T16

D-750

PLUNGER PUMP

MAINTENANCE MANUAL

OMEGA PUMP

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1. INTRODUCTION

Wheatley/Omega pumps are designed for high horsepower displacement of many types of fluids and have a proven track record in many applications.

These pumps are horizontal single acting triplexes with an 8" stroke. Plunger pumps are available in plunger diameters from 4" to 7-1/2".

The weight of the pump will vary considerable due to the gear ratio model and accessories but will not exceed 12,500 pounds.

Information on obtaining parts and service on this pump is given in section 1.1, and shipping and storage procedures are given in section 1.2.

The remaining portion of this manual is organized as follows:

Section 2 provides design data and basic specifications on the triplex pump.

Section 3 describes the components of the lubrication system.

Section 4 explains the procedure for installing the pump on mobile or skid-mounted units and the inspection and run-in procedure for the break-in period of the pump.

Section 5 lists the steps involved in the periodic routine maintenance of the triplex pump and the procedures for removing specific components of both the fluid end and the power end of the pump.

Section 6 lists the problems that can be encountered during the operation of the pump, their probable source, and remedies.

Supplemental material is provided in the appendices: optional bill of materials in appendix A, detailed installation drawings in appendix B, assembly drawings in appendix C, and pumping-related formulas in appendix D.

1.1 PARTS AND SERVICE

Wheatley/Omega maintains a large inventory of replacement parts at all times to ensure prompt service of its product line. To ensure prompt delivery you must include the following information when you place an order:

1. Part number and description (see the assembly drawing in appendix C.)

2. Quantity of each part required.

3. Fluid end or power end model number and serial number (see the identification tags on the pump).

4. Your purchase order or requisition number.

5. Designation of the shipping method you prefer. If overseas shipment is involved, designate the name of the export and crating company you prefer.

Parts and service orders may be placed through:

Wheatley/Omega
P. O. Box 3249
Tulsa, Oklahoma 74101

Telephone: (918) 587-6731

TELEX: 49-2482

Wheatley/Omega has qualified service personnel and service facilities for maintenance and repairs on its triplex pumps, should they be required. The service facility is located in Tulsa, Oklahoma.

1.2 SHIPPING AND STORAGE

All pumps are shipped dry and must be flushed and filled with the proper lubricant before operating. All pumps should be flushed with diesel or some other light oil regardless of how they were shipped or what type of container was used for shipping them. When pumps are shipped via ocean cargo, they should be crated in water-tight containers and shipped below deck to prevent excess rust and sea water contamination.

Pumps are not prepared for dry storage and should be put in service as soon as possible. To prepare a pump for storage after prior use, you should clean the fluid end and flush it with some type of rust preventative. Plug all discharge and suction openings at the fluid end. Drain oil from the power end, and clean and flush with some type of rust preventative that will not clog the oil passages. Remove the crankcase breather, and tape or plug all openings. Coat the pinion extensions and pony rods with a heavy rust preventative and store the pump inside a warm, dry place.

2. PUMP DESIGN

Wheatley/Omega triplex pumps are extremely compact and occupy a minimum of location space, yet provide the high volume and pressure capability that are required in modern day applications. The inherent qualities of these single acting pumps, together with the uniform discharge flow characteristics, permit easy and efficient paralleling for multiple pump operation and offer additional advantages in high pressure and high volume applications.

The power end and fluid end are two separable independent units joined by 12 alloy steel stay rods which remain in the power end when the fluid end is removed. The plunger is also separable from the pony rod so that the inside of the power end is never exposed during fluid end maintenance. A high degree of interchangeability of fluid ends between pump models is also an important design feature embodied in these pumps. This allows for a wide range of pressure and volume applications.

The lubrication of the power end is a forced fed design to ensure proper supply of oil to rod bearings, main bearings, gears, etc. Since the pump is designed for use with a variety of drive arrangements, the lube pump is not a standard option and needs to be mounted externally to best suit the particular drive arrangements used. It is recommended that in order to select the proper pump size and its subsequent installation, the lubrication section of this manual must be carefully read.

TABLE 2-1. PUMP DESIGN DATA

(a) POWER ENDS

COMPONENT	PARAMETERS
Power End Case	Fabricated steel, stress relieved, line-bored
	Light gauge steel covers with neoprene gaskets
	Aluminum or steel seal retainers
	Bronze crosshead guide sleeves
	Four heavy-duty roller bearings at the main journals
	1 inch pipe lubrication inlet
	4 inch pipe oil drain-back outlet
	1/2 inch pipe braided metallic oil hoses to each crankshaft lubrication inlet
	1/4 inch pipe braided metallic oil hoses to the main bearings, crossheads, and pinion gears
Crankshaft	One-piece, forged alloy steel
	Heat-treated and ground
	Nitrided on high horsepower applications
	Drilled for lubrication to rod journals through each end
	Diameters:
	* At main journals. 16.000
	* At rod journals 7.250
	* At gear fit, with 1-1/4 inch standard keyway. 7.00
Bull Gears	Helical gears at each side of the pump to counteract thrust, and equalize torque to both ends of crankshaft
	Machined from alloy steel, heat-treated, and crown-shaved
	Nitrided on high horsepower applications

TABLE 2-1. PUMP DESIGN DATA - cont

(a) POWER ENDS

COMPONENT	PARAMETERS
Bull Gears (cont.)	Uses bronze thrust ring to take minimal end thrust
	Attached to crankshaft with 1-1/4 inch keyway and four 1-1/4 inch capscrews
Pinion Gears	Machined from alloy steel, heat-treated, and crown-sheaved on 4.95:1 ratio model
	Attached to 4.95:1 pinion shaft by two 3/4 inch by 3/4 inch keys and locknut on each side of the pinion
	Integrally machined on alloy pinion shaft on other gear ratio models
Pinion Shaft	Supported by two heavy-duty double spherical roller bearings
	Available with single drive double extension on 4.95:1 ratio model
	All shafts machined from alloy steel
	Pinion gear teeth integrally machined on shaft on other gear ratio models
Pinion Bearing Housing	Precision-machined from steel
	Attached to the power end case with 3/4 inch capscrews
Crosshead	Ductile iron, fully cylindrical design with top oil groove
	Bronze backed babbitt lined thrust seat to accept rod load instead of wrist pin taking it
	Drilled and tapped through front side for wrist pin dogpoint locking set screw and lockscrew
	Outside diameter of 9.860 by 11-7/8 inch

TABLE 2-1. PUMP DESIGN DATA - cont

(a) POWER END (cont.)

COMPONENT	PARAMETERS
Connecting Rod	Tubular steel with precision-machined head to accept rod load insteal of wrist pin
	Attaches to rod bearing housing with six 3/4 inch alloy studs and self-locking nuts
Connecting Rod Bearing Housing	Jig-machined from cast steel
	Cap attached to base with four 1-inch studs and self locking nuts. Aligned with two 5/16-inch dowel pins
Rod Bearing	Bronze-backed and Babbitt lined split halves with a micro-overlay of tin flashplate all over for improved wear
	Uses 3/16-inch thick integrally machined bronze shim to prevent bearing spin, not for fit
	Inside diameter of 7.262 inches, a wall thickness of 3/8-inch, and a length of 7.906 inches
Wrist Pin	Serves to return crosshead only; accepts none of the rod load
	Slip-fit in crosshead with dogpoint set screw and locking set screw
Wrist Pin Bushing	Machined from bronze
	Press-fit in connecting rod
Pony Rod	Clamp type. Threaded type is optional
	Cast steel with hard overlay seal surface
	Attaches to crosshead with six 3/4-inch capscrews
Stay Rod	Machined from heat-treated alloy steel
	Precision-machined shoulder lengths for correct alignment
	1-3/4 inch 8-thread at both end

TABLE 2-1. PUMP DESIGN - cont

(b) FLUID ENDS

COMPONENT	PARAMETERS
Plunger Fluid End	Machined from heat-treated and sonic-tested alloy steel forging
	Plungers available in size range of 4 to 7-1/4 inches
	Mild steel plungers with hard overlay surface and clamp connection. Threaded connection is optional
	Available with chevron, or nonadjustable packing
	Uses a discharge flange at each end with a variety of thread or flanged connections
	Uses wing-guided valves with tapered seats
	Uses 6-inch sch. -40 suction manifold open at each end with a variety of connections, or special manifolds as required.

3. LUBRICATION SYSTEM

The triplex pump must be lubricated by an extreme pressure (EP) gear oil at a flow rate of 30 to 35 gallons per minute to the power end's lubrication inlet. See table 3-1 for specific grades, and table 3-2 for specifications. Because of the various applications and drive arrangements, the lubrication pump and other lubrication system components are not built into the power end and must be equipped separately for each application. The selection and mounting arrangement of all lubrication system components become critical with the use of a heavy gear oil. All the hydraulic components required, such as filters and strainers, are designed and rated for use with light hydraulic oils. Obviously, even the resistance to flow of a heavy gear oil through strainers and hoses is much greater than with a light hydraulic oil. The higher resistance to flow must be compensated for in all the components.

The components of the lubrication system are the lubrication pump, suction piping, the oil reservoir, the filter assembly, pressure line piping, the relief valve, gauges and warning devices, the oil cooler, the heat exchanger and sump heater, and plunger lubrication. These components are discussed in the following paragraphs.

3.1 LUBRICATION PUMP

Because of its positive displacement design and its reliability in contaminated systems, a gear pump should always be used as lubrication pump. To select the proper gear pump, you must first know the mounting and drive arrangement.

On triplex pumps with an engine and transmission or torque converter drive, the lubrication pump should be driven from one of the accessory drive locations provided on that equipment so that the lubrication pump always runs at a speed proportional to engine speed. This action provides the most lubrication when it is needed, even at high-pressure low-speed operation of the triplex pump. The lubrication pump must be mounted as low as possible, preferably at the lowest transmission PTO (power take-off), so that the lubrication pump suction does not have to lift the heavy gear oil any higher than is absolutely necessary. The lubrication pump should be set up with a positive drive so that any possibility of belt slippage is eliminated. A flange mount pump with a splined shaft or a foot mount pump with a small drive line can be used. To set up the lubrication pump the engine's speed and PTO ratio must be known. A gear pump that will deliver a minimum of 30 gallons per minute must be selected with the PTO ratio in mind so that actual pump RPM is known.

On triplex pumps that are not driven through a transmission or a torque converter and that will operate at about the same speed all the time (such as in a drilling service), the lubrication pump may be driven from the triplex pinion shaft. With this arrangement, you must know the speed at which the triplex will be operated. For example, if the 4.95:1 ratio power end is used and the triplex is to operate at 100 stroke per minute (SPM), a slow-speed foot mount gear pump that will deliver 30 gallons per minute at approximately 500 rpm should be selected. The slow-speed pump allows a 1:1 sheave ratio and provides maximum belt contact around both sheaves. Even with this arrangements, double V-belts are highly recommended to protect against a slipping or broken belt. Because some of the slow-speed gear pumps are offered with a built-in relief valve, the relief valve should have a spring pressure rating of no less than 125 pounds per square inch (PSI) if used. If one of the more common high-speed foot mount gear pumps is used and if the 4.95:1 ratio power end is to be operated at 100 SPM, then a 3.5:1 sheave ratio will be needed to drive the lubrication pump at 1750 rpm while the pinion is turning at 500 rpm. With this arrangements, the lubrication pump must be located far enough away from the pinion to allow for good belt contact around the small sheave. Whether the slow-speed or the high-speed pump is used, the pump should have the optional outboard bearings always offered so that the belt side load on the pump shaft will not damage the pump. The pump should also be mounted as low as possible so that its suction does not have to lift the heavy gear oil any higher than is absolutely necessary.

If the equipment is stationary mounted such as industrial or pipeline service, an electric motor driven lube pump can be used. These should be direct coupled and sized to provide 30-35 GPM.

3.2 LUBRICATION PUMP SUCTION PIPING

Proper sizing of lube pump suction piping is very important. Several guidelines are presented here to assure good suction characteristics of the lube system.

1. The flow velocity of the oil through the suction piping should not exceed 3 feet per second except, if necessary, for a short distance of no more than a few inches. Therefore, to obtain a flow rate of 30 gallons per minutes to the lubrication pump's inlet, you must use a pipe or a hose with an inside diameter no smaller than 2 inches. Thus, the largest porting available on the gear pump is needed so that the hose does not have to be reduced down with a bell reducer any more than is absolutely necessary at the inlet.

2. If a suction strainer is used it should be oversized to minimize the pressure drop through the screen. A factor of three is recommended for the strainers capacity to the actual flow. Large mesh screens (30 mesh) should be used with 3 to 5 PSI bypass valves to allow flow when the screen is plugged.

3. Since every additional foot of suction piping adds to the oil flow resistance you should keep the suction piping as short and free of bends as possible. IF the suction piping or hose has to be longer than 10 feet, hose or pipe with an inside diameter of 3 inches is highly recommended. Where hose is to be used, a suction hose with wire reinforcement will be needed to prevent it from collapsing.

3.3 OIL RESERVOIR

A well-designed oil reservoir or sump tank has these purposes:

It serves a place to store the oil.

It gives foreign particles, such as dirt and cuttings, a place to settle out of the oil.

It allows the oil to cool down more effectively.

It allows small air bubbles to purge themselves from the oil.

It compensates for the slow gravity return of the heavy gear oil to the tank without allowing the suction intake to become exposed.

The reservoir should have a capacity of 40 gallons and an additional airspace of 10% above. It should be built as deeply as possible to reduce the possibility of exposing suction intake. The reservoir should have a large weather-proof breather/filler cap with a built-in strainer and a sight glass or dipstick that are easily accessible. If the suction strainer is to be mounted in the tank, it should be mounted as low as possible and easily removable for periodic cleaning. A suction line fitting no smaller than 3 inches and a return fitting no smaller than 4 inches should be installed. The tank should also have a drain fitting no smaller than 1 inch and a clean-out opening that are easily accessible. If possible, a baffle that will force the oil to flow around the outside walls of the tank in order to reach the suction inlet should be installed. The baffle allows more time for particles to settle and air bubbles to be purged, and at the same time allows more oil to come in contact with the cool outer walls.

In some cases, a sump heater may be required to keep the oil warm. If the sump heater is required, a fitting of the right size and in the appropriate location should be installed. A fitting for a removable magnet can also be installed.

3.4 FILTER ASSEMBLY

Selecting the right filter for the pressure side of the lubrication system requires special consideration, because of the heavy gear oil. An ineffective filter allows scoring of the crankshaft and rod bearings and obviously shortens the life of the triplex. A multi-element filter rated at 90 gallons per minute and a working pressure of 150 PSI and having a 20-PSI built-in relief valve is recommended. Filter elements with a rating of 25 to 40 microns are preferred; however, a 25-micron element is the smallest that should be used.

3.5 PRESSURE LINE PIPING

Because of the positive displacement design of the gear pump and an allowable flow velocity of 15 feet per second, the pressure line pipe or hose carrying the oil to the triplex pump may be 1 inch on short to medium distance runs or 1-1/4 inches on runs of 15 feet or more. Either sch. 40 pipe or single-wire braided hose will be adequate.

3.6 RELIEF VALVE

A relief valve is necessary in the lubrication system primarily to protect the filter assembly. The relief valve may be intergal to the lube pump or mounted in the line. In the case of a valve intergral to the pump it should be set no lower than 125 PSI. A valve in the line should be mounted on the end of the lubrication manifold opposite the oil inlet and may be set at 90 to 100 PSI. This assures maximum flow of oil to the lube manifold. With 30-35 GPM flow at running temperatures above 100° F the relief valve will not be open.

3.7 GAUGES AND WARNING DEVICES

The triplex should have a liquid-filled oil-pressure gauge with a pressure range of 0 to 150 PSI installed at the end of the lubrication manifold. Any other sensors for a warning device or remote gauge should also be installed at the triplex lubrication manifold outlet so that the true pressure in the triplex is sensed.

The use of the vacuum gauge at the lubrication pump inlet is the only reliable way of determining when it is safe to operate the pump in cold weather. For this reason, the liquid filled vacuum gauge should be installed directly at the lubrication pump inlet. The vacuum of the gauge should range from 0 to 30 inches of mercury. In cold weather, the gear oil's viscosity will become so high that even though the pressure gauge may show sufficient pressure, the bypass will most likely dump much of the oil into the reservoir. A vacuum gauge will detect the point at which the oil begins to thin and flow better. The triplex can safely begin operating when the vacuum falls within the range of 8 to 20 inches of mercury at normal lube pump speed.

A temperature gauge is also helpful. It should preferably be installed to detect the oil temperatures as close to the oil sump as possible.

The use of a warning device to monitor at least the oil pressure and the temperature is highly recommended. Because the pump operates at a maximum load of 85,000 pounds (continuous rating) on each rod bearing, an early warning of lubrication system problems is essential for successful operation. If used, the warning device should be set to operate according to the following operating limits:

1. Minimum oil pressure of 30 PSI

2. Maximum oil temperature of 200° F (80° C)

3.8 OIL COOLER

Depending on operating conditions, the use of an oil cooler may be required in many warm-weather areas for successful continuous or intermittent operation of the triplex. Direct oil to air heat exchange allows lower oil temperature to be maintained. Although the maximum allowable oil temperature has been set at 200° F, a much more favorable oil viscosity and resulting oil pressure are experienced with an oil temperature that does not exceed 150° F. Operating conditions and cooler results will vary considerable, but the following guidelines for cooler selection and installation are recommended:

Heat transfer capacity should be no less than 5% of applied horsepower.

Flow capacity should be no less than 40 gallons per minute.

Working pressure should be no less than 200 PSI.

Inlet and outlet fittings should be no smaller than 1 inch NPT or #16 JIC.

The cooler should be plumbed into the lubrication system downstream from the oil filter so that the warmer, thinner oil will flow through the filter better.

The cooler should be mounted upwind of the radiator if it is used with a radiator and a fan already present.

If the cooler is used in an area that occasionally has cold weather, the plumbing should be installed with a ball valve and a 100 PSI relief valve to route the oil around the cooler during cold weather.

Oil to air cooler may not take full flow and a bypass may have to be installed between inlet and outlet lines of cooler.

3.9 HEAT EXCHANGER AND SUMP HEATER

An oil to water heat exchanger and preferably a sump heater will be required for triplex pumps operating in frequent cold-weather areas and exposed to the cold. The only other means of thinning the oil sufficiently is from heat generated by friction in the pump which may damage the bearings before sufficient oil flow is obtained. Operating conditions and the resulting time it takes to heat the oil before the triplex can be engaged will vary, but the following recommendations for selection and installation should be used:

The heat exchanger should be a single-pass type and should have a thermal rating as stated in paragraph 3.8. When used, the heat exchanger must be plumbed into the lubrication system with a 100 PSI relief valve to protect the exchanger tubes from bursting when the oil is cold and viscous. For best results, the flow of the engine water through the exchanger should be plumbed into the lubrication system upstream from the filter so that the heated oil will begin to flow through the filter elements sooner.

Sump heaters, when used, should have a switch or a thermostat to prevent overheating of the oil. Two basic types of sump heaters are available: The circulating type of heater (approximately 10 watts per square inch) can be used only while the oil is circulating; and the non-circulating type (approximately 4 watts per square inch) may be left on overnight as long as it has a thermostat to prevent overheating. The use of a sump heater is especially beneficial for preventing damage to the lubrication pump from cavitation on a cold start-up.

3.10 PLUNGER LUBRICATION

Fluid ends equipped with plungers must be equipped with either an air or a mechanically operated plunger lubrication device. Oil or grease should be pumped through a check valve into the 1/4 inch port above each plunger at the rate of about 1 pint per plunger per hour while operating.

TABLE 3-1. RECOMMENDED LUBRICATION OILS*

OIL COMPANY	BRAND NAME OF OIL
Oils Recommended For General Service	
Shell	Spirax HD 90
Texaco	Meropa 220
Exxon	Spartan EP 220
Gulf	EP Lubricant S-100 Transgear EP 90
Mobil	Mobilube HD 90
Atlantic-Richfield	Pennant NL S-1000 Arco HD Gear Oil 90
Cities Service	Citgo EP Compound 90 Extra Duty Circulating Oil, Grade 85
Amoco	Amoco MP Gear Lube #90
Sun Oil Company	Sunep 1070
Standard Oil (Chevron)	NL Gear Compound 220
Pennzoil	Maxol EP Gear Oil #3
Oils Recommended for Extreme Warm-Weather Service	
Shell	Spirax HD 140
Texaco	Meropa 460
Exxon	Spartan EP 460
Mobil	Mobilube HD 140 Mobilube SHC 634*
Chevron	NL Gear Compound 460
Amoco	Amoco EP Grand 5

TABLE 3.1 RECOMMENDED LUBRICATION OILS* - cont

OIL COMPANY	BRAND NAME OF OIL
Oils Recommended For Extreme Cold-Weather Service	
Shell	Spirax HD 80
Texaco	Multigear EP 80W
Exxon	Gear Oil GX 80
Mobil	Mobilube SHC 626*
Standard Oil (Chevron)	Universal Gear Lubricant 80W 90
Conoco	ND 600 Gear Oil

*These are sythesized hydrocarbon lubes and are relatively expensive. They do provide excellent lubrication under adverse conditions.

TABLE 3-2. SPECIFICATIONS FOR RECOMMENDED LUBRICATION OILS

Ambient temp., °F	Safe Operating temp. °F	U.S. Military Specification	Timken Rating, lb	Pour Point, °F	Viscosity, SSU's at 210° F	Type of Service
0 to 95	Not to exceed 175	MIL-L-2105B	No lower than 45	No higher than 0	No lower than 85	GENERAL
100 or more	Not to exceed 200	MIL-L-2105B than 45	No lower than 10	No higher	No lower than 140	WARM-WEATHE
Below 9 for extended periods	No to exceed 130	MIL-L-2105B	No lower than 45	No higher than 25	No lower than 55	COLD-WEATHE

TABLE 3-3. LUBRICATION SYSTEM OPERATING CONDITIONS

Minimum oil pressure at operating temperature:	
in psi	25
in bars	1.7
Minimum oil pressure on cold start-up:	
in psi	100
in bars	7
Maximum lubrication temperature with 90-weight oil only:	
degrees Fahrenheit	175
degrees Centigrade	80
Maximum lubricating oil vacuum at the lubrication pump inlet at full operating speed:	
in inches of mercury	10
in psi	5
Minimum lubrication oil viscosity at operating temperature:*	
in SSU's	150
in CST's	32
Additional vacuum created by height of lubrication pump suction inlet above oil level in reservoir:	
in psi	0.4
in inches of mercury	0.8

*Based on minimum standard for gear and bearing protection.

TABLE 3-4. LOSS AT LUBRICATION PUMP SUCTION FROM ALTITUDES HIGHER THAN SEA LEVEL*

Altitude, Ft.	Loss At the Pump Suction	
	Hg, Inc.	Pressure, PSI
1000	1	0.5
2000	2.2	1.1
4000	4.2	2.1
6000	6.0	3.0
8000	7.8	3.9
10,000	9.5	4.8

*This loss will not show up as a higher reading on the vacuum gauge, but the pump will begin to cavitate or starve for oil much sooner than the 10 inches of mercury that is the maximum allowable at sea level.

4. PUMP INSTALLATION

The following recommendation serve as general guidelines for installing a new pump on mobile or skid-mounted units. Refer to the installation drawings in appendix for further detail.

All information in Section 3, Lubrication System, should be read and adhered to closely. All of the lubrication information given is vital to the life of this pump as used on an otherwise well-designed pumping unit.

4.1 GUIDELINES ON PUMP INSTALLATION

To insure proper performance of this pump, it should be mounted on a flat, level surface with all four mounting brackets secured thoroughly. Mounting brackets are not generally furnished with the pump due to different mounting arrangements and should be welded to the power end case at each corner. Alignment bars welded to the mounting skid against the sides of the mounting brackets help to hold the pump against lateral movement and to realign the pump when it is removed from its mounting skid. It is also recommended that there should be some type of jack screw device installed between the pump skid and the fluid end. Such a device will help prolong the life of the stay rods connecting the power end and fluid end.

The pump drive system should run true with the pump's drive extension and should not be binding to it in any way. The power input to the pinion shaft can be by means of a driveline or a nonrigid coupling. Where a coupling is used, it should be aligned very closely and should allow enough room for a minimum of 1/8" end float of the pinion shaft. Those pumps utilizing a chain or belt drive will require the use of a separate jack-shaft assembly coupled to the pump's pinion shaft since the pinion shaft will not tolerate high side load. If torque converters are to be used, the pump drive should be equipped with some type of break to prevent creeping.

An adequate charge pump is required to pre-charge the fluid end to prevent cavitation or air-knocking. The size of the pump depends on the volume to be pumped with the triplex and should allow for a minimum of 20 PSI pre-charge when the pump is operating at maximum volume. Some type of suction dampener should be provided to reduce shock loads and cavitation. An adequate suction screen should also be provided in applications where the pumps will be subject to picking up rocks or gravel through the suction.

A safety shutdown switch is recommended for installation between pump's lube system and drive system. It should be set to kick the pump drive out when oil pressure drops below the minimum recommended value. An oil pressure and temperature gauge are also recommended.

4.2 INSPECTION AND RUN-IN PROCEDURE

The following inspection and run-in procedures have been established as general guidelines for maintenance personnel during the critical break-in process in the first several hours of pump operation. The first few hours of the run-in on pressure testing are extremely critical and the wearing in process may continue for 80-100 hours. It is necessary, therefore, to monitor the break-in maintenance very carefully and is the responsibility of the user. Nearly all moving parts of the pump go through this process, and particles of bronze, cast iron, and steel are often emitted into the lubrication oil. The contamination of the lubrication system with these particles, especially the filters and suction strainers, may cause serious problems if not attended to frequently during this period.

1. Fill the lubrication oil reservoir and the plunger lubrication reservoir with the correct grade of gear oil according to climate (see Table 3-1). Prime the lubrication pump and others as needed. Check to see that all drain plugs and fittings are tight and not leaking.

2. Remove the inspection covers from the power end so that the oil flow to all parts of the pump can be observed. If possible, with the pump drive disengaged start the lube pump and check to see that all cross-heads, wrist pin bearings, main bearings, rod bearings, pinion bearings, and gear oilers are receiving oil.

3. Run the lube pump at full rate and check for an acceptable vacuum reading of less than 10 inches of mercury at the lubrication pump suction inlet. Providing that the vacuum reading is acceptable, check for an oil pressure reading of at least 100 PSI if the oil is cold. Check the entire lubrication system for leaks. Adjust the relief valve at the triplex lubrication manifold to obtain an oil pressure of 100 to 125 PSI, if necessary. Stop the lube pump, and after a few minutes, check to see whether the oil reservoir needs topping off. Check to ensure that the oil flow from the triplex back to the reservoir is satisfactory. Replace all power end covers with a neoprene seal gasket material.

4. With the charge pump operating, bleed any trapped air from the fluid end. Start the plunger lubrication, and check to see that it is adjusted properly. Run the pump at 80 to 90 SPM and 20 percent of its rated pressure for approximately 1/2 hour (refer to the performance data in Table 4-1). During this time, observe closely the oil pressure, the oil temperature, and the lubrication pump vacuum. If, during this procedure or any of the following, the lubrication pump vacuum starts to rise, the suction strainer should probably be cleaned. As the oil temperature begins to rise and the oil thins, check covers and other areas for any new oil leaks.

5. Run the pump at 80 to 90 SPM for about 1/2 hours at 40, 60, 80 and 100 percent of its rated pressure. Closely observe the oil pressure, the oil temperature, and the lubrication pump vacuum. During this time, the oil pressure will normally not fall below 50 PSI.

6. On each pump equipped with a transmission, run the pump for 1/2 hour in the higher gear ranges, pulling full horsepower in each gear; and closely observe the oil pressure, the oil temperature, and the lubrication pump vacuum.

7. Shut the pump down and let it cool thoroughly before starting normal operations with it. Change all filter elements, and clean the suction strainer. Change the lubrication oil, and clean the reservoir to get rid of the metal particles present in the oil. This action will help prevent the suction strainer from becoming clogged during on-the-job pumping operations.

5. PUMP MAINTENANCE

5.1 PERIODIC ROUTINE MAINTENANCE

The most economical and trouble-free service will be obtained from the triplex pump if routine maintenance is performed on it. It is highly recommended that the customer establish a maintenance program for the pump at the time of purchase. Special emphasis should be placed on lubrication system maintenance. The operator or maintenance personnel should be familiar with the maintenance requirements before the pump is put into service. The following items should serve as a guideline for establishing a maintenance program.

5.1.1 Daily Checks

1. Check the oil level in the oil reservoir.

2. Check the oil pressure; 60 to 100 PSI at operating temperature is normal; 25 PSI is the danger point at which the pump should be shut down.

3. Check the oil temperature: 175° F maximum with a 90-weight oil, 130° F maximum with a 75-weight winter oil, 200° F maximum with a 140-weight summer oil.

4. Check the lubrication pump vacuum. Any reading higher than 10 inches of mercury or 5 PSI indicates that the suction strainer must be cleaned as soon as the pump can be shut down for a short period.

5. During the first 100 hours of operation, the filter elements will require changing because of the many foreign particles present during break-in.

6. Check for any abnormal noise or rough operation that might indicate the need for fluid end maintenance, such as changing valves or seats. Because of the higher pressure usually associated with a triplex pump, worn valves and seats should be changed as soon as possible to prevent washing through into the fluid end seat deck.

7. Check the plunger lubrication device to ensure that it is operating properly.

5.1.2 Monthly Checks

1. Change the filter elements.

2. Change the lubrication oil and clean the reservoir thoroughly after the first 100 hours of break-in operation.

3. Clean the lubrication system's suction strainer unless the vacuum reading during the operation remains below 8 inches of mercury. Some systems may not have suction stainers.

4. Check for any new oil leaks and eliminate any that are found.

5. Check all fluid end expendables, such as valves and seats, for wear and replace them as needed.

6. Check the fluid end mounting screws for proper torque.

7. Check the pony rod seals for leakage and replace if necessary.

5.1.3 Check Every 3 to 4 Months

1. Change the lubrication oil and clean the reservoir thoroughly.

2. Clean the lubrication system suction strainer, if equipped with one.

3. Check to see that all fluid end to power end stay rod nuts are tight. Check for any cracked or broken screws and replace if needed.

4. Check mounting bolts for tightness.

5. Clean or replace the breather cap.

6. Check supplies on hand needed for frequent maintenance, such as lubrication oil, filter elements, O-rings, seals, packing, valves, seats, and maintenance tools.

7. Check all pressure, vacuum and temperature gauges and replace if found defective.

8. Check the lubrication system alarm device by some artificial method to assure that it is still operational.

5.2 REMOVAL OF COMPONENTS

5.2.1 Fluid End

5.2.1.1 To Remove the Fluid End from Power End (Required only for Replacement or Power End Repair).

1. Disconnect suction and discharge lines and any accessories such as stroke counter or pressure gauge.

2. Unclamp plunger from pony rod and shove into fluid end a short distance to protect it.

3. Connect hoist to fluid end and tighten the line till it is snug only. Do not pull the line too tight as the stay rods may be damaged.

4. Remove all twelve (12 1-3/4" stay rod nuts from the fluid end flange with a 2-3/4" hammer wrench.

5. Pull the fluid end straight away from the power end till it is completely off and away from the stay rods before raising or lowering.

6. When the fluid end is replaced, check to be sure that all stay rod nuts are torqued to 2600 ft. lbs. When possible, it is much easier to tighten the stay rod nuts with the power end raised up off the skid. Also, check to be sure the fluid end support jack screws have been readjusted before running the pump.

5.2.1.2 To Remove Plunger and Packing

1. Remove the cylinder head cover retainer nut with the hex wrench provided with the pump. Remove the cover with a threaded cover puller.

2. Using a 3/8" Allen wrench, remove the two cap screws holding the pony rod clamp together.

3. Loosen the packing nut and remove the plunger through the front of the fluid end being careful not to damage the clamp end of the plunger.

4. Remove the packing nut, packing and brass being careful not to damage the brass or packing bore.

5. Before repacking the pump, check the plunger and packing brass for excessive wear or nicks and burrs. Also, clean and grease the packing bore in the fluid end. Check to see that the plunger lube passages are open and that lube is flowing.

6. Install packing and brass in the fluid end with the packing lips facing the front of the fluid end. See the packing diagrams included in this manual for a detailed view of other packing ring sequence. Make certain that the lubrication ring is properly positioned under the lube hole in the fluid end.

7. Install the packing nut and tighten slightly to align the packing, then loosen to permit installation of the plunger. Slide the plunger through the cylinder cover bore and into the packing. It may be necessary to bump the plunger through the packing with a hammer handle or some other soft object. Tighten packing nut.

8. Making certain that the mating surfaces of the pony rod and plunger are clean, install the clamp on them and tighten the clamp.

9. Replace the cylinder head cover, with new O-rings or seals if necessary, and install the suction cover nut. Tighten the cover retainer nut as much as possible with several blows of a sledge hammer on the handle of the hex wrench.

10. Reinstall the plunger oiler line to the packing bore before operating the pump.

5.2.1.4 To Remove Wing Guided Valves and Seats:

1. Remove the discharge cover retainer nut with the hex wrench provided with the pump. Remove the discharge cover with a cover puller. Remove the valve spring and valve.

2. The valve seat should be removed with a seat puller and seat puller jack. Do not remove a seat by heating and quenching or welding on it as heat adversely affects the alloy steel which the fluid end is made of. A seat puller and jack are available through Wheatley/Omega for each type and size fluid end.

3. If the seat to be removed is a suction seat, it will not be necessary to remove the discharge seat as the puller rod will pass through it. Remove the cylinder head cover and its retainer nut.

4. For plunger fluid ends with caged type suction valve keeper assembly:

   - Remove the cylinder cover retainer nut with the hex wrench.
   - Remove the cylinder cover using the threaded cover puller.
   - Remove the cage and valve keeper using the suction spring compression tool.
   - Remove the spring and valve.

5. The suction seat should also be removed with a puller and jack. If your seat puller is made of a plate which fits below the seat, it may be necessary to remove the suction connection at one end of the manifold in order to place the plate under the seat. A seat puller is available through Wheatley/Omega with which this is not necessary.

6. Before replacing the assembly, clean the seat deck bore thoroughly. Snap the seat into the taper by hand and check to see that it is snug. Place the valve on top of the seat and use a heavy bar to bump the seat into the taper two or three times till it is tight.

7. Should a new suction valve retainer or discharge cover be installed, check the valve clearance and make adjustments if necessary for recommended valve lift clearances.

8. Replace the covers and their retainer nuts.

9. Run the pump to maximum discharge pressure with clean fluid in order to seat the valve seats prior to pumping "dirty" fluids.

5.2.2 POWER END

5.2.2.1 To Remove a Stay Rod

1. The fluid end must always be removed to change a stay rod. Never torch cut and weld a stay rod that is to be changed.

2. After removing the fluid end and stay rod to be changed, clean and oil the threads in the power end and on the new stay rod. The power end, fluid end and stay rod mating faces must be free of nicks and burrs to assure proper alignment of the power end and fluid end. This will also prolong the life of all the stay rods. The stay rods should be torqued into the power end to 1000 ft. lbs, (2000 lbs. with 5 ft. cheater). Replace the fluid end and torque, the stay rod nuts to 2600 ft. lb.

3. Once the fluid end is replaced, the fluid end support jack screws should be readjusted to prevent further premature failure of stay rods.

5.2.2.2 To Remove a Pony Rod

1. Remove the plunger clamp and push the plunger into the fluid end out of the way. Remove the pony rod seal retainer.

2. Remove the pony rod which is held by six 3/4" cap screws. Remove the pony rod through the space between the stay rods at the side of the pump. If the pony rod to be changed is the center one, the pump may have to be rotated till the outer pony rod is out of the way.

3. Before replacing the seal retainer, check the double lip seal for wear and replace if needed.

4. Check to see that the pony rod and plunger mating faces are free of nicks and burrs which can cause misalignment and premature failure and excessive wear to packing or liners.

5. Replace the plunger, checking to be sure that the clamp is tight before operating the pump.

5.2.2.3 To Remove a Rod Bearing

1. Disconnect the pump drive in some way to prevent personal injuries or damage to the pump should the driver accidentally be started while disassembled.

2. Remove the top and rear covers from the power end.

3. Remove the four self locking nuts from each rod cap to be removed. Remove the rod cap noting that it and the other half are match-marked for correct reassembly. While removing the rod cap, take care not to lose the two 5/16" dowel pins which align the two halves.

4. Using a rubber or wooden hammer handle, tap on one edge of the bearing to work it around in the housing and out.

5. Clean the bearings and housings thoroughly before replacing the bearings. If new bearings or shims are to be installed, check to see that the contour of the shim, when it is held in place with the 5/16" dowel, matches the contour of the bearing perfectly. If the shim protrudes past the bearing at any point, it should be ground or filed to fit.

6. When replacing the rod cap, check to see that both 5/16" dowels are in place and that the marks on the cap and base match. Note that the dowels are located off center to the same side to help in correct installation.

7. When tightening the rod nuts, 350 ft. lbs. of torque should be used. If a torque wrench is not available, tighten the rod cap nuts with a 3/4" breakover and no more than a two foot cheater.

8. Before operating the pump again, move the rod bearing housing from side to side with a large screwdriver to make sure that it is free on the crankshaft. If new bearings have been installed, refer to the RUN-IN PROCEDURE included in this manual before operating the pump.

5.2.2.4 To Remove a Connecting Rod and Crosshead:

1. Disconnect the pump drive in some way to prevent personal injuries or damage to the pump should the driver accidentally be started while disassembled.

2. Remove the fluid end, top and rear covers, pony rod seal retainer and pony rod.

3. Rotate the crankshaft until the rod bearing housing of the connecting rod to be removed is in the highest position. Remove the three nuts on the bottom of the connecting rod with a pnuematic impact tool. If this is not available it may be necessary to fabricate a special tool to apply torque to the nuts. A 1-1/8 inch socket is required.

4. Remove the three nuts on the top of the connecting rod with an ordinary breakover and socket. After all six nuts have been removed, pull the connecting rod away from the rod bearing housing. Make use of the jack screw holes provided in the base of the connecting rod as it fits into the recessed connecting rod housing base with a boss fit.

5. Remove the crosshead and connecting rod assembly through the front of the power end. Remove the wrist pin lock screw and set screw from the front of the crosshead. A 5/16" Allen wrench is required to remove the set screw.

6. Remove the wrist pin from the crosshead. The connecting rod can now be removed from the crosshead, exposing the bronze thrust seat inside the crosshead. The bronze thrust seat can be removed by removing four 1/2" Allen head cap screws from the thrust seat keepers with a 3/8" Allen wrench.

7. Check wrist pin, wrist pin bushing, connecting rod head surface and thrust seat for wear. Replace if necessary. Clean before installation.

8. When replacing the wrist pin, make sure that the wrist pin set screw is seated in the hole provided for it in the wrist pin.

9. When replacing the connecting rod and crosshead assembly in the power end, make sure the oil groove in the crosshead is on top.

10. To tighten the connecting rod up to the rod bearing housing, only a two foot cheater should be used with the connecting rod wrench and breakover wrench or a 1/2" drive impact.

11. Check to be sure the wrist pin lock screw is in place in the front of the crosshead before installing the pony rod.

12. Do not replace the top and rear covers till the power end is rotated slowly and you can see that all parts are operating and oiling properly.

5.2.2.5 To Remove the Crankshaft:

1. Remove the pump from its skid and place it in an open area where it can eventually be turned over on its side. Remove the fluid end, top and rear covers and pony rod seal retainers.

2. Unbolt the connecting rods from the rod bearing housings. Slide the connecting rods forward till their flanges are resting in the bronze guide sleeve bore. This will permit the rod bearing housings to be pulled out intact on the crankshaft for easier disassembly and inspection later.

3. Remove the drive coupling from the pinion shaft noting where it is located on the shaft. If the pump has a double extended pinion, remove any sprocket, sheave or coupling from it noting where it is located.

4. Remove the pinion seal retainer, gear oiler and rotary unions before removing the gear covers.

5. After removing both gear covers, remove only the bull gear on the side of the pump which will be down when the pump is turned over on its side. If the pump has a single extended pinion, this will be the bull gear on the opposite side from the pinion extension.

Leaving the gear on the side that will be facing up will prevent the crankshaft from slipping out when the pump is turned over. To remove the bull gear, the 1-1/4" key and its set screw must be removed along with the four 1-1/4" cap screws. The gear will then be loose on the crankshaft and should not be heated to remove. The gear will have to spiral somewhat as it comes off due to the helical form of the teeth. A heavy duty C-clamp can be attached to the outer hub of the gear to remove it. Take great care to prevent any damage to the teeth of the gear.

6. Turn the power end on its side and block it up as level as possible. Also, block up under the crankshaft to keep it from sliding out the bottom when the other bull gear is removed. Remove the 1-1/4" key and four 1-1/4" cap screws holding the remaining bull gear. Remove the bull gear from the crankshaft using two 1-1/4" NC eyebolts.

7. Check to see that the connecting rod face of all three rod bearing housings is turned toward the center of the crankshaft. They must be turned this way so that they will slip through the main bearing races. The crankshaft can now be removed by using the two 1-1/4" NC eyebolts in the end of the crankshaft.

   NOTE: Although this pump can be completely disassembled in the field, it generally would not be advisable to install new bull gears, pinion gears, crankshaft or pinion shaft in the field. In order to install any of these new parts, new keyways have to be cut in the bull gears upon assembly in order to keep the gear timing correct or offset keys may have to be made for the bull gear for correct reassembly.

8. If the main roller bearings are to be replaced, it will be necessary to heat them slightly to remove them from the crankshaft. When heating the new bearings for installation on the crankshaft, care should be taken to not heat around the outside of the bearing as this may melt or shrink the bronze cage around the rollers. When replacing the main roller bearings and their races in this pump, it is also very important that the snap rings be brazed in two or three places before the pump is reassembled. Failure to do so may eventually let the snap rings and bearing work loose causing considerable damage. Do not braze the snap rings to the crankshaft, bearing races or power end housing. Be very careful to avoid excess heating of the adjacent bearing race..

9. Before reinstalling the crankshaft in the power end, the crankshaft oilways should be flushed out to remove any dirt or foreign particles which might otherwise damage the rod bearings and crankshaft. It is considerably easier to install the rod bearings and their housings at this time. The rod bearing housings again should be turned toward the center of the crankshaft in order to clear the main bearing races as the crankshaft is installed.

10. Install the crankshaft in the power end housing with a block underneath to keep the crankshaft from slipping too far out on the bottom side.

11. After checking the bronze thrust ring and its mating surface on the power end housing for nicks and burrs, install the bull gear on the crankshaft. Install the 1-1/4" key, its set screw and the four 1-1/4" key cap screws that hold the gear. The power end should now be turned upright again being careful not to let the crankshaft slip out of the bearing races.

12. Again, after checking the bronze thrust ring and its mating surface on the power end housing for nicks and burrs, install the remaining bull gear on the crankshaft. Due to the spiral action of the helical gears and crankshaft, the keyways should not be lined up as the gear starts on the crankshaft. The top of the bull gear will rotate to the front as the bull gear is slid onto the crankshaft. Install the key, its set screw and the cap screw which hold the gear. With both gears tight on the crankshaft, the crankshaft should have .040" to .060" end play.

13. Bolt the connecting rods onto the rod bearing housings. After checking to see that the rod bearing housing caps are tightened sufficiently, check the rod bearing housing with a large screw driver to see that it moves from side to side freely.

14. Install the gear oilers and pony rod seal retainers. Install new pinion seals.

15. Install any sheaves, sprockets or couplings which are used on the pinion extensions in the same positions as they were before removal, checking to see that there is at least 1/8" clearance between their faces and the pinion seal retainer to allow for pinion end float.

16. Install the fluid end on the power end, and the complete pump on its skid after all stay rod nuts have been tightened thoroughly. Do not replace the top and rear covers till the pump is rotating and oiling properly.

5.2.2.6 To Remove the Pinion Shaft

1. Remove the pump from its skid and place in an open area. Remove any sheaves, sprockets or couplings which might be used on the pinion extensions.

2. Remove the pinion seal retainers, gear oilers and rotary unions. Remove both gear covers and bull gears.

3. The pinion shaft may be removed from either side of the pump. Remove both pinion bearing housings from around the bearings. Care should be taken to match-mark the bearing housings to the power end housing. Some of the bearing housing cap screws are countersunk and will require a 5/8" Allen wrench to be removed.

4. To remove the pinion bearing, tilt the outer race and pick the rollers only from the pinion bearing on the opposite side of the pump from the side the shaft will be removed. While removing the shaft, care should be taken not to damage the exposed bearing race if it is to be reused. If the pinion bearings are to be replaced with new ones, remove the remaining outer race and warm the inner races to remove them from the shaft.

5. To reinstall the pinion, install the pinion bearing and its housing only on the side of the shaft that will go into the pump last. Check to see that the housing used was the same removed from this side. Insert the pinion shaft through the power end housing till the pinion bearing housing is in its bore. The countersunk holes in the pinion bearing housing should be located where the bull gear crosses the housing. Install the cap screws which hold this housing.

6. Warm the bearing from the opposite side and install it on the pinion shaft. After the bearing has cooled, use two long 3/4" bolts to align the pinion bearing housing with the bearing and tap the housing into place around the bearing. With the counter-sunk holes located correctly, install the cap screws which hold this housing. Rotate the pinion shaft by hand to see that the bearing housings are spaced correctly and not binding.

7. Reinstall the bull gears on each side of the crankshaft. Reinstall the gear covers, gear oilers and crankshaft rotary unions. Reinstall the pinion seal retainer with a new seal.

8. Install any sheaves, sprockets or couplings which are used on the pinion extensions in the same positions as they were before removal, checking to see that there is at least 1/8" clearance between their faces and the pinion seal retainer to allow for pinion end float.

   NOTE: Although the pinion shaft can be removed and disassembled in the field, it generally would not be advisable to install a new pinion shaft or pinion gears in the field. In order to install these new parts, new keyways have to be cut in the bull gears upon assembly in order to keep the gear timing correct, or offset keys may have to be made for proper installation.

TABLE 5.1

TORQUE SPECIFICATIONS

FLUID END

ITEM	SIZE	TORQUE IN FT. LBS.
Stay Rod Nut	1 3/4" - 8 Thread	2600
Discharge Flange Nuts	1" - 8 Thread	450
Suction Manifold Capscrews	7/8" - 9 Thread	250
Plunger Clamp Capscrews	1/2" - 13 Thread	45

POWER END

Stay Rod	1 3/4" - 8 Thread	1000
Gear Capscrew	1 1/4" - 7 Thread	930
Connecting Rod Bearing Housing Lock Nut	1" - 8 Thread	350
Connecting Rod Lock Nut	3/4" - 10 Thread	180
Pony Rod Capscrews	3/4" - 10 Thread	160
Pinion Bearing Housing Capscrews	3/4" - 10 Thread	160
Thrust Seat Keep Capscrew	1/2" - 13 Thread	50

6. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
A. Knocking or pounding in fluid end and Piping	Suction line restrictions caused by:	
	1. Trash, scale build-up, etc.	Locate and remove
	2. Partially closed or defective valve in suction line	Locate and correct
	3. Screens, check valves, or other restrictions	Rework suction to eliminate
	4. Sharp 90° bends or 90° blind tees	Rework suction line to eliminate
	Air entering suction line through loose connection or faulty pipe	Locate and correct
	Air or vapor trapped in suction	Locate rise or trap. Correct by straightening line, providing enough slope to permit escape and prevent build up
		Impose vacuum on supply
		Allow more settling time
		Reduce triplex speed
		Adjust suction stabilizer
	Low fluid level	Increase supply
	Worn triplex valves	Inspect and replace as needed
	Triplex valve propped open	Inspect and correct

PROBLEM	POSSIBLE CAUSE	CORRECTION
	Poor inlet and outlet arrangement at supply tank	Inlet to be at top of tank and baffled to break out gas and prevent channeling. Outlet to be 12" from bottom of tank and as far from inlet as possible, never close than 90°
	Loose packing adjusting nut	Tighten and/or replace packing as needed
	Inadequate sized suction line	Replace with individual suction line of next size larger than inlet of triplex
	Leaking pressure relief valve that has been piped back into triplex suction	Repair valve and rework piping to return to supply tank - not suction line
	By-pass piped back to suction	Rework to return by-passed fluid back to supply tank-not suction line
B. Knock in Power End	Worn wrist pin, connecting rod, connecting rod bearing, main bearing, thrust seat, crosshead	Locate and repace
	Worn crankshaft	Chrome plate and grind or replace
	Loose plunger pony rod, crosshead, connecting rod, connecting rod housing assemblies	Inspect for damage, replace as required and tighten
C. Low Oil Pressure	Low oil level	Check and add oil as needed.
	High oil temperature	See "E"
	Faulty gauge	Check and recalibrate or replace

PROBLEM	POSSIBLE CAUSE	CORRECTION
D. High Oil Pressure	Contaminated oil	Check and change oil
	Oil filter clogged	Change filter
	Restrictions in lube line	Locate and remove
	Relief valve faulty	Check and reset
E. High Oil Temperature	Heat exchanger malfunction	Clean tubes and shell
		Regulate coolant rate of flow. Make sure that the recommended lube oil is being used
	Improper clearances on bearings, crossheads	Check and adjust for proper clearances or replace
F. Oil Seal Leakage	Worn/damaged seal lip	Inspect and replace
	Outside diameter not seated	Clean and polish oil seal housing
	Foreign material at seal point	Clean and polish shaft
	Worn, damaged or corroded rod	Clean, polish or replace rod
	Pressure in crankcase	Clean or replace air breather. Check for proper crosshead and guide sleeve clearances and correct
G. Low Suction Pressure	Low head	Increase level of fluid supply
	Insufficient Charging	Increase charge pump speed
	Retarded fluid flow	Locate and remove restrictions from suction line
	Gauge malfunction	Check, replace or recalibrate

PROBLEM	POSSIBLE CAUSE	CORRECTION
H. Low Discharge Pressure	Worn or damaged valve assembly	Check and replace
	Valve propped open	Check and correct
	Improper Filling	Remove suction line restrictions
		Decrease pump speed
		Increase charge pump speed
		Prime fluid chambers
	Fluid Slippage	Replace plunger packing
	Defective gauge	Recalibrate or replace
I. Discharge Line Vibration	Malfunction or discharge pulsation dampener	Repair and recharge or replace
	Unsupported discharge line	Provide supports or hangers
J. Tattle-tale leakage	Loose cylinder head or discharge covers	Tighten cover retainer nuts
	Worn or damaged O-rings or seals	Replace
	Damaged O-ring or seal Surfaces	Replace covers. Repair or replace fluid end
K. Rapid Valve Wear	Cavitation (knock or pounding in fluid end and piping)	See "A"
	Corrosion	Treat fluid if possible
	Abrasives in fluid	Filter fluid if possible
	Valve spring Malfunction	Check for tension and replace if necessary
	Improper valve seating	Replace seat if worn or damaged
		Replace valve guide if worn or damaged

PROBLEM	POSSIBLE CAUSE	CORRECTION
	Pump not filling	See "G"
	Malfunction in pulsation dampeners	Repair or replace
L. Short Plunger-Packing life	Improper installation	Inspect and install as per assembly drawing
	Adjusting nut loose	Inspect and tighten. Check for worn or damaged threads and correct
	Scale build-up on plungers	Treat fluid as required
	Worn or pitted plungers	Replace
	Abrasives in fluid	Filter as required
	Abnormally high fluid temperature	Check with manufacturer for recommendations on type of packing
	Friction wear	Lubrication properly with rock drill oil
		Do not overtighten adjustable packing
	Scoring on plungers	Check plunger, packing nut alignments and clearances
		Check, replace worn packing brass rings
	Cavitation	See "A"

APPENDIX C

USEFUL FORMULAE

TO FIND DISPLACEMENT:

Gallons Per Revolution (GPR) For a Triplex Pump

= Dia. of Plunger (Piston) inches x itself x stroke: Length in inches x 0.0102

Gallons Per minute (GPM)

= Gallons Per Revolution (GPR) x Revolutions Per Minute (RPM)

Barrels Per Minute (BPM)

= Gallons Per Minute (GPM) Divided by 42.

TO FIND HORSEPOWER:

Hydraulic Horsepower (HHP) Based on 100% Efficiency

= Gallons Per Minute (GPM) x Pressure Per Square Inch (PSI) Divided by 1714

Note: 1. Friction and Gearing in the pump will lower the mechanical efficiency by approximately 15%.

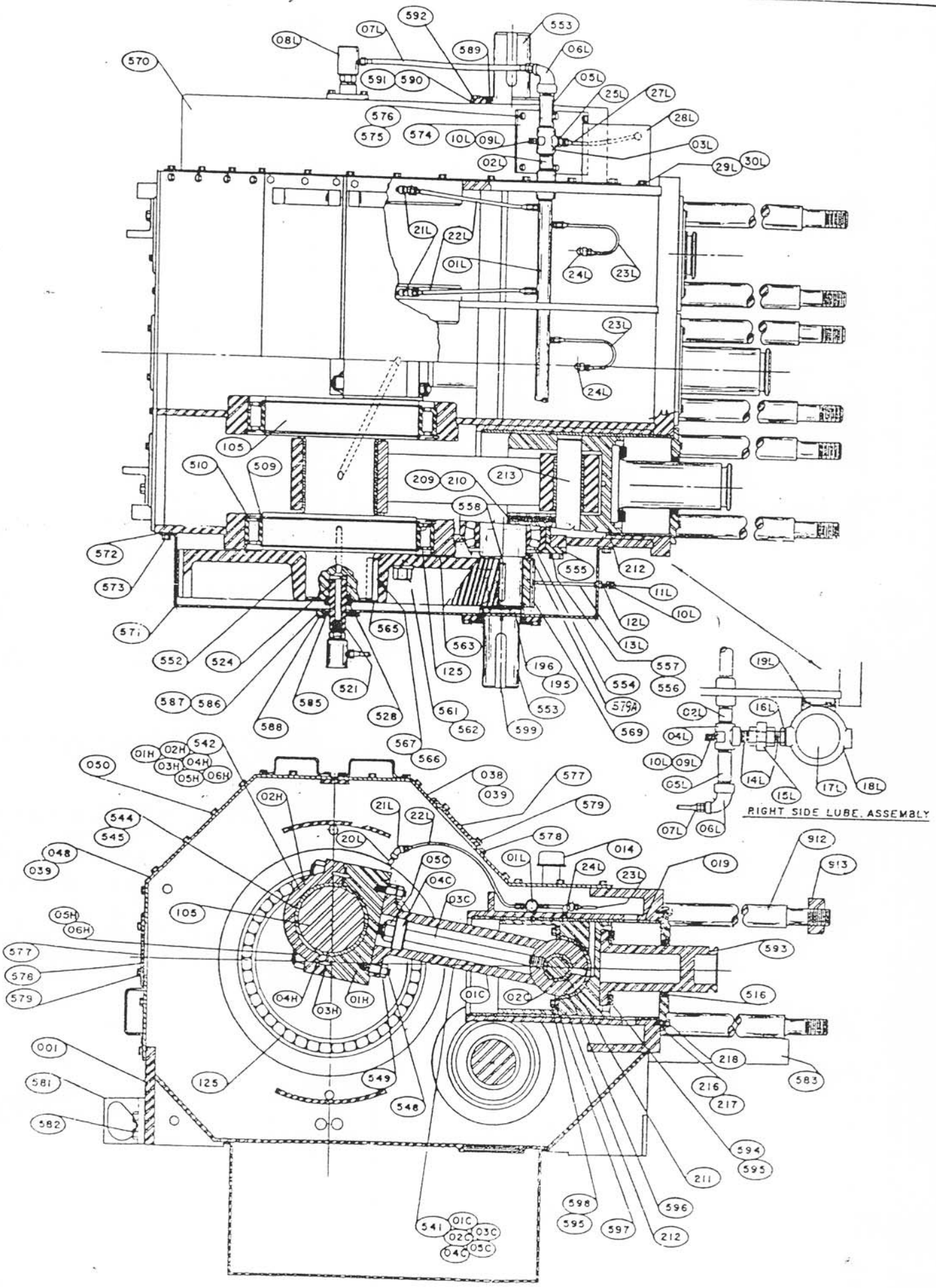
2. Allowances need to be made if additional gearing is coupled to the pump drive.

Input Horse Power Required Based on 85% efficiency

= Gallons Per Minute (GPM) x Pressure Per Square Inch Divided by 1457.

TO FIND ROD LOAD:

Rod Load Required = Diameter of Plunger in inches x Itself x .785 x maximum Pressure Per Square Inch Required


RIGHT SIDE LUBE. ASSEMBLY

ITEM NO.	PART NUMBER	NO. REQ'D.	PART NAME
001	008-050861-231	1	POWER FRAME
014	001-050650-999	1	BREATHER CAP
019	001-050026-302	3	CROSSHEAD SLIDE
038	004-050479-220	1	TOP COVER
039	004-050554-204	1	GASKET (TOP & REAR COVER)
048	004-050480-220	1	REAR COVER
050	100-038034-273	82	CAP SCREW
▲ 055	147-516012-220	4	DOWEL PIN (GEAR COVERS)
105	004-050434-220	1	CRANKSHAFT
125	121-160197-999	4	CRANKSHAFT BEARING
195	234-000020-220	2	LOCK NUT — (PINION SHAFT)
196	235-000020-220	2	LOCK WASHER — (PINION SHAFT)
209	324-058034-220	3	LOCK SCREW — (WRIST PIN)
210	324-058200-220	3	SET SCREW — (WRIST PIN)
211	001-050022-302	3	WRIST PIN BUSHING
212	004-050418-359	3	CROSSHEAD
213	001-050021-236	3	WRIST PIN
216	001-050027-231	3	WIPER BOX
217	002-050365-204	3	GASKET
218	100-058114-273	18	CAP SCREW
▲ 266	126-004014-220	4	DRIVE SCREW
▲ 267	004-050516-282	1	NAMEPLATE
509	177-001648-999	8	SNAPRING, INNER
510	177-002008-999	4	SNAPRING, OUTER
516	145-478600-999	3	WIPER BOX OIL SEAL
521	001-050076-275	2	LUBRICATION ADAPTER
524	110-000223-200	2	O-RING
528	272-516034-220	8	CAP SCREW
541	004-050425-220	3	CONNECTING ROD ASSEMBLY
	EACH CONNECTING ROD ASSEMBLY INCLUDES THE FOLLOWING PARTS:		
01C	064-050447-220	1	CONNECTING ROD SUB-ASSEMBLY
02C	064-050437-236	1	HEAD
03C	064-050439-275	1	STUD
04C	064-050438-236	1	WASHER
05C	150-114012-243	1	NUT
542	004-050412-221	3	ROD BEARING HOUSING ASSEMBLY
	EACH ROD BRG. HOUSING ASSEMBLY INCLUDES THE FOLLOWING PARTS:		
01H	064-050416-221	1	BASE
02H	064-050415-221	1	CAP
03H	001-050621-306	2	SHIM
04H	147-516200-220	2	DOWEL PIN
05H	104-100434-271	4	STUD
06H	150-100008-243	4	NUT
544	002-050212-301	3	SHELL BEARING, TOP
545	002-050213-301	3	SHELL BEARING, BOTTOM
548	104-034312-271	18	STUD (CONNECTING ROD)
549	150-034010-243	18	NUT
▲ 551	004-050551-220	1	BULL GEAR, L.H.
552	004-050448-220	1	BULL GEAR, R.H.
553	002-050242-274	1	PINION SHAFT
554	255-511905-999	2	BEARING
555	002-050222-231	2	BEARING CARRIER
556	442-034114-273	6	CAP SCREW
557	442-034200-273	6	CAP SCREW
558	148-034400-236	4	KEY (PINION GEAR)
561	442-114300-273	8	CAP SCREW — (BULL GEAR)
562	153-114194-220	8	LOCK WASHER — (BULL GEAR)
563	001-050032-302	2	THRUST RING
▲ 564	188-038034-306	16	CAP SCREW, FLAT HEAD
565	002-050364-236	2	KEY
566	324-012012-220	2	LOCK SCREW
567	324-012034-220	2	SET SCREW

ITEM NO.	PART NUMBER	NO. REQ'D.	PART NAME
▲ 568	002-050248-220	1	PINION GEAR, L.H.
569	002-050247-220	1	PINION GEAR, R.H.
570	004-050449-220	1	GEAR COVER, L.H.
571	004-050450-220	1	GEAR COVER, R.H.
572	002-050377-204	2	GASKET
573	100-038100-273	70	CAP SCREW
574	001-050067-231	2	GEAR INSPECTION COVER
575	002-050368-204	2	GASKET
576	001-050657-999	16	CAP SCREW, WASHER HEAD
577	001-050009-236	6	INSPECTION COVER
578	002-050367-204	6	GASKET
579	133-038016-286	24	NUT
579A	001-050044-236	2	SPACER, PINION
580	008-050886-999	1	LUBRICATION ASSEMBLY
	LUBRICATION ASSEMBLY INCLUDES THE FOLLOWING PARTS		
01L	002-050305-220	1	LUBRICATION TUBE
02L	157-100300-551	2	PIPE NIPPLE
03L	001-050054-353	1	REDUCING TEE
04L	001-050055-353	1	PIPE TEE
05L	157-100500-220	2	PIPE NIPPLE
06L	001-050684-604	2	REDUCING ELBOW
07L	002-050359-999	2	HOSE WITH END CONNECTIONS, 2
08L	001-050649-999	2	ROTARY UNION
09L	167-014030-353	2	STREET ELBOW
10L	002-050382-001	2	HOSE WITH END CONNECTIONS, 9
11L	166-014030-353	2	ELBOW, 90° (GEAR CASE)
12L	157-014078-551	2	PIPE NIPPLE (GEAR CASE)
13L	001-050052-551	2	FEED TUBE
14L	157-100112-551	2	PIPE NIPPLE (FILTER)
15L	178-100030-353	1	PIPE UNION
16L	161-112100-353	1	REDUCER BUSHING
17L	001-050651-999	2	OIL FILTER
18L	002-050363-999	1	FILTER BRACKET
19L	100-038012-273	2	CAP SCREW
20L	157-014200-551	4	PIPE NIPPLE
21L	168-014030-353	4	ELBOW, 45°
22L	002-050382-002	4	HOSE WITH END CONNECTIONS, 12
23L	002-050382-001	3	HOSE WITH END CONNECTIONS, 9
24L	167-014030-353	3	STREET ELBOW (CROSSHEAD SL
25L	161-012014-353	1	REDUCER BUSHING
▲ 26L	167-014030-353	1	STREET ELBOW (ALARM BOX)
27L	002-050382-003	1	HOSE WITH END CONNECTIONS, 14
28L	004-050517-999	1	ALARM BOX
29L	155-014034-220	4	WASHER
30L	100-014012-273	4	CAP SCREW
581	001-050007-231	2	LIFTING BRACKET
582	100-078200-273	4	CAP SCREW
583	004-050553-231	1	DRIP PAN
▲ 584	100-038034-273	4	CAP SCREW (DRIP PAN)
585	145-134213-999	2	OIL SEAL
586	001-050075-275	2	SEAL RETAINER
587	002-050366-204	2	GASKET
588	100-038114-273	8	CAP SCREW
589	145-334500-999	2	OIL SEAL
590	001-050045-236	2	SEAL RETAINER
591	002-050376-204	2	GASKET
592	100-038114-273	6	CAP SCREW
593	002-050232-400	3	PUSH ROD
594	105-034112-273	18	CAP SCREW
595	001-050656-220	90"	LOCK WIRE
596	001-050019-301	3	THRUST SEAT
597	001-050023-231	6	RETAINER
598	105-012114-273	24	CAP SCREW
599	146-100500-236	2	KEY (PINION SHAFT)
912	002-050250-274	12	STAY ROD
913	184-134008-243	12	NUT

...OV...R END ASSEMBLY AND PARTS LIST for MODEL D-750

▲ NOT SHOWN

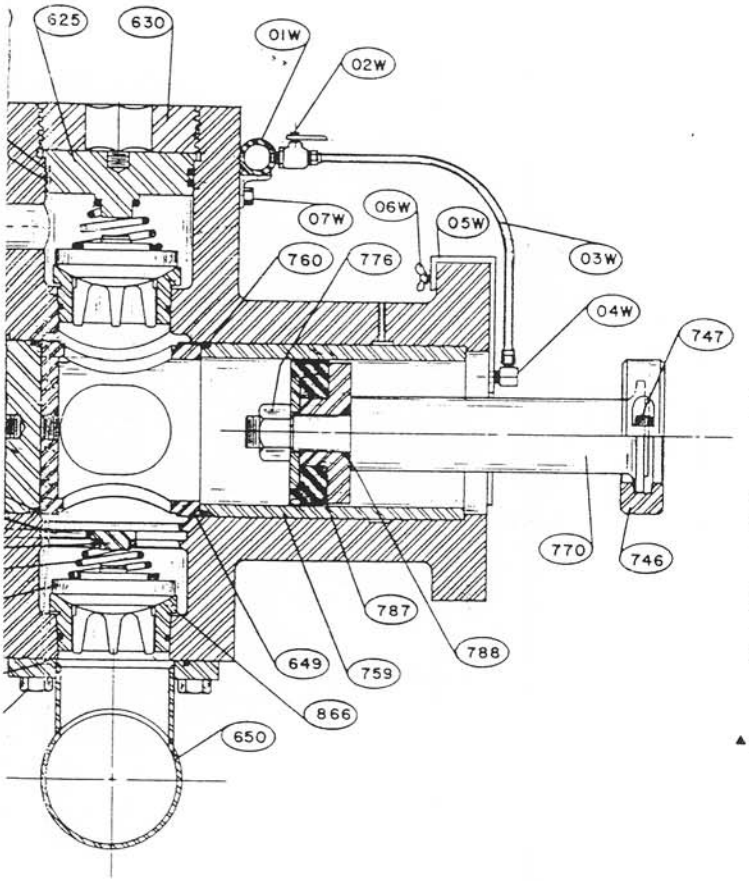
NOTE: WHEN ORDERING PARTS GIVE:

1.) PUMP SERIAL NUMBER
2.) PUMP MODEL NUMBER
3.) PART NUMBER
4.) PART NAME
5.) ITEM NUMBER
6.) MATERIAL
7.) QUANTITY

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ITEM NO.	PART NUMBER	NO. REQ'D.	PART NAME
	BASIC FLUID END PARTS		
600	008-050811-220	1	FLUID END BODY
625	001-050029-275	3	VALVE COVER
627	110-000362-200	6	O-RING
630	001-050093-275	3	RETAINER NUT
640	002-050298-236	3	CYLINDER HEAD
641	001-050117-211	3	SEAL
643	001-050087-275	3	RETAINER NUT
▲ 637	001-050089-220	1	3" HEX WRENCH
649	002-050299-220	3	LINER CAGE
650	008-050871-220	1	SUCTION MANIFOLD
651	110-000258-200	3	O-RING
652	100-078112-273	12	CAP SCREW
664	004-050414-220	1	DISCHARGE MANIFOLD
665	110-000344-200	3	O-RING
666	104-034312-271	18	STUD



ITEM NO.	PART NUMBER	NO. REQ'D.	PART NAME
667	127-034010-243	18	NUT
746	004-050477-275	3	PUSH ROD CLAMP
747	105-012112-273	6	CAP SCREW
751	117-100500-220	9	SET SCREW
759	277-612712-369	3	PISTON LINER
760	001-050079-211	3	SEAL
770	002-050272-274	3	PISTON ROD
776	140-138012-220	3	NUT
787	274-612000-216	3	PISTON
788	110-000225-200	3	O-RING
872	001-050084-231	3	VALVE KEEPER
874	001-050096-236	6	KEEPER PIN
875	110-000012-200	12	O-RING
876	170-038003-220	6	PIPE PLUG

914	004-050489-999	1	WATER SPRAY ASSEMBLY
	WATER SPRAY ASSEMBLY INCLUDES THE FOLLOWING PARTS:		
01W	002-050240-999	1	MANIFOLD
02W	229-000094-306	3	BALL VALVE
03W	002-050382-004	3	HOSE WITH END CONNECTIONS
04W	001-050678-204	3	90° HOSE CONNECTOR
05W	002-050306-220	3	SPLASH GUARD
06W	001-050672-001	6	THUMBSCREW
07W	100-038100-273	2	CAP SCREW

VARIABLE FLUID END PARTS

MAC-CLATCHIE VALVE, SUCTION & DISCHARGE

865a	998-231013-067	6	COMPLETE VALVE ASSEMBLY
866a	001-050632-220	6	SEAT WITH O-RING
868a	001-050691-999	6	BODY ASSEMBLY
871	002-050357-999	6	SPRING
	BODY ASSEMBLY INCLUDES THE FOLLOWING PARTS:		
8681a	001-050783-999	1	BODY
8682a	001-050784-999	1	INSERT

MISSION VALVE, SUCTION & DISCHARGE

865b	998-231013-066	6	COMPLETE VALVE ASSEMBLY
866b	001-050636-220	6	SEAT WITH O-RING
868b	001-050778-999	6	BODY ASSEMBLY
871	002-050357-999	6	SPRING
	BODY ASSEMBLY INCLUDES THE FOLLOWING PARTS:		
8681b	001-050779-220	1	BODY
8682b	001-050780-999	1	INSERT
8683	001-050781-220	2	CAP
8684	001-050782-220	1	RETAINING RING

OPTIONAL EQUIPMENT

▲ 890	001-050675-220	1	VALVE SEAT PULLER

NOTE: WHEN ORDERING PARTS GIVE:

1.) PUMP SERIAL NUMBER
2.) PUMP MODEL NUMBER
3.) PART NUMBER
4.) PART NAME
5.) ITEM NUMBER
6.) SIZE AND MATERIAL
7.) QUANTITY

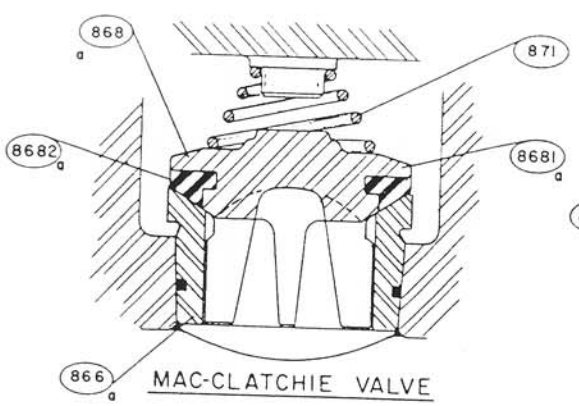
MODEL D-750 FLUID END ASSEMBLY & PARTS LIST 6½" PISTON

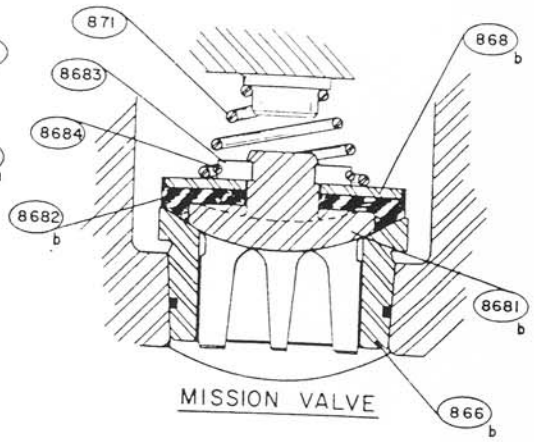
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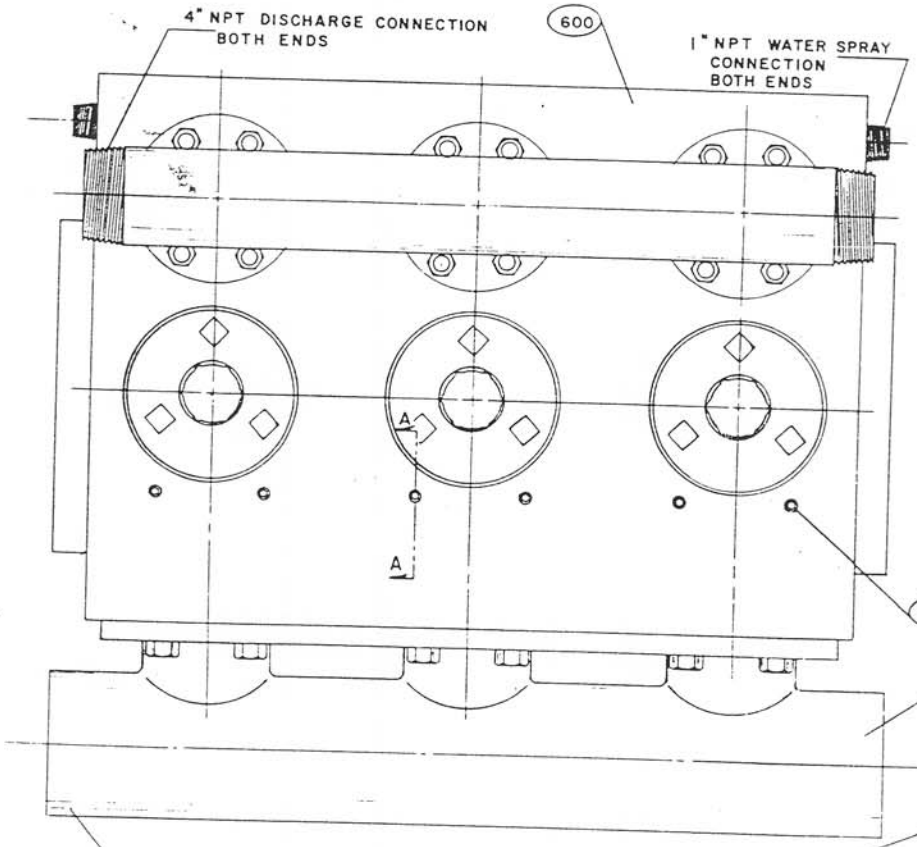
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WITH MAC-CLATCHIE VALVES: 595-646514-601
WITH MISSION VALVES: 595-646505-601

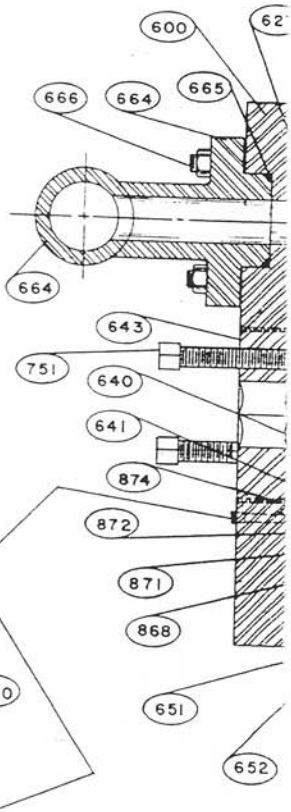
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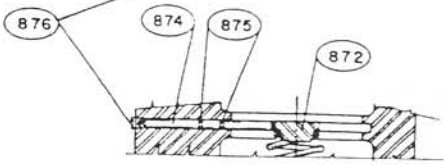
REVISED 1-23-84
7-20-83
ROMM











VALVE KEEPER PIN DETAIL
SECTION A-A

WHEATLEY / OMEGA

Tulsa, Oklahoma

PART N