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Technical Manual

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when weld repaired while SMALL. Cold weather causes faster expansion and brittleness than warm weather. Early detection and quick repair prevents failure. A stretch, bend or defect often shows up in condition of surface paint. A collection of dust along a line may indicate a crack in the metal. Look closely at areas around openings where angles are cut out. Also check gusset connections and points where thin and heavy metals join. The good crew watches for loose bolts, nuts, cap screws, lock washers and other locking devices. Rod bolts are important too. Signs of scuffed paint, worn or bright spots next to any part indicate movement and becomes second nature to most personnel. Retighten ALL bolts shortly after initial start-up. Grease and oil stains often indicate problems. Perhaps just poor housekeeping, but at least something is wrong.

Replacement and maintenance schedules may conform to planned shutdowns. Lack of proper lube, poor adjustments and abuse cause and speed up wear. These facts show up as the MAIN reasons for breakdown. If any part shows wear or distortion beyond expected normal wear, order replacement and quickly install. The cost of parts is nothing when compared to breakdown cost and loss of man hours and production.

Production machines operating 24 hours, 7 days every week deserve an 8 hour inspection and cleaning every 10 days. Cleaning before inspection eliminates dirt and dust falling into machinery parts when inspection plates and covers are removed.

On the upper works, a solvent makes removal of the accumulation of grease around bearings, gears, motors and the like easier. The dirt shield under the drag drum and the trough under the open gears may require a number 3 coal shovel to get the job done.

Start up the machine and dig enough to warm up machinery, open the inspection cover over gears and pinions. Look at gear teeth as machinery slowly goes thru its paces of hoist/lowering and drag-in/pay-out. Broken teeth are easy to spot, but splayed or an unusual wear pattern takes a closer look.

For a quick check, run a piece of soft wire thru the gear mesh at each side of the pinion. Measure thickness of the two adjacent loops with micrometer. The sum of the two loops indicates backlash. Comparing them gives an indication of misalignment. If excessive backlash is suspected, measure with a dial indicator. There just isn't enough room between the gear guard and the pinion to use a feeler gauge.

Slowly rotate the upper works several times in each direction. Look at condition of roller circle, rail, gear and swing pinion. Sound here may indicate a flat or chipped roller or even suggest burrs or damaged teeth on the rotating pinion.

While hoist operates, check condition of point sheaves groove and bearings. Test hold down bolts on boom point end plate. While operating drag, check fairlead sheaves, grooves and bearings. Look at fairlead swivel. Test ALL hold down bolts with impact wrench. Check

NOTE: The brakes are holding brakes ONLY and are NOT intended to stop or retard the rotating of the motor armature and/or machine motion EXCEPT in emergency. See PLUGGING THE MOTION.

6. M-G Set Stop. When this push button is pressed, it will stop all M-G sets.

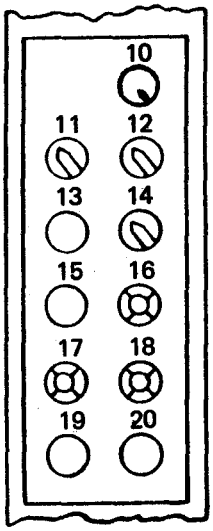
7. Excitation On. This green indicating light indicates that hoist, drag and swing controllers are energized.

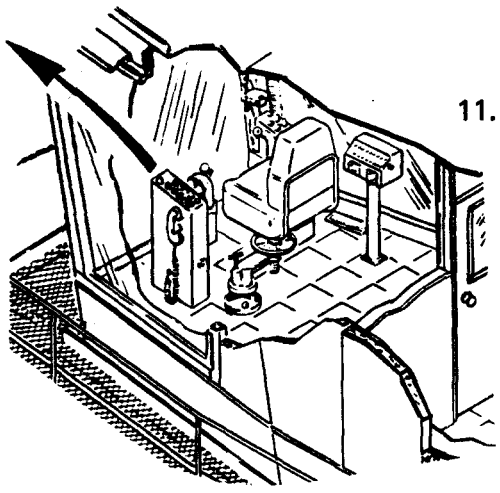
8. Emergency Stop. When this red mushroom type push button is pressed ALL brakes will set and ALL controls will de-energize. A power failure has the same effects as pushing this button.

9. Excitation Stop. This push button energizes the hoist, drag, swing controllers and the solenoid circuits.

The air pressure gauge is located on right side of this panel. The operator should monitor this gauge often. The gauge should read 95 to 115 psi while machine is in operation. When pressure drops below 95 psi, shutdown the machine and investigate the problem.

The panel located on top drag stand (left hand) contains three lights, four push buttons and three switches. They are:





10. Key operated switch used to open the ground check monitor circuit. This will disconnect the machine from the powerline.

11. Window Opener. This 3 position switch, SEAL, DOWN and UP operates front cab window. Before opening make sure bottom window locks are open. Move switch SLOWLY to UP position, the window will retract into the cab similar to a garage door opening. To close window move switch to DOWN position. After window is in closed position move switch to SEAL position. This will allow air, from air system to enter seal around window thru a magnet valve. Next lower hand knobs at bottom of window and tighten them down.

As bucket clears the ground the swing pedal, which corresponds to desired direction of swing is slowly depressed. (This avoids excessive bucket and rope swing). Swing and hoist bucket at same time so that dumping height is reached at same time bucket reaches spoil.

NOTE: 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 ropes allowing bucket to dump. As bucket dumps the hoist controller must be returned, moved forward to a point of less power. Do not allow excessive amount of drag to run out.

DO NOT hold load longer than necessary to complete the dumping cycle. After material clears bucket, slowly depress swing pedal (direction desired) to start return swing to pit and at same time lower bucket into pit.

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.

PROPEL CONTROL – Electrically, the propel equipment consists of:

1. D.C. drive motors on each machine side
2. A drag propel contactor and
3. A control and timing system

The motor (s) one each side independently drive its propel machinery. The drag-propel contactors electrically disconnects the drag motors from the drag generators and connects the propel motors to these generators. Thus, the drag master switch controls the propel motors when walking. Since the two sets of propel machinery are not connected mechanically, the two shoes are electrically timed or synchronized. This is done using a selsyn system that detects when one shoe is getting ahead of the other. The error signal from this system slows down the fast shoe and speeds up the slow shoe. Limit switches, detecting shoe position, slow the shoes during the step when shoes approach the ground and when the tub

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.

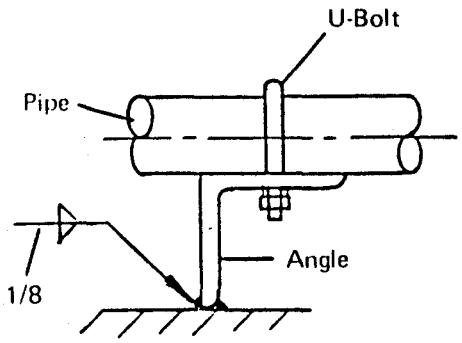
Open and semi-enclosed gear teeth coated with lube.

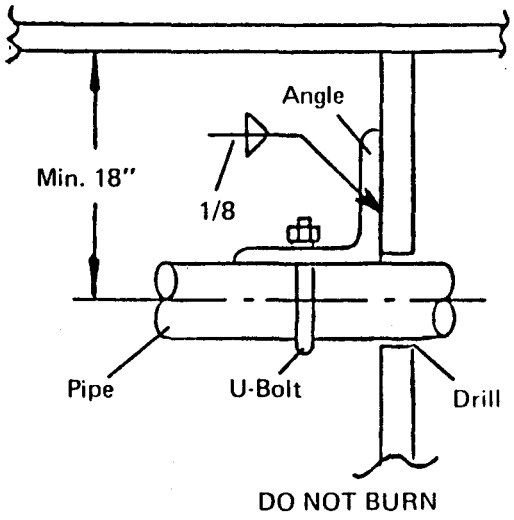
Automatic lubrication system with adequate lube supply.

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 Rotating 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	—	—	—	—

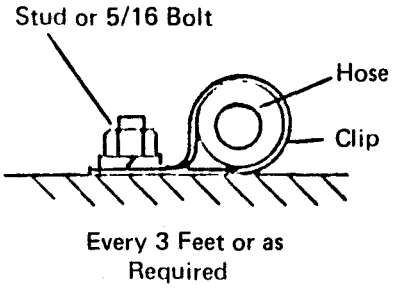
STANDARD LUBRICATION INSTALLATION

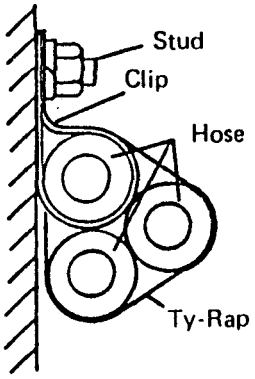
TYPICAL PIPE MOUNTING





TYPICAL HOSE MOUNTING



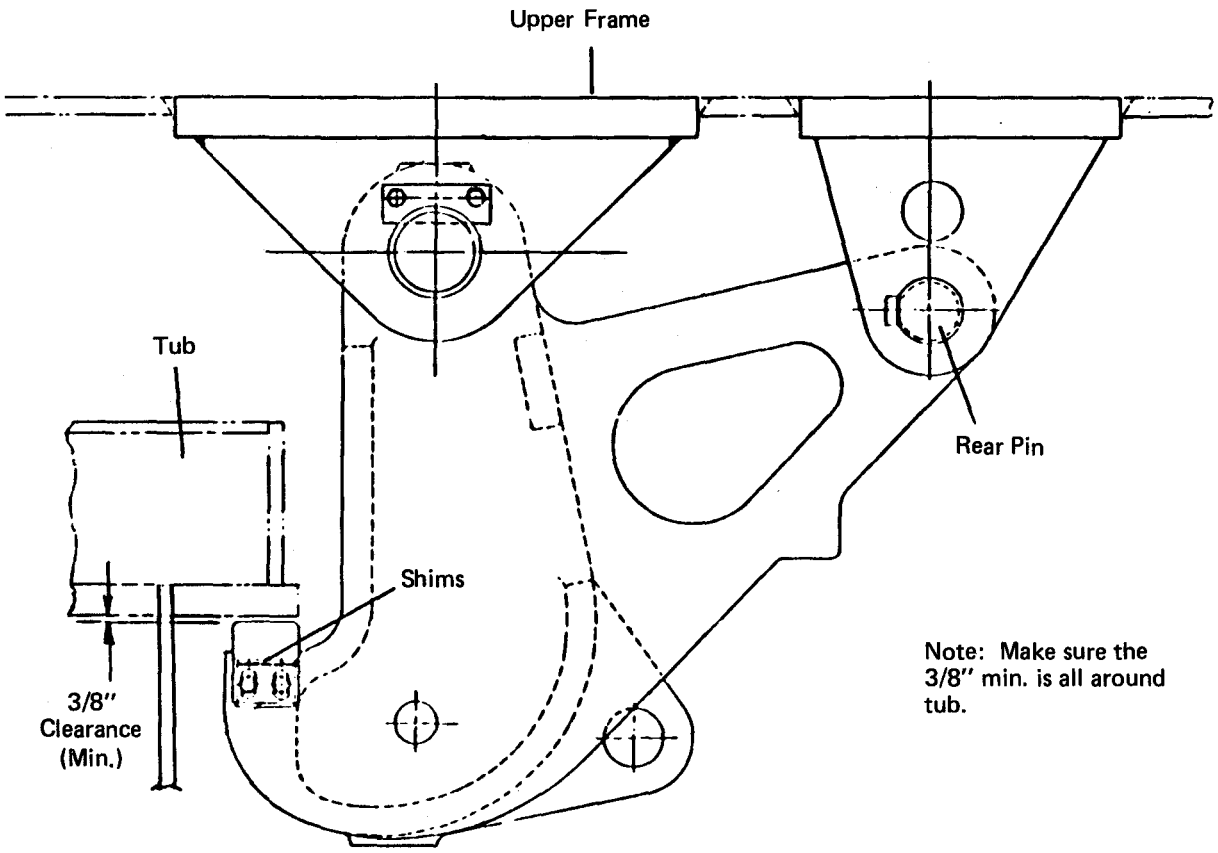


For more than one Hose, clip one, secure others to it with Ty-Rap

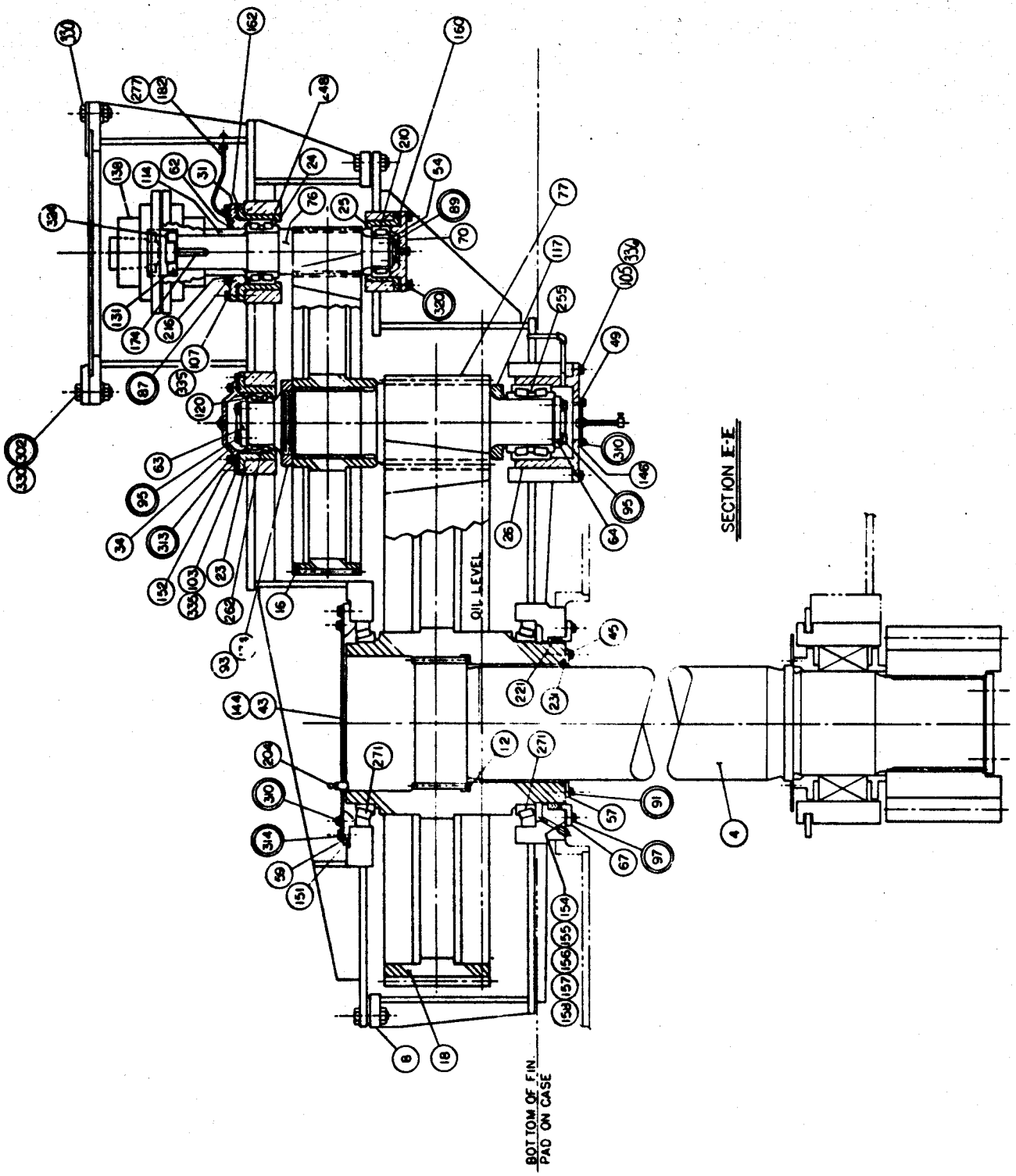
A matching rail is bolted to bottom of rotating frame and is the same as the tub rail except for the space provided to remove the rollers.

Two **HOOK SHOES** lift the leading edge of tub during the walking step. Each hook shoe is pinned to a support casting that is welded to the bottom of the rotating frame. Clearance of 3/8 inch exists between the hook rail on the tub and the wear plate on hook shoe when machine weight rests evenly on all rollers. Adjust clearance by placing or removing shims between the wear plate and hook shoe.

Disengage hook shoe by removing the rear pin and swing hook toward rear of machine and replace pin in top hole to hold hook shoe.



HOOK SHOE



GEAR CASE

HOIST AND/OR DRAG DRUM assemblies consists of two self supporting rope lagging sections bolted together at center with rod bolts. Parts are interchangeable.

The drum end castings and gear hub are rod bolted to the lagging.

The split double helical drive gear halves are joined together and mounted on drum end castings as described in Engineering Data Section.

NOTE: All bolts should be checked after first week of operation, thereafter, every 500 hours. Should any bolts appear loose, repeat tightening procedure.

The drum is supported by two large diameter spherical roller bearings. The bearings are mounted in bearing housings that are bolted to gear case and pedestal. The bearing cones are held in place on the stub shaft by a retainer plate. Be sure spacer ring is placed over stub shaft before bearing cone is assembled on shaft. The bearing cup is held in housing by a retainer plate and bearing cap with rod bolts. The gear end bearing cup is held snug between cap and plate. The opposite bearing cap is allowed to float on the drag drum while the right end of hoist drum is allowed to float. Hand pack bearings at assembly with MPG.

HOIST OR DRAG MACHINERY GEAR CASE motors and gearbox for hoist drum are located at left of drum. The drag drum motors and gearbox are located at right of drum.

The motors drive the drum thru a gear train consisting of motor extension shafts and intermediate shaft assemblies. The shaft assemblies are mounted in an oil tight case.

The motor extension is a shaft with integral pinion that is coupled directly to motor armature shaft by a flexible coupling. The shaft is supported in the gear case by two single row cylindrical roller bearings. The bearings and flexible coupling allow limited end play so that pinion can self align double helical gear mesh. Refer to eccentric cartridge mounting for gear teeth alignment.

The motor coupling hub is attached to the tapered motor armature shaft by the procedure described in Engineering Data Section under installation of shrink fit pinions.

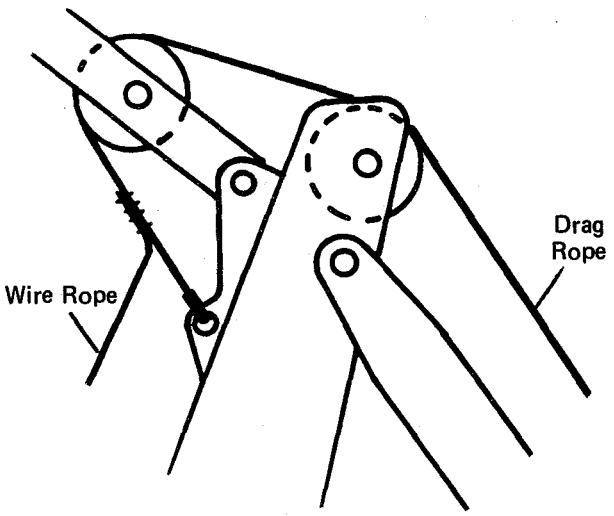
The intermediate shaft assembly consists of a large double helical gear that meshes with the motor extension shaft pinions. The gear is attached to the shaft and integral pinion by involute splines. The shaft is supported by two single row, cylindrical, roller bearings. One bearing is mounted in a boss of the gear case. The inside end of shaft is supported by a bearing mounted in an outboard bearing housing, bolted to gear case structure.

Only the drive gear is inside oil tight gear case. The pinion that turns main drum shaft gear is an open gear with suitable guard. A split oil seal on the shaft between gear and pinion is

To **RAISE BOOM, (Once Lowered)**, using drag machinery power raise mast until boom support ropes are in a tight position. Remove the cribbing that was used to support the mast.

Lift boom a few inches off cribbing and set brakes. If the brakes hold in this position, they will hold the boom at any angle.

After testing brakes, SLOWLY and CAUTIOUSLY raise boom until the bores on the mast link and gantry are aligned. Replace the mast link pins and all lube lines atop gantry.



If boom is raised to high to insert pins, an easy way to control a slight lowering is snap a brake magnet valve QUICKLY off and on with a screwdriver.

Run a wire rope up front of gantry and attach it to the drag rope near socket. Attach other end to a dozer or truck in a tight position. Remove the pin holding the socket to gantry.

Remove the electrical jumper from the hoist and drag brakes and readjust all brakes. Replace all hoist and drag ropes to the operating position.

While pulling wire rope, remove drag rope from both drums. Attach hoist winch line to end of drag rope to keep rope from running after it has cleared hoist drum.

Before starting digging cycle recheck placement of pins, retainers, lube line, etc.

Two **BOOM POINT SHEAVE** assemblies mount at the boom point. A sheave assembly consists of a sheave that turns on two tapered roller bearings. The bearings mount on a sleeve carrier that is supported by a ball joint and spherical bushing. The ball joint allows sheaves to oscillate in order to follow the fleet angle of the hoist rope.

Each sheave is returned to the normal or vertical position by a torsion bar. The live end of the torsion bar is attached to the bearing housing and the dead end is anchored to a bulkhead in the boom structure. With an aligning pin the male member and female member of the ball joint limit the oscillation of the sheave to a plane parallel to center line of boom.

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

PROCEDURE FOR ASSEMBLING FAIRLEAD SWIVEL PINS INTO MOUNTING BRACKET –

1. Assemble lower swivel pin (solid pin) into lower bracket.

   A. Pack pin in dry ice for a minimum of 12 hours, circulate the air inside the box to provide even cooling of the whole pin.

   B. Locate bracket so that pin may be removed from cooling box and installed into bracket in a minimum amount of time. Suggest a dry run before freezing pin to practice handling.

   C. After installing frozen pin, maintain pressure to hold pin against shoulder in bracket while it warms to room temperature.

2. Assemble upper swivel pin (hollow pin) into upper bracket.

   A. Assemble bearing complete, bearing retainer and bearing retainer sleeve on shaft.

   B. Pack pin in dry ice for a minimum of 6 hours, circulate the air inside the box to provide even cooling of whole pin.

   C. Locate bracket so that pin may be removed from cooling box and installed into bracket in a minimum of time. Suggest a dry run before freezing pin to practice handling.

   D. After installing frozen pin, maintain pressure to hold assembly against bracket clamping the bearing and bearing retainer sleeve while it warms to room temperature.

FAIRLEAD SNUBBERS (two used) consist of a two pieced friction band anchored to gantry and wrapped on a friction housing bolted to top of fairlead swivel bracket. A bolt and heavy spring join the band halves. Adjust snubber, by turning connection bolt nuts, tight enough to stop any swinging of fairlead bracket at start or stop of machine rotation.

NOTE: Many small motors use sealed bearings requiring no lube for 2 or 3 years. Add lube with units stopped and drain plug removed. After adding lube, run generator or motor with bottom plug removed for about one full hour to allow ALL excess lube to flow out. PLEASE REPLACE DRAIN PLUG. In most cases, the main hoist, drag and swing motors have no plug to remove. Surplus grease flows out in the pocket beneath bearing housing.

On vertical and a few horizontal motors, remove the plug same as with generators. As mentioned in the 250 hour lube procedure, these bottom plugs are removed before lubing to see that excess lube escapes. Probing with a clean wire assures the old grease has not hardened and blocked the passage. PLEASE REPLACE DRAIN PLUG.

About once a year, or after 7500 operating hours; purge bearings by pumping enough lube thru bearing while running so new grease appears at shaft or bottom plug hole. As lube seeps out along shaft, wipe away. This is important. Finally, after 15 or 20 minutes of operation, thoroughly clean off shaft. New grease usually appears first at bottom hole, but it may be seen first at the shaft. PLEASE DO NOT FORGET THE DRAIN PLUG.

Whenever possible, about once in 2 years, disassemble bearings and remove ALL old lube by thoroughly cleaning with light lube oil or petroleum solvent. Each time the bottom plug is removed, push a clean wire into the hole to check the lube is not hard and plugging the hole.

One measuring tablespoon equals approximately one ounce of grease. Use General Electric Company ball bearing grease D6A2C5 for their equipment. Use Westinghouse Electric grease 1449556 for their equipment.

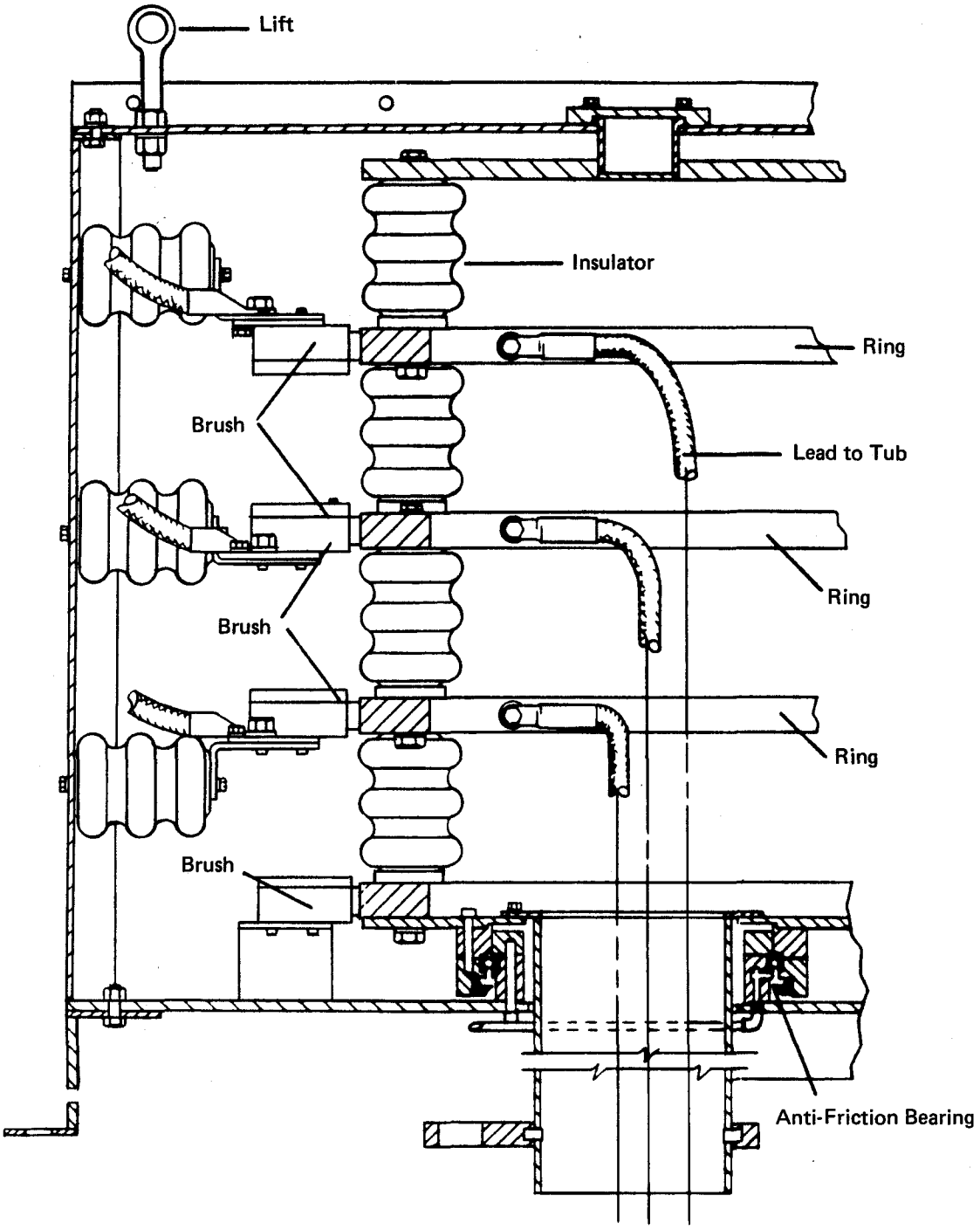
CAUTION: DO NOT MIX GREASE NOT OF THE SAME BASE.

In cold weather, when machine shuts down long enough to cool off, run hoist, drag and swing motors for warm up and allowing lube to flow before starting to dig. In extreme cold weather, motor bearings may be warmed with a radiant heater. As each set of motors warms up, run under light loads to maintain lube flow while the next set warms up.

FEEDER CABLE must contain a provision for a ground connection. Especially where 2300 volts and above are used. The power line end must attach (see paragraph on ground circuits) to a suitable permanent ground. The machine end must securely attach thru a bolted connection to ground machine frame. This provides a constant ground for the machine and electrical equipment. Failure to provide adequate ground endangers workers and equipment.

POWER LINE GROUNDING CIRCUIT ADEQUATE FOR THE MACHINE CANNOT BE OVER EMPHASIZED. Without a good grounding system, high voltage exists between the machine and ground. The portable cable and power lines supplying the machine must have a ground wire ample in capacity running parallel to the main wires over the entire distance from transformer to machine. A suitable grounding system must be used at the transformer. Consult your electric supplier or MPSD for details.

The **COLLECTOR RINGS** transmit incoming power from tub to rotating frame. ALWAYS DISCONNECT this incoming power at the source when servicing. This assembly consists of four rings stacked with ceramic insulators secured to tub center pin. Location is in space over center journal below deck of rotating frame. The brushes attach to the outside case. Clean and inspect every 30 days.



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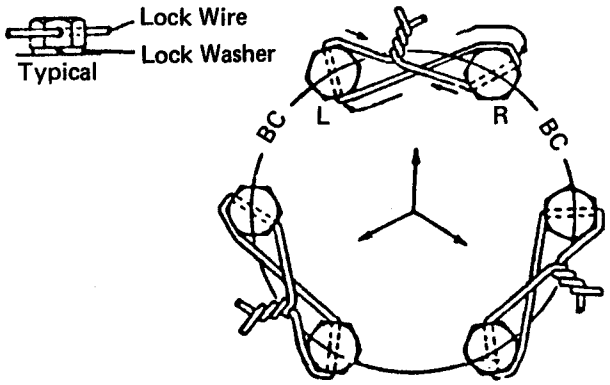


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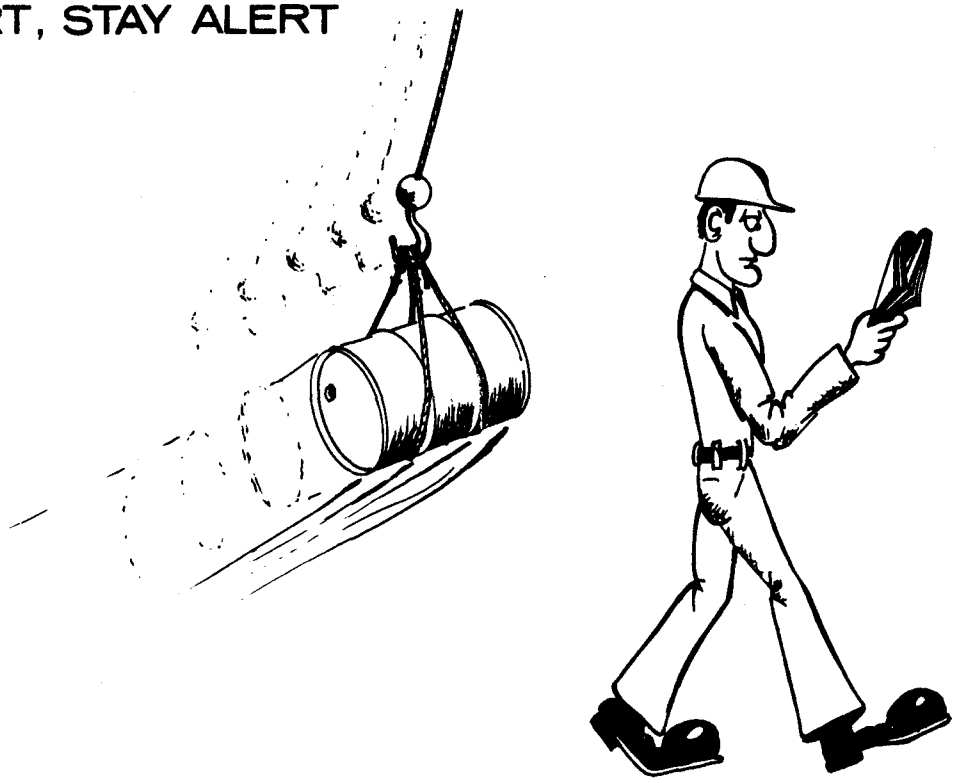
Shaft Nom. Diam.	Shaft O.D.	Running Clearance
34-1/2	34.500 34.494	.046 .068
34-3/4	34.750 34.744	.046 .068
35	35.000 34.994	.046 .068
35-1/4	35.250 35.244	.046 .068
35-1/2	35.500 35.494	.046 .068
35-3/4	35.750 35.744	.048 .070
36	36.000 35.994	.048 .070
36-1/4	36.250 36.244	.048 .070
36-1/2	36.500 36.494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

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.

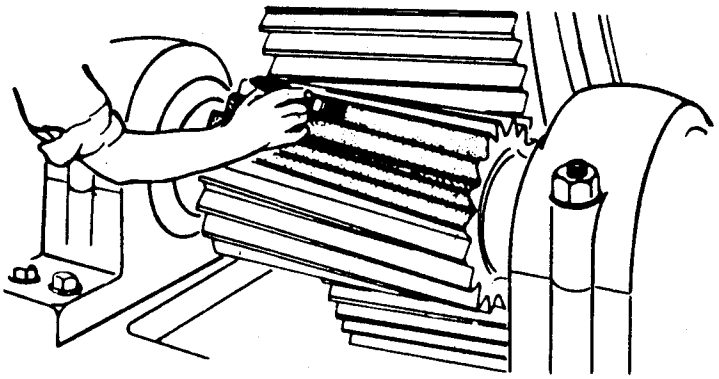


Wired in Pairs: Establish left and right hand fasteners as viewed from center of bolt circle. Insert left end of wire thru left hand fastener from inside to outside of bolt circle. Insert right end of wire thru right hand fastener from outside to inside of bolt circle.

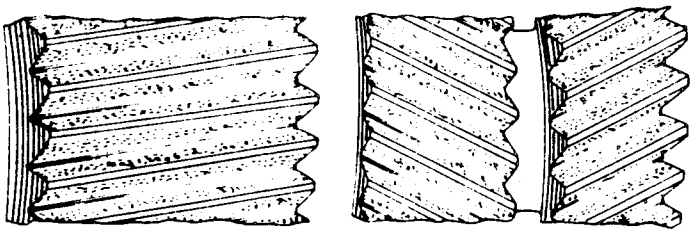
BE ALERT, STAY ALERT



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).



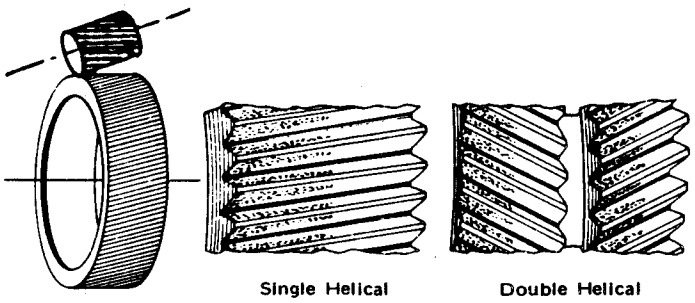
TYPICAL CONTACT PATTERNS: After a satisfactory pattern is established for the initial position of the gear, make the SAME contact check at three more points on gear, spaced 90 degrees apart. A minor adjustment to pinion may be necessary to produce the best average contact on the gear.



Single Helical Double Helical

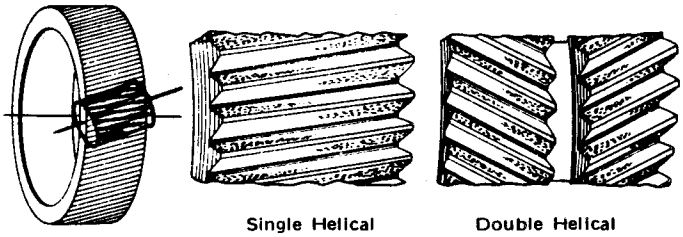
INSPECTION: Dowel ALL bearing pedestals and RECHECK ALL bolts to secure gear setting. INSPECT gear teeth and REMOVE ALL metal upsets and burrs that occurred in handling or assembly. CLEAN gear teeth and enclosures thoroughly BEFORE enclosing gears.

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

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.

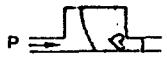
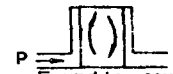
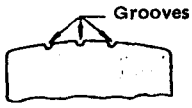
Use a simple timber brake against reel flange(s) to provide uniform unwinding and prevent slack from developing in strand on reel.

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

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.	

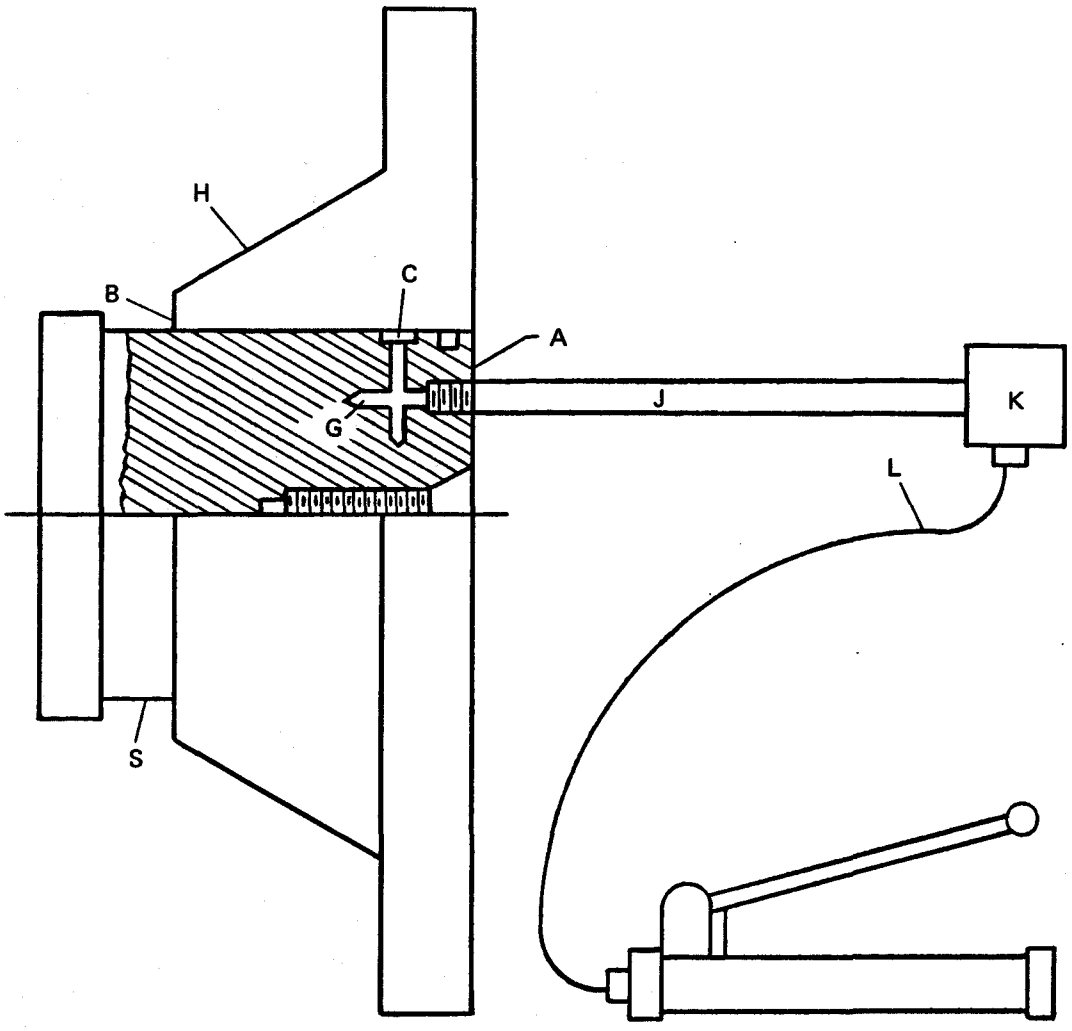
DECIMAL EQUIVALENTS

	.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	

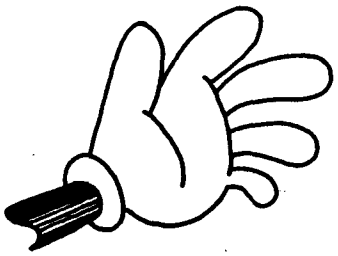
If oil does not appear on both hub ends due to insufficient pressure (excessive shaft end leaks), use heavier oil or grease. Slight, cautious peening around leak helps.

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.

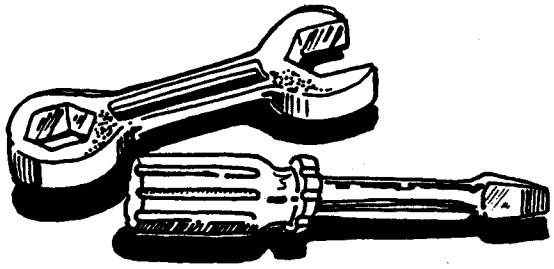
PRESSURE EQUIPMENT, such as a Blackhawk pump, connects to groove C by high pressure flex hose L, high pressure elbow K and high pressure nipple J. This nipple J is long enough for hub to pull clear of shaft extension and not interfere with elbow or hose. The nipple J also supports coupling when it drops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



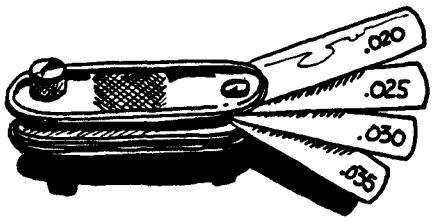
FEELING



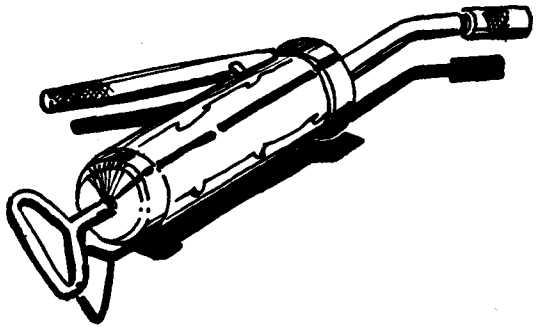
TIGHTENING



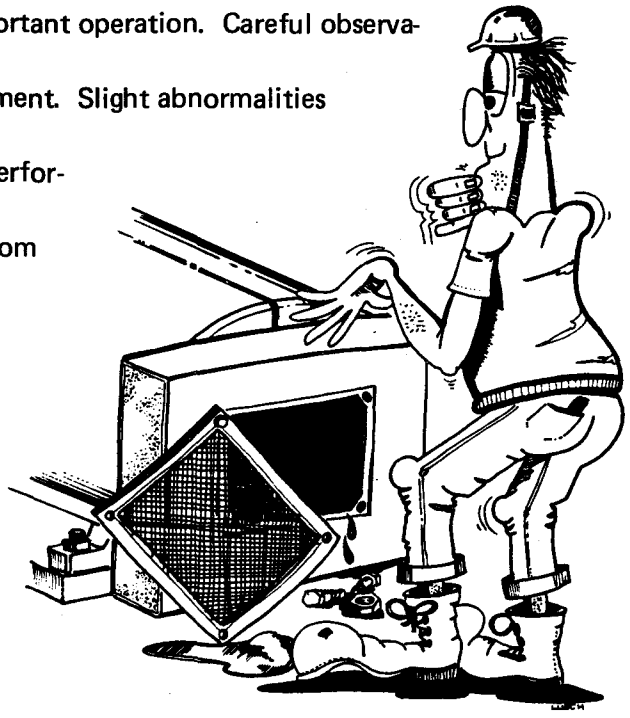
ADJUSTING



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.



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