BI006709

BUCYRUS®

Technical Manual

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SECTION 1

INTRODUCTION

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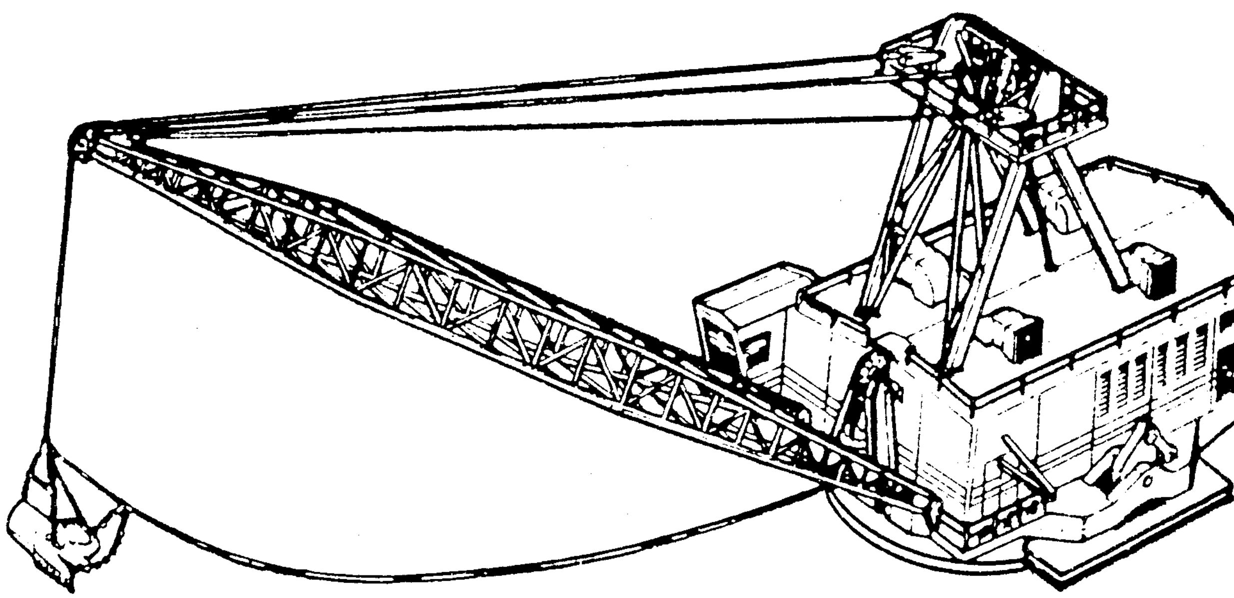


MAINTENANCE TIPS

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.

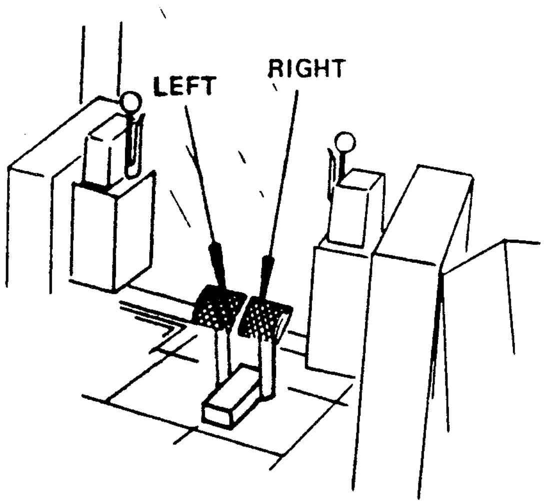
Check limit switches for proper operation.

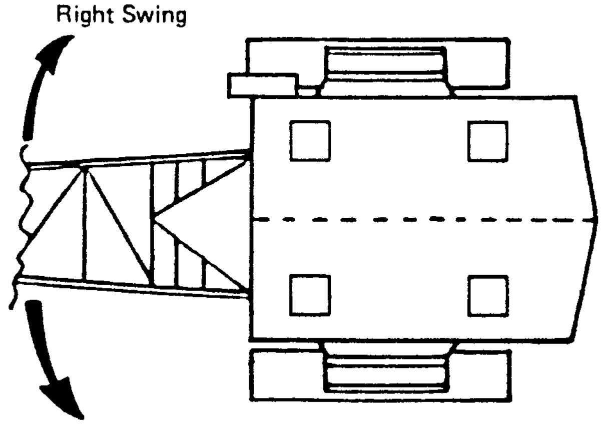
Check overloads and thermal breakers.

The thumb latch, when depressed, applies reduced hoisting power to hoist drum. This is used to remove hoist rope slack and hold bucket rigging off bucket when dragging.

When in **PROPEL MODE** full forward position of the lever controls the drag motor, which in turn drives the propel shaft. See OPERATING THE WALKING MECHANISM.

The swing pedals, centered on floor in front of seat, controls the machine rotation. Pressing right pedal, machine swings right. Left pedal causes a left swing or rotation. The swing motion is stopped also by plugging the motion, that is, depressing opposite swing pedal to





slow or stop motions. The pedals are linked together so that only one pedal can be pressed. When pressure is applied, the pedals will self-neutralize in the neutral position.

COMMENT ABOUT PRIMARY CONTROLS – The hoist and drag controller is a SPEED REGULATOR. Practically full torque or line pull is obtained with the slightest handle movement. Move lever only far enough to obtain desired speed. Do not move lever(s) too far, then back off. Use smooth movements, lever jockeying is not required and only results in overheating the motors.

The swing pedals are a TORQUE REGULATOR. The swing torque applied to machine increases as the pedal is pushed farther down and thus the acceleration rate is increased. This means full swing speed is obtainable at any pedal position.

PLUGGING THE MOTION means reversing the generator field to act as a braking force and stop motion.

30. Limit Bypass. This push button overrides the limit switch located on hoist and drag drum.

The hoist limit signal bell is located inside the drag stand.

When swinging, make sure the bucket has been raised to clear all obstructions and rear of machine has clearance.

As dump point is reached, reverse swing pedals bringing swing to a smooth stop. When machine comes to rest, the pedal should be brought immediately to neutral position (no pressure on pedals) or else the machine will start to swing in the opposite direction.

Now release tension on drag rope (forward on left hand lever) allowing bucket to dump. As bucket dumps the hoist lever must be moved forward to a point of less speed. DO NOT allow an excessive amount of drag rope to run out OR hold load longer than necessary to complete the dump cycle.

After material clears bucket, slowly depress swing pedal (direction desired) to start return swing to pit. At the same time move hoist lever forward and drag lever back to lower bucket into pit.

Should hoist motion be stopped by limit switch, the switch can be bypassed by depressing the push button at rear of drag stand and moving hoist lever past neutral in the lower position. While operating, the operator should observe components in his vision and be alert for pins coming out around bucket, support and running ropes for broken strands, fraying, etc. The wire ropes are expendable items. Kinks cause permanent damage. Replace these ropes promptly.

Also, note any uncommon feel or noise in the machine and notify maintenance of ANY problems while they are still minor.

Again, please keep safe operating procedures in mind at all times.

GROUND PREPARATION is very important. The walking dragline requires properly prepared ground, not just in the work area, but at roadways and erection site. The tub and walking shoe must have FULL contact with the ground. When machine weight distributes over the entire tub area and walking shoe, a moderate ground bearing pressure is obtained.

The ground supporting a dragline must be as near level as possible. Sand, clay and top soil level easily with a blade or grader. Remove large rocks and rock formations. Where this seems impossible, cover working area with a sufficient depth of fill dirt to cover rocks. Sharp rocks or boulders cause load points that damage bottom plates and bulkheads of the tub and walking shoe.

During the walking step cycle, the rear of the tub lifts off the ground. The front edge of the tub supports about 20 percent of the machine weight. As the forward edge of the tub drags to the rear in dry, sandy or powdery soil; this soil tends to pile up or roll ahead of the trail-

SECTION 3

LUBRICATION

INDEX

LUBRICATION SPECIFICATIONS

SPECIFICATION – GREASES

CODE OR SYMBOL NO.	ASTM or TEST	MPG	RGL	OGL TYPE B	OGL TYPE H
Penetration Worked 60X					
Summer, NLGI	D-217	2	semi-	1	–
Winter, NLGI		1	fluid	0	–
Penetration Worked 5000X, Max. Change	D-217	10%	–	–	–
Dropping Point, Min. °F.	D-566	350	–	325	–
Base Oil Viscosity @ 210°F., Min.	D-446	75 SUS	140 SUS	200 SUF	200 SUF
Oxidation Stability Max. psi Drop – 100 hrs.	D-942	10	–	–	–
Water Resistance Max. Loss @ 100°F.	D-1264	20%	–	10%	10%
Texture	Visual	Buttery	–	Adhesive	Tacky
EP Timken, Min. OK	–	35 lbs.	–	35 lbs.	35 lbs.

SPECIFICATION – OILS

CODE OR SYMBOL NO.		ASTM or TEST	MO	OILS PO
Pour Point °F. Max.	Summer	D-97	5	15
	Winter		0	15
Flash Point °F. Min.	Summer	D-92	450	410
	Winter		420	410
Viscosity @ 100°F. SUS		D-446	–	150 Min.

SPECIAL PRODUCTS:

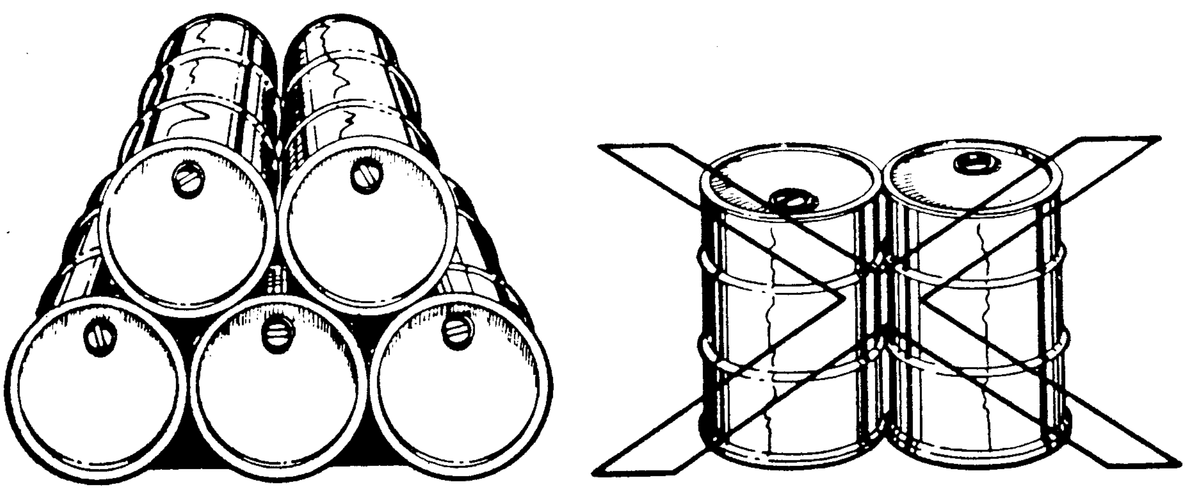
WRL – Wire Rope Lubricant. May be of either solvent cut-back asphaltic water resistant type or penetrating oil type containing corrosion and rust preventatives, anti-wear and other suitable polar additives. The former are preferred for wire rope operating in extremely wet environments while the latter are preferred for normal shovel and dragline operations where contamination of the wire with highly abrasive dust particles is the primary problem.

*WCL – Walking Cam Lubricant. A special product designed to lubricate bronze bushings. These bushings, up to 120" in diameter, are subjected to loads in excess of 2,000 psi in projected areas.

APPROVED PRODUCTS:

*Jesco "Walking Cam Lubricant"
Mobil Oil "Mobiltac E"
Bel-Ray "ALO-Open Gear Lubricant"
Whitmore "Liquid Gear Composition"

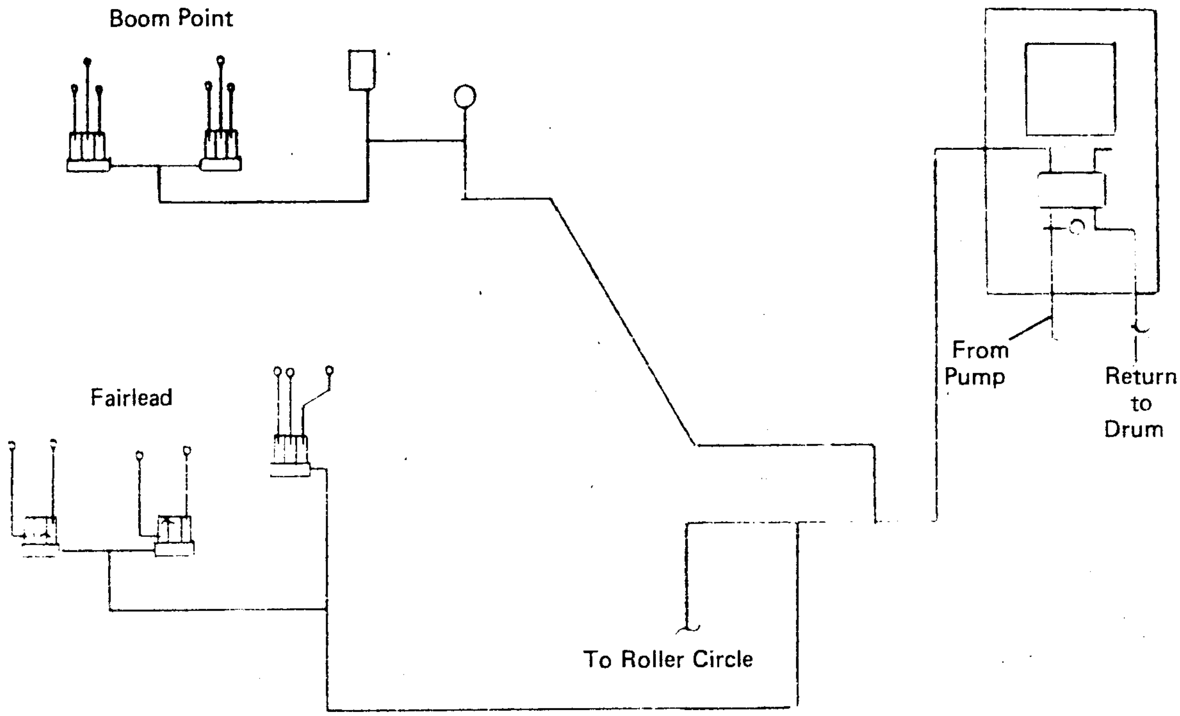
PLEASE STORE LUBRICATION DRUMS ON SIDE WITH OPENING UP. FILTER ALL OIL BEFORE ADDING TO SYSTEM.



NAME OF PART	TYPE	NO. OF POINTS	LOCATION	LUB. SYM.	METHOD & FREQUENCY
Point Sheave	Ball Bushing	4	Left of Sheave at Hub	MPG	Automatic, 20 Min.
Support Rope Damper	—	4	1 Each Damper	WRL	Manual 6 Months
Hoist Rope Deflecting Sheave	Anti-Friction	1	Left End of Shaft	MPG	Manual 500 Hrs.
Boom Raising Sheave	Bushing	1	End of Shaft	MPG	Manual, 6 Mo. & Before Use

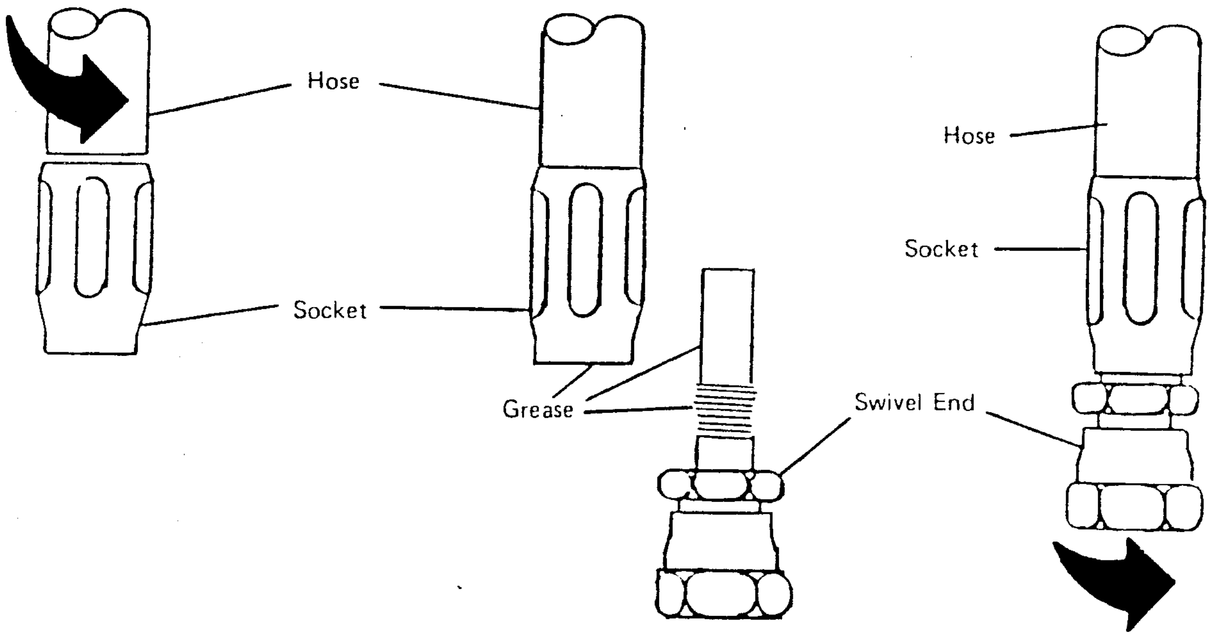
LUBRICATION OF FAIRLEAD

Top Sheave	Anti-Friction	1	Right End of Shaft	MPG	Automatic 20 Min., Dig Only
Bottom Sheave	Anti-Friction	1	Right End of Shaft	MPG	Automatic 20 Min., Dig Only
Top Fairlead Swivel	Bushing	1	Back of Swivel Frame	MPG	Automatic 20 Min., Dig Only
Bottom Fairlead Swivel	Bushing	1	Left Side of Swivel Frame	MPG	Automatic 20 Min., Dig Only
Top Fairlead Swivel Thrust	—	2	End of Thrust	MPG	Automatic 20 Min., Dig Only



FRONT END SYSTEM

ASSEMBLY OF HOSE FITTINGS



Step One – Cut hose end square with fine tooth saw or cut-off wheel

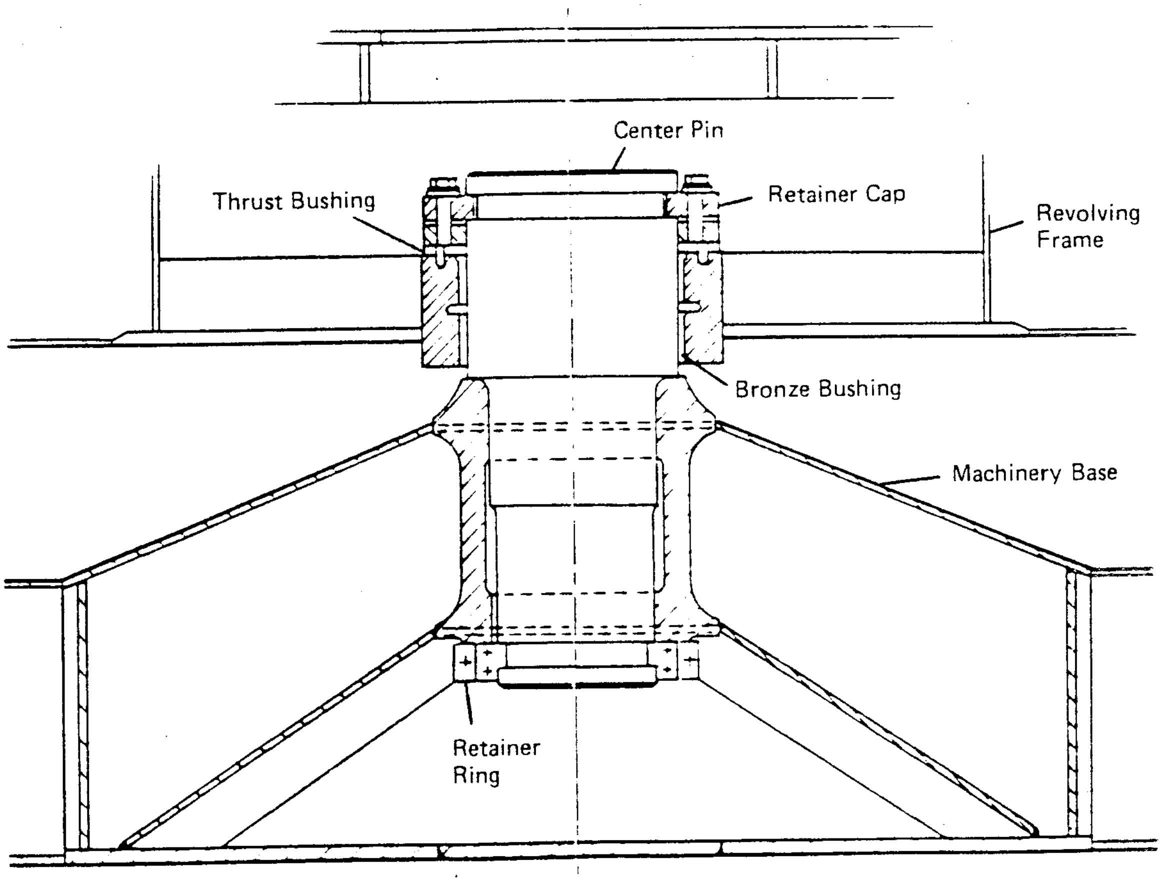
– DO NOT cut back outer cover of hose

– Secure socket. Screw hose counterclockwise onto socket until hose bottoms. Back off 1/4 turn.

Step Two – Liberally grease nipple threads and inside of hose.

Step Three – Screw nipple clockwise into socket and hose. Tighten until snug against socket.

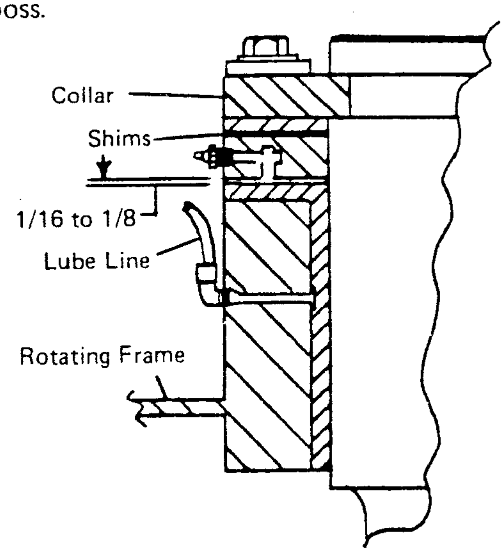
CENTER JOURNAL shafts holds the rotating (upper) frame and tub in concentric alignment at center of rotation.

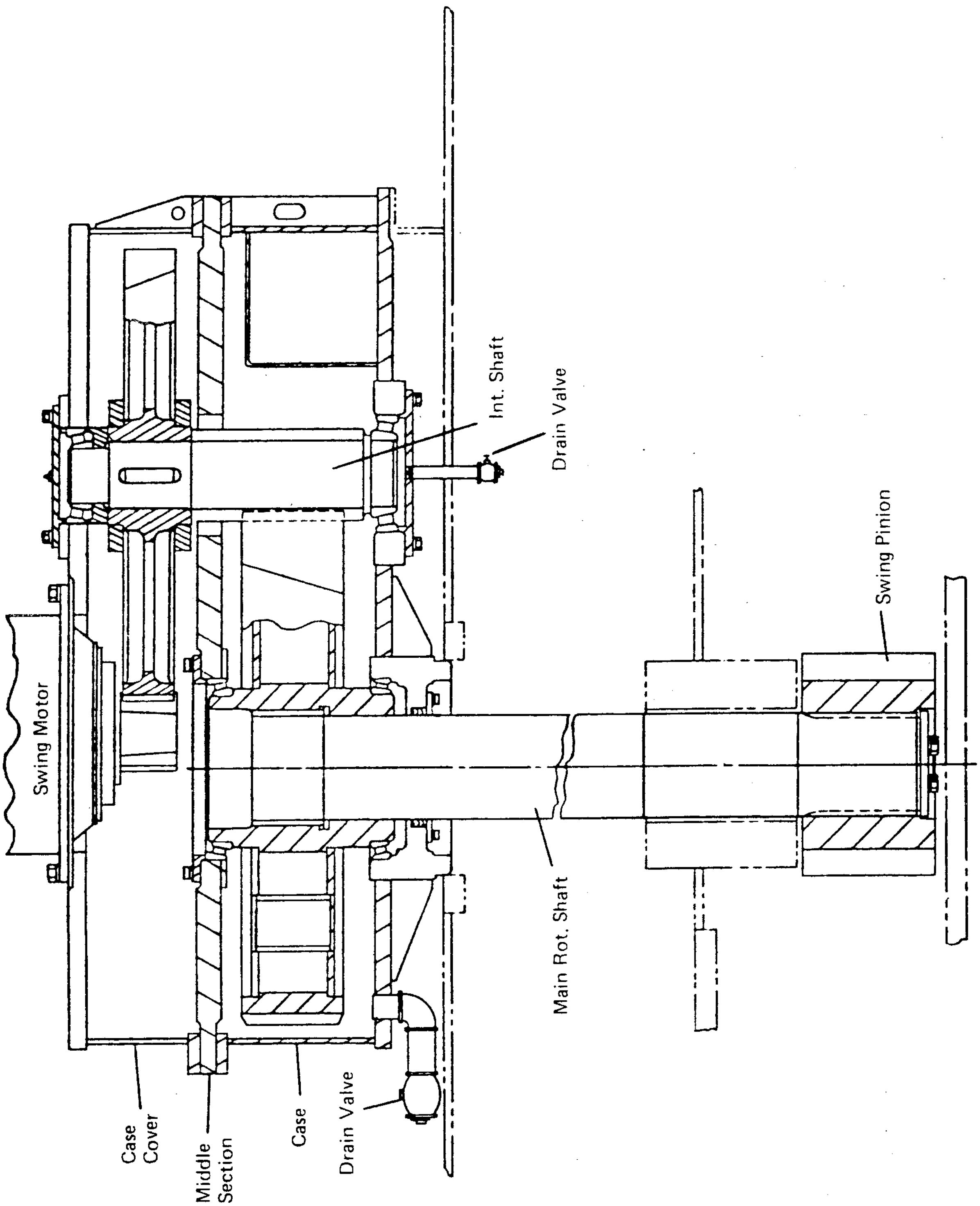


The shaft is secured in a heavy integral boss of the tub by a split collar and a split nut on outside of collar. A large bronze bushing is installed into the rotating frame center journal bore, with lube hole in line with the holes on boss.

A thrust washer (lube holes down) is on top of bushing. Shims, then Fabreeka pad followed by a split retainer that fits the groove of the shaft. The bolt that holds the thrust washer, shims, pad and retainer together has a Fabreeka washer under its head.

These bolts are tightened until the washer begins to bulge. A clearance of 1/16 to 1/8 inch should be between thrust washer and bushing when the machine is resting on the rollers.



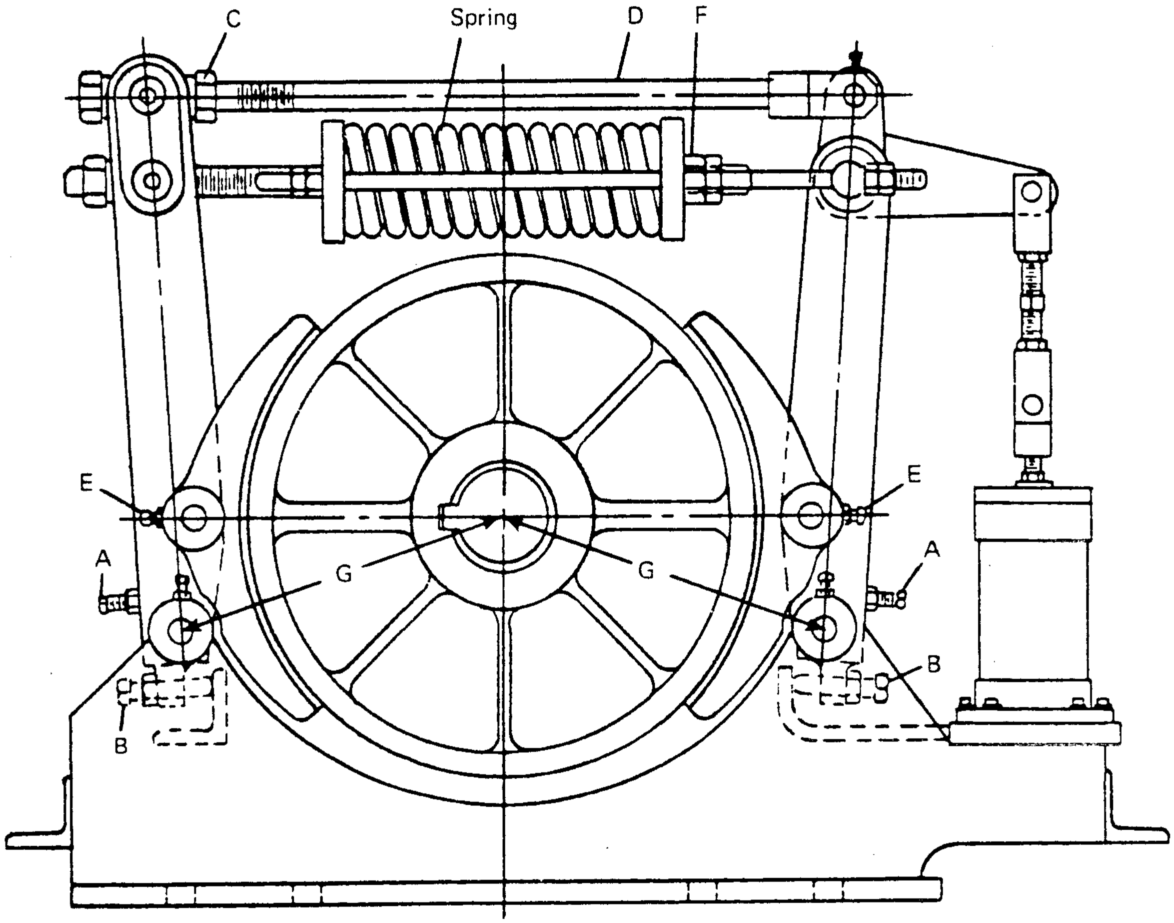


ROTATING GEAR CASE ASSEMBLY

Replace the bolts that secure the eccentrics and dowel pins. Replace bearing retainer and bolts at end of intermediate shaft. Coat rim that comes in contact with case with Permatex.

Replace seal and retainer at pinion side of gear. Add 45 gallons of GL lube in gear case.

HOIST AND DRAG MOTOR BRAKES are the same design and construction. Each brake consists of two shoes that act on a friction housing that is keyed to motor armature shaft. The brake is set by compression spring and released by an air cylinder.



Start **BRAKE ADJUSTMENT** with brake in the released position. Loosen set screws (A and B), turn nuts (C) on connecting rod (D) until clearance between shoe and friction housing is 0.12 inch. Balance clearance by turning set screws (B) at bottom of operating levers until clearance is the same at both sides of friction housing. Position shoe by turning set screw (A) so heel of shoe does not drag on the housing when brake is released.

A **LIMIT SWITCH** is installed on one end of hoist and drag drum. It is a convenience to the operator and IS NOT intended as fail-safe protection to the boom and/or bucket rigging.

The limit switching consists of a series of cam operated micro-switches. The switch component, on hoist, is driven by a shaft coupled to the hoist drum thru an in-line reduction gearbox. The drag limit switch operated from a 134 pitch chain.

In either style unit; the micro-switch wires connect to the hoist and drag control circuits for the purpose of:

> First, causing a single stroke alarm to indicate dead end of rope drum on payout or when bucket rigging approaches the boom point sheave.
>
> Second, cause hoist power field to reverse; thereby creating a braking force to halt the drum rotation.

The adjustment of the cams or the position of the micro-switches in the case is determined by the needed dumping height, line pull and hoist speed. Optimum settings depends upon the working condition of each application.

NOTE: When removing rope from drum, uncouple the hoist limit switch and/or remove the chain from the drag limit switch. Either switch must be reset when either end of rope is altered.

As a general rule: Set the payout limit to sound alarm when at least TWO FULL TURNS of rope remain on the drum.

Ideally, first alarm sounds when the hoist rope socket is within 16 feet of the boom point sheave. At this point, the operator MUST reduce hoist speed and proceed to the final limit stop with EXTREME caution.

Set the hoist limit stop to halt the hoist when the rope socket is NO LESS than 8 feet (or one half drum circumference) from boom point sheave.

Use the maximum specified dumping height of 86 feet as a guide here with one half turn on drum as the ABSOLUTE minimum clearance.

Hoisting the bucket up past the top limit deactivates the hoist. Back the bucket down by moving hoist control lever past neutral in lower position and press the bypass button on rear of drag stand.

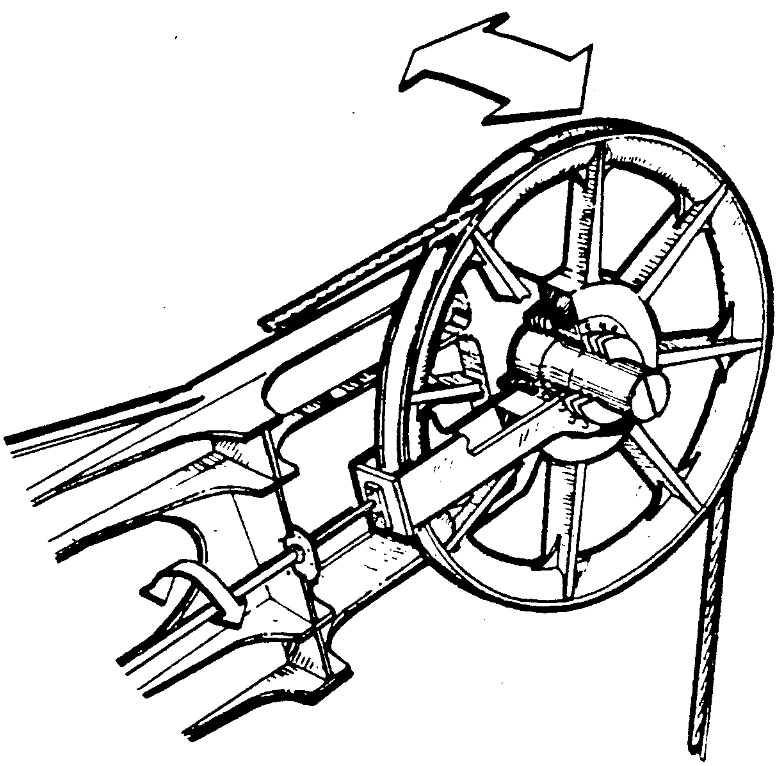
Raise, with deck winch, the boom support ropes and pin in place. Make sure the stripe on rope is straight from boom point to gantry. After both support ropes are in place SLOWLY lower boom onto support ropes.

Next, attach winch line to hoist rope at socket. Remove socket pin. Using hoist drum power and winch run socket to sheave on top of boom. Block hoist rope, remove socket, winch line, then hoist rope from sheave.

Reeve hoist rope over point sheave then to ground. Reattach socket and then socket to bucket rigging.

Remove cribbing from under rear of machine. Release swing brakes and swing machine to bucket.

Before starting to dig, check placement of pins, retainers, bolts, etc. Also check hoist drum limit switch setting.



The **BOOM POINT SHEAVE** assembly mounts on a balled shaft that allows the sheave to oscillate in order to follow the fleet angle of the hoist rope.

The sheave turns on two tapered roller bearings. The bearings mount on a sleeve carrier that is supported by a split spherical bushing on a ball shaft.

A torsion bar returns the sheave to the vertical or normal position. The live end of the torsion bar is attached to the bearing housing and the dead end is anchored to a bulkhead in boom structure. Aligning pins limit sheave oscillation to a plane parallel to center line of boom.

The fixed ball point shaft is held in place by two bearing caps and retainer plates bolted to boom structure.

The **HOIST DEFLECTOR SHEAVE,** located in the upper section of gantry, leads the hoist rope from hoist drum lagging to the boom point sheave.

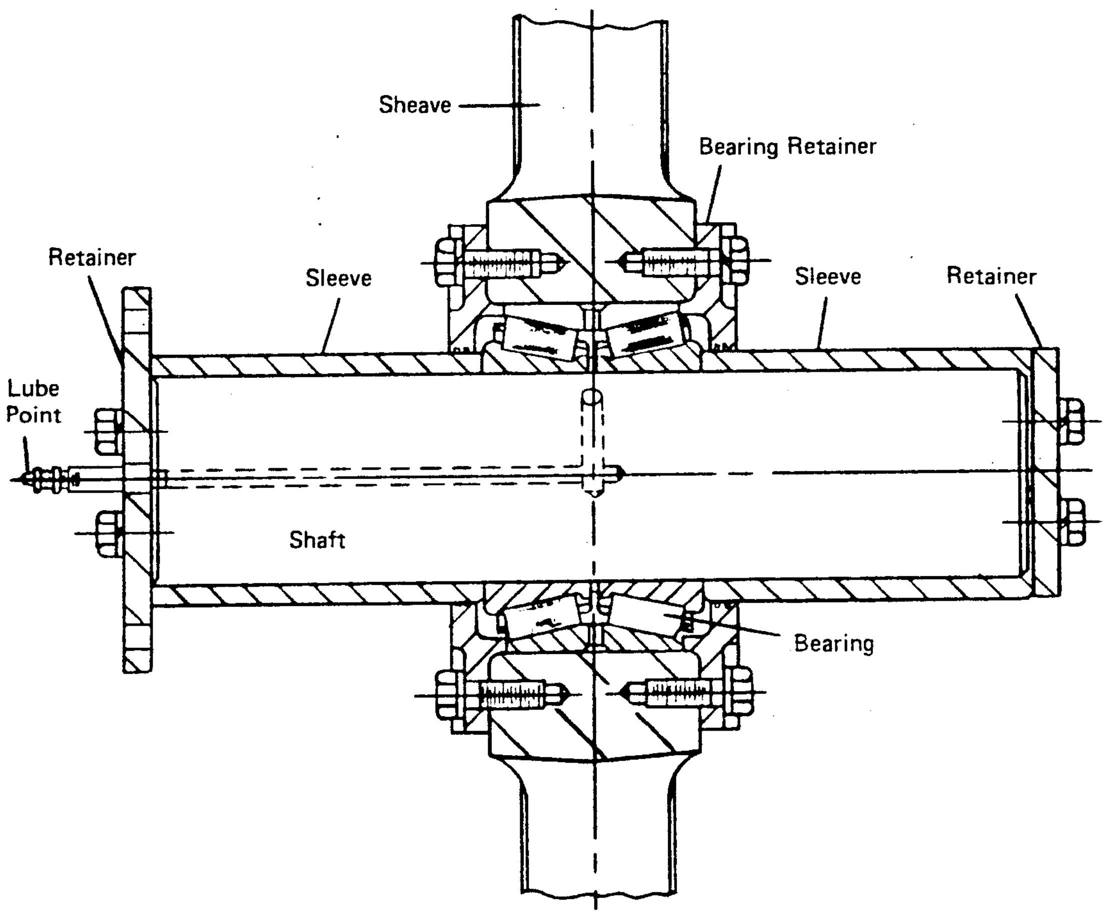
The sheave assembly is supported on bearing blocks and fixed shaft. The sheave turns on a double row, tapered, roller bearing.

Remove assembly from gantry if the bearing must be replaced. Attach a lifting device to sheave then remove the six outside bolts from the left hand retainer. Next remove the four rod bolts from each bearing cap, then remove the cap.

Lower the 2630 pound assembly to the ground. Once on ground, remove the lube pipe and retainers from each end of shaft.

Remove the bearing retainers and sleeve from shaft. The sheave and bearing can now be removed from the shaft.

Reverse procedure to replace sheave on shaft and the assembly on gantry. When replacing left hand retainer on shaft, make sure small hole in retainer and punch mark on shaft are aligned. The bearing caps rod bolts are torqued at 1750 foot-pounds.



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full spring pressure on brush. Hold sandpaper close to commutator and draw it in direction of rotation. Then lift brush, push sandpaper back and repeat. Continue this operation until brush shapes to an even contact with commutator. Be sure to raise the brush before moving sandpaper back for the next stroke. DO NOT raise sandpaper when removing from commutator. This act generally ruins the fit on the brush. DO NOT install brushes and allow to fit by wear. This method usually causes arcing and scoring before brush wears in. After sanding brushes in, thoroughly clean aramture, commutator, risers and brush assembly with dry compressed air. Remove ALL carbon and copper cuttings. This prevents possible grounding or short circuiting. Failure to follow this proper cleaning procedure has resulted in costly shutdowns due to damaged armatures. After grinding brush, run in under light loads for a short period. This allows the surface to set or wear in before applying heavier loads. Install a complete set of brushes rather than replacing them one by one.

COMMUTATORS frequently inspected by an electrician assures detection of surface faults in the early stages. This is important. Faults corrected early cost little in time loss or expense. Bar burning, high and low bars, high mica or flat spots become serious at an accelerating rate over time. When not seen and corrected early they often require a long shutdown. A good commutator surface is highly polished. It shows a chocolate brown color. If the commutator is only slightly blackened due to arcing, the best cleaning procedure is the use of a piece of canvas wrapped around a wooden block. The canvas cleans the surface and does not scratch the copper. When excessive arcing takes place over a long time, a burned and blackened commutator results. In these severe cases, use a very fine sandpaper (2/0 or 3/0).

NEVER USE EMERY CLOTH OR EMERY PAPER. Emery conducts electricity. Serious injury to personnel and equipment results.

Shape a wooden block to commutator contour. Fold sandpaper around block and hold against commutator while motor or generator runs at no-load. Use a slow lateral movement of the block to avoid diagonal scratches. Undue amounts of sandpapering destroys the needed polished surface and results in increased brush wear. Use sandpaper as little as possible. In most cases, polishing with canvas (see above) removes the blackening. One main objection to using sandpaper is that it rarely leaves bars properly grounded. On an unslotted commutator particularly with high mica, sandpaper tends to flatten the center of the bars.

Should the commutator become rough or pitted to a point where canvas and sandpaper cleaning does not remove bad spots, use a hand stone as needed. Sandpapering removes some slight spots, but not large flat ones. The effect merely broadens out the spots so they no longer show due to the flexibility of sandpaper. The stone smooths much better here. The stone presents a rigid contact surface and may be held firmly in place while grinding. Sanding or stoning destroys perfect brush contact. After polishing using either method, bring the unit to rest and remove carbon and copper dust with dry compressed air.

Has speed increased or decreased for light loads?

Has speed increased or decreased for heavy loads?

Next, question other witnesses and determine what they saw or heard; getting every detail. Then make a quick visual inspection of equipment for obvious things as flashover, smoke or other evidence of over-heating or broken components. (One electrician checked for hours—then noticed the generator stopped.) Moral – look for the obvious.

After listening to witnesses and making the first inspection, stop and consider ALL the facts before proceeding. Valuable time is lost by going off quickly in the wrong direction. So, carefully examine the problem logically, using what you know about the system. Consider all the data collected. Do not make hasty decisions on what to use or what info to discard. Give special value to obvious facts, easily confirmed (a stopped generator) and reserve opinion on contradictory facts.

Barring the obvious, you gain a direction from all this and knowledge of the system. For example, if no motion operates; look in circuits common to all motions, such as: D.C. exciter or A.C. circuits. Likewise, if one motion is normal in one direction; but not in the other, check the components for the separate directions. A few minutes spent analyzing here saves time spent in false, misled direction later.

Once a founded suspicion exists as to which set of components or circuits is faulty, select a starting point for tests that meets the following:

You know approximate value expected here for test conditions; whether at stall, no-load, neutral, hoist, lower, etc.

No false indications exist, you've avoided points where reading is effected by a sneak circuit.

This point, logically, is in the suspected circuit.

Also, it allows checking as many circuits as possible at one time.

With proper instrument, measure at a selected point and compare to expected value. If measurement is correct, apparently all system parts leading to this point are correct. Trouble exists further down the line. With an incorrect reading, trouble probably lies further back toward start of the system.

Based on first test, proceed toward system start or end and seek expected reading. The trouble, of course, lies between points where correct and incorrect readings occur. In other words, the faulty stage has correct input, but incorrect output. Be positive the correct stage bilizing circuits causes motor oscillation, but not if critical frequency is too high. A high frequency oscillation causes a reduction in output (particularly stall current) if it is severe enough. When suspect of one of these circuits, the best one can do with the usual instruments is check circuit components. When these tests do not locate trouble, assistance may be required.

Previously discussed was the importance of starting tests at the right point. This is the logical one that checks the most components at one time. With failure in one motion, first check stall current. With correct stall current, assume master switch, control equipment and generator okay and trouble probably exists in motor.

With stall current incorrect, check generator field and then master switch. Suspecting the D.C. excitation system, check voltage on BOTH sides of fuses and then proceed to indicated direction. If A.C. system is the suspect, start at any point where three phase 220 or 440 volt supply is measured. If D.C. and A.C. voltmeter exist on machine, check them.

In conclusion, a good troubleshooter attack plan includes:

- Adequate preparation including:
  - Understanding the system and components
  - Availability of wiring diagrams and test data
  - Quality test equipment designed for job
- Preliminary investigation to determine effect of fault
- Estimation of probable cause
- Testing for determining faulty part
- Correction of failure
- Preventative maintenance

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.

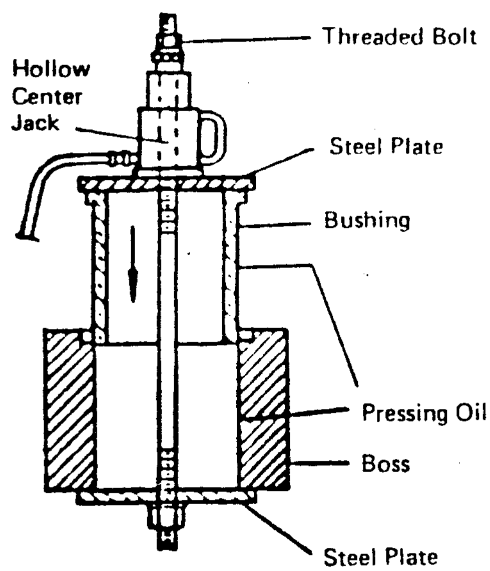
Each **FLANGE BUSHING** secures thru flange with a minimum of four dowels to restrict bushing rotation. Dowel material is softer than bushing.

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 Clear-ance	Shaft Nom. Diam.	Shaft O.D.	Running Clear-ance
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.

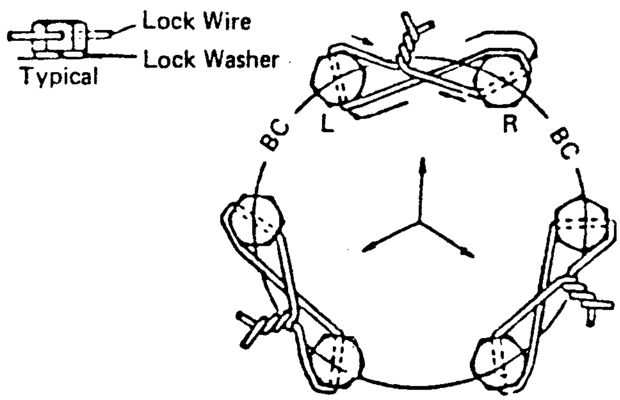
The pinion temperature indicated is a temperature difference between shaft and pinion. This is estimated ONLY and may be adjusted to maintain the specified advance of shaft. Heat pinion uniformly until temperature reaches needed reading above shaft temperature.

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.

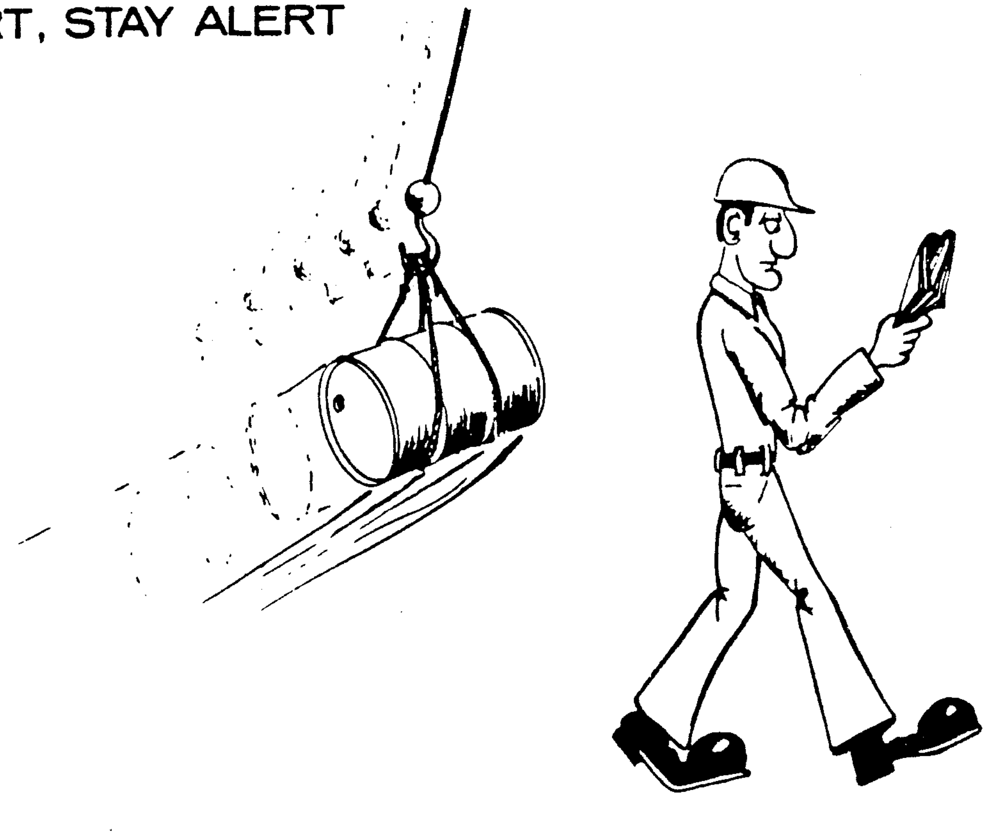
After removing pinion from oven, wait until it cools to desired temperature; then remove thermometer and QUICKLY mount as described in the following.

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.

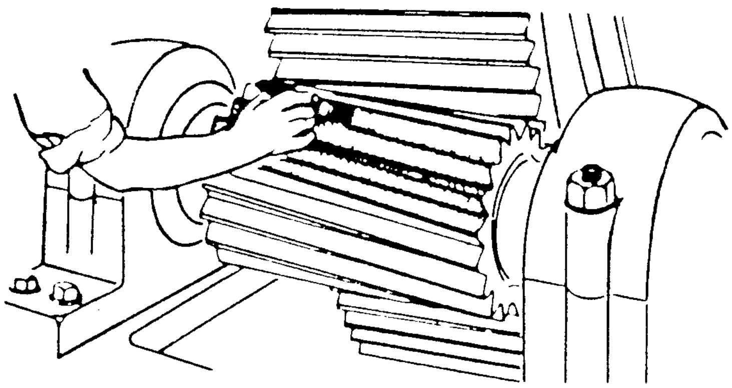
BE ALERT, STAY ALERT



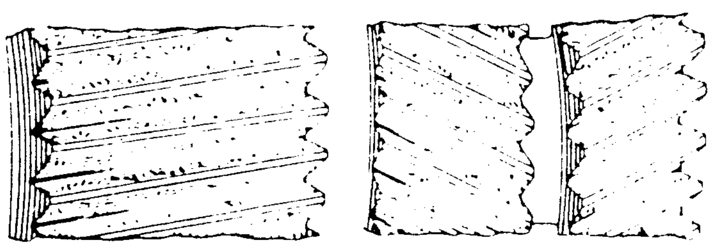
METHOD OF CHECKING SPACING AT SPLITS OF SPLIT RING GEARS (without hubs). After mounting on flange and tightening alignment and clearance bolts; place a cylindrical pin between gear teeth, several teeth away from the split. Set up a dial indicator and zero to maximum-plus reading as gear (with pin in 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).



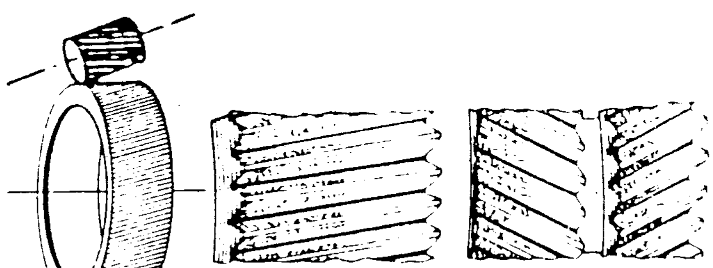
TYPICAL CONTACT PATTERNS: After a satisfactory pattern is established for the initial position of the gear, make the SAME contact check at three more points on gear, spaced 90 degrees apart. A minor adjustment to pinion may be necessary to produce the best average contact on the gear.



Single Helical   Double Helical

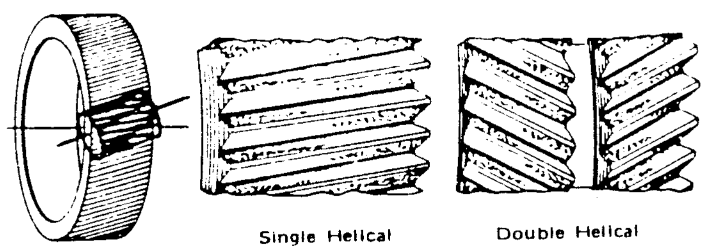
INSPECTION: Dowel ALL bearing pedestals and RECHECK ALL bolts to secure gear setting. INSPECT gear teeth and REMOVE ALL metal upsets and burrs that occurred in handling or assembly. CLEAN gear teeth and enclosures thoroughly BEFORE enclosing gears.

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.

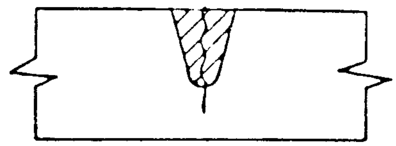
When using a swift turntable for larger diameter strands shipped in coils, as recommended, use also a drag-type brake to prevent any rapid rotating speed from exceeding the pulling speed. This prevents kinking and looping. The pulling device attaches to the socket tagged, FRONT END.

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.

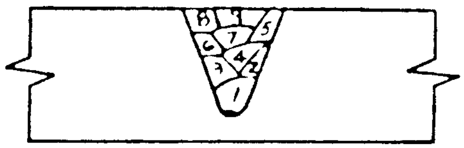
Use a simple timber brake against reel flange(s) to provide uniform unwinding and prevent slack from developing in strand on reel.

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

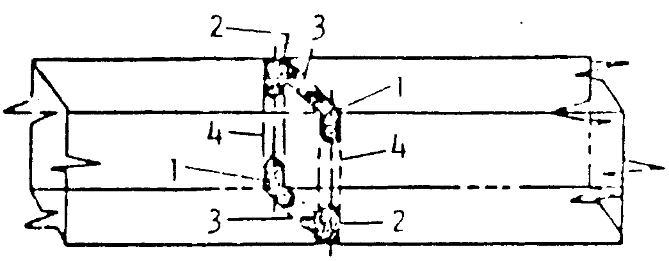
INCREASE preheat temperature 50 degrees F. or 27 degrees C. for material (at weld) 1-1/2 to 2-1/2 inches thick and up to 100 degrees F. or 55 degrees C. for material OVER 2-1/2 inches thick.

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

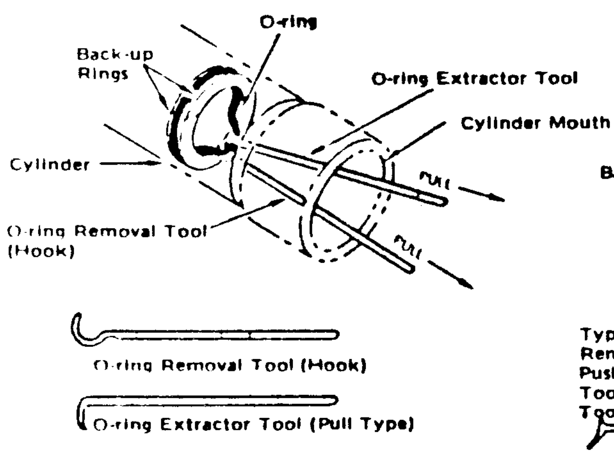
RIGGING COMPONENT PART	MATERIAL – MPSD SYMBOL
Bushings	KO4, Manganese
Chain Links (Build-up not recommended)	CO1
Dump Block, Frame	F, FHL, FK
Sheave	CC2A
Retainers	F
Socket Casting & Ball	KP3
Equalizer Block, Frame	F
Sheave	CC2A
Wear Blocks	CB
Pins (Build-up not recommended)	KO1 Ind. Hardened
Rigging Casting Misc.	CFE
Spreader Bar	CN, F, FHL

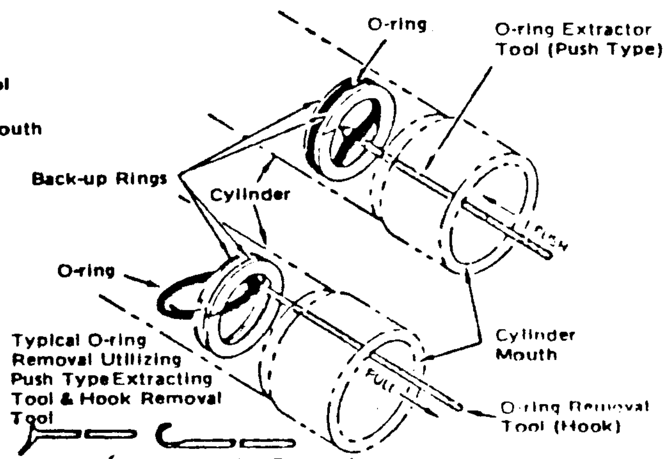
THIS INFORMATION IS FROM MPSD CI-937

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.

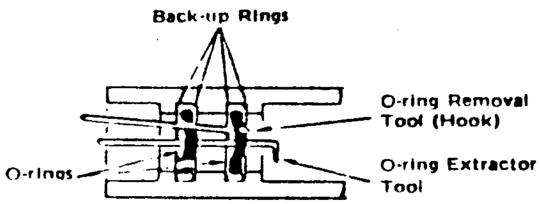
Tool surfaces need to be well rounded, polished and no burrs on working end. This obviously prevents scratches.

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



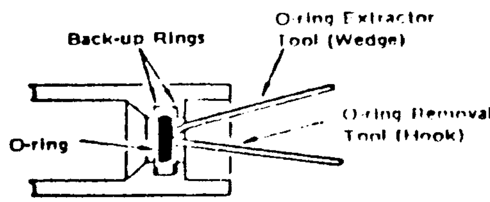


Typical O-ring Removal Utilizing Push Type Extracting Tool & Hook Removal Tool



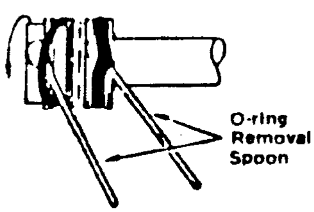
Typical Dual O-ring Internal Extraction & Simultaneous Removal

O-ring Removal Tool (Hook)



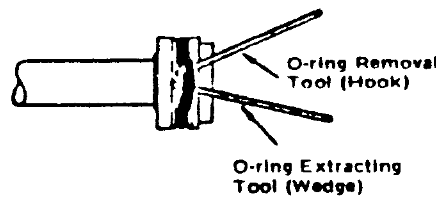
Typical Single O-ring Internal Extraction Utilizing Wedge Type Extracting Tool & Hook Removal Tool

O-ring Extractor Tool (Wedge)



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

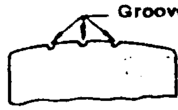
CAUTION: Do Not Permit Unnecessary Contact of Tools With Bearing and Cylinder Wall Surfaces. Avoid Dropping Tools Into Cylinders



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

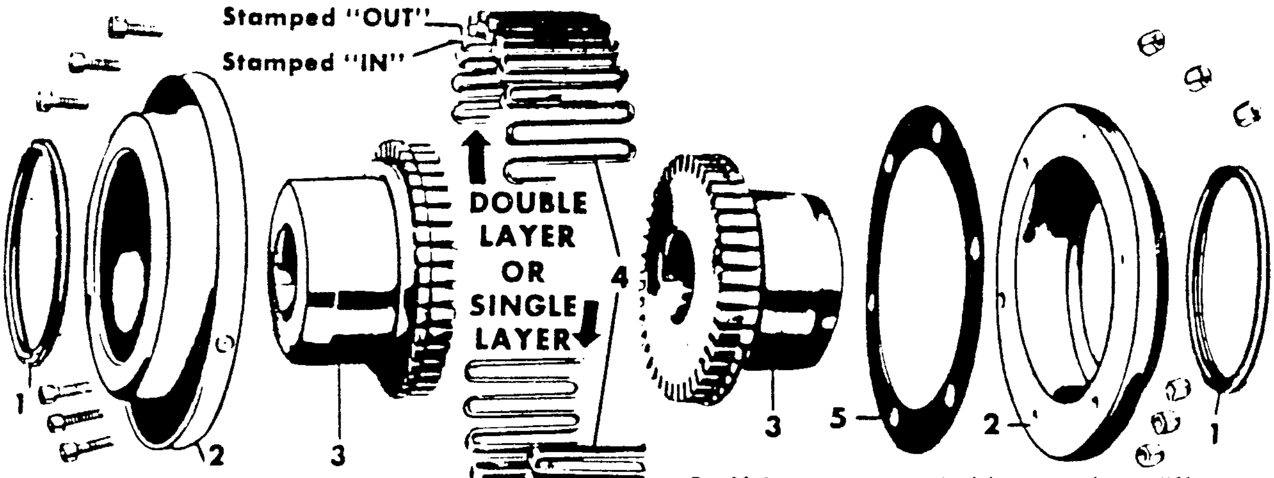
NOTE: After O-ring Is Dislodged from Groove, Hold Spoon Tool Stationary Simultaneously Rotate and Withdraw Piston from Ring

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.

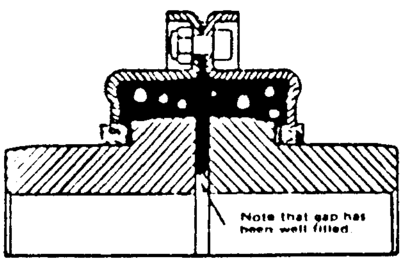
4. **Gridmember** for smaller sizes is in one piece. In larger sizes the gridmember is in several sections and layers.

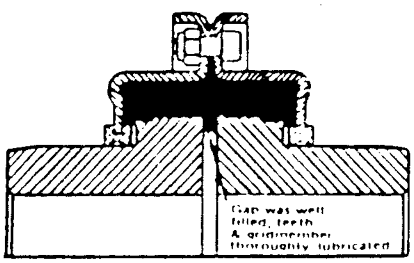
5. **Gasket** fits between the covers and prevents grease leakage.

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.

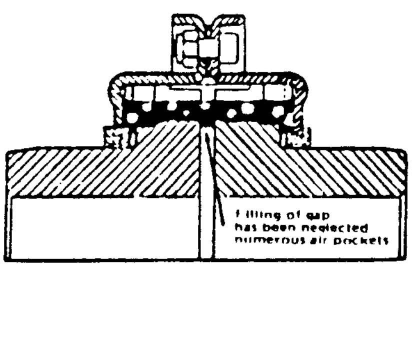
The lubricant in the gap acts as a reservoir. Centrifugal force causes it to flow from the gap into the voids and completely lubricate the coupling.

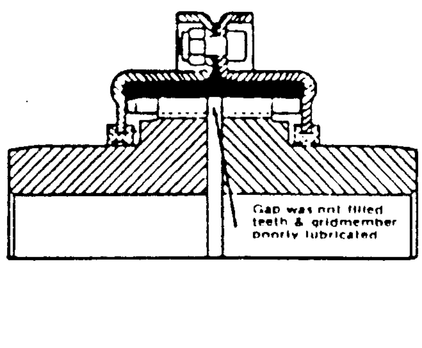




IMPROPERLY FILLED – Note the large number of air pockets and the absence of lubricant in the gap and at the inside diameter of the cover.

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

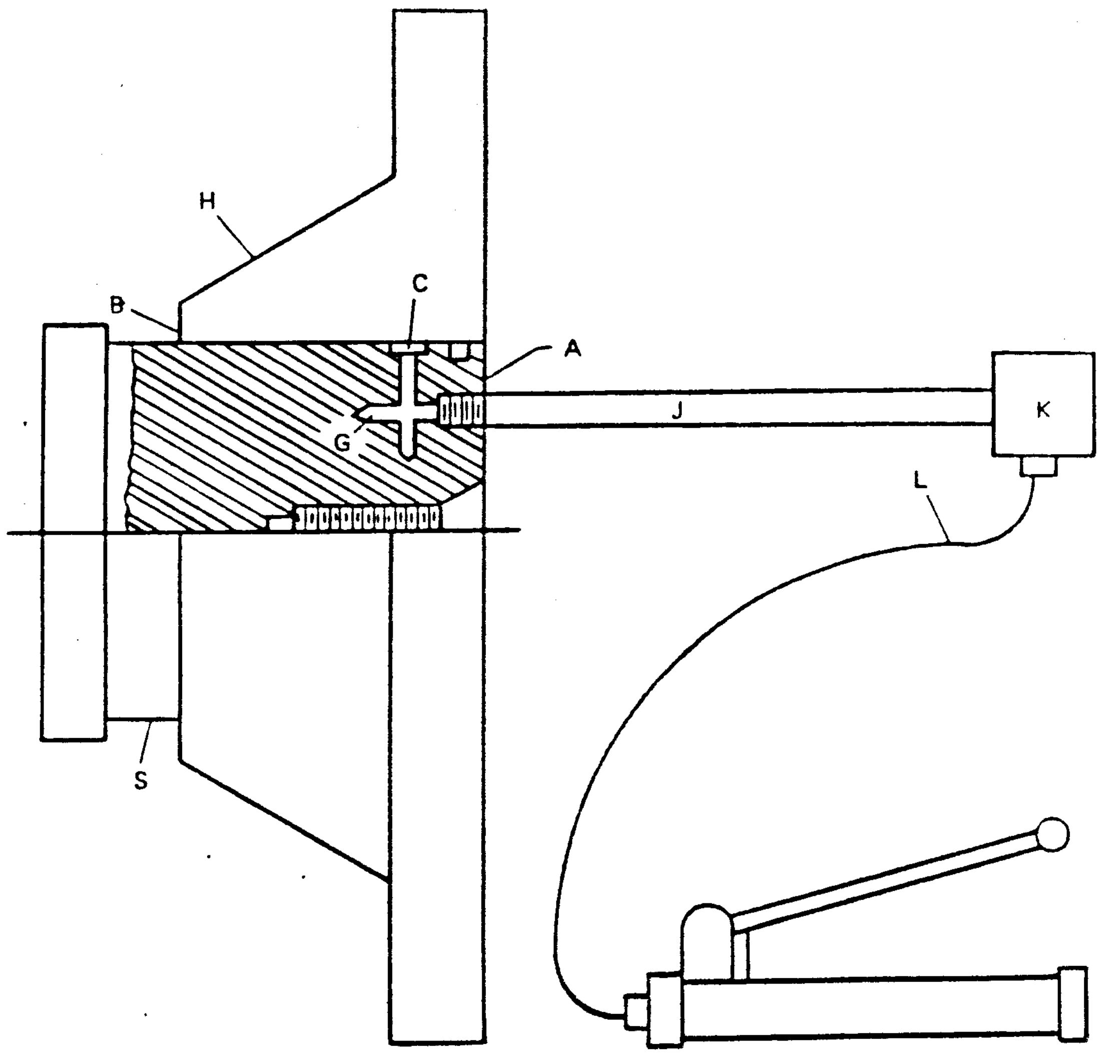




If oil does not appear on both hub ends due to insufficient pressure (excessive shaft end leaks), use heavier oil or grease. Slight, cautious peening around leak helps.

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°	C°	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.

SECTION 8

INSPECTION REPORTS

Trouble Free Maintenance or Preventive Maintenance Programs may be defined as a systematic series of operations, performed periodically on equipment to prevent breakdowns.

Breakdown WILL reduce productivity and increase overhead expense. Machinery is only new at one point in time. From that moment, machinery begins to deteriorate thru use and aging processes. A well organized program will avoid unexpected high cost breakdowns and increase component life.

A systematic approach to the program should be followed, and detailed records of all findings kept, to detect potential problem areas. Valuable time and effort can be saved if defects are corrected before they lead to a major breakdown. The records should be reviewed often and kept on file for future reference.

Personnel involved in the program should go thru an established training program, to know WHAT to check and HOW to rectify any potential problem area. Marion can provide, at minimal charge, several tape/slide/workbook training presentations to be used as our guidelines. When personnel are able to do routine maintenance and normal repairs efficiently, downtime is reduced and machine productivity increased. Also, to keep your machine in good running condition, the necessary part, tools and current information should be kept on hand.

Equipment maintenance is a science and its practice an art. This art can be divided into six types of operations; they are:

INSPECTION

CLEANING

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL