Technical Manual

SAFETY PRECAUTIONS – continued

Be sure heavy items are properly supported from cranes or hoists before removing supporting members from machine.

Have sufficient service personnel available when removing or installing large heavy items to maintain control at all times.

Always use safety stands in conjunction with hydraulic jacks or hoists. Do not rely on the jack or hoist to carry the load, they could fail.

Use safety catch on all hoist hooks. Do not take a chance, the load could slip off of the hook.

If a heavy item begins to fall, let it fall, don't try to catch it.

When disassembling machines, be sure to use safety stands and adequate cribbing to prevent tipping or rollover of components.

Keep work area organized and clean. Wipe up oil or spills of any kind. Keep tools and parts off of the ground. Eliminate the possibility of a fall which could result in a serious injury.

Floors, walkways and stairways must be clean and dry. After draining operations be sure all spillage is cleaned up. Electrical cords and wet metal floors make a dangerous combination.

Check all wire ropes for telltale signs of early wear or failure. Look for and secure any loose bolts or locking devices.

Use extreme caution while working near any electrical lines or equipment whether it be high or low voltage. Never attempt electrical repairs unless qualified. Check limit switches for proper operation.

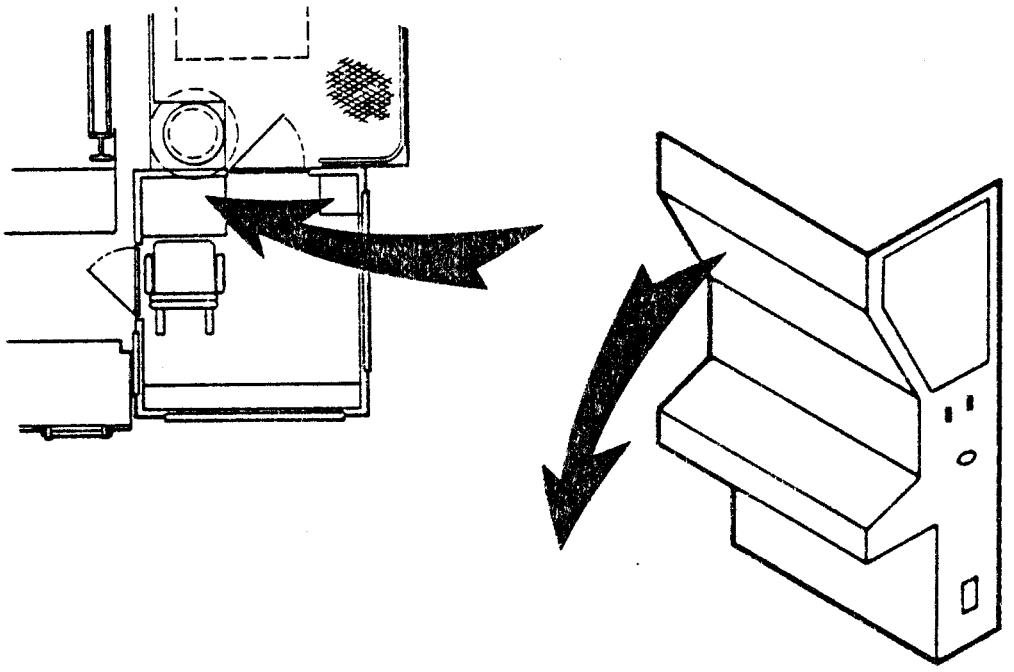
When using an acetylene torch, always wear welding goggles and gloves. Keep a "charged" fire extinguisher within reach. Be sure the acetylene and oxygen tanks are separated by a metal shield and are chained to the cart. Do not weld or heat areas near transformers or electrical cabinets and utilize proper shielding around lubrication lines.

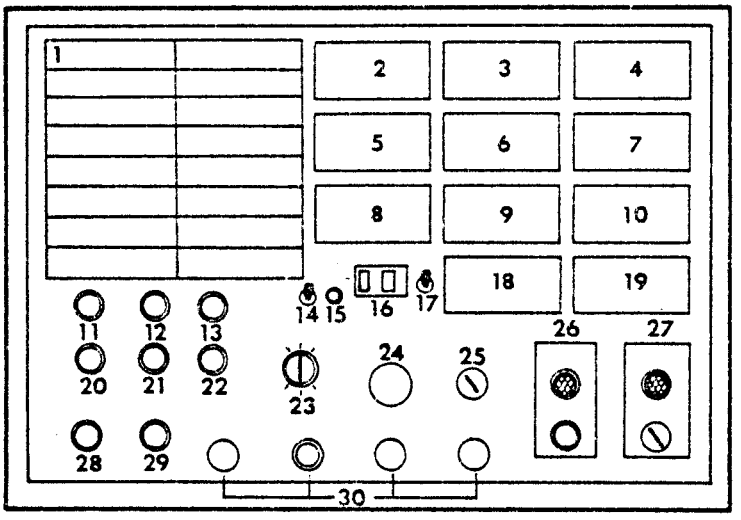
Use pullers to remove bearings, bushings, gears, cylinder sleeves, etc. when applicable. Use hammers, punches and chisels only when absolutely necessary. Then, be sure to wear safety glasses.

Be careful when using compressed air to dry parts. Use approved air blow guns, do not exceed 207 kPa (30 psi), wear safety glasses or goggles and use proper shielding to protect everyone in the work area.

DRILLING CONTROL STATION, located at left front corner of the operator's cab, contains the controls for the drilling operation. The following number list identifies the items, on the panel, for easy location on sketch(s) provided.

CAUTION: Understand the operating procedures, sequences and controls before operating this machine.





CAUTION: DO NOT OPEN top or side doors of Drilling Control station unless qualified to work on automatic drill control (ADC).

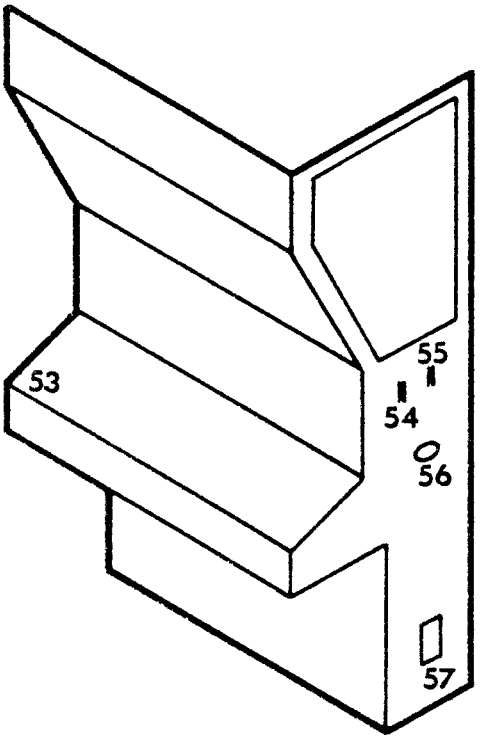
53. SPIRIT LEVELS – Indicates level of machine. See Machine Leveling in this manual section.

54. DIMMER – Use to lower brightness of cab interior light, directly behind drilling controls.

55. CAB LIGHTS – ON/OFF switch for cab lights not controlled by the dimmer switch (item 54).

56. MAST OUTLET – Plug mast raising and lowering control cable into this outlet. The control is stored in bottom of propel control station.

57. OUTLET – This is a 110V AC electrical outlet for coffee pot or hot plate to heat lunch.



PROPEL CONTROL STATION located on right side of operator's cab, contains the controls that propel the machine. The panel is energized by placing the Drill/Propel Mode switch (item 23) in the propel position. See Propelling Machine, in this section, for the operation of this panel.

58. EMERGENCY STOP – When this red mushroom type push button is depressed all operations stop and all brakes set. It does NOT stop diesel engine on diesel operated drills.

59. AUTO LUBE SYSTEM – Supplies lube to the crawlers and leveling jacks.

    ON – This green light indicates that the lube panel, located in the machinery house is energized.

    AUTO-LUBE FAILURE-RESET – Reo light push button. The red light indicates the the lube cycle has NOT completed in the given time period and the buzzer (63) on side of stand will sound. Check system for the malfunction before pushing the reset button.

60. PROPEL STATION – Two position selector switch, LOCAL to operate this panel or REMOTE for operating the optional outside, ground level propel joystick control.

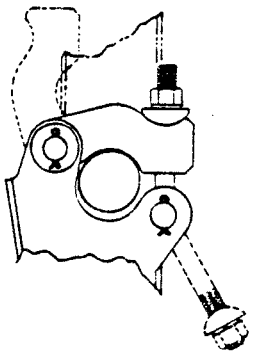
Now, remove the joystick control box from the storage compartment and the cable from the hooks on right, outside of cab.

Hold the dead man button down on top of box and move the brake toggle switch to release.

The joystick operates (speed and direction) of the propel motors the same as the levers on the propel stand.

When machine is in position and motion stopped, move brake toggle switch to SET and then release the dead man button. Replace the control box in the storage compartment and the cable on the hooks.

After each type of self-propel operation, move the hoist/standby/propel switch to standby position to de-energize the propel stand and prepare for drilling.



RAISING MAST, loosen bolts on the two hold down anchor caps and pivot them towards the front of the machine. The winch line must be secured to the mast to prevent the hook from swinging.

If applicable, make sure the left hand door on the operator's cab is closed and the mast brace sections are pinned together.

CAUTION: **Do not raise or lower mast unless rotary gearbox is fully down against bottom stops.**

Serious personal injury and or serious damage to equipment can result from failure to follow this warning.

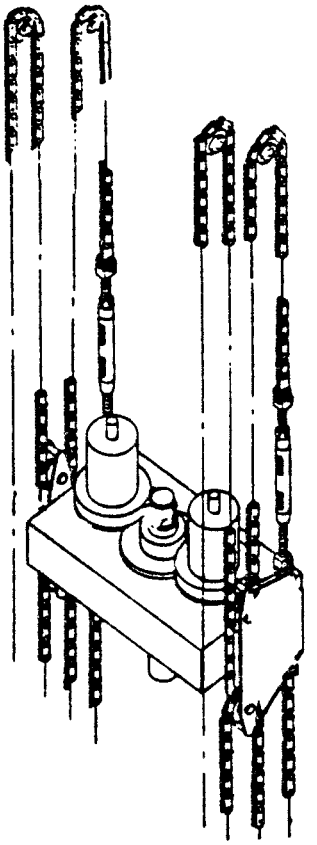
Lower leveling jacks (see Machine Leveling) to the ground to provide greater stability. Level machine USING REAR JACKS ONLY. The front jack(s) should be just touching the ground.

CAUTION: **Do not lift machine with front jack(s) when mast is in the down position.**

Remove the mast control from the storage compartment (in propel control station) and plug cable into outlet on right side of Drilling Control Station.

While standing on walkway, in front of cab or on the ground, SLOWLY move mast Raise/Lower control lever to the full Raise position.

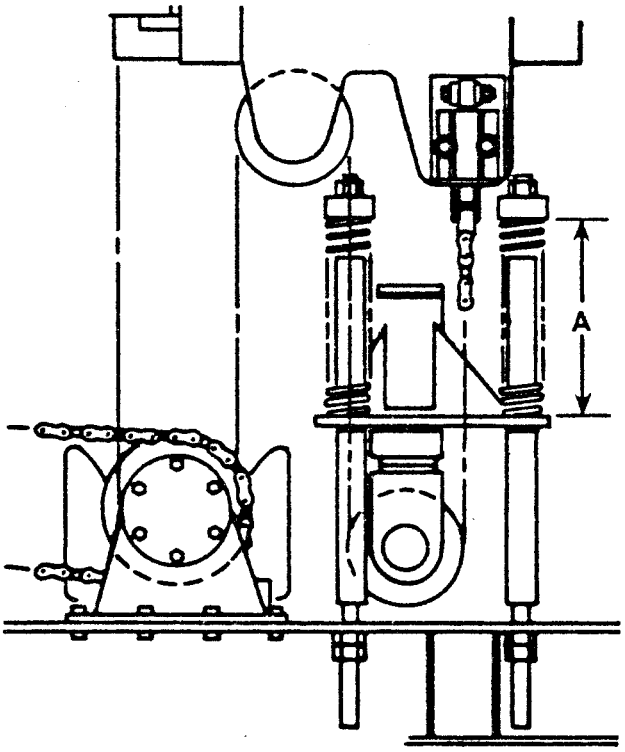
HOIST/PULL DOWN CHAIN(S) is reeved as shown in the sketch. Each chain contains standard (No. 140) 1.75 inch pitch link. The last 30 links on each end is assembled with pins that are held in place with cotter pins. The spring loaded sprocket on top of mast and the spring loaded hydraulic ram sprocket mounted on drill table are intended to absorb the slack in the chain.



The hydraulic ram is extended to take up chain slack when the machine is in the propel/leveling mode.

Chain adjustment is made by turning the turnbuckle at top of rotary gearbox. BEFORE making this adjustment, the machine must be level and mast in the full upright position.

First adjust rods, with cylinder retracted, until springs are compressed to 16 inches at "A" on sketch. Then turn turnbuckles until springs are compressed to 13 inches (at "A").



IMPORTANT: The hydraulic cylinder must be retracted and both chain adjusted to the same tension, so gearbox will remain in level position.

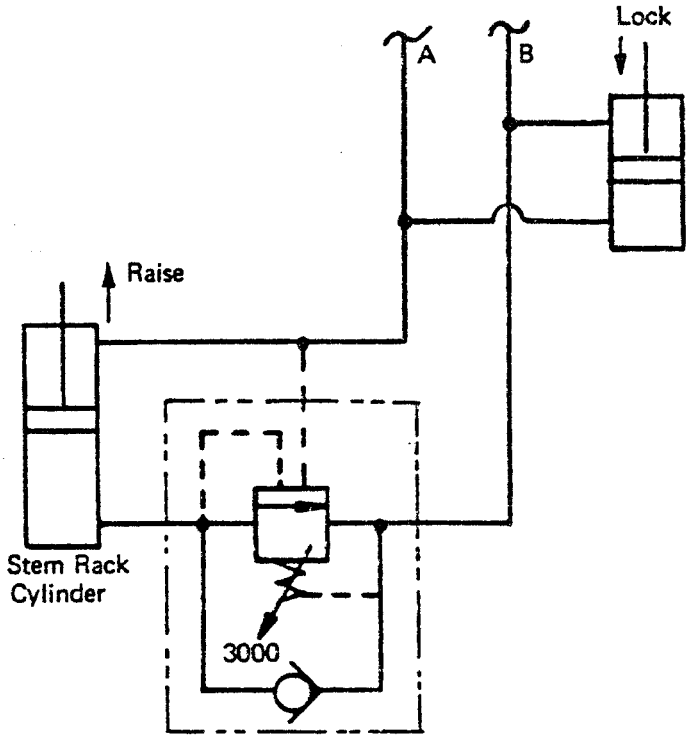
If for any reason a link or links must be removed from one of the chains, ALWAYS remove a corresponding number of links from the other chain. A difference in number of links in each chain can cause gearbox to be out of level. This could damage the stem, guide rollers or mast.

After adjustment is made, run gearbox to top of mast and back down again, recheck adjustment.

Symptom	Probable Cause
Bearings hot and noisy (cont.)	4. Worn out bearings 5. Defective 6. Loose
Dust leakage	1. Holes caused by wear 2. Worn impeller shaft seal 3. Leakage around dust gate or inspection ports
Unusually dusty clean air discharge	1. Worn impeller 2. Plugged dust nozzle or air port 3. Not efficient enough for fineness of dust being handled 4. Dust hopper filled
Excessive or unusual wear	1. Too high dust load 2. Plugged dust ports or return air ports 3. Dust excessively abrasive

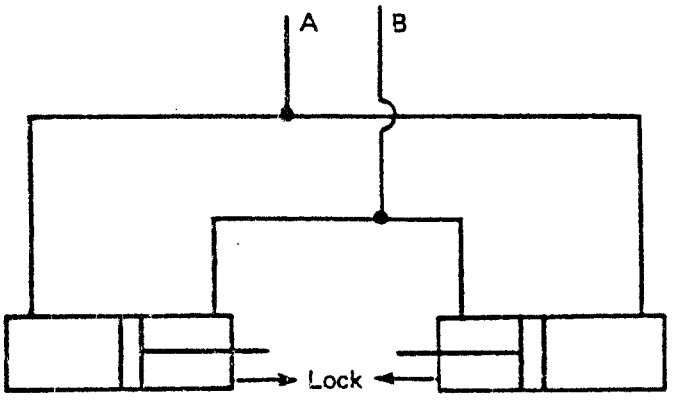
NOTES:

BREAKOUT TONG CIRCUIT consists of a double acting cylinder capable of operating at full system pressure when loosening the stem threaded joints.



STEM RACK CIRCUIT, Typical all Racks – A double acting cylinder actuates each stem rack assembly. A counterbalance valve with check bypass is in the raising line to cylinder. This valve is pressure released at 1000 psi (6895 kPa) from the lowering line or 3000 psi (20685 kPa) from the head end of the cylinder, due to a 3 to 1 pilot ratio. The oil is held in the cylinder (anchor end) until lowering pressure exceeds 1000 psi (6895 kPa), or head end pressure exceeds 3000 psi (20685 kPa). The safety lock cylinder is piped parallel to the actuating cylinder.

STEM LOCK CIRCUIT consists of two, double acting cylinders operating with full system pressure.



MAST RAISING AND LOWERING CYLINDERS – The mast is raised and lowered by two, double acting cylinders connected in parallel. A counterbalance valve in the lowering line holds the oil in cylinder rod end until the 1000 psi (6895 kPa) pilot pressure from the raising line releases the valve. The circuit bypasses the counterbalance valve thru a check valve.

At the base of each cylinder is a sequence valve. These two valves hold the oil in the head end of the cylinder until pilot pressure of 100 psi from the lowering line releases the valve. Adjust BOTH valves the same. The raising circuit bypasses these valve thru a check valve.

8. CHANGE HDF AT THESE TIMES:

   a. When filters frequently clog

   b. When fluid changes color or develops a strange odor

   c. When HDF becomes contaminated either chemically or with particulate matter

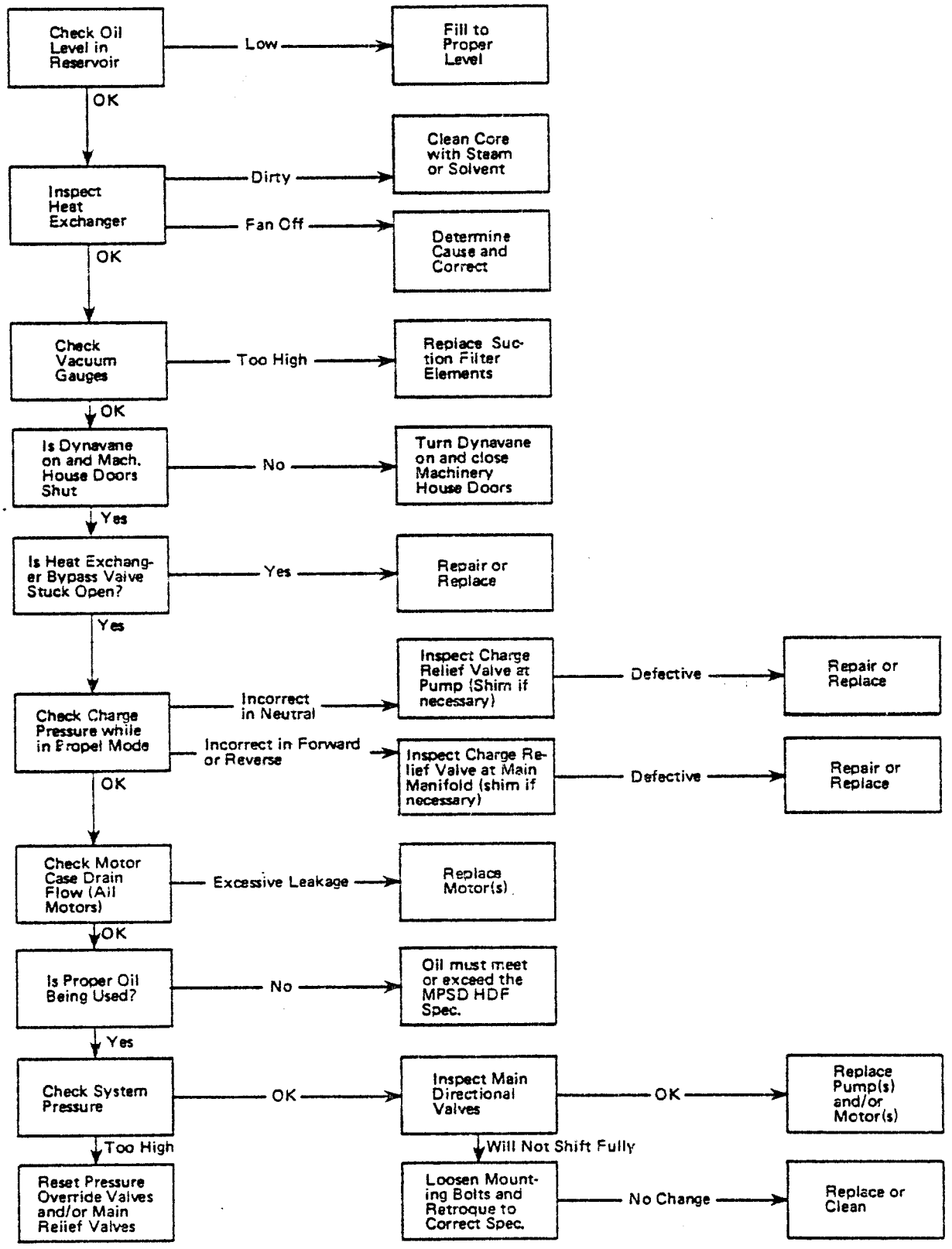
   d. With knowledge of a sizeable water content in system

   e. If wrong HDF is added

   f. If viscosity (ASTM D-445) drops over 10% in service, drain and replace HDF. A minimum viscosity of 90 SUS at HDF operating temperature in loop is essential to hydraulic motor life. (Oil suppliers generally run this test as a service to buyers.)

Normally (it's assumed) enough HDF is added to the system to eliminate concern about HDF oxidation life. However, if HDF goes 12 months without change for one of the above reasons, DRAIN AND REFILL the system. Prior to cold weather is the best time for a HDF change. If Summer and Winter fluids are used, drain and refill the system twice yearly.

MAIN SYSTEM OPERATING HOT



COMPONENT REPAIR AND REPLACEMENT –

Before removing any component, pump motor valve, etc., thoroughly clean part and area to prevent dirt from entering the system.

When removing hydraulic line or hose, cap the hose end and plug component port to prevent fluid loss and introduction of dirt into system.

Remove component from machine and place in clean plastic bag or wrap in lint free cloth. Do not disassemble part at job site, but transport part to a clean, dust free work area.

Properly seal new components, used for replacement, if not sealed when received from vendor. Do not use parts with broken seals.

We recommend maintaining a supply of standby components. Hydraulic pumps (two main and one auxiliary) and two hydraulic motors, as well as major valve assemblies should be available for replacement.

VARIABLE DISPLACEMENT AXIAL PISTON PUMP ASSEMBLIES (Sundstrand Model 23) – These high precision pumps require special fixtures and tools to efficiently repair or rebuild.

Repair and service of these pumps locally should be confined to minor replacement as listed. (NOTE: Be sure the pump is thoroughly cleaned).

MAIN PUMP REPLACEMENT:

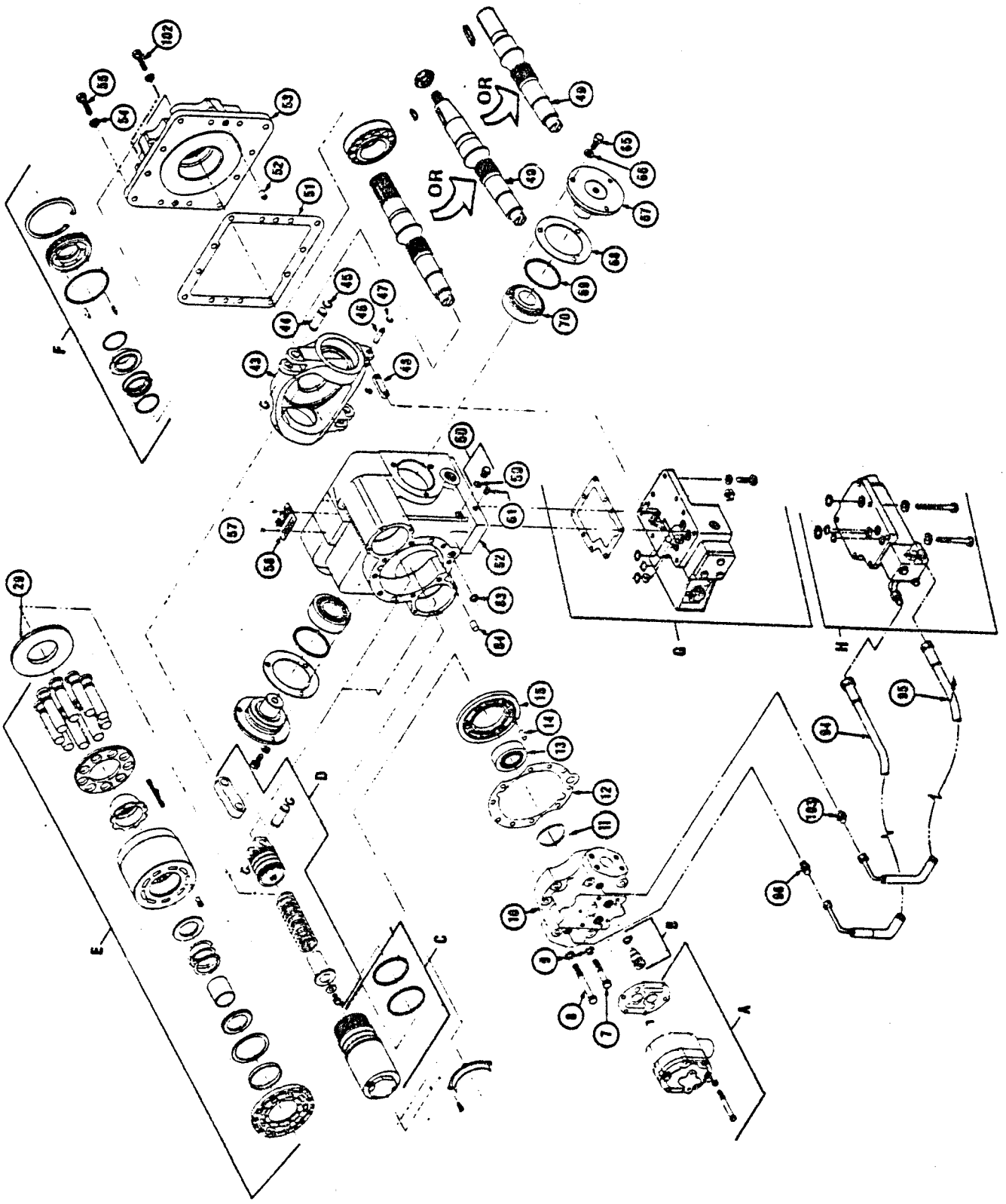
1. Loosen reservoir cap to relieve any tank pressure.

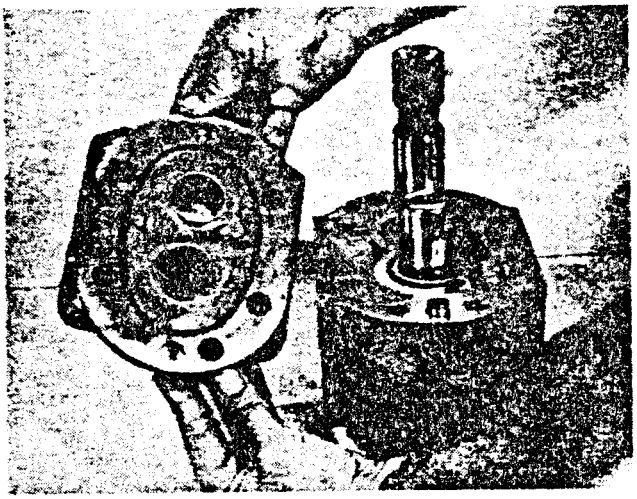
2. Remove hose and pipes. Place clean plugs in pump ports and cap hoses to prevent fluid loss.

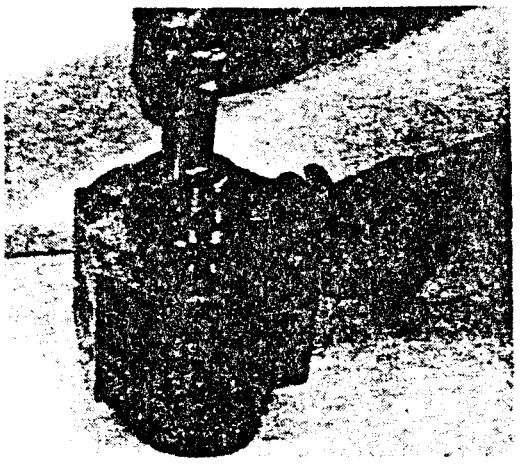
3. Remove the four mounting bolts.

4. Place sling (nylon) around pump or in eyebolt and remove pump from gearbox.

HEAVY DUTY VARIABLE DISPLACEMENT PUMP

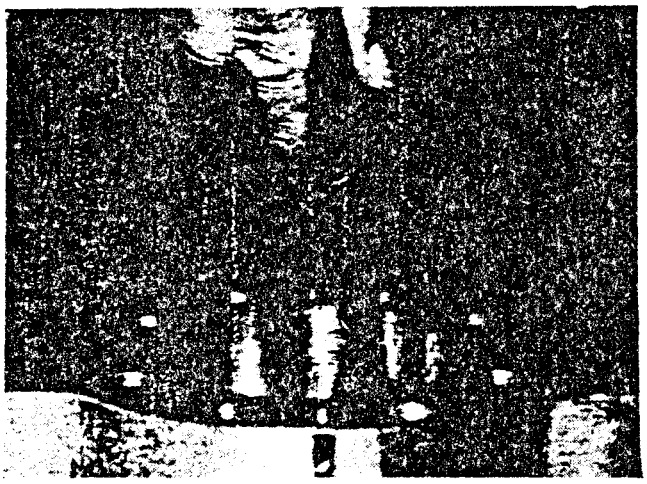


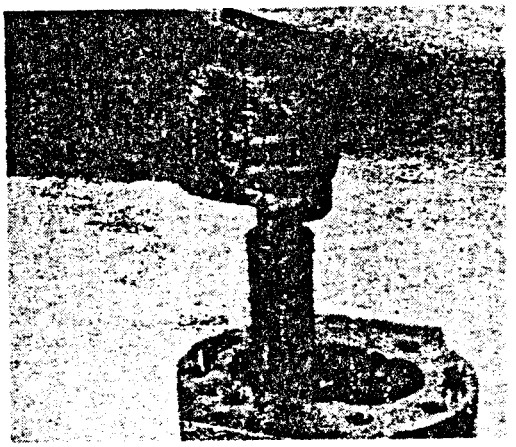




9. Lift the drive gear and idler gear straight up out of pump case.

10. Examine gear bores in pump body. During initial break-in, (at factory), the gears cut into the body. The nominal depth of this cut is .008 inch (.203 mm) and should not exceed .015 inch (.381 mm). As gears cut into body, metal is rolled against edges of the pressure plates. Using a knife or sharp scraper, remove the metal that was rolled against top pressure plate. See Fig. 5. Use the point of scraper, go around the outer





edge of the pressure plate in bottom of body. Use air to blow out any loose chips. this keeps the plate from hanging as it is lifted from the bottom of gear bore. DO NOT attempt to remove the track-in grooves.

Section 5 – Drill Air System (cont.) Page

The discharge temperature gauge monitors the temperature of the air leaving the compressor unit. For both air-cooled and water-cooled compressors the normal reading is approximately 190 degrees F. (87 degrees C.).

The air filter restriction gauge monitors the condition of the air intake filter and shows red when filter service is required. This restriction gauge must be reset manually.

The hourmeter records accumulative hours of operation for the compressor and is useful for planning and logging service operations.

The separator maintenance indicator monitors the condition of the separator element and shows red when element restriction is excessive. This indicator is automatically reset after the element has been changed.

The (bearing) lube filter maintenance indicator monitors the condition of the bearing oil filter element and shows red when the element should be changed. This indicator is also automatically reset.

NOTES:

however, the element should be used no longer than a period of one (1) year without changing.

Prior to cleaning an element, check the element for damage. Damaged elements are to be replaced.

When cleaning an element, never exceed the recommended maximum pressures for water (40 PSI or 276 kPa) or compressed air (30 PSI or 207 kPa).

Do not strike the element against any hard surface to dislodge dust. This will damage the sealing surfaces and possibly rupture the element.

Never "blow" dirt out of the interior of the filter housing. This may introduce dust downstream of the filter. Instead, use a clean damp cloth.

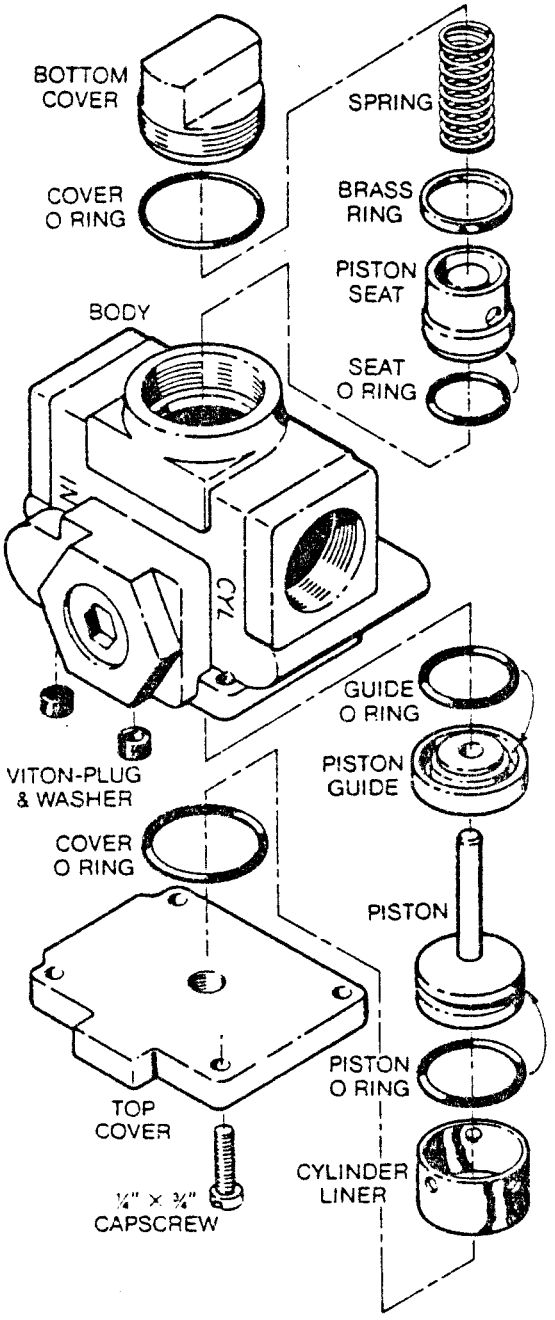
Do not oil the element.

METHOD 1 – CLEANING THE ELEMENT BY WASHING – When washing the element, never use petroleum solutions or solvents. Also, never immerse a dirty element in water or cleaning solution. This will carry dust into the "clean side" (inside surface) of the element. Instead, dust must be removed by reverse flushing the element. Use clean clear water with a garden hose at no more than 40 PSI (276 kPa). Direct the water up and down the pleats in the filter media from the "clean side" of the element until all dust is removed.

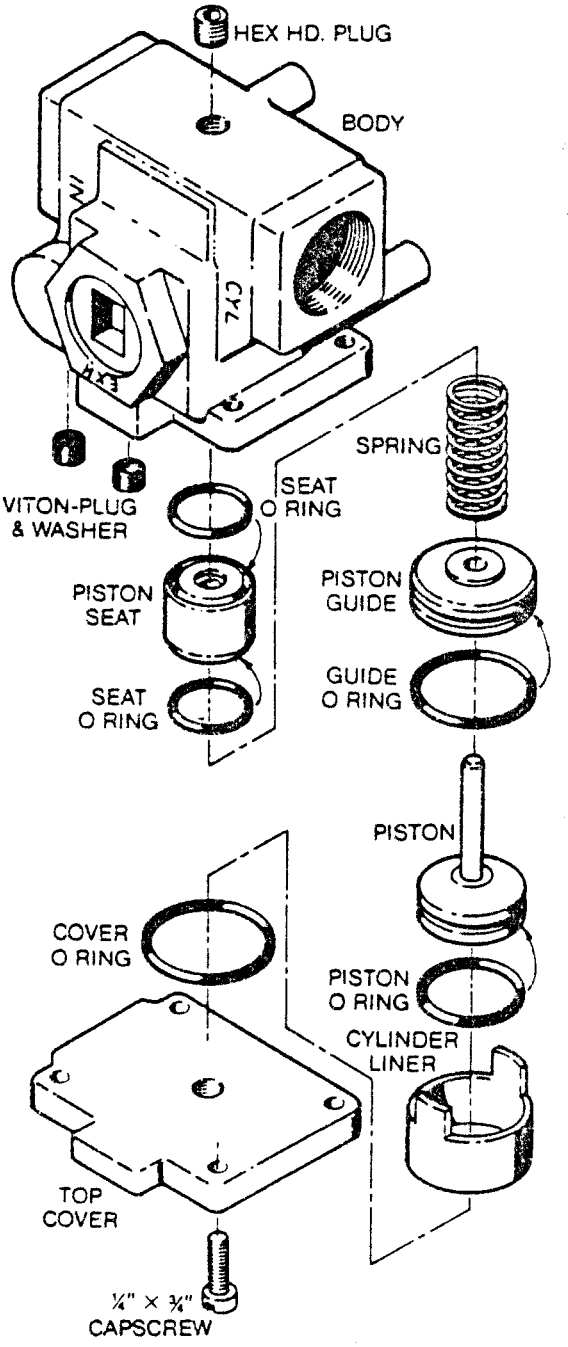
If, after washing as described above, the element is found to be contaminated with oil or greasy dirt, it should then be agitated in a solution of mild household detergent and water. Add 4 tablespoons of detergent to one gallon of lukewarm water and mix well. After a sufficient amount of agitation has been done, rinse thoroughly and carefully shake out excess water. Lay the element on its side and allow to dry before installation. The element should be protected from dirt and/or freezing while drying. Mechanical drying methods can be used; however, heated air must be well-circulated and must not be over 180 degrees F. (82 degrees C.). Do not use a light bulb for drying. Also, compressed air must not be used for drying procedure, always inspect the element for damage prior to installation. (See Element Inspection).

METHOD 2 – CLEANING THE ELEMENT WITH COMPRESSED AIR – When cleaning the element with compressed air, never let the air pressure exceed 30 PSI (208 kPa). Reverse flush the element by directing the compressed air up and down the pleats in the filter media from the 'clean side" of the element. Continue reverse flushing until all dust is removed. Should any oil or greasy dirt remain on the filter surface, the element should then be cleaned by Method 1. When the element is satisfactorily cleaned, inspect thoroughly prior to installation. (See Element Inspection).

SHUTDOWN BLOWDOWN VALVE



RUNNING BLOWDOWN VALVE



SECTION 6

AUXILIARY AIR SYSTEM

INDEX

SECTION 7

LUBRICATION

Application of CORRECT lubricant in the CORRECT amount thru a CORRECT program is required for the successful operation of any machine. Proper lubrication reduces maintenance and increases component life. Absence of proper lubrication wears moving parts quickly and failure results.

LUBRICATION FITTINGS on plain and anti-friction bearings not served by the automatic lubrication system are hydraulic type push on fittings, 1/8" or 1/4" as per MPSD standard. When contamination creates a problem, as in slow speed bearings using labyrinth seals, new grease may be added until clean grease seeps out of the seal. When a bearing runs excessively warm due to overfilling, remove the pressure fitting and allow excess lube to escape. Allow bearing to operate and purge excess lube for 10-15 minutes, then replace fitting.

ANTI-FRICTION BEARINGS, grease lubed, requires the full quantity of lube as specified in the Lubrication Specifications. Ball and roller bearings require only a relatively small amount of lube and relube intervals are generally long with good seals. Accurate predetermination of when to add new grease is impossible. Grease in a bearing generally deteriorates gradually, not suddenly. Thus only a small amount need be added. A small amount of lube applied every 500 operating hours, unless otherwise specified, maintains adequate lubricating properties.

ENCLOSED GEAR CASES must maintain the recommended lubricant level. Check the dipstick or plug at regular intervals. When a seasonal change of lube occurs, pump used oil into a drum for final disposal. Drain all remaining oil from case thru drain plug opening. Flush gear case with fuel oil or light lube oil after draining. Refill with proper lube.

EXTREME TEMPERATURE OPERATION of this machine below -20 degrees F. (-29 degrees C.) or above 110 degrees F. (44 degrees C.) requires special lubrication recommendations. Contact your local supplier or Marion Power Shovel Division at Marion, Ohio 43302. Give full particulars concerning specific conditions of your operation.

NAME OF PART	TYPE	NO. OF POINTS	LOCATION	LUB. SYM.	METHOD AND FREQUENCY
			LUBRICATION OF STEM RACK (cont.)		
Drill Table Lock Ram	—	2	In Top of Ram	MPG	As Required
			LUBRICATION MISCELLANEOUS		
Leveling Jack Housing (4)	Bushing	16	4 on Side of Cylinder	MPG	Automatic
Jack Foot Pad	Plain	4	Pour	GL	Keep Coated
Water Cooling Fan	Bushing	2	In Top of Pillow Block	MPG	300 Hours
Oil Cooling Fan (2)	Anti-Friction	—	In Top of Pillow Block	MPG	500 Hours
Ventilating Fan	Anti-Friction	2	In Top of Bearing	MPG	500 Hours
Push-Pull Control Levers	—	—	(Graphite Powdered Lubricant—Molybdenum Disulfide)		
Air Compressor, Electric Motors, Pumps, etc.	—	—	See Note	ALMO	—
Drilling Air Intake	Oilite	2	In End Bar of Set Collar	—	None Required
Hydraulic Pump Drive Gearbox	—	—	Fill Thru Plug at Side	GL	Check Weekly 1/2 gal.

NOTE: For lubrication instructions of Drill Air Compressor, see Section 5.

SECTION 8

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.

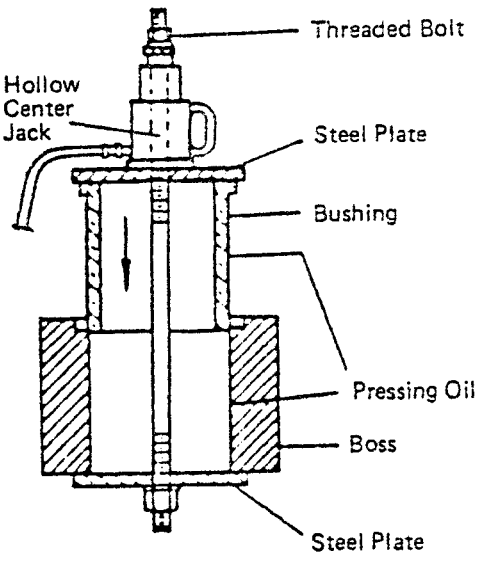
Each FLANGE BUSHING secures thru flange with a minimum of four dowels to restrict bushing rotation. Dowel material is softer than bushing.

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

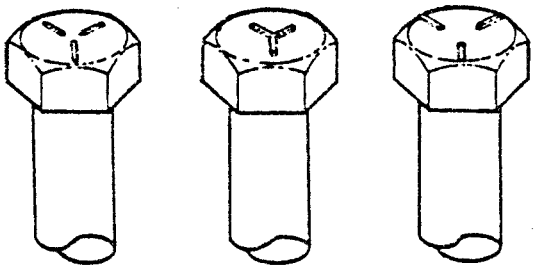
BUSHING REPLACEMENT first requires dismantling machinery and shaft assemblies. An air chisel, cautiously used, slits bushing for easy removal. Be careful not to CUT or SCORE the bearing boss. Clean the boss completely. Remove ALL burrs. Check the outer leading edge of bushing for insertion is de-burred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

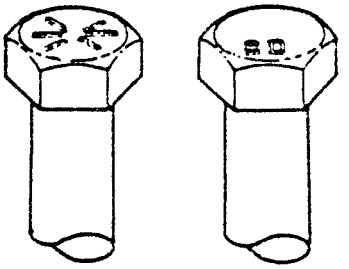
An alternate method installs the bushing using a long threaded rod, steel plates and a hollow center jack. Assemble items as shown in sketch. Lightly coat bushing O.D. and boss I.D. with high quality anti-scoring, extreme pressure, pressing oil. Then PULL the bushing in place.



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



GRADE 5



GRADE 8

Use the SAME GRADE washer and nut as bolt.

TIGHTENING METHOD – For selecting the proper method TORQUE VS. TURN-OF-NUT consider the following criteria:

TURN-OF-NUT METHOD
Small quantities involved
Inconsistent thread conditions and fits
Usually exceeds 2,000 foot pounds (2712 Nm)
Torque measures equipment impractical for assembly

TORQUE METHOD
Large quantities involved
Consistent thread conditions and fits
Usually less than 2,000 foot pounds (2712 Nm)
Torque measuring equipment available at assembly

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

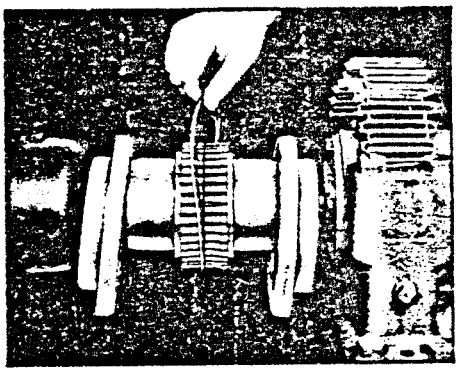
Use crayon, chalk or paint to mark nut at side and clamped surface to indicate the SNUG FIT position. Mark impact drive socket when used.

Hold bolt head with wrench and using a heavy duty impact, hand wrench and heavy hammer (or sensible alternate method); advance nut one-half-turn.

MPSD Symbol	Chemical Description	Electrode Standard	Electrode Alternate	Preheat Degrees F. .75 & Under	.88 - 1.50	1.62 - 2.50	2.50 & Over
CB	1025	E7018		70	70	100	150
CC2A, Q	MN-MO	*4130	E9018	250	300	325	350
CFE, S	4330	*4130	E9018	400	450	475	500
CH**	AUST-MN	E309		70	70	100	150
CK, Q, QS	8630	4130	E9018	450	475	500	550
CL4B	4320	*4130	E9018	400	425	450	475
CL5	4815	E8018C1	E7018	100	150	200	250
CN	NI-V	E8018C1	E7018	200	250	275	300
CO	4322	*4130	E9018	250	275	300	325
"D" Materials Contact Welding Engineering for Procedure							
F	1020	E70XX		70	70	70	70
F1	1020	E7018		70	70	70	70
F2	A36	E7018		70	70	70	100
FB	1055-80	Consult Welding Engineering					
FCHN**	AUST MN	E309		70	70	100	150
FHL		E9018	E8018C1	70	70	100	150
FHU	A543-65	E11018	E9018	300	375	450	500
FK	A572 GR 42-50	E7018		70	70	150	225
FK2	A572-72 GR 50	E8018C1	E7018	70	150	225	300
FR4	ABRA. RESIS.	E11018	E9018	150	200	250	300
FT1	A514-69	E11018	E9018	70	125	175	225
FT2	A514-69	E11018	E9018	70	125	175	225
FT3		E11018	E9018	100	150	200	250
KA, 1, 2	8630	*4130	E9018	300	325	350	400
KB, 1, 2	8625	*4130	E8018C1	300	325	350	400
KC, 1	4340	*4130	E11018	475	500	525	550
KL, 1	43L40	*4130	E11018	475	500	525	550
KM, 1, 2, 3	4140	*4130	E11018	350	400	450	500
KO, 1, 2	4150	Consult Welding Engineering					
KO, 3, 4	4150	Consult Welding Engineering					
KP, 1, 2	4150	Consult Welding Engineering					
KP, 3, 4	4150	Consult Welding Engineering					
P1, P2	A53	E70XX		70	70	70	70
S	1018	E70XX		70	70	70	70
SE, 1, 2, 3	1045	E8018C1	E7018	300	325	350	375
SE, 4, 5, 6	1045	E8018C1	E7018	300	325	350	375
SH, 1, 2, 3	1095	Consult Welding Engineering					
SL, 1	1035	E7018		100	175	225	250
SP	A 311-64 GR(1144)	Consult Welding Engineering					
SS	A108-73 (1117)	E7018		70	100	150	200
ST	1045	E8018C1	E7018	300	325	350	375
SX1, 2	4140	*E4130	E11018	350	400	450	500
TS-1	A519-72 (1015)	E7018		70	70	70	70
TS-2	A333-76 (1026)	E7018		70	70	70	70
TS-4	A519-72	Consult Welding Engineering					

* 4130 to be used when a hardness is required either as welded or flame hardened. Alternate electrode should be used when hardness is not required.

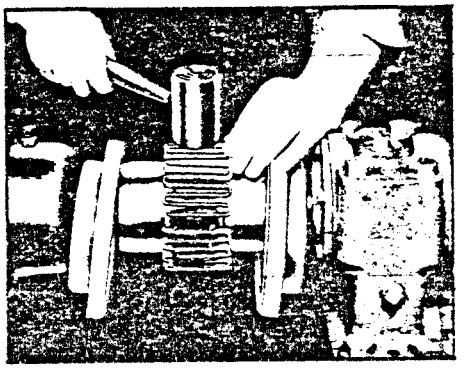
** Do not allow preheat or interpass temperature to go over 400 degrees F.



4 INSERT GASKET AND LUBRICATE

4. Once aligned, carefully insert gasket between hubs and hang it on either hub. DO NOT DAMAGE gasket. Force as much lube as possible into gap and gridmember grooves.

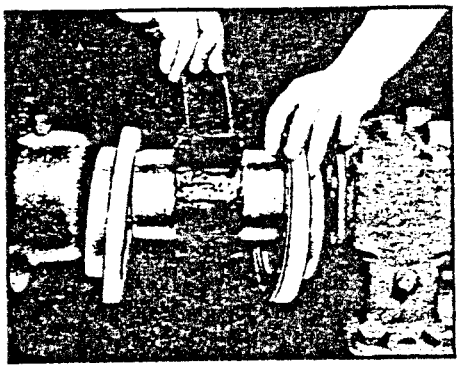
5. Insert gridmember. Coupling sizes 3 thru 11 use a single layer grid, painted aluminum. Size 12 thru 190 use a two layer grid with the inner layer painted aluminum and stamped IN while the outer layer is painted bronze and stamped OUT.



5 INSERT GRID

Installation – Gridmember rungs, truly radial, need spreading slightly to pass over coupling tooth at its O.D. To do this with minimum spreading, start grid at either end and tap rungs only part way into grooves. Once all rungs are partially into respective grooves, tap grid all the way in. When installing a two layer grid, center the outer layer sections over free ends of inner layer.

Removal – A round rod or screwdriver of a size to easily fit into open loop ends of grid is all that's needed. Begin at open end of grid section and insert rod into loop ends. Use next tooth as a pry point and pry grid out radially, in EVEN and gradual stages. Proceed alternately from side to side, lifting grid about halfway out until end of grid is reached. By repeating same steps again, grid clears teeth.



6 PACK WITH LUBRICANT

6. Pack spaces between and around grid with as much lube as possible. Scrape or wipe excess lube off flush with grid. Lightly oil hubs to ease sliding covers onto hubs.

KEYLESS COUPLINGS

ASSEMBLY OF KEYLESS COUPLINGS requires heating coupling uniformly in an oil bath or controlled oven (DO NOT unevenly heat with any torch type) to a temperature of 392 degrees F. or 200 degrees C., and shrinking onto a cylindrical shaft extension with no key or keyway. The amount of interference fit sufficiently gives adequate driving torque with adequate safety factor, using no key.

When reinstalling a removed coupling half, locate it in the original axial and angular position. Generally, axial position is when the hub end is flush with the shaft end. Space the pressure hole in the shaft as far as possible from the pull-off holes. Check the face of a solid coupling and insure it is perpendicular to the shaft. Check the periphery of the coupling and insure it is concentric with the shaft. If necessary, true up these surfaces. Peform these checking and truing operations with shaft accurately aligned in a lathe.

REMOVAL OF KEYLESS COUPLING uses hydraulic pressure applied to the circumference of groove C in shaft extensions S. (See sketch on following page for cutaway of section for removal). When this pressure exceeds initial radial stress, due to interference fit, coupling hub H expands a small amount and allows oil to seep into the fit in both directions from groove C. Although the distance from groove C to coupling face A is less than distance to face B, the end effect at corner maintains hydraulic pressure until entire bore length expands and oil appears at face B.

Upon reaching this condition (3 or 4 minutes after applying pressure) the coupling floats on a high pressure oil film and may be removed with a hand puller and wrench. When coupling face B uncovers groove C, oil pressure is instantly lost. The coupling now pulls harder to shaft end. However, this area is small enough that finishing with same wrench and puller adding a little more force does the job.

Protect the shaft center from damage with a small brass or copper shim under puller driving point.

WARNING: DO NOT USE ORDINARY PIPE FITTINGS. PRESSURES INVOLVED ARE WELL ABOVE RUPTURING STRENGTH OF ORDINARY PIPE AND FITTINGS.

Use threaded holes near shaft for pulling coupling. Distortion of coupling is possible when pulling near the outer rim.

If coupling removal is difficult using this procedure (bores or shaft surfaces abused) the following tips may help.

Although hand stone grinding restores a true cylindrical surface, it does not remove extreme bad spots or Out of Round. A good commutator is within .0005 to .001 Out of Round when checked with a dial indicator. Out of Round is not caused by severe arcing and poor commutation, although it may cause these problems. Often Out of Round is caused by commutator changing shape due to heat and age. In extreme cases, remove the armature and turn or grind in a lathe. See that a qualified person does this work. After grinding, undercut the mica on the commutator. Some large commutators may be ground in the frame by a skilled person using the proper equipment. This avoids time loss in removal. Commutator speed while grinding is important here. This is why operation must be in the hands of an experienced person to prevent commutator damage by grinding at the wrong speed. After grinding, bring unit to rest and remove ALL carbon and copper dust with dry compressed air. Run-in brushes for a short period under very light load. This allows brushes to seat before applying heavier loads.

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

Commutation not corrected by simple remedies should be reported to the electrical equipment manufacturer.

PROPER LUBRICATION of bearings requires following this established procedure for all general conditions. First, we caution against over greasing. Of course, establish a HAPPY MEDIUM. Keep in mind that excess lube accumulates on armatures and windings causing electrical failure. Lubricate all bearings on new equipment according to the following chart for the first day of service. After that, every 250 hours of actual running. Lubricate until a small amount appears at the shaft or starts out bottom drain hole (plug removed) of housing. After first day of service, lube with equipment at operating temperatures.

Shaft Diameter in inches	Amount of Lube in ounces
1	1/2
2	2
2-1/2	3
3	4-1/2
3-1/2	6
4	8
4-1/2	10
5	12-1/2
5-1/2	15-1/2
6	18

Refer to GENERAL ELECTRIC Instruction Manual for Detailed Electrical Information

DAILY ELECTRICAL INSPECTION

1. Check following bearings:
   Rotary motor bearings
   Hydraulic drive motor bearings
   Oil pump bearings
   Fan blower bearings

2. Are all contactors operating properly?

3. Are all lights operating properly?

4. Are all motors commutating properly?

5. Is the air conditioner operating properly?

6. Is the air filtering system operating O.K.?

7. Visually examine operator controls:
   Are the main controllers working O.K.?

8. Are the auxiliary controls working O.K.?

9. Is all electrical equipment clean and dry?