Technical Manual

SWINGING RESTRAINT

Before performing any maintenance on the mining shovel, it should be resting on a firm, level surface. A small ground slope is enough to cause the machine to freely rotate if the brakes are not set or other restraints are not used. *Once moving, it will keep going.*

The following shows the relation between an out-of-level or slope and the resulting difference in elevation over a 14 ft. swing rack:

Slope	%	Difference in Elevation
0.25°	0.4%	0.75"
1.0°	1.7%	2.9"
5.0°	8.7%	14.7"

Where possible, all work on the swing brakes, motors, gearcases, or rack pinions should occur with the dipper attached to the machine and the full weight of the dipper on the ground. If the dipper is not resting firmly on the ground, then an external means of preventing machine upper works rotation is required. Tie the upper works to the lower works using the preferred method mentioned below.

Mining shovels rotate using multiple swing units. Power is transferred from electric motors through individual gearcases, to pinions and into a fixed swing rack. Electric motor control prevents inadvertent machine rotation during operation. Should machine electric power be lost, spring-set brakes on the swing drive motors lock the geartrain to prevent machine rotation.

When working on the brakes, motors, or geartrains, it is an accepted practice to set the dipper on the ground. The weight of the dipper and handle will prevent machine rotation. EVEN IF ALL BRAKES, MOTORS, OR SWING GEARCASES ARE REMOVED the machine should not rotate.

In certain circumstances it may not be possible to rest the full weight of the dipper firmly on the ground. For instance, the dipper, handle or the boom may not be attached to the machine.

To prevent machine rotation, with any of the major structures removed, two swing motor brakes should be set. A single brake in good operational condition is acceptable. However, a minimum of two brakes is recommended due to the possibility that the proper operation of a single brake may be unknown.

Caution: **ON MACHINES USING PLANETARY DUAL-OUTPUT SWING DRIVES, BOTH SWING PINIONS PER DRIVE MUST BE ENGAGED WITH THE SWING RACK IN ORDER FOR THE SWING BRAKE TO BE EFFECTIVE. The internal differential drive in the gearcase allows one pinion to rotate, even if the brake is set, when the other pinion has been removed.**

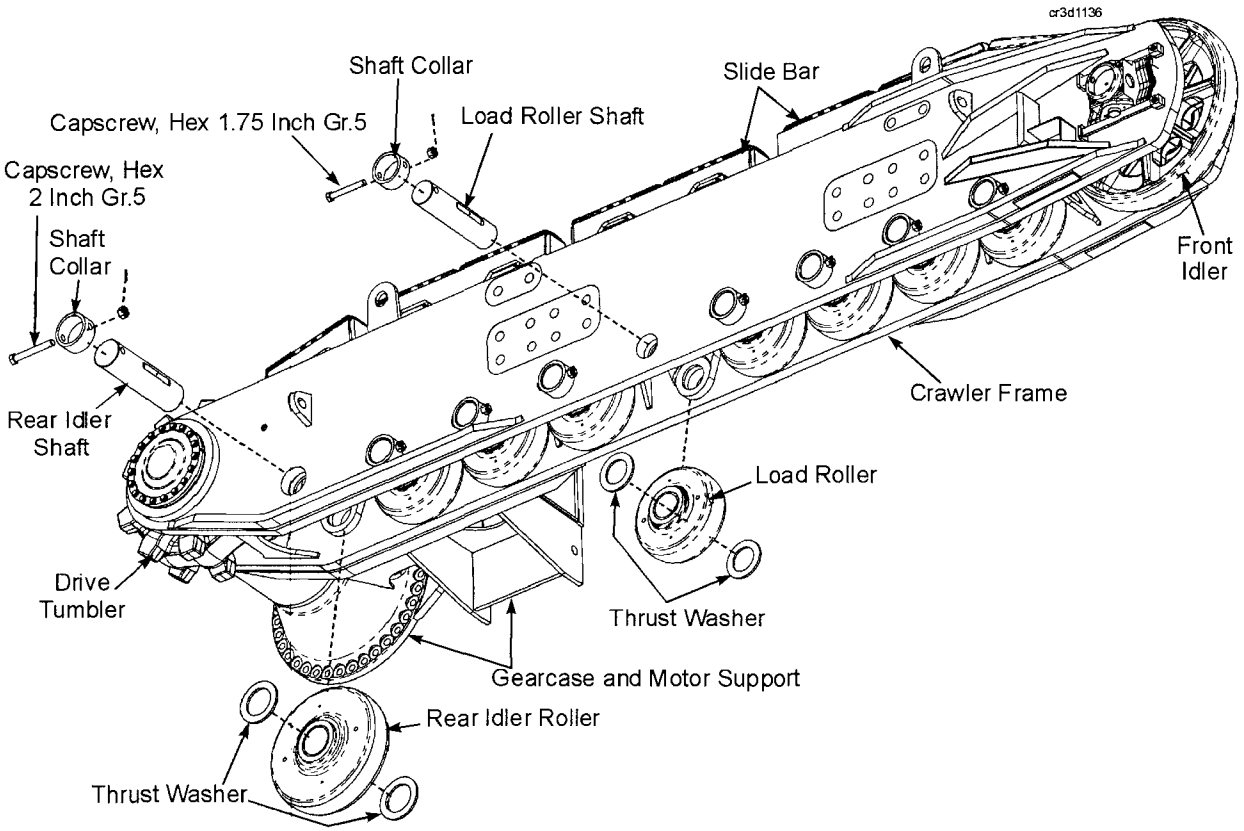
CRAWLERS

This machine is provided with a crawler system composed of 2 independently-driven crawler frame assemblies, one on each side of the truck frame. Each crawler has its own belt driven by a sprocket-type drive tumbler. Individual crawler links are heavy alloy steel castings connected by heat treated pins.

Innovative drive tumblers made from large diameter steel castings have lugs extending beyond the tumbler rims. They are mounted on forged alloy steel shafts which turn on large anti-friction bearings mounted within the crawler frame. The sprocket type lugs provide a large area of contact against the crawler links, extending the life of both links and tumblers.

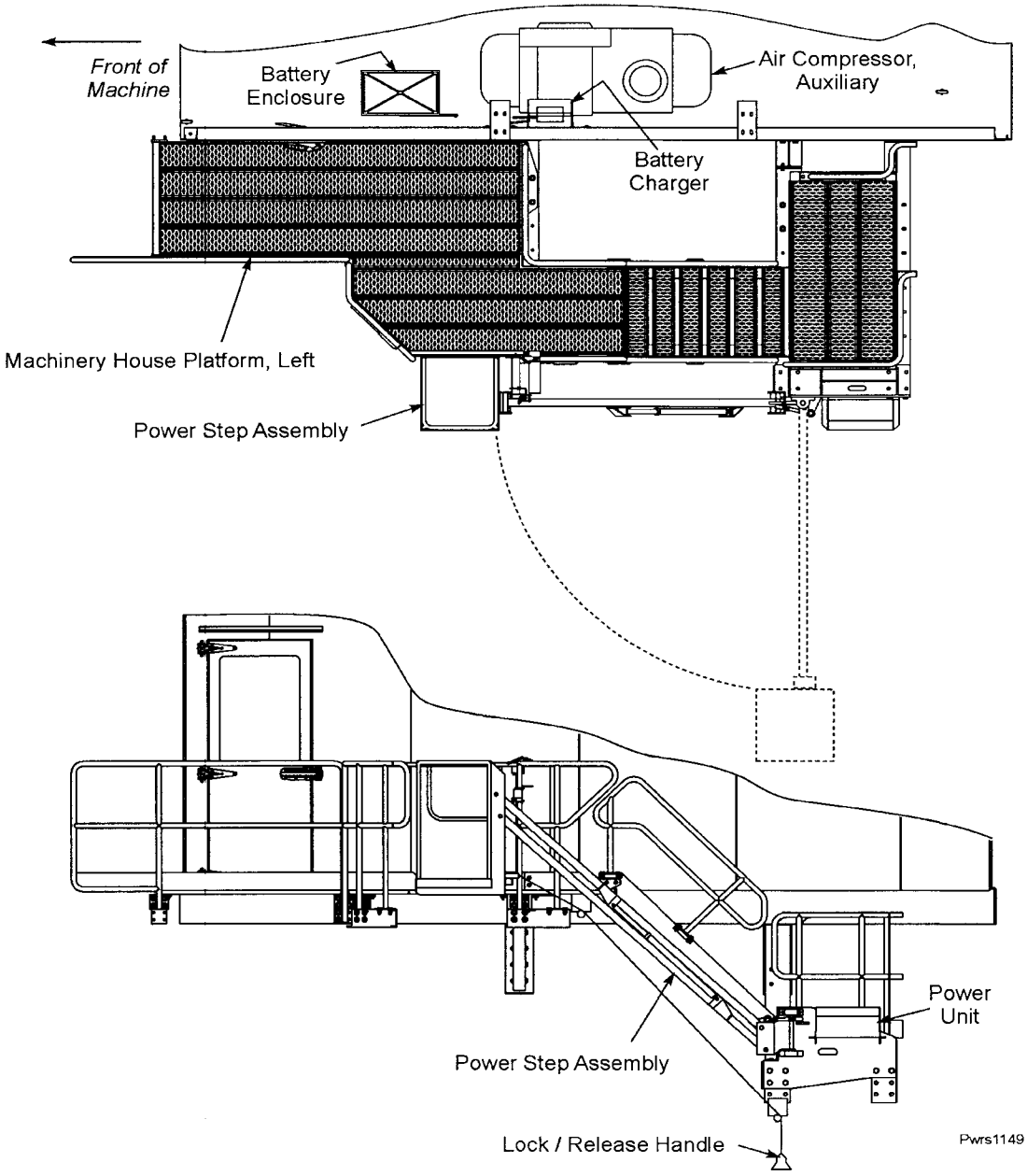
Lower rollers rotate on forged steel shafts mounted within the crawler side frames. Eight smaller rollers and 1 large roller per frame are specially suited to withstand the periodic single point ground reaction caused by uneven pit floors. Slide bars on top of each frame support the upper crawler belt, reducing propel friction and drag. These side frames are stress relieved weldments comprised of steel castings and cold weather steel plates.

The crawler assemblies are bolted to the truck frame with large diameter rods and torque nuts. Each crawler belt can be independantly adjusted for tension.



Right Crawler Assembly (Left Opposite)

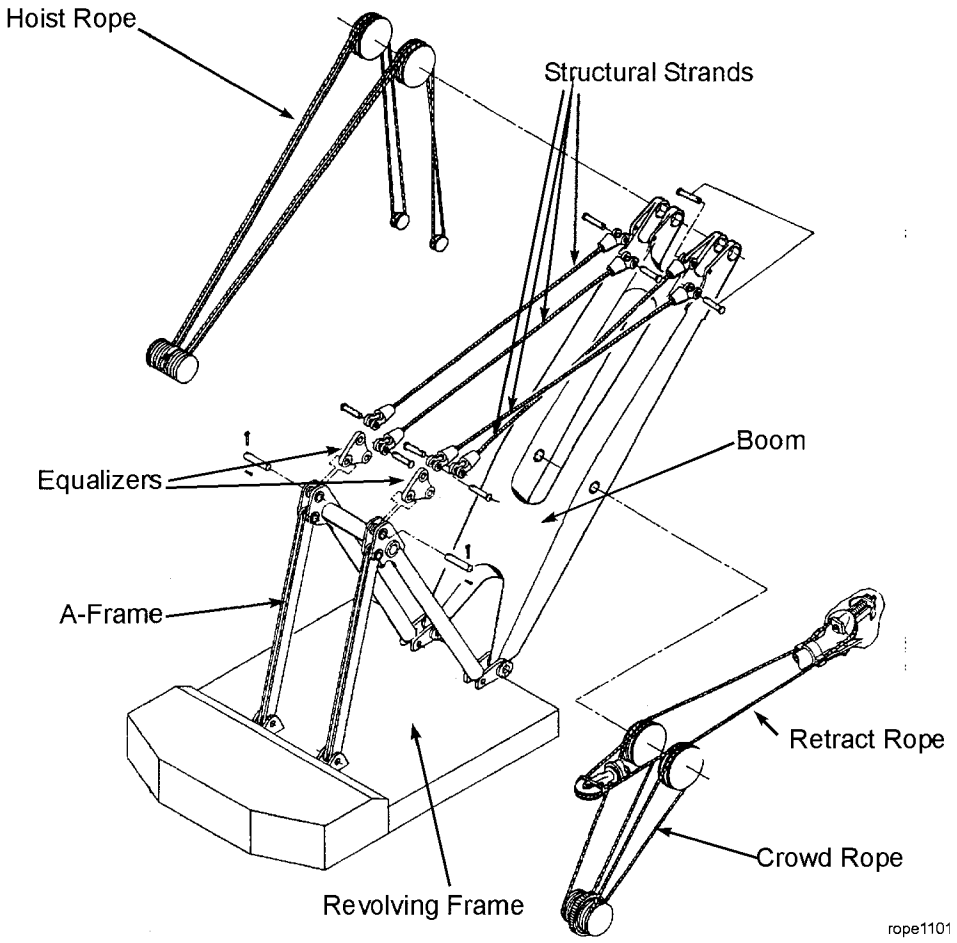
POWER STEP



The Power Step is one of the means for boarding the machine. It is located on the left side of the machinery house, near the center of the lower platform. Use the lock / release handle from ground level to lower the power step for boarding. When the power step is NOT latched in place, the operator's controls are deactivated.

RUNNING ROPES

Hoist, crowd, retract and dipper trip ropes are all plastic impregnated for increased life and for sheave and drum grooving life enhancement. The double twin hoist ropes are attached to the center of the hoist drum using ferrule-becket anchoring for faster rope change out. Each rope passes over a boom point sheave through the padlock and back over the boom point sheave to the hoist drum. The dual twin hoist rope configuration stabilizes the dipper while digging by attachment to the outer edges of the dipper body.



Ropes - General Arrangement

Crowd and retract ropes are attached to the crowd drum and work as an integral system. As the crowd rope is wound on to the drum, the retract rope is reeled off.

Section **2**

Operation

GENERAL INFORMATION

This section of the manual will assist in the operation of this machine. It provides the operator with the location and explanation of the controls, instructions for machine operation and certain maneuvering techniques. Throughout this section and the remainder of the manual, the use of the terms "*LEFT*, *RIGHT*, *FRONT* and *REAR*" refer to machine locations as viewed by the operator sitting in the operator's seat in the cab.

Safe operation of the machine minimizes production delays and costly damage to equipment. Carefully study and follow all recommended procedures in this manual. Safety guidelines are intended to prevent accidents from occurring and are provided in the interest of all mine personnel. Overall safety depends upon the use of good judgment and the alertness of the entire mining crew. Refer to Section 1 in this manual for specific safety precautions.

OPERATION NEAR ELECTRICAL LINES

DANGER: HIGH VOLTAGE! The following precautions shall be complied with whenever operating around or near electrical distribution and transmission lines.

Working in the vicinity of electrical power lines presents a very serious hazard and special precautions must be taken. For purposes of this manual we are considering the entire machine or its load, in any position, that can reach to within the minimum distance specified by local, state and federal regulations.

Safe operating practices require that you maintain the maximum possible distance from the lines and never violate the minimum clearances.

Before working in the vicinity of power lines, always take the following precautions:

- Always contact the owners of the power lines or the nearest electric utility before beginning work.
- You and the electrical utility representative must jointly determine what specific precautions must be taken to insure safety.
- It is the responsibility of the user and the electric utility to see that necessary precautions are taken.

START PUSHBUTTON

A pushbutton that, when pressed, will power up the drive system. The system ready light will go out.

PLC POWER ON

A green light that indicates the status of the PLC.

DRIVE CABINET TEMPERATURE

A green light that indicates temperature in the drive cabinet is neither too low nor too high.

INCOMPLETE SEQUENCE

A red light that indicates an incomplete sequence of startup events.

SYSTEM READY

A green light that indicates that the drive system is ready to start, but not yet started.

PHASE SEQUENCE

A green light that indicates that the phase sequence is okay in the incoming power.

AUXILIARY GROUND FAULT

A green light that when lit, indicates that no auxiliary power ground fault exists. If the light is off, alert an electrician as soon as possible.

HOIST BRAKE

A selector switch used to set or release the Hoist Brake.

CROWD BRAKE

A selector switch used to set or release the Crowd Brake.

SWING BRAKE

A selector switch used to set or release the Swing Brake.

AIR COMPRESSOR

A 3-position selector switch use to select either compressor No.1, No.2 or off.

DIG/PROPEL TRANSFER SWITCH

The Dig/Propel Transfer Switch is used to switch between the two primary operating modes of the machine. The current mode of operation will be indicated on the Operator's screen on the Operator's Display.

IMPORTANT:

- WHILE IN THE DIG MODE, THE PROPEL CONTROLS ARE DISABLED.
- WHILE IN THE PROPEL MODE, THE DIG CONTROLS ARE DISABLED.

The recommended procedure to transfer from hoist to propel is to bring all motions to a controlled stop by the operator. Turn the hoist brake switch to the SET position and then press the control stop pushbutton. Turn the transfer switch from DIG to PROPEL.When the indicator on the Operator Display screen indicates that the transfer has been completed, turn the propel brake switch to release.

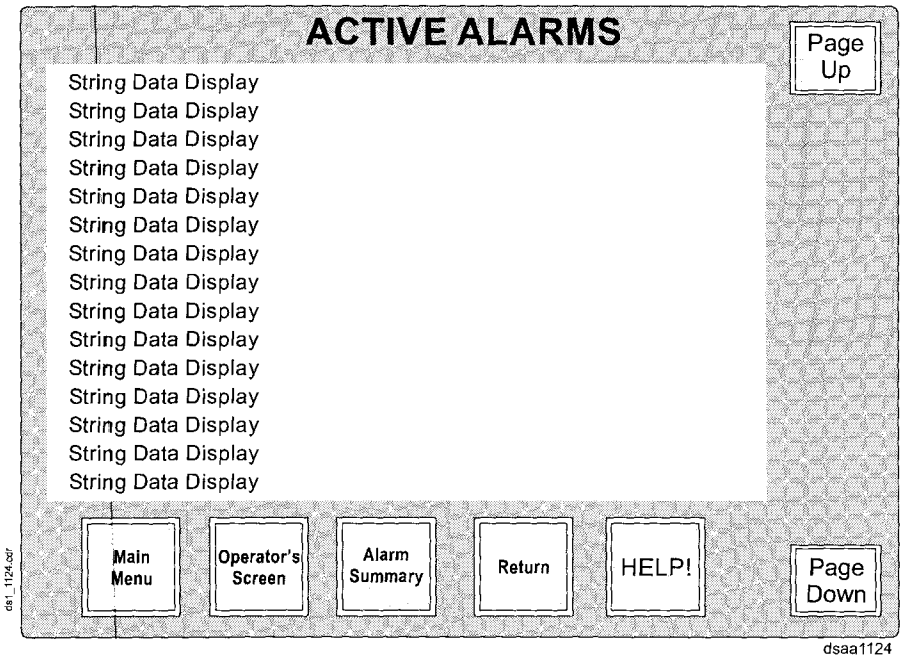
HEATED MIRRORS

The heated mirrors switch is a 2-position switch located on the right control console. It is used to activate the heating mechanism in the operator's cab outside mirrors.

MAIN POWER OFF PUSHBUTTON

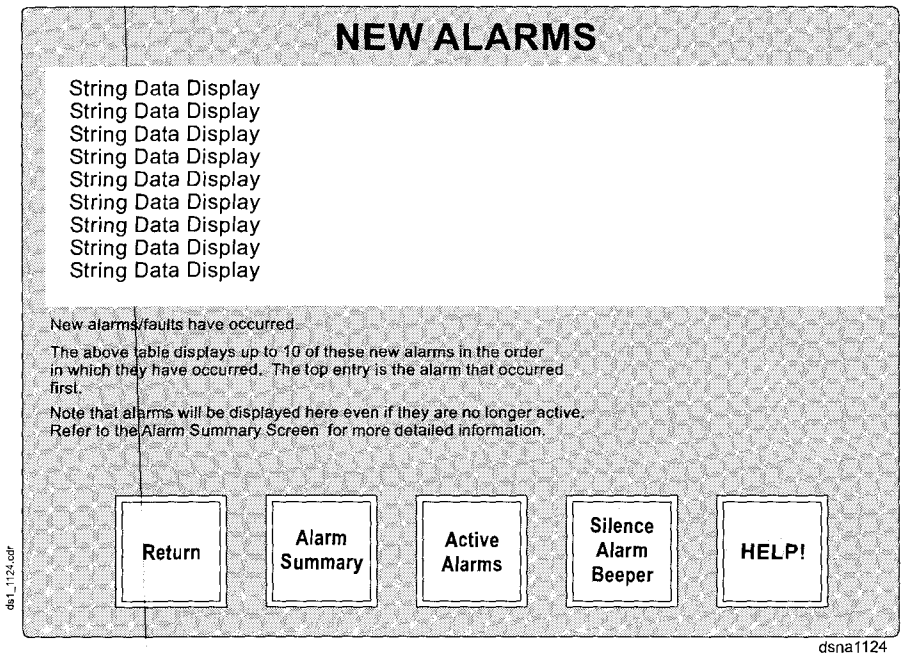
The main power off pushbutton is located on the right operator's console. It is used only to immediately remove power from the drives in case of an electrical emergency involving component failure or fire.

CAUTION: PUSHING THE "POWER OFF" PUSHBUTTON WHILE IN MOTION WILL IMMEDIATELY SET THE MECHANICAL BRAKES AND REMOVE INCOMING HIGH VOLTAGE FROM THE DRIVES. THIS ACTION MAY RESULT IN COMPONENT DAMAGE. It will also result in the inability to power the DC bus voltage down to a low value. This voltage will decay slowly, taking several minutes.



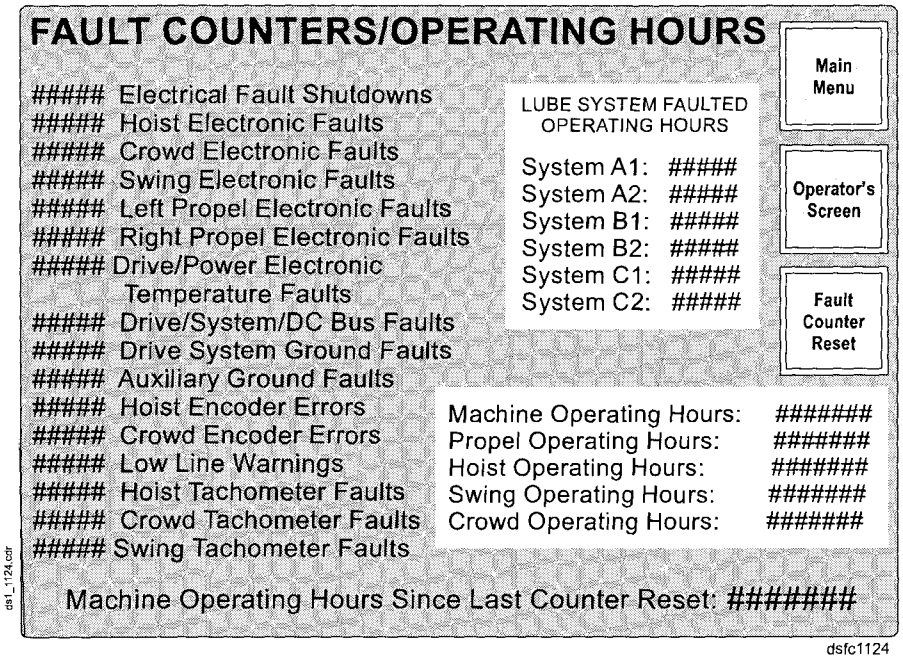
Active Alarm

The Active Alarm screen will provide a list of all active alarms and faults that have been initiated on the machine and have not been RESET. Once an alarm or fault has been sensed, these messages will remain visible and WILL NOT be removed from this screen until it is RESET.



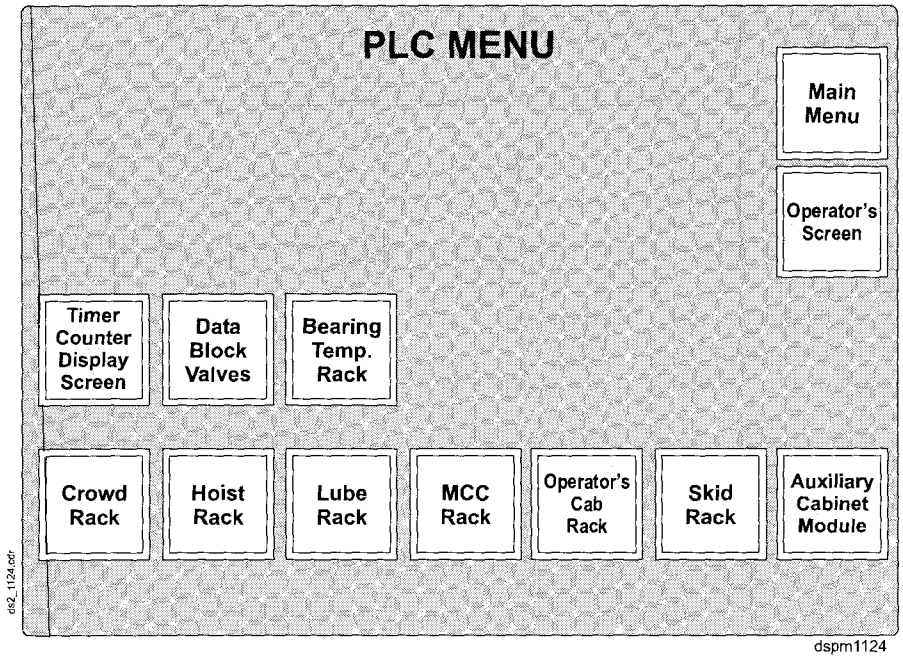
New Alarm

The New Alarm screen appears automatically any time a machine sensor detects a newly occurring fault or warning message. This screen has the ability to list up to 10 of the new fault messages that



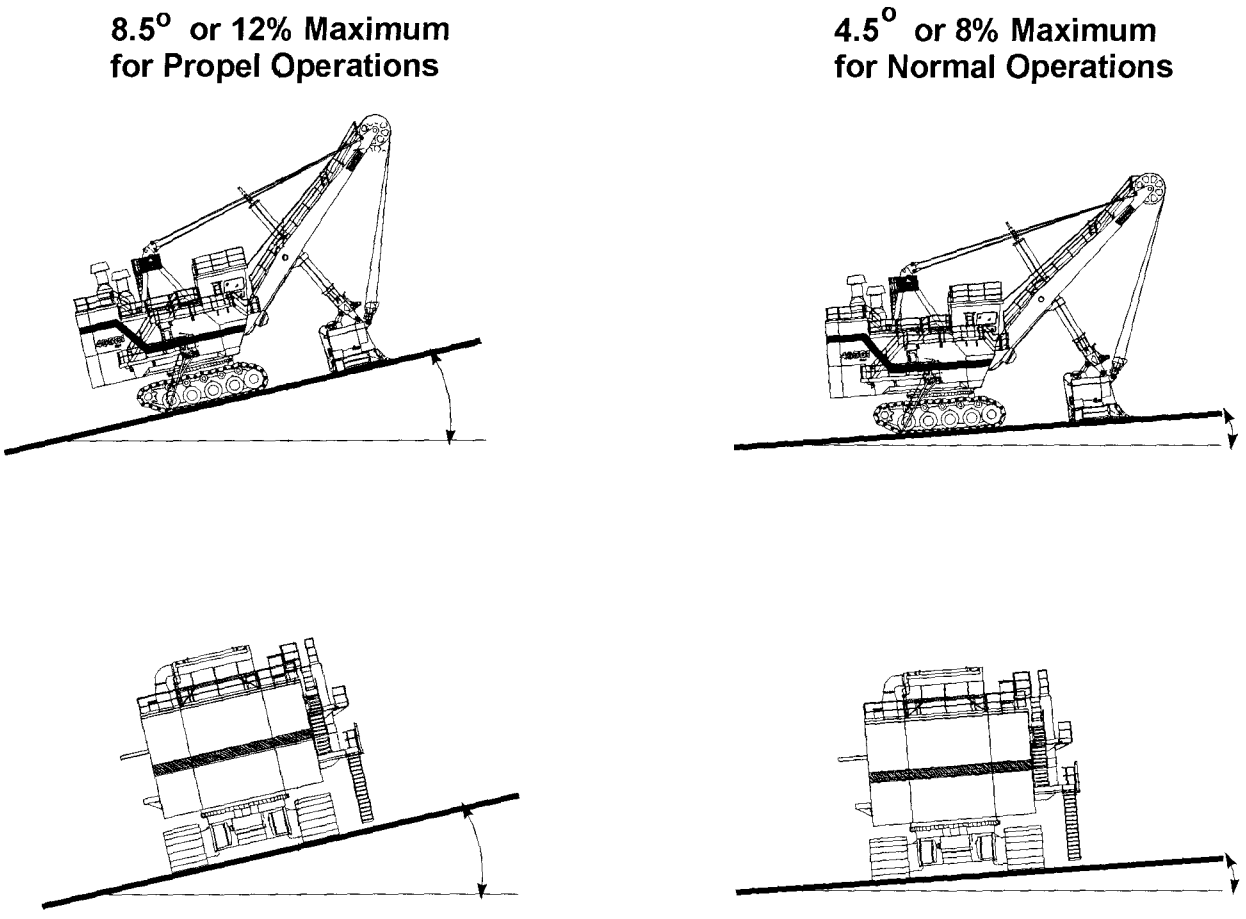
Fault Counters/Operating Hours

The Fault Counter/Operating Hours screen provides the operator with information on the number of faults that have occurred since last RESET. It also provides the total operating hours.



PLC Menu Screen

This screen will provide access to additional screens, which are used to monitor the various racks within the PLC cabinets.



Rollover and Operation Limits

EXCAVATED MATERIAL

It is important that the operator not only know the controls but recognize other aspects of the mining operation. Chief among these is the type of material to be excavated. It plays a great part in the overall efficiency of the machine.

Materials can be roughly divided into four categories:

1. *Easy digging.* This category includes all loose, free-flowing materials, such as sand and gravel deposits, stock pile materials such as finely crushed stone, ore fines, coal fines and any other similar materials. The dipper will usually obtain a heaped load.

2. *Medium digging.* This category includes only materials which can be excavated from their natural beds without blasting, and which break up in bulk with some voids. Such material includes clay, dry earth, clay-gravel mixtures, gravel with some boulders, certain types of ores, and coal. The dipper will usually obtain a full load, with filling augmented by the material's natural tendency to break apart when it encounters the dipper lip and teeth.

NOTES:

1. Ambient Temperature - The ambient temperature shall be the temperature at the point of lubricant application.

2. Low Temperature Grease - For extended use in low temperature (+10° to -50°F) areas, this product should be capable of slumping in containers and should be pumpable through lube lines without the aid of heat tracing. In order to minimize compatibility problems, it is desirable that the thickener and additive system be the same as NLGI #1 and #2 greases.

3. Pumpability Tests - Major manufacturers of automatic lubrication systems check for pumpability at the designated ambient temperatures. The results of these tests should be sent to the Bucyrus International Service Department for review.

4. Seal and Packing - If a vendor should recommend a multipurpose grease which would require a special type of material for seals and packing, he should contact the Bucyrus International Service Department and discuss these requirements with them.

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

MPO - MULTIPURPOSE OIL

SCOPE: Lubricant performance requirements for Multi-Purpose Oil.

APPLICATION: The addition of a lubricant to the compressed air system (not for screw-type air compressor systems - see ACSL), hand oil cans, etc.

GENERAL REQUIREMENTS:

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

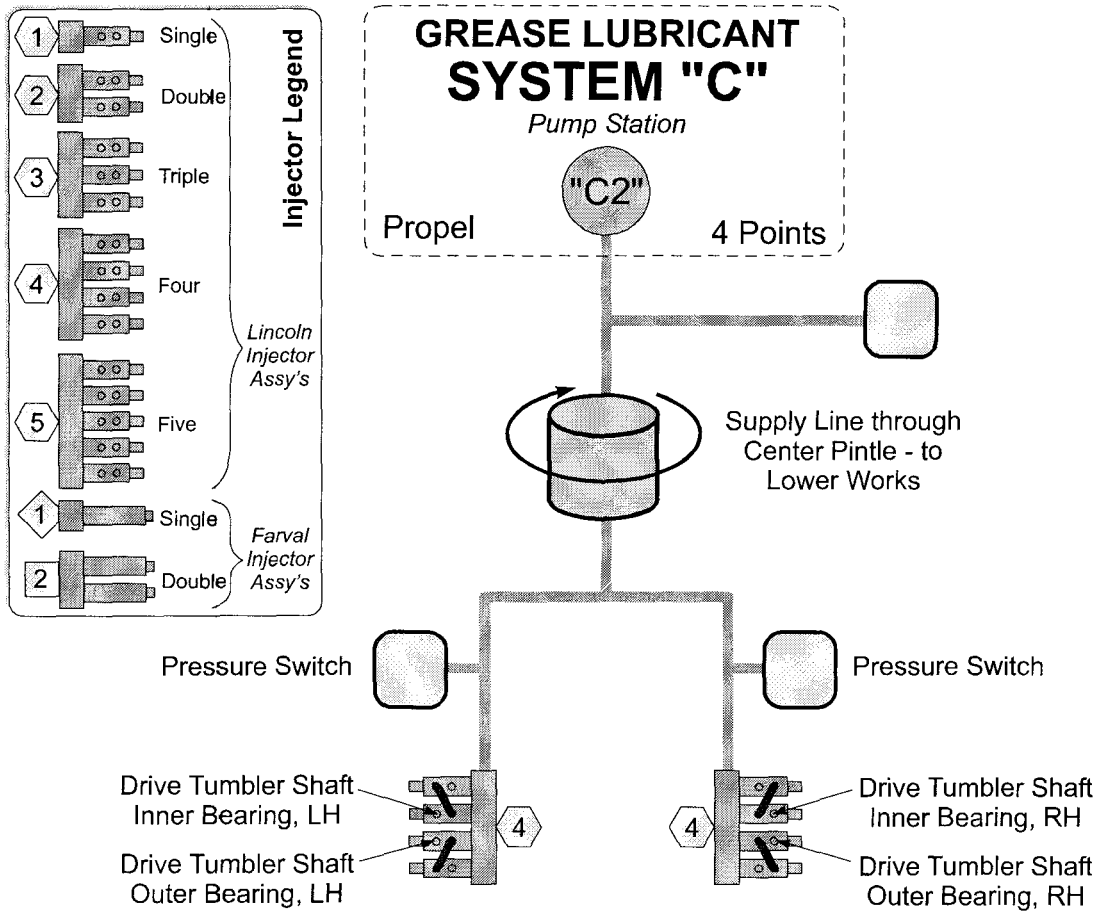
VISCOSITY RECOMMENDATIONS:

1. Air Line Lubricant

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

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

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



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MPG Circuit C2 ~ PROPEL

Electrical PM & Service

					3000	HR
EMERGENCY LIGHTING & STOPS	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK OPERATION OF EMERGENCY LIGHTING **Light Bulb - 8018657**				x	x	x
1.2 CHECK BATTERIES					x	x
1.3 CHECK ALL CONNECTIONS					x	x
1.3 CHECK OPERATION OF MACHINE STOP & EMERGENCY STOP IN HOUSE					x	x

Comments & Corrective Action:

ONBOARD TELEPHONE	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK OPERATION OF ALL STATIONS				x	x	x

Comments & Corrective Action:

MISCELLANEOUS	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK LADDER LIMIT SWITCH, MOUNTING & OPERATION				x	x	x
1.2 CHECK OPERATION OF TUGGER MOTORS, CONTROLLER & CABLE CORD				x	x	x
1.3 CHECK OPERATION & MOUNTING OF BOOM LIMIT SWITCH				x	x	x

Comments & Corrective Action:

HOUSE FANS	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK HOUSE MOTOR #1 WIRING & CONNECTIONS					x	x
1.2 Grease Blower Motor brgs with Mobilith SHC100 Grease	SPECIAL					x
Drive End Bearing **Non-Drive End Brg**						
1.3 CHECK HOUSE MOTOR #2 WIRING & CONNECTIONS					x	x
1.4 Grease Blower Motor brgs with Mobilith SHC100 Grease	SPECIAL					x
Drive End Bearing **Non-Drive End Brg**						
1.5 CHECK CONTROL ROOM MOTOR WIRING & CONNECTIONS					x	x
1.6 Grease Blower Motor brgs with Mobilith SHC100 Grease	SPECIAL					x
Drive End Bearing **Non-Drive End Brg**						

Comments & Corrective Action:

LUBE SYSTEM	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK LUBE PANEL WIRING & LIGHTS					x	x
1.2						

Comments & Corrective Action:

DIPPER TRIP MOTOR	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK CONNECTIONS FOR TIGHTNESS				x	x	x
1.2 CHECK CONDITION OF BRUSHES & CHANGE IS NECESSARY					x	x
1.3 CHECK CONDITION OF COMMUTATOR. CLEAN IF NECESSARY				x	x	x
1.4 Grease Blower Motor brgs with Mobilith SHC100 Grease						x
Drive End Bearing **Non-Drive End Brg**						

Comments & Corrective Action:

CAB	GOOD	R'PD	ALERT	1000	3000	6000
1.1 CHECK OPERATION OF SEAT/CONTROLS				x	x	x
1.2 CHECK OPERATION & CONNECTIONS OF CAMERA'S AND MONITORS				x	x	x
1.3 CHECK CONTROLLERS, SWITCHES & INDICATOR LIGHTS				x	x	x
1.4 CHECK AM/FM/CD PLAYER				x	x	x
1.5 CHECK CAB WINDOW/WIPERS				x	x	x
1.6 CHECK INTEGRITY OF MOUNTS ON MICROWAVE, 2-WAY RADIO, ETC.				x	x	x
1.7 CHECK OPERATION OF MACHINE STOP & EMERGENCY STOP IN CAB				x	x	x

Reassembly is the reverse of disassembly:

a. The diameter of the new roller must be within ±.001 inch of adjacent rollers. Measure the diameter of its adjacent rollers and grind the new roller(s) to match.

b. Coat the nylatron bushing, thrust washer and bore of the roller with a winter grade of MPG.

c. With the roller seated against the thrust rail, the gap between the thrust washer and roller is to be .12 inch nominal. Refer to "Roller Circle Adjustment Procedure" above.

d. Tighten the capscrews to 210 Ft.Lbs.

SLIDE BAR REPLACEMENT

Eight Cast Manganese Slide Bar Caps guide the crawler belt over each crawler side frame. These slide bar caps are welded to 4 supports on each crawler and are intended to be replaced when worn.

The procedure for replacement is as follows:

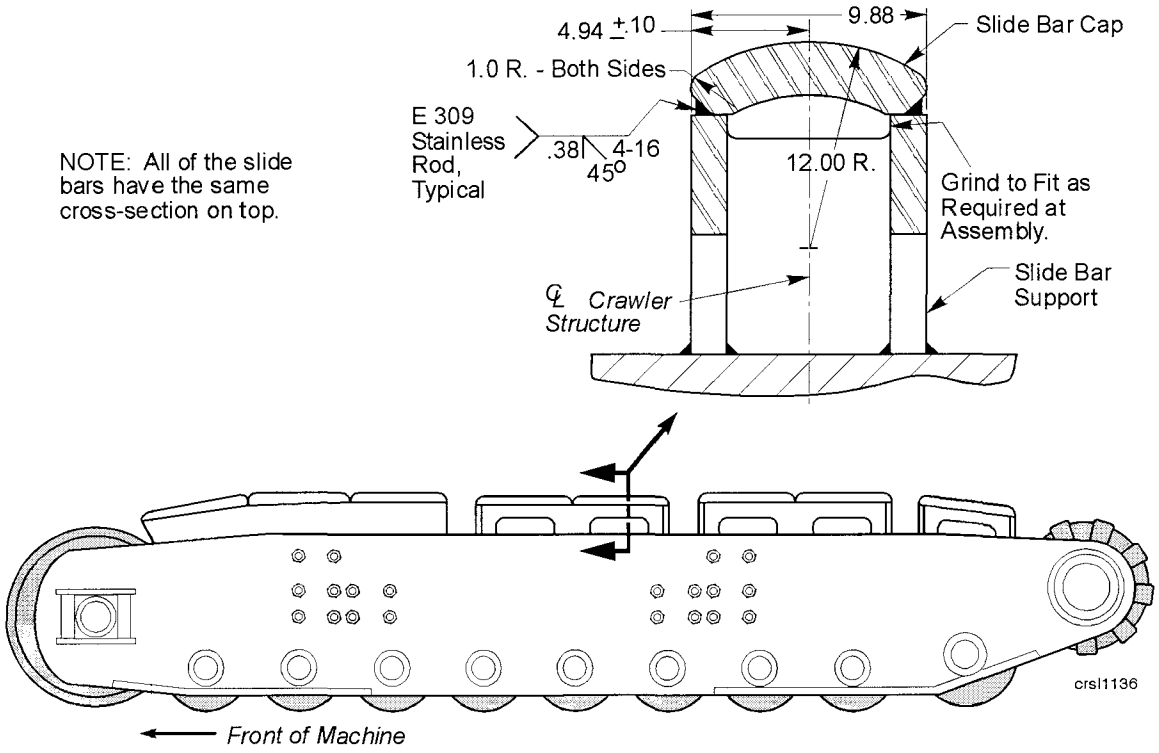
1. Park the machine in a level work area.

2. Remove all tensioning shims in the front idler. This will provide as much slack as possible in the crawler belt. Raise the shoes over the slide bar(s) to be removed at least 6.5 inches.

3. Remove the 6 welds which attach the slide bar *cap* to be removed to its support and remove the slide bar cap.

4. Grind the new slide bar cap as required for a proper fit.

5. Install the new slide bar cap and weld in place. Refer to the figure below.



Crawler Mounted Slide Bars

MAIN PROPEL DRIVE SHAFT REMOVAL

1. Park the machine safely on a level work area.

2. Rotate the revolving frame to gain access to the propel machinery.

3. Release the tension in the crawler belt to unpin the belt.

4. Have a qualified electrician disconnect the trail cable from the machine and move it out of the way.

DANGER: HIGH VOLTAGE! Only qualified personnel are permitted to perform this operation. Failure to comply could result in bodily injury or death.

5. Remove the walkway from the front of the wing, above the propel machinery.

6. Separate the belt on top of the crawler, forward of the drive tumbler.

DANGER: Secure the belt before separating it so that it cannot move unexpectedly under its own weight. Failure to do this could result in personal bodily injury.

7. Lift the belt from the drive tumbler and lay it on the ground.

8. Mark the tumbler and the shoe under it with a visible mark (paint) so that the tumbler can be repositioned to the belt in same location.

9. Remove the guard from the propel motor coupling and disassemble the coupling.

10. Support the propel gearcase (approx. 15,800 Lbs.) with a crane.

11. Unbolt the propel gearcase and remove it. Store in a clean area.

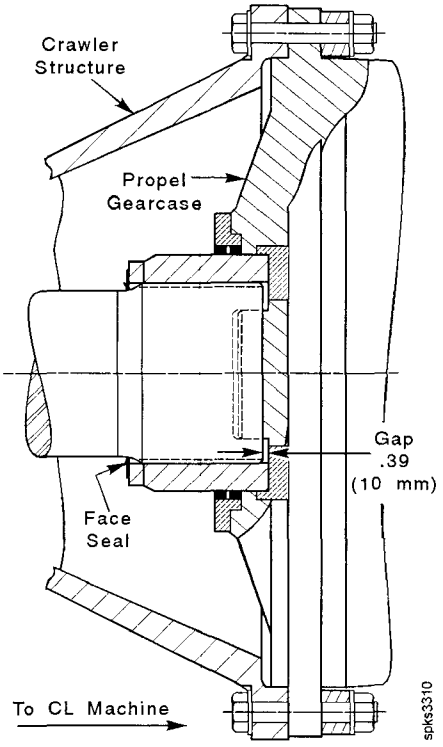
12. Remove the lube line to the inboard propel bearing at the inside of the gearcase housing.

13. Disconnect and plug the lube line to the outboard bearing retainer. Remove the retainer with its shim pack from the end of the main propel shaft. Support the tumbler with the crane.

14. Pull the outboard bearing carriage from its bore using 3 - M24 x 3 x 200 jack screws in the tapped holes provided in the cartridge flange.

15. Remove the retainer plate from the outboard end of the tumbler shaft.

2. Install the a new face seal onto the propel shaft as shown in the sketch.



3. Pack the rear of the spline cavity in the propel gearcase for the main propel shaft with 1 pint of Molub-Alloy grease paste (P/C 480206-3) or equivalent.

4. Coat the internal and external spline surfaces and all shaft pilot surfaces with Molub-Alloy grease paste or equivalent.

5. Install the gearcase by engaging the splines of the gearcase with the main propel shaft and the pilot register of the gearcase with the crawler housing. Install the spacer and 36 fasteners and tighten to 7,380 Ft.Lbs.

NOTE: Align the match marks if the same gearcase is being reinstalled. This will minimize the time required to align the coupling. If a *NEW* gearcase is being installed, add new match marks after the gearcase has been installed and the coupling aligned.

6. Fill the gearcase with the proper lubricant to the specified capacity. Refer to Section 3 - LUBRICATION, in this manual. Be sure to install the breather and case plugs.

7. The reassembly of the propel motor coupling can be assisted by releasing the disc brake with the manual override on the air control valve. This will allow the rotation of the motor shaft.

8. Align the motor coupling per the specifications in Section 6 - BRAKES AND COUPLINGS, in this manual. Install the grids and cover.

9. Fill the propel motor coupling to the recommended level with special long term grease (P/C 295148-7).

10. Install the cable reel, if furnished, with the machine and reconnect the trail cable.

DANGER: HIGH VOLTAGE! - RE-CONNECTION OF THE TRAIL CABLE SHOULD ONLY BE PERFORMED BY A QUALIFIED ELECTRICIAN. Failure to comply could result in severe bodily injury or death.

6. Remove the control collector rings from the swivel shaft. Remove the swivel assembly retainer and remove the retainer with swivel assembly attached. Remove the collector ring support and remove the support and collector rings as a unit.

7. Secure the swivel support at the top so that when it is removed it will not fall. Remove the access cover from the bottom of the truck frame and enter truck frame. Disconnect and tag the air and lube lines and the electrical cables and tie them out of the way.

8. Remove the swivel support base from the truck frame and lower the swivel support with base out of the truck frame.

9. Remove the lock bars, lower nut, and thrust washer from the lower end of the pintle sleeve

10. Install the lifting lug, supplied with the machine, to the top of the pintle and connect the auxiliary winch to the lifting lug.

CAUTION: Be sure to apply a load to the center pintle lifting lug sufficient to lift the center pintle - before proceeding.

11. Remove the bolts, lockwashers and dowels that fasten the upper nut to the revolving frame. Remove the upper lock bars and their hardware. Remove the hardware joining the 2 halves of the upper nut then remove the upper nut from the pintle sleeve.

NOTE: The upper nut is a split collar design to aide in removal and assembly.

12. Using the auxiliary winch, lower the sleeve into the pit. Replace a worn or damaged sleeve with a new one. Check the pintle sleeve bushing for wear or damage. Replace if required. Check the truck frame around the pintle structure for cracks. If the pintle structure area needs repair, contact the Bucyrus International Service Department for instructions.

Center pintle sleeve installation is the reverse of disassembly.

NOTES:

1. When installing the upper center pintle nut, assemble it in place around the center pintle and fasten the 2 halves together. Install the lock bars and their hardware.

2. If the lower nut was burned apart for removal, reassemble the nut as follows:

   a. Install new O-Rings on the alignment pins and insert the pins in the nut halves.

   b. Clamp the two halves of the nut together. To install the new T-Bolts which have an interference fit of 0.47 to 0.53 inch to the nut, heat the T-Bolt to 900-950°F. Do not heat the T-Bolts to more than 1,000°F.

SWING MOTOR REMOVAL

NOTE: Removal of the appropriate roof panel is required for the removal/replacement of either the left or right swing motor. Complete instructions for the removal and replacement of the motor coupling hub and swing brake hub may be found in Section 6 *~BRAKES AND COUPLINGS*, in this manual.

1. Position the machine with the dipper lip and front flat on the ground. Set all brakes.

DANGER: BEFORE ATTEMPTING TO DISCONNECT ANY POWER LEADS or REMOVE ELECTRICAL COMPONENTS, PRESS THE *MAIN POWER OFF* BUTTON AND TAG IT TO AVOID INADVERTENT ENERGIZING OF THE ELECTRICAL CIRCUIT. Electrocution may lead to serious injury or death if appropriate safety measures are not followed. Electrical connections should only be handled by trained electrical personnel.

2. Have a qualified electrician tag and disconnect the electrical leads to the motor.

3. Remove the swing motor blower and duct assembly.

CAUTION: STORED ENERGY! RELEASE THE AIR PRESSURE TO THE BRAKE BEFORE DISCONNECTING THE AIR LINE. Plug the line immediately after disconnecting. Failure to comply could result in personal injury.

4. Release the air pressure in the line to the swing brake, and disconnect the air line.

NOTE: The swing motor and brake can be removed as a unit if desired. If so skip the next step.

DANGER: STORED ENERGY! Gearing or drum must be blocked prior to performing maintenance in order to prevent unwanted movement. Failure to comply could result in death, severe personal injury, or damage to the machine. Refer to Section 1 - Swing Restraint.

5. Remove the swing brake from the motor per the proper instructions. The weight of the swing brake is approx. 490 Lbs.

6. Remove the bolts securing the motor drive coupling halves together per the proper instructions in Section 6 of this manual.

7. Attach a lifting device to the motor and remove slack from sling.

8. Remove the bolts securing the motor to the planetary gearcase housing.

9. Remove the motor from the planetary gearcase and store in a dry location if to be reinstalled. The weight of the motor is approx. 4,600 Lbs.

SWING PINION SHAFT DISASSEMBLY

With the pinion shaft assembly resting in a near horizontal position, disassemble the shaft as follows:

1. Remove the 6 capscrews that attach the lower carrier retainer to the carrier. Remove the retainer.

2. Remove the inspection cover and its 6 capscrews. Separate the O-Ring from the inside of the inspection cover.

3. Pull the bearing carrier from the bearing. Separate the O-Ring from the top side of the carrier.

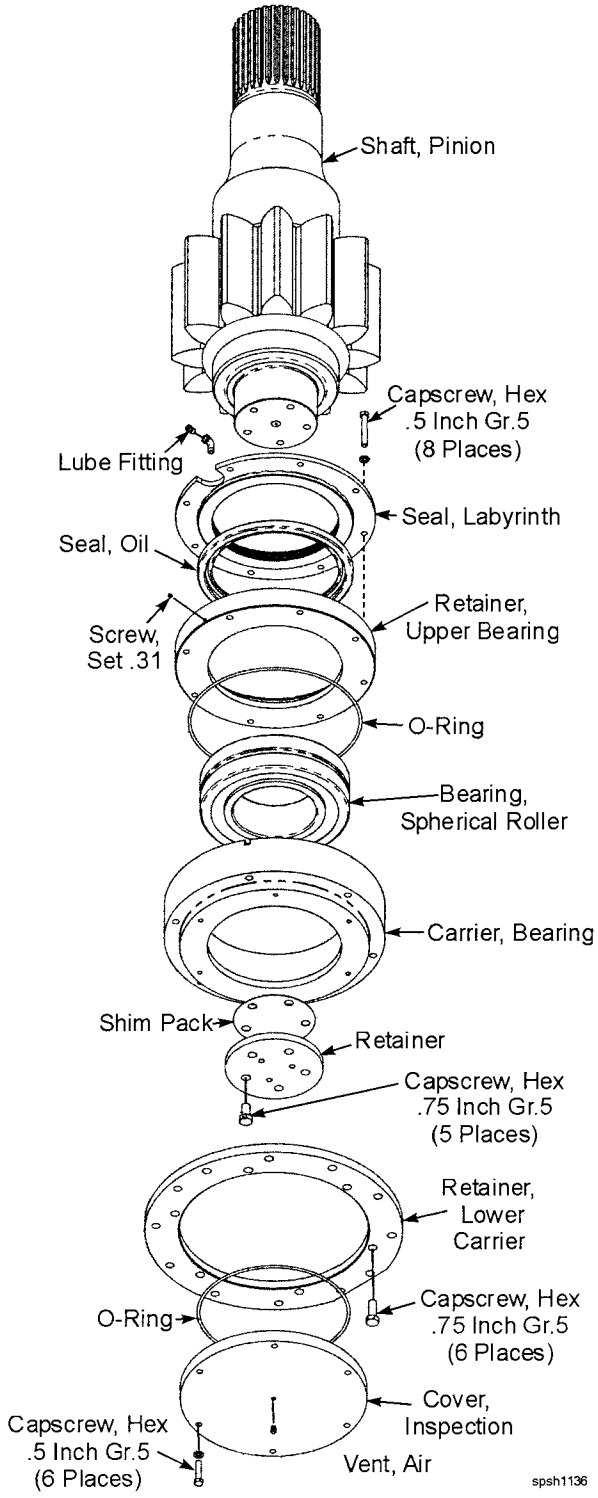
4. Remove the 5 capscrews from the bearing retainer. Remove the bearing retainer and the shim pack from the end of the shaft.

5. Use a suitable puller to remove the bearing from the end of the shaft.

6. Remove the 8 capscrews from the back side of the labyrinth seal.

7. Disassemble the upper bearing retainer, the oil seal and the labyrinth seal and remove these components from the shaft.

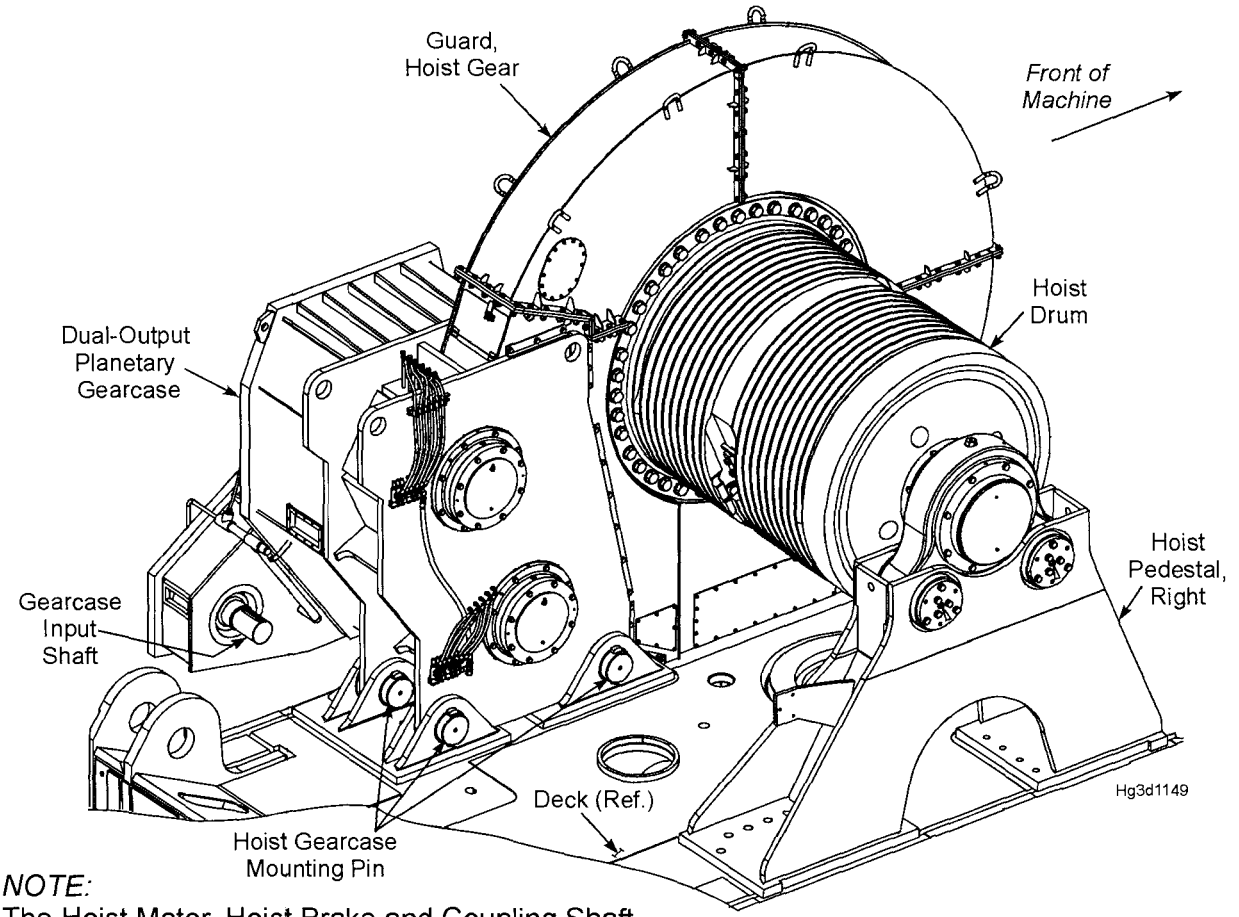
8. Inspect all parts. Repair or replace any worn or broken components.



HOIST GEARCASE ASSEMBLY

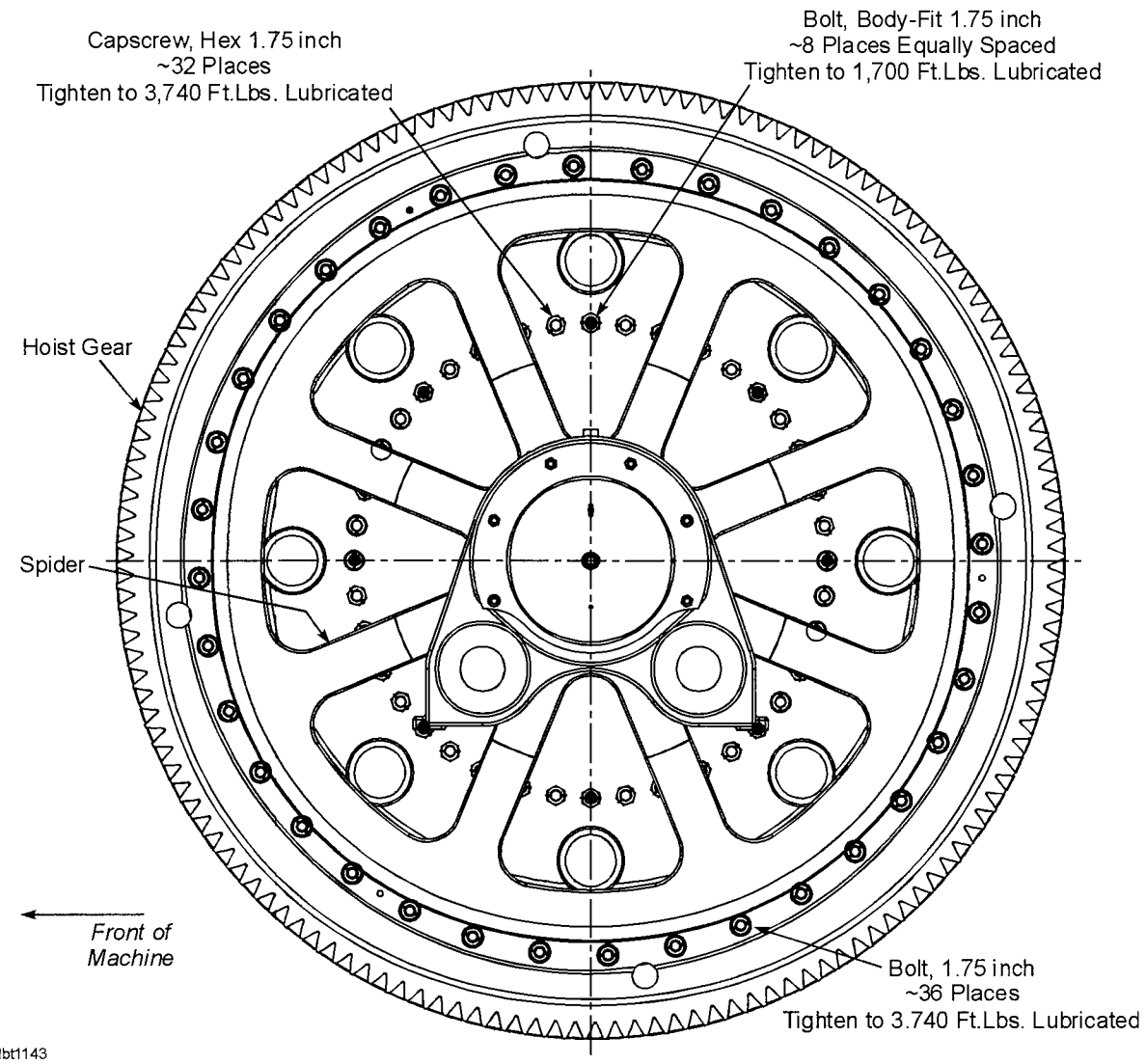
The Hoist Gearcase is a split-power, planetary gearcase. Power is transferred from the Hoist Motor through a single input shaft to dual helical output pinions mated to the main hoist gear. Three pins fasten the gearcase to the left hoist pedestal. The gearcase utilizes an oil circulating system to lubricate internal gearcase components and to maintain cooling.

DANGER: **STORED ENERGY! Equipment must be blocked prior to gearcase removal to prevent unwanted rotational movement. Failure to comply could result in death, severe personal injury, or damage to the machine. On machines using planetary dual-output swing drives, both swing pinions per drive must be engaged with the swing rack in order for the swing brake to be effective. The internal differential drive in the gearcase allows one pinion to rotate, even if the brake is set, when the other pinion has been removed.**



NOTE:
The Hoist Motor, Hoist Brake and Coupling Shaft have been removed for clarity.

Installation of the Hoist Gearcase



4. Remove the 36 - 1.75 inch body-fit bolts that fasten the hoist gear to the spider.

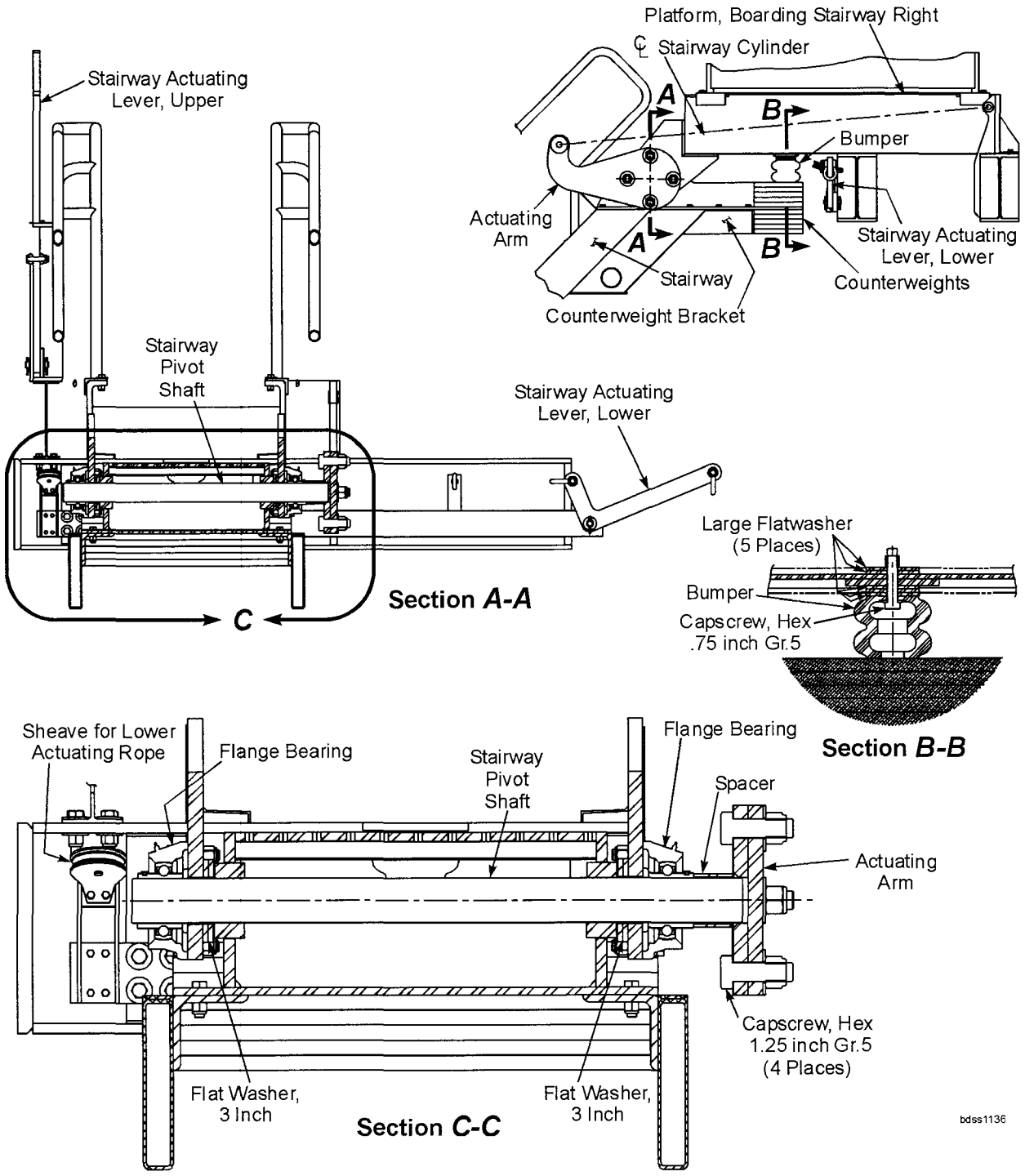
5. Lift the drum and spider assembly away from the hoist gear.

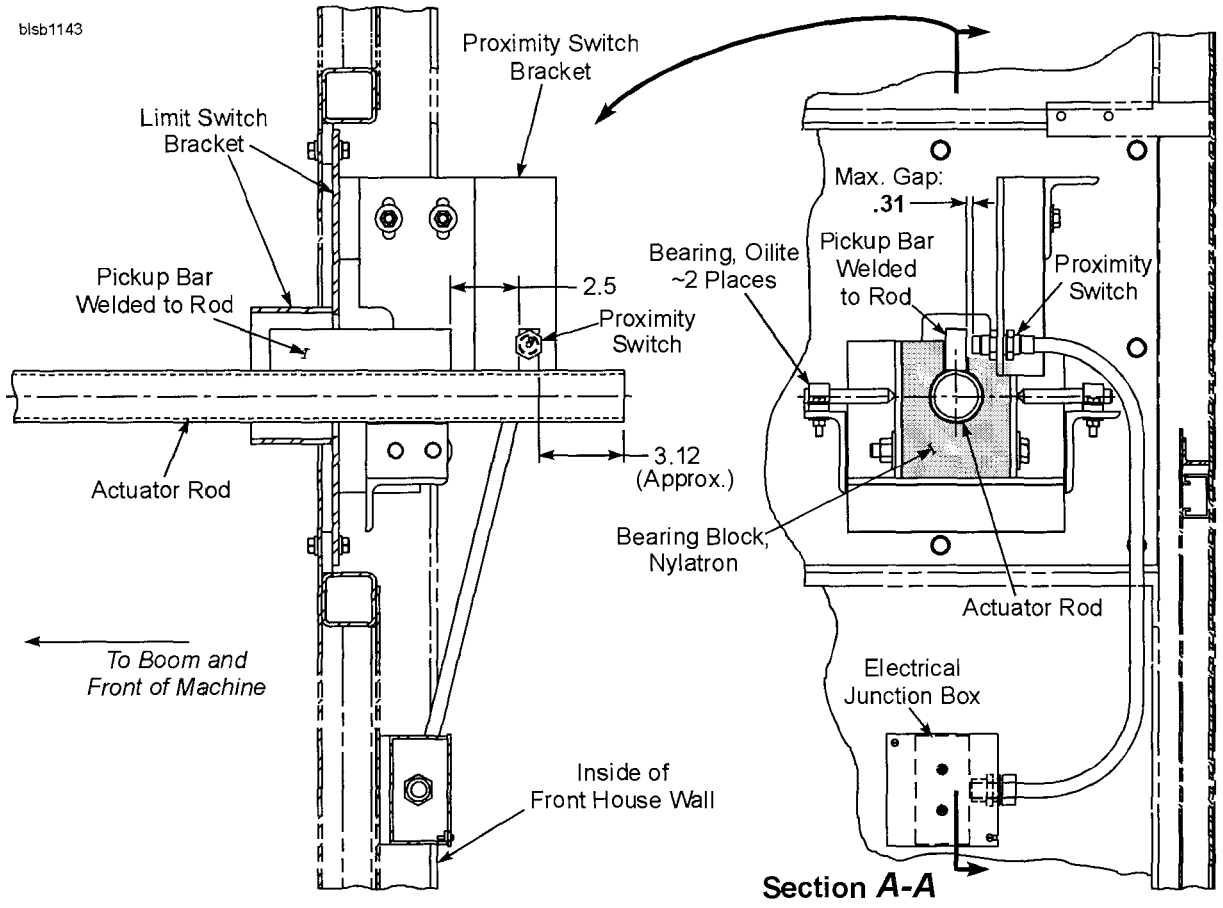
6. Place the drum and spider assembly onto the new hoist gear (resting on cribbing).

NOTE: If reversing the existing hoist gear, set the drum and spider assembly on cribbing, turn over the existing gear with an additional crane, then set the drum and spider assembly on the gear. The hoist gear weighs approx. 12,000 Lbs.

7. Install the 36 body-fit bolts and tighten.

8. The drum shaft can now be reinstalled in the machine using the above procedure.

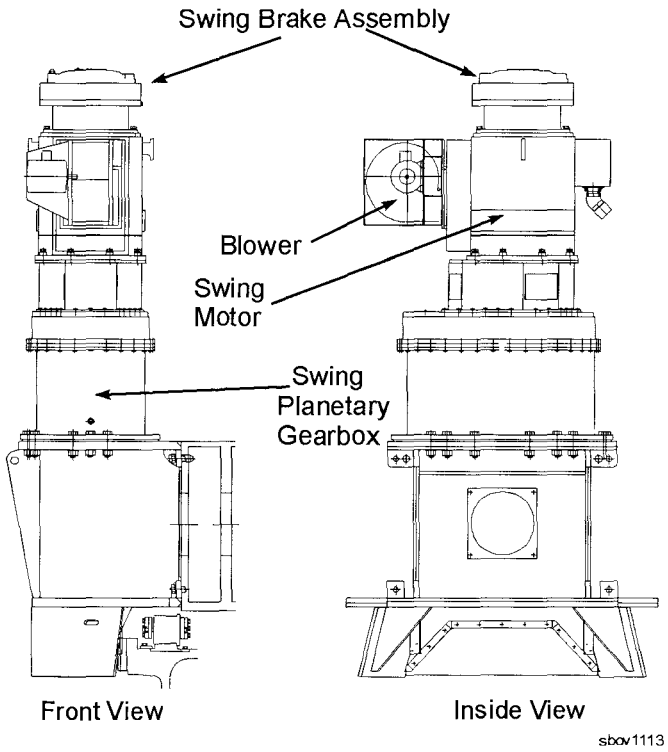

Platform, Boarding Stairway Right
℄ Stairway Cylinder
Stairway Actuating Lever, Upper
A
B
Bumper
Actuating Arm
A
B
Stairway
Counterweight Bracket
Stairway Actuating Lever, Lower
Counterweights
Stairway Pivot Shaft
Stairway Actuating Lever, Lower
C
Section A-A
Large Flatwasher (5 Places)
Bumper
Capscrew, Hex .75 inch Gr.5
Section B-B
Sheave for Lower Actuating Rope
Flange Bearing
Stairway Pivot Shaft
Flange Bearing
Spacer
Actuating Arm
Capscrew, Hex 1.25 inch Gr.5 (4 Places)
Flat Washer, 3 Inch
Flat Washer, 3 Inch
Section C-C
bdss1136

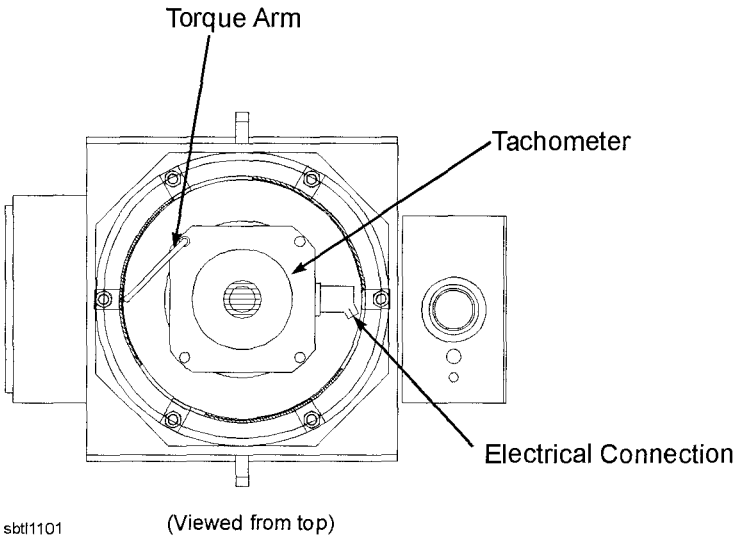


Boom Inductive ProximitySwitch

Overall sensitivity can be further adjusted from this initial position to suit conditions.

SWING BRAKE


Swing Brake Assembly
Blower
Swing
Motor
Swing
Planetary
Gearbox
Front View
Inside View
sbov1113


Torque Arm
Tachometer
Electrical Connection
sbtl1101
(Viewed from top)

3. Re-check to total cylinder movement. If total movement is greater than .270 inch, place the unit back into service.

If the brake has already had a single shim removed, a second adjustment is possible. If the brake movement is greater than 0.400 inch the second shim may be removed using the same steps as for the first shim.

NOTES:

- When removing the second shim the friction discs and center plates be removed and inspected. Use care during disassembly to keep track of the order in which the components were removed.
- If the wear is unequal between the inner and outer friction discs they should be reversed during reinstallation (Place the inner disc to the outside and the outer disc to the side nearest the motor).
- Always be certain the machined step on the disc (near the center) is facing the motor during installation.
- Replace the brake piston and nuts. Tighten to a maximum of 120 Ft.Lbs. as above and check total piston movement. If the movement is greater than 0.270 inch the brake can be returned to service.

HOIST BRAKE INSTALLATION

The tachometer, furnished with the electric motor, must be installed before installing the brake assembly.

1. Install the drive hub and keyway on the motor. Refer to Pinion and Hub Installation Procedure in Section 9 - Engineering Data.

2. Install motor shaft nut and secure to shaft with loctite.

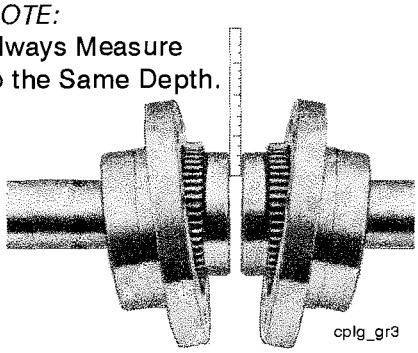
3. Install brake adapter onto the motor and secure with hardware. Use care to align the access slots in the adapter for future tachometer inspections.

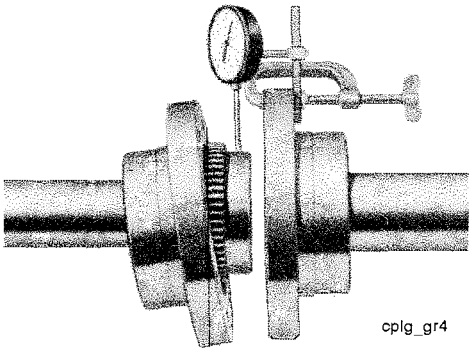
4. Lubricate the hub and friction disc splines with a light coat of teflon grease or anti-seize compound.

5. Install the friction discs and center plates onto the shaft adapter in the required order before sliding on the brake assembly. Tighten the drive ring hardware and install the brake guard.

3. Gap and Angular Alignment - Use a spacer bar equal in thickness to gap specified in Table. Insert bar, as shown, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements should *NOT* exceed the *ANGULAR* limit specified in the table.

NOTE:
Always Measure to the Same Depth.

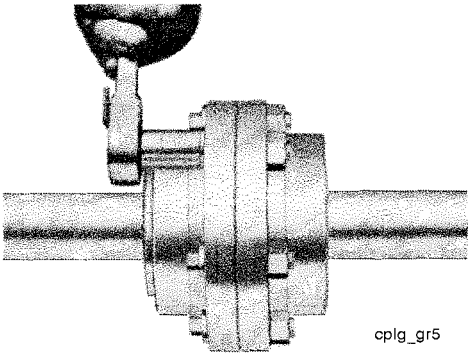

cplg_gr3


cplg_gr4

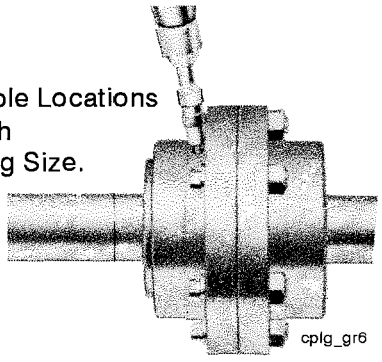
4. Clamp a dial indicator to the rigid hub as shown and rotate the rigid hub one complete turn. The total indicator reading *DIVIDED* by two must not exceed the *OFFSET* limit specified. Tighten all foundation bolts and repeat Steps 3 and 4. Realign coupling if necessary. Grease the hub teeth.

5. Insert gasket, *DO NOT DAMAGE the GASKET*, between flanges. Position flanged covers with lube holes at 90° and draw flanged cover into position. Use bolts, nuts and lockwashers furnished with couplings.

IMPORTANT: Tighten the flange bolts and nuts to the torque specified in the Table.

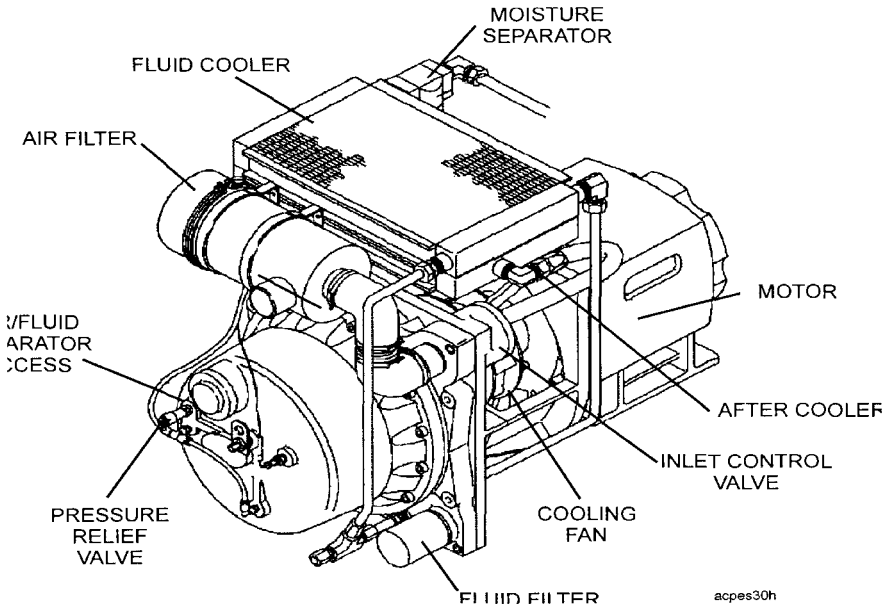

cplg_gr5

NOTE:
Lube Hole Locations vary with Coupling Size.

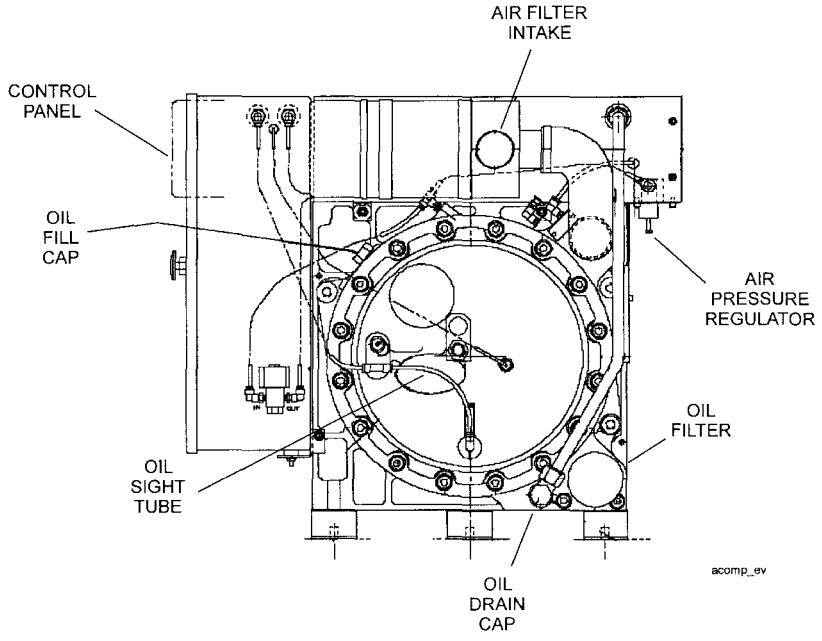

cplg_gr6

6. For *TYPE G* couplings, fill with recommended grease until excess appears at the open hole; then insert plug. For *TYPE GV* couplings, proceed as outlined above. *IN ADDITION*, when flex hub is on *TOP*, vent by inserting a .010 thick *SMOOTH* feeler gauge between seal and hub. Fill until excess appears at feeler. Repeat at 90° intervals.

CAUTION: Make certain all plugs are inserted after lubricating.



Air Compressor

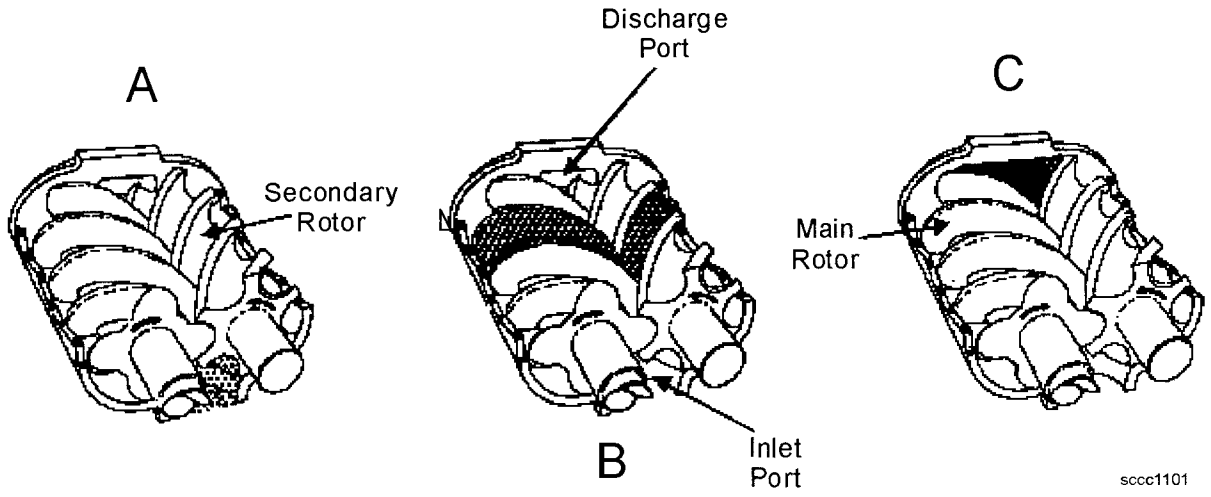


Service Features

For further specific information on the air compressor, refer to the compressor manufacturer's manual supplied with this machine.

THE COMPRESSION CYCLE

Compression is accomplished by the main and secondary rotors synchronously meshing in a one-piece cylinder. The main (driven) rotor has four helical lobes 90° apart from one another lengthwise. The secondary (idler) rotor has six matching helical cut flutes placed 60° apart in order to allow meshing with the main rotor.



Screw Compressor - Compression Cycle

The compression cycle begins as the rotors begin to un-mesh at the inlet port and the air is drawn into the cavity between the main rotor lugs and the secondary rotor's flutes (figure A). When the rotors pass the inlet port's cutoff, the air is trapped in the cavity between the two rotors (figure B). As the rotational meshing continues, a greater amount of the main rotor lobe will enter the secondary rotor flute and the air volume is reduced as the pressure of the air increases. Oil is introduced to reduce the heat of compression and provide sealing for the internal clearances between the rotors. Volume reduction and pressurization will increase as the rotation continues until the air/oil mixture passes the discharge port (figure C) and is released to the oil reservoir.

Flashing: When flashing, this indicates that an alarm is being displayed.

• **P2 -** Lit: When lit steadily, this indicates that P2 (Line Pressure) is being displayed.

Flashing: When flashing, this indicates the presence of a line pressure alarm.

• **dP1 -** Lit: When lit steadily, this indicates that dP1 (Sump Pressure & Line Pressure) is being displayed.

Flashing: When flashing, this indicates the presence of a sump pressure and line pressure alarm.

• **T1 -** Lit: When lit steadily, this indicates that T1 (Unit Discharge Temperature) is being displayed.

Flashing: When flashing, this indicates the presence of a temperature alarm.

• **MOTOR** - Flashing: Indicates that the motor overload contactor has opened.

• **ON -** Lit: Indicates that the compressor is running.

Flashing: When flashing this indicates that the Restart Timer HAS NOT expired, or that a Remote Stop or Sequence Stop condition exists.

CAUTION: When displayed, the compressor may start-up without further warning.

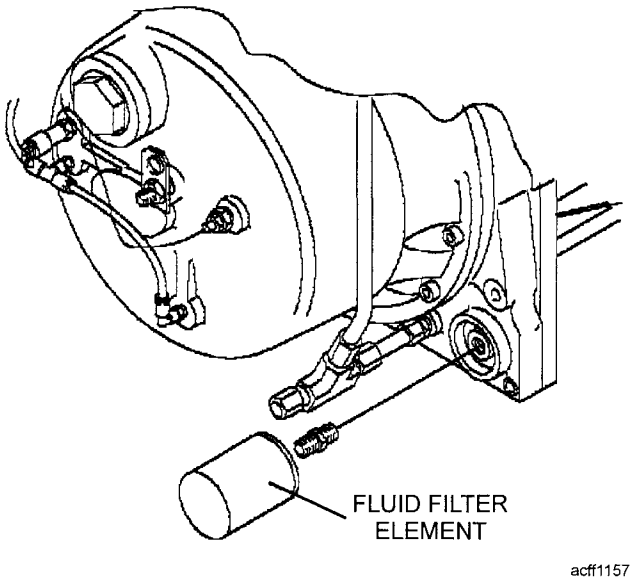
• **AUTO -** Lit: When list steadily, the compressor is running and Auto Mode is active.

Flashing: When flashing, this idicates that the Restart Timer HAS NOT expired, or that a Remote Stop or Sequence Stop condition exists.

CAUTION: When displayed, the compressor may start-up without further warning.

FLUID FILTER MAINTENANCE

The fluid filter element is to be replaced as recommended in the Compressor Lubrication Guide table, or with every fluid change.



Fluid Filter Assembly

FLUID FILTER REPLACEMENT

1. To prevent spillage and loss of reusable fluid, place a contaminate-free fluild receptacle beneath the fluid drain valve and fluid filter.

2. Drain fluid by removing fluid drain cap at tee located beneath compressor.

NOTE: For a complete fluid drain, drain the fluid from the cooler.

3. Using a strap wrench, remove the old element and gasket.

COMPRESSOR PREVENTIVE MAINTENANCE CHECKLIST

Hours of Operation	*Required Maintenance*
8 hours	1. Check oil reservoir level - add if required. 2. Observe if the unit loads/unloads properly. 3. Drain moisture traps on air receiver and separator*
125 hours	1. Check for accumulation of foreign matter on oil cooler and aftercooler* core faces. 2. Check for accumulation of foreign matter on the fan and fan motor.
8,000 hours	Replace oil filter.
8,000 hours	Replace compressor oil and filter. Adverse conditions may dictate a more aggressive maintenance schedule.

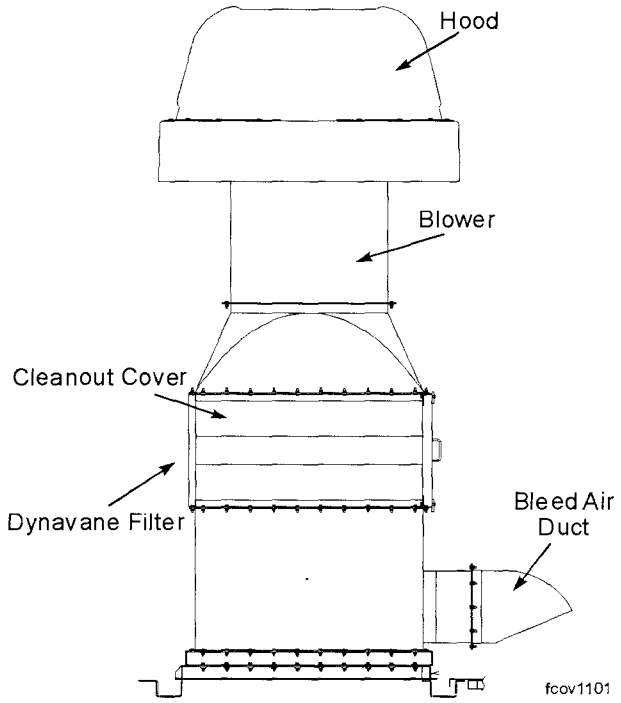
** if used*

Use a low pressure grease gun for fan bearings. Either the gun or the fitting should be vented. To prevent overfilling apply a small amount of grease. This is especially important when extended lubrication piping is used and the bearing cannot be observed.

DYNAVANE AIR CLEANER

Dynavane air cleaners are self-cleaning and do not require the routine service typical of air filters which collect and hold the dirt removed from the air. There are a few maintenance procedures which should be observed.

- The air entering the side of the cells should be kept free of rags, leaves and papers to assure free airflow. Applications exposed to this type of material should have intakes covered with a course mesh (5 mesh) screen to prevent entry of material larger than the bleed slot.



Filter Components Overview

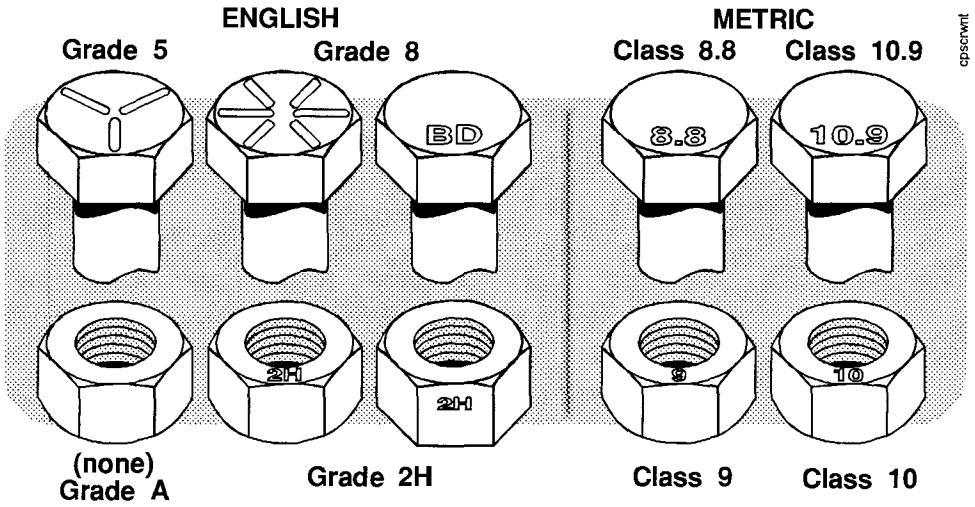
- Check the bleed system to make sure nothing has impaired bleed air flow.
- The cells should be examined for buildup of deposits on the blades. A light coating of dust is normal and will not impair the operation or efficiency of the cell. Occasionally, due to the presence of oil mist or similar vapors in the air, heavier surface accumulations will occur and the cell will require cleaning. Cleaning the cells can be accomplished by brushing the surface of the blades or blowing down with compressed air.
- Another method of cleaning the Dynavane filters is to reverse the direction of fan rotation. This creates reverse air pressure which helps free up the dirt. The units can be removed for a more thorough cleaning.

Section **9**

Engineering Data

CAPSCREW (BOLT) GRADE

The grade classification of a capscrew (bolt) is identified by the marks on the head as shown below:



Use the SAME GRADE washer and nut as the capscrew. *NEVER SUBSTITUTE A LESSER GRADE CAPSCREW IN PLACE OF THAT WHICH IS SPECIFIED.*

TIGHTENING PROCEDURE FOR ONE 3-INCH TORQUE NUT

1. Ensure that 2 special steel washers, supplied with the torque nut, is placed beneath the torque nut. DO NOT USE STANDARD COMMERCIAL WASHERS.

2. Check the base of the torque nut to ensure that all jackbolts are flush with the bottom.

3. Spin the torque nut onto the rod or bolt by hand.

4. Tighten the jackbolts to **200** Ft.Lbs. as follows:

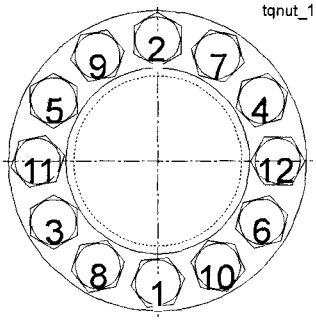
   a. Snug all jackbolts to **10** Ft.Lbs. each.

   b. Using the STAR pattern shown, tighten all jackbolts to **100** Ft.Lbs.

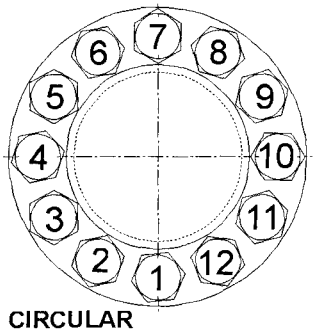
   c. Switch to the circular pattern shown and tighten all jackbolts to **150** Ft.Lbs.

   d. Continue with the circular pattern and tighten all jackbolts to **220** Ft.Lbs.

tqnut_12



"STAR" Tightening Pattern



CIRCULAR Tightening Pattern

Torque Nut with 12 Jackbolts

NOTES:

- With longer rods and bolts, stretch in the rod or bolt occurs during tightening of the jackbolts. Therefore, after tightening with the circular pattern in step 4-d above, the first jackbolt may have loosened. The higher torque value is used in this step only to speed the tightening process. After performing the above steps, use a torque wrench for the final torque values and continue tightening the jackbolts in a circular pattern until all jackbolts are tightened to a value of **200** Ft.Lbs.
- An impact wrench can be used for the initial tightening sequences, *however a torque wrench must be used to achieve the final torque values.*
- Repeat the above steps for all remaining torque nuts.

TORQUE NUT REMOVAL PROCEDURE

CAUTION: THE PROPER REMOVAL OF TORQUE NUTS REQUIRES FOLLOWING STRICT PROCEDURES. LONGER ANCHOR BOLTS AND RODS REQUIRE GREATER CARE. If some jackbolts are completely unloaded prematurely, the remaining jackbolts will carry the entire load of the fastener. This may cause the jackbolts to become extremely hard to turn or even deformed.

NOTE: It is a good practice to spray the entire fastener and jackbolts with a penetrating type lubricant prior to attempting removal. This step will be critical if rust exists on the components.

1. Turn the first jackbolt counter-clockwise until it feels loose, but no more than 1/2 turn.

2. Repeat the loosening with the rest of the jackbolts. Use the reverse of the star pattern used to tighten the jackbolts. This will minimize loading on the last few jackbolts.

3. Repeat the entire loosening pattern, turning each jackbolt no more than 1/2 turn at a time, until the torque nut can be spun off the rod or bolt by hand.

After removal of the torque nut:

- Remove all jackbolts from the torque nut. Clean, inspect and lubricate the toque nut, hardened washer and the jackbolts for later reassembly.

NOTE: On smaller torque nut fasteners it may be possible to utilize impact tools to speed removal after performing step 2 above. However, *DO NOT USE IMPACT TOOLS FOR THE INITIAL LOOSENING PROCEDURE.* Longer anchor bolts may require several repetitions of the initial loosening process prior to switching to impact tools for assistance.

THREAD LUBRICATION

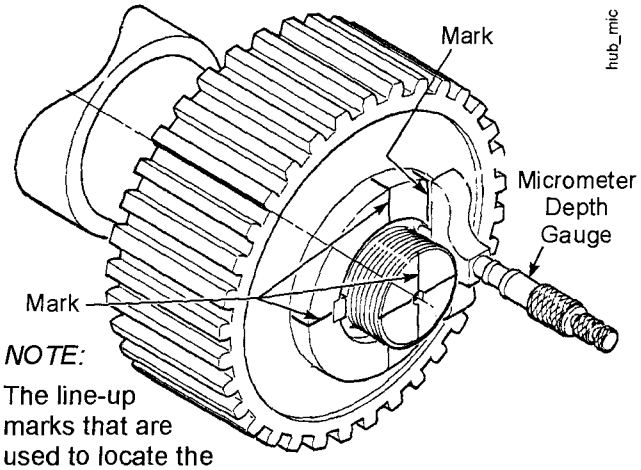
For the main studs of torque nut fasteners any standard anti-seize compound may be used. A thin, brush-on type application, or aerosol spray lubricant is acceptable.

Jackbolts are pre-lubricated from the factory with either moly or graphite lubricants depending on the intended use. Similar lubricants may be used on the jackbolt tips and hardened washer during installation.

not bind on the key.

3. Mount the pinion, brake drum or coupling cold by placing it on the shaft and snapping it into position by hand. Measure the "cold" position of the pinion, brake drum or coupling using a micrometer depth gauge. The following figure illustrates the method of using the depth gauge.

   Mark the places where the depth gauge was resting so measurements can be made from the same position after the pinion, brake drum or coupling has been mounted.



NOTE: The line-up marks that are used to locate the gauge, component and shaft are in identical positions for "HOT" or "COLD" measurements.

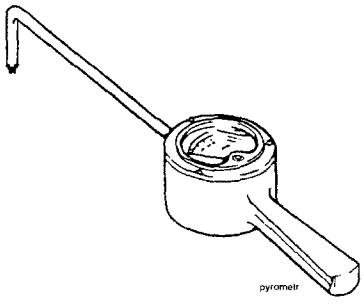
4. Remove the pinion, brake drum or coupling from the shaft and heat it in a suitable oven to the temperature specified. If the pinion, brake drum or coupling is heated in oil, the bore must be thoroughly cleaned before mounting. To avoid the cleaning, the use of an oven is recommended.

CAUTION: Use suitable protective equipment when handling hot items.

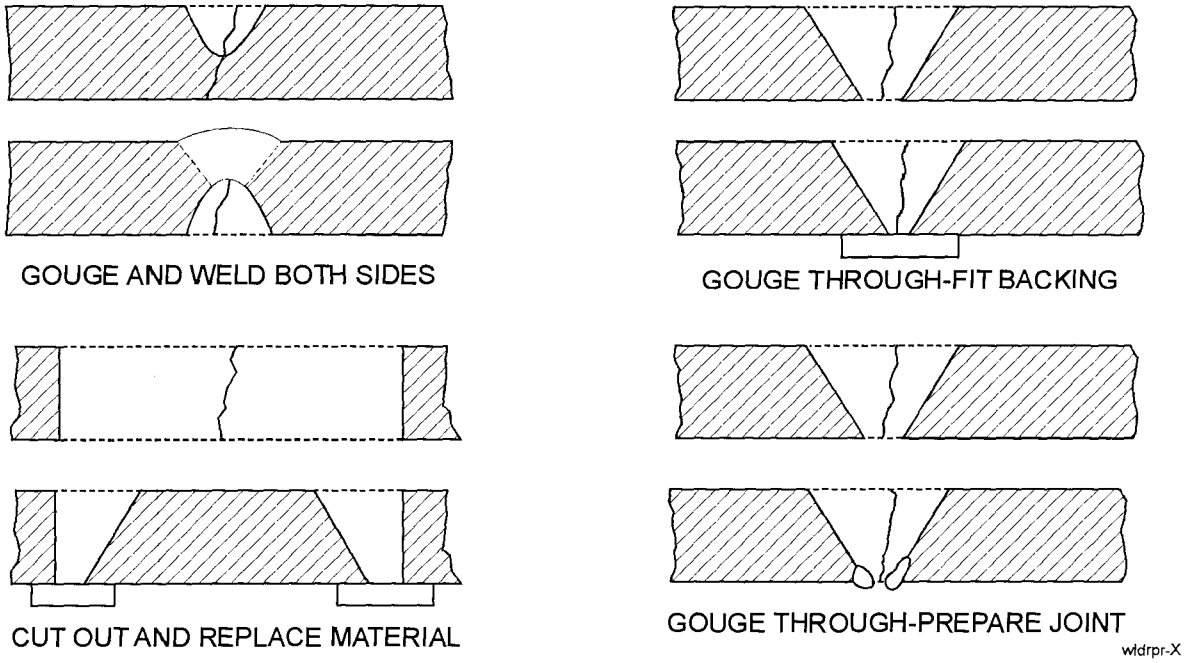
The pinion, brake drum or coupling temperature is indicated as a temperature difference between the shaft and pinion; this temperature difference is estimated only and can be adjusted to maintain the specified advance. Heat the pinion, brake drum or coupling in the oven until the temperature is uniform at the required number of degrees above the shaft temperature. For example, if the shaft temperature is 25°C (77°F) and the estimated difference is 125°C (225°F), heat the pinion, brake drum or coupling to 150°C (320°F) for mounting.

WARNING: Pinion, brake drum or coupling temperature must never exceed 190°C (374°F).

Some accurate method must be provided for quickly measuring the temperatures of the pinion, brake drum or coupling and shaft before mounting them. This is best done with a hand pyrometer (refer to the figure). When a hand pyrometer is not available, a centigrade thermometer can be used by placing putty over the bulb to hold it against the pinion or coupling. Heat the pinion, brake drum or coupling a few degrees above the desired temperature before removing it from the oven. Wait until it has cooled to the temperature desired, remove the thermometer and quickly mount the pinion, brake drum or coupling as described below.



REPAIR WELDING OF CRACKS



Joint Preparation for Repair of Cracks

Remove the entire crack by arc air-gouging or grinding. Prepare a V-groove of approximately 45-60° included angle for rewelding. If cracked through the full thickness and if it is possible to make the repair from both sides, a double V preparation is preferred. When welding from both sides, back-gouging for complete penetration is always recommended.

When it is not physically possible to back-gouge and weld the second side, an alternate approach must be taken. Sometimes it is possible to gouge through to completely remove the crack, then fit a backup bar on the underside to facilitate making a complete penetration weld.

NOTE: The backup bar must fit tightly to the underside otherwise poor welding conditions conducive to cracking may occur.

When it is not possible to fit a backup due to limited accessibility to the underside, it is advisable to remove a portion of the defective plate and weld in a new piece, using back up bars on all sides to ensure complete penetration welds.

A further alternative is to gouge through, removing the crack, and then weld small stringer beads to close the gap and prepare a groove for a repair weld. In this case, the repair weld will be essentially full penetration, but will be less than perfect on the under side. The other methods are preferred in the order described, that is, welding both sides, welding against a backup bar, or completely replacing a section of plate.

NOTE: Contract services are available for field application of resistance heating equipment. Suggested source:

Stresstech
Box 11
Red Wing, MN 55066
(612) 388-7117

3. During welding, the repair area must be continually checked with temperature indicating crayons to be sure that the minimum temperature is being maintained. Do not weld at temperatures below the specified minimums.

WELDING PROCEDURE

1. Refer to the previous butter-welding figures. The purpose of the butter weld layer is to provide a buffer between the weld required to fill the groove and the alloy cast steel. This technique is essential in preventing heat affected zone cracking in the cast steel which otherwise is likely to occur due to the shrinkage of the weld as the groove is filled. Butter welding permits the repair weld to be made at the preheat temperatures specified. Much higher temperature would otherwise be required for crack free welding.

2. Butter welding is done using 1/8 inch diameter E11018-M electrodes at a minimum preheat temperature of 250°F. (See section under *WELDING ELECTRODES* regarding use of the electrode drying oven.) Horizontal weld beads are applied to completely cover the cavity or surface to be welded. The edges of the butter weld must overlap the adjacent surface about ½ inch. This is to prevent subsequent welding from impinging upon the cast steel.

3. Before starting the butter weld, position a piece of thin mild steel plate under the bottom end of the tooth. This is to provide a shelf for starting the weld and to avoid irregular weld beads at the bottom which would become stress risers to cause cracking when the tooth is loaded in service.

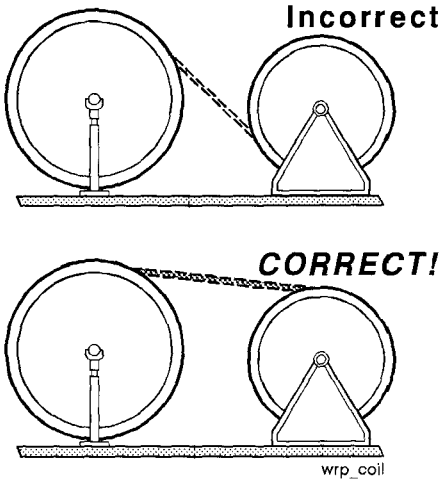
4. Apply the butter weld, progressing with horizontal beads from bottom to top. Use care to keep the butter weld layer as smooth and regular as possible. When finished, remove all slag and grind any high spot which could trap slag when welding to fill the groove. In the case of repairing a broken tooth the prepared tooth segment is butter welded separately before positioning for final welding in place.

5. Filling the groove is done with 1/8 inch or 5/32 inch E11018-M electrodes at a minimum preheat temperature of 175°F. (See section under *WELDING ELECTRODES* regarding the use of the electrode drying oven.) Weld vertically up using a split layer technique as soon as the groove is wide enough to accommodate 2 or more beads. Refer to the butter-weld figures for the approximate weld bead sequence.

6. For replacing a tooth segment as shown, it will be necessary to prepare a tooth profile template. The template must be carefully made to fit the rack teeth as accurately as possible. Use the template to position the tooth segment prior to tack welding. When welding the tooth segment in place alternate welding from side to side to control distortion. Check frequently with the template.

HANDLING WIRE ROPE

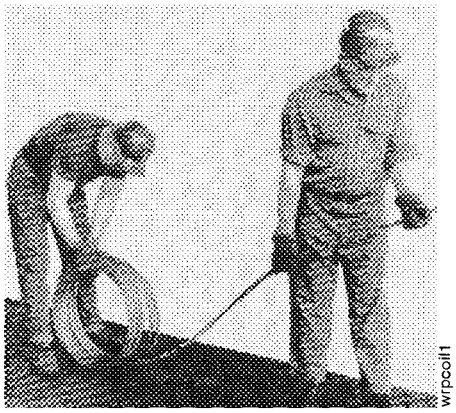
When re-reeling wire rope from a horizontally supported reel to a drum, keep in mind that a wire rope has a "memory" to be considered. If at all possible, it is preferable for the rope to travel from the top of the reel to the top of the drum during this process. The same would hold true for the bottom of the reel to the bottom of the drum. Re-reeling in this manner will avoid putting a reverse bend into the rope as it is being installed. If a rope is installed so that a reverse bend is induced, it may cause the rope to become "cranky" and, consequently, more difficult to work with.



There are several methods, which can be used to uncoil rope from a spool or coil. The particular situation, or application, will determine the method used.

One method begins by placing the coil or spool on a vertical unreeling stand. The stand consists of a base with a fixed vertical shaft. On this shaft there is a "swift" or rotating sleeve" consisting of a plate with inclined pins. This is positioned so that the coil or spool may be placed over them allowing the coil or spool to rotate in the horizontal axis. The whole swift and coil then rotate as the rope is pulled off without adding twist or the possibility of kinks. This method is particularly effective when the rope is to be wound on a vertical drum.

The most common, and the easiest uncoiling method is merely to hold one end of the rope while rolling the coil along the ground like a hoop.

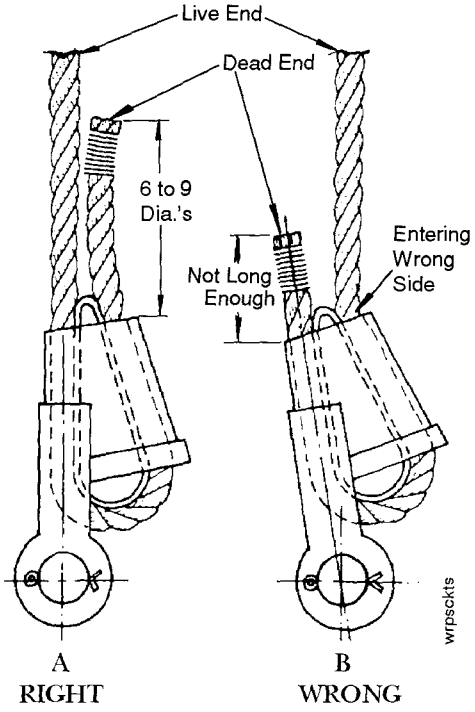


NOTE: Avoid unreeling and uncoiling methods that are likely to provide kinks. Such IMPROPER procedures should be strenuously avoided in order to prevent the occurrence of loops. These loops, when pulled taut, will inevitably result in kinks. No matter how a kink develops, it will damage strands and wires, resulting in a kinked section that must be cut out. Proper and careful handling will keep the wire rope free from kinks.

WEDGE SOCKETS

One of the more popular field end attachments for wire rope is the wedge socket. Attachment, and the dismantling of this device is both easy and simple.

1. Inspect the wedge and socket; remove all rough edges/ burrs that might damage the rope.



2. Welded ends of the rope should be cut off prior to assembly. This will allow the rope strands to distort slightly as they bend sharply around the wedge. If the welded end were not removed the minimal sliding of the strands would be restricted and evidenced further up the rope. This may result in the development of high strands, wavy rope and uneven loading.

3. Place the socket in an upright position and bring the rope around it in a large, easy to handle loop. Care must be taken to make certain that the live-loaded-side of the rope is in line with the ears.

4. The dead end of the rope should extend from the socket for a distance of six to nine times the rope diameter. The wedge is now placed in the socket.

5. Secure the socket and carefully apply a gradually increasing load to the live side of the rope in order to pull the wedge into position. Only tension sufficiently to hold the pieces in place.

6. After checking alignment increase the load GRADUALLY until the wedge is properly seated.

***IMPORTANT:* Avoid sudden shock loads.**

NOTE: This is the recommended procedure. If variations are made to suit special conditions, they should be carefully evaluated beforehand.

Wire Rope Inspection Criteria

The following is a fairly comprehensive listing of critical inspection factors. It is not, however, presented as a substitute for an experienced inspector. It is rather a user's guide to the accepted standards by which ropes must be judged.

Abrasion

Rope abrades when it moves through an abrasive medium or over drums and sheaves. Most standards require that rope is to be removed if the outer wire wear exceeds 1/3 of the original outer wire diameter. This is not easy to determine and discovery relies upon the experience gained by the inspector in measuring wire diameters of discarded ropes.

Reduction in Rope Diameter:

Any marked reduction in rope diameter indicates degradation. Such reduction may be attributed to:

- Excessive external abrasion.
- Internal or external corrosion.
- Loosening or tightening of rope lay.
- Inner wire breakage.
- Ironing or milking of strands.

In the past, the determination on the continued service of a rope was largely dependant on the rope's diameter at the time of inspection. Recently this practice has undergone significant modification.

Previously, a decrease in the rope's diameter was compared with published standards of minimum diameters. The amount of change in diameter is, of course, useful in assessing a rope's condition. But, comparing this figure with a fixed set of values can be misleading. These long-accepted minimums are not, in themselves, of any serious significance since they do not take into account such factors as:

- Variations in compressibility between IWRC and Fiber Core.
- Differences in the amount of reduction in diameter from abrasive wear, or from core compression, or a combination of both.
- The actual original diameter of the rope rather than its nominal value.

As a matter of fact, all ropes will show a significant reduction in diameter when a load is applied. Therefore, a rope manufactured close to its nominal size may, when it is subjected to loading, be reduced to a smaller diameter that stipulated in the minimum diameter table. Yet, under these circumstances, the rope would be declared unsafe although it may, in actuality, be safe.

SEALS

Oil and grease seals are critical to machine availability. Careless storage, handling, removal and installation can contribute to reduced service life of machine components and higher cost of operation.

Seals come in all sizes, shapes and materials. Wherever possible, Bucyrus has specified the use of the most common solid molded element type seals for use on Bucyrus machines.

All types of oil and grease seals have a limited shelf life. Store seals in a cool, dry location protected from direct sunlight. Keep in sealed containers or packaging until ready to use. Seals keep lubricant clean and contained in their respective housings, bearings or passageways. Always handle seals carefully to prevent exposure to nicks, bends or pinching. Do not wash them in solvents as some solvents may destroy properties of the seal.

SEAL INSTALLATION

Solid molded seals are installed at time of manufacture with interference fit between seal and bore. This method of installation creates an oil tight fit. When partial disassembly of a machine component involves removal of solid molded seal before reassembly inspect it carefully for cuts, nicks or cracking. Replace with a split seal if complete disassembly is inconvenient or with a new solid molded seal. Split seals, especially those made with interference fit at butt, also install with compression at the joint. Split seals used as substitutes for solid molded seals should be replaced at next major component overhaul.

CAUTION: Do not cut a solid seal and reuse for a split seal.

Check shaft for scratches, burrs or surface roughness that may cut or score the lip of seal. Be aware of sharp threads key-ways or splines over which the seal must travel. Protect seal lip by covering these interferences with tape.

Inspect the bore area for surface roughness, dirt or burrs. Remove and clean as required. The bore and shaft need .0625 in. (1.588 mm) chamfer to accommodate a leak free installation. If shaft or bore do not have chamfer, carefully provide one by trimming inside flange of seal.

Determine the correct direction for lip installation and start the seal into the cavity by finger pressure, then tap evenly all around until seated or flush with the housing face. (Tap only on outer edge of seal with hammer on wood block.)

A double seal, installed back to back can be used to retain grease or oil plus be more effective in preventing egress of contaminants.

SWINGING RESTRAINT

Before performing any maintenance on the mining shovel, it should be resting on a firm, level surface. A small ground slope is enough to cause the machine to freely rotate if the brakes are not set or other restraints are not used. *Once moving, it will keep going.*

The following shows the relation between an out-of-level or slope and the resulting difference in elevation over a 14 ft. swing rack:

Slope	%	Difference in Elevation
0.25°	0.4%	0.75"
1.0°	1.7%	2.9"
5.0°	8.7%	14.7"

Where possible, all work on the swing brakes, motors, gearcases, or rack pinions should occur with the dipper attached to the machine and the full weight of the dipper on the ground. If the dipper is not resting firmly on the ground, then an external means of preventing machine upper works rotation is required. Tie the upper works to the lower works using the preferred method mentioned below.

Mining shovels rotate using multiple swing units. Power is transferred from electric motors through individual gearcases, to pinions and into a fixed swing rack. Electric motor control prevents inadvertent machine rotation during operation. Should machine electric power be lost, spring-set brakes on the swing drive motors lock the geartrain to prevent machine rotation.

When working on the brakes, motors, or geartrains, it is an accepted practice to set the dipper on the ground. The weight of the dipper and handle will prevent machine rotation. EVEN IF ALL BRAKES, MOTORS, OR SWING GEARCASES ARE REMOVED the machine should not rotate.

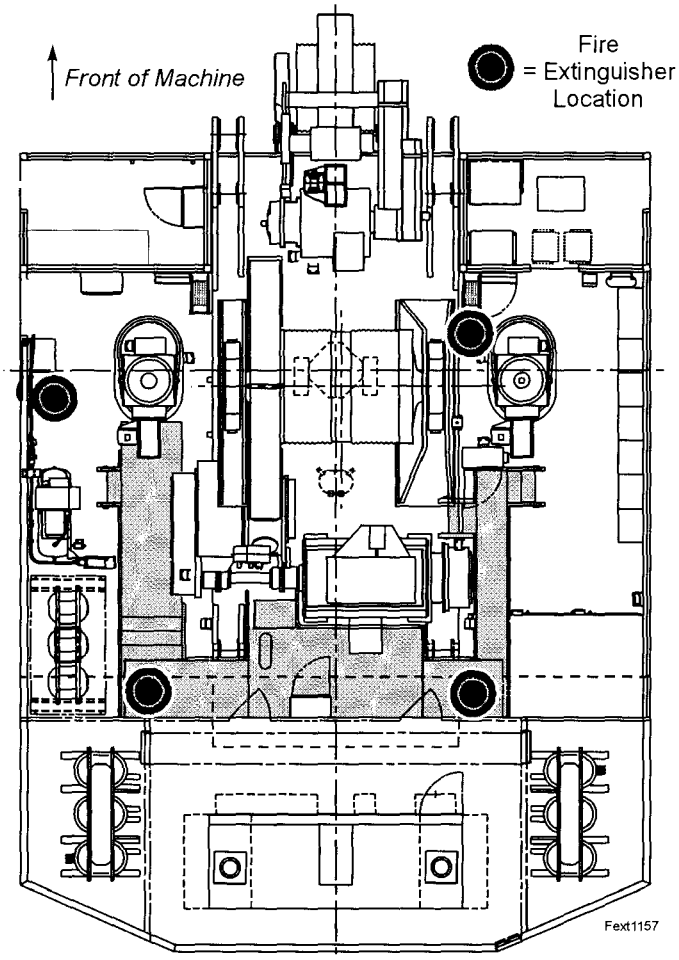
In certain circumstances it may not be possible to rest the full weight of the dipper firmly on the ground. For instance, the dipper, handle or the boom may not be attached to the machine.

To prevent machine rotation, with any of the major structures removed, two swing motor brakes should be set. A single brake in good operational condition is acceptable. However, a minimum of two brakes is recommended due to the possibility that the proper operation of a single brake may be unknown.

Caution: **ON MACHINES USING PLANETARY DUAL-OUTPUT SWING DRIVES, BOTH SWING PINIONS PER DRIVE MUST BE ENGAGED WITH THE SWING RACK IN ORDER FOR THE SWING BRAKE TO BE EFFECTIVE. The internal differential drive in the gearcase allows one pinion to rotate, even if the brake is set, when the other pinion has been removed.**

FIRE PREVENTION

- Always have a "charged" fire extinguisher on hand and know how to use it. Inspect and service the extinguisher as indicated on its instruction plate.
- DO NOT smoke while handling flammables or when near batteries.
- Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque. See Chapter 4 of this manual for the Scheduled Maintenance recommendations and the Daily Inspection procedure.
- Repair or replace loose or damaged lines, tubes and hoses as soon as possible.
- Make certain all clamps, guards and shields are replaced correctly so as to prevent vibration and the chafing of parts during operation.
- DO NOT carry flammable fluids such as gasoline or solvents on board the machine.
- DO NOT over-bend or strike pressurized lines or hoses. DO NOT install bent or damaged lines, tubes, or hoses. Replace them immediately.
- DO NOT start the machine or move any of the controls if a warning tag is attached to the controls or the start panel.



Fire Extinguisher Locations

- Keep all cleaning rags properly stored. DO NOT discard them into a pile on board.
- Keep all structural frame compartments, walkways and work areas clean and free of lubricant residue.
- NEVER weld, burn, or perform service on the machine alone.
- If a motor or other component is running hot, shutdown the machine until it has cooled and the cause is determined and repaired.

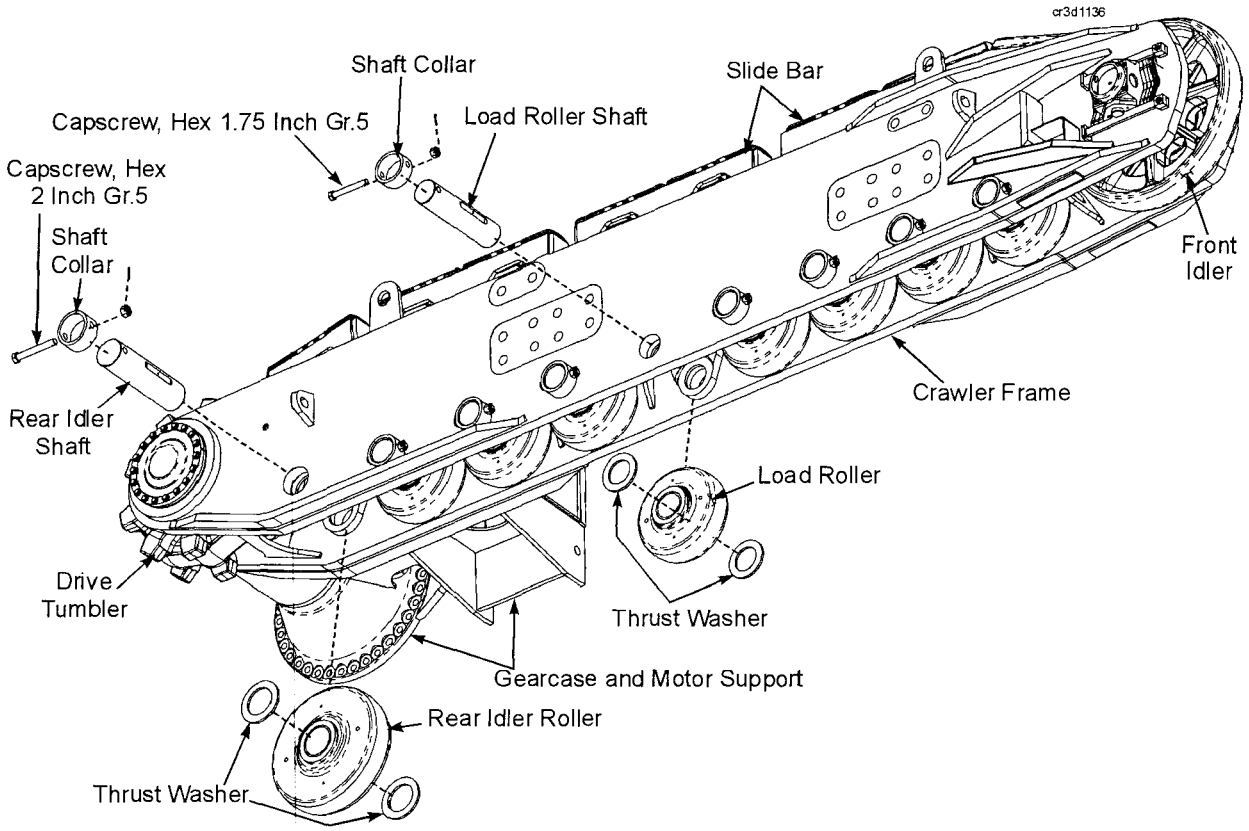
CRAWLERS

This machine is provided with a crawler system composed of 2 independently-driven crawler frame assemblies, one on each side of the truck frame. Each crawler has its own belt driven by a sprocket-type drive tumbler. Individual crawler links are heavy alloy steel castings connected by heat treated pins.

Innovative drive tumblers made from large diameter steel castings have lugs extending beyond the tumbler rims. They are mounted on forged alloy steel shafts which turn on large anti-friction bearings mounted within the crawler frame. The sprocket type lugs provide a large area of contact against the crawler links, extending the life of both links and tumblers.

Lower rollers rotate on forged steel shafts mounted within the crawler side frames. Eight smaller rollers and 1 large roller per frame are specially suited to withstand the periodic single point ground reaction caused by uneven pit floors. Slide bars on top of each frame support the upper crawler belt, reducing propel friction and drag. These side frames are stress relieved weldments comprised of steel castings and cold weather steel plates.

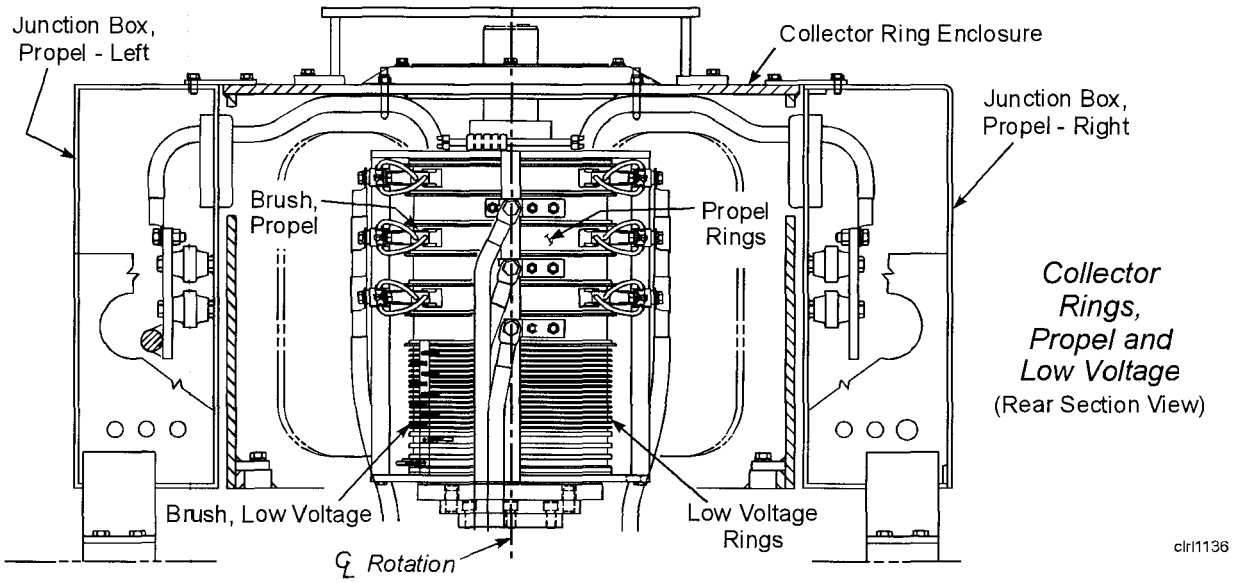
The crawler assemblies are bolted to the truck frame with large diameter rods and torque nuts. Each crawler belt can be independantly adjusted for tension.



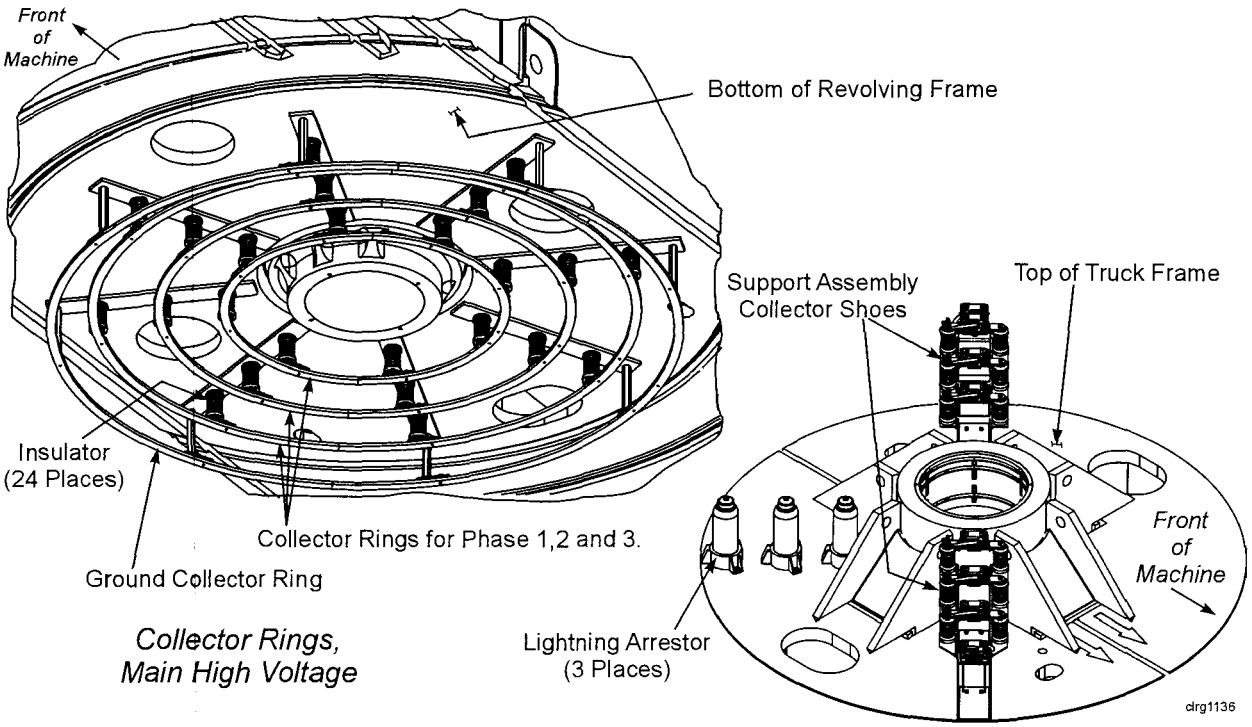
Right Crawler Assembly (Left Opposite)

COLLECTOR RINGS

High voltage collector rings between the revolving frame and truck frame transfer electric power from the truck frame to the rotating deck. Electric power enters the truck frame between the propel motors and is transferred by means of collector ring shoes to the collector rings. The shoes are mounted between the cast center pintle hub and the swing rack.

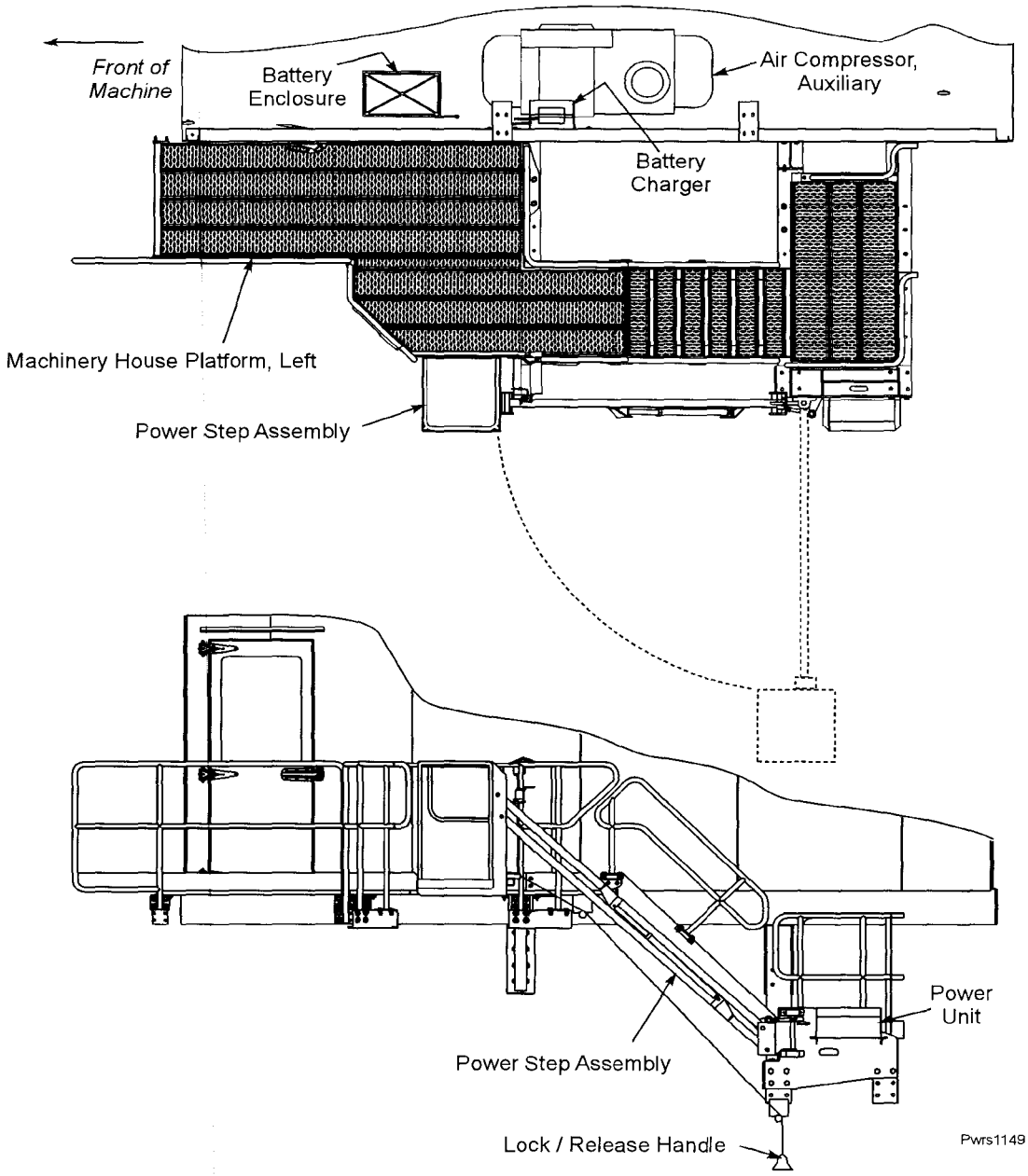


Collector Rings, Propel and Low Voltage
(Rear Section View)



Collector Rings, Main High Voltage

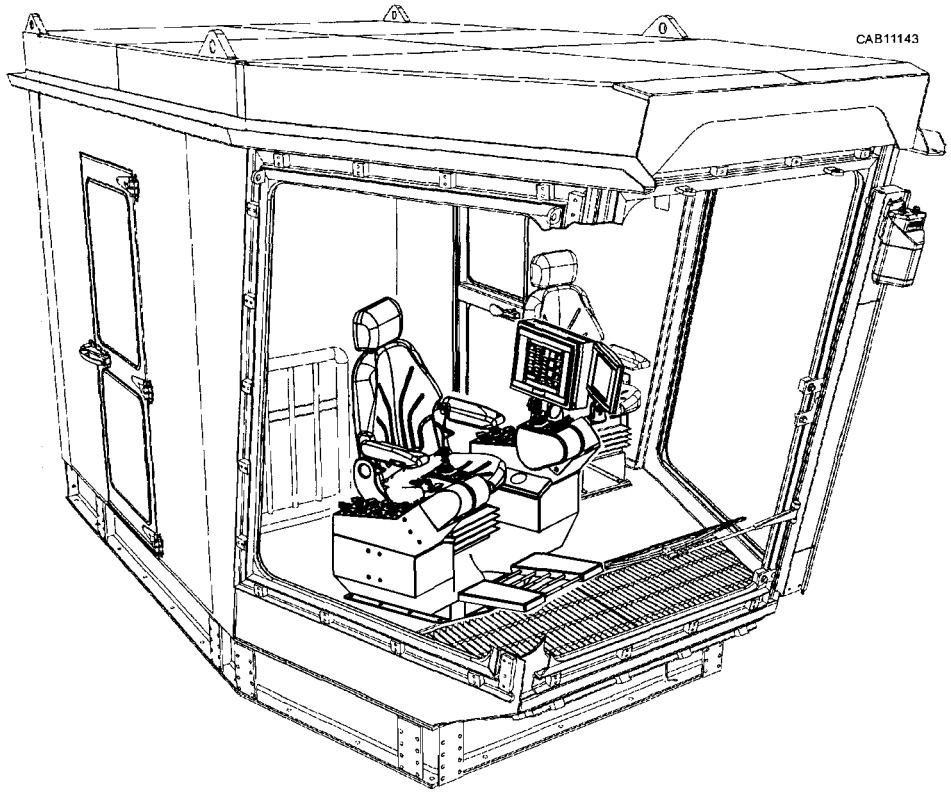
POWER STEP



The Power Step is one of the means for boarding the machine. It is located on the left side of the machinery house, near the center of the lower platform. Use the lock / release handle from ground level to lower the power step for boarding. When the power step is NOT latched in place, the operator's controls are deactivated.

OPERATOR'S CAB

The isolated and elevated operator's cab at the right, front of the machinery house provides a comfortable, safe and efficient working environment for the operator. Sufficient space is provided for the fully adjustable operator's seat, a helper's seat and the standard operator's display panel.



All operating controls are incorporated into the arms of the seat.

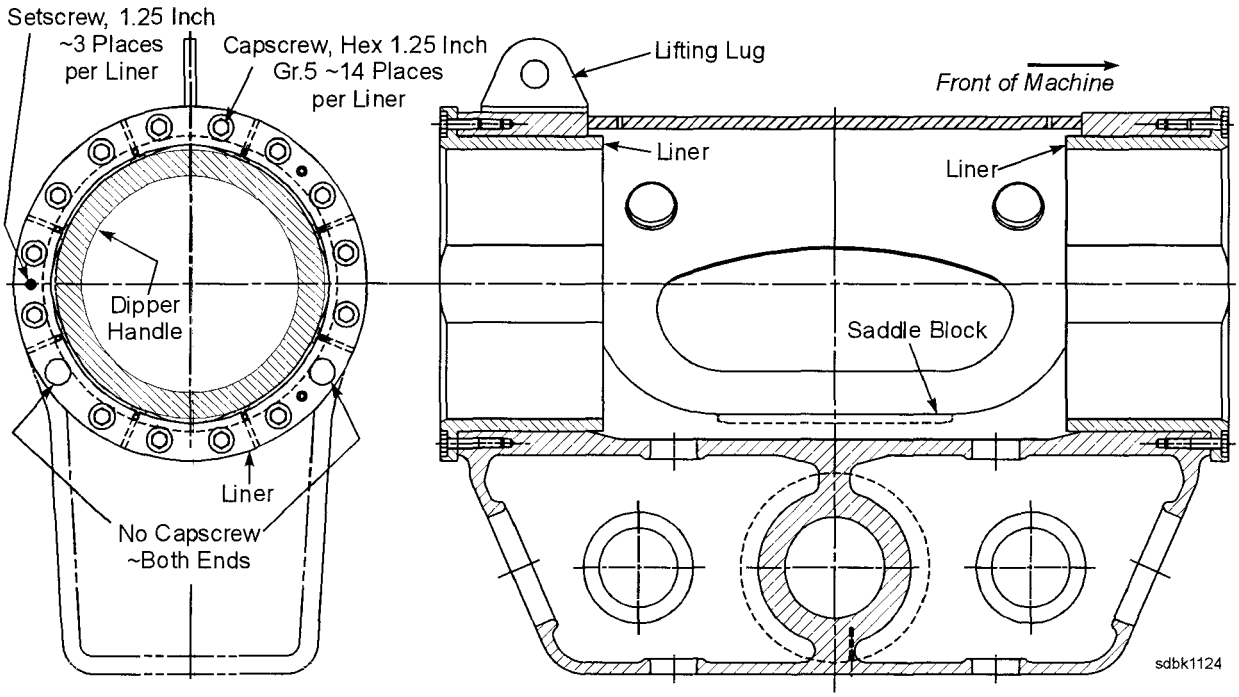
The cab is sound and heat insulated with interior walls made of a sound deadening steel-plastic-steel composite. Electric powered windshield wipers are provided for quiet, dependable operation. A one-piece front window is supplied in a rugged, easy-to-change frame. A forward front window slant with over hanging roof helps keep the window clean. Transparent sun shades are provided in front and side windows.

Visibility through both side and front windows is excellent. The operator has the best view in the industry of the digging face and for truck spotting. This view is enhanced by the streamlined sides and top surfaces of the boom, unencumbered by crowd machinery or dipper handles on the outside of the boom.

An air conditioner and pressurizing unit utilizes environmentally friendly 134a refrigerant in the cooling system. Interior ducting distributes the airflow to best suit the comfort of the operator.

SADDLE BLOCK

The saddle block is positioned between the boom side girders in the mid-section of the boom. It pivots on manganese-bronze bushings about the shipper shaft. It acts as a guide for the longitudinal movement of the dipper handle. The free-floating design of the handle in the saddle block eliminates handle torsion.



DIPPER HANDLE

The dipper is attached to one end of the large diameter handle. The crowd rope half-sheave is attached to the other end. A hydraulic rope take-up mechanism at the dipper end, and the crowd rope adjusting mechanism are used to remove slack from the crowd/retract rope system. The dipper handle crowds out and retracts within the saddle block.

An electrical rate reduction circuit, along with the crowd ropes, absorb digging shock loads encountered when the dipper is crowded into the bank.

PROPEL BRAKE

A selector switch used to set or release the Propel Brake.

HVAC UNIT SELECTOR

A 3-position selector switch used to select air conditioner unit No.1, No. 2, or off.

TEMPERATURE

A rheostat used to control the temperature in the operator's cab relative to the selected mode of operation.

HVAC SYSTEM CONTROL

A 4-position selector switch used to select the HVAC system mode of operation.

HVAC FAN SPEED

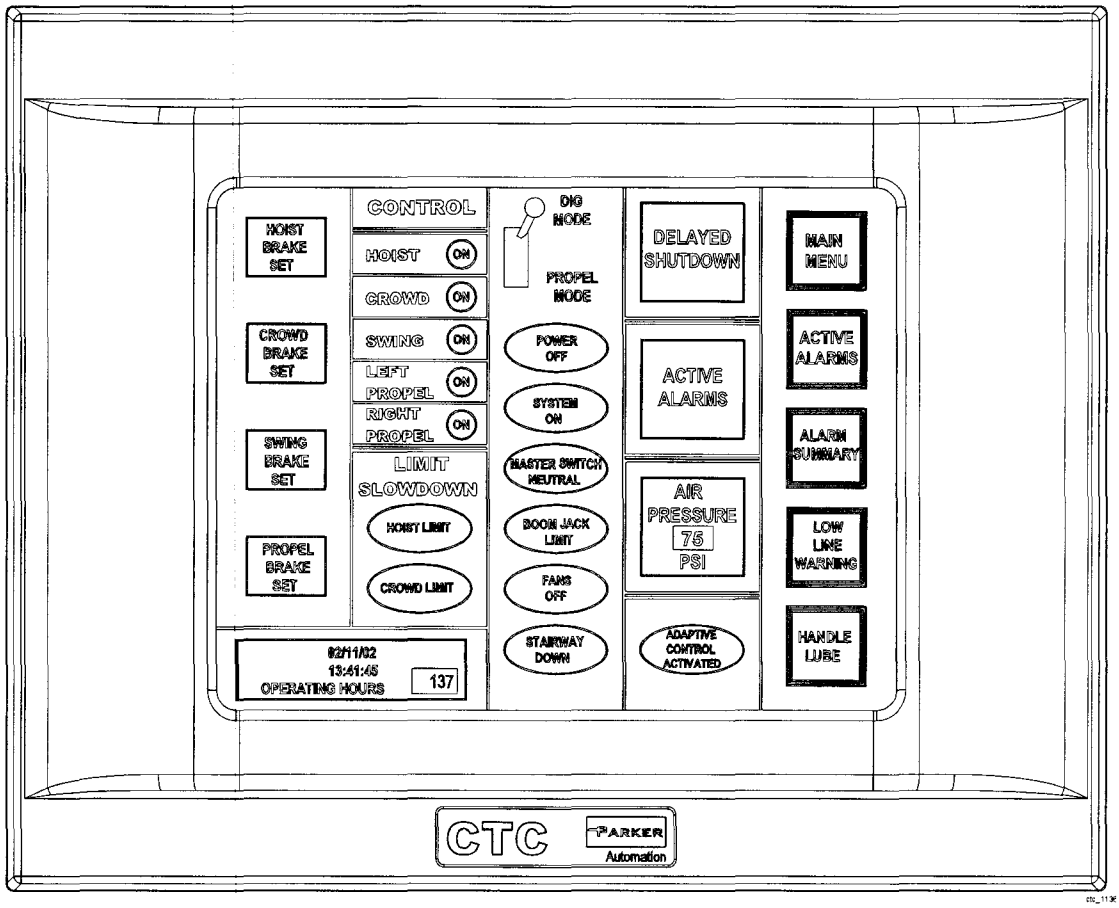
A 3-position selector switch used to control the volume of air moved by the system.

AUXILIARY HEATER

A 3-position selector switch used to control the auxiliary heater.

OPERATOR'S DISPLAY

The Operator's Display is a CTR panel used to provide the operator with an interface to the machine and it's functional areas. From this informational display the operator can make inputs that effect machine operation, monitor systems and make system adjustments. Through this display terminal the operator will receive pertinent fault data to identify potential problems and prevent machine damage.



The display panel is mounted on a tilt-swivel bracket on the left side of the operator. Individual operators can position the screen in any desired position.

DISPLAY AREA AND INDICATORS

The display area of the monitor screen is the large area in the center of the screen. This area is "touch sensitive." All information will be displayed on this area in either a text format or in the form of visual icons. The buttons and icons that appear on the screen will respond to touching the screen in the appropriate area of the icon.

BRAKE INDICATORS

The 4 rectangular areas in the upper left portion of the operator's screen provide DISPLAY ONLY information on the motion brakes. The HOIST, CROWD, SWING and the PROPEL brakes are separately identified at this location.

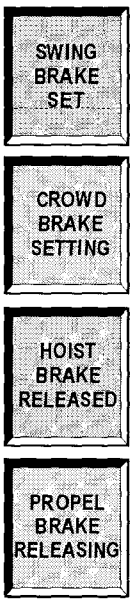
NOTE: The hoist, CROWD AND SWING brakes ARE not to be used as a braking device, except as a holding brake or with an electrical fault or in an emergency. The primary function of the brake is to prevent motor rotation while the particular function is not in use.

1. SET - This will indicate a condition where the brake for that system is fully set and functional as a braking device to prevent movement of that system.

2. SETTING - This message indicates that the brake is in a transition period between the RELEASED and the SET positions. During this period the brake is not functional and care should be exercised to not rely on the brake at this time.

3. RELEASED - This message is an indication that the brake is fully released for the system in question.

4. RELEASING - This is an indication that the brake is in a transition phase from the Set position and has not yet achieved the fully RELEASED position.



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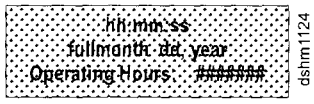
NOTE: While in transition from one setting to another (ie: during the RELEASING and SETTING periods, the button will be displayed in yellow. While fully SET or fully RELEASED the button will be displayed in grey.

NOTE: Unlike the other brakes on the machine, the propel brakes are intended as operational brakes and are used in the operation of the machine

TIME/DATE WINDOW



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The Time/Date window, locate in the lower left corner of the screen will provide the current local time and date information to the operator at all times. In addition, the total operating hours on the machine will also be displayed.

2. Inspect the crawler belts for missing links or lock pins, excessive belt sag, cracked shoes or other deterioration. Check the oil level in the propel planetary gearcase. Add oil as required.

3. Check the swing rack and pinion guards for rocks, dirt and other debris that will interfere with the operation of the machine. Inspect the swing rack gear and rollers for the proper lubricant film.

DANGER: **HIGH VOLTAGE! THE MACHINE TRAIL CABLE CARRIES A LETHAL VOLTAGE. Handle the cable in an approved manner with appropriate rubber gloves and insulated hooks or tongs.**

4. Visually inspect the trail cable for cuts, abrasions and other damage.

5. Visually inspect exterior of machinery house for damage or evidence of internal leakage.

6. Inspect the dipper trip mechanism, rope, latch bar and associated hardware for damage, adjustment and wear.

7. Inspect the dipper door, hardware and bumpers for damage and excessive wear.

8. Inspect fulcrum attachment points, take up cylinders and spacers and dipper handle for damage, excessive wear and evidence of adequate lubrication.

9. Inspect boom bumper for security and damage.

10. Inspect the dipper and tooth adapters for tightness and excessive wear.

11. Inspect padlocks for damage, wear and evidence of adequate lubrication.

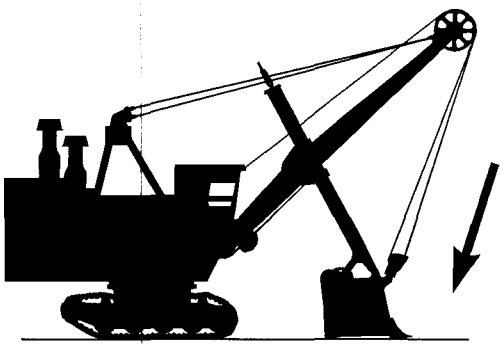
12. Check both the running ropes and the boom structural strands for broken strands and loose sockets.

MACHINERY MOTIONS

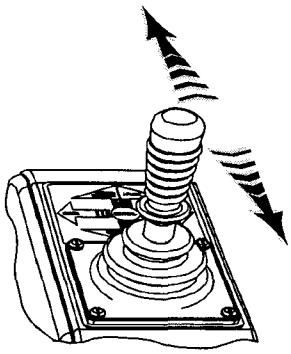
HOIST MOTION

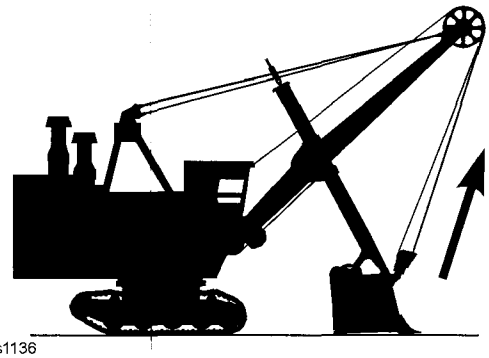
Hoist motion is controlled by the operator's right joystick. Set the propel transfer switch in the DIG mode. The crawlers should be positioned so that the digging is done over the front of the crawlers. Move the joystick between the hoist and lower until a "feel" is developed for the height, depth range and speed at which the dipper moves. Practice the hoist function until movement can be stopped smoothly.

CAUTION: This joystick also controls the swing motion through left and right motions.



To ***LOWER*** the Dipper:
Push the *Right* Joystick Forward, away from the Operator.





To ***HOIST*** the Dipper:
Pull the *Right* Joystick Back, toward the Operator.

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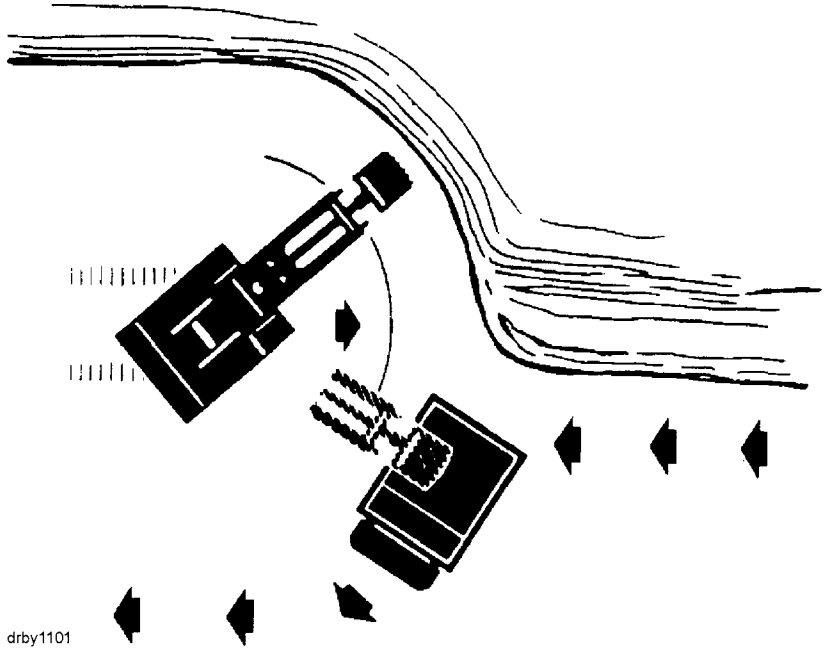
DRIVE-BY METHOD

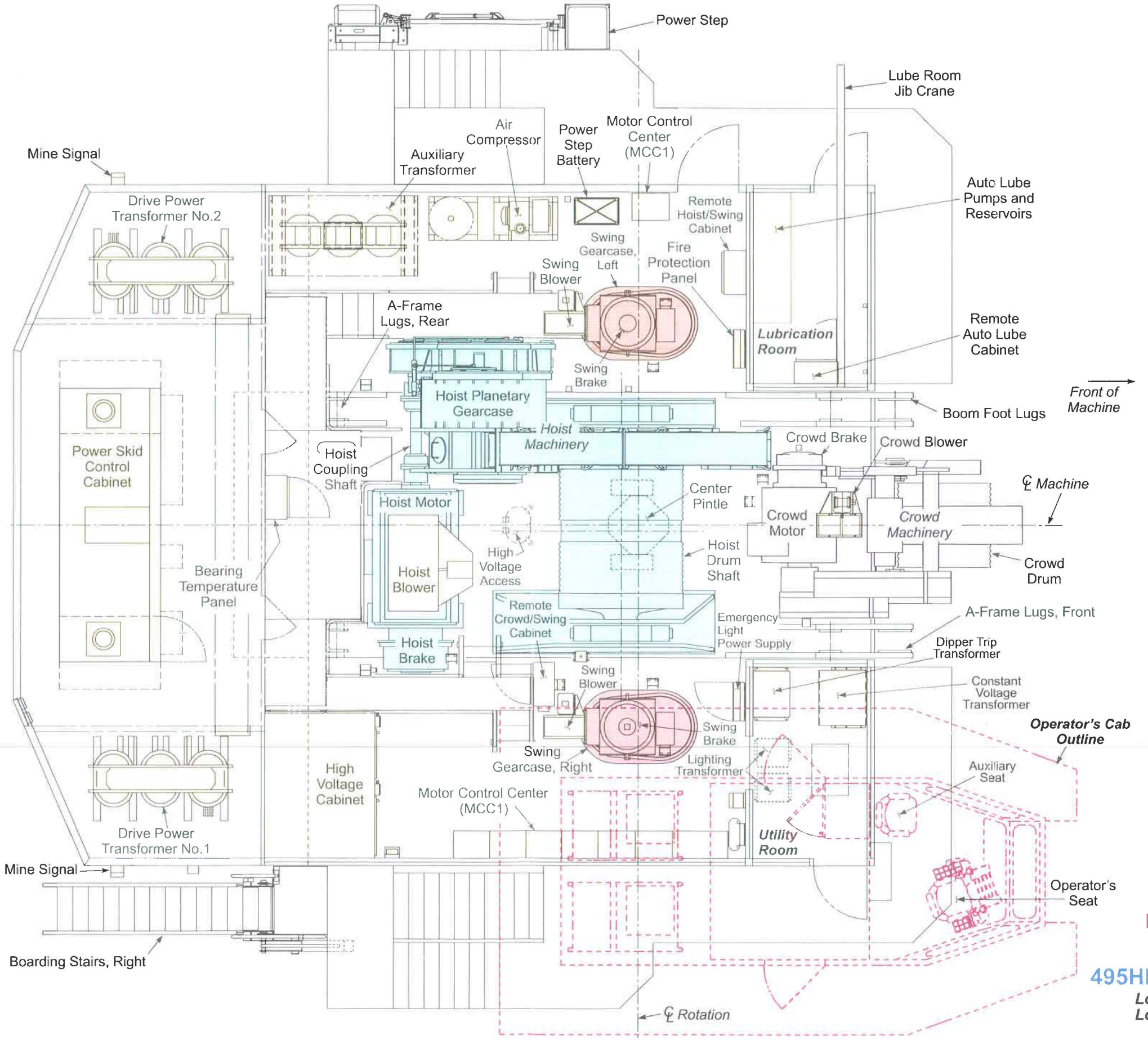
NOTE: If the machine and haulage units cannot be set up as described below, the drive-by method should be avoided.

Position the machine crawlers parallel to the bank with the inside edge of the outer set of crawler tracks directly in line with the bank toe.

The trucks must approach the machine from the front making a turn away from the machine as the front wheel approaches the outside crawler. The truck should stop in a position to allow backing toward the point of the bank for loading.



During the load cycle, the swing arc should not exceed 90°. The time between finishing one truck to the first digging cycle of the next should not exceed that of any cycle during a load.



BUCYRUS

495HD Deck Plan

Lot 55, SN: 141157
Lot 56, SN: 141162

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