Pioneer HSO Series
Operation & Maintenance Manual

Manual #5001

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PIONEER PUMP, INC

When contacting Pioneer Pump, Inc. for technical assistance or parts ordering the following information should be provided in order to ensure accurate and prompt service.

Model designation_____
Pump serial number_____
Package serial number_____
Engine serial number_____
Date of purchase_____

An exploded parts drawing with part number references has been provided in this manual for your convenience . Contact Pioneer Pump, Inc. at 503-266-4115 or fax information to 503-266-4116

INSPECTION

All equipment is inspected at the factory prior to shipment. However, you should inspect, upon arrival, for shipping damage and item shortages from the packing slip. Report any damage or shortages to the carrier and **Pioneer Pump, Inc.**

WARRANTY INFORMATION

LIMITED WARRANTY: Seller warrants for one year from the date of shipment Seller's manufactured products to the extent that Seller will replace those having defects in materials or workmanship when used for the purpose and in the manner which Seller recommends. If Seller's examination shall disclose to its satisfaction that the products are defective, and an adjustment is required, the amount of such adjustment shall not exceed the net sales price of the defective products, and no allowance will be made for labor or expense of repairing or replacing defective products or workmanship or damage resulting from the same. Seller warrants the products which it sells of other manufacturers to the extent of the warranties of their respective makers. Where engineering design or fabrication work is supplied, buyer's acceptance of Seller's design or of delivery of work shall relieve Seller of all further obligation, other than as expressed in Seller's product warranty. **THIS IS SELLER'S SOLE WARRANTY. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER.** Seller neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of its engineering designs or products. This warranty shall not apply to any products or parts of products which (a) have been repaired or altered outside of Seller's factory, in any manner; or (b) have been subjected to misuse, negligence or accidents; or (c) have been used in a manner contrary to Seller's instruction or recommendations. Seller shall not be responsible for design errors due to inaccurate or incomplete information supplied by Buyer or its representative.

How the Hydraulic Submersible Operates

Figure 1 is sectional view of a typical Pioneer Hydraulic submersible pump.

The **hydraulic motor** is of the gear type and bolts to the top of the **bearing block** which contains oil lubricated **upper bearing** and **lower bearing**. A **mechanical seal** isolates the hydraulic oil in the **hydraulic motor** and **bearing block** from the pumpage. The **motor shaft** connects to the **pump shaft** via a splined coupling and drives the **impeller**. Oil flows from the **pressure port**, through the gears, to the **return port** of the **hydraulic motor** driving the **motor shaft** and thus the **pump shaft** and the **impeller**. The **impeller** and **motor shaft** thus turn at the same speed

As the **impeller** turns liquid is expelled outward into the **volute casing** by the centrifugal action of the **impeller**. This, in turn, causes a reduction in pressure at the **suction inlet**, and draws liquid into pump. The centrifugal action of the rotating **impeller** imparts velocity and, thus, kinetic energy, to the liquid. As the liquid is decelerated in the casing the velocity energy is converted to pressure. Higher **impeller** rotational speed results in higher pressure and flow. In fact, the pressure will increase as the square of the speed increase ratio (ratio of the new speed to the old speed), and flow will increase directly with the speed increase ratio. The increased pressure of the liquid within the pump forces the liquid out through the **volute discharge elbow**, up to the **discharge flange** and into the discharge hose or pipe.

Pioneer submersibles must be submerged to a depth that will completely cover the top of the casing, otherwise it is likely that air will be drawn into the pump interrupting or preventing priming.

Figure 2 shows the Pioneer Hydraulic Submersible Pump, diesel power unit and discharge line in a typical operating position.

The submersible pump is capable of running dry without damage. The bearings and seal are lubricated by the hydraulic oil and do not require pumpage for lubrication and cooling.

Operation / Fittings and Connectors

Connect hydraulic high pressure line to the **pressure port** labeled "in." Connect the return hydraulic line to the **return port** labeled "out." Connect the case drain line to the **case drain port** located directly between the "in" and "out" connections. When hose "whips" are supplied, connect the hydraulic lines to the swivel fittings on the whip ends. Except in special cases, Pioneer Hydraulic submersibles are equipped with case drain lines to prevent excessive pressure against the mechanical seal when hydraulic lines must be very long. This protects the mechanical seal from premature wear and failure.

Caution: Reversing the hydraulic hose connections will result in the impeller spinning backwards. This can result in the **impeller** unscrewing from the shaft and damaging the impeller or inlet side of the **volute casing**.

WARNING!: Hydraulic oil at pressures sometimes in excess of 2000 psi is potentially very dangerous. Be certain that the hose fittings are tightly connected using open-end and pipe wrenches. Hose fittings should be attached to the hoses only by qualified distributors of hydraulic equipment.

Use Teflon® tape or thread compound when joining male hose-ends to female swivels on the hose whips.

Connect the power source hydraulics to the **hydraulic motor** and start the unit at low speed to fill the lines and purge air. Stop the unit and check all connections for leaks. All leaks must be eliminated prior to continued operation.

WARNING!: Never tighten connections with hydraulic lines under pressure. Small leaks at high pressure can be deadly.

Connect steel piping or rubber hose to discharge flange or quick disconnect fitting. Flanged fittings must employ a resilient gasket between flanges to prevent excessive leakage and wear of the flanges. Tighten flange bolts to the following torque values:

Bolt Size	Torque Ft-Lbs
½"	45
5/8"	90
3/4"	150
7/8"	200
1"	300

Operation: Fittings and Connectors (cont'd)

Sharp kinks in rubber hoses are to be avoided. Use proper elbows for smooth hose transitions where the angle exceeds the minimum bend radius of the particular hose grade.

Operation: Pump Placement

One method of placing the hydraulic submersible pump into the liquid is to connect a chain or cable to the lifting eye on the pump and suspend the pump with a backhoe or crane. If the power unit is equipped with a boom the pump can be suspended directly from the boom. If the pump is equipped with a stand or optional "rock guard" and the bottom of the pit or ditch is firm, then the pump can be suspended resting on the bottom. However, for sludges and pits with soft, muddy bottoms the pump should be suspended so that it does not become buried and nearly impossible to pull out!

WARNING!: Stand clear of the pump when lifting. The pump may swing and strike anyone standing too close.

Attach the pump securely to the cable or chain. Use safety hooks or pass the chain through the lifting eye on the pump, and attach the hook to the chain. Never connect and open hook directly to the lifting eye. If the chain method is used make certain that the chain is not slackened, or it may come loose.

Caution: When placing the pump make certain that the hydraulic and discharge hoses are of adequate length to reach the desired position without placing the hydraulic lines in tension.

Operation: Hydraulic Power Unit

The power units manufactured by Pioneer Pump, Inc. include the following components typical of a "remote pilot operated relief valve" hydraulic system: a hydraulic pump, remote pilot operated relief valve, reservoir, pressure outlet and return inlet. See **Figure 3** for an illustration of the hydraulic system.

WARNING!: Never operate a hydraulic system without a properly sized and functioning relief valve. In the absence of a relief valve pressures can build to a level that will exceed the ratings of the hydraulic hose and pump. Rupture can result and can lead to serious injury or death.

Operation: Hydraulic Power Unit (cont'd)

Change the oil filter at least every 250 hours. Maintain a proper pressure gauge to monitor system performance and filter condition.

Caution: Keep the hydraulic oil clean and at the proper level. Dirty oil is the number one cause of hydraulic system failure.

Use hydraulic oil meeting the following specifications:

ISO viscosity grade 32 to 68, anti-wear type hydraulic oil. The oil used will depend upon ambient and operating conditions. Select the oil grade according to the following conditions:

VISCOSITY GRADE (@104°F)	START-UP 860 cSt	RUNNING 54 cSt Max	RUNNING 13 cSt Min
32 cSt	11°F	80°F	143°F
46 cSt	22°F	94°F	159°F
68 cSt	32°F	108°F	177°F

From this data it can be seen that an ISO 68 viscosity grade is preferred for high temperatures (up to 177°F) and an ISO 32 is better for a cold start-up (down to 11°F).

Operation: Pumping

Check all fittings and connections.

Start the pump slowly, easing the throttle, and fill the discharge line slowly. Increase the rpm gradually to the desired operating point. Check the hydraulic pressure gauge, and do not exceed the factory setting (usually 2000 to 2200 psi).

Caution: Exceeding the recommended (factory set) operating pressures will lead to excessive wear and early failure.

After five to ten minutes of operation the oil temperature should be around 100°F. Temperatures to 180°F can be tolerated but are not preferred.

WARNING!: Hot oil can severely burn you. Do not run hydraulic units at too high a temperature, and do not stand in a location where hot oil can easily reach you in the event of a rupture.

The hydraulic operating pressure is determined by the hydraulic motor load imposed by the centrifugal pump. A given system may be operating correctly at a pressure of 1000 psi if that is all that the hydraulic motor requires to enable the centrifugal pump to produce the desired flowrate and head.

Preventative Maintenance:

Hydraulic oil is used to transfer power as well as lubricate and cool. Dirty oil is the number one cause of excessive wear and early failure of the hydraulic motor, hydraulic pump and valves. A clean system with clean, fresh oil will accumulate contaminants in a short time, and these must be removed continuously. Change the oil filters and oil as often as practical. The hydraulic oil filter should be changed every 250 hours or less. Filters with indicator gauges should be changed when indicated. Use a 25 micron filter.

Hydraulic oil should be changed after every year of operation. This interval will be shorter or longer depending upon frequency and duration of use. Frequent operation at the upper end of the recommended temperature range will require more frequent oil changes. If the oil has gotten too hot it will have a burnt or decaying odor.

Caution: If the hydraulic pump, motor, bearing block or seals should fail, the system will, most likely, be contaminated with metal bits or water. The oil should be drained, the reservoir and lines flushed and cleaned and new oil added.

On a regular interval and after each duty cycle the centrifugal pump and hydraulic system should be inspected as follows:

1. Is the impeller free of foreign objects?

2. Are hydraulic hoses damaged in any way?

3. Are all fasteners in place and tight?

Each pump season:

1. Replace the filters and oil.

2. Remove the suction cover and inspect the impeller for excessive sideplay and endplay, and replace the bearings if necessary.

3. Replace worn bolts and nuts

4. Clean and repaint as required to control corrosion.

If hydraulic motor life is short, the following causes should be investigated:

1. Operation at higher than factory set pressures or those recommended by the motor manufacturer.

2. Improper oil viscosity or quality.

3. Operating at high temperatures for extended periods.

4. Inadequate filtering.

5. Misalignment of motor and bearing block shafts.

6. Air or water contamination of the system.

7. Running at too high a speed.

Maintenance / Disassembly - Reassembly

WARNING!: Shut-off hydraulic power unit and disconnect hydraulic motor from hydraulic lines before performing any disassembly. Escape of hydraulic oil under high pressure can cause severe injury or death. Contact with rotating parts can cause severe injury or death.

Refer to **Figure 4** for part names and numbers.

Complete disassembly

Remove the nuts and lockwashers holding the **suction guard** in place. Remove the remaining nuts and washers holding the **suction cover** in place, and remove the **suction cover**. Remove the nuts and lockwashers securing the **backplate** to the **volute**, and remove the **volute**. Remove the capscrews which connect the **hydraulic motor** to the **bearing block**, and lift the **hydraulic motor** until its shaft is clear of the female spline in the **bearing block**. Place a long, flat bar between the vanes of the **impeller** to prevent it from turning, and using a 11/4" - 14 tooth male spline wrench, unscrew the **impeller** from the **shaft**.

Maintenance / Disassembly - Reassembly (cont'd)

Removal of impeller only

If only the impeller is to be removed then remove the **suction guard** and **suction cover** as in the preceding instructions. Remove the capscrews securing the **impeller** to the **hub adapter**. Pry the **impeller** down through the **suction cover** or remove with a puller. Optionally, it may be easier to access the impeller by removing the entire **volute** from the **backplate**.

Complete disassembly cont'd

Refer to **Figure 5** for **bearing block** part names and numbers.

Remove the four bolts securing the **bearing block** to the **backplate**. Remove the screws securing the **seal retainer** to the **bearing block**, and pull the **seal retainer** out of the **bearing block**. Remove the **o-ring** from the **seal retainer**. Remove the **retaining ring** adjacent to the **upper bearing**. Now, place the **bearing block** under a small shop press with the splined end of the **shaft** up, and push the **shaft** and bearings out of the **bearing block**. Remove the **mechanical seal** from the **sleeve**. If the **sleeve** is to be replaced, it can be removed by "peening." Support the **shaft** with the sleeve resting against a solid metal surface such as an anvil or vice. Using a hammer, tap along the length of the **sleeve** in a line, hard enough to indent the **sleeve**. It may be necessary to repeat this process in several lines around the **sleeve** in order to stretch it enough to remove it. Now the **upper bearing** and **lower bearing** can be removed using a puller or a press.

Complete reassembly

Refer to **figures 4 and 5** for part names and orientations

The bearings can be installed by heating them to a maximum temperature of 230°F in an oven or on a hot plate and sliding them onto the shaft before they can cool. Make certain that the **bearing** is firmly butted against the **shaft** shoulder, and hold it there for a few moments until it cools enough to grip the shaft. Alternately, the bearings can be installed with a press. Make certain that the press bears only against the inner race during installation. Never press against the outer race or drive the bearings on using impact.

Maintenance / Disassembly - Reassembly (cont'd)

Install a new **sleeve** by heating the **sleeve** in an oven and sliding onto the **shaft** and up against the **shaft** shoulder.

Thoroughly clean the **bearing block** with a clean solvent, and blow the block out with shop air. Set the **bearing block** on the press bench, and insert the **shaft** and **bearing** assembly through the upper end of the **bearing block** with the threaded end of the **shaft** inserted first. In this case, press against the outer race of the **upper bearing** until it comes to rest against the shoulder in the **bearing block**. Install the **retaining ring** into the groove adjacent to the **upper bearing**.

Now thoroughly lubricate the **sleeve** with 30 wt to 90 wt motor or gear oil. Place the **mechanical seal** spring over the **shaft** and up against the inner race of the **lower bearing**. This step is made easier by standing the **bearing frame** upside down, with the threaded end of the **shaft** pointing upward. Lubricate the inside diameter of the **mechanical seal** rubber bellows, and push the **mechanical seal** onto the **sleeve** and against the spring. Lightly lubricate the o-ring of the **mechanical seal** stationary seat, and press the seat into the **seal retainer** with your thumbs with the lapped and polished side of the seat facing you. Install a new **o-ring** into the groove in the outside diameter of the **seal retainer**, lubricate the **o-ring**, and install the **seal retainer** into the **bearing block** against the face of the **mechanical seal**. It will be necessary to press against the seal spring and maintain pressure while installing and tightening the **seal retainer** screws.

CAUTION: Make certain that once the **mechanical seal** installation is begun that it is completed and the **seal retainer** fastened in place fairly quickly, otherwise the **mechanical seal** may seize to the **sleeve** in the wrong position, resulting in seal failure.

Bolt the **bearing block** to the support on the **backplate**.

Impeller installation is the opposite of disassembly; using the 1 1/4" - 14 male spline wrench and a flat bar to prevent impeller rotation, thread the **impeller / hub adapter** assembly onto the **shaft** and tighten snugly.

Place a new **gasket** over the studs on the top side of the **volute**, and attach the **bearing block / backplate / impeller** assembly to the **volute** using the nuts and lockwashers. Place a new **gasket** over the studs on the inlet side of the **volute**, and attach the **suction cover** to the **volute** using the nuts and split-washers. Reattach the **suction guard**, if so equipped.

Maintenance / Disassembly - Reassembly (cont'd)

Place a new **o-ring** over the register on the **hydraulic motor**. Lower the **hydraulic motor** onto the **bearing block**, taking care to line up the motor's male spline with the female spline in the **bearing block shaft**. Bolt the **hydraulic motor** to the bearing housing.

NOTE: When replacing the hydraulic motor make certain that the shaft seal in the motor is removed before installation onto the **bearing block**. The **bearing block** relies on the hydraulic oil for bearing lubrication and is equipped with its own mechanical seal.

TROUBLESHOOTING GUIDE

PROBLEM	PROBABLE CAUSES	POSSIBLE SOLUTIONS
Pump does not deliver adequate flowrate	Rotational speed to low	Rebuild or change hydraulic motor, check relief setting
	Wrong rotation direction	Reverse supply and return lines to hydraulic motor
	Impeller clogged	Stop unit and remove clog or open slurry gate if equipped
	Discharge pipe plugged	Make certain there are no kinks or sharp bends
	Incorrectly sized motor or improper operation	Check motor displacement size versus application
	Static head or friction losses too high	Refer to pump performance curves for max heads /flows
	Slurry gate partially open	Check actuator position. Check for debris in gate
	Impeller or casing excessively worn	Replace as necessary
Hydraulic oil gets too hot	Excessive bypass of oil thru relief and back to tank	Shut down, check relief valve Impeller jammed or hose disconnected Hydraulic pump and motor are mismatched. Call factory for assistance

PROBLEM	PROBABLE CAUSES	POSSIBLE SOLUTIONS
Hydraulic oil getting too hot	Inadequate cooling	Use larger reservoir, add oil cooler or add fan to system
	Hydraulic hose and fittings are too small in diameter	Use a larger hose.
	Hydraulic pump or motor is worn	Rebuild or replace
Pump vibrates or is noisy	Rotating parts rubbing against stationary parts	Replace bearings or shaft
	hydraulic motor worn out or defective	Replace the hydraulic motor
	Impeller is clogged causing imbalance	Stop and unclog or try opening slurry gate if eqp'd
	Flowrate is too low - pump is in "recirculation"	Open valve, reduce head or select smaller pump
Bearing have short life	Inadequate lubrication	Check quality and condition of oil, check filter
	water contamination	Replace the seal. Check mechanical seal regularly
Hydraulic motor life is short	Pressures are too high	consult factory for proper maximum pressure setting
	contaminated oil	clean entire system. Flush the tank and lines, add oil

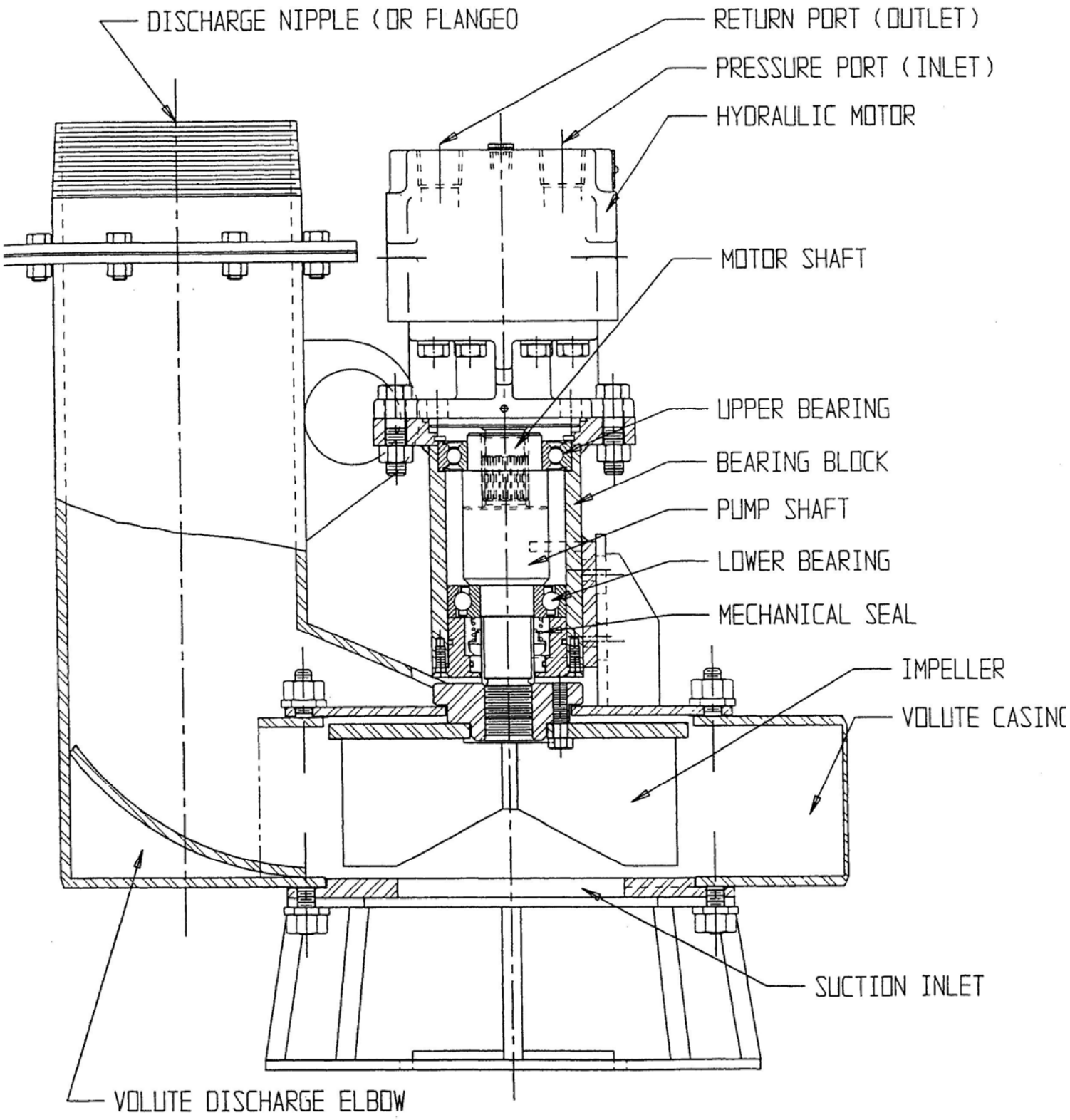
DISCHARGE NIPPLE (OR FLANGED
RETURN PORT (OUTLET)
PRESSURE PORT (INLET)
HYDRAULIC MOTOR
MOTOR SHAFT
UPPER BEARING
BEARING BLOCK
PUMP SHAFT
LOWER BEARING
MECHANICAL SEAL
IMPELLER
VOLUTE CASING
SUCTION INLET
VOLUTE DISCHARGE ELBOW

FIGURE 1

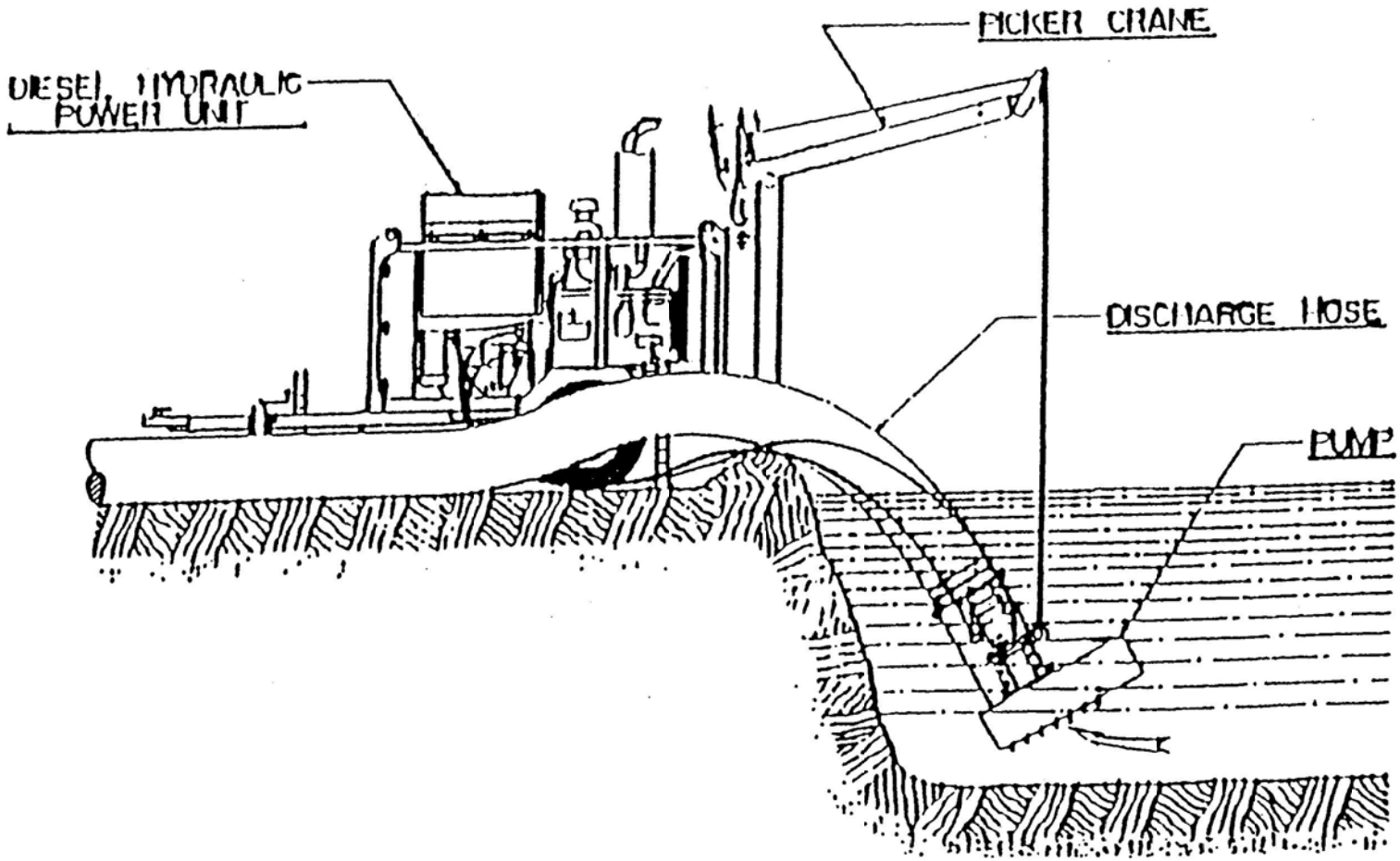

FIGURE 2: POWER UNIT AND PUMP

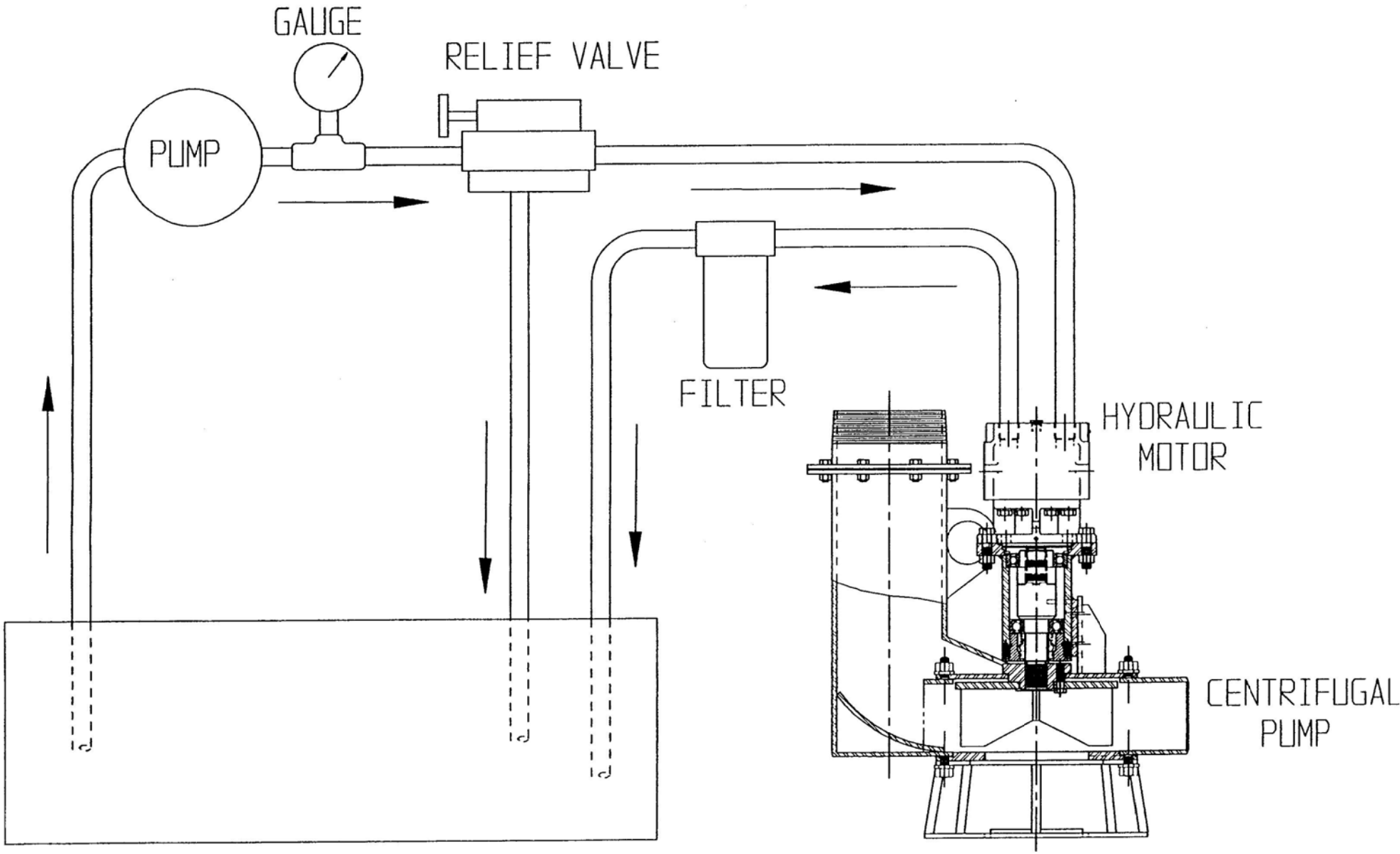
GAUGE
RELIEF VALVE
PUMP
FILTER
HYDRAULIC
MOTOR
CENTRIFUGAL
PUMP

FIGURE 3

DWG NO. A991A

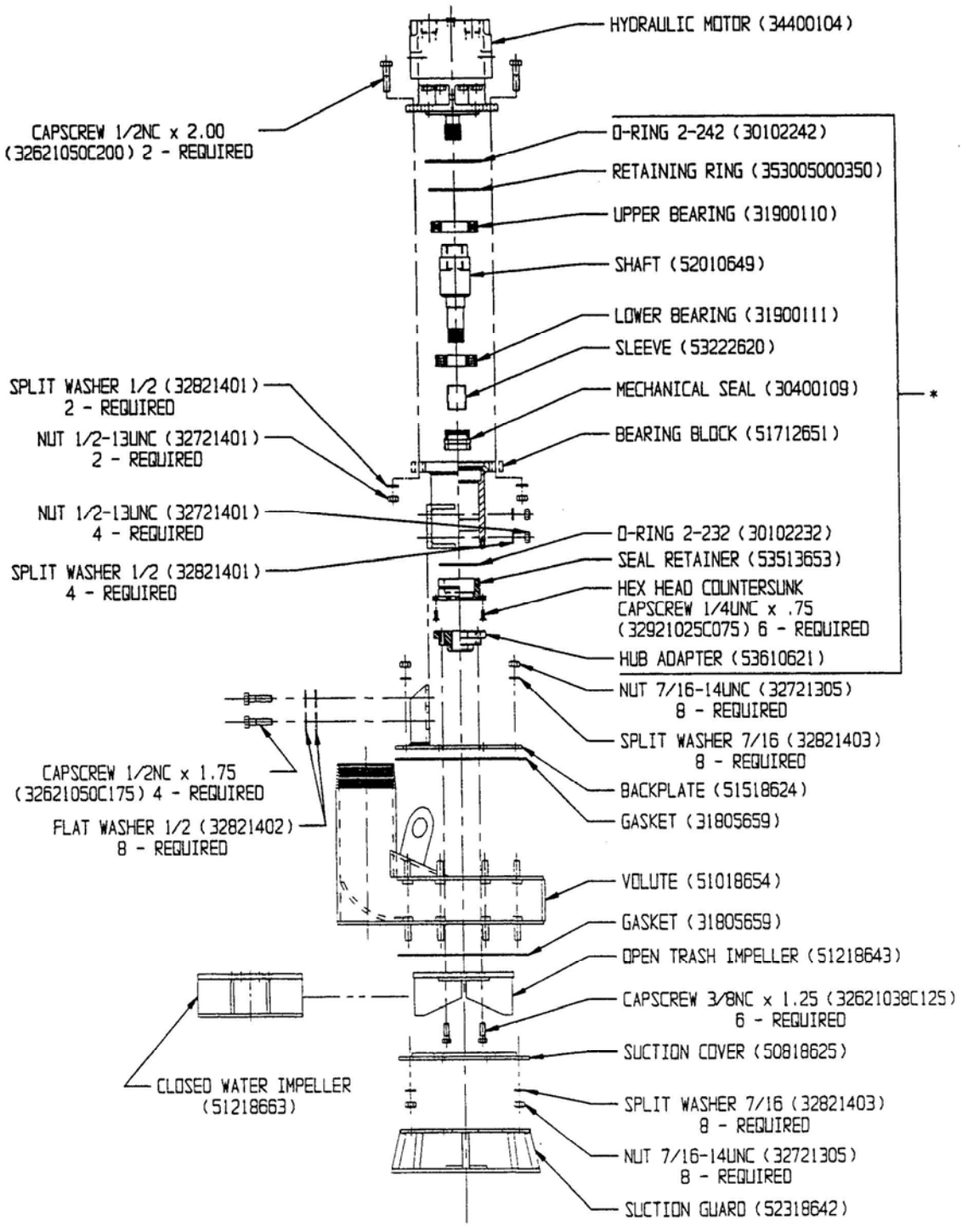

FIGURE 4

NOTES: PIONEER PUMP PART NUMBERS IN ( ).
* ORDER BS173 FOR BEARING BLOCK ASSEMBLY.

DWG NO. A991A

PIONEER PUMP, INC.

MODEL: HS4 (OIL LUBED VERSION)

DWG NO. A999A

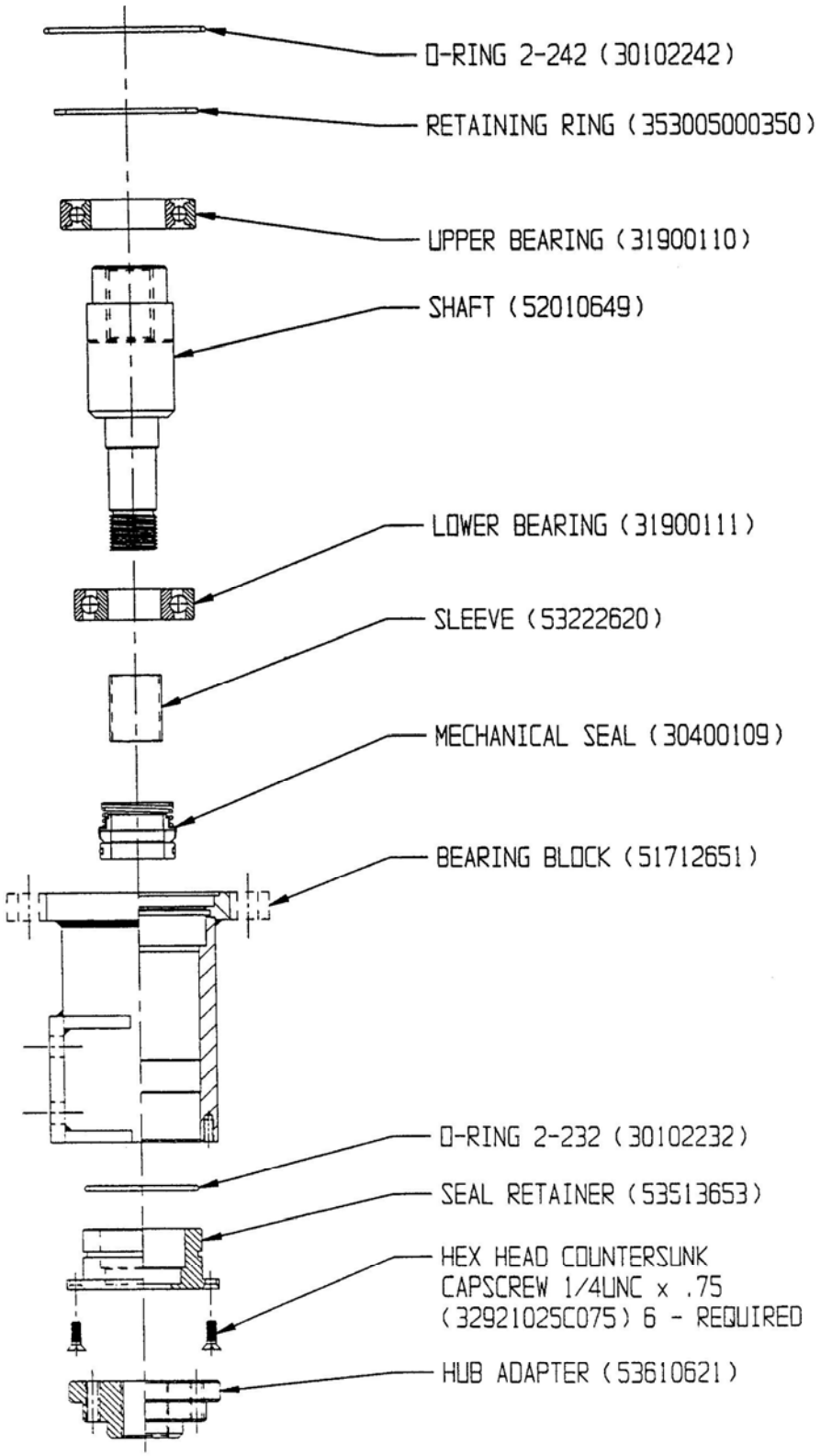

FIGURE 5

NOTES: PIONEER PUMP PART NUMBERS IN ( ).
* ORDER BS173 FOR BEARING BLOCK ASSEMBLY.

DWG NO. A999A

PIONEER PUMP, INC.

OIL LUBED BEARING BLOCK (HS4 & HS6)