Technical Manual

MAINTENANCE TIPS

Just as the operator acquires a "feel" for the machine, the entire crew should try to sense failure before it strikes. Take that extra step to examine anything that appears out of place. How about a bubble or discolored crack in the paint? It is an early warning for metal stress or breakage. Could that slight hiss indicate a growing air leak? After all, it is easier to tighten a packing nut than shut down for packing repairs. An alert crew will:

Check operating air pressure.

Wipe away excess lube around bearings and gears.

Maintain correct supply lubricants.

Lube regularly.

Never lubricate parts in motion, that is gears, etc.

Look for and secure any loose bolts or locking devices.

Check all wire ropes for early signs of wear or failure.

Promptly replace all guards, inspection plates, access covers or other safety devices after inspection/repair.

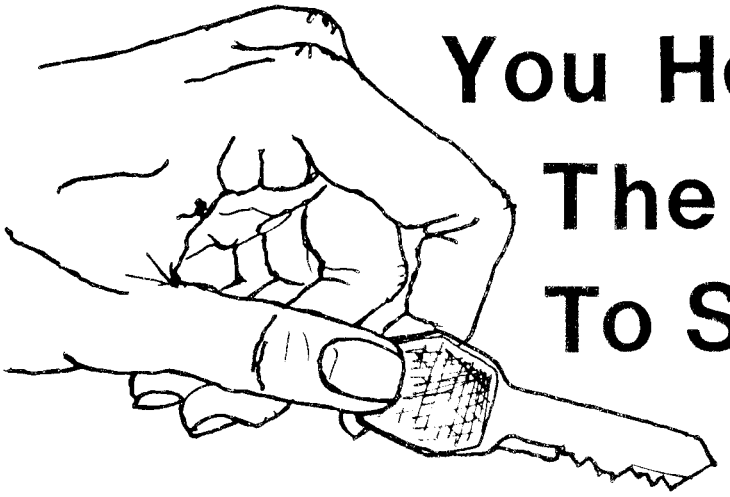
USE EXTREME CAUTION around ANY electrical lines and equipment. This pertains to low as well as high voltage.

Never attempt electrical repairs, unless qualified.

Assure power source is properly grounded.

Check limit switches for proper operation.

Check overloads and thermal breakers.



You Hold The Key To SAFETY!

OPERATING SAFETY SUGGESTIONS

KEEP SAFE OPERATING PROCEDURES IN MIND AT ALL TIMES.

CAUTION IS THE BY-WORD.

OPERATING MACHINE ON AS NEAR LEVEL GROUND AS POSSIBLE.

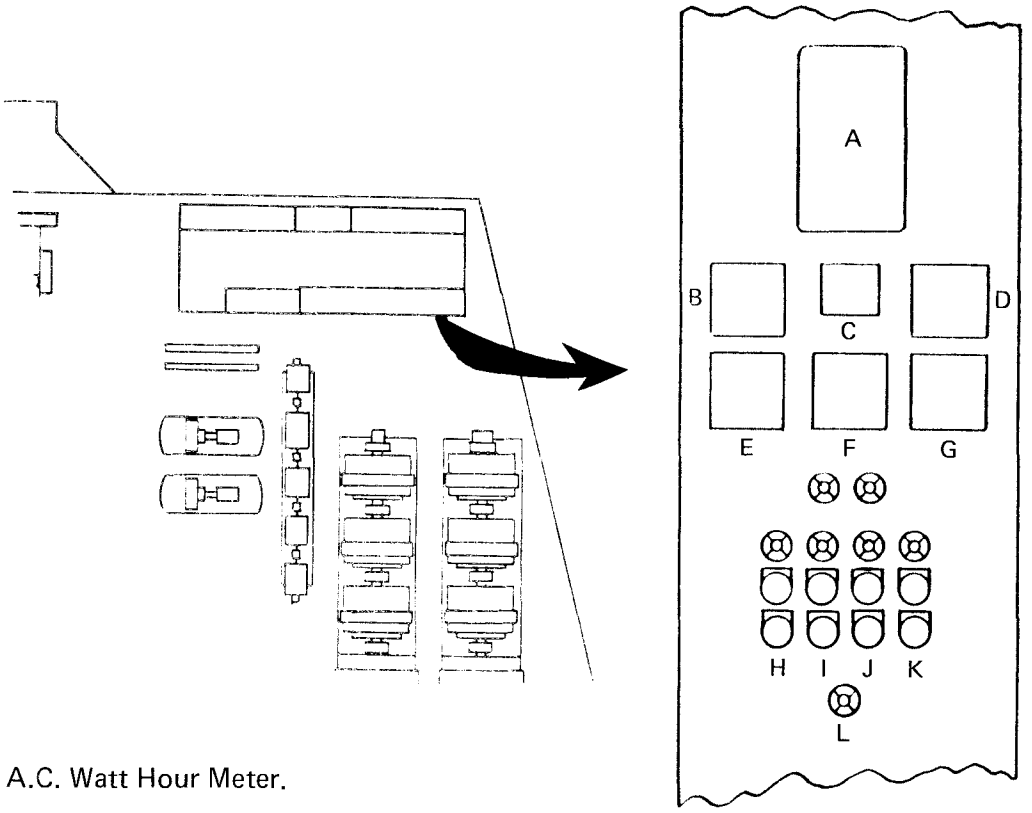
DO NOT BOARD AN OPERATING MACHINE.

WATCH CLEARANCE WHEN SWINGING (BUCKET AND REAR END.)

DO NOT APPLY SWING BRAKES WHILE MACHINE IS ROTATING, EXCEPT IN EMERGENCY.

DO NOT HOLD THE BUCKET LONGER THAN NEEDED IN DUMPING CYCLE.

CONTROLS IN MACHINERY HOUSE, located on outside of power control room are used by the operator for start-up and shutdown.



A. A.C. Watt Hour Meter.

B. A.C. Watt Meter.

C. Time Meter. Registers total operating time.

D. Var Meter.

E. D.C. Volt Meter. Measures the house exciter (D.C. control) voltage.

F. A.C. Ammeter. Shows the current in the high voltage lines, thru the auxiliary transformer and the M.G. set motors.

G. A.C. Voltmeter provides a visual reference of incoming voltage to the machine.

H. Exciter Set. Start, stop push buttons and green (on) indicator light.

I. M.G. Set. Start, stop push buttons, green (on) light and green field light.

J. M.G. Set. Start, stop push buttons, green (on) light and green field light.

Each assembly consists of an eccentric, a walking arm with stabilizer bar and walking shoe. The walking arm connects to the walking shoe by a ball swivel joint that allows the shoe to swivel in all directions and have limited lateral movement. This way the shoe adapts itself to the propel machinery. A walking step is created by rotating the main propel shaft and eccentric. The eccentric top always turns toward machine rear. The walking arm turns on the eccentric arm and when restricted by the stabilizer bar, generates the walking step motion of each side.

During the first eccentric quarter turn, the walking shoe moves from the raised position toward machine rear. The shoe continues to move rearward and down until the shoe contacts the ground behind the machine center of gravity. Just before eccentric reaches the second quarter turn of rotation, the machine rear and tub rear edge raises and moves slightly forward. This motion raises tub out of any depression formed while digging and breaks any suction under the tub.

In the second quadrant of eccentric rotation, the shoe moves down and toward machine front. This causes machine to be propelled to rear, dragging tub front edge.

The third quarter turn of eccentric completes the propelling step. Machine and tub slowly lower to the ground.

The last or fourth quarter turn returns shoe to raised or park position.

The shoe return mechanism align shoes parallel to the rotating frame when in park or raised position.

Refer to DRAG MODE on how to get the machine from the propel to drag mode.

TYPICAL PARTIAL SHUTDOWN for shift change or lunch break. At end of each shift, the operator should swing machine one complete revolution. This will change position of rollers in the roller circle for even wear.

For this type of shutdown, only the primary operating controls (hoist, drag and swing) will be deactivated. Lower bucket to ground and return all controllers to neutral.

Place hoist, drag and swing brake selector switches in the set position. Make sure all controllers are in neutral position. Now, fully depress and release the emergency stop push button located on right hand panel. This will de-energize the primary controls.

To **COMPLETELY SHUTDOWN** follow procedure just described, then leave cab and go to the control panel on outside of power control room.

NOTE: Unusually dusty or dirty atmosphere, high humidity and extreme temperatures alter the effective life of a lubricant. Therefore, it shall be the responsibility of the owner/operator to determine the most effective lubricant interval according to existing environmental conditions for all components, bearings (plain and anti-friction), gears, gear cases, etc.

WIRE ROPE PENDANT LUBRICATION dislodges with the movement of strand against strand. This permits moisture to enter and causes deterioration of the rope. The area where greatest deflection occurs is at or adjacent to the socket connection. Experience shows this the most likely point of boom point support bridge strand rope failure. To avoid this condition and increase useful life expectancy of the bridge strand support rope apply wire rope lube to the socket area using the hand spray.

CHECK LIST for initial lubrication start up and any inspection following:

Clean up spilled petroleum products immediately.

Remove promptly any petroleum product that gets on your skin.

Don't use gasoline, naphtha, turpentine, or similar solvents to remove oil or grease from your skin.

Don't use dirty wipe cloths.

Avoid breathing oil mist or solvent vapors.

Don't wear oil-soaked garments.

Remove grease accumulation around bearing and gears.

All grease piping connected and filled.

Proper lube supply to all bearing and lube points.

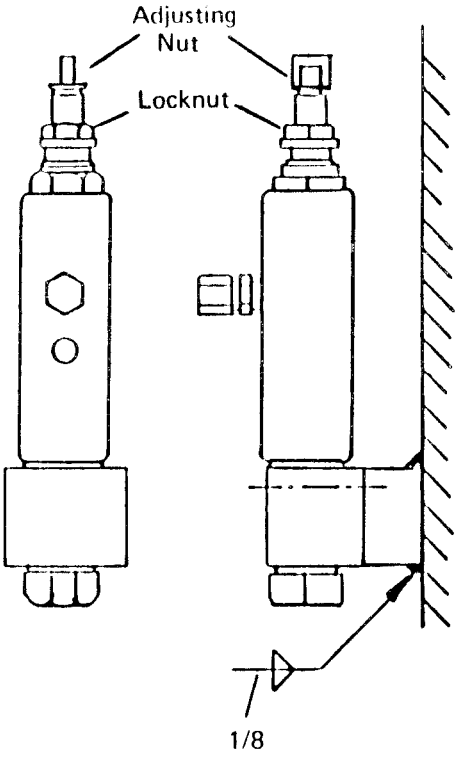
Proper oil level in all gear cases.

Open and semi-enclosed gear teeth coated with lube.

Automatic lubrication system with adequate lube supply.

NAME OF PART	TYPE	NO. OF POINTS	LOCATION	LUB. SYM.	METHOD AND FREQUENCY
LUBRICATION OF ROTATING MACHINERY (1 of 4)					
Main Rotating Gear Case	—	—	Fill at Dip Stick	GL	280 gal. capacity Check weekly
Main Rot. Shaft Top Bearings	Anti-Friction	—	From Gear Case	—	—
Intermediate Shaft Bearings	Anti-Friction	—	From Gear Case	—	—
Motor Extension Shaft Bearings	Anti-Friction	—	From Gear Case	—	—
Rotating Shaft Bearing Bottom	Anti-Friction	4	Bottom of Upper Frame	MPG	Automatic
Rotating Motor Coupler	—	—	Plug in Coupler Flange	MPG	500 Hrs., as required
Rotating Pinion	—	2	Drip On	OGL	Automatic
Main Rotating Shaft Spline	—	1	Fitting at Top of Swing Case	MPG	Hand, 500 Hrs.
Rotating Motor	Anti-Friction	2	In Motor End Bell	EMG	Hand, 500 Hrs.
Rotating Bearing	Anti-Friction	1	Bottom of Shaft in Upper Frame	MPG	Automatic
LUBRICATION OF ROLLER CIRCLE					
Roller	Nylatron	120	In End of Spacer	MPG	Every 3 to 6 Months
Roller Thrust Washer	Nylatron	—	—	—	—

ADJUSTING AND MOUNTING OF LINCOLN INJECTOR



LINCOLN injector is preset for maximum discharge.

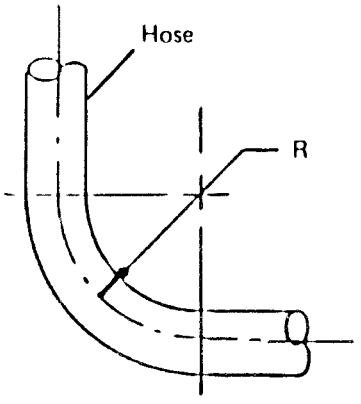
To Reduce Discharge:

– Loosen Locknut

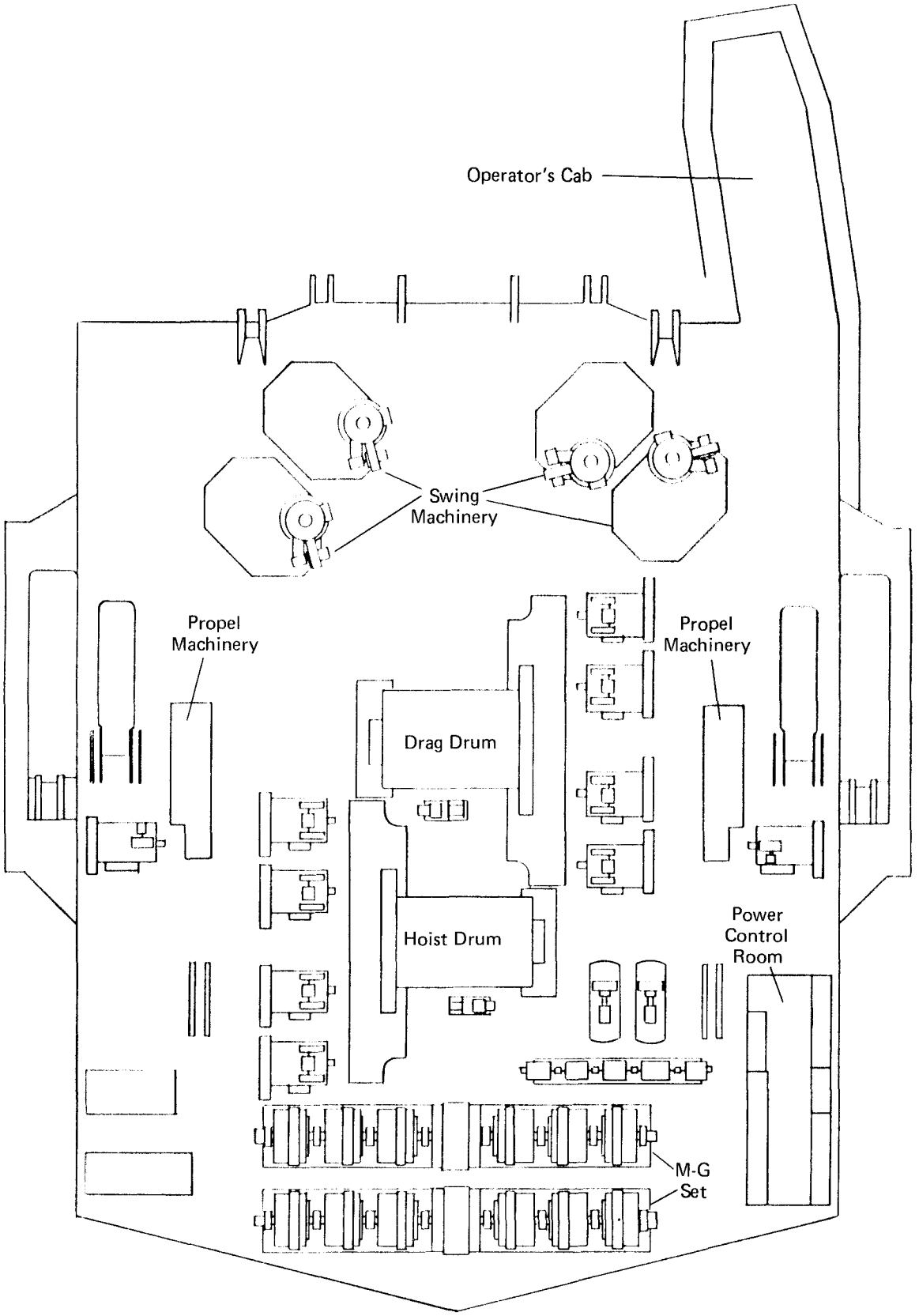
– Turn Adjusting Nut Clockwise

– Tighten Locknut

HOSE BEND RADIUS



MPSD No.	Min. Radius (R)
Hose R5-5	3-3/8
Hose R2-8	7
Hose R2-12	9-1/2
Hose R2-16	11


Operator's Cab
Swing Machinery
Propel Machinery
Propel Machinery
Drag Drum
Hoist Drum
Power Control Room
M-G Set

Next separate the motor coupler. Match mark all parts, including bolts, before separating the dynamically balanced motor coupler. By match marking all parts, they can be reassembled in proper order to maintain balance. Remove bolts and slide off coupler internal gear sleeve.

Remove cap screws from top half of all bearing plates, eccentric and flanged sleeves. Loosen bottom cap screws about two turns.

Remove gear case cover. It may be necessary to drive a small wedge between case and cover to break seal. Lift off cover using lifting holes provided.

Remove bearing retainer plates and shims, wire shims to retainers to prevent loss. Remove cap screws from bottom of bearing housing. Starting with motor extension shaft, then first and then second intermediate shafts. Carefully lift shaft assemblies from gear case. Drain and flush out case with light oil, clean thoroughly.

If the same parts reassemble, use the same shims, BUT if any parts are replaced, always use new shims.

ASSEMBLE GEAR CASE by lowering second intermediate shaft in place first, then proceed to high speed shaft. Coat outside of bearing housing with Permatex that has contact with case. Be sure bearings are well seated in housing.

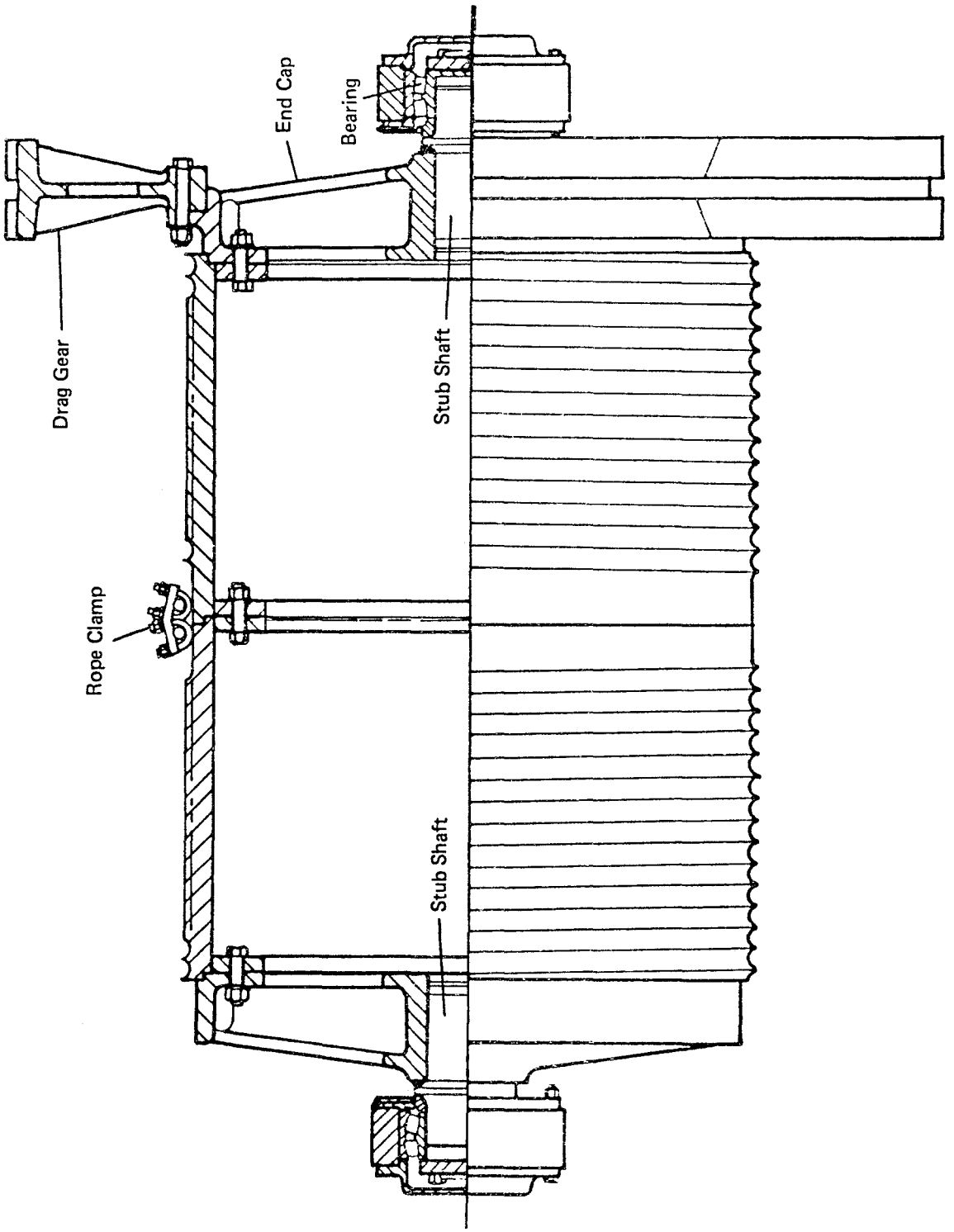
Carefully align gear faces.

Apply Permatex to top of case, 1/64 inch thick. Lower cover in place, install rod bolts, and hold down bolts. Lubricate and tighten rod bolts to 3078 foot-pounds. Also, lubricate and tighten hold down bolts to 954 foot-pounds.

Adjust anti-friction bearings next. The bearing clearance is determined by placing shims between bearing retainer cap and bearing housing on one end only. Draw down retainer cap WITHOUT shims, turning cap screws progressively until bearing binds slightly when rotated. Measure, 120 degrees apart, gap between cap and housing at three places. Average the three measurements and install shim(s) of this dimension plus 0.000 to 0.005 inch. Be sure to coat both sides of shim material with Permatex before installing. One shim is laminated (0.002 to 0.003 increments), peel lamination with a sharp knife.

Reassemble bearing retainer with proper shim(s) and tighten cap screws, one end only, to proper footpound (See Section 7). Lock cap screws with wire.

Replacement oil seal on input and output shafts are split seals. Spray lip seal area of shaft



DRAG DRUM

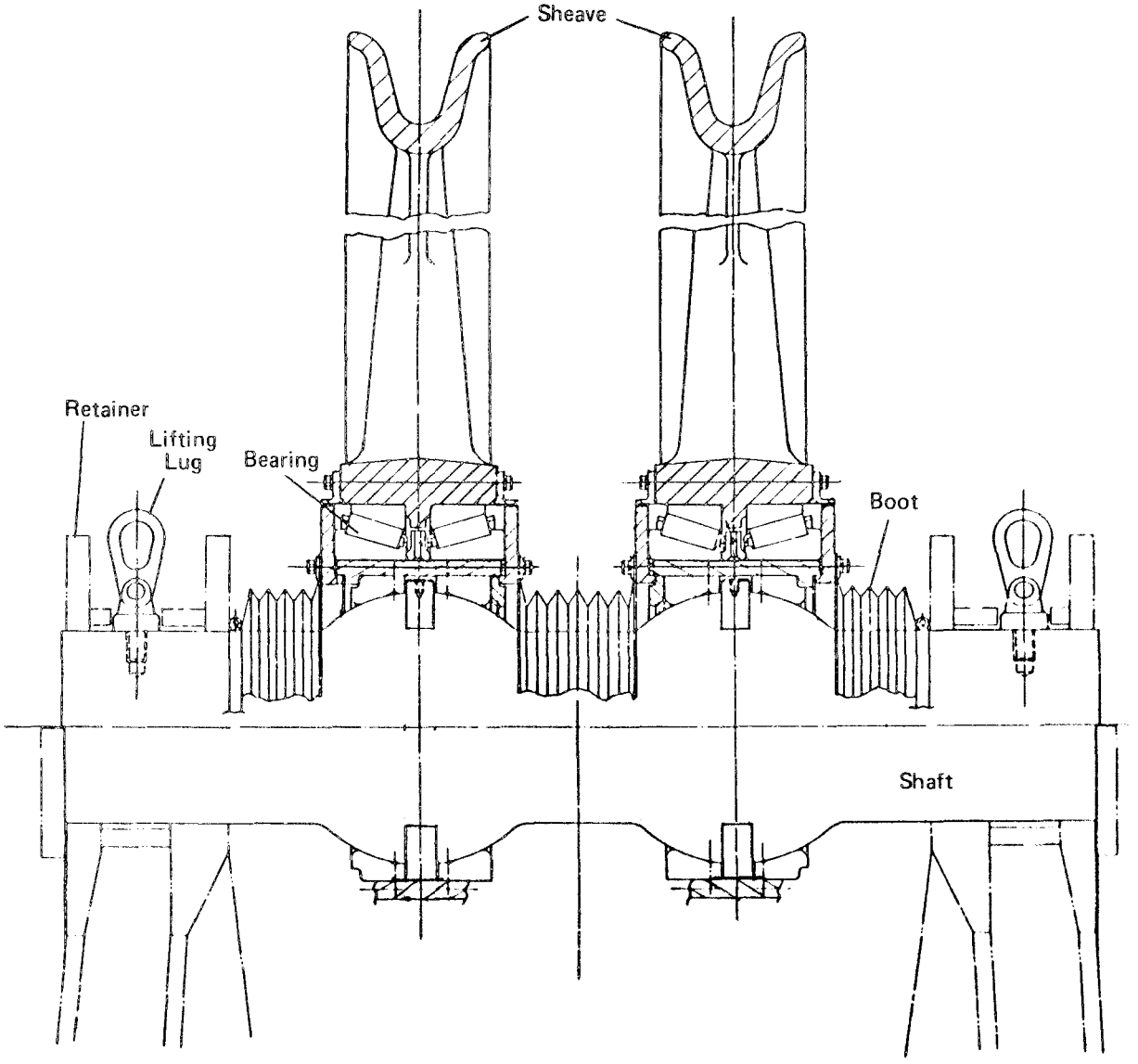
NOTE: Winch line should already be attached to drag rope. With winch line lower drag rope to deck, then remove rope from machine.

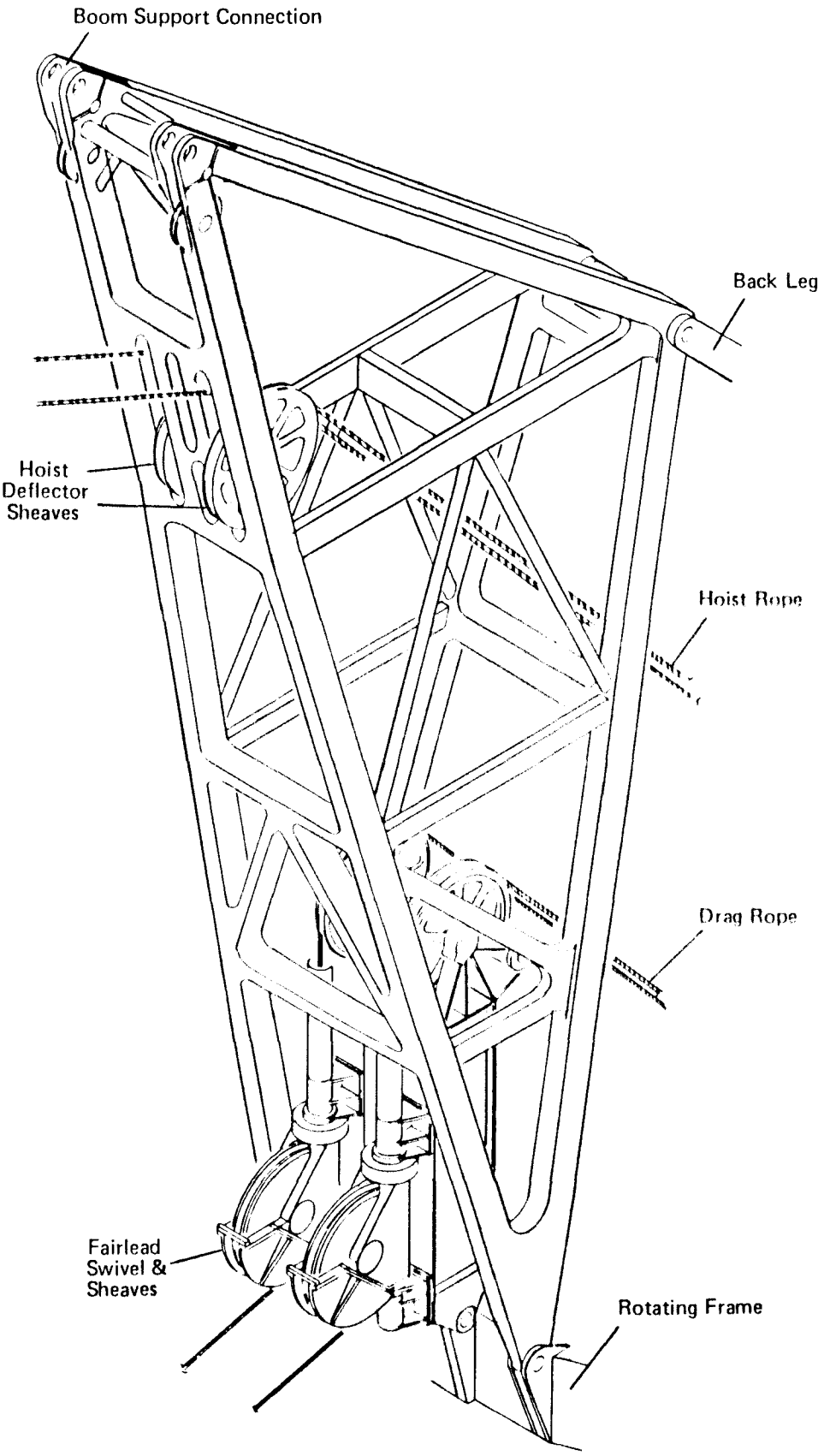
Remove winch line from its present reeving on top of tri-structure. Reeve line over sheave C, then down to intermediate ropes on top side of boom. Attach line to ropes and pull ropes up to point G and pin in place. See sketch 2. Remove winch line from rope and tri-structure.

Replace ALL lube lines and adjust tension on intermediate ropes.

Replace hoist and drag ropes on machine. Adjust both drum limit switches.

Two **BOOM POINT SHEAVE** assemblies mount at the boom point. A sheave assemblyconsists of a sheave that turns on two tapered roller bearings. The bearings mount on a sleeve




Boom Support Connection
Back Leg
Hoist
Deflector
Sheaves
Hoist Rope
Drag Rope
Fairlead
Swivel &
Sheaves
Rotating Frame

SECTION 5

ELECTRICAL MAINTENANCE

CARE OF D.C. MOTORS AND GENERATORS holds one watchguard – cleanliness. Keeping this equipment free of dirt, oil and grease is of prime concern. The operator generally recognizes and may correct the few common problems. Failure of this equipment is rare. Serious problems require a competent electrician. In the case of poor commutation, where simple remedies can not solve the problem, consult the electrical equipment manufacturer.

BRUSHES with an excessive amount of arcing between brush and commutator when operating under normal loads and speeds need checked for the following:

Are brushes sticking in holders?
Are brushes making full contact on commutator?
Are contact surfaces of the brushes clean?

NOTE: Determine this by removing the brush and looking at it's surface. The surface is smooth and polished where the brush rubs. Any portion not in contact has a rough, dark appearance. Loose brush holder studs throw brushes out of line and cause excessive arcing. Here the brush rides on heel or toe out of normal commutating plane. Tighten brush holder into correct position to solve the problem. Loose brush holder yoke set screws permit the yoke to rotate and shift all the brushes. So they arc. Reposition the holder yoke and tighten. Another problem solved. Keep even spring pressure on ALL brushes. This exact pressure varies with unit type. Call the factory for specific information on your unit. The brush springs are set originally at one point. One may assume this pressure setting as correct and keep it exact when installing a new brush. This initial brush pressure should be the same for all brushes on any one motor or generator. Inspect all brushes regularly. Brushes worn beyond a point of good contact need replaced. Put in new one(s). Avoid allowing rapid brush wear. This results in improper brush pressure and causes severe arcing. Excessive brush wear may even cause the pigtail to wear into the commutator proper. Check the brush springs. Are they in their slots? When using fairly long brushes, it's a good practice to increase spring tension after brushes wear to make up for brush pressure loss. Use the same brush type as originally furnished with the unit when replacing. Serious problems occur when using an incorrect brush. A change in brushes sometimes improves a condition of poor commutation and severe arcing. First, consult manufacturer before making this change.

BRUSH INSTALLATION–Brush should properly fit holder or guide, to work up and down freely. Grind brush with 2/0 or 3/0 sandpaper until contact surface matches the commutator contour. Use the following procedure: Place brush in holder, release spring and insert sandpaper (wider than brush, rough side to brush) between brush and commutator. Exert

Accurate, properly maintained test equipment, suitable for the quantities for measurement is needed also.

a D.C. voltmeter for 125 - 600 volts,

a D.C. millivoltmeter for 600 millivolts,

zero center meters preferred,

a volt-ohm-milliamp meter or

a multi-meter (example, Simpson 260),

an A.C. voltmeter, unless multi-meter is accurate,

a quality tachometer is often handy, and

a 500 volt D.C. megger test insulation quickly.

Knowing the capabilities and limitations of each instrument helps keep repair and replacement costs reduced, since most test equipment suffers from the wrong connection rather than damage from dropping.

Now – get set to find the trouble.

INVESTIGATION: When trouble occurs, the operator is the "Expert Witness", so contact him first for answers to the following important questions:

How many motions are effected?

Is motion dead or just retarded?

Is it intermittent or continuous?

Did trouble develop slowly or suddenly?

What happened just before the failure?

A complaint concerning POWER means different things to different people, so try to get specific answers to the following:

Will machine lift as heavy a load as before?

reducing stall current reduces motor torque so an equally heavy load cannot be lifted as before. A reduction in no-load voltage causes decreased speeds.

A change in motor field strength offers various effects. A lower field voltage provides higher speed for light loads, but lower speed for heavy loads. Complete field loss gives very high speeds for light loads. Although this is uncommon, too strong a field creates low speed with light loads and probably high speed with heavy loads.

Many failures effect BOTH stall current and no-load voltage. A master switch failure generally effects BOTH.

Fortunate and rare is the case of an intermittent problem occurring with the electrician aboard, so finding these requires a combination of skill and luck.

The starting procedure is the same. Gather needed info regarding effect on speeds and pulls. Determine what the operator did just before the failure. Ask yourself, if any special weather or temperature conditions existed; how long did failure last in time and what was done to restart, etc. Study the system with this info and estimate the circuit(s) at fault. Look for the obvious first. Loose connections are commonplace.

As a last resort; simulate the fault. In other words, open the circuit felt to cause the trouble and see if it occurs again. **CAUTION** is the byword here since opening the wrong circuit could cause more damage than the failure. **NEVER OPEN** a critical circuit such as; current-limit or voltage feedback unless it is positive the results will not prove damaging. Again, know your system.

As an example of simulated troubleshooting.

The complaint is of a sluggish swing motor. Although the troubleshooter rode the machine for several days, the trouble never re-occured. The operator remembered that the trouble occured only on hot days and he felt he'd know it if duplicated. The machine used three-field control. A weak motor field or weak generator field could cause sluggishness.

Simulating the trouble required first opening the motor field contactor, but to no avail. Next, the self field contactor was opened and produced the same intermittent result. Investigation proved the contactor did not close in hot weather since coil resistance increased not allowing sufficient coil current to flow. Weakening spring tension solved the problem.

Unfortunately, some circuits do not check with the common instruments. These include anti-hunting or stabilizing circuits, plugging control circuits, rate circuits, etc. The use of these circuits is minimized, but often unavoidable on newer, sophisticated, fast response control systems. Failure of a plugging control circuit causes higher plugging currents and possibly bad commutation; but the operator generally notices a harder plug. Failure of sta-

SECTION 6

COMPRESSED AIR SYSTEM AND COMPONENTS

INDEX

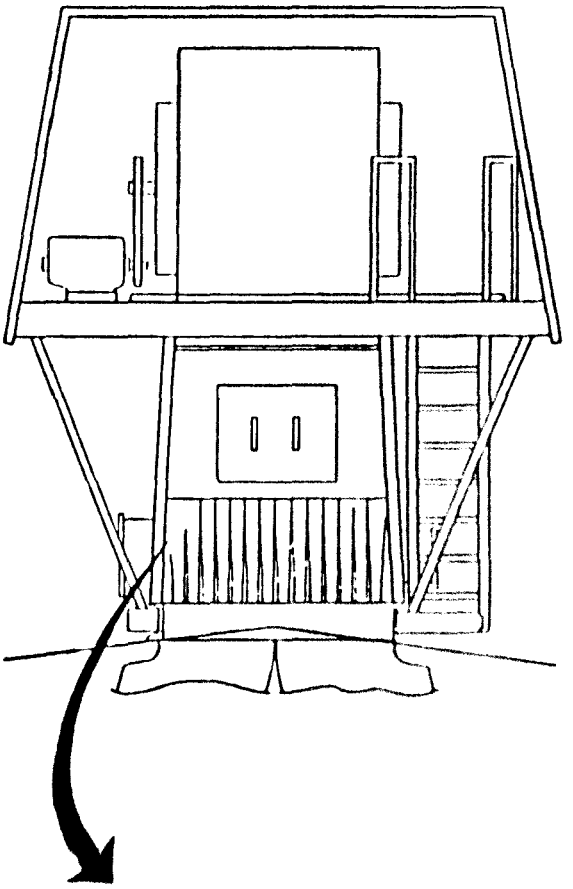
AIR FILTER SYSTEM

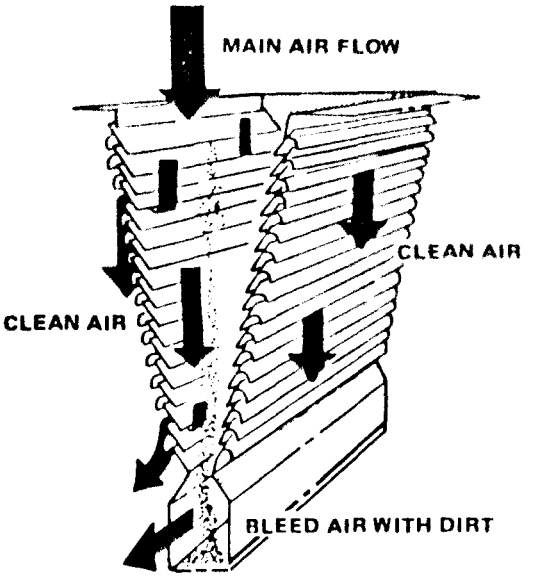
The entrance of dust and dirt into electrical equipment and other machinery causes extra wear to components. This is why ALL air entering the machinery house passes thru the filter house on top. Blowers create a slight pressure above the outside air. Leaving an access door open reduces this pressure. Dust and dirt generally enter. In operation, this slight pressurizing reverses any possible IN FLOW thru cable openings and personnel opening and CLOSING doors. This means ALL air drawn into the house is FILTERED. Thus protecting D.C. motors and generators, while providing longer life to commutators, carbon brushes and other machinery. Filtered air circulation reduces dust accumulation and results in lower operational temperatures of ALL equipment, including personnel.

Dirty air passes into the inlets located at the wide end of wedge shaped cells. Most air (about 90%) changes direction quickly and passes thru the narrow side passages. The dirt particles due to their greater mass, tend to continue straight into the bleed air duct. The dirt ladden bleed air (about 10%) continuously cleans the bleed air duct. Thus dirt particles and bleed air return outside. These self-cleaning filters require no regular maintenance.

A few suggestions may be helpful. For instance, keep air passages free of paper, leaves, wiping cloths, etc. This allows constant air flow. An inspection helps here. Check also for build-up of deposits on filter blades. A light coat of dust is normal. Heavier build-up may require cleaning. Oil mist and similar vapors generally cause this problem. Remove the filters and scrub in soapy water. Please do not use solvents. The filter vanes do not need oil. Believe it or not, it's been done.

AIR FILTER HOUSE
ATOP MACHINE





SECTION 7

ENGINEERING DATA

The Marion machine design and construction follows rigid specifications in accordance to acceptable industry standards. This section provides information for proper machine maintenance. NOTE: Consider the information in this section general in nature. It includes established procedures recommended by Marion Engineers which may or may not wholly apply to your machine, but remains applicable by reference.

STRAIGHT BRONZE SLEEVE BUSHINGS assemble in bearing boss with a light press fit.

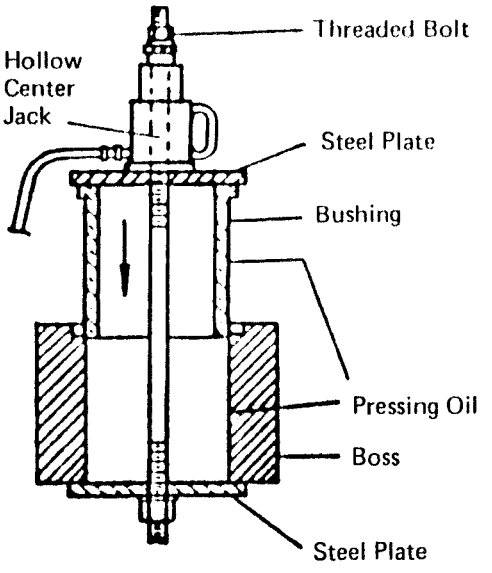
Each **FLANGE BUSHING** secures thru flange with a minimum of four dowels to restrict bushing rotation. Dowel material is softer than bushing.

BUSHING LIFE is figured on the table so that when running clearance exceeds three times the figures shown, REPLACE the bushing.

BUSHING REPLACEMENT first requires dismantling machinery and shaft assemblies. An air chisel, cautiously used, slits bushing for easy removal. Be careful not to CUT or SCORE the bearing boss. Clean the boss completely. Remove ALL burrs. Check the outer leading edge of bushing for insertion is de-burred and a chamfer exists. This is important.

The de-burred clean bushing installs easily in a clean bore if bushing is cooled (using dry ice and alcohol) to point where it drops freely into place.

An alternate method installs the bushing using a long threaded rod, steel plates and a hollow center jack. Assemble items as shown in sketch. Lightly coat bushing O.D. and boss I.D. with high quality anti-scoring, extreme pressure, pressing oil. The PULL the bushing in place.



Shaft Nom. Diam.	Shaft O.D.	Running Clearance	Shaft Nom. Diam.	Shaft O.D.	Running Clearance
34-1/2	34.500 34.494	.046 .068	38-3/4	38.750 38.744	.051 .073
34-3/4	34.750 34.744	.046 .068	39	39.000 38.994	.051 .073
35	35.000 34.994	.046 .068	39-1/4	39.250 39.244	.051 .073
35-1/4	35.250 35.244	.046 .068	39-1/2	39.500 39.494	.051 .073
35-1/2	35.500 35.494	.046 .068	39-3/4	39.750 39.744	.052 .074
35-3/4	35.750 35.744	.048 .070	40	40.000 39.994	.052 .074
36	36.000 35.994	.048 .070	40-1/4	40.250 40.244	.052 .074
36-1/4	36.250 36.244	.048 .070	40-1/2	40.500 40.494	.052 .074
36-1/2	36.500 36.494	.048 .070	40-3/4	40.750 40.744	.054 .076
36-3/4	36.750 36.744	.049 .071	41	41.000 40.994	.054 .076
37	37.000 36.994	.049 .071	41-1/4	41.250 41.244	.054 .076
37-1/4	37.250 37.244	.049 .071	41-1/2	41.500 41.494	.054 .076
37-1/2	37.500 37.494	.049 .071	41-3/4	41.750 41.744	.055 .077
37-3/4	37.750 37.744	.051 .073	42	42.000 41.994	.055 .077
38	38.000 37.994	.051 .073	42-1/4	42.250 42.244	.055 .077
38-1/4	38.250 38.244	.051 .073	42-1/2	42.500 42.494	.055 .077
38-1/2	38.500 38.494	.051 .073	42-3/4	42.750 42.744	.056 .079

INSTALLATION OF SHRINK FIT PINIONS requires cleaning the entire seating surface on bore and pinion shaft using recommended, safe solvents. Wipe dry with a clean cloth.

Remove ALL high spots or scoring on either of the parts. Check with "blueing" by spotting the cold pinion on the shaft by hand to obtain at least 75 percent fit. Scrape the pinion and repeat "blueing" until desired fit is obtained. Repeat this scraping and "blueing" as needed.

Break ALL sharp edges of the key with a fine file to obtain 1/64" (approx.) at the edge. Fit key to shaft. Take care here not to disturb shaft metal next to key. A tight key fit is needed, but NOT a fit requiring a hammer to place the key.

Try the cold pinion on the shaft. MAKE CERTAIN pinion does NOT bind on key. This is important.

Mount the cold pinion on shaft and snap into position by hand.

Measure this "cold" pinion position using a micrometer depth gauge as indicated in the sketch. Record this measurement. Mark the place where depth gauge rests so following measurements from this position can be made after mounting the pinion.

Remove the pinion from shaft and clean ALL blueing marks from pinion, bore and shaft.

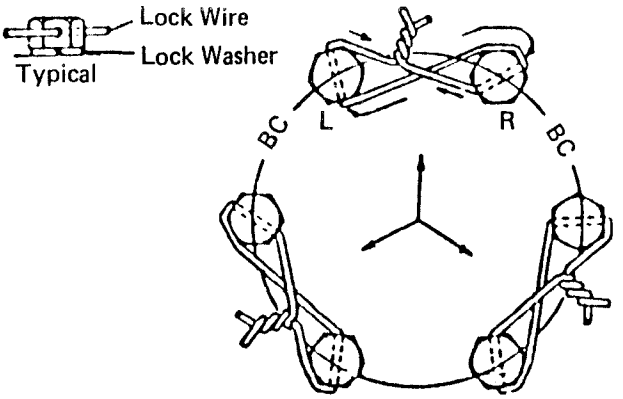
Once pinion is removed and clean, heat in suitable oven or other device for DRY HEAT to the temperature specified in table provided.

NOTE: DO NOT USE OIL OR WATER TO HEAT THE PINION.

> The pinion temperature indicated is a temperature difference between shaft and pinion. This is estimated ONLY and may be adjusted to maintain the specified advance of shaft. Heat pinion uniformly until temperature reaches needed reading above shaft temperature.
>
> For example, if shaft temperature is 77 degrees F. (25 degrees C.) and estimated difference is 225 degrees F. (107 degrees C.), then heat pinion to 302 degrees F. (150 degrees C.) for mounting. NEVER HEAT PINION ABOVE 340 degrees F. (171 degrees C.).
>
> Check pinion temperatures by placing putty over the bulb of thermometer and holding against pinion. Heat pinion a few degrees above desired temperature before removing from oven.

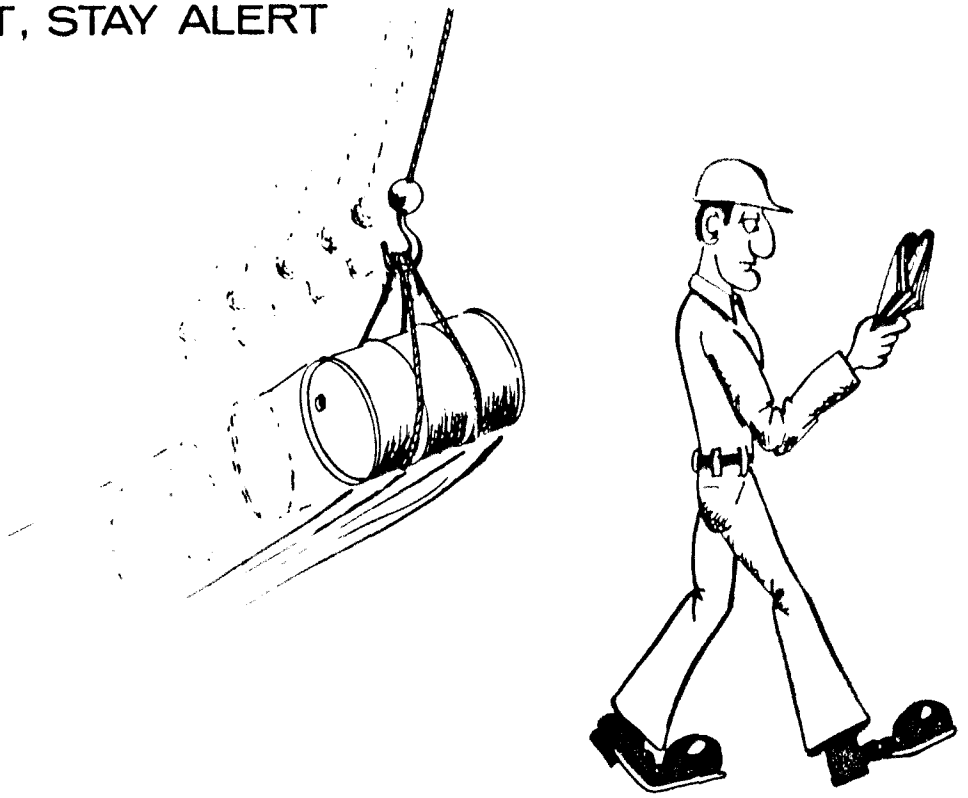
After removing pinion from oven, wait until it cools to desired temperature; then remove thermometer and QUICKLY mount as described in the following.

ENGINEERING STANDARD 1101-2 for wire lock cap screws. This standard establishes recommended method for these features. Use here is for designs where maximum locking assurance is required and periodic visual inspection is not possible. Check classification 121F for special fasteners with 1/8" holes for locking with 14 gauge soft annealed wire. RECOMMENDED WIRING METHOD: The following procedures will exert a tightening force on cap screws as the wire is twisted tight.



Wired in Pairs: Establish left and right hand fasteners as viewed from center of bolt circle. Insert left end of wire thru left hand fastener from inside to outside of bolt circle. Insert right end of wire thru right hand fastener from outside to inside of bolt circle.

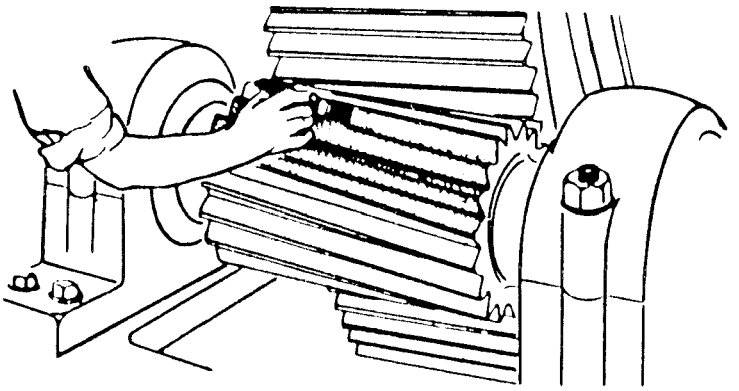
BE ALERT, STAY ALERT



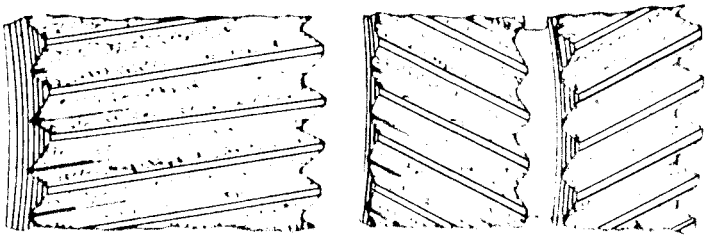
METHOD OF CHECKING SPACING AT SPLITS OF SPLIT RING GEARS (without hubs). After mounting on flange and tightening alignment and clearance bolts; place a cylindrical pin between gear teeth, several teeth away from the split. Set up a dial indicator and zero to maximum-plus reading as gear (with pin in teeth) rotates past the indicator stem. Remove the pin without disturbing indicator setting and place in the adjacent space toward the split. Rotate gear again (pass the pin under the indicator stem). Record the maximum-plus reading. Repeat this procedure for three spaces on EACH SIDE of the split, as well as, for the space AT each split. An indicator reading AT a split varying by .005" or more in the negative direction from other readings indicates the split is OPEN. This open split is caused by interference between gear bore and a mounting flange surface; bolting pads burred or foreign material between their surfaces; or the gear mounted elliptical, (egg-shaped) with large diameter at splits preventing tightening there. The gear egg-shaped mounting can be determined by making a radial runout check as described in a following paragraph. Take steps to correct this open split condition: Remove the interference between gear bore and flange register by clearing bolting pads of dirt or burrs. REMOUNT gear, if needed, to eliminate the elliptical shape. If this gear operates with open splits, bumping will occur every time a split passes thru mesh point with pinion.

NOTES:

teeth across the face. Roll pinions back and forth thru the mesh several times to trace contact pattern on gear teeth. If motor power unavailable, use a torque arm and BUMP teeth on BOTH sides as pinion is rolled back and forth. This contact pattern may be scattered, but shows across at least 80 percent of the gear face. (See following sketch).



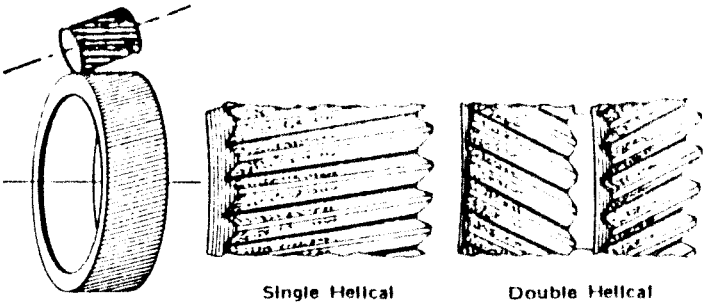
TYPICAL CONTACT PATTERNS: After a satisfactory pattern is established for the initial position of the gear, make the SAME contact check at three more points on gear, spaced 90 degrees apart. A minor adjustment to pinion may be necessary to produce the best average contact on the gear.



Single Helical Double Helical

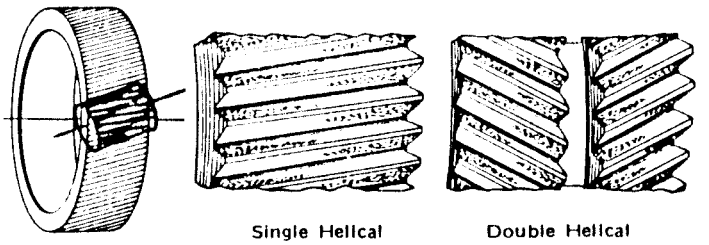
INSPECTION: Dowel ALL bearing pedestals and RECHECK ALL bolts to secure gear setting. INSPECT gear teeth and REMOVE ALL metal upsets and burrs that occurred in handling or assembly. CLEAN gear teeth and enclosures thoroughly BEFORE enclosing gears.

AVOID MISALIGNMENT IN PLANE OF CENTERS: If gears are misaligned in plane of centers, pattern develops as shown in sketches at right. MOVE pedestals to correct this condition and obtain FULL contact across ENTIRE face width of gear.



Single Helical Double Helical

AVOID MISALIGNMENT AT RIGHT ANGLE TO PLANE OF CENTERS: If gears are misaligned at right angles to plane of centers, pattern develops as shown in sketches at left. To correct, MOVE pedestals until obtaining a FULL contact across ENTIRE face width of gear.



Single Helical Double Helical

on a new rope due to minimum surface contact of each wire. As these wires wear, they present a flattened surface and the rate of normal wear decreases.

Determine the cause of outer wire breaks by examining the break.

Tension breaks show a cup and cone effect at the break. This is caused by overload, shock load, jerking a load or catching a falling load.

Careless operational load handling.

Fatigue break showing a square end break with granular metal appearance. Repeated bending over sheave causes fatigue or the sway and vibration at dead end anchor and static sheave.

A shear break indicated by a smooth, twisted break generally comes from external damage (nicks or kinks) in the rope.

Several outer wire breaks at isolated areas along rope length cause little concern. Concentrated breaks at a single location indicate severe rope damage. Retire this rope.

External corrosion indicated by rust, scales or pitting on rope surface remains out in the open. Internal corrosion may appear as pitting in strand valley or rust and scale working out from under strands. Outside wire or strands appear slack or seem to stand out from inner portion with severe corrosion. Under a load this rope shows a loss in diameter.

Internal wear or core fatigue indications emulate those of severe corrosion. Wire or strands appear slack and noticeable loss in diameter occurs under load. Internal wear often results from faulty equipment (tight sheave groove, etc.) in a local area.

Rope retirement from service requires a decision based upon a combination of factors.

Inspection determines the abrasive wear effect on outer wires. Percentage of rope area intact indicates rope strength percentage remaining.

The number of broken wires contained within one lay (one full strand wrap) evaluates remaining rope strength to some degree.

No reliable means of determining corrosive effect and internal wear exists. Good operating conditions and effective lubrication keeps these factors to a minimum.

Study the entire rope to determine the section suffering the most severe deterioration. One or more of the following indicates this deteriorating.

Drastic loss in rope diameter and lay lengthening.

Outer wire abrasion.

Intermittent bands applied to large diameter strands during manufacture minimize outer wire displacement while handling. These bands should remain on the strand until after installation.

After accurate measurement at the factory, a longitudinal strip is placed on the strand. During installation, it is extremely important that this longitudinal stripe is kept in a straight line and NOT permitted to spiral around the strand.

If rotating the strand to align socket pin hole is absolutely necessary; then its BEST to rotate in a direction opposite to the strand lay. For example, right lay strand (outer wires spiral to the right) may be turned in a counterclockwise direction. Left lay (outer wires spiral to left) may be turned in a clockwise direction. It is IMPORTANT that the strand be turned so as to tighten, rather than loosen the lay of the outer wires. Exception: only if adjustment is very small.

Following installation, and periodically thereafter, lube the strands at socket base for a minimum distance of three feet.

COILS, small enough for uncoiling by hand, require that one man hold the socket tagged, FRONT END. The second man rolls the strand coil along a level and obstacle-free surface away from the first man. This permits the strand to uncoil naturally without spiraling or twisting.

Please DO NOT attempt to uncoil the strand in the manner often used to uncoil a garden hose. (DO NOT lay coil on ground and carry one end away from it). This is wrong. This method easily results in completely ruining the strand. Besides its not great for hoses either.

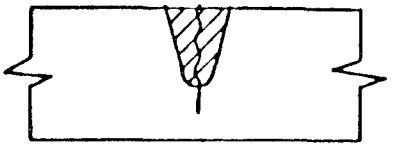
When using a swift turntable for larger diameter strands shipped in coils, as recommended, use also a drag-type brake to prevent any rapid rotating speed from exceeding the pulling speed. This prevents kinking and looping. The pulling device attaches to the socket tagged, FRONT END.

Needless to say, observe all the Common Precautions also. Remember the longitudinal stripe and keep it aligned.

REELS need a shaft thru a center hole and enough height to clear ground and revolve properly.

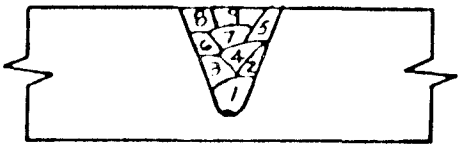
Use a simple timber brake against reel flange(s) to provide uniform unwinding and prevent slack from developing in strand on reel.

correctly and brace, clamp, or tack weld to maintain alignment. Use the specified welding preheats for ALL arcing or burning.



Crack not completely removed reappears in repair weld

PREHEAT area adjacent to weld area to specified temperatures. (See Welding Specifications).



Whenever possible make center pass last as shown

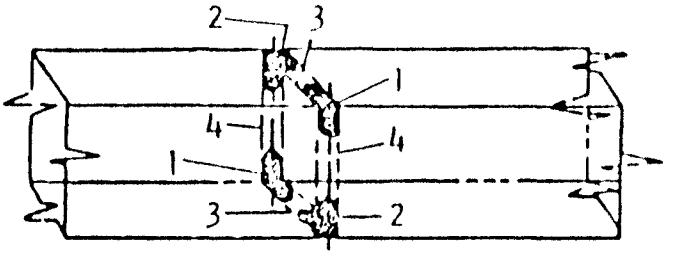
INCREASE preheat temperature 50 degrees F. or 27 degrees C. for material (at weld) 1-1/2 to 2-1/2 inches thick and up to 100 degrees F. or 55 degrees C. for material OVER 2-1/2 inches thick.

MAINTAIN preheat until weld is completed. This is important. Templi-Stiks (from Tempil Corp., N.Y., N.Y.) are helpful for temperature determination.

POSTHEAT area adjacent to weld 100 degrees F. or 55 degrees C., higher than preheat specified. (See Welding Specifications). MAINTAIN postheat for one hour PLUS 1/2 hour for each inch of thickness. CONTROL cooling rate so temperature is about 50 degrees F. or 27 degrees C. per hour until temperature reaches 150 degrees C. (65.5 degrees C.) This is important.

THE ORDER OF WELDING reduces warpage and provides a favorable locked up or residual stress pattern. The use of block welding (short, full size welds) helps reduce warpage. In many cases, V-ing out small areas and rewelding each of these areas; continuing until completing repair eliminates warpage. A favorable locked up or residual stress condition is obtained by making FULL DEPTH welds at the area farthest from the neutral axis first; then making welds closest to this neutral axis last.

To eliminate fusion cracks that persist when welding castings; first deposit a thin layer of weld metal on surfaces for weld, then complete the weld. In box section members this means; first, weld the two diagonal corners; second, the remaining corners; third, the top and bottom; and last, the sides. (See sketch). This procedure creates residual compression at the extreme fibers where it is most beneficial.



Preferred sequence for blocking in butt joint in box section

PEENING often reduces locked up stresses and maintains original dimensions and alignment, as well as, help prevent weld metal cracking in rigid sections. Use a blunt nosed tool. DO NOT peen the first (root or base) pass or cover passes. Avoid EXCESSIVE peening in other passes.

TABLE 2 (cont.)

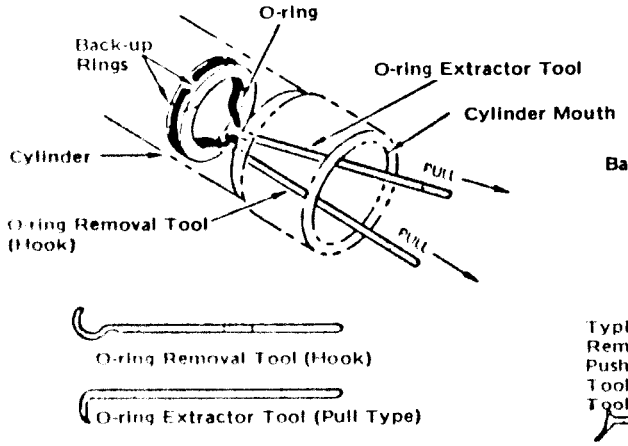
BUCKET COMPONENT PART	MATERIAL – MPSD SYMBOL
Runners	FR4
Shrouds	CL4B
Tooth Point	CFE-S, CK-QS
Top Corner Casting	CK-Q
Tooth Wedge	CK-Q
Top Rail Casting	CK-Q
Trunnion	CL4B
Wear Shoes	CFE
RIGGING COMPONENT PART	**MATERIAL – MPSD SYMBOL**
Bushings	KO4, Manganese
Chain Links (Build-up not recommended)	CO1
Dump Block, Frame	F, FHL, FK
Sheave	CC2A
Retainers	F
Socket Casting & Ball	KP3
Equalizer Block, Frame	F
Sheave	CC2A
Wear Blocks	CB
Pins (Build-up not recommended)	KO1 Ind. Hardened
Rigging Casting Misc.	CFE
Spreader Bar	CN, F, FHL

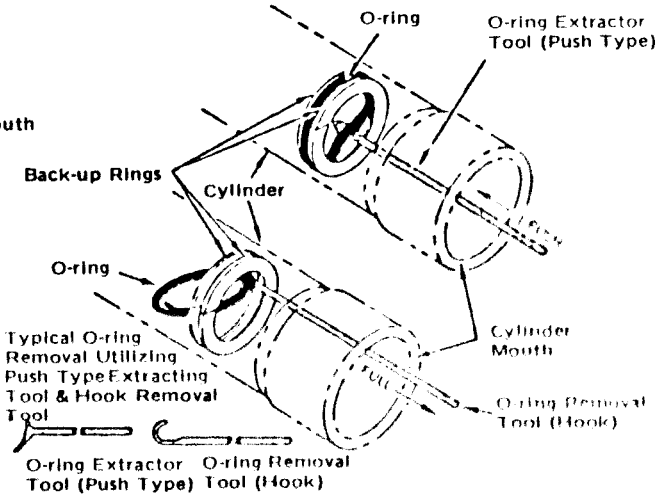
THIS INFORMATION IS FROM MPSD CI-937

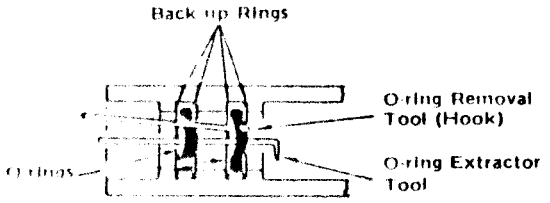
DO NOT USE pointed, sharp-edged or hardened steel tools (screwdrivers, church keys or knives) for removal or installation of backup rings or seals. Soft-metal tools of brass or aluminum, plastic, wood or phenolic rod when formed into desired shape save the critical surfaces.

Tool surfaces need to be well rounded, polished and no burrs on working end. This obviously prevents scratches.

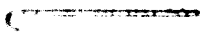
Removal from cylinders and pistons means every effort is needed to avoid contact with machined surfaces.



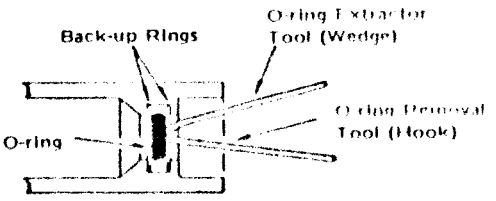




Typical Dual O-ring Internal Extraction & Simultaneous Removal

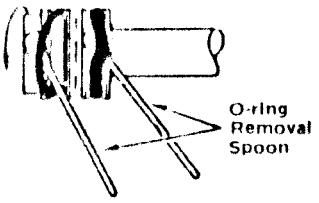


O-ring Removal Tool (Hook)



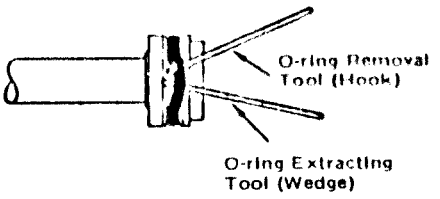
Typical Single O-ring Internal Extraction Utilizing Wedge Type Extracting Tool & Hook Removal Tool

O-ring Extractor Tool (Wedge)



Typical External O-ring Removal Utilizing O-ring Removal Spoon

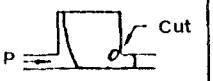
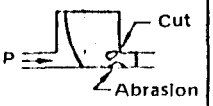
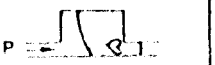
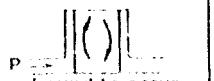
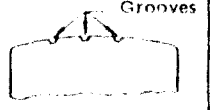
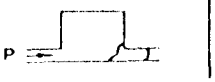
CAUTION: Do Not Permit Unnecessary Contact of Tools With Bearing and Cylinder Wall Surfaces. Avoid Dropping Tools Into Cylinders



Typical Single O-ring Removal Utilizing Wedge Type Extracting Tool and Hook Type Removal Tool

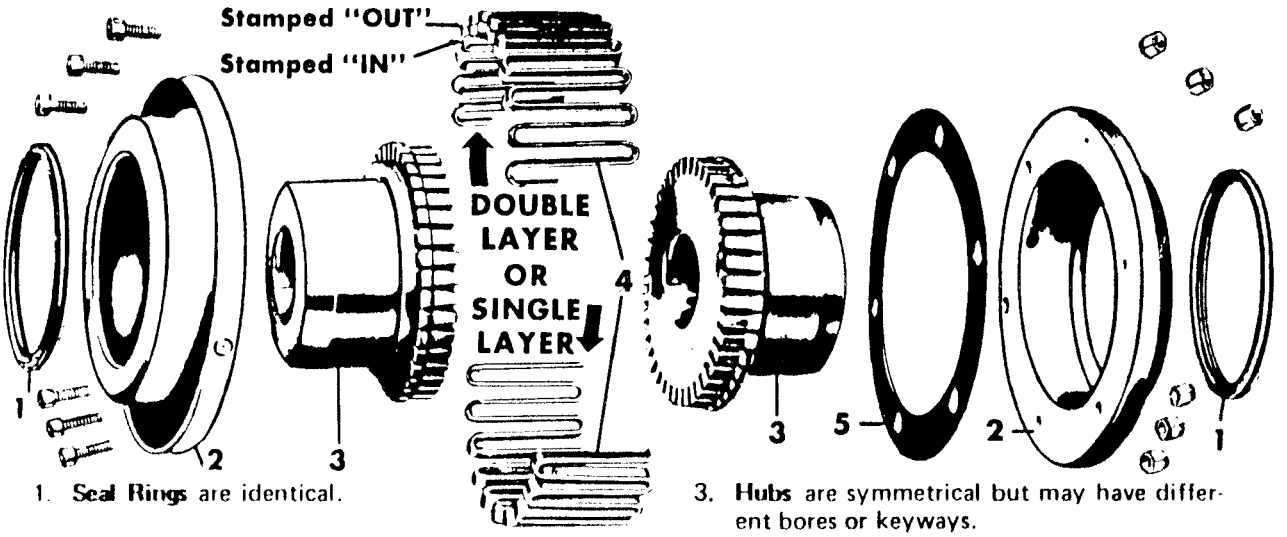
NOTE: After O-ring is Dislodged from Groove, Hold Spoon Tool Stationary Simultaneously Rotate and Withdraw Piston from Ring

MODES OF FAILURE

FAILURE	GENERAL CONDITION	EXAMPLE
Progressive cutting by corner of piston groove.	Pulsating pressure on O-Ring.	
Progressive cutting as in static packing plus abrasive wear.	Pulsating pressure on O-Rings.	
Knibbing extrusion. Rupture of material, large pieces torn off.	Fatigue from shock loads, high temperature, local seizure, pulsating pressure, etc.	
Rotation of part or all of circumference of packing in groove. (Sometimes called "spiral failure"	Complete explanation not found. Occurrence not predictable. Possibly sudden increase in friction on working face.	 Found to occur chiefly when packing was moving in same direction as pressure.
Axial grooves worn in working surface.	Imperfections in cylinder surface. Particles of dirt, metal, or rubber.	 Segment of Plan View
Axial grooves as above.	Rapid passage of oil across working face.	See above sketch
Packing totally extrudes thru clearance space.	Large radial clearance. Soft packing.	

DECIMAL EQUIVALENTS

	.0156	1/64
1/32	.0312	
	.0468	3/64
1/16	.0625	
	.0781	5/64
3/32	.0937	
	.1094	7/64
1/8	.1250	
	.1406	9/64
5/32	.1562	
	.1719	11/64
3/16	.1875	
	.2031	13/64
7/32	.2187	
	.2344	15/64
1/4	.2500	
	.2656	17/64
9/32	.2812	
	.2969	19/64
5/16	.3125	
	.3281	21/64
11/32	.3437	
	.3594	23/64
3/8	.3750	
	.3906	25/64
13/32	.4062	
	.4219	27/64
7/16	.4375	
	.4531	29/64
15/32	.4687	
	.4844	31/64
1/2	.5000	
	.5156	33/64
17/32	.5312	
	.5469	35/64
9/16	.5625	
	.5781	37/64
19/32	.5937	
	.6094	39/64
5/8	.6250	
	.6406	41/64
21/32	.6562	
	.6719	43/64
11/16	.6875	
	.7031	45/64
23/32	.7187	
	.7344	47/64
3/4	.7500	
	.7656	49/64
25/32	.7812	
	.7969	51/64
13/16	.8125	
	.8281	53/64
27/32	.8437	
	.8594	55/64
7/8	.875	
	.8906	57/64
29/32	.9062	
	.9219	59/64
15/16	.9375	
	.9531	61/64
31/32	.9687	
	.9843	63/64
1	1.0	

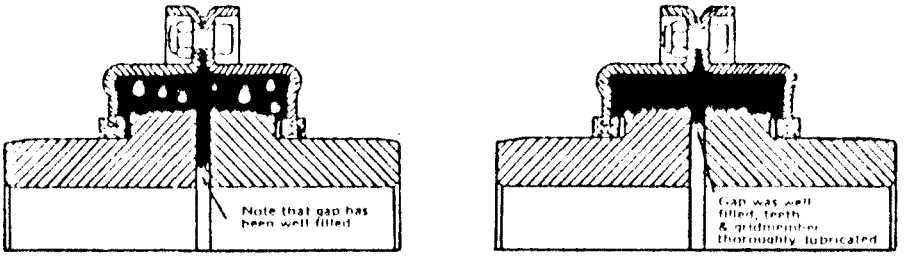


1. **Seal Rings** are identical.
2. **Cover Halves** are furnished with permanent lube fittings or, in some sizes, 1/8" or 3/8" NPT holes to receive your lube fittings. Cover halves are interchangeable and otherwise identical.
3. **Hubs** are symmetrical but may have different bores or keyways.
4. **Gridmember** for smaller sizes is in one piece. In larger sizes the gridmember is in several sections and layers.
5. **Gasket** fits between the covers and prevents grease leakage.

LUBRICATION OF COUPLING DURING ASSEMBLY

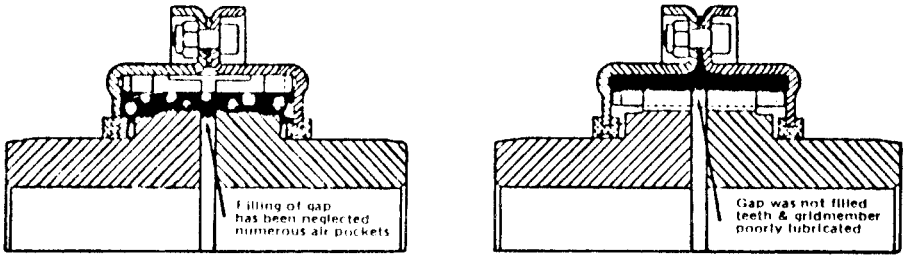
PROPERLY FILLED – Air pockets have been reduced to a minimum by careful packing and the gap between the hubs has been well filled.

The lubricant in the gap acts as a reservoir. Centrifugal force causes it to flow from the gap into the voids and completely lubricate the coupling.



IMPROPERLY FILLED – Note the large number of air pockets and the absence of lubricant in the gap and at the inside diameter of the cover.

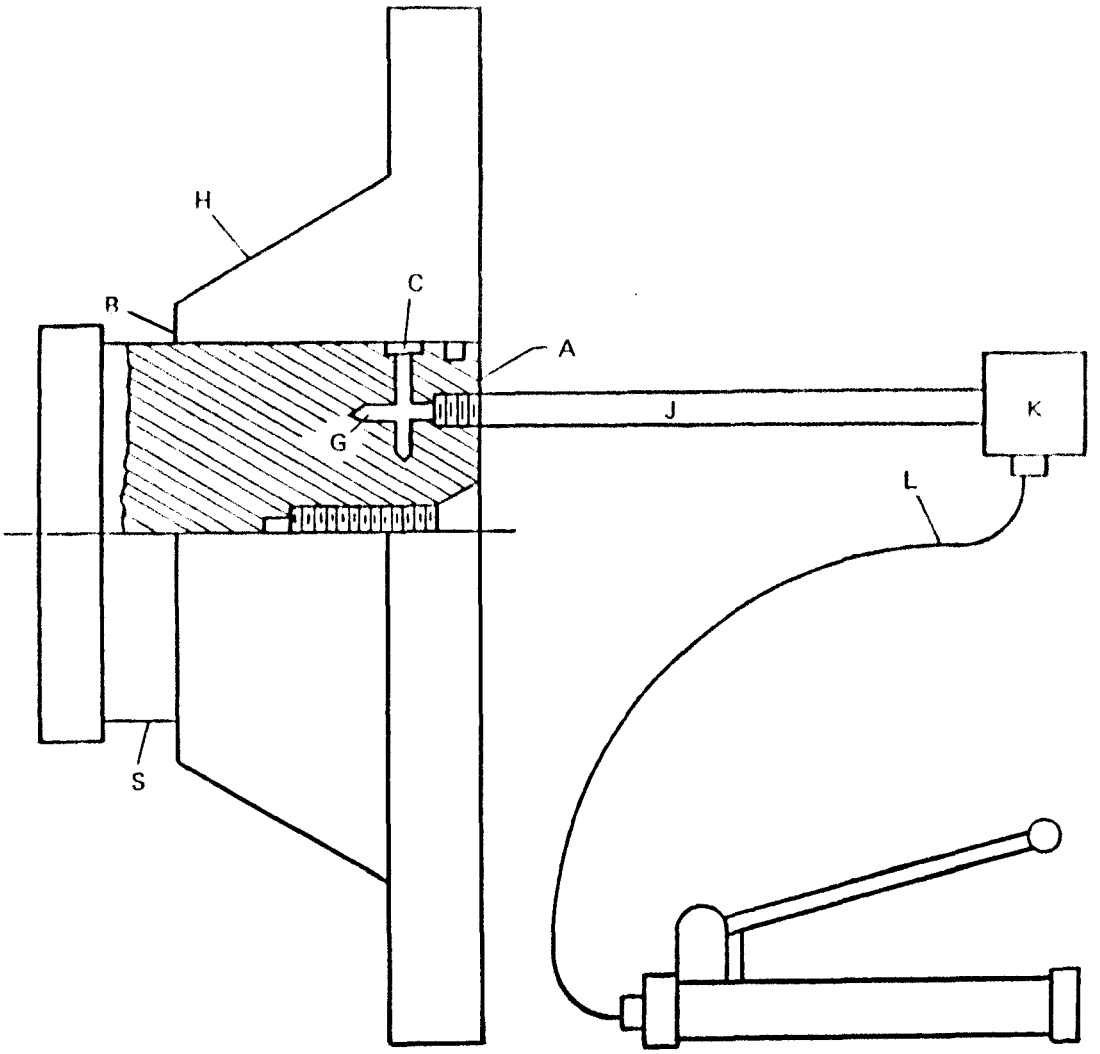
Centrifugal force throws the grease outward leaving the rubbing surfaces unprotected, thus causing excessive wear.



If oil does not appear on both hub ends due to insufficient pressure (excessive shaft end leaks), use heavier oil or grease. Slight, cautious peening around leak helps.

If pressure builds up, but no oil appears at hub end opposite shaft end; heating hub helps. Apply torch carefully and evenly to hub as far back from shaft end as possible. This heat relieves the back area of fit and allows oil to appear at both hub ends.

PRESSURE EQUIPMENT, such as a Blackhawk pump, connects to groove C by high pressure flex hose L, high pressure elbow K and high pressure nipple J. This nipple J is long enough for hub to pull clear of shaft extension and not interfere with elbow or hose. The nipple J also supports coupling when it drops free. The nipple screws into a pipe tap in the shaft end which connects to groove C thru two drilled holes G.



PRESSURIZING PROCEDURE –

1. Blow out air line moisture from air compressor BEFORE attaching charging apparatus.

2. CLOSE valve on charging apparatus.

   ATTACH compressor air line and pressurize.

3. Connect hose to weldment with quick connect coupler.

4. SLOWLY, open air valve. Watch BOTH pressure gauges for positive readings.

   NOTE: IF BOTH gauges fail to correspond, determine the faulty one and replace.

5. Pressurize (charge) weldment to figure shown in chart.

Ambient Temperature		Charging Pressure	KGS/SQ.CM.
F^o	C^o	PSI	
-31	-35	9.5	.67
-20	-29	10.0	.70
-13	-23	10.5	.74
0	-18	11.0	.77
10	-12	11.5	.81
23	- 5	12.5	.89
32	0	13.0	.91
41	5	13.5	.95
50	10	14.0	.98
59	15	14.5	1.02
68	20	15.0	1.05

ALARM PROCEDURE when pressure loss occurs.

SHUTDOWN the machine.

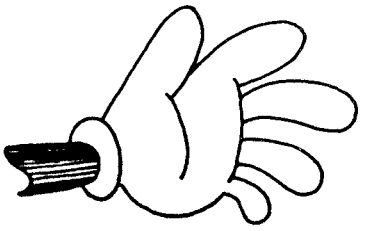
The escaping air sound indicates most failures. Others may need the old paint with liquid soap and water trick.

Extreme cases require the use of magnetic particle inspection (Magna Flux).

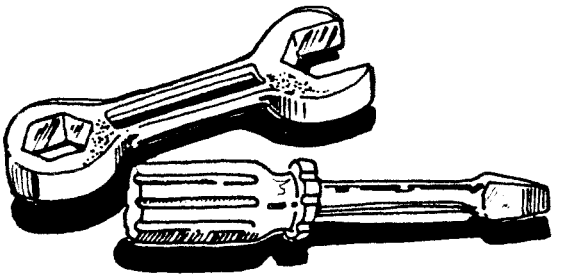
After the needed repairs, pressurize the weldment again.

Refer to description about pressurizing (charging) and the chart for proper pressure at the various ambient temperatures.

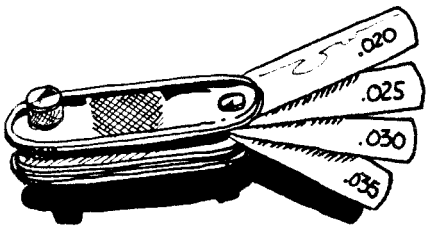
FEELING



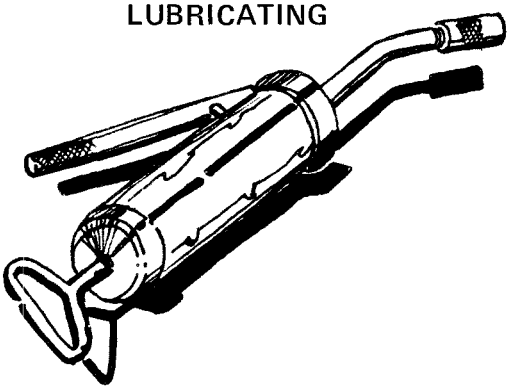
TIGHTENING



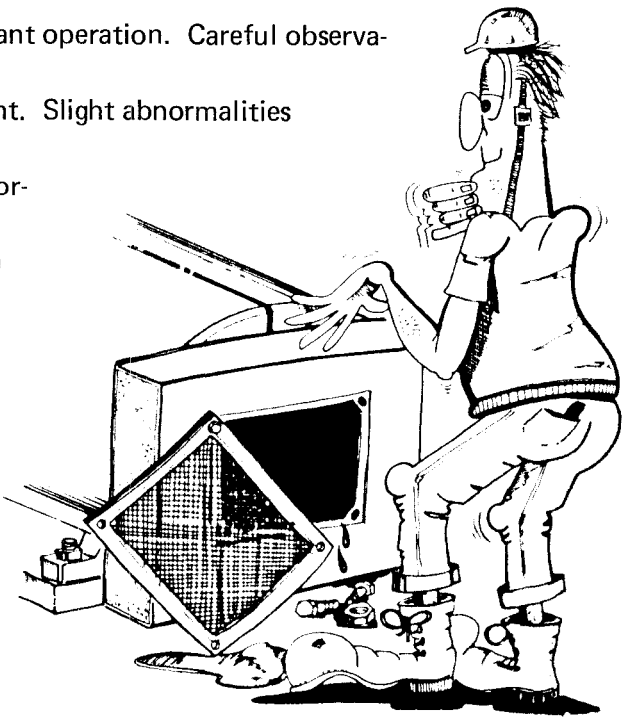
ADJUSTING



LUBRICATING



INSPECTION is probably the most important operation. Careful observation is required of all parts of the equipment. Slight abnormalities may not interfere with the equipment performance BUT those that are a deviation from the normal should be discovered early. When inspecting, notice placement, state of cleanliness, color, etc. of parts(s). Example: discoloration indicates overheating; all guards, bolts in place and good housekeeping.



WALKING DRAGLINES

DAILY MECHANICAL INSPECTION

ROTATING MACHINERY

1. Check all bolts for tightness
    a. Gear Case Bolts?
    b. Gear Case Lid Bolts?
    c. Motor Hold Down Bolts?
2. Remove Inspection covers and check:
    a. Pinion to Gear Wear Pattern Good?
    b. Oil Level Correct?
    c. Oil Contamination?
    d. Leaks in Cases?
3. Do the gear cases vibrate in operation?
4. Visually examine rotating motor brakes
    a. Do Motor Brakes Operate Properly?
    b. Are the Brake Linings Worn?
    c. Are Air Cylinders and Linkages OK?
5. Are oil circulating pumps working?
6. Do main rotating pinions mesh properly with gear on tub?
7. Are all guards in position?

NOTE: If problem exists on individual rotating motors, be sure to specify which. Make out separate sheets if required.

HOIST/DRAG MACHINERY (continued)

5. Visually examine all brake band assemblies
    a. Do the Brakes Operate Properly?
    b. Do Air Cylinders and Linkages Work OK?
    c. Do Band Lifters Work?
    d. Are Brake Linings Worn?
    e. Is Band Adjustment OK?
    f. Does Limit Switch Operate? (On Hoist and/or Drag)
6. Are all guards in place?
7. Are laggings in good condition?
8. Are rotoseals operating OK?
9. Do flexible couplings meet specifications?
10. On drag only, examine clutch assembly. (If applicable)
    a. Do the Clutches Operate Properly?
    b. Are Jaw Clutches in Good Condition?
    c. Do Air Cylinders Work OK?
    d. Band Lifters Alright?
    e. Are Band Linings OK?
    f. Is Band Adjustment OK?
    g. Does Limit Switch Operate?

NOTE: Fill out separate sheet for hoist and drag every day and indicate by circle. When corrections are required specify which units or if all units are involved. This is to be shown in remarks section.

WALKING DRAGLINES

DAILY MECHANICAL INSPECTION

FAIRLEAD

1. Visually examine fairlead weldment
    a. Any Cracks or Damage?
    b. Any Cracks in Weld?
2. Examine fairlead sheave
    a. Any Defects in Sheave Casting?
    b. Are Bearings Operating OK?
    c. Is Lubrication Efficient?
3. Are there any loose bolts?
4. Does the snubber brake work?
5. Are the padlock stops working OK?
6. Are the dirt troughs securely in place?

WALKING DRAGLINES

WEEKLY MECHANICAL INSPECTION

FILTER FAN HOUSES

1. Visually check following items:

    a. Do All Fans Operate?

    b. Are All Motor Bolts Tight?

    c. Are All Filters in Place?

    d. Do the Filters Need Cleaning?

    e. Do the Filters Need Changing?

    f. Filters Assembly Hold Down Tight?

    g. Are Fans Vibrating?

    h. Is the V-Belt Tension Correct?