Technical Manual

Lower bucket/dipper to ground and shut down machine. Inspect bucket/dipper for cracks and breaks. Do not permit tooth base exposure. Teeth may be reversed. Remove bucket/dipper from service and rebuild in shop before breakdown. Check main rotating gear hold down bolts. Use impact wrench if needed. Test ALL hold down bolts on rotating frame. Especially swing gear case, motor mounting, machinery pedestal and base bolts. Check also motor generator and air compressor mount and base bolts. Tighten rod bolts on bearing housing.

Examine and readjust, if needed, hoist and drag brakes and drag clutch. Look at the condition of brake and clutch lining. Remove inspection plate from swing gear case. Look at condition of gears. Use pry bar to detect any side motion of shaft indicating worn bearings. Examine condition of rotating brakes and their adjustment. Adjust, if needed. Inspect air compressor "V" belt tension, replace if needed. Fill the anti-freezer but don't drink that stuff. Check auto-lube system for loose or broken fittings or injectors.

Check center journal thrust washer and bearing. Secure ALL guards and safety features in place. DISCONNECT POWER SOURCE with machine shut down so electrical crew may adequately clean and inspect motor generators and electrical cabinets. NOTE any discolored electrical parts, it's a sign of overheating. In humid areas, look for fungus and mildew. Dry compressed air at LOW pressure works well for dust removal. Clean corrosion from parts, joints and connections. Retighten, where needed, any loose connections and terminals. Use of proper tool here eliminates broken terminals and terminal blocks. Replace missing or damaged tags and labels. Bundle loose wiring. Fasten ALL components and wiring in cabinets. Check the cable armor tight in the fixture. Look closely where wires and cables pass thru openings and grommets. Insulation damage generally occurs here. Replace grommets if needed. Arcing of motors and generators causes discolored commutators. Look at brushes and brush holder condition. Correct brush spring tension where needed. Collector rings need cleaning and checking also. Use a hand grease gun at each injector. Fill ALL grease lines and purge EACH bearing with MPG. Remember to replace ALL plugs, covers and inspection plates.

This may seem like a lot of running around checking, looking, inspecting, cleaning and then greasing; but this is the machine that makes the payroll possible. Keeping it running is very important.

Passing equipment condition reports along the line is important also. Wear patterns show up at varying degrees in time. Recording and checking these reports at a future date allows comparison and planned shutdowns. Planned repairs, part orders and crews for a scheduled shutdown eliminates idle downtime.

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Shaft Nom. Diam.	Shaft O.D.	Running Clearance	Shaft Nom. Diam.	Shaft O.D.	Running Clearance
17	17.000 16.996	.027 .041	21	21.000 20.996	.031 .045
17-1/4	17.250 17.246	.027 .041	21-1/4	21.250 21.246	.031 .045
17-1/2	17.500 17.496	.027 .041	21-1/2	21.500 21.496	.031 .045
17-3/4	17.750 17.746	.027 .041	21-3/4	21.750 21.746	.031 .045
18	18.000 17.996	.028 .042	22	22.000 21.996	.033 .047
18-1/4	18.250 18.246	.028 .042	22-1/4	22.250 22.246	.033 .047
18-1/2	18.500 18.496	.028 .042	22-1/2	22.500 22.496	.033 .047
18-3/4	18.750 18.746	.028 .042	22-3/4	22.750 22.746	.033 .047
19	19.000 18.996	.028 .042	23	23.000 22.996	.034 .048
19-1/4	19.246 19.246	.028 .042	23-1/4	23.250 23.246	.034 .048
19-1/2	19.500 19.496	.028 .042	23-1/2	23.500 23.496	.034 .049
19-3/4	19.750 19.746	.028 .042	23-3/4	23.750 23.746	.034 .049
20	20.000 19.996	.030 .044	24	24.000 23.996	.034 .049
20-1/4	20.250 20.246	.030 .044	24-1/4	24.250 24.245	.034 .050
20-1/2	20.500 20.496	.030 .044	24-1/2	24.500 24.495	.034 .050
20-3/4	20.750 20.746	.030 .044	24-3/4	24.750 24.745	.035 .052
25	25.000 24.995	.034 .052	29	29.000 28.995	.041 .059
25-1/4	25.250 25.245	.034 .052	29-1/4	29.250 29.245	.041 .059
25-1/2	25.500 25.495	.034 .052	29-1/2	29.500 29.495	.041 .059

THE CAP SCREW (BOLT) CLASS is identified by the marks on the head as shown below:

CLASS A CLASS B CLASS C

Please USE the SAME CLASS washer and nut as bolt.
DO NOT USE spring lock washer with Class C bolts.

For selecting the proper tightening method, (TORQUE VS. TURN-OF-NUT), consider the following criteria:

TURN-OF-NUT METHOD
Small quantities involved
Inconsistent thread conditions and fits
Usually exceed 2,000 foot pounds
Torque measures equipment impractical for assembly

TORQUE METHOD
Large quantities involved
Consistent thread conditions and fits
Usually less than 2,000 foot pounds
Torque measuring equipment available at assembly

TURN-OF-NUT METHOD: Install bolts and tighten to SNUG FIT. This means tight with a hand tool, (50 pounds torque with 24 inch wrench) or if using impact wrench (when the drive stops and racheting starts).

Use crayon, chalk or paint to mark the nut at side and clamped surface to indicate the SNUG FIT position. Mark impact drive socket when used.

Hold bolt head with wrench and using a heavy duty impact, hand wrench and heavy hammer (or sensible alternate method); advance the nut 1/2 turn.

Tighten nuts progressively from fixed edge to free edge. This achieves tension and prevents loosening under most severe conditions.

TORQUE METHOD: The recommended torque figures listed ALL apply to non-plated fasteners as received from manufacturer with no special lube applied. If using high stress lube during assembly, multiply torque figures by 0.90 factor. Apply lube under heads or nuts (rotating elements) plus threads.

Apply torque valve to standard locknuts as listed.
DO NOT ADD run-down torque to chart valves.

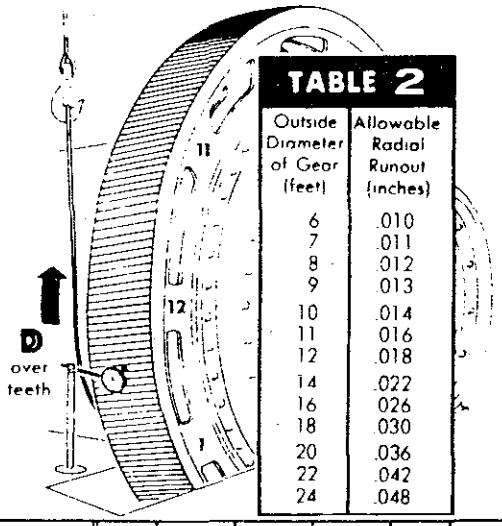


TABLE 2

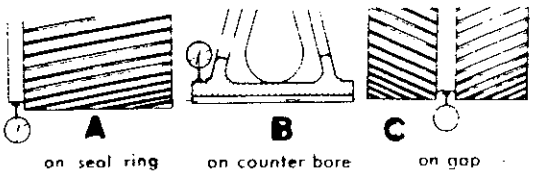
Outside Diameter of Gear (feet)	Allowable Radial Runout (inches)
6	.010
7	.011
8	.012
9	.013
10	.014
11	.016
12	.018
14	.022
16	.026
18	.030
20	.036
22	.042
24	.048

Station No	1	2	3	4	5	6
Indicator Reading	000	+ 004	+ 005	+ 004	000	− 005

7	8	9	10	11	12	1
− 010	− 014	− 015	− 014	− 010	− 005	.000

ceeds allowable figure shown in table 2, correct by recentering the gear. Use jackscrews or hydraulic jacks. If error cannot be corrected, check mounting flange for concentricity. When gear is centered, install remaining flange bolts.

EXAMPLE: Readings for a 16 foot diameter gear are listed in a chart below. Total radial runout of .020" is obtained between station 3 with a maximum plus reading of .005" and station 9 with a maximum minus reading of .015". This is within allowable .026" shown in table 2.



REQUIRED BACKLASH for gear application of this type varies with diametral pitch. Table 3 lists these backlash requirements. PLEASE NOTE: ALL backlash values are given in NORMAL PLANE. Therefore, backlash checked with a dial indicator requires this indicator be set PERPENDICULAR to the helix of the teeth.

Establish ALL backlash values with LOAD on the gear. Apply cable load to drum by raising an empty bucket/dipper.

TABLE 3

DIAMETRICAL PITCH GEARS

D.P.	Minimum	Maximum
1	.026	.038
1¼	.023	.035
1½	.020	.032
1¾	.019	.029
2	.017	.027
2½	.013	.023
3	.011	.021
4	.009	.019
5	.007	.017
6	.005	.015
8	.004	.014

CIRCULAR PITCH GEARS

C.P.	Minimum	Maximum
8	.100	.120
7	.090	.110
6	.080	.100
5½	.075	.090
5	.070	.080
4½	.060	.070
4	.045	.060
3½	.030	.045
3	.026	.038
2½	.023	.035
2	.020	.032
1½	.017	.027
1	.011	.021

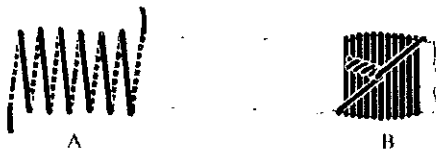
SETTING OF PINION FOR BACKLASH AND TOOTH CONTACT: Roll the gear bringing a favorable checking station to the mesh position. This is one with either maximum plus or maximum minus rim face reading.

Another method requires hand pouring of lube onto rope after brush or air jet cleaning. In either method, the rope must remain coated at all times.

Inaccessible boom supports and bridge strands need lubricant applied at and around boom hoist sheaves, as well as, the dead end anchor area. Spray can lube helps here.

Proper Methods of Seizing

Sketch of Method No. 1 for applying seizings. At A the turns of the seizing wire are spread apart to illustrate method of applying them. Completed seizing is shown at B.



Sketch of Method No. 2 for applying seizings. At A the turns are spread apart to show method of applying them. Completed seizing is shown at B.

Properly seizing a wire rope end prevents the strands from slipping. Any strand movement causes uneven load distribution in the strands and reduces rope life.

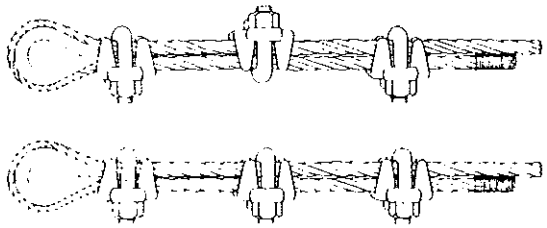
Seize rope BEFORE cutting. Tighten wrap, (a soft, annealed wire), about strand size wire; around rope. Pull wrap tight. Twist wire end secure. Use 1/4 inch wrap length on all rope up to 1/4 inch. On all other rope, measure wrap length at least one rope diameter in length. Place the first wrap about 1 to 1-1/2 inches from the intended cut. Then place a second wrap or seizing about 4 to 6 inches from the first.

APPLYING WIRE ROPE CLIPS

Use a portable cable cutter whenever possible. Often a flame cutting torch is used and generally fuses the strand and wires together. Do not use a melting tip here.

The Right Way to Clip Wire Rope

Space wire rope clips about 6 rope diameters apart. Tighten clip on rope BEFORE placing rope in tension. Then retighten after rope is in use. Any rope diameter loss caused by pulling on rope, loosens clips. Retighten clips.



The Wrong Way to Clip Wire Rope

Only one correct method of attaching U-bolt clips on wire rope exists. The clip base must bear on the live end of rope. The U of the bolt bears on the rope dead end (see sketch). Otherwise, the U-bolt kinks or cuts the anchor live end and causes failure.

Wire rope adjacent to the dragline bucket is subject to the greatest abrasive wear. This is true of the shovel dipper ropes too. When this rope section shows excessive wear, remove the rope socket, seize the worn area and cut off.

MATERIAL INFORMATION

RAIL STEEL – MPS Symbol FB

To repair steel rail areas with spalled surfaces; first grind away ALL cracked edges. Preheat. Build up (pad) area, using E-9018M electrodes, to within 1/4 inch of finished surface approximately. Complete build up, using E-11018M electrodes, then grind weld to desired contour.

For crack repair, other than in rail wear surfaces; preheat, then use E-9018M or E-309 electrodes.

NOTE: The above is not an accepted practice for new rails, and **MPS** will not be responsible. New rails should be ordered (from MPS) as repair may be short lived.

AUSTENITIC MANGANESE STEEL – MPS Symbol CH and FCHN

NEVER exceed 500 degrees F. (260 degrees C.) (1/2 inch back from joint) when welding OR flame cutting this steel; otherwise an embrittled (heat affected) zone results. Manganese, normally non-magnetic, may be slightly magnetic when work hardened. Because of this, remove the work hardened area by grinding BEFORE welding.

CAST IRON

FRICTION HOUSINGS

Welding for permanent repair is NOT recommended. Brazing or bronze welding gives temporary repair. Use general preheat. SLOWLY preheat entire part to a minimum of 400 degrees F. (204 degrees C.) MAINTAIN heat during welding. SLOWLY COOL after welding. When application does not permit brazing, use electric arc process, using ENiFe-CI electrodes (such as "Ni-Rod 55"). General preheat applies here.

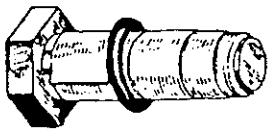
WELDING INSTRUCTIONS

WELDING ELECTRODE TYPES, shown in Welding Specifications, are calssified according to the American Welding Society standards. Use any reliable brand electrode conforming with A.W.S. We recommend LOW HYDROGEN ELECTRODES (AWS EXX-18) for all repair work. Please keep these electrodes dry. Use according to manufacturer's recommendations for the best results. Bake electrodes, when possible, in oven for one hour at 700 degrees F. (371 degrees C.). Then place in holding oven at 250 degrees F. (121 degrees C.) until used. If wire chemistry is compatible to specified stick electrodes; use CO2 semi-automatic, flux-core wire for flat position joints.

In hydraulic systems, flow wash bearing surfaces with hydraulic fluid and wipe parts, if needed ONLY with a dust free cloth.

In an oxygen system DO NOT PERMIT OIL AND GREASE around the O-ring. The mixture of oxygen; oil and grease causes an explosion.

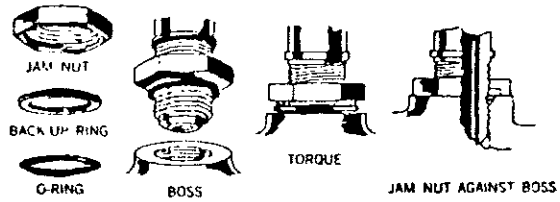
INSTALLATION on a piston does require a bit of stretching, but try to keep it uniform. Once installed, remove any and ALL twists. When pushing piston into cylinder, push straight in; DO NOT TURN while pushing. Turning causes bunching and eventually a leak. Most installations are the removal procedure in reverse.

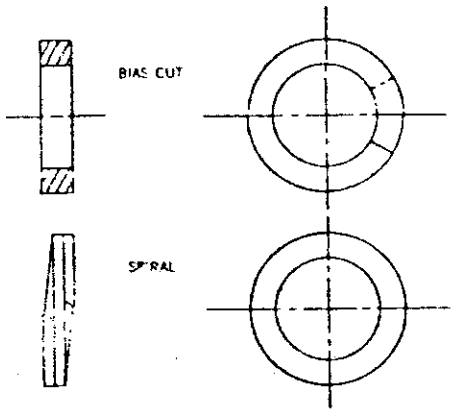


TAPE PROTECTS O-RING DURING INSTALLATION

Some installations require the O-ring to slip over sharp edges, such as screw threads. Cover these edges with thin plastic tape or aluminum foil, lube ring and work into place. Perhaps making a thimble of plastic to place over threads first is even easier.

Other installations, such as placing a ring in a positioning type, universal fitting are more involved. In this case, a backup ring is lightly coated with lube and then worked into the counterbore of the jamb nut. The O-ring is stretched and rolled over fitting threads and into smooth threadless surface designed for the backup and O-rings. Next, jamb nut is pushed firmly against lower threaded section of fitting. Fitting installs in boss until ring contacts boss and increases torque. Jamb nut is held stationary in this position while applying 1-1/2 turns to fitting. Then turn fitting into boss NOT MORE than ONE added turn to position it. Final step is to hold fitting and torque jamb nut properly.





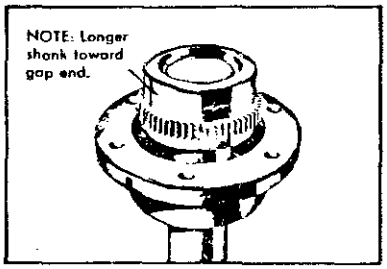
A similiar procedure is used for non-positioning ifttings, but the jamb nut and backup ring may be omitted.

BACKUP RINGS provide a firm surface for O-rings to press against to avoid extrusion, under high pressures, into clearance between sealed surfaces. Any surface movement with O-ring so extruded results in high wear rate which finally leads to ring failure.

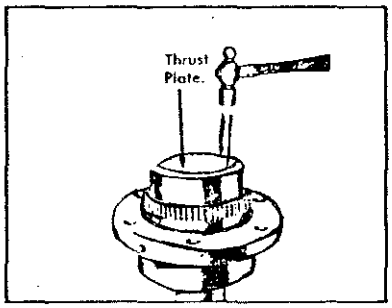
Backup rings are needed on each side of an O-ring when pressure is in alternate directions. Using a single ring, install on the downstream side of the O-ring.

GV TYPE COUPLING INSTALLATION

A. MOUNT FLANGED SLEEVES, SEALS AND HUBS—Refer to step 1. Place flanged sleeves WITH seal rings on shafts BEFORE mounting hubs. DO NOT DAMAGE SEALS. Mount hubs on respective shafts, as shown, so counterbore face is flush with shaft end.



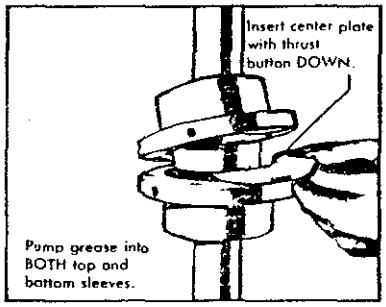
A MOUNT FLANGED SLEEVES, SEALS AND HUBS



B INSTALL THRUST PLATE IN LOWER HUB

B. INSTALL THRUST PLATE IN LOWER HUB—Tap thrust plate into counterbore until fully seated and stake in place. Position equipment. Refer to Steps 3 and 4. IMPORTANT: With coupling aligned, pack lower flanged sleeve with grease and correctly position sleeve and gasket DO NOT DAMAGE GASKET.

C. INSERT CENTER PLATE WITH THRUST BUTTON DOWN—Insert center plate with THRUST BUTTON DOWN. Center plate in counterbore of lower flanged sleeve. IMPORTANT: Pack upper hub teeth with grease and then complete assembly per Steps 5 and 6.



C INSERT CENTER PLATE WITH THRUST BUTTON DOWN

MAINTENANCE—Lubricate couplings at least once every six months. Lubricate more frequently when exposed to excessive moisture, extreme temperatures, rapid reversing or shock loads or excessive misalignment.

Table — INSTALLATION DATA

COUPLING SIZE		10	15	20	25	30	35	40	45	50	55	60	70
Gap (Hub Separation) —inches	G	1/8	1/8	1/8	3/16	3/16	1/4	1/4	5/16	5/16	5/16	5/16	3/8
	GV	7/16	7/16	7/16	7/16	7/16	1 13/64	7/8	1	1	1	1 1/8	1 3/8
Operating Alignment Limits — inches*	Offset Max	.005	.005	.010	.010	.012	.012	.012	.012	.012	.012	.012	.012
	Angular Max	.005	.005	.010	.010	.015	.015	.020	.020	.020	.030	.030	.030
Coupling Speed Range with NLGI #1 Grease — rpm★		1030/★ 10000	700/★ 8000	550/★ 6500	460/★ 5500	380/★ 4800	330/ 4300	290/ 3850	250/ 3600	230/ 3300	210/ 3000	190/ 2850	160/ 2500
Max Bore with Sq. Key — inches		1 1/8	2 1/8	2 5/8	3 1/4	3 3/4	4 1/2	5 1/8	5 1/2	6 3/8	7	7 3/4	8 1/2
Grease — pounds	G	1/16	1/8	3/8	1/2	3/4	1	1 3/4	2 3/8	3 1/2	4 1/4	7 5/8	14
	GV	1/8	1/4	1/2	3/4	1 3/8	2 3/8	3 3/8	5 1/4	6 3/4	8 1/4	11 1/4	23 1/2
G & GV10	Flange Bolt Torque—lb-in.	95	170	170	420	420	845	845	845	1490	1490		
G & GV20	Flange Bolt Torque—lb-in.	85	145	360	720	720	1290	1290	1290	1430	1430	1430	2160

* Align couplings within the operating alignment limits specified above. Exceeding these limits reduces coupling life and the maximum speed stated.

★ Coupling speed range with NLGI #0 grease is from zero rpm to the maximum shown in Table 1 for NLGI #1 greases except for the following: Size 10, 7000; Size 15, 6000; Size 20, 5000; Size 25, 4750 and Size 30, 4500.

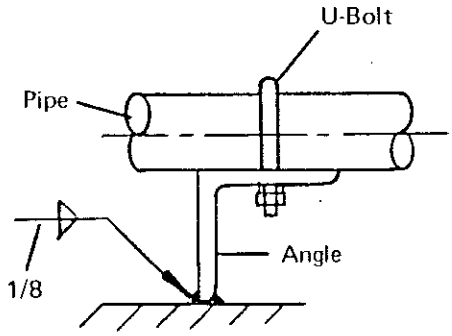
(Section 2 — Lubrication continued)

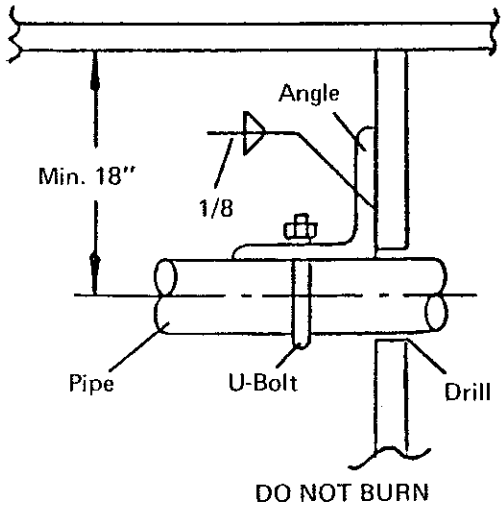
LUBRICATION OF PROPEL MACHINERY (1 of 2)

NAME OF PART	TYPE	NO. OF POINTS	LOCATION	LUB. SYM.	METHOD AND FREQUENCY
Walking Arm Eccentric	Bushing	16	Outside of Bushing	WCL	Automatic
Stabilizer Arm, Top	Bushing	1	In Edge of Bushing	WCL	Automatic
Stabilizer Arm, Bottom	Bushing	1	In Side of Bearing Boss	WCL	Automatic
Shoe Swivel Ball Joint	Bushing	4	In Top of Ball Socket	WCL	Automatic
Lateral Ball Joint Shaft	Bushing	6	In End of Shaft		Automatic
Main Propel Outer Bearing	Bushing	8	In Side of Bearing Boss	WCL	Automatic
Main Propel Inner Bearing	Bushing	8	In Side of Bearing Boss	WCL	Automatic
Main Bearing Thrust Washer (Outside)	Bushing	4	In Side of Washer	WCL	Automatic
Main Bearing Thrust Washer (In Side)	Bushing	4	In Side of Washer	WCL	Automatic
Drive Gear Bearing	Anti-Friction	2	Piped to Side of Bearing Housing	MPG	Hand, 500 Hrs.
Propel Gear	—	—	Drip on Gear	OGL	Automatic
Propel Shaft Spline (In Eccentric)	—	2	Hand Pack Before Assembly	MPG	6 Months
Propel Shaft Spline (In Gear)	—	2	Hand Pack Before Assembly	MPG	6 Months

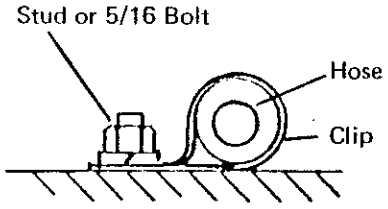
STANDARD LUBRICATION INSTALLATION

TYPICAL PIPE MOUNTING

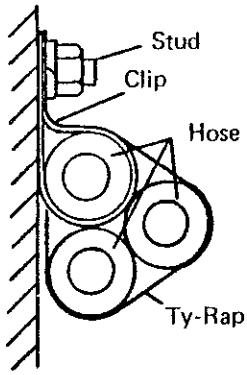




TYPICAL HOSE MOUNTING



Every 3 Feet or as Required



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

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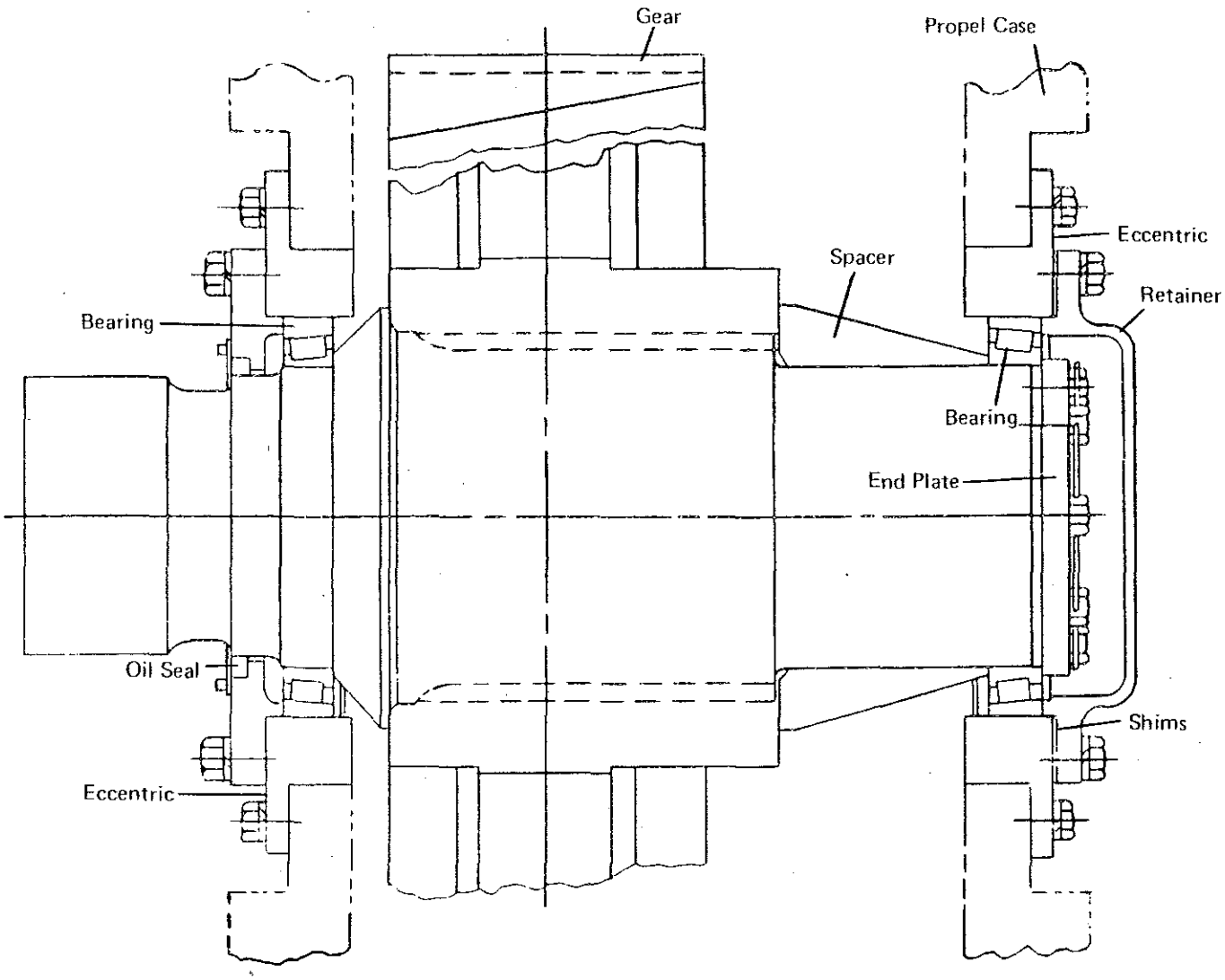
(Section 4 – Mechanical Adjustments)

The **SECOND INTERMEDIATE SHAFT** consists of a large gear that meshes with the first intermediate pinion. The gear is attached to the shaft by involute splines. The shaft extends outside the gear case and connects to the propel pinion by means of a crowned spline coupler.

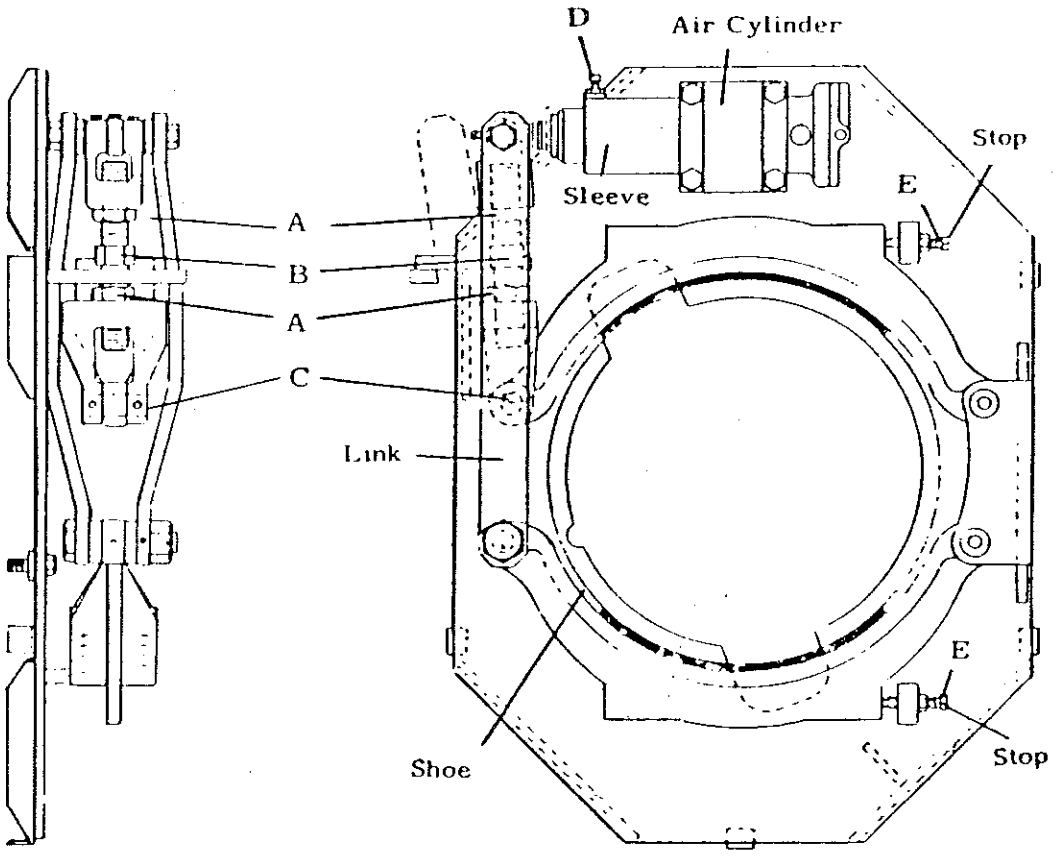
The second intermediate shaft assembly is supported by a cylindrical roller bearing at each end. Each bearing is housed in an eccentric for proper gear alignment.

All shaft assemblies in the propel gear case can be removed from the case without draining the lubricant.



A **ROTATING BRAKE** mounts atop of each rotating motor. The brake wheel keys to the motor armature shaft. An air cylinder releases the brake and it is set by a compression spring inside cylinder. The brake is a holding brake and not intended to stop or retard machine rotation, except in case of emergency. In normal operation swing is stopped by "plugging" or reversing the motor.

The brake is set by moving the two operating links into near toggle position. Adjust the position by turning the adjusting bolts between end castings of inside link.



ADJUST ROTATING BRAKE in set position. First loosen the two locknuts (A) on the adjusting bolt. Turn bolt (B) until links are 5/8 inch from full toggle position when measured at point (C).

To increase set spring tension, loosen set screw (D) and turn spring adjusting sleeve clockwise. DO NOT tighten spring to a point where air cylinder will not release brake, nor will spring bottom before operating levers have reached lever stop.

Reeve winch rope and attach it to the hoist rope at drum. Remove hoist rope from drum clamps. Operate winch to remove hoist rope from machine.

Reverse procedure to install new hoist rope(s).

NOTE: Reset drum limit switch after changing rope(s).

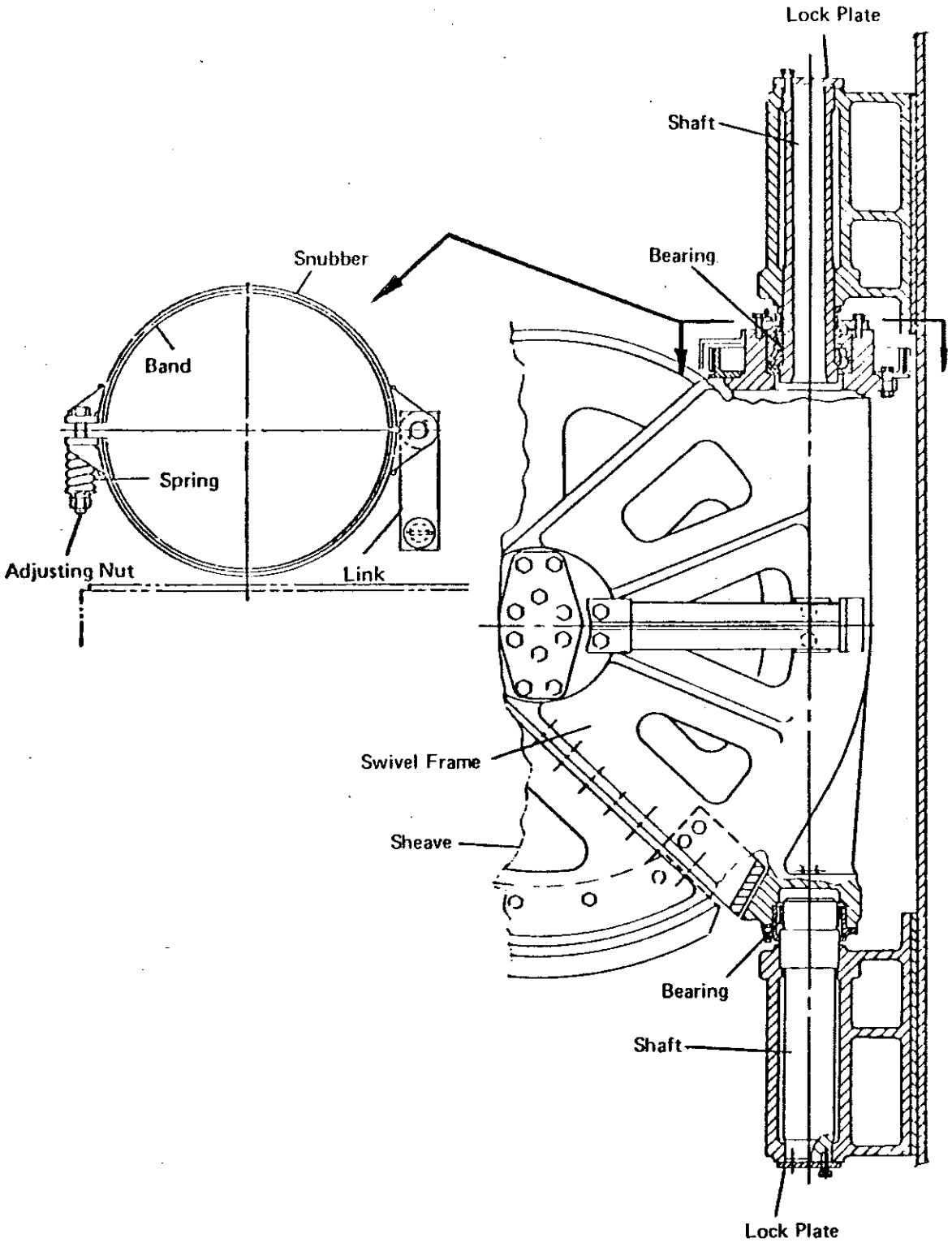
CHANGE DRAG ROPE(S) by disconnecting them from bucket and unwind rope from drum. Pull rope away from machine with dozer or truck.

Reeve winch rope and attach it to drag rope at drum. Remove rope clamps on drum. Operate winch to remove drag rope from machine.

Reverse procedures to reassemble drag ropes.

NOTE: Reset drum limit switch after changing rope(s).

NOTES:



FAIRLEAD ASSEMBLY

Although hand stoning will restore a true, cylindrical surface, it will not eliminate eccentricity or extremely bad spots. Eccentricity may cause severe arcing or poor commutation. Sometimes eccentricity is in the commutator initially. It may also be caused by changing shape with heat and age.

Where commutator eccentricity exists or there are extremely bad spots, remove the armature and have the commutator turned or ground in a lathe by someone familiar with this work. After turning or grinding, undercut the commutator mica.

Some large commutators can be ground in the frame by a skillful mechanic using proper equipment. This avoids loss of time and expense involved in removing a large armature. Speed of commutation while grinding is important. Therefore, it is essential that this be done by experienced men to prevent damage. A good commutator is within .0005 to .001" out of round when checked with a dial indicator gauge.

After grinding or sanding a commutator, blow off all copper or carbon dust with dry compressed air. Brushes should then be run for a short time under very light load. This allows the brushes to get a fairly good seat before applying full load. Whenever a commutator is ground, stoned or sanded, perfect brush contact is destroyed.

DO NOT USE EMERY PAPER OR CLOTH on a commutator, especially when a current is flowing. Emery is an electrical conductor and particles are likely to become inbedded between segments and cause short circuits.

If commutation is bad and cannot be corrected by simple remedies, consult the electrical equipment manufacturer.

LUBRICANT OF BEARINGS—

The following procedure has been established as suitable for proper lubrication of bearings on electrical equipment under general conditions.

Do not over grease. Usually, more damage can be done to a bearing by over greasing than from insufficient grease. Too much lubrication may result in electrical failures because of grease accumulation on commutators or windings.

On new equipment, lubricate all bearings according to the following chart for the first day of service and every 250 hours of actual running time thereafter. Add grease unit a very small amount of grease appears at the shaft or the bottom drain hole (plug removed) of the bearing housing. After the first day of service, grease while the equipment is at operating temperature.

SWING CONTROL PEDALS, two located in front of operator, connect to the electric swing controller thru compound linkage. This linkage uses anti-friction bearings.

A spring loaded plunger, mounted under the deck plate, returns the pedals to the neutral position. When pedal reaction becomes sluggish or binds; check here. Remove the plunger from the case, clean and lube with a small amount of MPG. Spacers, placed between spring and end caps, increase the spring tension.

Adjust pedal stop to strike floor plate at FULL left and FULL right swing. Adjust the pedal return lug by rotating the eccentric button on the lug so BOTH eccentric buttons contact the spring plunger in the neutral position. Once adjusted, weld button to lever plug.