PULSA Series®

DIAPHRAGM METERING PUMPS

Installation
Operation
Maintenance
Instruction

Bulletin No. IMP-98

PULSAFEEDER
A Unit of IDEX Corporation

Manufacturers of Quality Pumps,
Controls and Systems.

Engineered Pump Operations
2883 Brighton-Henrietta Townline Road
Rochester, New York 14623 USA
Telephone: (585) 292-8000 Fax: (585) 424-5619
http://www.pulsa.com
Email: pulsa@idexcorp.com

TABLE OF CONTENTS

TABLE OF CONTENTS

INTRODUCTION

GENERAL DESCRIPTION

PULSA Series metering pumps are positive displacement, reciprocating pumps. They combine the high efficiency of plunger pumps with a diaphragm seal to eliminate product leakage. Each pump consists of a power end and a liquid end separated by the hydraulically operated diaphragm. Individual pumps may vary in appearance due to various liquid ends, accessories and multiplexing. The basic principles of operation however, remain the same.

PRINCIPLES OF OPERATION

I. OVERALL OPERATION

Figure 1
A piston reciprocates within an accurately sized cylinder at a preset stroke length displacing an exact volume of liquid. This piston however does not pump various chemicals. It pumps a stable oil that has excellent lubricating qualities. A diaphragm separates the oil from the product pumped. The diaphragm is free to move within contoured support plates in exact response to the volume displaced by the piston. The diaphragm does no work but acts only as a separator. Consequently, the displacement of the oil is translated into an equal amount of product displacement. The reciprocating action of the piston causes the product to enter through the suction check valve as the piston travels to the rear of its chamber. A like quantity of product is discharged through the discharge check valve on the forward stroke of the piston.

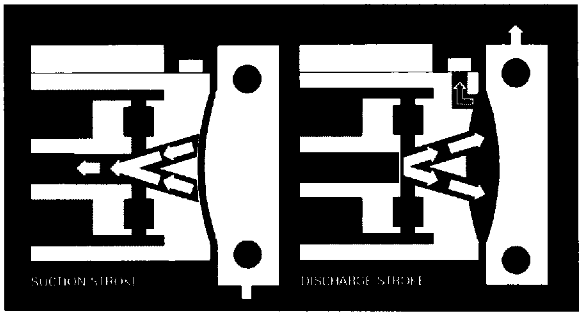


Fig. 1

II. COMPONENT OPERATION

Figure 2 illustrates a typical model fitted with a flat diaphragm head and external stroke adjustment. As mentioned previously individual pumps may vary in appearance but the operating principles are the same. Study the figure carefully and become familiar with the function of the various subassemblies and the terminology used.

A. Standard Flat Diaphragm Reagent Head Assembly

Figure 3 shows a typical flat diaphragm reagent head assembly. This assembly, consists of reagent head, diaphragm and suction and discharge check valves. The head design protects the diaphragm and maximizes flow. The valves, inserted at the top and bottom of the head contain precision ground balls or disks that assure free liquid flow. The reagent head assembly is the only part of the pump to come in contact with the liquid being pumped. Consequently proper maintenance of the reagent head assembly is critical for optimum pump performance.

B. HYDRATUBE Reagent Head Assembly

Figure 4
The HYDRATUBE Head Assembly consists of a ductile iron casting which positions the HYDRATUBE and contains the intermediate liquid, a support plate to protect the diaphragm from over-travel, and suction and discharge check valves. The HYDRATUBE is a flexible elastomer or PFA cylinder that confines and isolates the liquid pumped from any contact with the hydraulic system. The HYDRATUBE responds exactly to the action of the primary flat diaphragm through the medium of an inert intermediate liquid which can be selected for compatibility with the liquid pumped.

C. Custom Head Assemblies

Figure 5
Certain applications involve conditions which cannot be handled using a standard assembly. For these, Pulsafeeder offers a variety of custom head assemblies. They use the same basic parts as the standard assembly but incorporate different mounting arrangements and sometimes multiple parts.

D. Pump Head/Piston Assembly

Figure 6
The pump head piston assembly mounts at the end of the hydraulic oil reservoir referred to as the gearbox. This assembly contains the pumps hydraulic system which consists of a pumphead, cylinder, piston assembly, diaphragm support plate and 3 valves referred to as the automatic bleeder, hydraulic makeup valve, and hydraulic bypass valve. The automatic bleed valve is located at the top of the pumphead and is used to remove gases from the hydraulic system. The hydraulic makeup valve, depending on the type, may be located inside the gearbox or externally below the pumphead. It automatically replaces any hydraulic oil which is lost past the piston or through the automatic bleeder. The hydraulic bypass valve protects the pump from damage in case of system failure by relieving any excess pressure in the hydraulic system. Again depending on the type, it may be located inside the gearbox or externally on the pumphead.

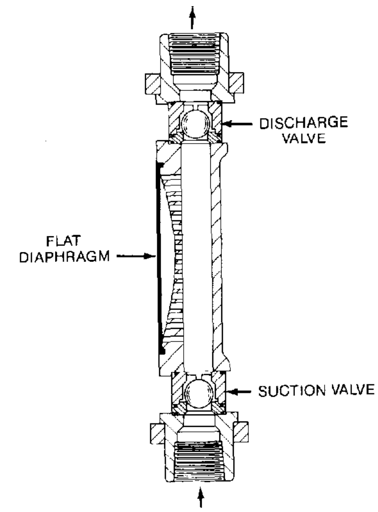


Fig. 3

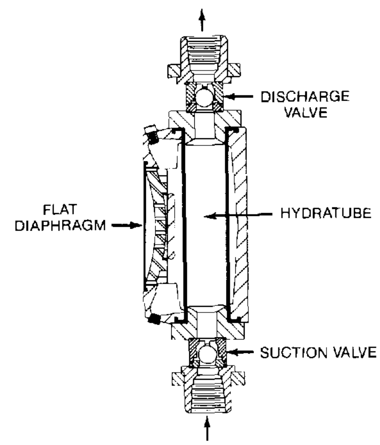


Fig. 4

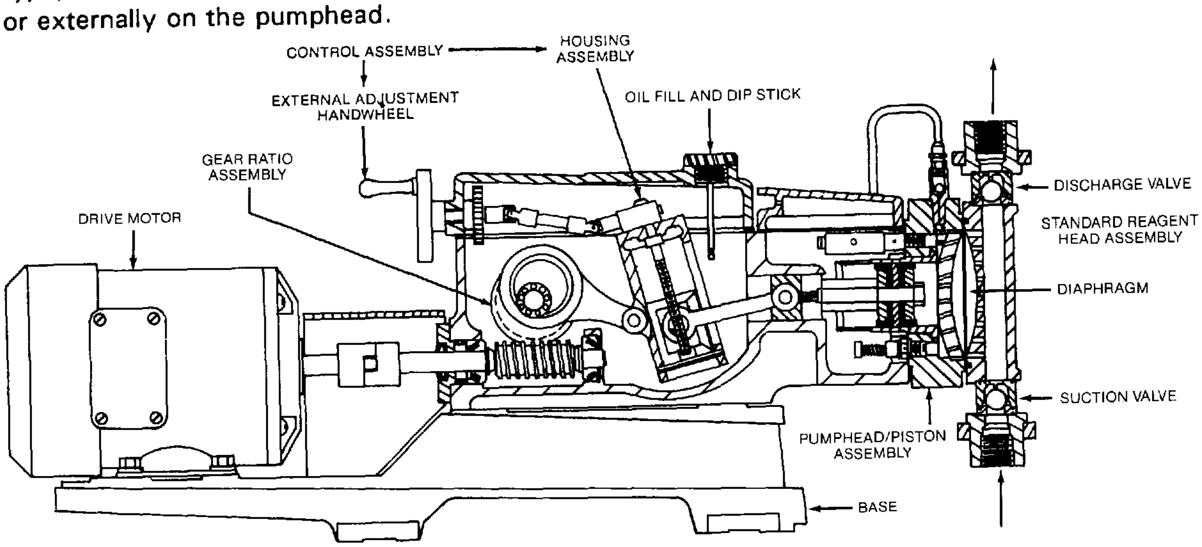


Fig. 2

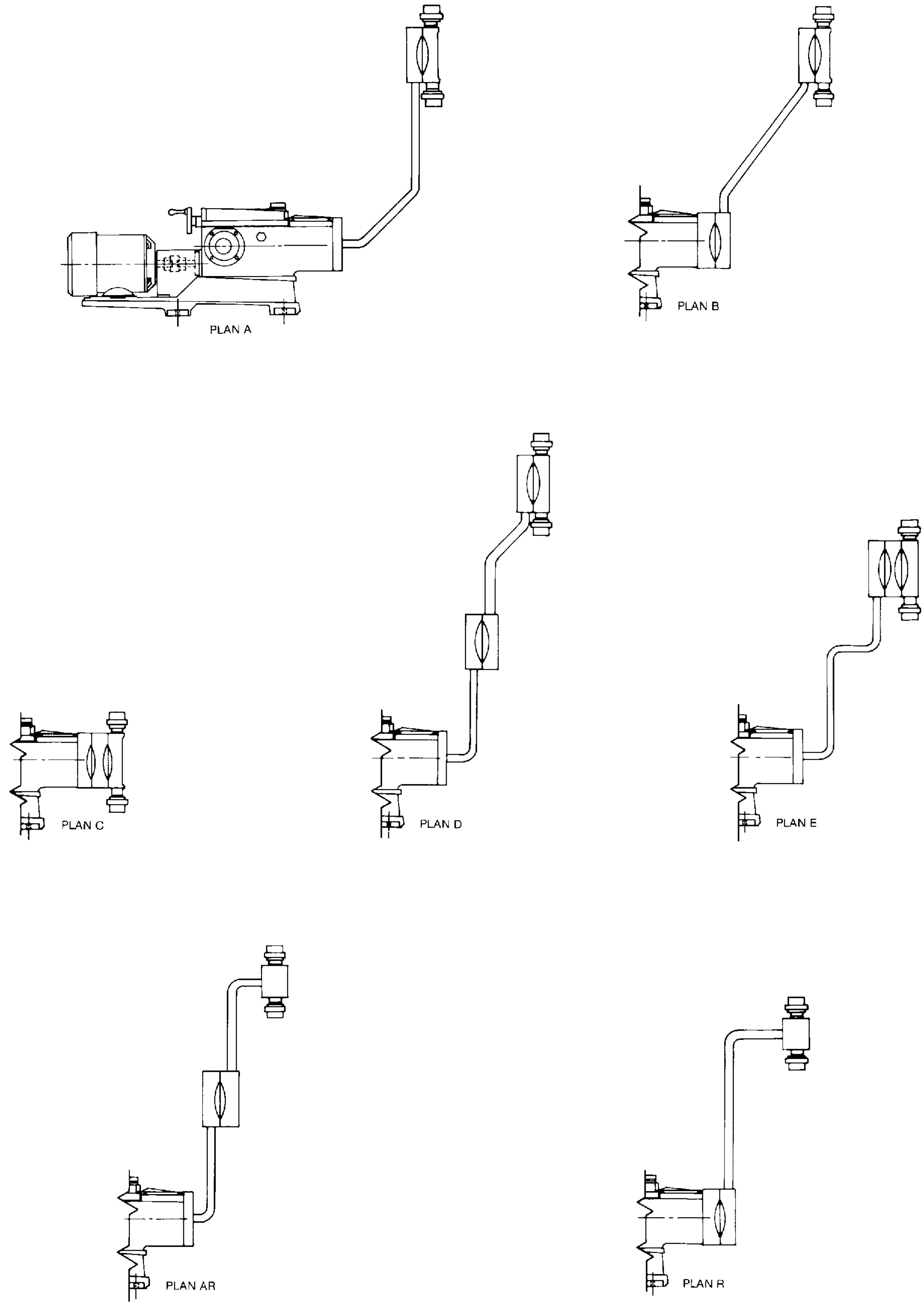


Fig. 5

E. Control Assembly

By changing the length of the piston stroke in a pump, the amount of product displaced can be increased or decreased. PULSA Series diaphragm metering pumps, Models 7120 to 8480 contain an adjustment mechanism which controls stroke length (Figure 7). The mechanism consists of an oscillating housing, a slider block which fits inside the housing and a connecting rod attached to the block. The housing pivots on horizontal bearing pins and oscillates through a fixed arc from the action of the eccentric-driven rear connecting rod. The position of the block within the housing is adjustable (through manual or automatic control). Figure 2 shows a manual control assembly, rotating the external handwheel causes a threaded shaft in the housing to turn.

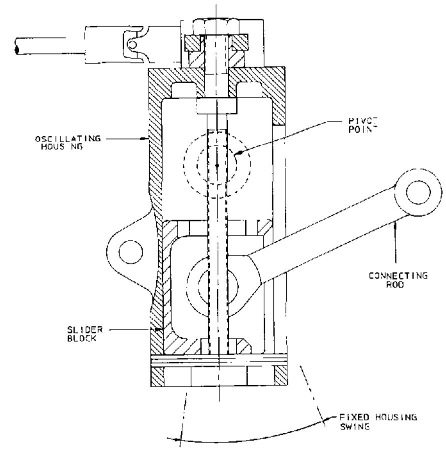


Fig. 7

This shaft is threaded through the block and raises or lowers the block as the handwheel is turned. When the block is centered on the pivot point of the housing it is motionless. As it is lowered off center it develops increasing reciprocating movement (Figure 8) which is transmitted through the connecting rod. Side thrust on the piston is eliminated by the use of a crosshead block which travels in a bore between the connecting rod and piston assembly.

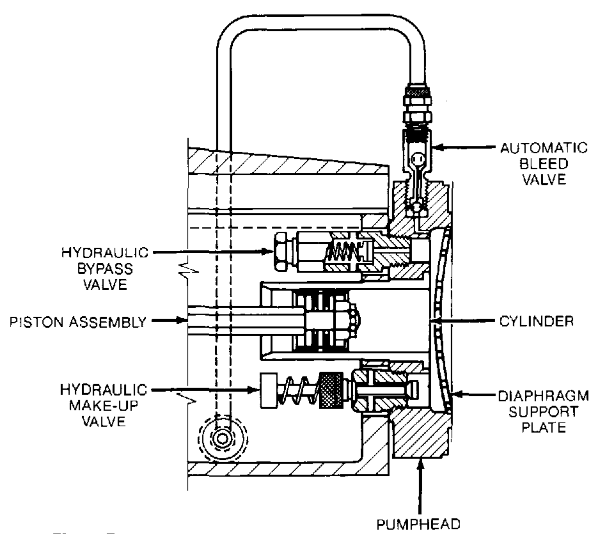


Fig. 6

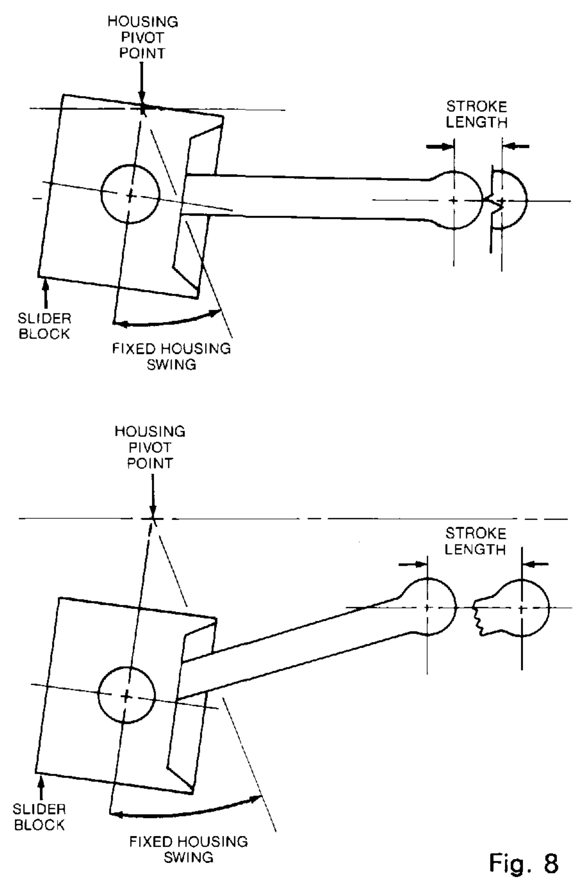


Fig. 8

F. Gear Ratio Assembly

Pulsafeeder pumps are generally driven by a standard electric motor. The motor drives a set of worm gears which convert rotational speed into torque. They in turn power the eccentric shaft assembly that converts rotary to reciprocating motion.

More than one pump can be driven through a single drive assembly. This is referred to as multiplexing. The pumps are mounted on a common base and one of two drive arrangements is used. In the first (Figure 9) one pump acts as a driver and powers the other pumps through extended eccentric shafts. The driven pumps contain no worm gears. In the second arrangement (Figure 10) an external gear reducer is used to drive all the pumps which again are connected through extended eccentric shafts. In this case none of the pumps contain worm gears.

Whenever pumps are multiplexed they are set up to cycle in a specific sequence in order to place a uniform load on the driver. Before disassembling the eccentric shaft couplings, always note the relative position of each shaft so that they can be reassembled in the same position.

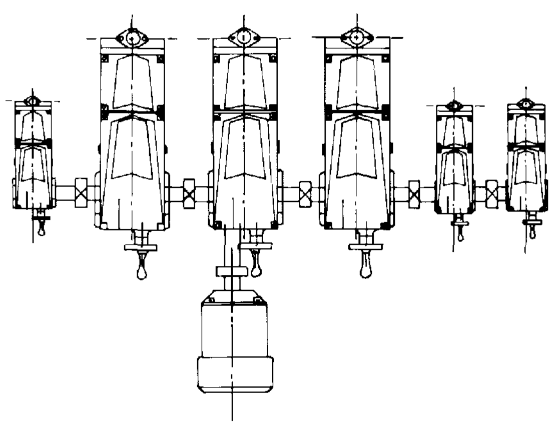


Fig. 9

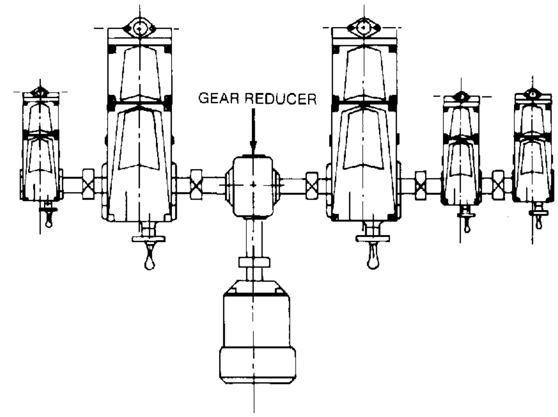


Fig. 10

EQUIPMENT INSPECTION

Check all equipment for completeness against the order and for any evidence of shipping damage. **Shortages or damage should be reported immediately to the carrier and to your PULSA Series representative.**

STORAGE INSTRUCTIONS

I. SHORT TERM

Storage of PULSA Series pump for up to 12 months after shipment is considered short term. Under this condition the recommended storage procedures are as follows:

A. The pump should be stored indoors at room temperature in a dry environment.

B. Pumps with a HYDRATUBE reagent head assembly are shipped with the diaphragm in the neutral position. It must be kept in this position during storage. Refer to MAINTENANCE, Section II B.

C. The pump gearbox and hydraulic reservoir is to be completely filled with PULSAlube oil within two months after date of shipment.

D. The gearbox and hydraulic reservoir should be inspected every 3 to 6 months. Maintain the oil level and assure that no water or condensate builds up in the gearbox. If water or condensation is present, follow Procedure II, Step A below.

E. It is recommended that the stroke length of the pump be adjusted to its midpoint and that the piston be manually cycled through 3 to 6 cycles every 6 months.

F. Prior to start-up, perform a complete inspection and then start up in accordance with instructions in this manual.

II. LONG TERM

For storage longer than 12 months in addition to the above, the following procedures should be followed.

A. Every twelve months PULSAlube oil should be drained from the gearbox and hydraulic reservoir. The gearbox and hydraulic reservoir should be flushed with kerosene or petroleum base solvent, thoroughly dried out with a rag, and then refilled with fresh PULSAlube oil.

B. Every twelve months the motor should be connected to a power source and the pump operated for a minimum of one hour. It is not necessary to have liquid in the reagent head during this operation but the suction and discharge ports must be open to atmosphere.

After twelve months storage Pulsafeeder's warranty cannot cover such items as oil seals, gaskets, piston cups and other items which are subject to deterioration with age. If the pump has been in storage for longer than 12 months it is recommended that these items be replaced prior to going into service. Material and labor to recondition or replace this class of item is the purchaser's responsibility. For a one year service warranty after extended storage the refurbishment and equipment inspection must be done by a Pulsafeeder serviceman.

INSTALLATION

I. LOCATION

When selecting an installation site, or designing a skid package, consideration should be given to access in order to perform routine maintenance.

PULSA Series pumps are designed to operate indoors or outdoors but it is desirable to provide a hood or covering for outdoor service. Alternate oil or external heating is required if ambient temperatures will be below 40°F (4.4°C). Check with the factory if concerned with the suitability of the operating environment.

The pump must be rigidly bolted to a solid and flat foundation to minimize vibration. Vibration can loosen gaskets and pipe connections. When the pump is bolted down care must be taken to avoid distorting the base and affecting alignments. This is especially important for multiplex units. The pump must be level within 2°. This will assure that the oil in the gearbox is maintained at the correct level and that the check valves can operate properly.

II. PIPING SYSTEM

Figure 11 illustrates the piping system for a standard pump. Custom head assemblies require special piping arrangements, refer to separate instructions. Regardless of the arrangement required, all piping systems should include the following:

A. Shut off valves and unions (or flanges) on the suction and discharge piping. This allows routine inspection of the check valves without draining long runs of piping. The shut off valves should open to full pipe line diameter. Ball valves are preferred (do not use needle valves).

B. An inlet strainer if the product is not a slurry. Pump check valves are susceptible to dirt and other contaminants unless designed for that service. Any accumulation can cause a malfunction. The strainer should be placed between the suction shut-off valve and the pump suction valve. The sizing must accommodate the flow rate and expected contamination, one hundred mesh screen is generally used.

C. Hangers and straps to support piping.

Do not allow the weight of the piping to be supported by the valve housings or other portion of the reagent head, or leaks will occur. Where necessary provide for thermal expansion and contraction so that no strain is placed on the pump.

D. Vacuum/pressure gauges in the suction and discharge lines are recommended in order to check system operation. All gauges should incorporate shut-off valves to isolate them when they are not being monitored.

E. In addition, a separate process relief valve should be installed in the process piping to protect piping and sensitive process equipment.

In assembly of piping, use pipe thread tape or similar compound compatible with the product being handled. Whether new or existing piping is used all lines should be flushed with a clean liquid and blown out with air before making final connections to the pump. Ensure that the flushing liquid is compatible with the liquid to be pumped.

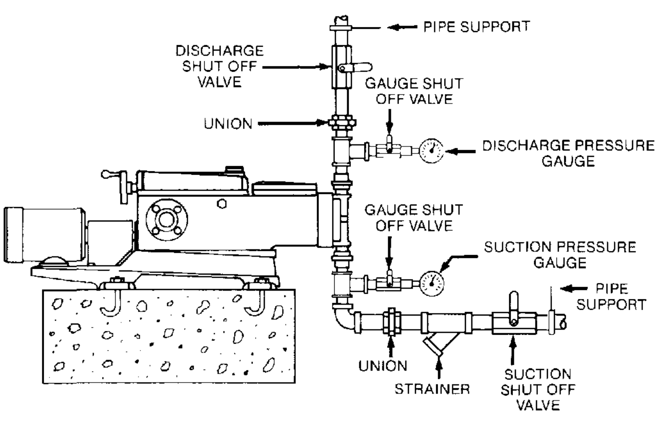


Fig. 11

III.SUCTION PRESSURE REQUIREMENTS

Although PULSA Series metering pumps have the capability of suction lift, an installation will be easier to operate with flooded suction. Wherever possible, the pump should be located below the level of the suction side reservoir and as close to it as possible.

If suction lift is required, the minimum practical suction pressure is 9.5 psia. Below this pressure the hydraulic makeup valve will not operate properly and degasification of the hydraulic oil can occur. In addition the suction pressure must be at least 5 psi above the vapor pressure of the liquid being handled.

Refer to Appendix I for information on calculating suction pressure.

IV. DISCHARGE PRESSURE REQUIREMENTS

All PULSA Series metering pumps are designed for continuous service at the rated discharge pressure. To prevent liquid flow through, it is necessary that the discharge pressure exceed suction pressure by at least 5 psi. When pumping downhill, a back pressure valve should be placed in the discharge line.

Refer to Appendix I for information on calculating discharge pressures.

V. AUTOMATIC CONTROL

Pumps equipped with either electronic or pneumatic output controls are supplied with separate instructions on hookup and adjustment. Make all required connections prior to performing a start-up procedure.

EQUIPMENT START UP

I. LUBRICATION

Every PULSA Series metering pump is tested at full capacity and operating pressure before shipment. However, for shipping purposes the gearbox and hydraulic reservoir oil has been removed. Fresh oil is included in separate container(s).

CAUTION!

1. **Do not run pump without oil.**

2. **Do not remove main gear box cover while pump is running.**

3. **Do not run pump with coupling guard removed.**

4. **Do not put hands or fingers in gear box or reservoir when pump is running.**

5. **Do not remove the front gearbox cover while the pump is running (Model 7440, 3 inch piston only).**

A. Oil Specifications

PULSAlube #1 is a custom blended lubricant which is suitable for most PULSA Series applications. It has an effective temperature range of 40°F to 280°F (4.4°C to 137.8°C). For adverse temperature conditions, -40°F to +400°F (-40°C to 204°C) PULSAlube #5 must be used. For complete specifications refer to Appendix II.

B. Oil Capacities

All PULSAlube oils are available in:

- 1 quart containers (.95 liters)
- 1 gallon containers (3.8 liters)
- 5 gallon containers (18.9 liters)
- 55 gallon drums (207 liters)

It is recommended that an adequate supply of PULSAlube be on hand to handle periodic oil changes and emergency requirements.

The amount of oil required to fill PULSA Series gearboxes is as follows:

- 7120 - 1.0 gallon (3.8 liters)
- 7440 - 1.0 gallons (3.8 liters)
- 7660 - 6.0 gallons (22.7 liters)
- 8480 - 8.0 gallons (30.3 liters)

C. Oil Fill

All PULSA Series pumps use a partitioned gearbox to provide oil reservoirs for the gear/control mechanism and hydraulics. Most models utilize a separate cover for each reservoir, the exception being AE (Auto Electric Control) models which have a full length cover with a removable front section. The purpose of the front cover (hydraulic reservoir) is to provide a free acting diaphragm which allows the reservoir to breathe and at the same time seals it from the atmosphere.

AG(Agricultural) models do not use this diaphragm but instead have an external breather to vent the gearbox. Also, due to the high displacement on some model 7440's an external breather is used in conjunction with a diaphragm cover.

Figure 12 portrays a typical model. Depending on the control option ordered, the covers may vary in appearance. Before filling the gearbox check Section B to determine the approximate oil capacity. Add oil through the dip stick opening labeled OIL FILL. Add oil until the level reaches the mark on the dip stick,(the dipstick must be screwed in). It may take time for the oil level to stabilize since the liquid must transfer to the front reservoir. If desired the front cover can be removed and oil poured directly in. The final oil level should be 1/2" to 3/4" from the top of the reservoir. (cover removed). Do not overfill. When replacing the cover make sure the diaphragm is properly lined up.

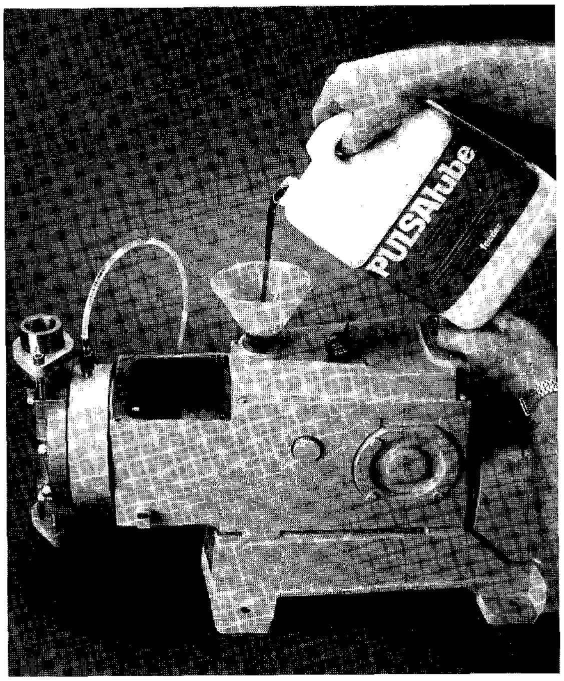


Fig. 12

D. Oil Change

The recommended oil change interval is dependent upon the operating environment, two classifications are used.

1. Normal Service: Clean/Dry atmosphere and a gearbox operating temperature of 40°F to 100°F (4.4°C to 37.7°C).

2. Severe Service: Humid atmosphere and a gearbox operating temperature below 40°F or over 100°F.

The first oil change should be done after 6 months of continuous operation (approximately 4500 hours) and then every 12 months (9000 hours) for normal service and every 6 months (4500 hours) for severe service. Follow the procedure below when changing the oil.

1. Remove all pressure from the reagent head.

2. Disconnect power to the motor.

3. Remove the motor coupling guard.

4. Set the pump stroke to 0%.

5. Remove both covers from the pump (refer to MAINTENANCE, Section XI).

6. On the side of the pump at the bottom of each reservoir is a pipe plug, remove these to drain the oil. Note, on some models an oil return tube may be piped to the drain hole, remove the tube and fitting to drain the reservoir. It is not necessary to drain the oil in the hydraulic system including any piping to remote heads unless the system has been contaminated due to a diaphragm failure.

7. Wash down the inside of the gearbox with kerosene or a petroleum base solvent. It may be helpful to rotate the motor coupling by hand in order to reach all areas of the box.

8. Flush the box and remove all traces of solvent by drying out the box with a rag. Replace the pipe plugs and/or fittings.

9. Refill both reservoirs with fresh PULSAlube oil. The level should be 1/2" to 3/4" from the top of each reservoir.

10. Reinstall the covers. Grease the slip joint and gearing on top of the oscillating housing prior to installing the rear cover. (Refer to MAINTENANCE, Section XI).

11. Reinstall the coupling guard.

II. START UP

A. Output Adjustment

Due to the possibility of piping leaks it is best to start the pump at 0% output and then slowly increase the setting to 100%.

The manually controlled PULSA Series pump is equipped with a handwheel for stroke length adjustment. Mounted on the back of the cover (Figure 13), the handwheel can be turned to any setting from zero to 100%. A digital indicator shows the setting for output reference. (See Table I for maximum indicator readings).

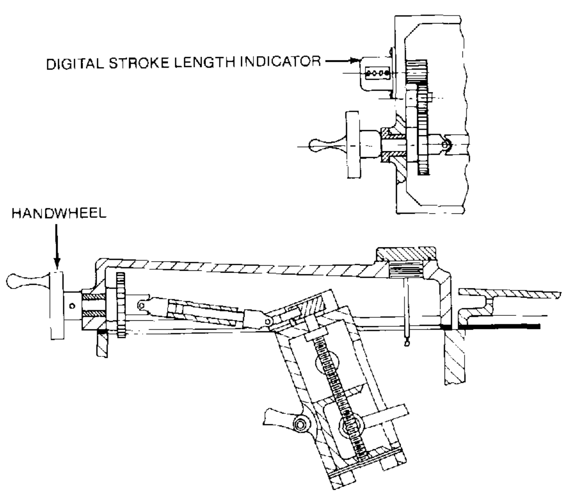


Fig. 13

MAXIMUM STROKE LENGTH INDICATOR READINGS

PUMP MODEL	MAXIMUM READING
7120	0400
7440	0400
7660	0500
8480	01415

Table I

Pumps equipped with automatic electronic control can be adjusted either manually or through electronic control. Refer to Bulletin No. 418 for further information. Pumps equipped with pneumatic control cannot be adjusted manually therefore an instrument air signal is required for start-up. Refer to Bulletin No. 411-86 for further information.

Regardless of the type of control, pump output should only be adjusted when the pump is running.

B. Priming the Pumphead (Standard heads only, refer to separate instructions for custom heads).

All pumps, excluding those with remote pump heads, are shipped with a fully primed hydraulic system. However, during shipping and handling some air may enter the hydraulic system due to the reservoir being empty. This air will automatically be purged after a short run-in period.

C. Priming the Reagent Head (Standard heads only, refer to separate instructions for custom heads).

1. Open the suction line and discharge line shut-off valves.

2. If the piping system design and the storage tank are such that the product flows by gravity to the pump, no priming is required. If, however the discharge line is under high pressure with a considerable quantity of air trapped, it may be necessary to lower the discharge pressure to enable the pump to prime itself.

3. If the pump must handle a suction lift, it may be necessary to prime the reagent head and suction line. Try priming the reagent head first. Remove the discharge valve by unscrewing the two tie bar bolts and then lifting the valve out as a complete unit. Fill the head with the process liquid, or a compatible liquid, then replace the valve in the same orientation and retighten the tie bar bolts. The pump is now ready for start-up.

4. Start the pump at 0% and slowly increase the stroke setting to 100%. If the pump does not prime then the suction line will have to be filled also.

This will require the use of a foot valve or similar device on the end of the suction line so that liquid can be held in the line above the reservoir level. Remove the suction valve assembly to fill the line. Replace the valve and fill the reagent head as described in Step 3. The pump will now prime itself.

D. Calibration

All pumps must be calibrated in order for the operator to know the required stroke setting for particular outputs.

A typical displacement chart is shown in Figure 14. The output is linear with respect to indicator settings. However, an increase in discharge pressure decreases output and describes a line parallel to the line of output at atmospheric pressure.

Capacity at atmospheric pressure is a theoretical value equal to the hydraulic wipe of the piston (cross sectional area X stroke). As discharge pressure is increased there is a corresponding decrease in capacity at a rate of approximately 1% per 100 psi (7Kg/cm^2) increase in pressure. Whenever possible calibration should be performed under actual process conditions (i.e. same or similar liquid at system pressure).

To assure a completely sound hydraulic system, run the pump for one half to one hour prior to calibration. This will allow the automatic bleed valve to purge any air from the system.

To construct a calibration chart check the capacity several times at three or more stroke length settings (i.e. 25%, 50%, 75% & 100%) and record these valves on linear graph paper. For all stable conditions, these points should describe a straight line.

On models with external stroke adjustment, calibration can be disturbed when the cover is removed (Refer to MAINTENANCE, Section XI for details).

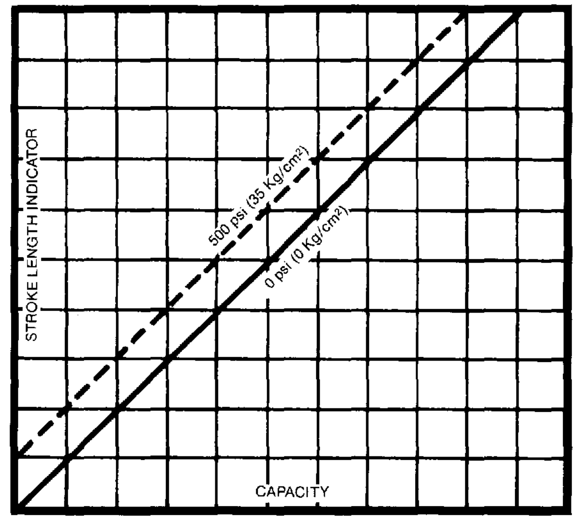


Fig. 14

MAINTENANCE

CAUTION

Before performing any maintenance requiring reagent head (wet-end) disassembly be sure to remove pressure from the piping system and flush pump thoroughly with a neutralizing liquid. Wear protective clothing and handle equipment with proper care.

Accurate records in the early stages of pump operation will reveal the type and amount of maintenance that will be required. A preventative maintenance program based on these records will insure trouble-free operation. It is not possible in these instructions to forecast the life of such parts as the diaphragm, check valves and other parts in contact with the product you are handling. Corrosion rates and conditions of operation affect the useful life of these materials so an individual metering pump must be gauged according to particular service conditions.

PULSA Series Kopkits contain all replacement parts normally used in a preventative maintenance program. It is recommended that Kopkits and PULSAlube oil be kept available at all times.

All PULSA Series pumps are shipped with an individual specification data sheet supplied in the parts list package. This data sheet contains important information relating to both the application and the pump specifications (materials, piston size, stroking rate etc.). Please refer to this sheet during maintenance operations and when ordering spare parts.

I. WET END REMOVAL, INSPECTION AND REINSTALLATION

A. Flat Diaphragm

PULSA Series flat elastomer, TFE and metal diaphragms are not subject to stress fatigue and will not fail from repeated flexure in normal use. However, long-time accumulation of foreign material or entrapment of hard sharp particles between the diaphragm and dish cavity can eventually cause failure. Failure may also occur as a result of over-pressurization or chemical attack. Periodic inspection of all flat diaphragms is desirable. (Figure 15).

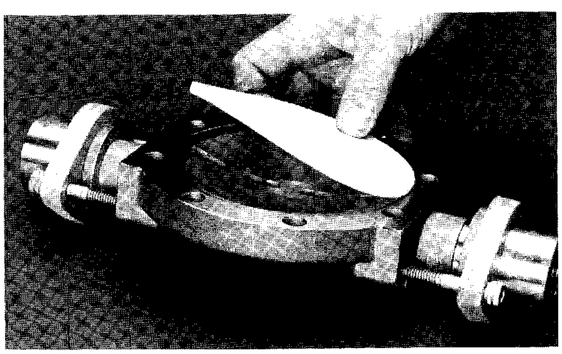


Fig. 15

To remove the diaphragm the first six steps are the same for TFE or metal diaphragms, custom head assemblies included.

1. Remove all pressure from the piping system.
2. Disconnect the power source to the drive motor.
3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous liquid.
4. Close the inlet and outlet shut-off valves.
5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if liquid is hazardous.**
6. Place a pan under the pump head to catch oil or intermediate liquid leakage.

   CAUTION: If the diaphragm has failed, product may have contaminated the pump oil. Handle with proper care.

   For plastic and elastomer diaphragms, follow Steps 7 through 15. For metal follow Steps 16 through 21.

7. Remove all but one top reagent head bolt. Oil (or intermediate liquid depending on the model), will leak out between the heads as the bolts are loosened.
8. Rotate the head and pour any residual product/neutralizing agent trapped by the check valves into a suitable receptacle. **Use extreme caution if hazardous.** Custom head assemblies utilizing remote valves may require disassembly of the pipe between the reagent head and valves.
9. Remove the last bolt and rinse the head in water or a compatible liquid.

10. PULSA Series TFE and elastomer diaphragms incorporate an integral "o" ring design which seats into the reagent head. If the diaphragm has been damaged, insert a knife along the diaphragm's periphery and pry it out. If plastic head construction, use extreme caution so as not to mar, gouge, or damage the head or sealing area during diaphragm removal. If the diaphragm cannot be removed by this method use air pressure as described in Step 11.

11. If there is no evidence of damage on the pump head side, the diaphragm can be removed for complete inspection by forcing compressed air into the suction port while plugging the discharge port. Inspect the diaphragm for damage. It may appear convex or concave as a result of conforming to the dishplates. This is a normal condition and does not require replacement. If the diaphragm appears warped, deformed or excessively dimpled replace it.

12. On diaphragm reinstallation, it is not necessary to follow the original orientation to the reagent head or pump head hole pattern. Set the diaphragm in place on the reagent head and work the integral o-ring into place by pressing around the periphery. Insure that the diaphragm sealing area is clean and free of debris.

13. Before mounting the reagent head make sure the pump head dish plate is seated in the head with the concave cavity facing the diaphragm, and one of the four holes closest to the edge of the dish plate is at the top of the pump head (Figure 16). This assures that any gases are vented out of the dish cavity.

14. Reinstall the reagent head bolts and tighten in an alternating pattern to ensure an even seating force. Refer to Appendix III for recommended torque values.

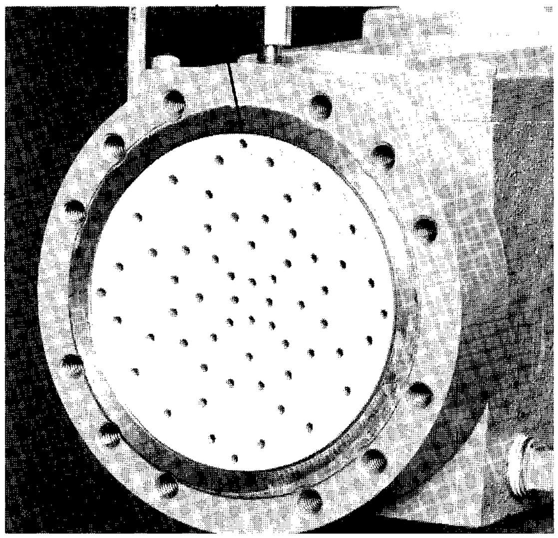


Fig. 16

15. For repriming follow procedures in MAINTENANCE, Section II.

The following steps apply to metal diaphragms:

16. As the diaphragm is sealed by "o" rings, or gaskets, at both the pump head and reagent head, leakage of both oil and product pumped can occur simultaneously when the reagent head bolts are loosened. It is, therefore, desirable to remove the inlet check valve to drain the reagent head and cavity of any residual product/neutralizing agent. **Use extreme caution if hazardous.**

17. When removing the reagent head bolts leave the two bottom ones in place but back them out until the heads can be separated and the diaphragm is exposed at the top. Carefully extract the diaphragm using needle nose pliers. If the pump is equipped with a PULSAfram, leak detection diaphragm then the vacuum tube leading from the diaphragm to the alarm will have to be disconnected at the alarm.

18. The diaphragm should appear smooth and flat. If there are any signs of damage such as dents, nicks or cracks, replace it.

19. If the "o" rings are extruded or cut, replace them. On older models with flat gaskets replace the gaskets each time the head is removed. The gaskets must be properly centered on the serrations located on the pump and reagent head. In order to facilitate installation hold the gaskets in place with a compatible adhesive.

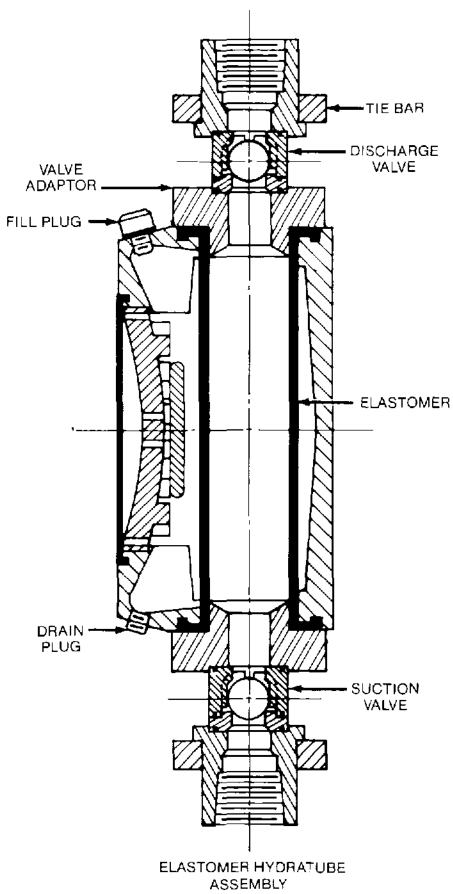
20. Before reassembly, make sure all faces of the reagent head and pump head are clean. See Appendix III for recommended torque values.

21. For repriming follow procedures in MAINTENANCE, Section II.

B. HYDRATUBE Diaphragm

Like flat diaphragms, the HYDRATUBE is not subject to stress fatigue and will not fail from repeated flexure. Failure may occur however as a result of improper prime, over-pressurization or chemical attack.

To remove and reinstall the HYDRATUBE the first 7 steps are the same for elastomer or PFA HYDRATUBE. (See Figures 17a and b).



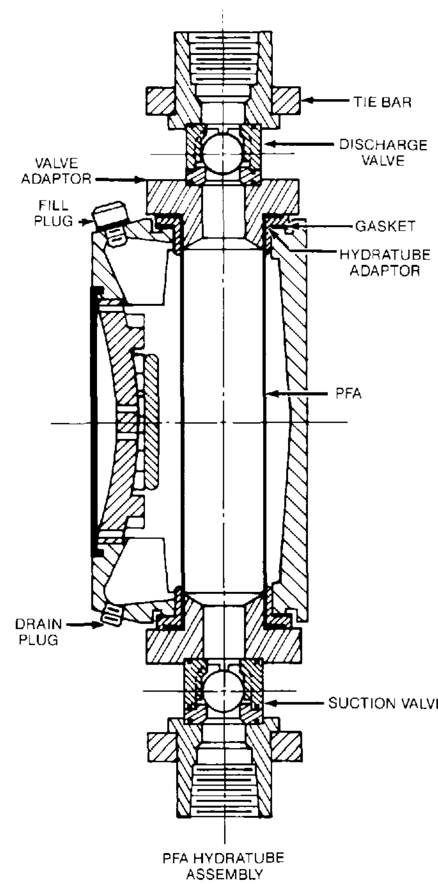


Fig. 17a and b

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.

4. Close the suction and discharge shut off valves.

5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if the product is hazardous.**

6. Remove the top fill plug from the HYDRATUBE housing. Next place a pan under the housing and remove the bottom pipe plug to drain the intermediate liquid. Note: On models equipped with a CHEMALARM the bottom pipe plug is replaced with a conduction probe. Refer to separate instructions for removal and reinstallation of the probe.

CAUTION: If the diaphragm has failed, intermediate liquid could have process liquid mixed into it. If the primary diaphragm has also failed, product may have contaminated the pump oil. Handle with proper care.

7. Remove the tie bars, valves and valve adapters from both the suction and discharge.

For elastomer HYDRATUBES follow Steps 8 through 20. For PFA HYDRATUBES follow Steps 21 through 36.

8. Pick up on edge of the HYDRATUBE flange (Figure 18) and push that same edge down the throat of the HYDRATUBE. The balance of the flange will fold and follow.

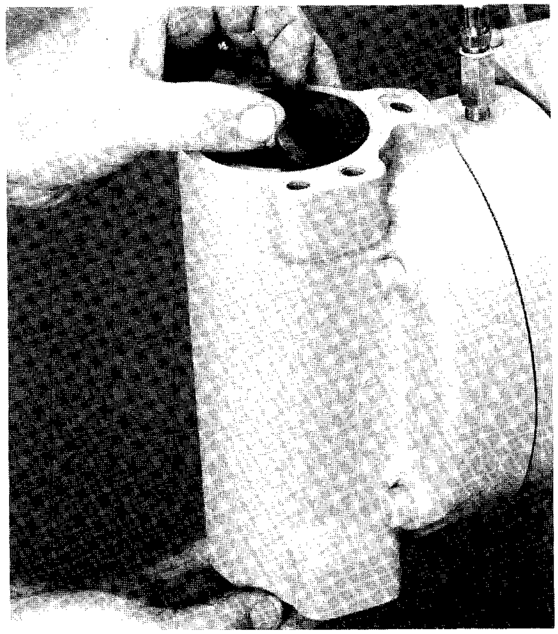


Fig. 18

9. Pull the HYDRATUBE out from the bottom of the housing by a combination of twisting and bending sideways.

10. Inspect the HYDRATUBE for any damage, i.e. cuts, cracks, chemical attack or excessive deformation. Replace if necessary.

11. When installing a HYDRATUBE do not use tools which may cut or damage the tube.

12. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

13. Fold a point on the edge of the flange upward (Figure 19). Push the edge down the throat of the HYDRATUBE (Figure 20). Fold the sides of the flange inward to form a compact 45° "nose" and wrap tightly with a rubber band (Figure 21). This wrapped nose should be reasonably compact and secure.

14. Work the wrapped nose of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the tube upward to the top of the housing.

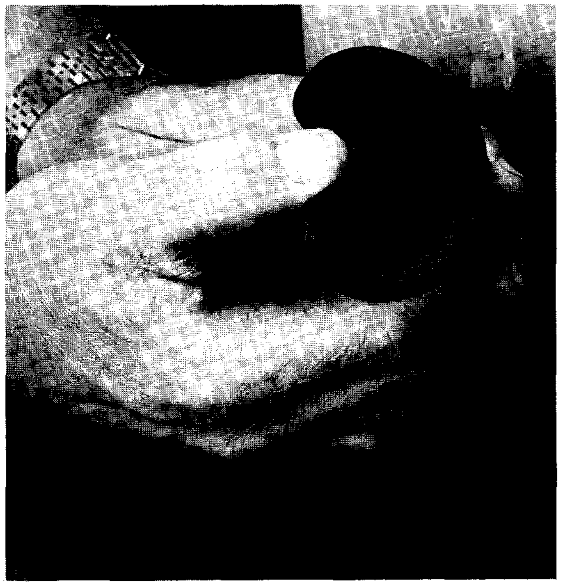


Fig. 19

Fig. 20

15. At this stage, with a slight push at the bottom flange of the HYDRATUBE guide the nose of the HYDRATUBE to the center and out the top hole in the housing (Figure 22).

16. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded, reinstall the bottom valve adaptor and drain plug and then partially fill the housing with the appropriate liquid.

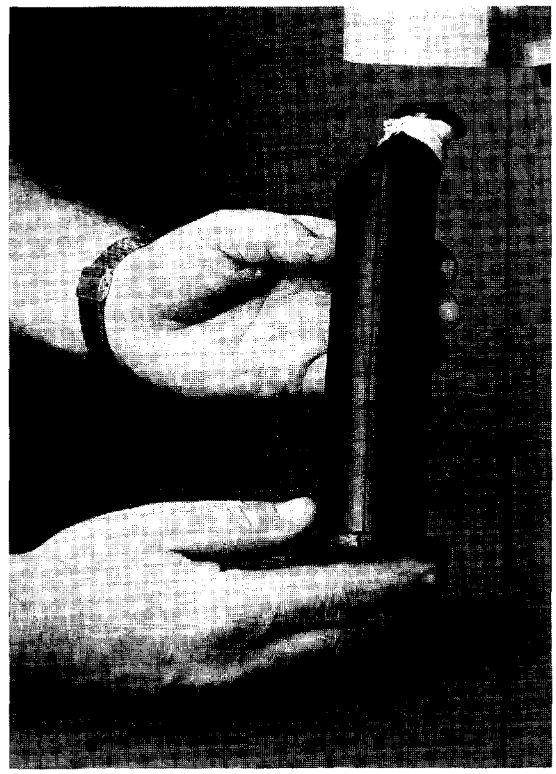


Fig. 21

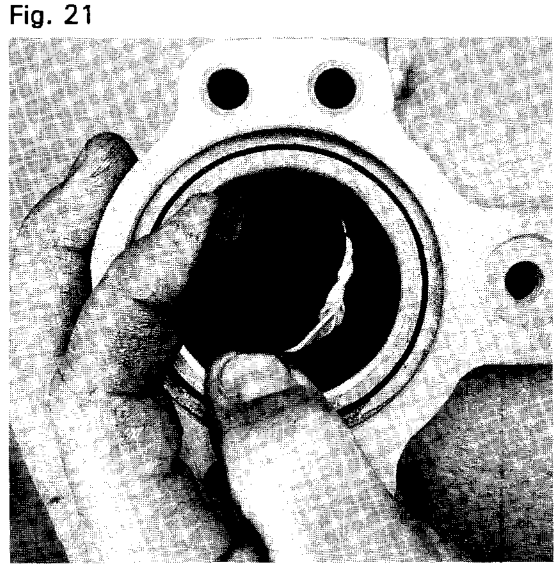


Fig. 22

17. Remove the rubber band.

18. Unfold the top flange (Figure 23) and center both the top and bottom of the HYDRATUBE.

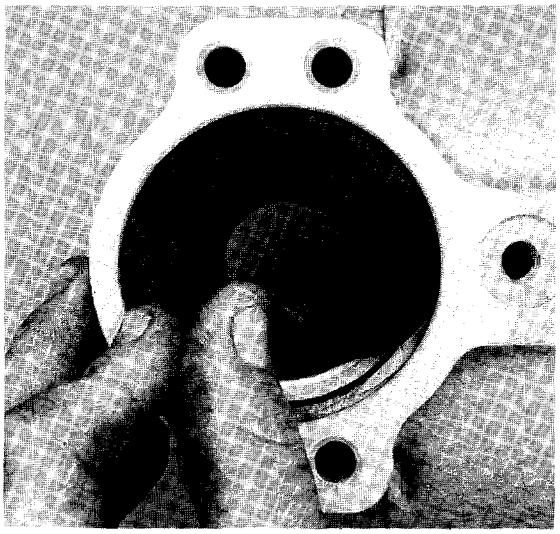


Fig. 23

19. Reassemble the top and bottom adaptor parts, torquing the tie bar bolts to the recommended value, see Appendix III. Replace the bottom drain plug.

20. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat diaphragm repriming procedure before repriming the intermediate or housing chamber. See MAINTENANCE, Section II.

The following steps apply to PFA HYDRATUBES.

21. Pick up the edge of the HYDRATUBE flange and bend it upwards so that it is even with the body of the tube (Figure 24). Avoid creasing the tube material.

22. While keeping the flange bent up, lift and remove the HYDRATUBE adaptor and any gaskets beneath it (Figure 25).

23. Pull the HYDRATUBE out from the bottom by a combination of twisting and bending sideways. Also remove any gaskets which were beneath the bottom tube adaptor.

24. Inspect the tube for any damage, i.e. cuts, cracks, chemical attack. Replace if necessary.

25. When installing a HYDRATUBE do not use tools which may cut or damage the tube.

26. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

27. Place one flat gasket in the top recess of the HYDRATUBE housing (Figure 26).

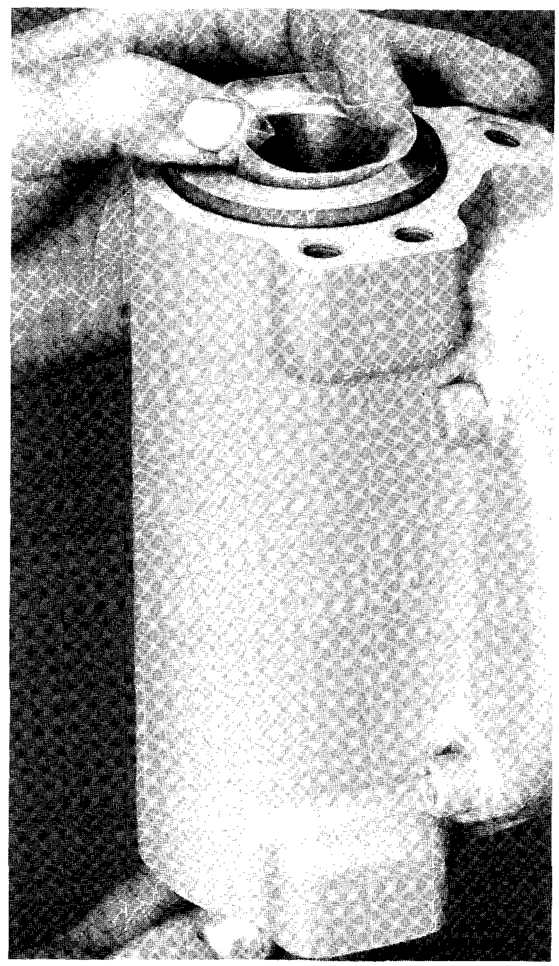


Fig. 24

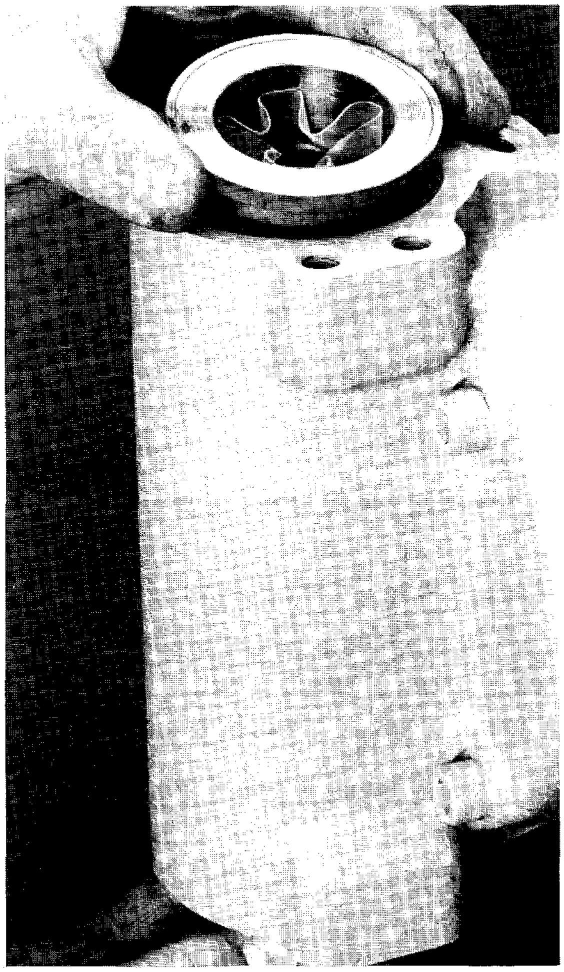


Fig. 25

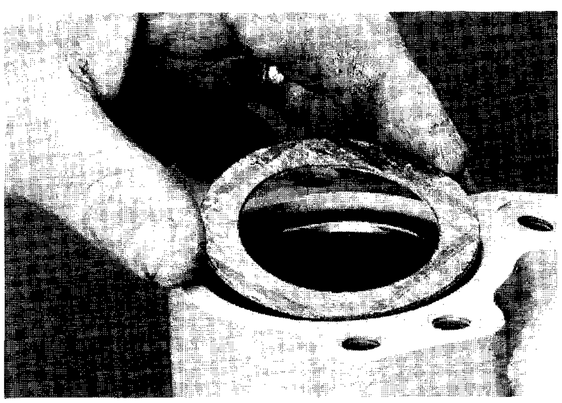


Fig. 26

28. Check the bottom HYDRATUBE adaptor, it should have one flat gasket on it. Carefully straighten the flange on one end of the HYDRATUBE and work it through the adaptor and gasket (Figure 27). Slide the adaptor and gasket to the opposite end of the HYDRATUBE.

29. Now tightly wrap the straightened end of the HYDRATUBE with a rubber band. (Figure 28).

Fig. 27

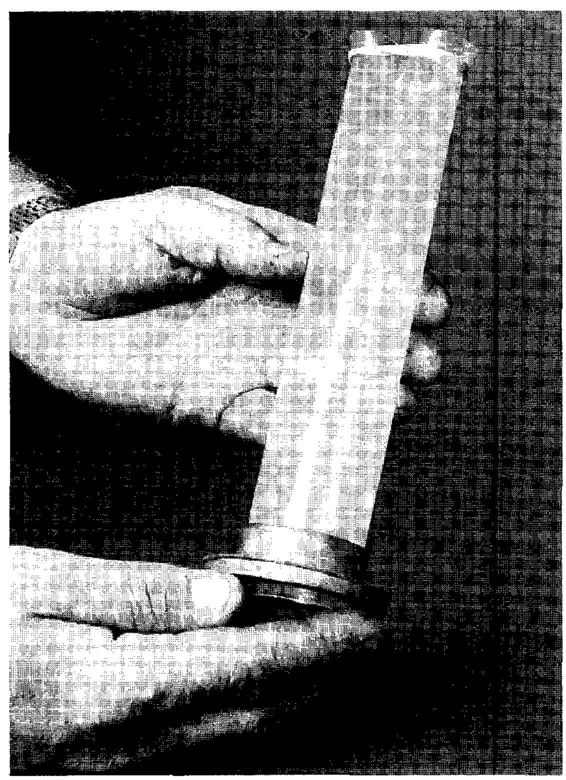


Fig. 28

30. Work the wrapped end of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the HYDRATUBE upward to the top of the housing.

31. At this stage, with a slight push at the bottom flange of the HYDRATUBE, guide the nose of the HYDRATUBE, to the center and out the top hole in the housing (Figure 29).

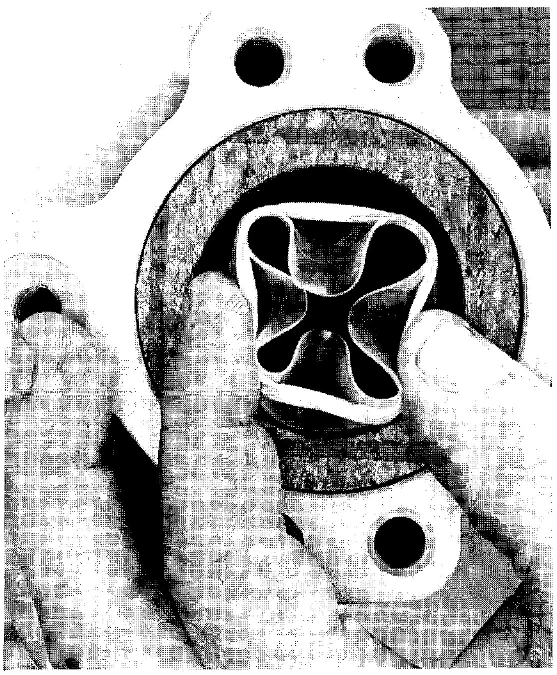


Fig. 29

32. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded, reinstall the bottom valve adaptor and drain plug and then partially fill the housing with the appropriate liquid.

33. Work the top HYDRATUBE adaptor over the top end of the HYDRATUBE. It may be necessary to remove the rubber band first.

34. Unfold the top flange (Figure 30) and center both the top and bottom of the HYDRATUBE. Make certain the HYDRATUBE flanges are seated in the HYDRATUBE adapters.

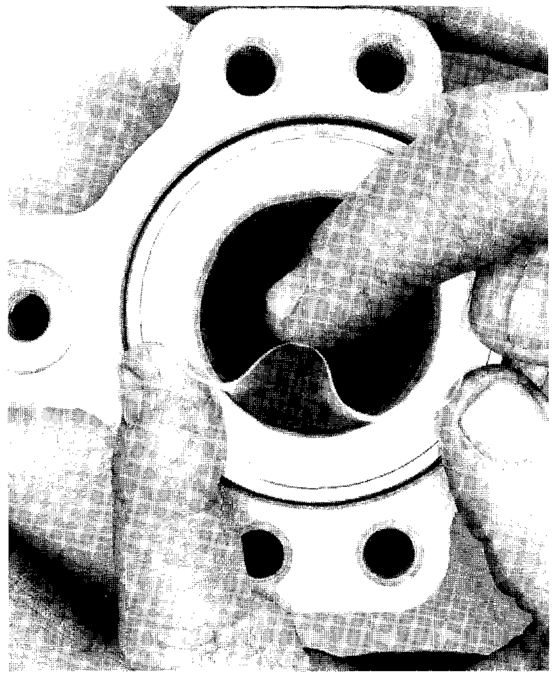


Fig. 30

35. Reassemble the top and bottom adaptor parts, torquing the tie bar bolts to the recommended value, see Appendix III. Replace the bottom plug.

36. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat diaphragm repriming procedure before repriming the intermediate or housing chamber. Refer to MAINTENANCE, Section II.

II. REPRIMING THE PUMP

(Standard heads only, refer to separate instructions for custom heads).

A. Presets

1. Adjust the stroke length (capacity) to maximum. (See "Output Adjustment" Page 12).

2. Disconnect power source.

3. Close inlet and discharge shut off valves.

4. Loosen or remove suction and discharge check valve assemblies.

5. Remove the coupling guard.

6. Remove the front reservoir cover assembly.

7. If HYDRATUBE design, remove intermediate fill plug.

B. Priming the Pumphead

1. Unscrew the tube fitting nut at the top of the automatic bleed valve and remove the plastic tube. Do not remove the actual tube fitting from the bleeder body.

2. Fill both the gearbox and hydraulic reservoir with PULSAlube oil to within 1/2" to 3/4" (13 to 19 mm) from the top.

The next step is dependent on the particular pump model. (See Figure 31). Proceed to 2(a) and 2(b).

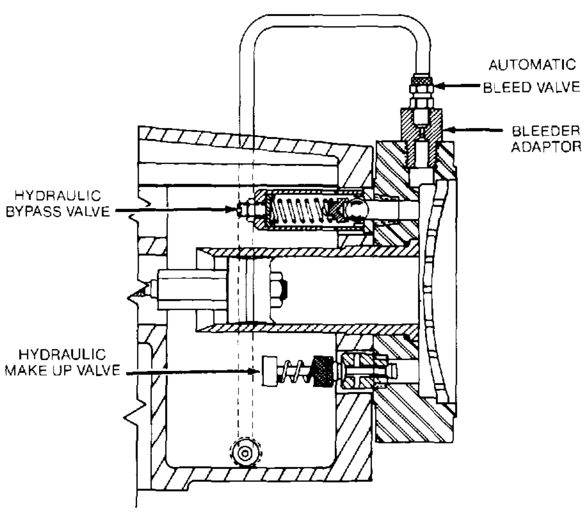


Fig. 31

2a) For all models with a bleeder adaptor: Remove the bleeder adaptor from the pumphead. Rotate the motor coupling (with bleeder attached) and as the piston is being retracted, slowly pour PULSAlube oil through the bleeder adaptor opening until the pumphead is full and the piston is in the full rearward position (proceed to Step 5).

2b) For all other models: Use a wrench on the body of the bleeder valve to remove it from the pumphead. Now place a plastic pipette (i.e., funnel, etc.) into the threaded hole and fill it with PULSAlube oil.

3. Turn on the pump and operate it until all air has been purged from the pumphead (add oil to the pipette as required).

4. Shut off the pump and manually retract the piston to full rearward position. Remove the pipette.

5. Replace the automatic bleed valve (and adaptor if preset) into the pumphead.

6. Manually rotate the motor coupling to move the pump piston forward. If, at some point, it becomes difficult to turn the coupling loosen the hydraulic bypass valve until oil is forced back into the gear box, thus allowing the piston to move to the full forward position. Keep track of how many turns the bypass valve is loosened.

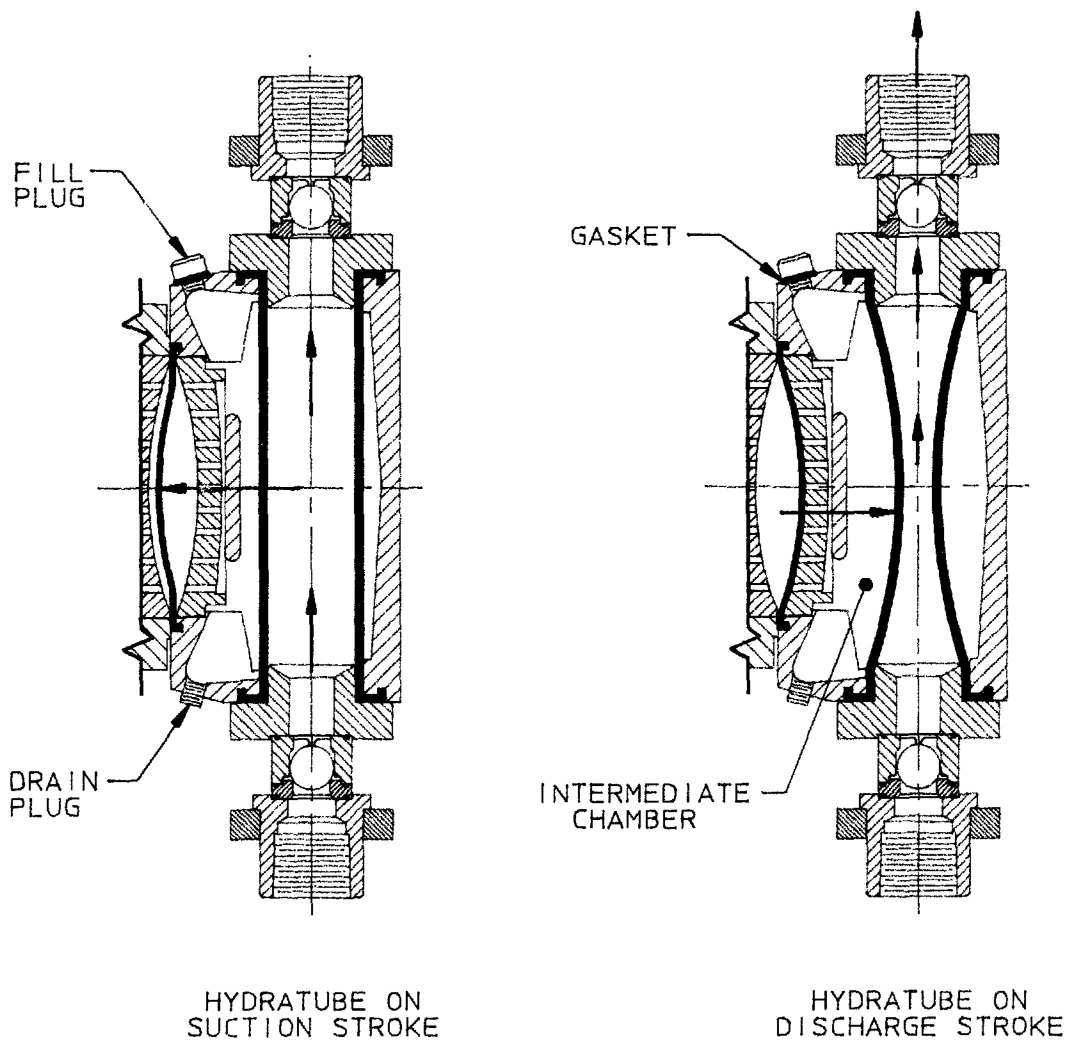
7. Retighten the bypass valve the number of turns recorded in Step 6. The primary hydraulic system is now fully primed.

C. Priming the HYDRATUBE (Intermediate Chamber)

In priming the intermediate chamber the flat diaphragm and HYDRATUBE must be properly synchronized. For any given piston/pumphead assembly the flat diaphragm utilizes only 40 to 70% of the combined dish volume. The objective of this procedure is to have the flat diaphragm work off the front dishplate, meaning that on every discharge stroke it just reaches the front dishplate, and on every suction stroke it moves back an amount dictated by the piston volume. The HYDRATUBE, when properly primed should be in its neutral position (fully round) when the diaphragm is in its rearmost position (as dictated by the piston, Figure 32a), and should begin to close as the diaphragm moves forward (Figure 32b). Primed in this way assures stable performance and protects the HYDRATUBE from damage during system upsets. The priming procedure is the same for elastomer and PFA HYDRATUBES. (See Figures 17a and b).

1. Make certain the primary/flat diaphragm has been hydraulically primed by referring to Priming the Pumphead before proceeding.

2. With the intermediate chamber fill plug removed manually rotate the motor coupling until the pump piston assembly is in the full rearward position.



Figs. 32a and b

3. Fill the intermediate chamber using a mixture of water and 1/3 ethylene glycol by volume, or other liquid selected for the particular application.

4. Check the seal on fill plug and replace if necessary. Reinstall and tighten the fill plug to the intermediate chamber.

5. Reinstall the coupling guard and front reservoir cover. Allow the pump to run for 5 to 10 minutes. Observe the action of the HYDRATUBE through the discharge valve port. It may be helpful to shine a light up through the suction port. It should go from a complete round form at the end of the suction stroke to an elliptical shape at full discharge stroke, but not closing off at the middle. The pump now has a correct intermediate prime and is ready for service.

6. Reinstall the suction and discharge valve assemblies.

III. CHECK VALVES

A. General Description

Operating experience on thousands of installations has indicated that most metering pump troubles have to do with check valves. Problems usually stem from (a) an accumulation of solids between the valve and seat, (b) corrosion which damages seating surfaces, (c) erosion from high velocity flow, or (d) physical damage.

Although several valve designs are available, the basic valve incorporates a ball, guide and seat (Figure 33). Flow in the unchecked direction lifts the ball off the seat allowing liquid to pass through the fluted areas of the guide. Flow in the opposite direction forces the ball down sealing it against the sharp edge of the valve seat. The guide allows the ball to rotate but limits its vertical and lateral movement thus minimizing slippage, or flow in the checked direction. By allowing the ball to rotate it seats on a different area each time thus prolonging its useful life. Because the ball returns to the seat by gravity the valve must be in the vertical direction to operate properly. O-rings provide a seal between all the parts. Both the ball and seat are available in a selection of materials best suited for resistance to chemical attack and physical damage.

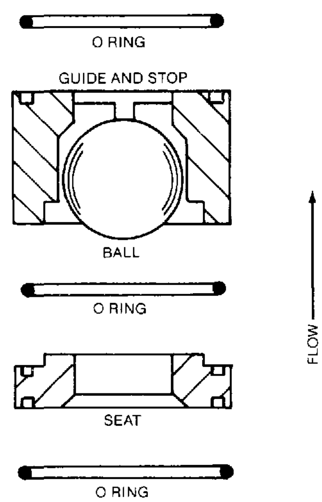


Fig. 33

Other available types of valves include:

a) Slurry Valves (Figure 34), which have an elastomer seat for use with slurries containing abrasive particles.

b) TFE Valves (Figure 35), for applications requiring the chemical resistance of TFE.

(c) Disc Valves (Figure 36), for flows over 400 gph. Also available with elastomer seats (Figure 37), and in TFE (Figure 38).

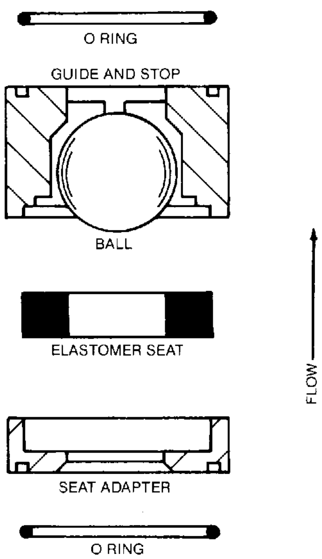


Fig. 34

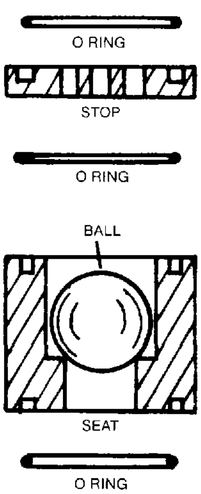


Fig. 35

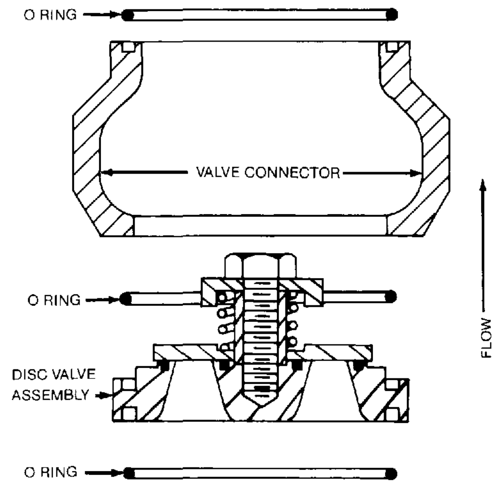


Fig. 36

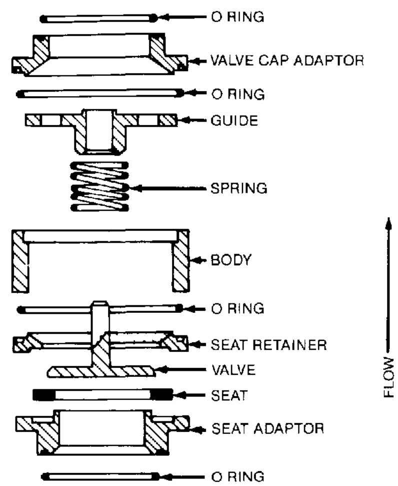


Fig. 37

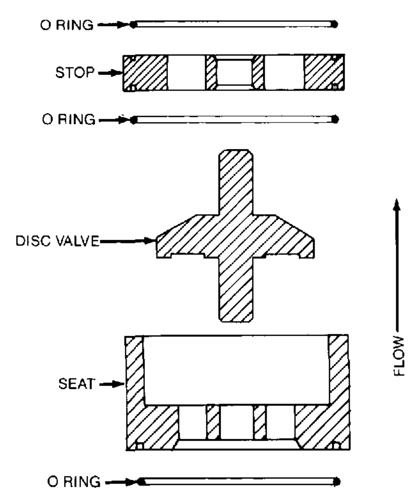


Fig. 38

B. Removal, Inspection and Reinstallation

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.

4. Close the suction and discharge shut off valves.

5. Carefully loosen the suction valve tie bar bolts. Spring the suction piping slightly to drain any liquid in the reagent head cavity. If the piping is closely connected it may be necessary to disconnect a union or flange.

6. Carefully remove the suction check valve assembly as a complete unit. (See Figures 33-38 for illustration).

7. Loosen the tie bar bolts on the discharge valve. Again, spring the piping slightly to drain any liquid.

8. Carefully remove the discharge check valve assembly as a complete unit.

9. Separate the valve assembly and examine the components for wear, damage or accumulation of solids. A ball valve seat should have a sharp 90° edge, free of any nicks or dents. Hold the ball firmly on the seat and examine against a light. If light is visible between the two then replace the seat and/or ball. Disc valves seal on a flat surface. Check to see that the sealing surfaces are clean, smooth and make full contact.

10. Reassemble each assembly using new parts as required. Note, for disc valves the entire valve assembly must be replaced, its components are not considered serviceable items. When replacing parts, use new o-rings, they cannot be removed from old parts and reused.

11. Plastic valve assemblies have metal sleeves which should be coated with a corrosion inhibitor on their interior surface prior to reassembly.

12. Reinstall both valve assemblies. Make certain the valves are not upside down, refer to Figures 33-38 for proper orientation.

13. Tighten the tie bar bolts evenly, making sure the valve assemblies are assembled squarely. Note: TFE components require very little tightening. Refer to Appendix III for torque values.

14. Check for leaks and retighten the tie bar bolts if necessary.

IV. HYDRAULIC MAKEUP VALVE

On each discharge stroke of the pump a very small amount of oil is lost through the automatic bleeder and past the piston seals. This causes the diaphragm to be drawn back further on each successive suction stroke until it contacts the rear dish plate. When this happens the pressure in the hydraulic system becomes negative and the hydraulic makeup valve allows oil to enter the system. All hydraulic makeup valves are factory set to open at a pressure of 7.2 psia (0.51 Kg/cm^2 or approximately 1/2 atmosphere). This setting allows the pump to produce suction at the inlet valve (9.5 psia maximum) and still maintain a sound hydraulic system. If the hydraulic makeup valve is set to a lower absolute pressure, dissolved air within the hydraulic system will come out of solution forming bubbles. These bubbles are subject to compression and can cause capacity loss and erratic operation.

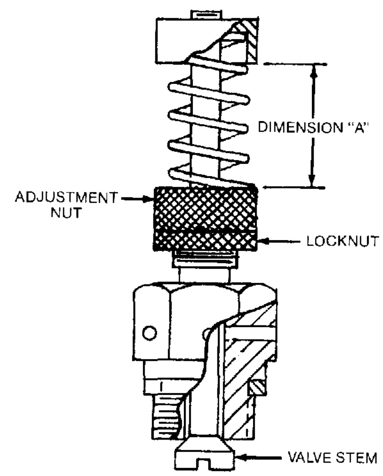


Fig. 39

Pulsafeeder pumps utilize two types of hydraulic makeup valves. The first is an internal, adjustable valve (Figure 39), located on the back of the pumphead inside the front hydraulic reservoir. The second type is external, non-adjustable valve located on the bottom of the pumphead (Figure 40).

All hydraulic make up valves are preset at the factory (parts orders included) and will typically require no maintenance provided the oil is clean and free of moisture. If however it becomes necessary to adjust the internal type follow the procedure below.

The internal type valve can be adjusted by turning the adjustment nut (Figure 39) to vary the spring tension on the valve stem. Normally the distance between the adjustment nut and endcap (dimension "A") should be set to 13/16" (20.6mm). When the valve is working properly it should just "crack" open on every third or fourth stroke of the pump. If the spring

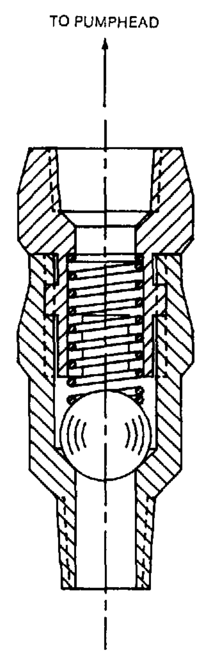


Fig. 40

is set too tight (dimension A is less than 13/16") large air bubbles will form in the hydraulic system and will be seen coming out of the automatic bleeder. If the spring is set too loosely (dimension A is greater than 13/16") then excess oil will be drawn into the hydraulic system which will cause the pressure relief valve to operate. Use dimension "A" as a starting point and carefully adjust the nut in either direction until the valve operates properly. Note: These valves are very sensitive and adjustments should be made gradually. MAKE ALL INTERNAL ADJUSTMENTS WITH THE PUMP TURNED OFF. After setting the adjustment nut tighten the locknut up against it. If the hydraulic make-up valve has to be removed make sure that the copper gasket which goes between it and the pumphead (or in some cases an adaptor bushing) is in place upon reinstallation. On models using an adaptor bushing there is also a copper gasket between it and the pumphead.

As mentioned previously, the external type make-up valve is non-adjustable or serviceable (other than cleaning) and must be replaced as an assembly.

Should either type valve require cleaning rinse with an appropriate solvent and blow dry with air.

V. HYDRAULIC BYPASS VALVE

The hydraulic bypass valve is an adjustable, spring loaded valve. It is designed to protect the pump against excessive hydraulic pressure, it is not meant to limit or regulate system pressure. The valve is factory adjusted for pressure as originally specified, or at 10% above the rated pump pressure.

All pumps, excluding the Model 7440 2 1/8" piston and up, utilize an internal hydraulic bypass valve located on the back of the pumphead, in the front hydraulic reservoir. Several variations of this internal valve are used as shown in Figures 41-43. These valves are adjusted by turning the adjustment screw clockwise (as seen facing the screw) to increase the bypass pressure and counterclockwise to decrease it. Some screws incorporate a locking nut which must be tightened after adjustment. MAKE ALL INTERNAL ADJUSTMENTS WITH THE PUMP TURNED OFF.

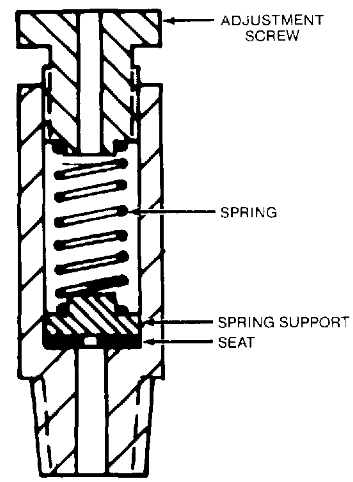


Fig. 41

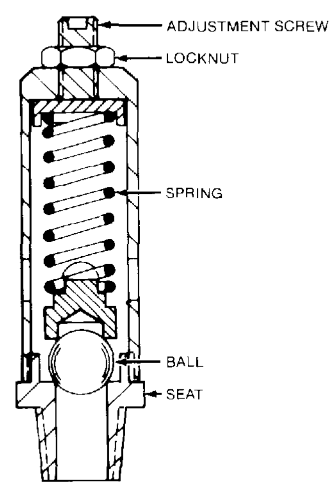


Fig. 42

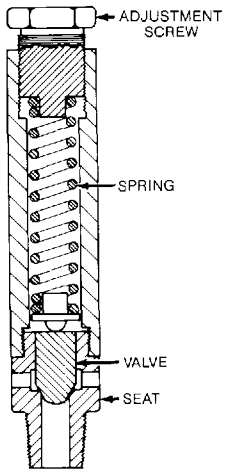


Fig. 43

If the hydraulic bypass pressure is set higher than 10% over the design pressure of the pump damage may occur during a system upset.

Conversely, if the hydraulic bypass pressure is set too low the valve will operate on each discharge stroke. This results in decreased pumping capacity and will eventually affect the efficiency of the valve.

To check the hydraulic bypass pressure setting requires a gauge and shut-off valve in the pump discharge line. The gauge must be between the pump and valve. For convenience locate the two as close to the pump as possible. With the pump operating at maximum stroke, gradually close down on the shut-off valve and observe when the hydraulic bypass valve starts to operate. When the valve operates, oil will either come out the hole in the adjusting screw or through the radial holes in the valve body (depending on what type valve is used). Because the valve is partially submerged in oil it may be necessary to drain some off so that any weeping of the valve can be detected. The cracking pressure of the valve must be at least as high as the maximum pressure of the system but no more than 10% over the pump's rated pressure.

The Model 7440, piston sizes 2 1/8" and up utilizes an external hydraulic bypass valve (Figure 44). It operates in the same manner as the internal valves, except that when it operates, the discharged oil passes through a tube to the rear reservoir. The adjustment procedure is the same as for the internal valves, to check if the valve is operating look for oil movement in the return tube. This is best done by observing any air bubbles. After adjustment always tighten the lock nut and reinstall the safety cap.

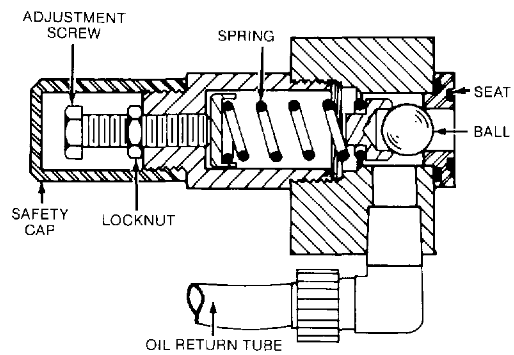


Fig. 44

Periodic inspection of the valve and seat is recommended. If either becomes worn or damaged leakage will occur regardless of how tight the valve is adjusted.

VI. AUTOMATIC BLEED VALVE

Figure 45

A. General Description

The automatic bleed valve is a gravity operated, ball check valve designed to remove gases from the hydraulic system. On each discharge stroke, pressure raises the ball off the lower seat and expels any accumulation of gases. Flow through is limited because the ball also seats against an upper seat. On the suction stroke a weight forces the ball down and prevents gas from reentering the system. When all gases have been expelled a very small quantity of oil will be displaced on each discharge stroke. This oil is returned to the gearbox reservoir through a plastic tube. This tube is only for oil transfer and will normally not be full.

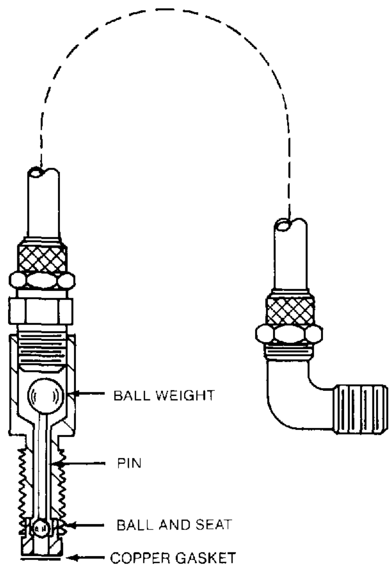


Fig. 45

B. Removal and Cleaning

Any accumulation of solids can cause the valve to malfunction and must be removed.

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Remove the motor coupling guard.

4. Unscrew the nut and remove the plastic tube from the valve. Do not remove the actual tube fitting form the bleeder body.

5. Slowly unscrew the valve, if oil begins to bleed out around the thread manually rotate the motor coupling until it stops.
6. Remove the valve and clean it in kerosene or other petroleum solvent. Blow air through the valve in both directions. You should be able to hear the ball move freely within the valve.

7. Check to see that there is a copper gasket at the bottom of the threaded hole in the pumphead.

8. Manually rotate the motor coupling until oil fills the threaded hole.

9. Reinstall the valve and tubing.

If the valve still fails to operate properly then it must be replaced as an assembly, there are no serviceable components within it.

VII. PISTON SEALS

A. General

PULSA Series pumps utilize several different piston sealing arrangements depending on the pump model and application. The most common type utilizes elastomer impregnated, leather piston cups (Figure 46). These are used on the majority of all pumps. Pumps having smaller pistons (i.e. 1" or less) may use synthetic rubber U packing (Figure 47), elastomer impregnated leather discs (Figure 48), or a plunger and elastomer impregnated leather V-rings (Figure 49). All model 7120's with 2 5/8" piston use a synthetic rubber U packing with a 1 piece piston (Figure 50).

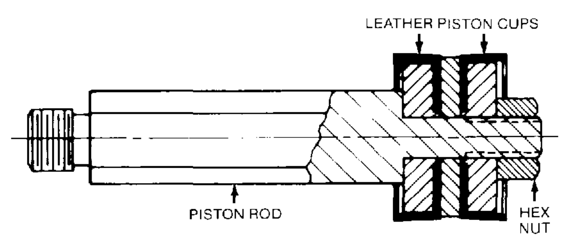


Fig. 46

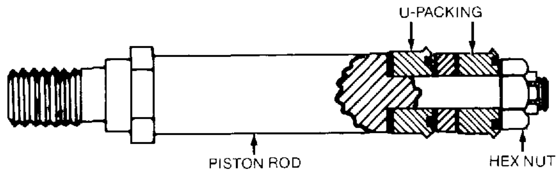


Fig. 47

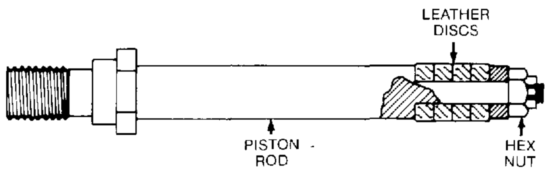


Fig. 48

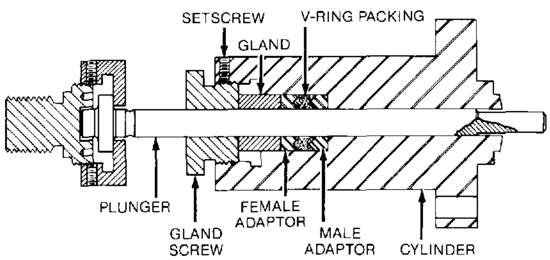


Fig. 49

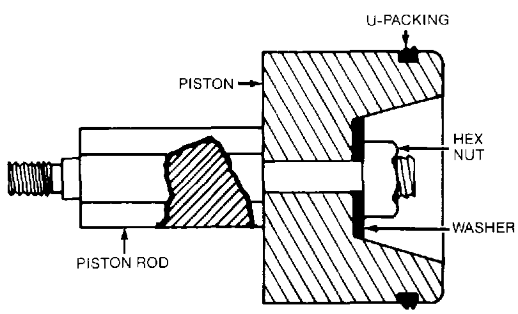


Fig. 50

The useful life of any of these seals depends on several factors such as stroking rate, temperature, pressure, and is therefore impossible to predict for every pump. When a piston seal does wear out however, it will become evident through a loss in capacity and excessive operation of the hydraulic makeup valve.

B. Removal

1a. Standard Heads and Plan C: Refer to MAINTENANCE, Section I and follow the instructions for removal of the wet end. For Plan C, remove the intermediate head also.

1b. Remote Heads: Remove all pressure from the piping system and disconnect the power source to the drive motor. The pipe which transfers hydraulic pressure to the remote head must be removed at the pumphead. There must also be sufficient room to pull the pumphead away from the gearbox.

2. Remove both gearbox covers, refer to MAINTENANCE, Section XI for removal of the rear cover. Drain the gearbox of oil.

3. Using a wrench on the hex portion of the piston rod, unscrew it from the crosshead block. Always place a wrench on the front connecting rod when loosening or tightening the piston rod in order to keep the block from turning.

4. On the Model 7440 with standard heads 1/2" piston and larger, the piston can be removed from the front of the cylinder thus eliminating the need to remove the pumphead. Remove the piston assembly and proceed with Step 7.

5. Remove the two socket head capscrews holding the pumphead to the gearbox. These screws are located on the back of the head inside the front gearbox reservoir. On some models it may be necessary to remove the hydraulic makeup valve in order to access these screws.

6. Slowly pull the pumphead away from the gearbox, keeping the piston in the cylinder. Now remove the piston from the rear of the cylinder.

7. Assemblies using piston cups should be placed in a vise while changing the seals.

C. Reinstallation

The next step is dependent on the particular type of piston assembly:

1a. Standard Piston Cups (Figure 46): Remove the hex nut on the end of the rod and replace the cups, note the direction in which the cups face. The smaller pistons normally incorporate shoulders on the expanders so that the assembly cannot be overtightened, on these the hex nut should be tightened firmly. On pistons with no shoulders, tighten the hex nut just until the piston cups cannot be rotated by hand. Overtightening will deform the cups while looseness will cause seal leakage.

1b. U-Packing (Figure 47): Remove the capscrew (or hex nut) on the end of the rod and replace the seals, note the direction in which they face. Tighten the capscrew firmly.

1c. Leather Discs (Figure 48): Remove the capscrew on the end of the rod and replace the seals. Tighten the capscrew to a snug fit so that the discs cannot be rotated by hand. Overtightening will deform the discs while looseness will cause seal leakage.

1d. Packed Plunger with Leather V-Rings (Figure 49): Loosen the setscrew and remove the gland screw from the rear of the cylinder. Remove gland, female adaptor and v-rings. Replace the v-rings with new ones. Reinstall the female adaptor, gland, gland screw and plunger. Tighten the gland screw until the plunger is snug. Overtightening will deform the seals while looseness will cause seal leakage. As the pump operates, the v-rings will loosen up therefore the gland screw must be retightened at periodic intervals. Proceed with Step 3.

1e. U-Packing, 7120 2 5/8" Piston Only (Figure 50): Use a small screwdriver or similar tool to pry the old seal out of its groove. Stretch the new seal over the piston and slide it into the groove. Now loosen the hex nut on the end of the rod.

2. If the pump is a Model 7440 1/2" piston and larger, the piston assembly can be installed from the front of the pumphead. First dip the seals in PULSAlube oil and then push the assembly into the cylinder. Proceed with Step 3.

   On all other models the piston assembly must be installed from the back of the cylinder. (Pumphead must be removed). Again, dip the seals in PULSAlube oil first. Clean the rear face of the pumphead and the front of the gearbox, use a new gasket to assure a leakproof seal and reinstall the pumphead.

3. With the pumphead back in place, screw the piston rod back into the crosshead block. On the Model 7120, 2 5/8" piston, tighten the hex nut on the end of the piston rod, which was left loose in order to center the piston.

4. Refer to MAINTENANCE, Section I for reinstallation of the wet end. For remote head pumps, reinstall the pipe connecting the pumphead and remote head.

5. Reinstall the hydraulic makeup valve if it had to be removed.

6. Refill the gearbox with oil and replace the cover assemblies. Refer to MAINTENANCE, Section XI to install the rear cover.

7. Reprime the pump as outlined in MAINTENANCE, Section II.

VIII. HOUSING ASSEMBLY

The housing assembly requires no maintenance other than keeping the gearbox oil at the proper level and periodically greasing the gears and slip shaft on top of the housing. Should the assembly ever have to be removed, follow the procedure below.

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Remove both gearbox covers, refer to MAINTENANCE Section XI. Drain the rear oil reservoir.

4a. Models 7120 and 7440 Only: Remove the allen setscrews located in the gearbox sides directly above the housing bearing pins. Use a screwdriver to pry out the pins. (Figure 51).

4b. Models 7660 & 8480: Remove the bolts which hold each bearing pin in place. To remove the pins, thread the bolts into the tapped holes and turn. The pin will then be driven out. (Figure 52).

5. Raise the housing up and remove the front connecting rod pin from the crosshead block by loosening the allen setscrew in the rear face of the block.

6. Remove the rear connecting rod pin in the back of the housing by removing one of the cotter pins.

Reinstall the assembly by following the reverse sequence of procedures described in Steps 3-6. When reinstalling the housing bearing pins make certain the o-ring is in place against the shoulder of the pin. On the Model 7120 make certain the pins are all the way in before installing the locking setscrews. Grease the gears and slip shaft on top of the housing before installing the rear cover.

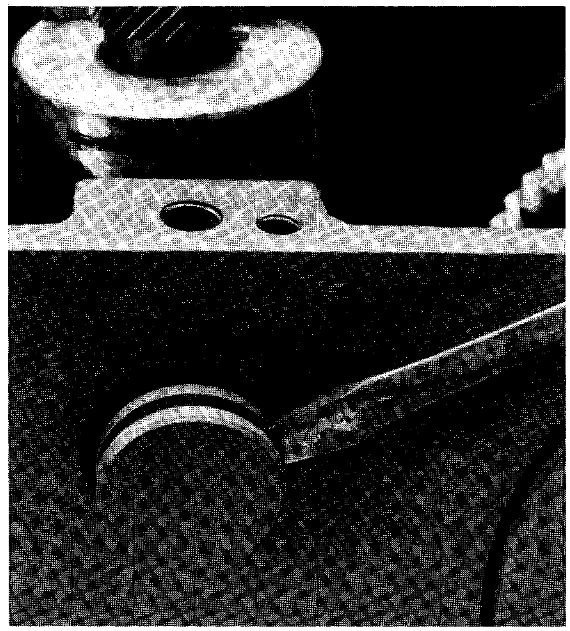


Fig. 51

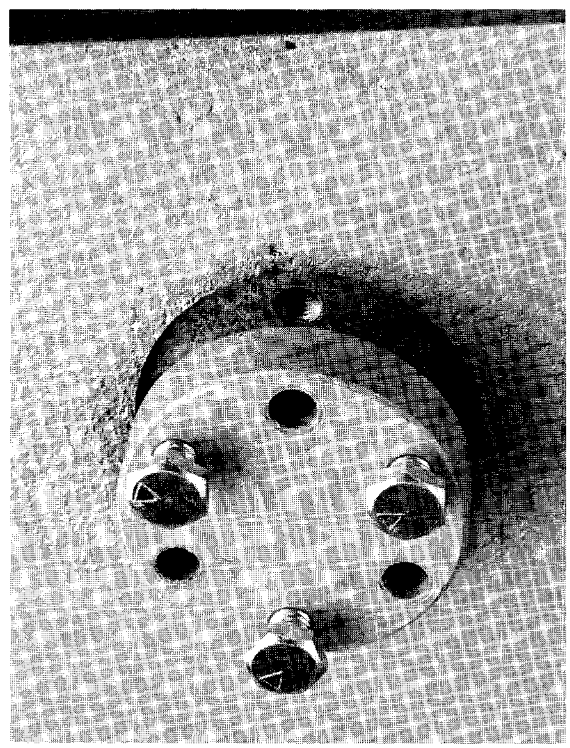


Fig. 52

IX. WORM GEARING, BEARINGS, ECCENTRIC ASSEMBLY

A. General Description

The worm gearing, bearings and eccentric assembly require no maintenance other than keeping the gearbox oil at the proper level and changing it as required.

The worm shaft assembly is a one piece shaft with a tapered roller bearing pressed on each end (Figure 53). The cup or race for the front worm shaft bearing is pressed into the gearbox and is not removable. The rear cup slides into the gearbox bore and is held in place by the bearing cap. By changing the shim thickness underneath the bearing cap, the preload on the bearings can be adjusted. All worm shaft assemblies are adjusted for zero endplay and no preload.

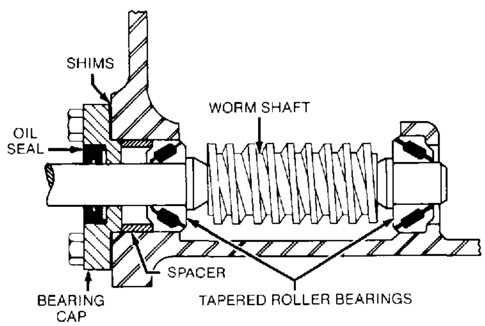


Fig. 53

The eccentric shaft assembly consists of a shaft, key, gear, eccentric cam, spacer, and two tapered roller bearings (Figure 54). All the items excluding the spacer, are pressed onto the shaft. The bearing cups are pressed into the bearing blocks and are not removable. The shims beneath each bearing block are used not only to adjust the bearing preload but also the position of the gear over the worm shaft. Again these assemblies are adjusted for zero endplay and no preload. The assemblies can be removed and replaced without readjusting the shims provided that none of the components are changed. Should a change be required, follow the procedure below to determine the correct shimming.

B. Worm Shaft Assembly Shimming

1. The eccentric shaft assembly must be removed from the gearbox. Note which side of the gearbox each bearing block goes into and also the shims used on each.

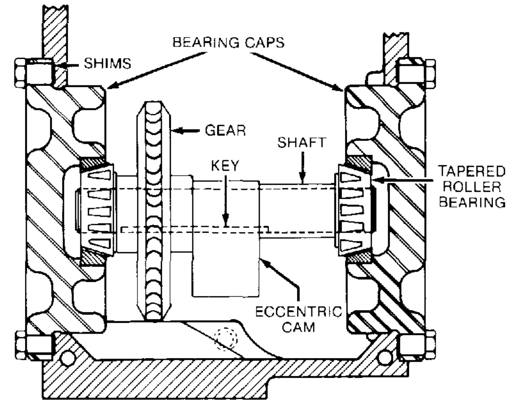


Fig. 54

2. Insert the worm shaft assembly into the gearbox.

3. Place the rear bearing cup and spacer over the worm shaft and slide them into the gearbox bore.

4. Remove any shims which are on the bearing cap. Thoroughly clean the cap and mating surface of the gearbox. Slide the cap into place, do not scratch the shaft in the area where the seal rides.

5. Place an even pressure on the bearing cap while using a feeler gauge to measure the gap between it and the gearbox.

6. Select a combination of shims which is approximately .002" to .003" less than the reading obtained. The shims are color coded for thickness as follows: Green = .003"; Blue = .005"; Clear = .0075"; and Yellow = .020".

7. Put the shims in place, insert the bolts into the bearing cap and tighten.

8. Rotate the worm shaft several times. It may be necessary to install the coupling in order to do this. Check to see that the worm shaft has no end play yet turns freely. If the shaft has visible end play, reduce the amount of shim. If the shaft is difficult to rotate increase the amount of shim.

9. After the amount of shims has been determined, remove the 4 bolts, apply a thread sealant and reinstall them.

C. Eccentric Shaft Assembly Shimming

1. The worm shaft assembly must be in place.

2. Place the eccentric shaft assembly in the gearbox without the rear connecting rod and turned 180°, so that the gears are not meshing. (Figure 55.)

3. Install each bearing block in the same side of the gearbox from which it was removed using the same shims that had been on them previously. Install all the bolts and tighten.

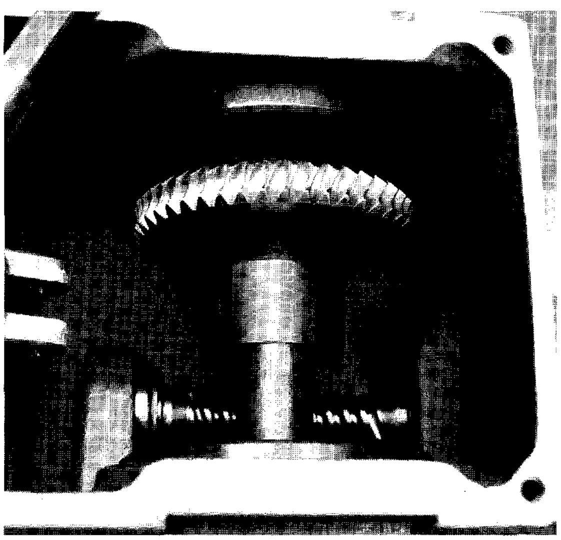


Fig. 55

4. Check to see that the shaft has no end play yet still turns freely. If the shaft has visible end play, reduce the amount of shim. If the shaft is difficult to rotate, increase the amount of shim. The shims are color coded for thickness as follows: Green = .003"; Blue = .005"; Clear = .0075; and Yellow = .020".

Make all shim changes on the bearing block farthest from the worm shaft.

5. Remove the eccentric shaft assembly. Coat the worm threads with prussian blue, red lead, or similar compound designed to check gear teeth contact.

6. Reinstall the eccentric shaft assembly in the correct position with the connecting rod installed. Do not change the amount of shims on the bearing blocks.

7. Rotate the worm shaft by hand in the direction indicated on the coupling guard (counter-clockwise looking at the end of the shaft). Rotate it until the worm wheel has gone around several times.

8. Look at the contact pattern on the driven side of the worm wheel teeth, compare it with Figure 56. Contact should appear in the center of the tooth and continue to the leaving side. If the contact pattern is not correct it can be changed by moving shims from one bearing block to the other. Remove shims on the same end of the shaft as the direction in which you want the contact pattern to move. For example, if the contact pattern is on the entering side of the wheel, remove shims from the bearing block closest to the wheel and place them on the opposite block. A different combination of shims may be used to obtain the proper adjustment however, the total thickness must be the same as determined in Step 4, or the bearing preload will be changed.

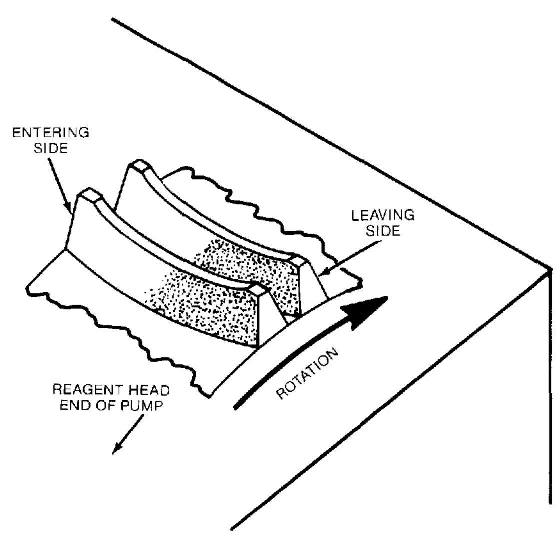


Fig. 56

9. After the correct shim combinations have been determined reassemble the bearing blocks using thread sealant on all bolts.

X. OIL SEAL

A. General

The worm shaft oil seal (Figure 53) properly installed and operating under favorable conditions, should give years of satisfactory leak-free service.

Unfavorable operating conditions such as a corrosive atmosphere, excessive dust or dirt, or contaminated lubricating oil can result in frequent replacement of the seal and worm shaft.

B. Removal and Replacement

1. Disconnect the power source to the drive motor.

2. Remove the coupling guard, electric motor and motor coupling.

3. Refer to MAINTENANCE, Section XI for removal of the rear gearbox cover. Drain the rear oil reservoir.

4. Remove four bolts from the rear bearing cap and slide the cap off the shaft. Retain the plastic shims for reassembly.

5. Using a screwdriver or other pointed tool pry the oil seal from the rear bearing cap.

6. Install a new oil seal into the rear bearing cap by gently tapping it into the counterbore, the part numbers on the seal must be facing out. If the outside edge of the seal is uncoated i.e. bare metal, coat it with a gasket sealant before installation. Seat the oil seal flush with the face of the bearing cap.

7. Before replacing the bearing cap, check the worm shaft sealing area for scratches, burrs, rust or foreign material which may have caused the seal to leak. Also check the shaft-run out, and end play. There should be no visible end play and runout must be less than .010", total indicator reading. If the sealing area is damaged or rusty try restoring it with emery cloth. The surface must be smooth and scratch free in order for the seal to work. If necessary replace the worm shaft.

8. Cover the entire length of the worm shaft keyway with plastic electricians tape. This will keep the sharp edges from damaging the seal as its slid over the shaft. A single strip is sufficient, it is not necessary to wrap tape around the shaft.

9. Apply a light coating of grease to the worm shaft and the inside of the seal. Slide the rear bearing cap over the shaft (make sure the plastic shims are in place between the bearing cap and gearbox). Replace the four bolts.

10. Remove the tape from the worm shaft. Reinstall the coupling, motor and coupling guard. Make certain the motor is properly aligned.

11. Refill the gearbox with oil and replace the rear cover. Refer to MAINTENANCE, Section XI.

XI. REAR GEARBOX COVER ASSEMBLY

A. Manual Control

The handwheel on manually controlled pumps is liked to the oscillating housing by universals and a telescoping slip joint (Figure 57). When the cover is removed the relationship between the two halves of the joint must be maintained or pump calibration will be affected.

Removal

1. Disconnect the power source to the drive motor.

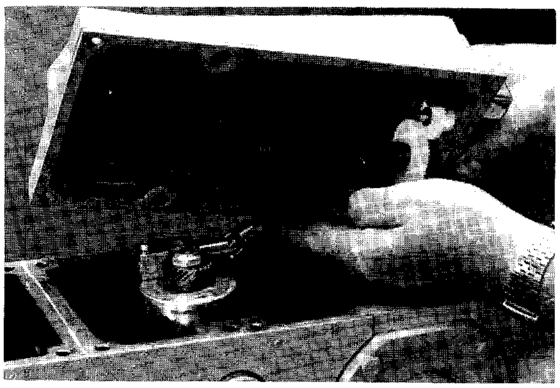


Fig. 57

2. Make sure the handwheel indicator registers zero.

3. Remove the cover screws.

4. Pull the cover back toward the motor and lift off.

5. Do not disturb the relationship between the two halves of the slip joint.

Reinstallation

1. Coat all surfaces of the slip joint assembly and handwheel gearing with a light grease or corrosion inhibitor such as LPS-3.

2. Make sure the handwheel indicator registers zero. Hold the cover sideways to expose the square tube. Then, holding the tube, carefully move the cover forward to engage the shaft (Figure 57). The shaft and tube must be reassembled with the same orientation as when the cover was removed.

3. Place the cover on top of the gearbox and replace the screws.

4. Turn the handle fully counter-clockwise, the indicator should read zero. If it does not then remove the cover, turn the handle until it reads zero and reinstall it as described in Step 2.

B. Auto Electric Control (AE)

The AE actuator is linked to the oscillating housing by universals and a reciprocating shaft. (Figure 58). There is also an external handwheel which can be engaged for manual adjustment.

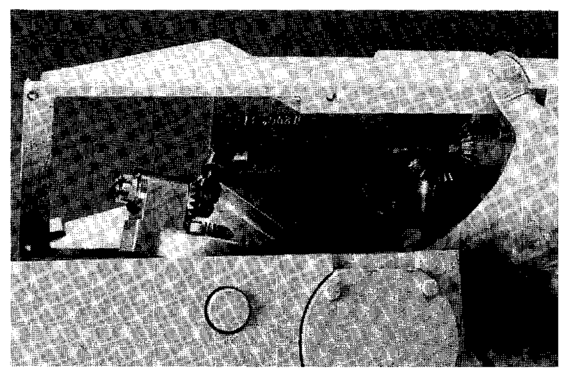


Fig. 58

Removal (Non-Explosion Proof)

1. Disconnect the power source to the drive motor and actuator.

2. Make sure the stroke length indicator registers zero.

3. Remove the cover screws.

4. Lift the cover slightly and hold the shaft horizontal to prevent binding. Pull the cover back towards the motor until the diamond screw shaft is disengaged from the actuator.

Reinstallation (Non-Explosion Proof)

1. Check to see that the block inside the oscillating housing is at the top by turning the shaft counterclockwise (as seen standing behind the pump).

2. If the diamond shaft is dry, lightly coat it with grease.

3. Hold the cover over the pump and carefully insert the shaft into the actuator as you lower the cover in place, (Figure 58). Be sure the stroke length indicator remains at zero.

4. Replace the cover screws.

Removal (Explosion Proof)

On explosion proof models the diamond shaft cannot be withdrawn from the front of the actuator and must therefore be removed from the oscillating housing.

1. Disconnect the power source to the drive motor and actuator.

2. Make sure the stroke length indicator registers zero.

3. Remove the coupling guard.

4. Remove the front gearbox cover.

5. Manually rotate the motor coupling until the oscillating housing is vertical. It may be necessary to remove pressure from the piping system.

6. Remove the cotter pin, nut and washer from the end of the drive shaft on top of the housing.

7. Remove the cover screws.

8. Lift the cover slightly and pull it back towards the motor. As the shaft disengages, the miter gear, bushing and bushing pin will come loose, don't allow them to fall into the gearbox.

Reinstallation (Explosion Proof)

1. Check to see that the block inside the oscillating housing is at the top by turning the miter gear clockwise.

2. If the end of the shaft is dry, coat it with grease.

3. Hold the cover over the pump and insert the shaft into the housing bore as you lower the cover. Make sure the miter gear, bushing and bushing pin are in place and that the stroke length indicator remains at zero.

4. Replace the washer and nut on the shaft. Snug the nut and then back it off to the nearest hole for insertion of a cotter pin.

5. Replace the cover screws, front cover and coupling guard.

C. Auto Pneumatic Control (AP)

The AP actuator is linked to the oscillating housing by a clevis and pin. (Figure 59). The actuator unit must be removed before the cover can be taken off.

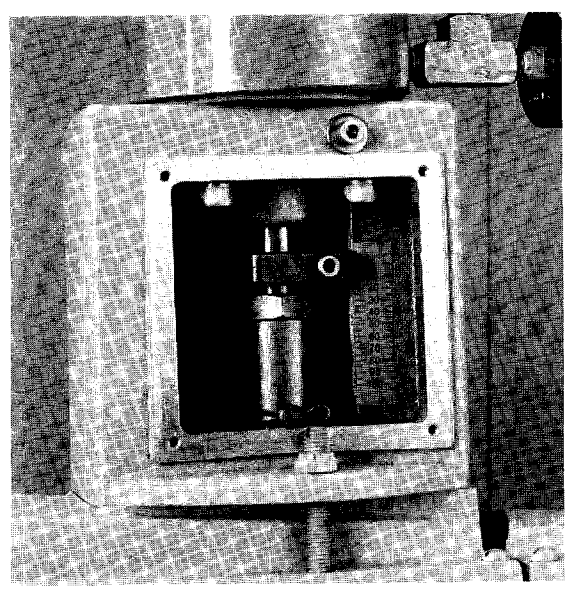


Fig.59

Removal

1. Disconnect the power to the drive motor and the air supply and air signal to the actuator.

2. Remove one of the plexiglass covers from the actuator mount.

3. The stroke length indicator should register zero.

4. Remove one of the cotter pins and drive the pin out of the clevis. The actuator and cover can now be removed.

Reinstallation

1. The gearbox cover must be in place.

2. Clean the bottom surface of the actuator mount and mating surface of the gearbox cover. Use a gasket compound on one of the surfaces.

3. Place the actuator assembly on the pump and install the lock nuts.

4. Make sure the clevis has not rotated. The holes for the clevis pin must be perpendicular to the side of the pump.

5. Pull up on the oscillating housing adjustment rod until the block is firmly against the top of the housing. Now turn the rod 1 turn counter-clockwise and reconnect it to the clevis. This positions the block just off the top of the housing to prevent stressing the parts at 0% stroke setting.

6. Install a new cotter pin in the clevis pin and replace the plexiglass cover.

I. REPLACEMENT PARTS

A. PULSA Series KOPkits Program

PULSA Series KOPkits contain all replacement parts normally used in a preventative maintenance program. (PULSAlube oil is also available for preventative maintenance programs. See Section on Equipment Start-up). There is a specific KOPkit for every PULSA Series pump model. Each KOPkit is vacuum sealed to keep the parts clean even when stored for extended periods of time. All PULSA Series pumps shipped since June 1985 have the KOPkit number on the pump nameplate, the specification data sheet and Pulsafeeder order documents. KOPkits can also be selected from the technical data sheet shipped with the pump or by a Pulsafeeder representative.

B. Ordering KOPkits or Parts

When ordering replacement parts always specify:

* Pump model and serial number (stamped on pump nameplate) e.g., 7120-S-AE with S/N 8604146-1.

* Part name and part number from the PULSA Series part list. Add the part number suffix that designates the material of construction of the wet end. (Note: PULSA Series part numbers begin with the letter "W" e.g., W094136-HYP).

TROUBLE SHOOTING CHART

Difficulty	Probable Cause	Remedy
Pump Does Not Start	1.Coupling disconnected	Connect and align
	2.Faulty power source	Check power source
	3.Blown fuse, circuit breaker	Replace - locate overload
	4.Broken wire	Locate and repair
	5.Wired improperly	Check diagram
	6.Pipe line blockage	Locate block and clear pipe lines
	7.Shutoff valves closed	Open valves
No Delivery	1.Motor not running	Check power source. Check wiring diagram.
	2.Supply tank empty	Fill with liquid
	3.Lines clogged	Clean and flush
	4.Closed line valves	Open pipeline valves
	5.Ball check valves held open with solids	Clean-inspect
	6.Vapor lock, cavitation	Increase suction pressure
	7.Prime lost	Reprime, check for leak
	8.Strainer clogged	Remove and clean. Replace screen if necessary.
	9.Hydraulic system under-primed	Refer to Pages 22 and 23
Low Delivery	1.Motor speed too low	Check voltages, hertz, wiring, and terminal connections. Check nameplate vs. specifications
	2.Check valves worn or dirty	Clean, replace if damaged
	3.Hydraulic Bypass valve operating each stroke	Refer to Pages 29 and 30.
	4.Calibration system error	Evaluate and correct
	5.Product viscosity too high	Lower viscosity by increasing product temperature. Increase pump size and/or piping.
	6.Product cavitating	Increase suction pressure. Cool product as necessary.
	7.Piston cups worn or hardened by contamination	Inspect and replace if deteriorated. Refer to Pages 31-34
Delivery Gradually Drops	1.Stroke adjustment creeping	Consult factory. Replace worn parts.
	2.Check valve leakage	Clean, replace if damaged
	3.Leak in suction line	Locate and correct
	4.Stainer fouled	Clean or replace screen
	5.Product change	Check viscosity
	6.By-pass leakage	Correct for bypass valve leakage
	7.Piston cups worn or hardened by contamination	Inspect and replace if deteriorated. Refer to Pages 31-34
	8.Hydraulic Makeup Valve improperly set	Refer to Pages 28 and 29.
	9. Supply tank vent plugged	Unplug vent

Difficulty	Probable Cause	Remedy
Delivery Erratic	1.Leak in suction line	Locate and correct
	2.Product cavitating	Increase suction pressure
	3.Entrained air or gas in product	Consult factory for suggested venting
	4.Motor speed erratic	Check voltage, hertz
	5.Fouled check valves	Clean, replace if necessary
Delivery Higher Than Rated	1.Suction Pressure higher than discharge pressure	Install back pressure valve or consult factory for piping recommendations.
	2.Discharge piping too small	Increase pipe size-install PULSAtrol at pump in discharge line
	3.Back pressure valve set too low	Increase setting
	4.Back pressure valve leaks	Repair, clean, or replace
Pump Loses Oil	1.Diaphragm ruptured	Replace
	2.Leaky oil seal	Replace
	3.Cover gasket leaks	Replace or tighten
	4.Pump head gasket leaks	Replace-tighten pump head bolts, seal with permatex
	5.Gear box overfilled	Remove excess oil
Air Continuously Bleeds From Automatic Bleeder	1.Oil in reservoir low	Refill to correct level
	2.Hydraulic Bypass Valve operating each stroke	Refer to Pages 28 and 29.
	3.Suction pressure too low	Increase pressure
	4.Breakdown of oil, temperature high	Change oil type, consult factory
Noisy Gearing, Knocking	1.Discharge pressure too high	Reduce pressure or discharge pipe size
	2.Water hammer	Install PULSAtrol
	3.Worn bearings	Replace
	4.Worn gears	Replace gears Adjust hydraulic bypass valve (see Pages 28 and 29).
	5.End play in worm shaft	Shim for thrust
	6.Eccentric or worm gear	Tighten or replace assembly
	7.Hydraulic bypass valve set too high	Readjust (see Page 28 and 29).
Piping Noisy	1.Pipe size too small	Increase size of piping. Install PULSAtrol.
	2.Pipe runs too long	Install PULSAtrol in line
	3.Surge chambers full of liquid	Recharge with air or inert gas. Replace diaphragm and recharge if PULSAtrol being used
	4.No surge chambers used	Install PULSAtrols
Motor Overheats	1.Pump overloaded	Check operating conditions against pump design
	2.Oil too viscous	Use lighter grade oil
	3.Low voltage	Check power supply
	4.Loose wire	Trace and correct
	5.Mechanical binding	Check gearbox mechanism

SUCTION HEAD REQUIREMENTS

All reciprocating metering pumps require a net positive suction head ($NPSH_R$) as shown in Table 1. The $NPSH_R$ is defined as the pressure required above the absolute vapor pressure of the process fluid at the pumping temperature. This pressure is required at the suction port of the pump throughout the entire pump stroking cycle in order to prevent cavitation of the process fluid within the reagent head. The $NPSH_R$ is one of the requirements necessary to assure metering accuracy.

Table 1. $NPSH_R$ values

$NPSH_R$	Pulsar	Pulsa
English (psi)	3	5
Metric (bar)	0.21	0.35

The net positive suction head available ($NPSH_A$) must be greater than the $NPSH_R$. The $NPSH_A$ of any given system is calculated as follows for comparison to the $NPSH_R$ as shown in Table 1.

Equation 1. For fluid viscosity below 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \left(\frac{L_S RGQ}{C_1\ d^2}\right)$$

Equation 2. For fluid viscosity above 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \sqrt{\left(\frac{L_S RGQ}{C_1 d^2}\right)^2 + \left(\frac{L_S \mu Q}{C_2 d^4}\right)^2}$$

The variables used in Equations 1 through 4 must be in the units shown in Table 2 for the constants listed below to be used correctly.

Table 2. Unit sets and constant values for use in Equations 1 through 5.

Variable	Units Set	
	English	Metric
NPSH	psi	bar
P_A	psia	bar(a)
P_H	psi	bar
P_V	psia	bar(a)
L_S	feet	meters
R	strokes/min	strokes/min
G	no units	no units
Q	gallons/hr	liters/hr
d	inches	millimeters
μ	centipoise	centipoise
L_D	feet	meters
P_T	psi	bar
P_P	psi	bar
V_P	feet/sec	meters/sec
C_1	24,600	640
C_2	45,700	1.84
C_3	46.8	0.91

Note: If piping sizes vary throughout the suction line, different additive values may be used for the pressure losses attributed to the liquid's acceleration and deceleration. Use the last term of Equation 1 or 2 as many times as needed in the equation to adjust for different lengths of different pipe diameters in the suction line. (Everything but the pipe length and diameter will stay the same in the equation.)

All reciprocating metering pumps also require that a minimum absolute pressure, minimum suction head (MSH), be maintained at the pump inlet throughout the pumping cycle to ensure a stable hydraulic system and proper pump operation. The sum of the $NPSH_A$ and the vapor pressure (P_V) must be greater than the values shown in Table 3.

Table 3. Minimum values for the sum of $NPSH_A$ and vapor pressure. (MSH)

MSH	Pulsar	Pulsar*	Pulsa
English, (psia)	5	7.5	9.5
Metric, (bar(a))	0.35	0.53	0.66

* Pulsar Pump with PULSAlarm leak detection diaphragm.

SYSTEM BACKPRESSURE

The system backpressure must exceed the suction pressure by at least 5 psi (0.35 bar) in order to prevent flowthrough, however it must not exceed the rated discharge pressure of the pump. Flowthrough can be defined as the process liquid flowing from a higher pressure to a lower pressure (downhill pumping), which attributes to pump failure and undesired flow at pump shutdown. If the system backpressure is not at least 5 psi (0.35 bar) greater than the suction pressure, a backpressure valve must be installed in the discharge piping. To calculate the system's total backpressure use Equation 3 or 4.

Equation 3. For fluid viscosity below 50 centipoise.

$$P_T = \left(\frac{L_D R G Q}{C_1 d^2}\right) + P_P \pm P_H$$

Equation 4. For fluid viscosity above 50 centipoise.

$$P_T = \sqrt{\left(\frac{L_D R G Q}{C_1 d^2}\right)^2 + \left(\frac{L_D \mu Q}{C_2 d^4}\right)^2} + P_P \pm P_H$$

APPENDIX II OIL SPECIFICATIONS

PULSAlube #1

For service 40°F to 280°F

Typical Characteristics:
API Gravity = 28-30
Viscosity SUS @ 100°F = 450
Viscosity SUS @ 210°F = 73-78
Viscosity Index = 95-160
Pour Point = 15° to -25°F
Four Ball Wear Test:
1800 RPM, 20 KG Load,130°F,1 Hr. = 0.30 MM Scar Diameter
OK Timken Load = 60-70 lbs
Rust Test (ASTM D-665) = Pass
Demulsibility Test (ASTM D-2711) = Pass
Oxidation Test (ASTM D-2893) = Pass
Nearest Commercial Equivalent:
Exxon Std. Oil - Nuto Series
Shell Oil - Tellus Series
Texaco - Rando Series (Suitable only

PULSAlube #5

For adverse temperature conditions
Service range -40° to 400°F

Typical Characteristics:
API Gravity = 34
Viscosity SUS @ 100°F = 150
Viscosity SUS @ 210°F = 46
Viscosity Index = 135
Pour Point = 65°F
Four Ball Wear Test:
1800 RPM, 40 KG Load, 200°F, 1 Hr = 0.40 MM Scar Diameter
OK Timken Load = 60 - 70 lbs
Rust Test (ASTM D-665) = Pass
Demulsibility Test (ASTM D-2711) = Pass
Oxidation Test (ASTM D-2893) = Pass
Nearest Commercial Equivalent:
Mobil Oil Corporation-Mobil SHC 624

APPENDIX III BOLT TORQUE RECOMMENDATIONS

FOR MODELS WITH METAL HEADS AND TFE DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W201544	8 * 5/16-18	5.8	7.9	2 * 1/4-20	12.2	1.4
W203344	12 * 1/2-13	21.7	29.4	2 * 5/16-18	50.7	5.7
W205343	12 * 5/8-11	41.4	56.1	2 * 5/16-18	81.0	9.2
W201983	8 * 3/8-16	11.3	15.3	2 * 5/16-18	29.7	3.4
W205699	8 * 1/2-13	21.0	28.5	3 * 3/8-16	49.7	5.6
W203017	10 * 3/4-10	100.8	136.7	2 * 1/2-13	265.0	30.0
W202420	6 * 1/2-13	23.7	32.1	2 * 1/2-13	49.0	5.5
W209786	6 * 1/2-13	23.7	32.1	2 * 1/2-13	140.3	15.9
W204938	12 * 5/8-11	50.8	68.9	2 * 1/2-13	168.0	19.0
W203806	6 * 3/4-10	89.7	121.6	2 * 1/2-13	180.4	20.4
W205341	6 * 3/4-10	38.2	51.8	2 * 1/2-13	48.1	5.4

1. Reagent heads in these categories can be referenced by the head # which is stamped or cast on the part.

2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

FOR MODELS WITH METAL HEADS AND METAL DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W204524	6 * 3/8-16	8.3	11.3	2* 1/4-20	12.2	1.4
W204335	12 * 1/2-13	18.4	25.0	2 * 5/16-18	50.7	5.7
W208287	12 * 5/8-11	34.4	46.1	2 * 5/16-18	76.0	8.6
W205117	8 * 7/8-9	120.4	163.2	2 * 3/8-16	152.2	17.2
W204537	6 * 1/2-13	17.2	23.3	2 * 1/4-20	7.1	0.8
W204331	8 * 3/4-10	49.8	67.5	3 * 3/8-16	27.4	3.1
W205505	8 * 1-1/8-7	249.0	337.6	2 * 1/2-13	121.8	13.8
W205011	10 * 1-1/4-7	369.0	500.3	2 * 1/2-13	203.0	22.9
W204241	8 * 1/2-13	27.7	37.6	2 * 1/2-13	26.9	3.0
W205799	12 * 3/4-10	68.1	92.3	2 * 1/2-13	66.3	7.5
W205533	10 * 1-1/8-7	217.6	295.0	2 * 1/2-13	117.6	13.3
W205144	10 * 1-1/2-6	653.9	886.6	2 * 1/2-13	265.0	29.9
W205631	8 * 3/4-10	73.8	100.0	2 * 1/2-13	49.0	5.5
W205137	12 * 1-1/4-7	281.0	381.0	2 * 3/4-10	252.0	28.5
W206986	8 * 3/4-10	77.4	104.9	2 * 1/2-13	80.2	9.1
W207481	8 * 1-1/4-7	290.1	393.3	2 * 1/2-13	180.4	20.4

1. Reagent heads in these categories can be referenced by the head # which is stamped or cast on the part.

2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

FOR MODELS WITH TFE/PVC HEADS AND TFE DIAPHRAGM (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W204374	8 * 5/16-18	1.5	2.0	2 * 1/4-20	3.0	0.3
W203668	4 * 3/8-16	5.9	8.0	2 * 3/8-16	9.3	1.1
W204785	6 * 1/2-13	10.2	13.8	2 * 1/2-13	21.0	2.4
W209925	6 * 1/2-13	8.8	11.9	4 * 3/8-16	17.8	2.0
W204008	6 * 3/4-10	29.9	40.5	2 * 5/8-11	68.0	7.7
W204829	6 * 3/4-10	47.7	64.7	2 * 1/2-13	90.6	10.2

FOR MODELS WITH HYDRATUBE HEAD AND METAL VALVES (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W094147	8 * 5/16-18	5.8	7.9	2 * 5/16-18	15.2	1.7
W094544	4 * 3/8-16	9.8	13.3	2 * 3/8-16	15.5	1.8
W094689	4 * 1/2-13	22.9	31.0	2 * 1/2-13	52.1	5.9
W096319	4 * 3/4-10	67.3	91.2	2 * 1/2-13	90.2	10.2

FOR MODELS WITH HYDRATUBE HEAD AND TFE VALVES (1)

	REAGENT HEAD BOLTS			TIE BAR BOLTS		
Reagent Head #	# Bolts and Thread Size	Torque (2)		# Bolts and Thread Size	Torque (2)	
		FT-LBS	N-M		IN-LBS	N-M
W094147	8 * 5/16-18	1.5	2.0	2 * 5/16-18	3.8	0.4
W094544	4 * 3/8-16	5.9	8.0	2 * 3/8-16	9.3	1.1
W094689	4 * 1/2-13	15.2	20.6	2 * 1/2-13	47.5	5.4
W094689	4 * 1/2-13	15.2	20.6	4 * 3/8-16	17.8	2.0
W096319	4 * 3/4-10	44.9	60.9	2 * 1/2-13	54.8	6.2

1. Reagent heads in these categories can be referenced by the # of bolts and thread size.
2. Torque values are for Grade 8, Carbon Steel Socket Head Capscrews only, with lubricated threads.

APPENDIX IV PULSAFEEDER ACCESSORIES

I. PULSATROL INSTALLATION, OPERATION AND REMOVAL INSTRUCTIONS

The PULSAtrol is a pneumatically charged diaphragm type chamber that continuously stores energy. Used on the inlet it will improve $NPSH_a$ (Net Positive Suction Head available) characteristics of the suction piping system. On the discharge line it will reduce dangerous peak pressures, eliminate shock waves and if of sufficient volume will reduce pulsating flow to almost linear.

INSTALLATION

Figures 60 a and b

On both discharge and suction lines it is desirable to mount the PULSAtrol as close to the pump connection as possible. It can be mounted in any position, but vertical is preferred for ease of charging, draining and servicing. The air chamber is sealed and will not require replenishing regardless of position. A shut off valve should always be used between the piping system and PULSAtrol, also a drain valve should always be installed directly below the PULSAtrol. If the discharge line is open to atmospheric pressure then a back pressure valve should also be incorporated in the system near the PULSAtrol to assure proper operation.

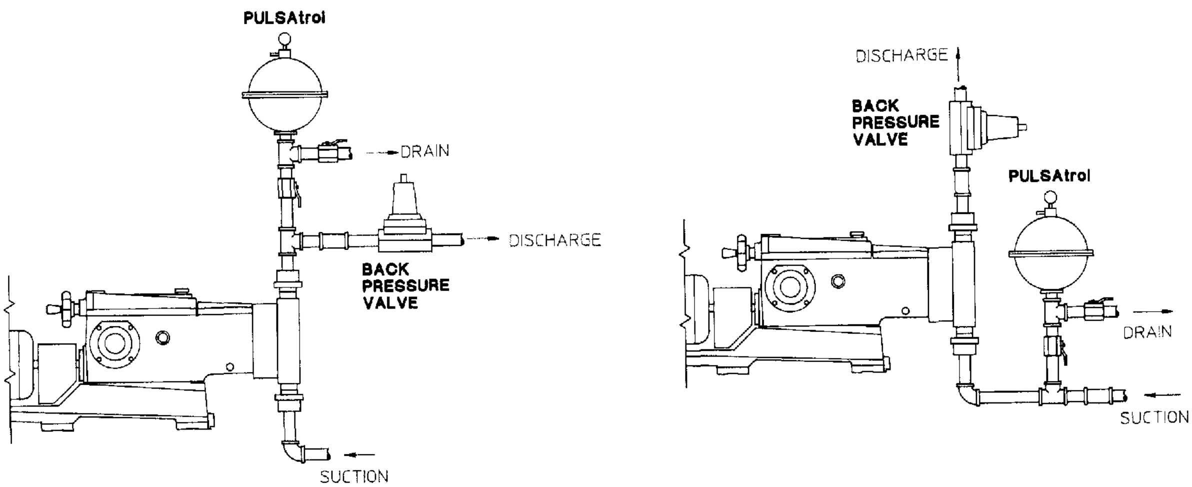


Fig. 60 a and b

OPERATION (Charging the PULSAtrol)

A Discharge Installation

The air side of the PULSAtrol must be precharged to approximately 50 percent of anticipated mean line pressure before placing on stream. This will permit the diaphragm to move to a neutral position between the chambers when operating.

PROCEDURE

Pre Charge Procedure for Discharge Installation

1. Calculate the precharge pressure

    Mean Line Pressure (PSIG)
    + Atmospheric Pressure
    Absolute Pressure (PSIA)
    x Precharge Percentage (80% Max.)
    Pressure Absolute
    - Atmospheric Pressure
    Precharge Pressure (PSIG)

    = Precharge Pressure

2. Isolate PULSAtrol from line.

3. Carefully drain off process fluid by opening a drain valve (see recommend piping arrangement).

4. Apply precharge pressure (additional liquid may drain as diaphragm moves).

5. Close drain valve.

6. Place PULSAtrol in stream.

B. Suction Installation (Flooded Suction)

Charge the PULSAtrol with adequate pressure to overcome the static suction head. Start up the pump. Depress the stem on the charge valve, but only during discharge strokes of the pump, until the gauge indicates pressure pulses. The diaphragm has not centered allowing the PULSAtrol to accumulate liquid while the pump is discharging. If too much air becomes released and the gauge will not indicate pressure pulses then recharge the PULSAtrol and repeat the procedure.

PROCEDURE

Pre Charge Procedure for Suction Installation

1. Isolate accumulator from line.
2. Carefully drain off process fluid by opening a drain valve (see recommended piping arrangement, attached).
3. Apply 5-10 psi precharge pressure (additional liquid may drain as diaphragm moves).
4. Close drain valve.
5. Bleed off all pressure on the PULSAtrol.
6. Open the valve to put PULSAtrol in stream.
7. Push in on the stem of the charging valve during the discharge stroke of the pump and release during the suction stroke.
8. Continue this for about 10 times and observe the compound gauge. As accumulator functions, the needle will go from pressure to vacuum.

C. Suction Installation (Suction Lift)

Consult your PULSA Series representative or the factory for details.

II. DIAPHRAGM BACK PRESSURE VALVES

Figure 61

Pulsafeeder diaphragm back pressure valves create a constant back pressure without chatter or cycling. A TFE diaphragm, offering maximum chemical protection and service life, seals spring and bonnet from product. This diaphragm seals directly on a replaceable seat.

Be sure to install with fluid flow in direction of arrow on valve body. If arrow is missing from plastic valve body, install with flow exiting out center hole of valve body.

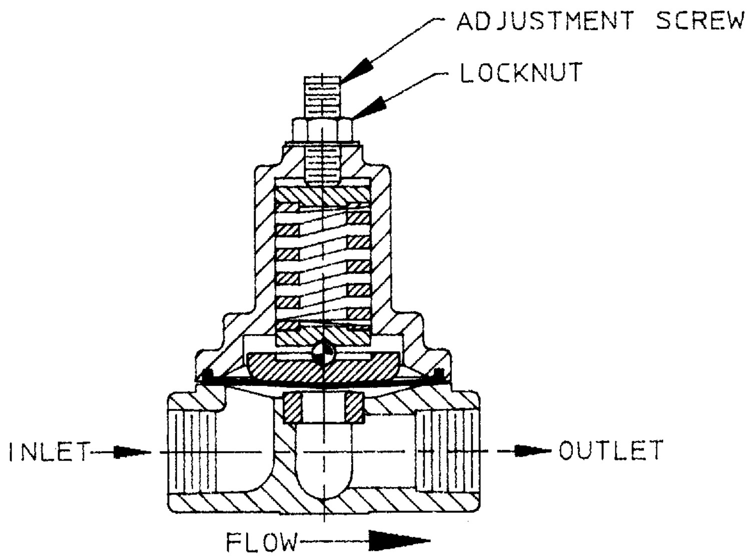


Fig. 61

MAINTENANCE LOG

Pump Model______________________ Serial #__________________________

Gear Ratio______________________ Maximum Flow____________________

Piston Diameter__________________ Maximum Pressure_______________

KOPkit____________________

All the above information can be obtained from the pump nameplate. Refer to the Pump Specification Data Sheet for additional information.

Date	Serviced By	Maintenance Performed

PULSAFEEDER
A Unit of IDEX Corporation
IDEX CORPORATION
CP 2/98
ISO 9001 SGS ANSI • RAB ACCREDITED REGISTRAR
Printed in U.S.A.