING RETAINER | 35. OIL SEAL |
| 10. PROPEL CLUTCH | 23. RETAINER O-RING | 36. BEARING SPACER |
| 11. HUB RETAINER | 24. OIL SEAL | 37. INNER BEARING |
| 12. CLUTCH HUB | 25. BEARING SPACER | |
| 13. BEARING SPACER | 26. RETAINING RING | |

PROPEL MOTOR SHAFT

FIGURE 18

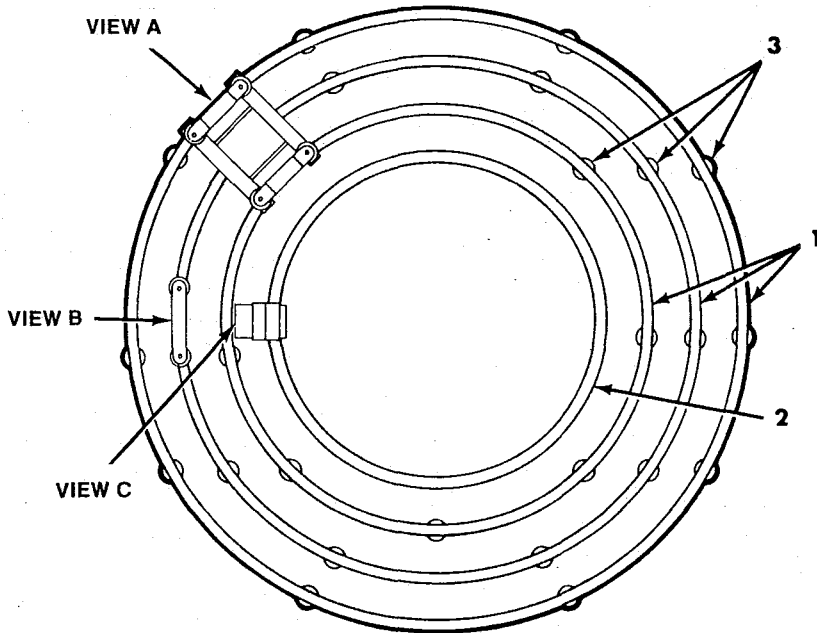
11. Remove the retainer from the coupling end of the motor shaft, and slide the coupling half off the shaft (figure 18).
12. Remove the oil seal retainer from the motor coupling side of the gearcase. Inspect the oil seal and O-ring in the retainer for cuts or damage and replace if necessary. Remove the coupling spacer.
13. Remove the shaft bearing inner retaining ring.
14. Remove the nuts which mount the clutch to the brake drum and slide the clutch off the drive hub. Be careful not to damage the splines.
15. Remove the retainer securing the clutch hub to the propel motor shaft. Remove the clutch hub.
16. Remove the bearing spacer, retaining ring and 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 ball bearing from the shaft.
18. Remove the retaining ring securing the brake drum to the propel shaft sleeve and remove the drum from the sleeve. Remove the key from the sleeve.

the shoes mounted to the truck frame is obtained by entering the truck frame through the bottom access opening (figure 26).

3. Install new insulators or shoes (figure 26) and (figure 27). Make sure all electrical leads

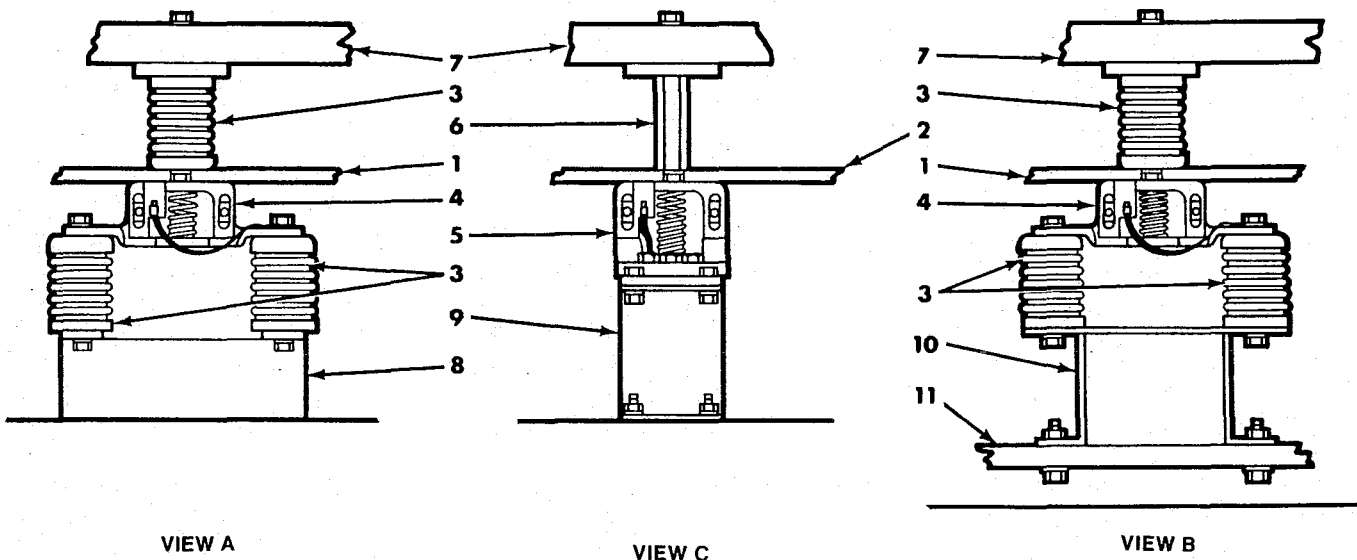
are securely attached to the shoes and collector rings.

CAUTION: Do not attempt to inspect the underside of the revolving frame until power to the machine is disconnected.



1. MAIN COLLECTOR RINGS
2. GROUNDING RING
3. INSULATORS
4. SHOE ASSEMBLY-MAIN
5. SHOE ASSEMBLY-GROUND
6. SPACER
7. REVOLVING FRAME
8. SHOE ASSEMBLY SUPPORT
9. SHOE ASSEMBLY SUPPORT
10. SHOE ASSEMBLY SUPPORT
11. TRUCK FRAME

VIEWED FROM BOTTOM



MAIN COLLECTOR RINGS

FIGURE 26

1. Shut off air to brake at air tank shutoff valve and disconnect air coupling on cylinder.
2. Remove socket head capscrews attaching piston to front plate.
3. Remove all the cylinder stud nuts except for two nuts 180 degrees apart. Slowly back off on the two remaining nuts, taking turns on each nut so that the cylinder releases gradually. When the tension is off the expansion springs the nuts can be completely removed and the cylinder with piston lifted off the studs.
4. Inspect the expansion springs for breaks or weakness. Replace all weak or broken springs.
5. Assemble the brake in reverse order of disassembly being careful to align and evenly seat springs in their proper grooves.
6. Reconnect air coupling to cylinder, and open air tank shutoff valve.

HOIST LIMIT SWITCH (OPTIONAL)

The hoist limit switch, when used, prevents the padlocks on the dipper from being pulled into the boom point sheaves. It also prevents spooling the dead wrap off the hoist drum when lowering the dipper by electrically cutting the reference signal and plugging the hoist-lower function. The limit

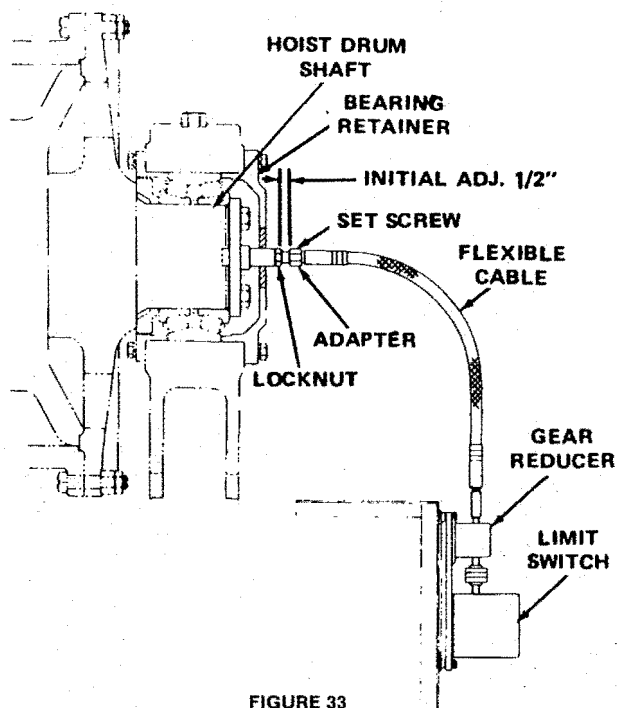


FIGURE 33

switch is mechanically connected to the drum shaft by a flexible cable which drives a 4:1 gear reducer coupled to the limit switch (figure 33).

Inspection

Frequently check the flexible cable attachment at the drum end of the cable, and tighten if loose. Also, check the limit switch mounting hardware and tighten if loose.

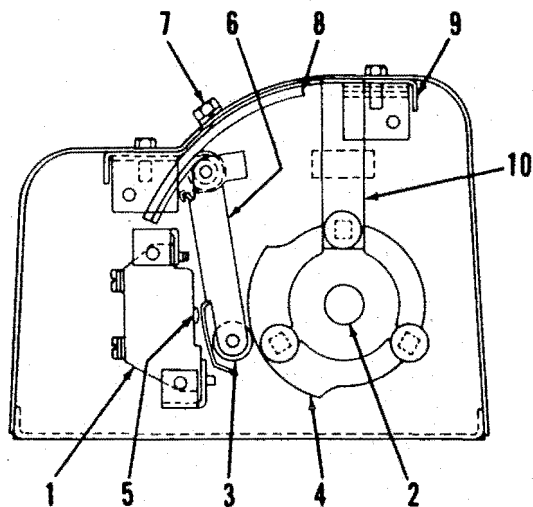
Visually observe the padlock to boom sheave clearance. The padlocks should be six inches off the sheaves. If less or greater clearance is observed adjust the limit switch as covered in the following topic.

Check the condition of the switch contact unit. The silver contacts require no attention but must be replaced before the silver is worn away. Filing or dressing the contacts is not recommended since the end result is loss of silver and reduction of contact life.

Inspect the cam follower rollers for wear and damage. To obtain full access to the rollers, remove the two forward bolts holding the cam follower bracket and swing the entire bracket back.

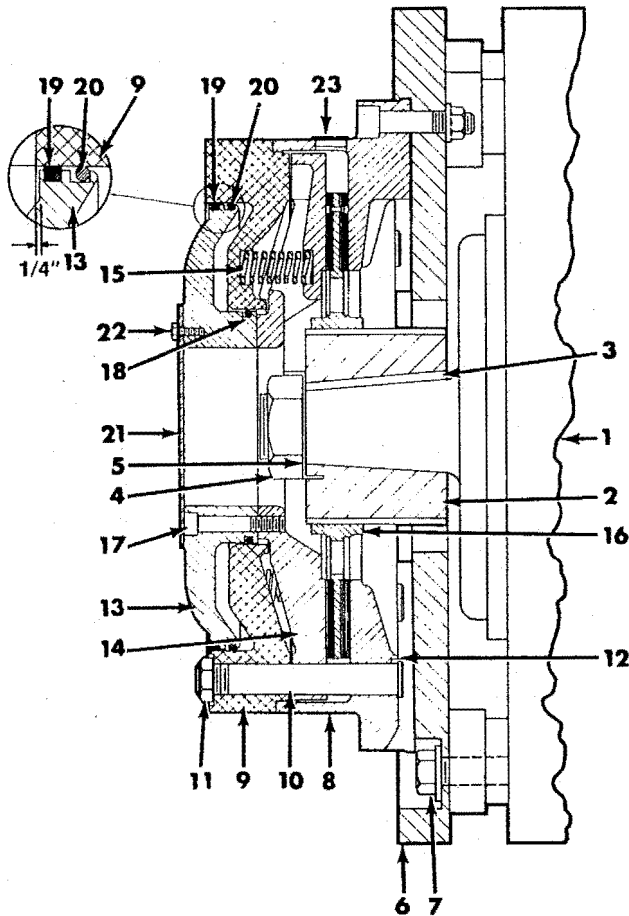
Operation

The construction of one complete unit is shown in figure 34. The contact unit (1) is a normally closed



- | | |
|------------------------|-------------------------------------|
| 1. CONTACT UNIT | 7. VERNIER-ADJUSTMENT LOCKING SCREW |
| 2. CAMSHAFT | 8. VERNIER PLATE |
| 3. CONTACT ARM ROLLER | 9. CAM FOLLOWER BRACKET |
| 4. OPERATING CAM | 10. FILLER STRIPS |
| 5. SWITCH UNIT PLUNGER | |
| 6. CONTACT ARM | |

FIGURE 34



- | | |
|---------------------|----------------------|
| 1. CROWD MOTOR | 13. PISTON |
| 2. DRIVE HUB | 14. FRONT PLATE |
| 3. HUB KEY | 15. SPRING |
| 4. MOTOR NUT | 16. DISC ASSEMBLY |
| 5. LOCK PLATE | 17. SOC. HD CAPSCREW |
| 6. BRAKE SUPPORT | 18. O-RING |
| 7. SUPPORT CAPSCREW | 19. SEAL |
| 8. DRIVE RING | 20. O-RING |
| 9. CYLINDER | 21. COVER PLATE |
| 10. CYLINDER STUD | 22. PLATE CAPSCREW |
| 11. STUD NUT | 23. HOLE COVER |
| 12. STUD LOCK PIN | |

CROWD BRAKE

FIGURE 43

Repair

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 socket head cap-screws securing piston to front plate 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.
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.
6. Connect the air piping to the cylinder air coupling. Open the air tank shutoff valve.

To replace O-rings disassemble the brake as follows:

1. Shut off air to brakes at air tank shutoff valve.
2. Remove the socket head capscrews attaching the piston to the front plate and remove the piston.

NOTE: Do not remove cylinder stud nuts securing cylinder to front plate as this will release the expansion springs and make re-assembly difficult.

3. Inspect O-rings for cleanliness, wear, deterioration, or cracks. Clean each as required and replace old or damaged O-rings.
4. Lubricate O-rings and groove judiciously before assembly. Install O-rings in grooves as they would lay naturally. Do not nick, pinch, or twist O-rings.
5. Reassemble piston to front plate with socket head capscrews.
6. Open air tank shutoff valve.

To replace expansion springs disassemble the brake as follows:

1. Shut off air to brake at air shutoff valve and disconnect air coupling on cylinder.
2. Remove the socket head capscrews attaching piston to front plate.
3. Remove all the cylinder stud nuts except for two nuts 180° apart. Slowly back off on the two remaining nuts, taking turns on each nut so that the cylinder releases gradually. When the tension is off the expansion springs the nuts can be completely removed and the cylinder with piston lifted off the studs.

OPERATOR'S CAB (figure 50)

SEAT

The individual operator may adjust the operator's seat as desired with respect to height, tilt, and swivel travel (figure 51). Periodically oil all pivot points and bearings to maintain smooth movement of the seat. Check the condition of all seat plungers, retainers, and lock seats as well as the seat cushions.

WINDSHIELD WIPERS

There are two air operated windshield wipers on the front window of the cab, one for the lower portion of the window, and one for the upper portion of the window (figure 52).

Check the wiper blades to make sure they swing freely across the window without contacting the window frame. Reposition the pantograph arm on the wiper motor shaft if necessary to prevent contact with the window frame.

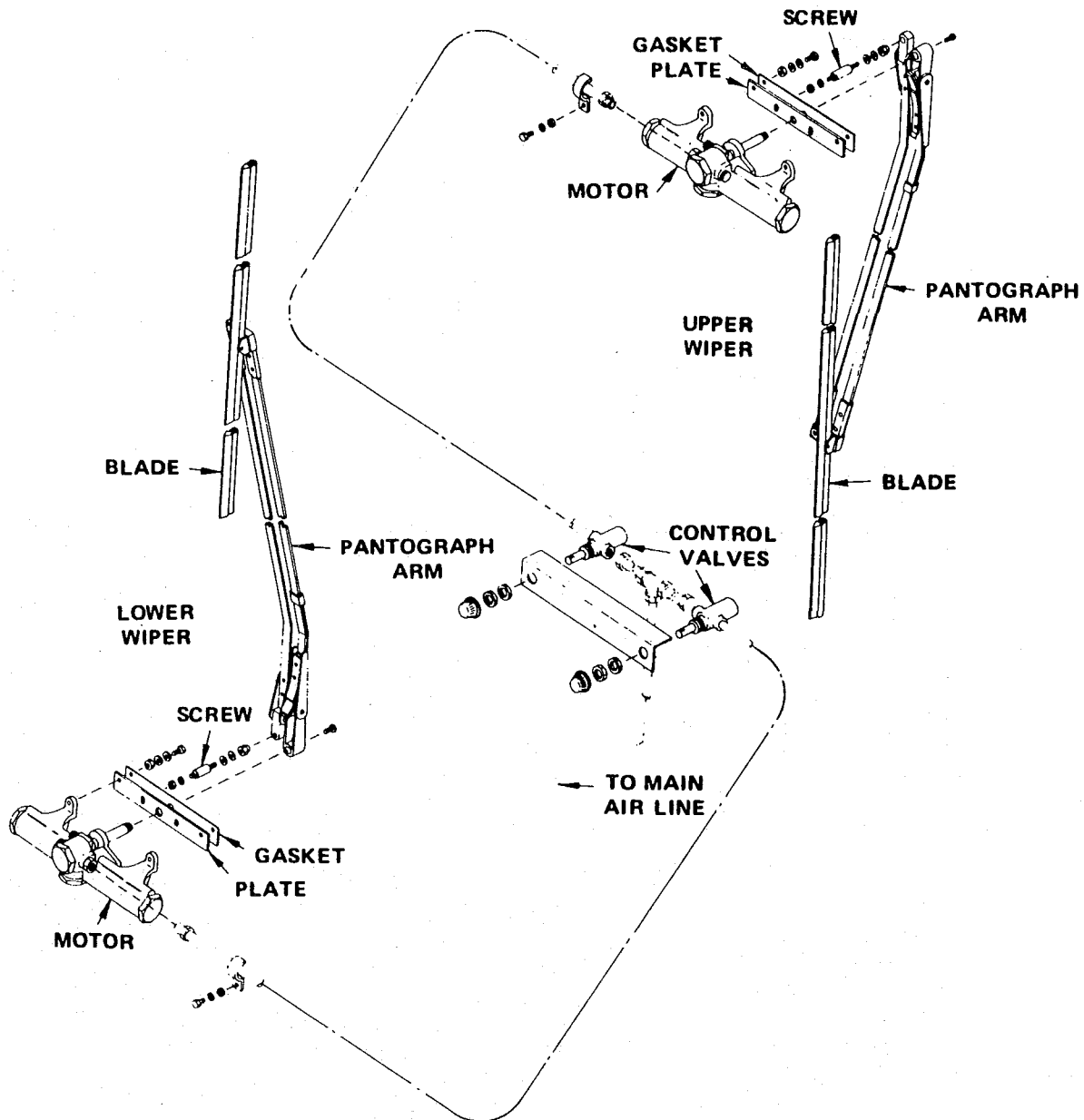


FIGURE 52

6. Inspect and replace any worn sheave bushings or bearings and seals, and saddle block bushings.
7. Reinstall the saddle block in the boom. Reconnect the lube lines. Reinstall in reverse of disassembly.

DIPPER HANDLE

The dipper handle can be of two basic designs: the first is for pin connected dippers, the second is for dippers that are welded directly to handle. Except for this difference, the remaining portion of the dipper handles are basically the same.

The dipper handle (figure 61) should be checked regularly for cracking or bending. If cracking or bending is noticed the handle should be removed and repaired as listed in appendix.

Also check the handle for proper lubrication.

Check condition of the crowd cushion and retract take-up mechanism.

DIPPER HANDLE REMOVAL

1. Lower the dipper to the ground.
2. Remove the crowd and retract ropes.
3. With a crane remove the handle crowd cushion.
4. Secure a crane with adequate power to lift the dipper handle. Chain the saddle block to the boom so that it will not rotate when the handle is removed from it.
5. Slowly back the machine up. The dipper handle will slide from the saddle block. Set the dipper handle on blocking and perform the required maintenance. While the handle is on the ground the crowd cushion and retract take-up mechanism should be inspected and repaired if required.
6. Reinstall dipper handle in reverse of removal. Install the crowd cushion. Install the crowd and retract ropes.

FRONT STOP & SPREADER REMOVAL

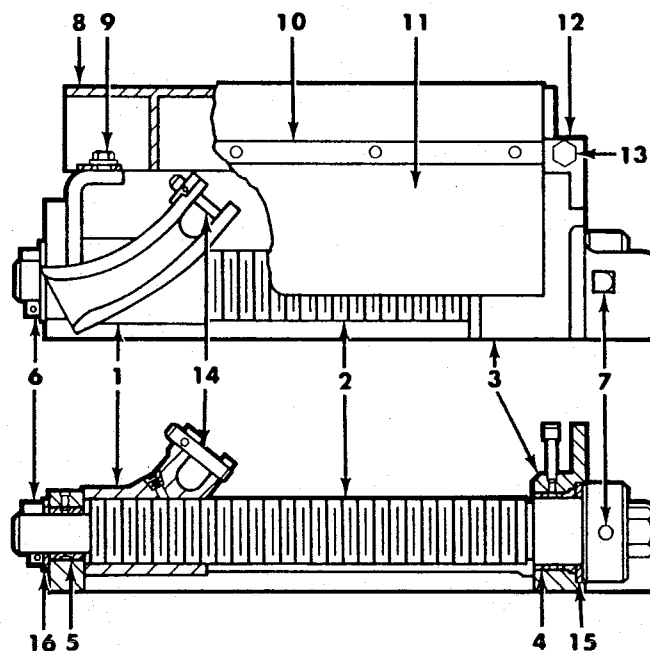
1. Lower the dipper to the ground.
2. Back off the retract take-up nut as far as possible.
3. Remove the retract rope retainer bolts and retainers. Lift the retract rope out of the spreader grooves.

4. With a torch remove the lower splice plate (figure 61). Then remove the upper splice plate. Be sure to follow all safety measures.
5. Attach a crane to one side of the spreader and remove the anchor bolt. Lift the spreader from the handle. Remove the other side in the same way.
6. When reinstalling the spreader be sure to maintain an equal distance on each side of the handle.

RETRACT TAKE-UP MECHANISM REMOVAL

Mechanical Operated

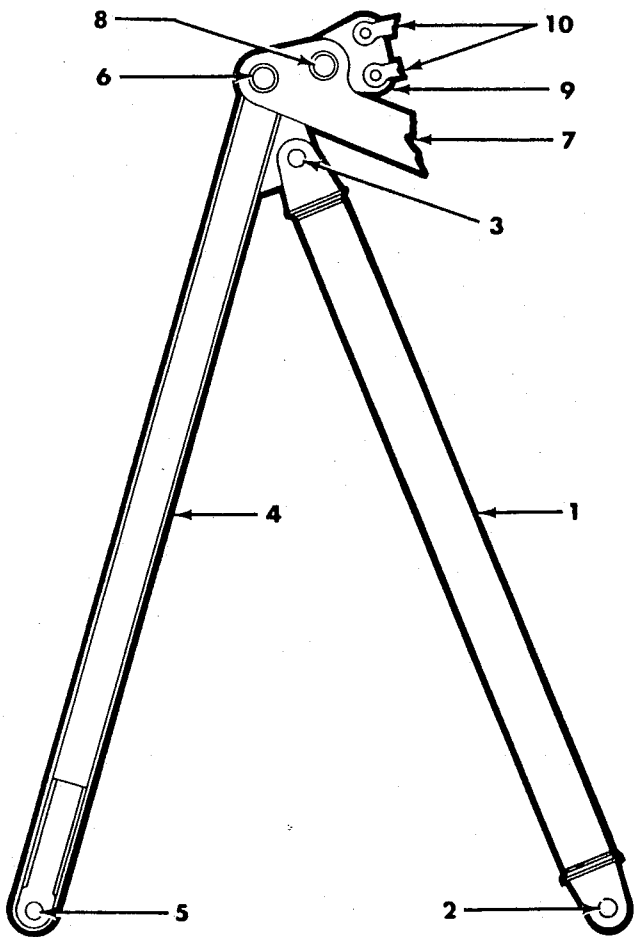
1. If the retract take-up mechanism must be repaired, lower the dipper so that the front of the dipper is flat on the ground.
2. Remove the guard bolts and lift off the guard (figure 62).



- | | |
|------------------|----------------------|
| 1. TAKE-UP NUT | 9. GUARD CAPSCREW |
| 2. TAKE-UP SCREW | 10. GUARD CURTAIN |
| 3. SUPPORT | 11. CURTAIN RETAINER |
| 4. BUSHING | 12. GUARD HINGE |
| 5. BUSHING | 13. HINGE BOLT |
| 6. "T" BOLT | 14. "T" BOLT |
| 7. LOCK BOLT | 15. THRUST WASHER |
| 8. GUARD | 16. PLAIN WASHER |

RETRACT TAKE-UP MECHANISM MECHANICAL OPERATION

FIGURE 62



- | | |
|----------------------|------------------------|
| 1. A-FRAME FRONT LEG | 6. UPPER PIN |
| 2. LOWER PIN | 7. BOOM STRUT |
| 3. UPPER PIN | 8. EQUALIZER PIN |
| 4. A-FRAME REAR LEG | 9. EQUALIZER |
| 5. LOWER PIN | 10. STRUCTURAL STRANDS |

A-FRAME

FIGURE 72

Check the condition of the platforms to see that they are secure and safe. At the same time inspect the equalizer links and connections of the boom structural strands.

BOOM STRUCTURAL STRANDS

The boom structural strands are not subject to the same wear conditions as the running ropes but they should be kept lubricated to protect them from the elements (figure 73).

Of special importance in extending the useful life of the structural strands is the use of penetrating oil at the sockets. Moisture enters the strands at the socket nose and rusting occurs unless the

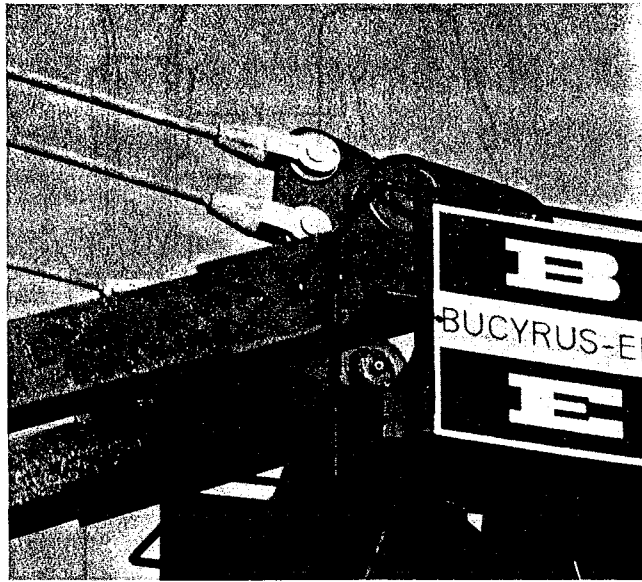


FIGURE 73

strand at or near the socket is saturated with a light penetrating oil. This oil should have high penetration properties and should contain approximately 50 percent lubricating oil, as well as a penetrating solvent.

In addition, it should have the property of displacing water on the surface of the steel to prevent corrosion from moisture already present inside the strand and to prevent moisture penetration in the future. A suitable oil for this purpose is Rust Ban 392 (Esso Standard Oil Company) or an equivalent oil. (Refer to Lubrication Benchmarks.) Periodic inspection of the outer layer of wires immediately adjacent to the stockets should be made. Refer to appendix for INSPECTION AND MAINTENANCE OF STRUCTURAL STRANDS.

WIRE RUNNING ROPES

In designing excavating machinery, careful study of the size and operating speed of all sheaves and drums is conducted to determine the proper wire rope for each application. Continual contact with many machines in the field and repeated consultation with leading rope manufacturers permits the selection of the most satisfactory rope for each machine. To maintain the shovel at its highest level of efficiency, purchase new ropes which conform to Bucyrus-Erie Company Specifications, and thus obtain the wire rope best suited for the particular application. Here are a few pointers relative to the proper inspection, lubrication, and replacement of wire ropes on the 195-BI shovel.

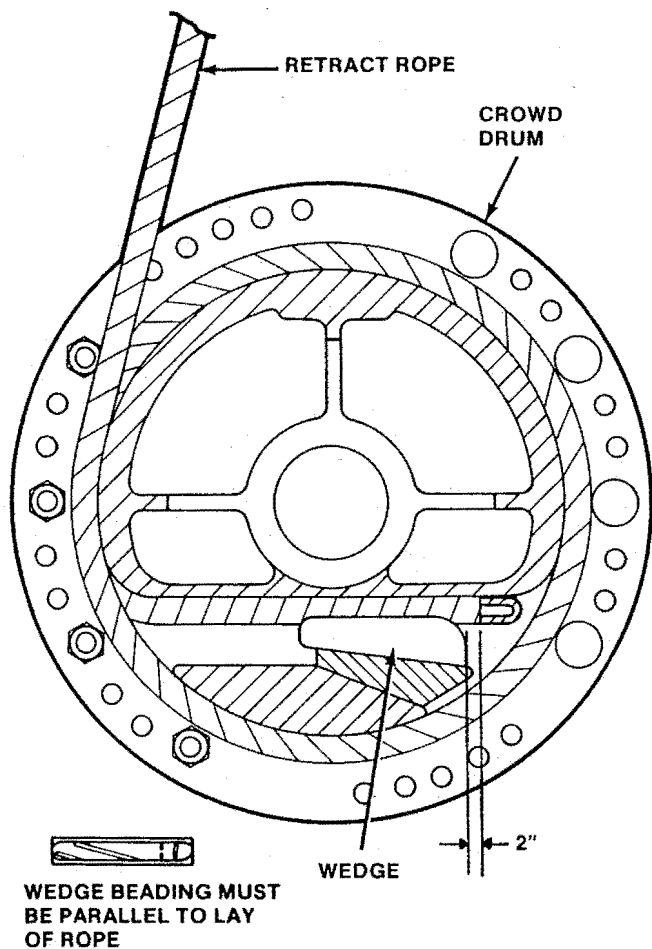


FIGURE 92

14. Replace the front spreader rope retainers and take up nut tee bolts.
15. Remove as much slack as possible from the retract rope with the take up mechanism. Hoist the dipper handle to a horizontal position and measure the sag in the sheave and the front spreader. The ropes are correctly adjusted when the sag is between 2 and 4 inches (figure 93). If the machine is equipped with a crowd limit switch have an electrician adjust it. Recheck the drum wedge for tightness.

DIPPER TRIP ROPE REEVING (Figure 94)

1. Use steps one and two from HOIST ROPE REPLACEMENT.
2. Have an electrician remove the dipper trip fuse from the DC cabinet.
3. Crowd the dipper handle to unwind the trip rope from the reel. Lower the dipper to the ground and retract it slightly to get some slack in the trip rope.
4. Open the side cover on the trip reel and loosen the rope clamp to free the trip rope. Attach a safety line to the trip rope. Pull the trip rope over and off of the trip rope guide sheave. The safety rope will remain on the guide sheave and will be used to pull the new trip rope on.
5. Reeve one end of the new trip rope under the socket on the dipper door.
6. Reeve one end of the new trip rope under the guide roller, around the latch lever sheave and secure it to the rope socket with the rope socket wedge.
7. Attach the other end of the new trip rope to the safety line still in place on the guide sheave. With the safety line pull the trip rope onto the guide sheave and up to the trip reel. Secure the trip rope to the reel with the rope clamps.
8. Have an electrician replace the dipper trip fuse and adjust the trip for proper operation.

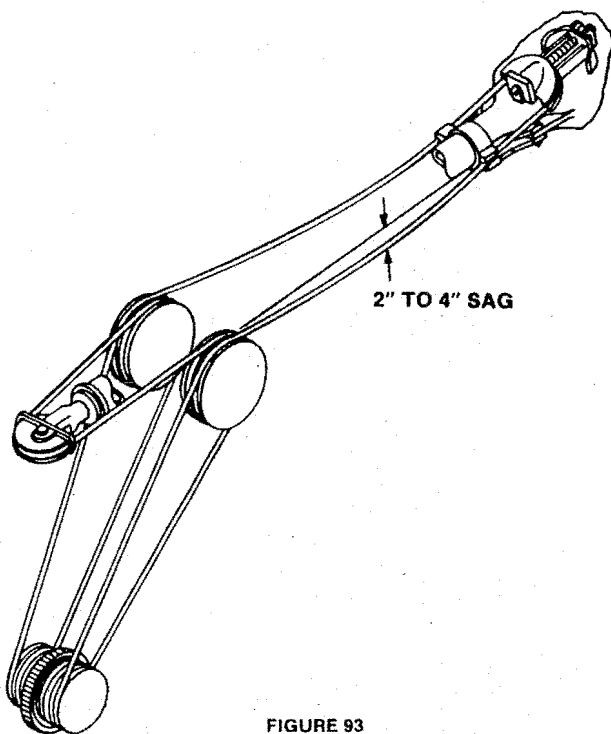


FIGURE 93

4. Remove side plate.
5. To remove pistons, drive the lockpins into the wrist pins with a drift or pin punch and push out wrist pins.
6. To remove connecting rods, remove rod bolts. Keep rods and caps in matched sets, noting position of the identification marks on one side of each so that the connecting rod can be replaced in the same position it originally occupied.
7. To remove crankshaft, take out key, remove end cover and slide crankshaft out of base, being careful not to damage "V" oil feeder ring.
8. If oil seal is to be replaced, drive it out of base from inside with evenly spaced blows.

REASSEMBLY

1. Piston-Cylinder — Check fit before assembling pistons to connecting rods. Pistons without rings should slide through the cylinder of their own weight, and holding the skirt of the piston with the two thumbs there should be no appreciable side motion at any point of piston travel. Scored cylinders or pistons should be replaced.
2. Wrist Pin — Piston should be "tap" fit by hammer (figure 105). See that lockpin holes are in line.
3. Wrist Pin-Needle Bearing (figure 105) — Wrist pin should fit needle bearing in connecting rod so that pin can be pushed through bearing with moderate pressure when rod is held in both hands with thumbs pressing on end of

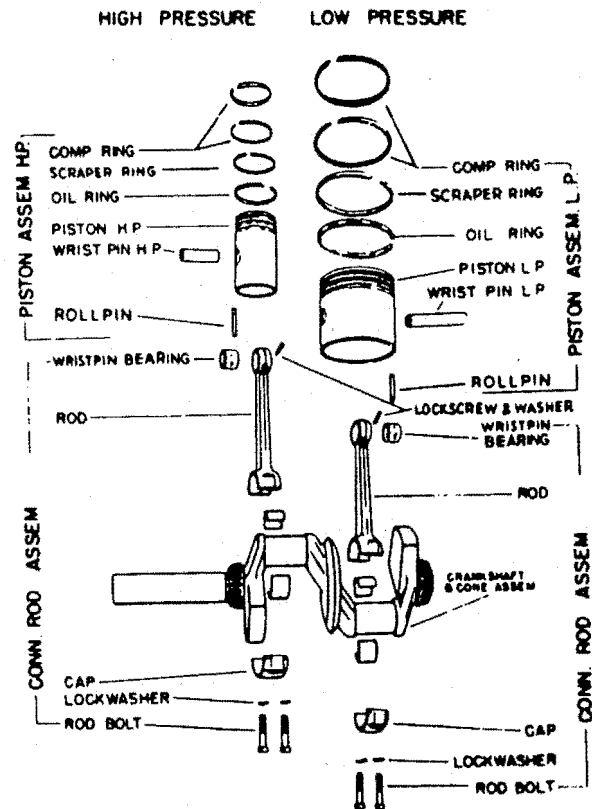


FIGURE 105

pin. Pin should not fall through bearing of its own weight. Where adjusting screws are provided they may be tightened or loosened to provide proper fit. When the piston is assembled to the connecting rod, drive the lockpin into the wrist pin so that it comes flush with the boss. If replacement of a needle bearing ever becomes necessary, be sure the small hole through the casing of the new bearing lines up with the oil hole in the rod. Wrist pin should be replaced also.

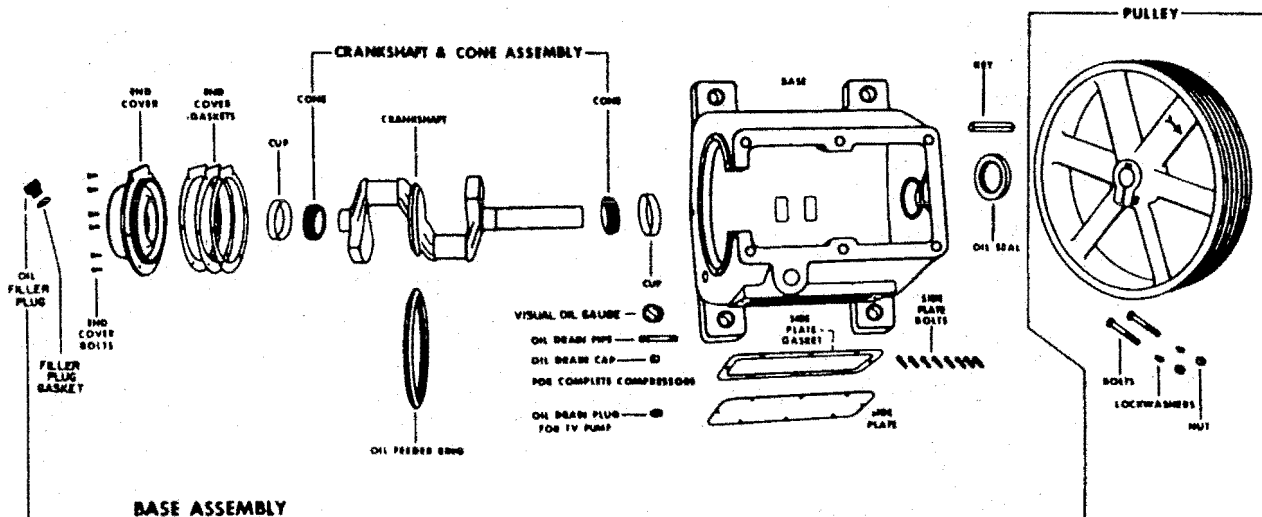


FIGURE 106

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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 there is one 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.
6. Remember that accumulated excess grease or oil represents a fire hazard. Use good house-keeping techniques.

LOWER WORKS

Even though the machine is not propelled very much, there is back and forth movement while the machine is working. This movement tends to squeeze grease out of the bushings and wearing will occur if lubrication is neglected. Because of the possibility of operating in water, the grease used should be a water repellent, general purpose grease. When propelling for long distances the machine should be lubricated every 1500 feet (approx. 1/3 mile) or every 1/2 hour. All bushings should be watched carefully and if there is any heating, force in grease until the bushings run cool. If propelling conditions are particularly severe, such as deep mud or water, continuous propelling up hill or frequent steering, then the frequency of lubrication should be increased.

Propel gear cases and crawler drive gear cases should be checked every six 8 hour shifts. Check oil level with machine on level ground and add lubricant if necessary. If water has accumulated in gear case, remove drain plug and allow it to drain off. Twice a year, or when temperature changes make it necessary, drain and flush the propel and crawler drive gear cases. Draining of the gear cases is best accomplished if done immediately after the machine has been propelled and the oil is still warm. Refill with the correct grade of gear lubricant.

Keep the swing rack and roller path coated with proper lubrication and check daily. If dirt accumulates, wash off the old lubricant and apply a fresh coat. With the drip oiler, adjust to maintain adequate lubricant film.

The rollers are separately lubricated through pressure grease fittings tapped in the ends of the pins. With sealed bushed roller pins inspect and grease every 2000 hours.

Propel the machine back and forth a short distance after greasing to insure distribution of the grease all the way around the bushings of the crawler rollers.

ROTATING DECK

On machine without auto-lube, all anti-friction bearings in the main machinery (hoist) are brought out to a common "header" located on the left hand side of the unit.

The swing machinery two gear reductions from the motors to the vertical swing shafts are totally enclosed and lubricated by splash. Keep the gear case filled to the indicated level with the proper oil.

A filter on the breather pipe prevents dirt from entering the gear case.

Both shafts are mounted in anti-friction bearings lubricated by oil except the intermediate shaft upper bearing which is lubricated by grease.

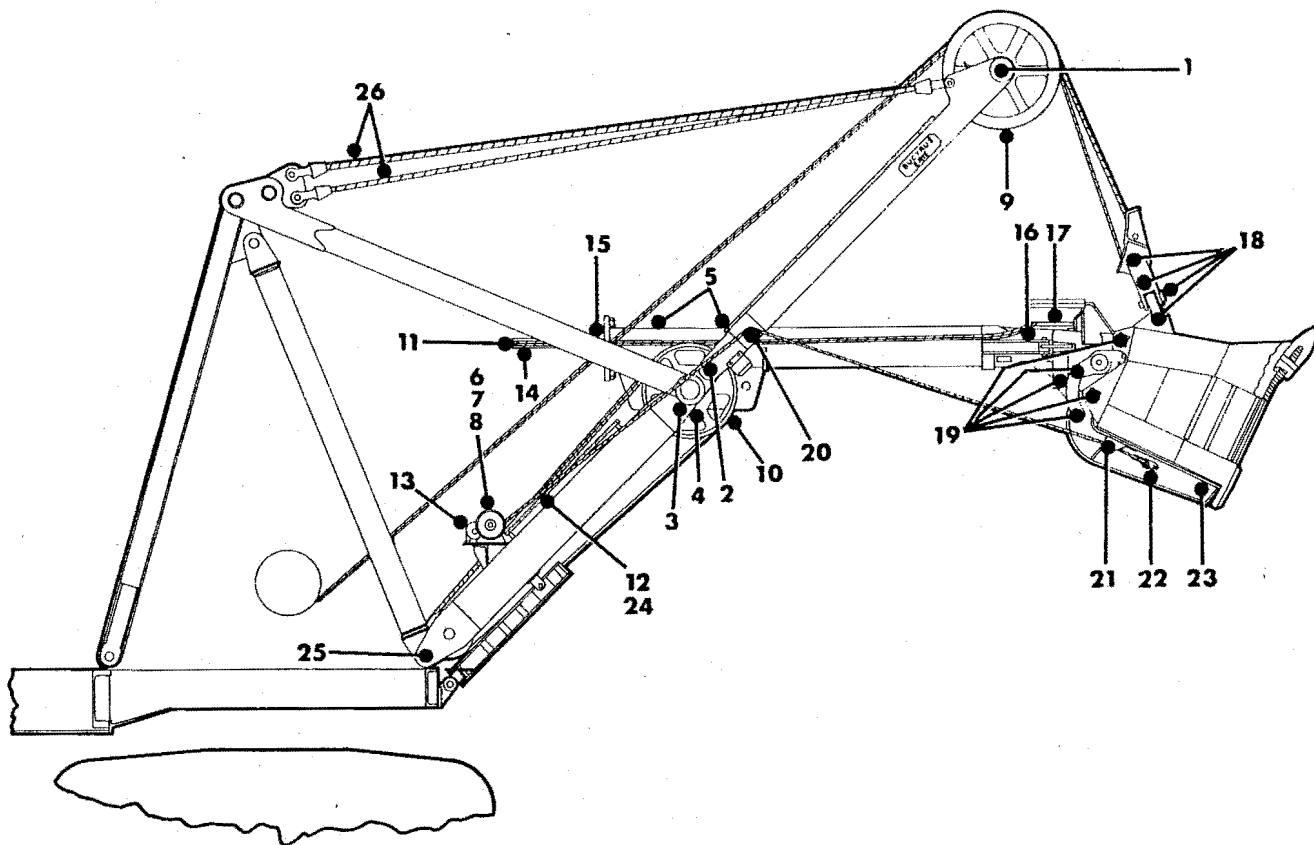
The crowd first and second reductions are totally enclosed and oil lubricated. The third reduction pinion and gears are protected by guards and require open gear lubricant. Inspect the open gears once a shift, and recoat if necessary. The crowd shafts anti-friction bearings are grease lubricated.

The air compressor oil level should be checked once a day by removing the oil filling plug and observing the oil level. The oil lubricator in the main air line should be filled with light oil as required.

1. Place a few drops of oil on all levers, pins, etc., not provided with fittings.
2. Inspect all open gears once a shift for sufficient lubricant.

FRONT END

Since the front end equipment is working under severe dirt and moisture conditions, it is very important that lubrication be performed regularly. Use a water repellent grease for all front end



LUBE POINT	NO. OF POINTS LUBRICATED	TYPE LUBRICANT	ONCE A SHIFT	EVERY 6 SHIFTS	AS REQD.	AUTOMATED	COMPONENT
1	2	MPG				X	BOOM POINT SHEAVE BUSHINGS
2	2	MPG		X			UPPER BOOM PIN BUSHINGS
3*	2	MPG				X	SADDLE BLOCK BUSHINGS
4*	2	MPG				X	SADDLE BLOCK SHEAVE BUSHINGS OR BEARINGS
5	6	OGL				X	DIPPER HANDLE
6	1	MPG				X	DIPPER TRIP GEAR
7	1	MPG				X	DIPPER TRIP BEARING
8	1	MPG				X	DIPPER TRIP BEARING
9	2	RWRL			X		BOOM POINT SHEAVE GROOVES
10	2	RWRL			X		SADDLE BLOCK SHEAVE GROOVES
11	1	RWRL			X		CROWD CUSHION SHEAVE GROOVE
12	2	RWRL			X		RETRACT ROPE DEFLECTOR SHEAVE GROOVES
13	1	MPG				X	DIPPER TRIP MOTOR
14	1	MPG		X			CROWD CUSHION SHEAVE BUSHING
15	2	MPG		X			CROWD CUSHION HOUSING
16	2	MPG			X		RH & LH SPREADER
17	3	MPG		X			TAKE-UP NUT AND SCREW
18	8	MPG	X				DIPPER PADLOCK PINS
19	10	MPG			X		DIPPER PINS
20	1	MPG		X			TRIP ROPE GUIDE SHEAVE BEARINGS
21	1	MPG	X				TRIP ROPE GUIDE ROLLER
22	1	MPG	X				LATCH LEVER SHEAVE
23	1	MPG	X				DIPPER DOOR LATCH BAR
24	2	MPG	X				DEFLECTOR SHEAVE BUSHINGS
25	2	MPG		X			BOOM FOOT PIN BUSHINGS
26	2	SWRL		X			BOOM STRUCTURAL STRANDS

*ON SOME MACHINES THESE BUSHINGS ARE LUBRICATED WITH OGL LUBRICANT. WHEN BEARINGS ARE SUPPLIED THE BEARINGS ARE ALWAYS LUBRICATED WITH MPG LUBRICANT.

INJECTOR SETTINGS

ON INITIAL SETTINGS ALL INJECTORS ARE SET FOR MAXIMUM OUTPUT AND THEN READJUSTED AS REQUIRED IF EXCESSIVE LUBRICANT IS OBSERVED.

FRONT END EQUIPMENT — LUBRICATION POINTS

FIGURE 117

lubricator body with compressed air before reassembly. Clean bowl only with household soap, never use carbon tetrachloride, trichlorethylene, thinner, acetone or similar solvents as these solvents will damage the plastic bowl.

REGULATORS

Installation

In piping-up always be sure pipe ends are reamed clean to assure a smooth flow. Before installing regulator always blow out line to remove scale or other foreign matter. Apply pipe compound to male threads only and only enough to make tight joints.

1. On the underside of the regulator body, the piping connections are marked on each port; the regulator should be installed in the line so that air flow is from in to out. Tappings L and R are normally for gauge use but may also be used for outlet or service purposes in certain applications.
2. Install a shutoff valve ahead of all equipment. It is recommended that a filter be installed directly ahead of the regulator. On air lines, if there is excessive condensation a trap (automatic type preferred) should be installed.
3. It is recommended that the regulator be installed as near as practical to the point of use or the equipment it is supplying.

Adjustment

Changes in reduced pressures on relieving type regulators can be made upward and downward without bleeding or venting the reduced pressure system. To increase pressure turn adjusting screw clockwise, to decrease turn screw counterclockwise.

Maintenance

To obtain best efficiency and longest periods of trouble-free service, the air supply must be kept clean.

Inspection

The working condition of the regulator may be indicated by reduced pressure.

Reduced Pressure

Unsteady reduced pressure or deviation in excess of normal observed setting usually indicates:

1. Diaphragm swollen or stiffened - replace diaphragm.
2. Inner valve disc dirty or worn, or seat is scored. Clean and/or replace.
3. Be sure filter is clean and the supply valve is wide open.
4. Air leakage through vent in cage — This is a normal relieving function indicating an excess reduced pressure over that which the regulator is set. If constant relief is noted, it may be caused by a dirty or worn inner valve requiring cleaning or replacement.

Replacement of Diaphragm

Release spring tension by turning adjusting tee handle counterclockwise. Remove 6 flange screws, and spring cage. Reassemble new diaphragm assembly to body.

NOTE: Make sure diaphragm gasket is in place before replacing spring cage. Tighten cage firmly to body and reset valve as instructed under ADJUSTMENT.

Replacement of Inner Valve

Remove bottom plug, strainer, bottom spring, and inner valve assembly. Wipe seat clean, insert new inner valve assembly, and replace bottom spring, bottom plug, and strainer.

AIR LINE FILTERS

Installation

In piping-up, always be sure pipe ends are reamed clean to assure smooth flow. Before installing filter:

1. Always blow out line to remove scale and other foreign matter.
2. All filters are supplied with dryseal pipe thread connections and normally no pipe compound is required. However, if pipe compound is desired as a lubricant, apply only to male threads.
 - a. Install with filter bowl vertical in pipe line so that air flows in direction indicated on filter body. Install ahead of all devices in the line, but as near as practical to the equipment protected. A shutoff valve should be installed ahead of filter.
 - b. Operating maximum for plastic bowls are 250 PSIG at 120°F.

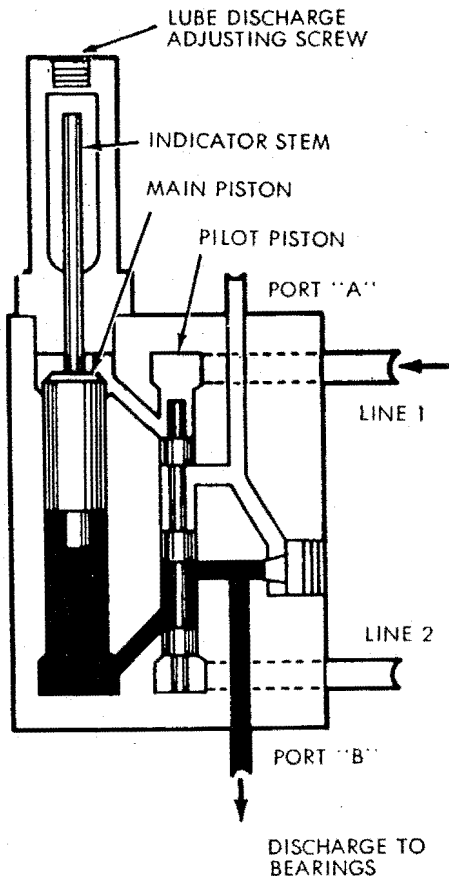


FIGURE 137

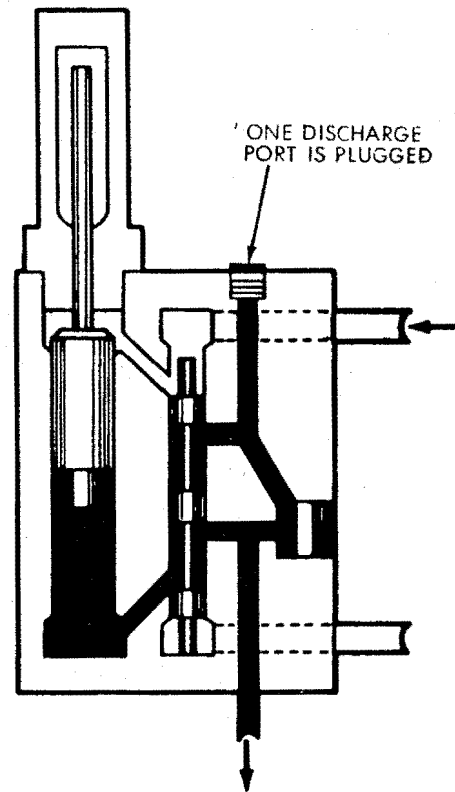
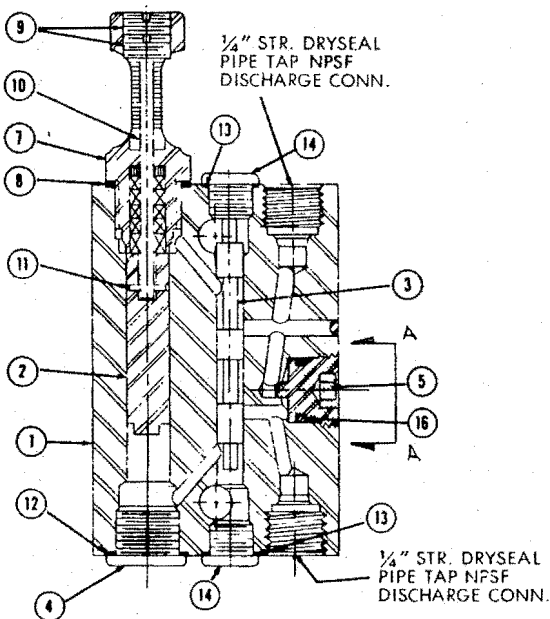


FIGURE 138

4. Indicator stem shoes when valve is operating. Valve discharge can be varied by adjusting screw in packing gland to alter main piston travel.

The operating sequence for single outlet (figure 138) is basically the same. The only difference being that one outlet is plugged and the total discharge ($2 \times$ disc./piston stroke) of each Operation is directed out of one outlet to a single bearing.



NOTE: Packing Gland has permanent packing assembled in it.

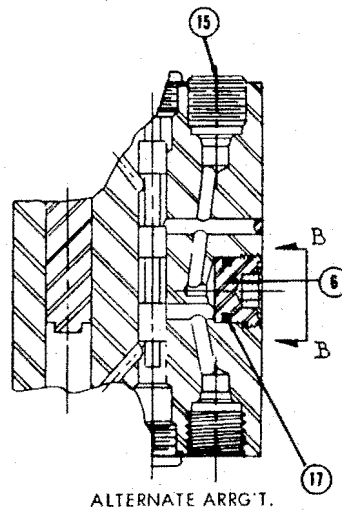
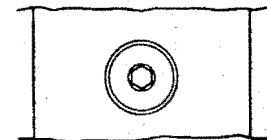
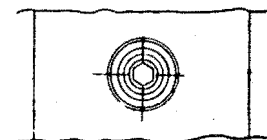


FIGURE 139



VIEW AA

PLAIN PLUG INDICATES SEPARATE DISCHARGES



VIEW BB

PLUG WITH GROOVE IN FACE INDICATES CROSS-PORTED VALVES.

PROBLEM	CAUSE	CORRECTIVE ACTION
Propel Motor Shaft (cont.)	<p>4. Improper lubrication of bearings.</p>	<p>a. Inspect grease guns and reservoir for contaminants and correct as required. Clean grease fittings before and after applying grease gun.</p> <p>b. If contaminants are found in the grease, thoroughly flush bearings with clean grease.</p> <p>4. Use only recommended types and grades of lubricants.</p> <p>a. Check that all lubricant passages are open.</p>
Motor shaft flexible coupling overheating and/or short life.	<p>1. Short coupling life due to misalignment.</p> <p>2. Coupling overheats due to lack of lubricant.</p>	<p>1. Realign propel motor to motor shaft.</p> <p>2. Flush out old grease. Refill with recommended type and grade of grease. Check alignment.</p>
Flexible coupling does not remain tight on shafts.	<p>1. Mating tapers in coupling and on motor shaft do not match.</p>	<p>1. Check which taper is wrong and correct.</p> <p>NOTE: It is easiest to remachine the coupling to fit the shaft. If this is done and the shaft is wrong, the next replacement coupling must be machined to match.</p> <p>a. Tapered half not properly installed. Expand, install, and tighten locking plate and nut on motor shaft. Be sure key is fitted into coupling before installing coupling half.</p> <p>b. Be sure coupling does not fit too loose on the motor propel shaft. Torque shaft retainer capscrews correctly. Lockwire capscrews.</p>
		<p>NOTE: Do not drive coupling half onto shaft as this will damage shaft bearings.</p>

PROBLEM	CAUSE	CORRECTIVE ACTION
Hoist Intermediate Shaft Assembly (cont.)	2. Contamination in bearing lubricant passing through seal. 3. Damaged bearings.	2. Remove contamination from lubricant and lube system. a. Refinish seal surface and replace seal. 3. Replace bearings. Inspect all related parts and repair as required.
Oil leakage at middle seal assembly.	1. Damaged seals.	1. Replace the seals being careful not to damage the seals. When installing this shaft, it must be suspended level or these seals can very easily be damaged. Exercise care when installing shaft into bearings.
Cutting and/or spalling of gear teeth.	1. Insufficient lubrication of gear. 2. Wrong type of lubricant in gear case.	1. The oil level in the gear case must be kept at the proper level to allow lubricant to splash onto the gear teeth. a. Be sure that shovel is level when operating. If not level, lubricant will not splash onto teeth. 2. Drain, flush, and refill gear case with the recommended gear lubricant. Be sure to fill to specified level.
Uneven wear on herringbone gear and pinion.	1. Loose intermediate shaft bearings. 2. Misaligned hoist motor on base. 3. Loose or broken bearing retainer capscrews on intermediate or hoist shaft.	1. Check for and correct cause of retainers becoming loose. Retighten bearing retainers. 2. Reposition and realign the hoist motor so that the motor shaft pinion is aligned with the intermediate gear. 3. Check for and correct cause of retainers becoming loose. Retighten bearing retainer.
HOIST SHAFT ASSEMBLY		
Overheating of shaft bearings.	1. Bearing on both ends have outer races clamped tight.	1. The right hand outer race is clamped tight by the right hand retainer cap. The left hand retainer cap must not contact the left hand bearing race at all.

PROBLEM	CAUSE	CORRECTIVE ACTION
Swing Machinery (cont.)	<ul style="list-style-type: none"> 4. Contaminant in gear oil. 5. Loose swing motor mounting. 6. Broken or cracked gear teeth. 7. Loose shaft end retainers. 8. Incorrect bearing clearances. 9. Loose motor pinion. 10. Contamination in gear case seam. 	<ul style="list-style-type: none"> 4. Drain and flush gear case. Do not forget to clean and flush lower swing shaft tube area. 5. Tighten all motor mount bolts. Be sure there is no contaminant between the motor flange and gear case. 6. Replace failed gear or pinion. 7. Tighten capscrews on loose shaft end retainers. Torque all capscrews evenly. There should be no clearance between the retainer and the part it is holding on the shaft. 8. All tapered bearings have a maximum end clearance of .003 inches at approximately 70° Fahrenheit. 9. Clean pinion, check bore and pinion shaft for matching tapers. Heat pinion to approximately 150° to 175° Fahrenheit and reinstall on shaft. Install lock plate and shaft end nut. Turn up portion of lock plate to lock nut in position. 10. Clean mating flanges of gear case and gear case cover before assembly. O-ring must be in place. Commercial gear case sealants are permissible.
Leaking gear cases.	<ul style="list-style-type: none"> 1. Too much oil in gear case. 2. Wrong type of oil. Oil of too high viscosity. No non-foaming additive in the oil. 3. Plugged gear case breather. 	<ul style="list-style-type: none"> 1. Keep oil at levels marked on dipstick. Be sure machine is level when checking oil. 2. Drain and refill. Use only oils and additives recommended by Bucyrus-Erie Company. Most major oil companies can meet and/or exceed these requirements. 3. Clean gear case breather periodically. This should be done at least once per month.

PROBLEM	CAUSE	CORRECTIVE ACTION
<p>Dipper Handle (cont.)</p> <p>Retract rope take up screws seizing in the bearings.</p>	<ol style="list-style-type: none"> 1. Not lubricated often enough. 2. Damage from material being excavated. 	<ol style="list-style-type: none"> 1. Both rope take up-screw bushings should be lubricated a minimum of twice per shift. This is especially important under very dusty conditions. 2. The damage from material and/or bank slough is an inherent part of normal operation. Replace take up screws.
<p>Dipper padlock pin wear.</p>	<ol style="list-style-type: none"> 1. Insufficient lubrication. 	<ol style="list-style-type: none"> 1. Padlock pins should be lubricated at least once each shift. Bucyrus-Erie Company recommends that pins be lubricated as prescribed in Care and Maintenance Manual.
<p>Bent padlock frames.</p>	<ol style="list-style-type: none"> 1. The dipper is being raised into the point sheave. 	<ol style="list-style-type: none"> 1. Avoid this practice. Repair as required.
<p>Cutting hoist ropes in padlocks.</p>	<ol style="list-style-type: none"> 1. Material from the bank entering the upper padlocks and cutting the rope. 2. Sharp corners etc. from mechanical damage to the padlock frames. 	<ol style="list-style-type: none"> 1. Whenever material from bank enters padlocks it should be removed immediately. 2. Remove the sharp corners with an acetylene torch or a hand grinder.

TABLE 3

WELDING ELECTRODES AND PREHEAT TEMPERATURES

STEEL SD NO.	WELDING ELECTRODE		MINIMUM PREHEAT TEMPERATURE °F BASED ON MAXIMUM THICKNESS OF STEEL			
	AWS CLASS.	TYPE OF WELD DEPOSIT	UP TO ¾"	OVER ¾" TO 1½"	OVER 1½" TO 2½"	OVER 2½"
3023 3116 3155 3510 3716	E7018 ⁽¹⁾	CARBON STEEL	WHEN BASE METAL IS BELOW 32°F, PRE- HEAT TO 70°F AND MAINTAIN	70	150	225
3156	E8018-C1	NICKEL ALLOY STEEL				
3149 3150 ⁽²⁾ 3323	E11018-M	NI-CR-MO ALLOY STEEL	50	125	175	225
3515	E7018 ⁽¹⁾	CARBON STEEL				
3123 3520	E8018-C1	NICKEL ALLOY STEEL	70	150	225	300
3526	E8018-C1 ⁽³⁾	NICKEL ALLOY STEEL	250	300	350	400
AMSCO ⁽⁴⁾	E308-16	CR-NI STAINLESS STEEL	NONE	NONE	NONE	NONE

(1) E8018-C1 CAN ALSO BE USED.

(2) MAY REQUIRE MAXIMUM INTERPASS TEMPERATURE CONTROL. SEE SECTION ON PREHEAT IN THE TEXT.

(3) E11018-M CAN ALSO BE USED. SEE SECTION ON WELDING ELECTRODE SELECTION IN TEXT.

(4) MANGANESE STEEL. AWS CLASS EReMn-A (NICKEL MANGANESE) ALSO USED. SEE SECTION ON WELDING ELECTRODE SELECTION IN TEXT.

REMOVAL OF CRACKS

In repair welding structural members which have cracked, it is important to completely remove the cracks, if possible, prior to welding. Any remnant of a crack left in the structure will probably grow in service to ultimately cause a failure or at least a repetition of the repair operation. Welding over partially removed cracks will conceal their presence temporarily but will not prevent their recurrence.

Cracks can be removed by air-carbon arc gouging or grinding. After removal, the cavity should be inspected by dye penetrant or magnetic particle testing for assurance that removal is complete. For cracks that are suspected or known to extend through the thickness of the member it would be well to consider how the repair is to be made before the crack is removed. If both sides of the member are accessible for welding the best approach is to partially remove the crack from one side first, weld that side then gouge and weld from the second side. Inspection for complete crack removal is done after gouging the second side. If the second side is accessible but too restrictive for welding it may be possible to insert steel backing material to permit a complete penetration full thickness weld from one side. When the opposite side is completely inaccessible there are two methods of obtaining a full thickness weld. The first is to cut out a

section of material containing the crack and replace with new material fitted in with backing strips. The other method is to completely remove the crack from one side and prepare a groove for open root welding.

The foregoing methods of crack removal and preparation for welding are illustrated in Figure 4.

WELD GROOVE PREPARATION

The details of weld groove preparation depend upon which of the foregoing methods of crack removal is used, and also the position in which welding is to be done. Correct groove preparation is important because it determines the welder's ability to make a sound repair. The various recommended groove details are shown in Figure 4.

BUTTER WELDING

When the depth of the weld groove preparation exceeds 3/4" on alloy cast steel SD 3520 or SD 3526, the cavity or side walls of the welding groove should be butter welded before filling the groove. Butter welding is effective in reducing the possibility of base metal heat affected zone cracking when repair welding. The butter welding is done with small size electrodes of the same type specified for the steel. The technique is illustrated in Figure 5.

passed an AWS or ASME pipe welding qualification test in the 5 G position using low hydrogen electrodes. Cross country pipeline welding experience will not be adequate because of the fast vertical down welding procedures used in that type of work. Power plant or similar vertical up welding experience and qualification is preferred. When finished grind the weld smooth and flush with the outside surface at the bottom.

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 B-E to determine the proper location of the cut for removal of the casting. Prior to cutting it may be necessary to remove parts attached to the handle in the vicinity of the casting to tube weld joint. When this is done note 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.

Four welding the new casting to the handle, follow instructions for welding tube without backing ring, except maintain a minimum preheat and interpass temperature of 300°F until welding is completed.

Stress relieving of the handle end casting weld is recommended. See section on stress relieving welded tube.

TUBE REPLACEMENT

For replacement, modification or lengthening of handle tubes follow instructions for welding tube with or without backing ring. Tube welds made as described herein without the use of backing rings have higher fatigue strength and will last longer in service.

STRESS RELIEVING WELDED TUBE

Local stress relieving of the welded joint is recommended to achieve maximum service life. This can be done by the application of electrical resistance or induction heating at the weld with controlled heating and cooling rates. Thermocouples attached to the weld are required to monitor the stress relieving cycle. The recommended cycle is as follows:

Below 600°F, the rate of heating can be the maximum obtainable with the heating equipment. Above 600°F the rate of heating should not exceed 400°F divided by the thickness of the tube in inches. Heat to a temperature of 1125°F and hold the temperature in the range of 1100-1150°F for a length of time equal to 1 hour per inch of tube thickness. Above 600°F the rate of cooling should not exceed 500°F divided by the thickness of the tube in inches.

Contract services⁽⁴⁾ are available to do stress relieving of tubular weld joints.

(4)

Suggested Source: Stresstech
Box 11
Red Wing, Minnesota 55066
(612) 388-7117

BE SURE ALL SAFETY MEASURES ARE FOLLOWED.

SERVICE ASSISTANCE:

If additional information or assistance is required, contact:

Bucyrus-Erie Company
Service Department
P.O. Box 56
South Milwaukee, Wisconsin 53172
Phone: (414) 768-4000

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