



**AURORA<sup>®</sup>**

# **VERTICAL DRY PIT PUMP**

## **INSTRUCTION AND INSTALLATION MANUAL**

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

**CALIFORNIA PROPOSITION 65 WARNING:**

**▲ WARNING** This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

**GENERAL.** The life of your Aurora pump can be extended considerably by carefully following the installation instructions contained herein. Each step of the pump installation instructions plays a vital part in assuring long life, efficient operation and reduced maintenance, from the initial location of the pump through prestaring directions.

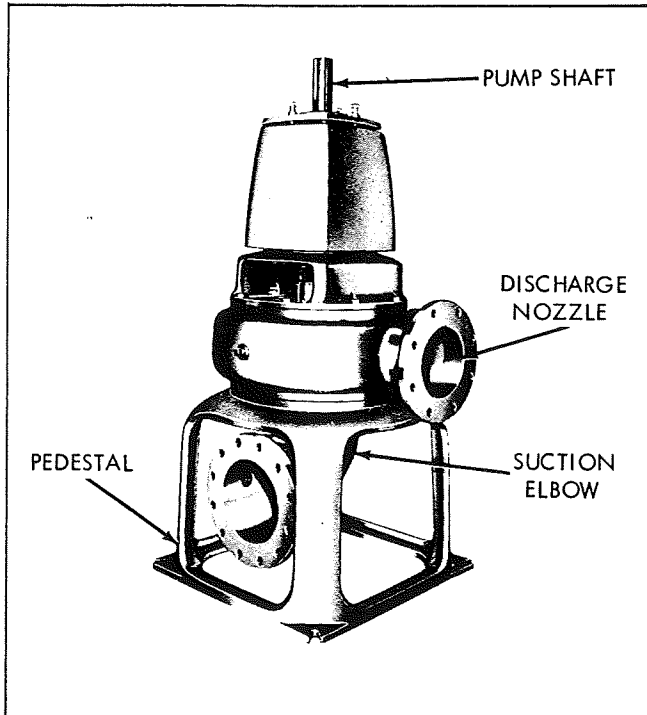


FIGURE 1. TYPICAL VERTICAL DRY PIT PUMP WITH INDEPENDENT DRIVER

**UNPACKING YOUR PUMP.** The crate containing your pump should be opened immediately upon receipt from the factory, and the pump generally inspected for damage and shortage of parts. Particular attention should be given to the discharge and suction nozzles, threads, or flanges. Any damage or shortage of parts should be reported to the carrier immediately.

**CLEANING.** If your pump is to be installed immediately, it will be necessary to remove the protective covers from all openings, and to clean the exposed metal parts thoroughly with white gasoline or some other suitable solvent to remove the preservative coating. Cleaning should be accomplished in a well ventilated area to prevent personnel from

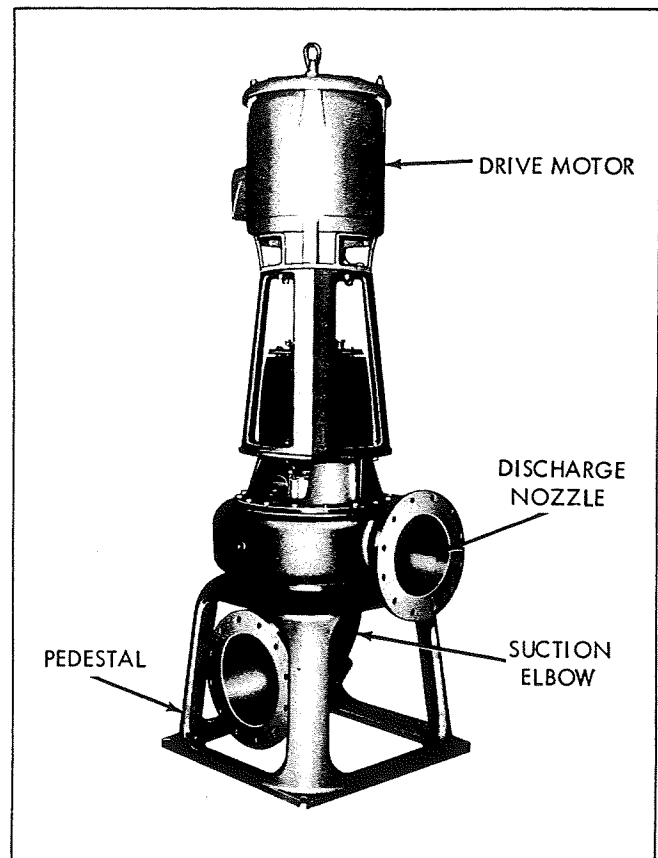


FIGURE 2. TYPICAL VERTICAL DRY PIT PUMP WITH FLEXIBLE COUPLED MOTOR

inhaling toxic vapors, and also to protect against a possible fire hazard.

**STORAGE.** If your pump is not to be put in service immediately, it should be covered and stored in a clean dry area. The protective covers and preservative should be left intact until the pump is put into service. For extended storage, the pump should be dried internally with hot air or some other suitable means and once free of moisture, filled with a protective fluid such as light oil or kerosene. Accordingly, at time of installation the pump will have to be completely dismantled and thoroughly cleaned.

**PLANNING THE PUMP LOCATION.** You probably have spent considerable time planning where your pump will be located. However, you may have overlooked some factor which may affect pump operation or efficiency.

## VERTICAL DRY PIT PUMP INSTALLATION

The pump should be located as close as possible to the liquid source so that the suction line can be short and direct. It should be located in a clean, open area, where it is easily accessible for lubrication, inspection, and repair. Pumps installed in dark, dirty areas, or in cramped locations are often neglected which can result in premature failure of both the pump and driver.

The pump and driver if located on different levels, should be accurately located to prevent excessive angular misalignment of the universal joints on the driveshaft.

Your pump should be located so that a hoist or crane can be used to move it without interference from piping and other construction. This factor is often overlooked in the advance planning stages.

The pump should be protected against the possibility of flooding. Water in the pump bearings or other pump components, can cause premature failure. Also the drive motor, on close coupled applications, can be damaged.

Your pump should be located in an area where moisture from leakage through the packing or from condensation can be adequately drained off. Moisture dripping onto exposed metal or wood can cause rapid deterioration of the area. Also wet floors produce a definite safety hazard.

Adequate provisions should be made for electrical wiring to the pump motor. A switch and overload protection should be installed near the pump unless it is impractical. The electrical conduit should be positioned in such a way as to preclude the possibility of moisture entering the conduits or the motor and causing short circuits or grounding.

If your pump is to be installed out of doors, it is recommended that a weather shelter be provided.

**FOUNDATION.** The foundation for your pump must be sufficiently rigid to absorb any vibration and stress encountered during pump operation. A raised foundation of concrete is preferable for vertical dry pit pumps. The raised foundation assures a satisfactory base, protects against flooding, simplifies moisture drainage, and facilitates keeping the area clean.

Your pump should be firmly bolted to the foundation. The mounting bolts or studs should be imbedded in concrete, and accurately located per the applicable Aurora dimension sheet. Foundation bolts should be enclosed by a sleeve 2 to 4 diameters larger than the bolt, to allow movement for proper alignment with the pump base mounting holes.

On applications where the driver is located above the pump and connected by a driveshaft, it is necessary to also bolt the driver to a foundation. The

same instructions should be followed for mounting the driver as are used for mounting the pump.

**LEVELING THE PUMP AND DRIVER.** Leveling the pump and the driver will require sufficient shims to support the pump and the driver. The shims should be located adjacent to the foundation bolts, and large enough to allow a gap of from 3/4" to 1-1/2" for grouting.

The pump unit should be set on the foundation, being careful not to damage the threads on the foundation bolts. The shims should be inserted and the pump leveled. On close coupled installations, a spirit level can be used on the discharge flange, and on the motor or some other reference point to assure that the pump is reasonably level in a vertical plane. On applications where the pump is connected to the motor by a driveshaft, the pump should be leveled visually until it is approximately level in all vertical directions. The universal joints on the driveshaft will compensate for any slight misalignment between the driver and the pump. After the pump is reasonably level, the foundation bolts should be tightened down. On pumps with a bottom suction, the foundation bolts can be firmly tightened. On installations where the base or pedestal is to be grouted in place, the bolts should be tightened evenly but not too firmly.

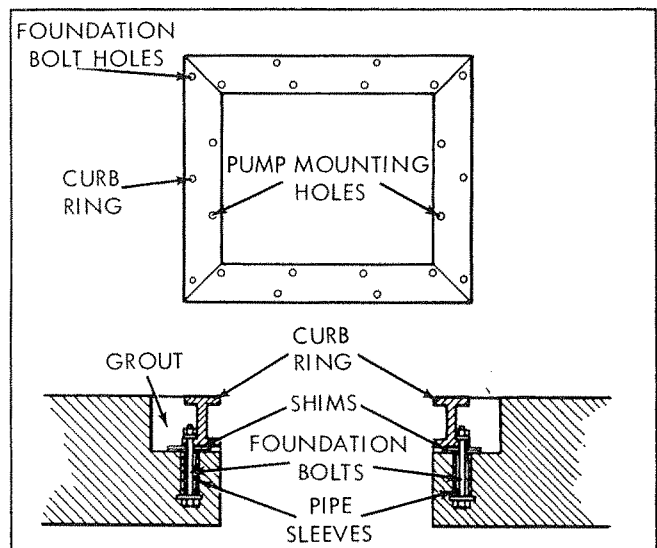
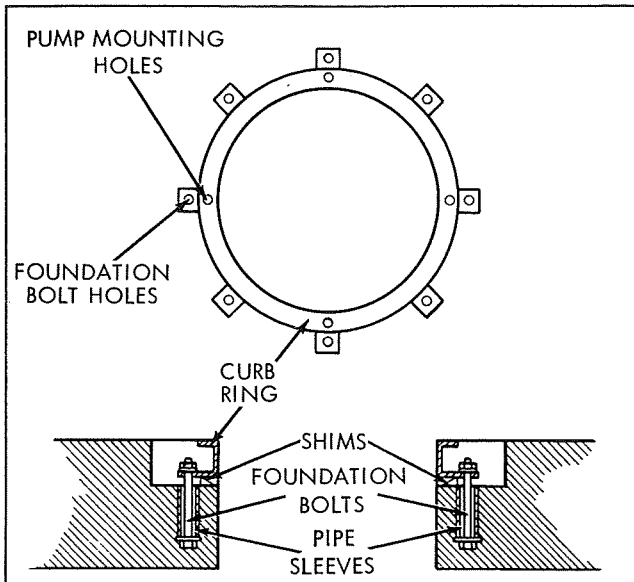


FIGURE 3. INSTALLATION OF RECTANGULAR CURB RING

**GROUTING THE INSTALLATION.** Your pump may or may not be grouted in place depending on your application. For example, a pump with a bottom suction may have to be removed periodically from the installation and therefore would not be grouted, while pumps with a side suction, would be grouted in place. However, it may be desirable to mount pumps with a bottom suction on curb rings which will be grouted in place. Grouting, whether it be for the pump base plate or curb ring is essentially the same. Waste material should be stuffed into the sleeve around the foundation bolts, to prevent grout from filling the sleeves during the grouting operation. A dam should be constructed around the base plate or curb

## VERTICAL DRY PIT PUMP INSTALLATION



**FIGURE 4. INSTALLATION OF CIRCULAR CURB RING**

ring, to contain the grout while it is being poured. When grouting, it is important to fill the entire space under and around the base plate or curb ring. A non-shrinkable type grout, such as manufactured by EMBCO is recommended. The grout should be puddled frequently to remove any air bubbles from it. The leveling shims can be grouted in place. Allow ample time for the grout to set, usually from 48 to 72 hours after pouring, before proceeding with the installation. After the grout has set, the foundation bolts should be firmly tightened down.

**GROUTING THE DRIVER.** If your application requires that the driver be mounted at a different level than the pump, it will be necessary to grout this installation also. The driver may be grouted directly to the foundation, or again it may be mounted on a curb ring. The grouting operation is the same for the driver as it is for the pump.

**INSTALLATION OF INTERMEDIATE DRIVESHAFT AND STEADYING BEARINGS.** On those applications where the driver is located at a different level above the pump, it is necessary to connect them by means of a universal joint type intermediate shaft.

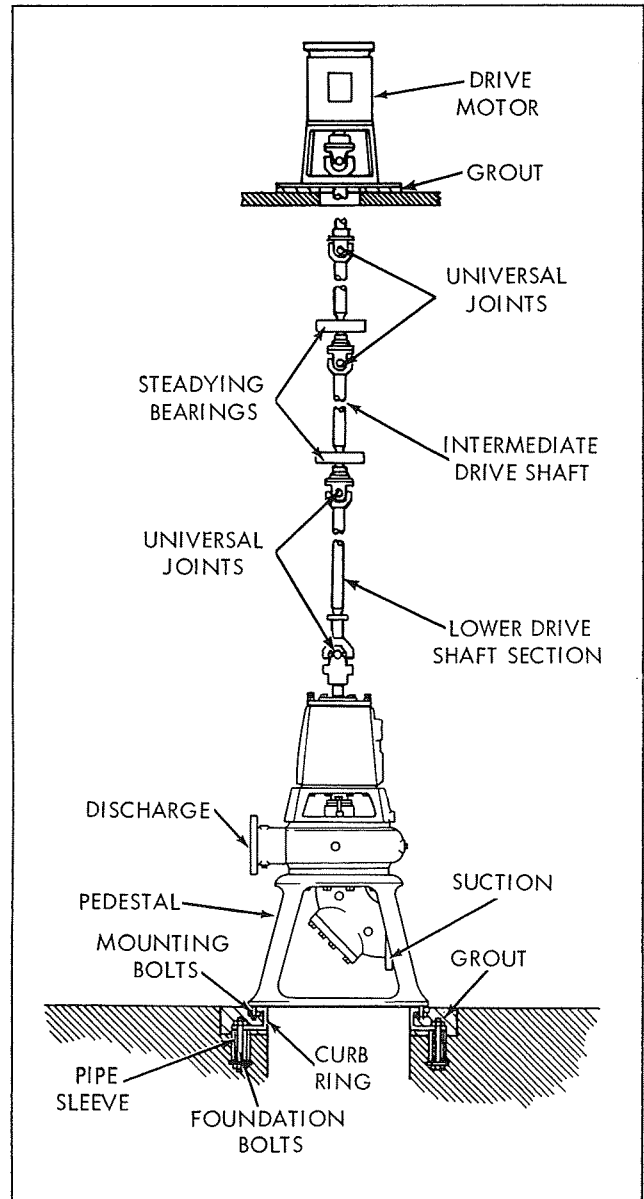
Small or medium sized vertical pumps usually utilize the hollow tubing universal joint type intermediate shafting. The lower section, or the section connected to the pump, has a universal joint at each end, while each section above the lower section has a guide bearing supporting the lower end, and a universal joint at the upper end. The universal joint type shafting compensates for angular misalignment and also compensates for any minor length discrepancies by incorporating a splined joint in the lower section.

**NOTE**

Most flexible shaft manufacturers recommend some misalignment of the shafting to provide adequate lubrication of the universal joints. Ideal joint operating angle is 1° to 5°. Check the manufacturer's specifications for details.

On applications where the torque is greater than what can be carried by the universal joint type of shafting, solid shafting can be used either with solid or with flexible type couplings. This type of installation is not completely satisfactory for applications where extremely long lengths of shafting is required, because of the difficulty in maintaining alignment of the support bearings.

The intermediate bearings are usually of the anti-friction type and are grease lubricated to enable retaining lubricants in a housing with the shaft projecting vertically through it. The supports for the intermediate bearings and vertical shaft pumps must be sufficiently rigid to prevent any deflection which can cause premature failure of the bearings and the shaft. The bearing supports should not allow deflection in any direction. Use of either horizontal or vertical mounted intermediate bearings is permissible, and will depend on your specific application.



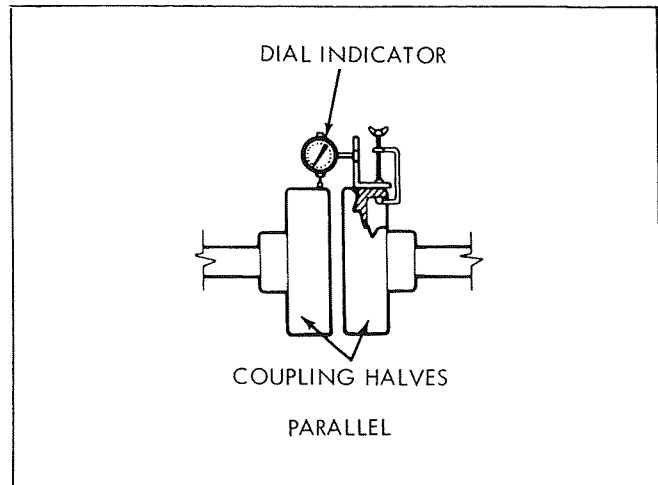
**FIGURE 5. TYPICAL INTERMEDIATE SHAFT INSTALLATION WITH STEADYING BEARINGS**

## VERTICAL DRY PIT PUMP INSTALLATION

**FLEXIBLE COUPLING ALIGNMENT.** Vertical pumps that have the drive motor mounted on the same frame, have a register fit construction which were accurately aligned at the factory. However, it is impossible to maintain this alignment during shipping and handling. Therefore it will be necessary for you to realign the pump and driver. Flexible couplings are not universal joints. They should not be used to compensate for misalignment of the pump and motor shafts. Their function is to transmit power from the driver to the pump while compensating for thermal expansion and shaft end movement.

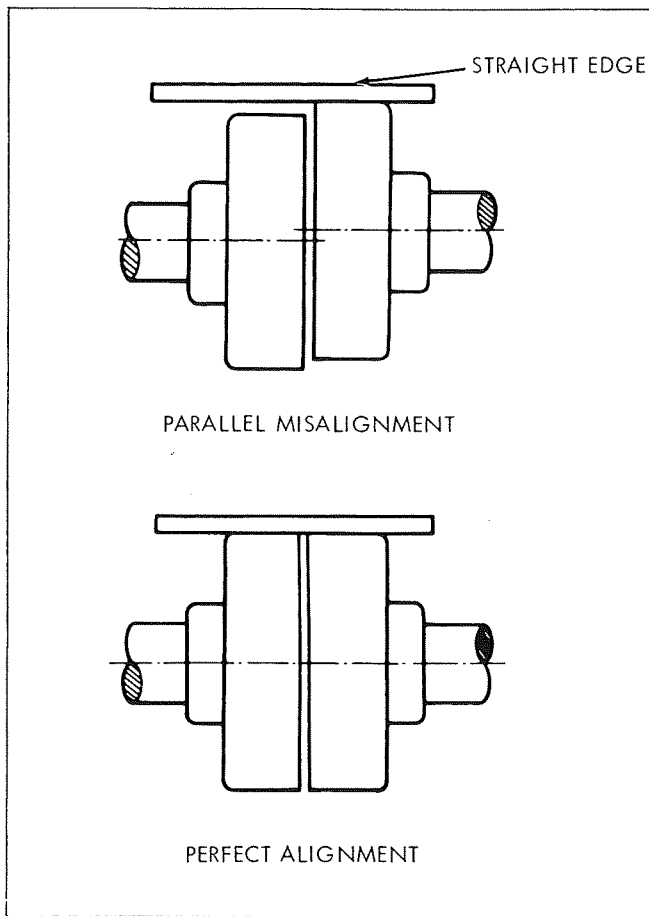
In order to properly align the coupling, you will need a taper gauge or set of feeler gauges, and a straight edge, or if available, a dial indicator.

The only type of misalignment encountered with flexible couplings, on this type of pump, is parallel misalignment. The shafts are parallel but not on the same axis.



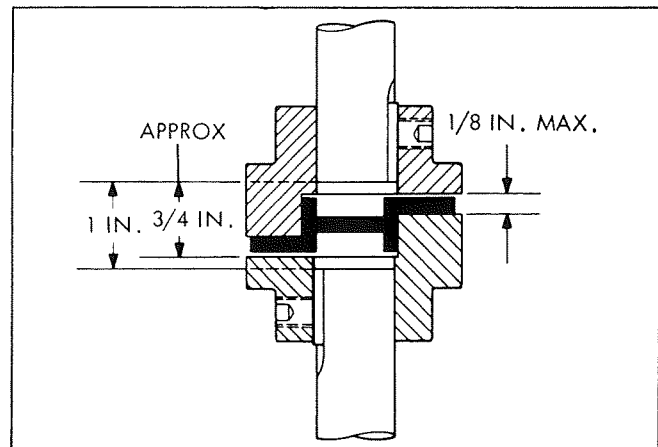
**FIGURE 7. CHECKING ALIGNMENT WITH DIAL INDICATOR**

To check parallel alignment with the dial indicator, the ball should rest on periphery of the motor coupling half. A chalk mark should be made at the point of contact, and the shafts rotated equally so that the reading is taken with the ball on the chalk mark at all check points.



**FIGURE 6. FLEXIBLE COUPLING ALIGNMENT**

To check parallel alignment, a straight edge should be held against the edges of the coupling halves at any four places 90° apart around the coupling. The straight edge should be parallel to the pump and driver shafts at all times. Shift the motor until the straight edge lies flat against both coupling halves at all four check points. The pump and driver will then be in proper parallel alignment.



**FIGURE 8. TYPICAL FLEXIBLE COUPLING**

When the unit is properly aligned, the motor bolts should be tightened, but not too firmly.

**PIPING.** Your pump unit is now ready to be piped. The piping practices you follow will directly affect the efficiency and power consumption of your pump. Pay particular attention to the seemingly insignificant details involved in piping your pump, for they make the difference between a good and a bad installation.

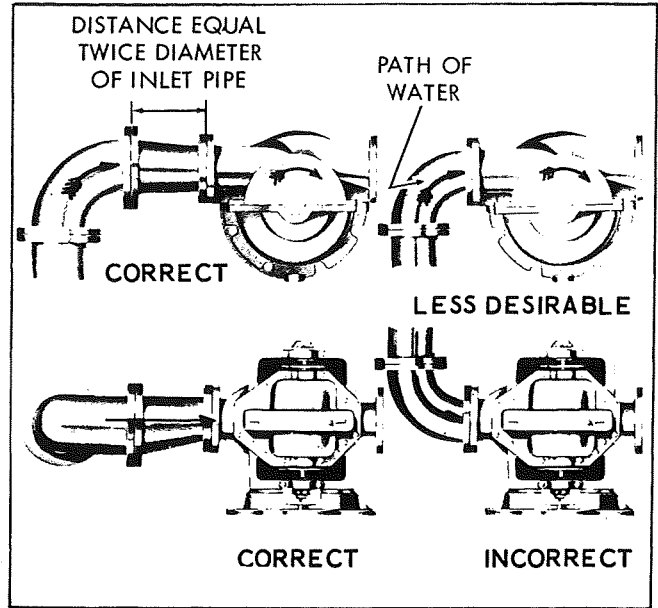
**SUPPORTING THE PIPE.** Both the suction and the discharge piping should be independently supported near the pump. Liberal use of pipe hangers and support blocks will prevent excessive strain on the pump casing and on the pipe joints.

## VERTICAL DRY PIT PUMP INSTALLATION

**SUCTION PIPING.** The suction piping should be short but no less than ten pipe diameters in length, and direct with as few elbows and fittings as possible to keep head loss from friction to a minimum. However, the suction pipe should provide a minimum uninterrupted length, equal to ten pipe diameters, to the pump suction. A horizontal suction line should have a gradual rise to the pump and pass under any other interfering piping.

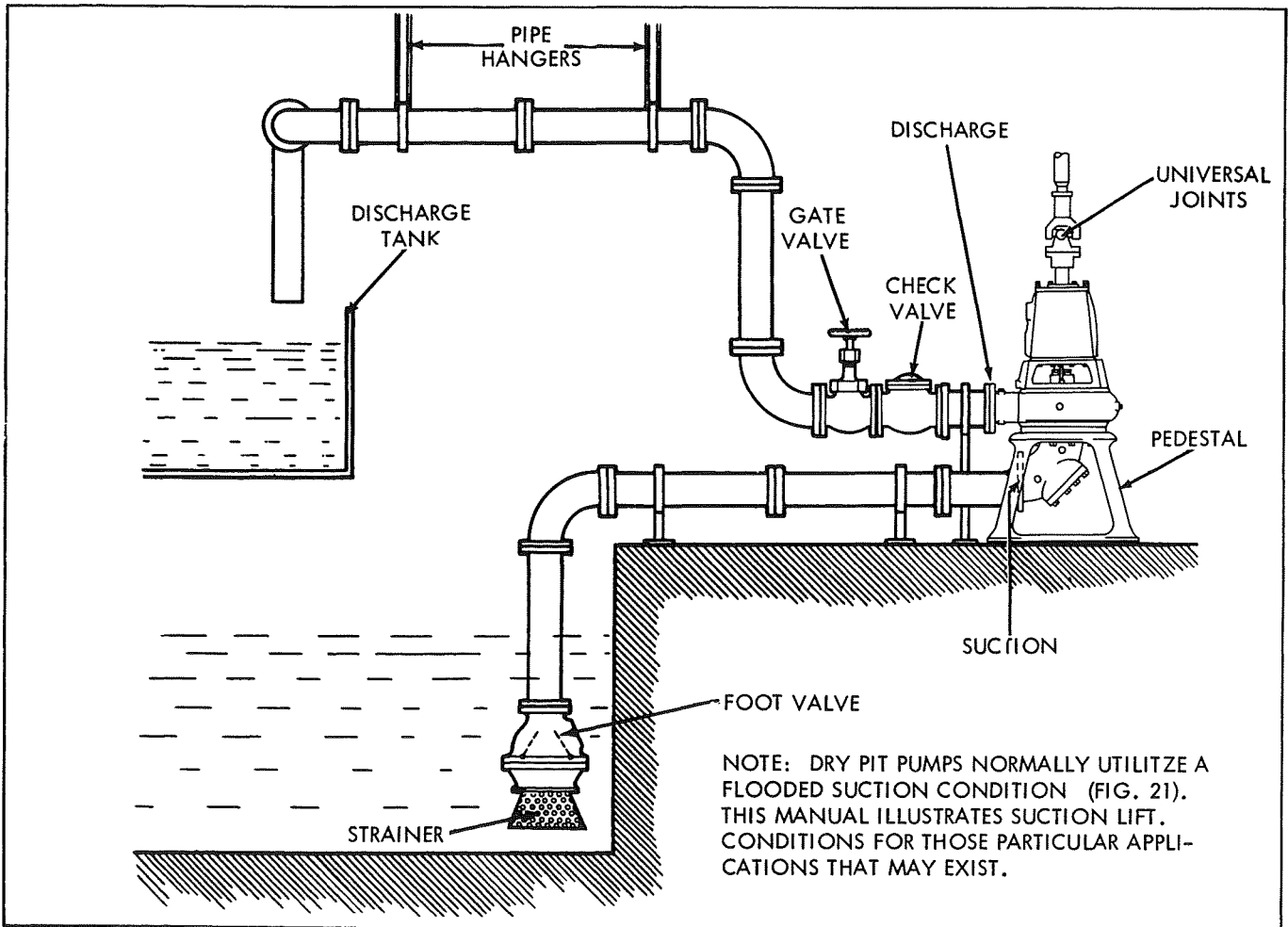
**PIPE.** The suction pipe diameter should be at least the same diameter as the suction nozzle and the pump, and preferably larger. Use of a small diameter pipe will result in head losses due to friction. All joints must be tight to maintain prime on the pump.

**ELBOWS.** Long radius elbows should be used in place of standard elbows wherever possible because of their superior flow characteristics. For instance head loss in a standard four inch elbow is equivalent to the head loss in a piece of pipe 11 ft. long, while the head loss in a long radius elbow is approximately half as much. Elbows should not be used at the suction nozzle, but if it is unavoidable, they should be installed in a vertical position. Elbows installed in any position at the suction nozzle, have a tendency to distribute the liquid unevenly in the impeller chamber, causing a reduction in capacity, and creating an undesirable thrust condition.



**FIGURE 9. SUCTION PIPING ON DOUBLE SUCTION PUMPS**

Suction connections for vertical mounted double suction pumps should be installed the opposite of horizontal pumps. That is, if an elbow is installed close to the suction nozzle it should only be mounted hori-



**FIGURE 10. SUPPORTING SUCTION AND DISCHARGE PIPING**

## VERTICAL DRY PIT PUMP INSTALLATION

zontally. Any angle other than horizontal will cause more water to enter one side of the impeller than enters the other side. This causes a reduction in capacity and efficiency and creates an axial thrust load which may over heat and possibly cause rapid wear of the thrust bearing.

**REDUCERS.** Eccentric taper reducers should be installed directly at the suction nozzle, with the taper at the bottom to prevent air pockets from forming. Straight taper reducers should not be used in a horizontal suction line because of the air pocket that is formed at the leg of the reducer and the pipe.

**DISCHARGE PIPING.** Discharge piping should also be short and as direct as possible with a few elbows and fittings to reduce head loss due to friction.

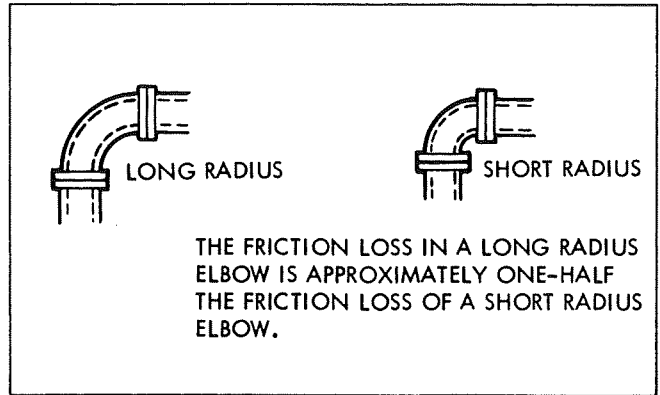


FIGURE 11. LONG VERSUS SHORT RADIUS ELBOWS

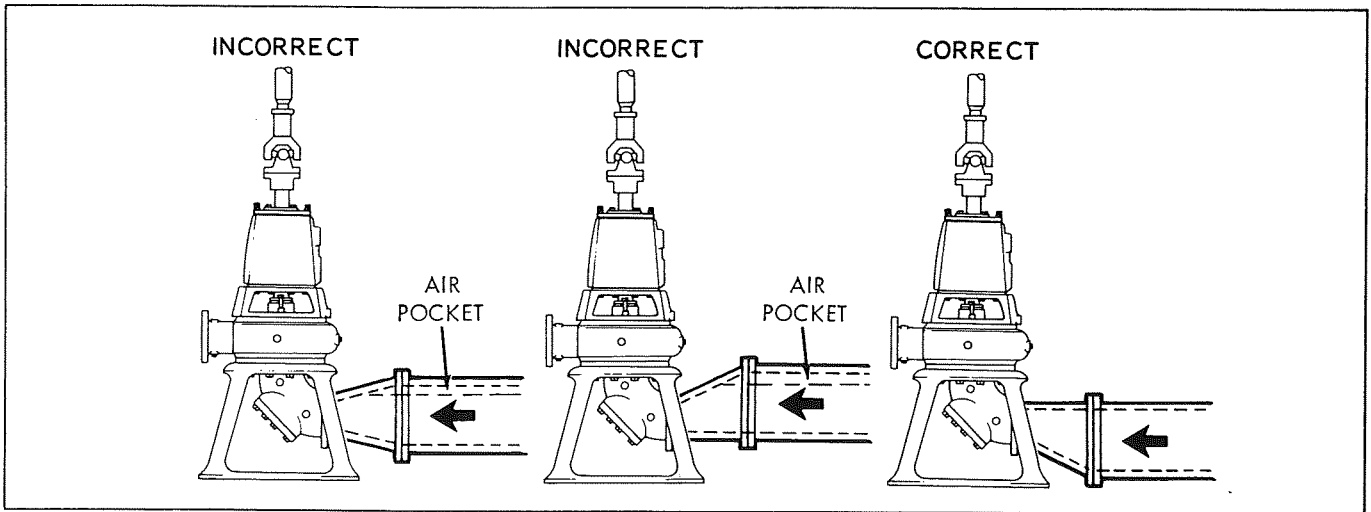


FIGURE 12. INCORRECT AND CORRECT INSTALLATION OF TAPERED REDUCERS

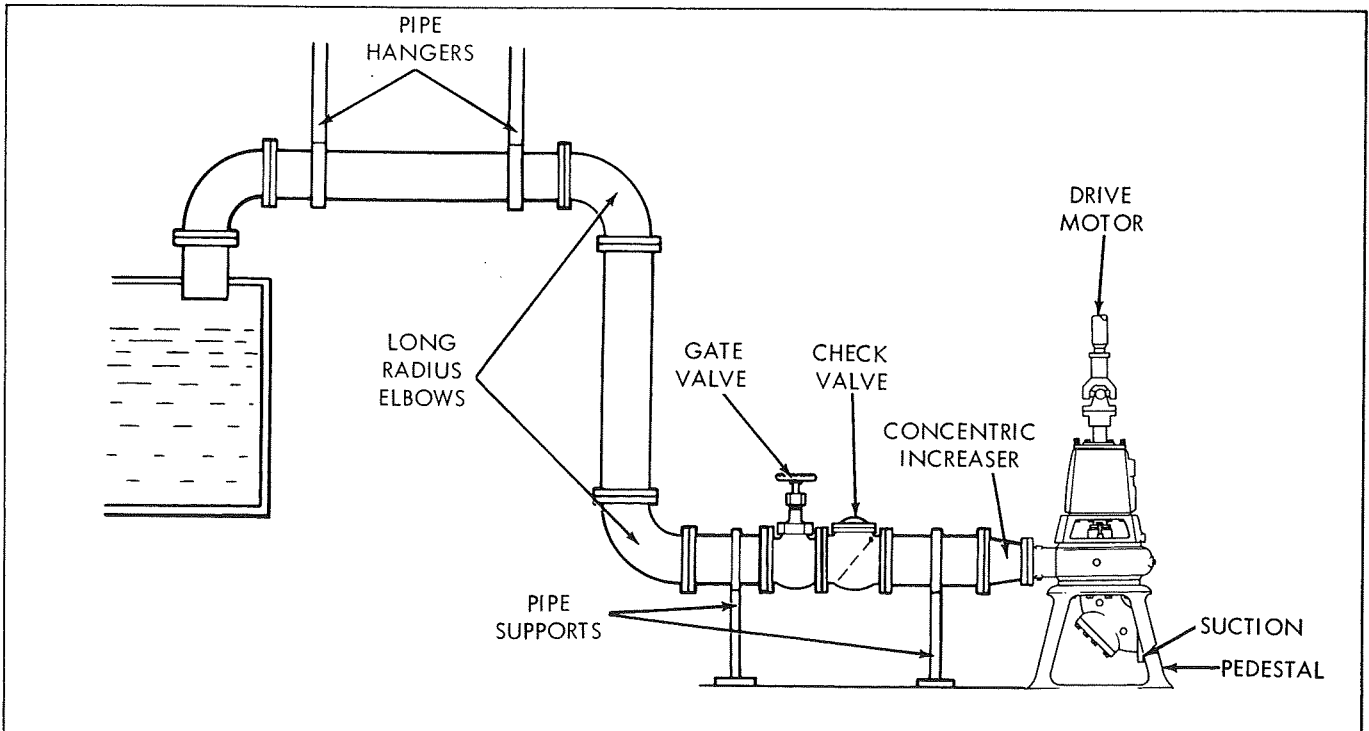


FIGURE 13. DISCHARGE PIPING

## VERTICAL DRY PIT PUMP INSTALLATION

**PIPE.** The discharge pipe diameter should be the same as or larger than the discharge nozzle diameter. The size of the discharge piping is dependent on the application. The recommended pipe diameter can be obtained from your nearest Aurora Pump Sales Office.

**ELBOWS.** Long radius elbows should be used in the discharge piping as well as in the suction piping to prevent excessive head loss. Whenever possible, elbows should not be installed directly at the discharge nozzle, as the turbulence created by the elbow will affect pressure gauge readings.

**REDUCERS AND INCREASERS.** An increaser, should be installed at the discharge nozzle if larger diameter discharge piping is to be used. Straight taper increasers and/or reducers, are satisfactory in the discharge application, because air pockets on the discharge side do not affect pump efficiency.

**EXPANSION JOINTS.** Expansion joints are used primarily to prevent transmission of piping strain, caused by thermal expansion and contraction, piping misalignment, pressure changes, or other causes, to the pump casing. They are also used to suppress any noise that may be transmitted through the piping.

It is recommended that the flexible metal type of expansion joint be used, because rubber expansion

joints have a tendency to deteriorate, making frequent replacement necessary.

If an expansion joint must be used, an anchor or restraining device should be installed between the joint and the pump to prevent objectionable forces from being transmitted to the pump. If an anchor is not installed at this point, a force equal to the area of the expansion joint times the pressure in the pipe is developed and transmitted to the pump. This force may exceed the allowable flange loading and could result in damage to the pump or piping.

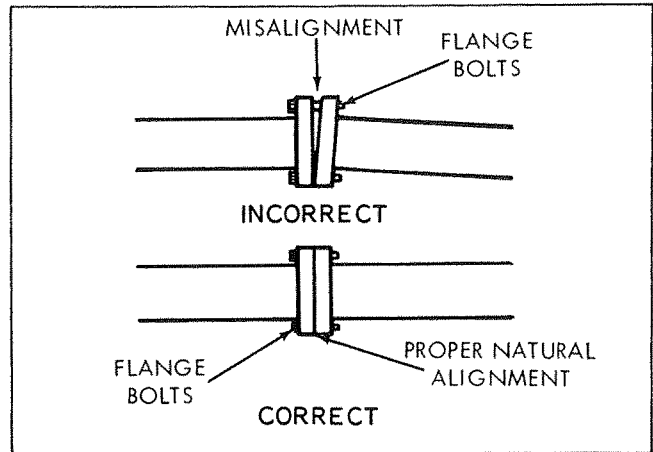


FIGURE 15. PIPE ALIGNMENT

**PIPE ALIGNMENT.** All piping should line up naturally when connected. Forcing pipes into line by using flange bolts or some other means can produce excessive strain on the piping and the pump casing. Flange bolts when used, should be loosely inserted and pipe alignment checked. Then the bolts can be tightened securely in an alternate pattern.

**AIR IN PIPING.** One of the most common conditions affecting pump efficiency is the formation of air pockets in the suction line. The air pockets are

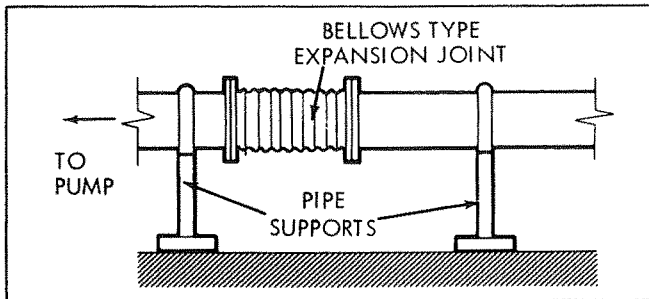


FIGURE 14. TYPICAL EXPANSION JOINT INSTALLATION

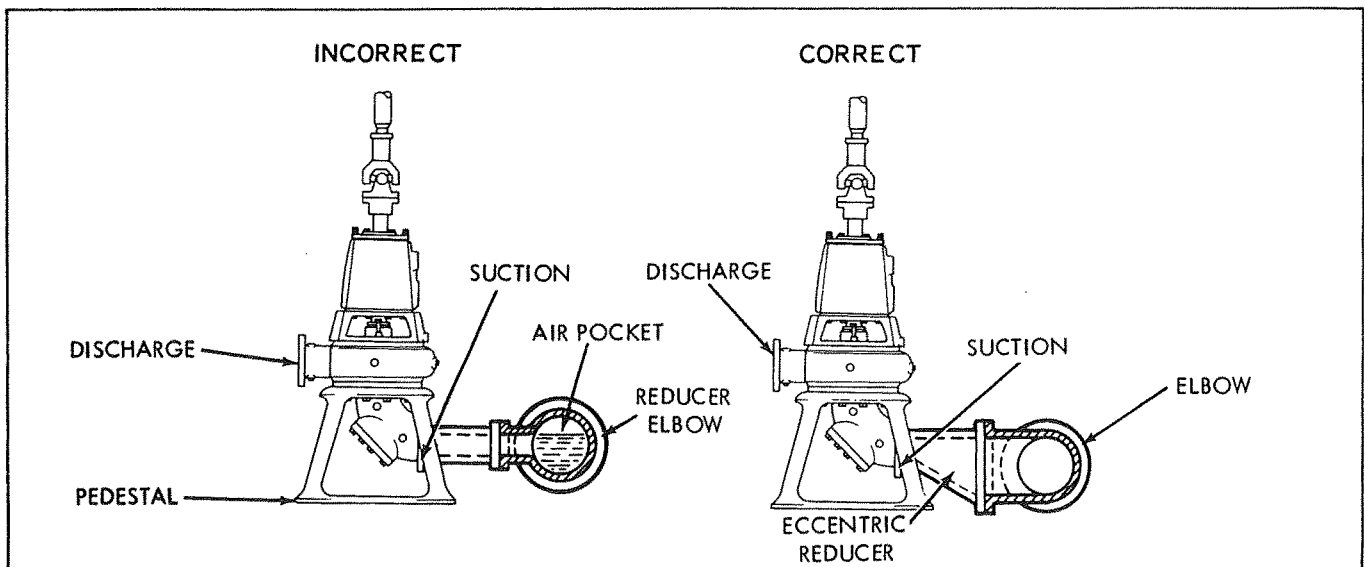


FIGURE 16. AIR POCKET FORMED BY INCORRECT USE OF ELBOWS AND REDUCERS



## VERTICAL DRY PIT PUMP INSTALLATION

formed by improper use of elbows, reducers, valves, high points in the suction line and improper installation of elbows, reducers and valves in the suction piping. For suction lift applications, lantern rings are required to prevent air from leaking through the stuffing box into the pump.

In suction lift applications the suction pipe in the liquid well must be sufficiently submerged to prevent exposure of the end of the pipe when the well is at its minimum level, and to prevent vortexing action (whirlpool effect) of the liquid at the suction pipe which will draw air into the pipe. Also care should be taken to keep the suction pipe located away from the well inlet since the incoming liquid may be carrying air bubbles. Another cause of air in liquid is dropping of the liquid from a considerable height into the well.

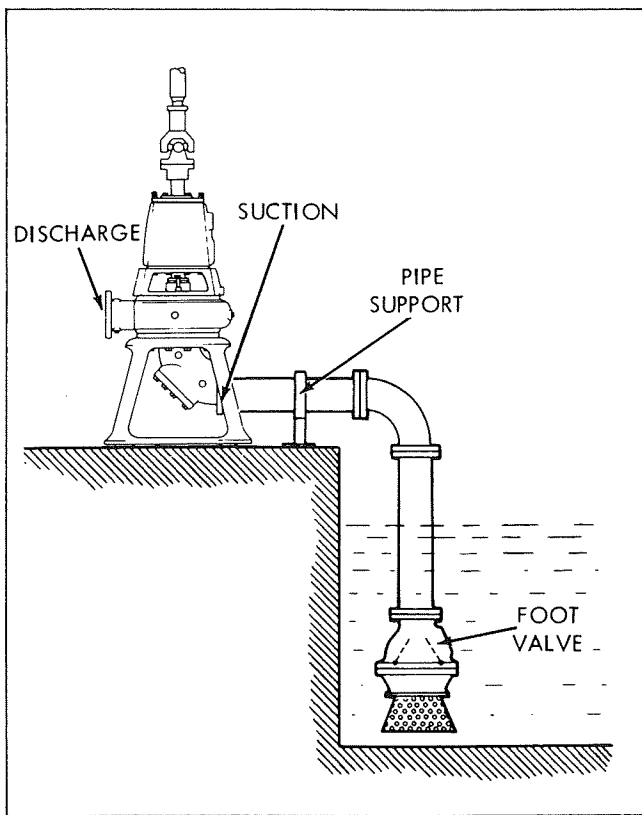


FIGURE 17. FOOT VALVE INSTALLED

**VALVES.** Valves are an important part of your installation, for they facilitate priming of the pump, control the volume of the pumped liquid, and prevent possible damage to the pump.

**SUCTION LIFT.** In suction lift applications where the suction lift is low, a foot valve can be installed to maintain the prime on the pump. A foot valve is essentially a check valve, allowing flow in one direction only, toward the pump. When the pump is shut down, the pressure of the liquid returning to the well, causes the valves to close, retaining the liquid in the suction line.

A slow closing check valve should be installed when the static discharge head is high. A foot valve

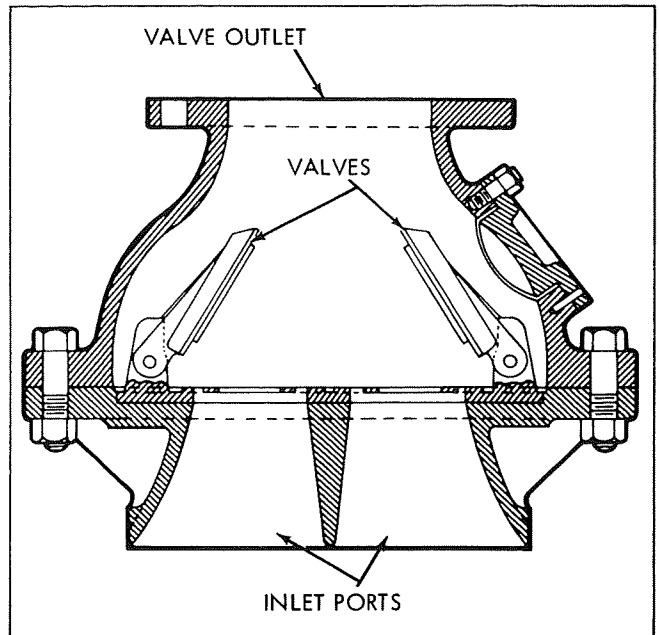


FIGURE 18. TYPICAL FOOT VALVE CUTAWAY VIEW

should not be used under these conditions as failure of the driver would allow the liquid to rush back suddenly causing a heavy water hammer. Foot valves, when used, should be of the flat type rather than the multiple spring type. Also, the valve should have a large inlet area because the friction loss in a foot valve is extremely high. A check valve or foot valve should be installed as indicated by the arrow on the valve to insure proper operation.

**FLOODED SUCTION.** When the liquid source is above the pump center line, a flooded condition exists, and a gate valve is required to shut off the liquid supply for inspection and maintenance of the pump. The gate valve should be installed with the stem in a horizontal or downward position to prevent formation of an air pocket at the top of the valve.

**DISCHARGE.** The discharge piping should include a check valve and a gate valve. The check valve should be located between the gate valve and the

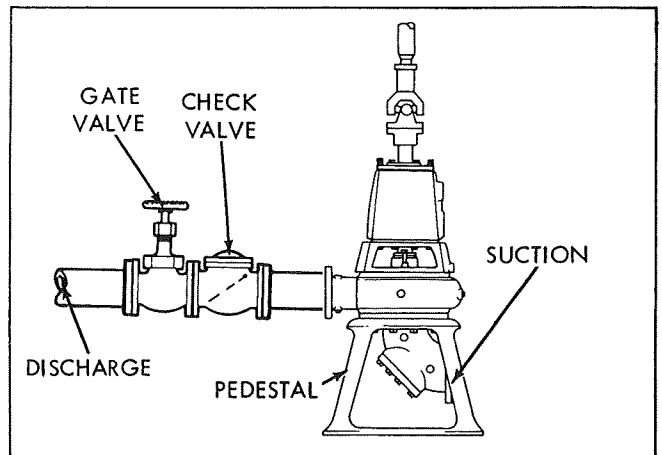


FIGURE 19. VALVES IN DISCHARGE LINE

## VERTICAL DRY PIT PUMP INSTALLATION

pump. The check valve protects against a reverse flow of the liquid if the driver fails. If an increaser is used in the discharge piping, the increaser should be installed between the pump nozzle and the check valve.

The gate valve is used in the priming operation, as a throttling valve to control pump volume, and to shut down the pump for inspection and maintenance.

**AIR VENT VALVE.** Vent valves are installed at one or several high points in the pump casing to allow air or vapor to escape. These valves are used to release trapped air from the pump casing during priming and when the pump becomes air bound. The pump is considered air bound, when there is sufficient air in the suction line to prevent any liquid from being pumped.

**STRAINERS AND SCREENS.** It is important to screen the suction piping to remove foreign matter that can clog the pump and impair its capacity or stop it completely, particularly in those applications where liquid is being handled. If your pump is to be used on an application where solids are to be handled, screening is not necessary.

Strainers should be selected so as to have a total area of holes equal to at least four times the suction pipe area. This will prevent small particles such as sand, dirt, pipe scale and other extraneous materials from getting into the close clearance parts of the pump and causing considerable damage to the parts.

In applications where sticks, twigs, leaves and other large debris are present, a larger outside screen should be placed around the suction inlet to prevent choking of the strainer. This screen should have sufficient openings so that the flow velocity does not exceed two feet per second.

**PRIMING THE PUMP.** Your pump will not operate satisfactorily until it is primed. All air must be expelled from the suction piping and pump casing, and replaced by the liquid to be pumped. There are several methods of priming pumps. The one you select will depend on your specific requirements.

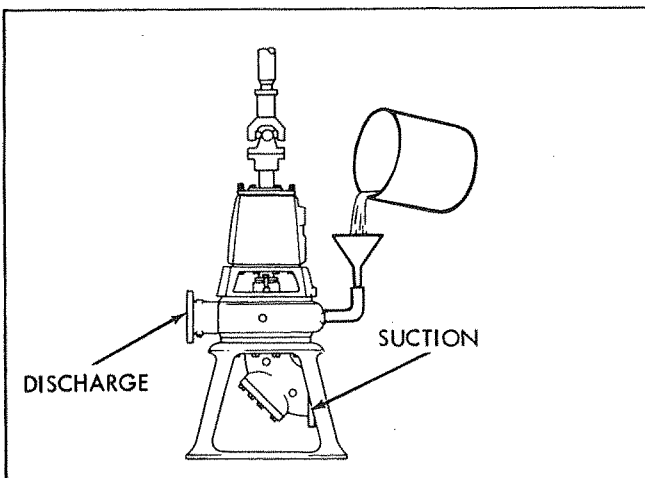


FIGURE 20. PRIMING THE PUMP BY HAND

**FLOODED SUCTION PRIMING.** This method of priming a pump is relatively simple. The liquid source is located above the pump, and all that is necessary to prime the pump is to open the air vent valve or plug in the pump casing, and to crack the gate valve in the suction line. The suction line and pump should be filled slowly until a steady stream of liquid is observed flowing from the air vent. After your pump is operating, it is recommended that the air vent valve or plug be opened again to insure that all air has been expelled from the pump casing.

Vertical dry pit pump installations normally utilize a flooded suction condition.

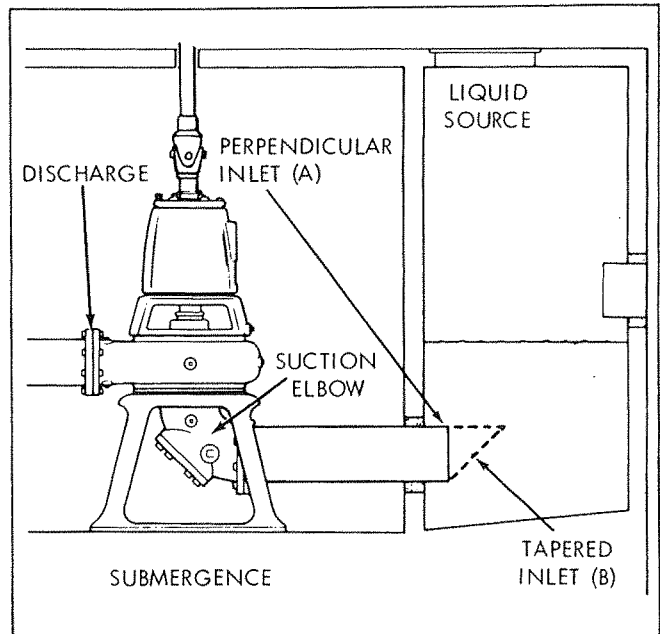


FIGURE 21. FLOODED SUCTION PRIMING

**FOOT VALVE PRIMING.** A foot valve can be used for priming on suction lift applications. The foot valve, located at the bottom end or foot of the suction piping, functions as a check valve which allows flow in one direction only, toward the pump.

Initial priming is accomplished by completely filling the suction piping and pump casing with the liquid to be pumped. This can be done by removing the air vent valve or plug at the top of the pump casing and inserting a pipe nipple in the orifice, with an appropriate increaser to accommodate a hose connection. A priming line can also be inserted in the discharge piping between the check valve and the pump or the priming can be done with a bucket and funnel. The important thing is to completely fill the suction pipe and pump casing with liquid.

When the pump is started, the vacuum created by pumping the priming fluid, combined with atmospheric pressure in the liquid well, forces liquid into the suction piping, thus opening the valve and keeping it open until the pump is shut down. When the pump is shut down, the liquid being pumped reverses its flow, causing the valve to close, trapping the liquid in the suction piping and pump casing, thus maintaining a prime on the pump.

## VERTICAL DRY PIT PUMP INSTALLATION

**VACUUM PRIMING.** Vacuum priming consists of removing air from the pump casing and suction piping and drawing liquid into them by means of a vacuum creating device. The types of vacuum equipment range from a simple hand pump to complex central priming systems. Your specific priming requirements will govern what type of vacuum primer you use.

**AIR EJECTOR.** One type of vacuum primer is the air ejector. If liquid under pressure or steam is available, an ejector can be used. The ejector is connected to the air vent orifice. A stream of the ejecting medium is passed through the ejector creating a vacuum in the ejector, and drawing air from the pump casing and suction piping. When liquid flows steadily from the ejector discharge pipe, the pump is primed.

**VACUUM PUMPS.** Rotary or reciprocating pumps are frequently used as vacuum pumps. They fall into two categories, wet-vacuum and dry-vacuum. The principle of operation is essentially the same, however, the dry-vacuum pump cannot accommodate a liquid and air mixture while the wet-vacuum pump can accommodate liquid, air or a combination of both.

Vacuum pumps can be installed as part of a central priming system servicing many pumps, as an automatic priming system, or as a manually controlled independently driven pump.

The suction piping of the vacuum pump is connected to the air vent orifice on the pump to be primed. The vacuum produced by the vacuum pump removes air from the centrifugal pump suction piping and casing, and draws liquid from the liquid well into

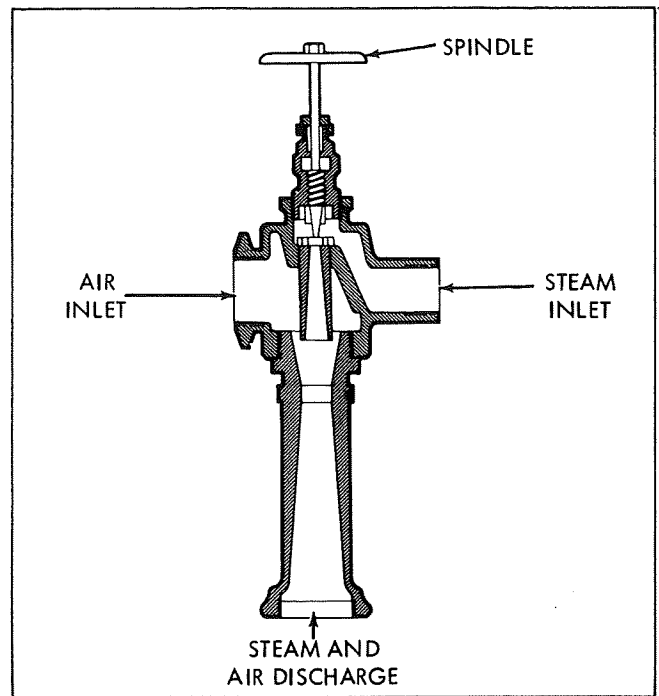


FIGURE 23. EJECTOR CUTAWAY VIEW

the centrifugal pump. Dry-vacuum pumps must be installed so that no liquid is taken into the air pump. Installation of a water trap, or use of a vacuum tank are recommended for dry vacuum pumps.

**INDUCTOR PRIMING.** On suction lift applications it may be desirable to prime your pump with a priming inductor. This type of primer is comprised of a liquid nozzle and an inductor at the foot end of the

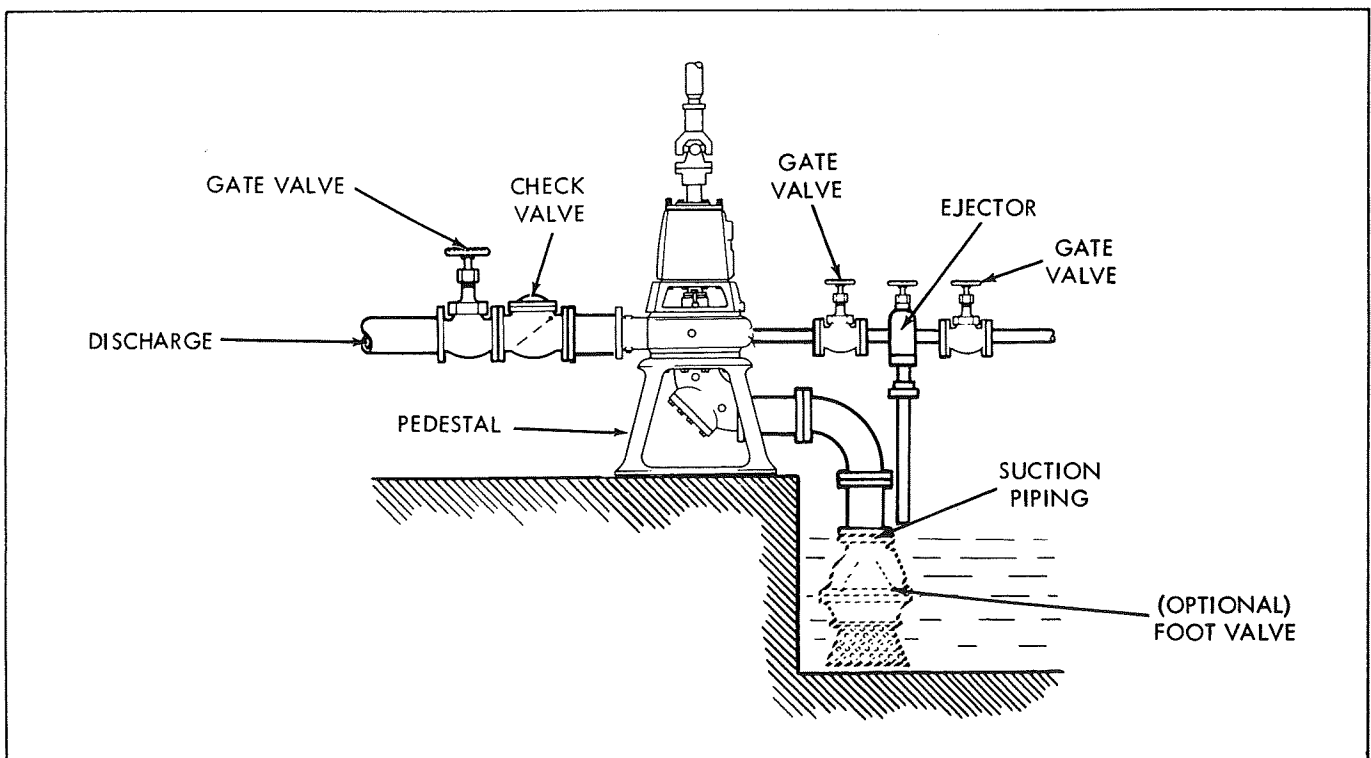


FIGURE 22. PRIMING BY EJECTOR

## VERTICAL DRY PIT PUMP INSTALLATION

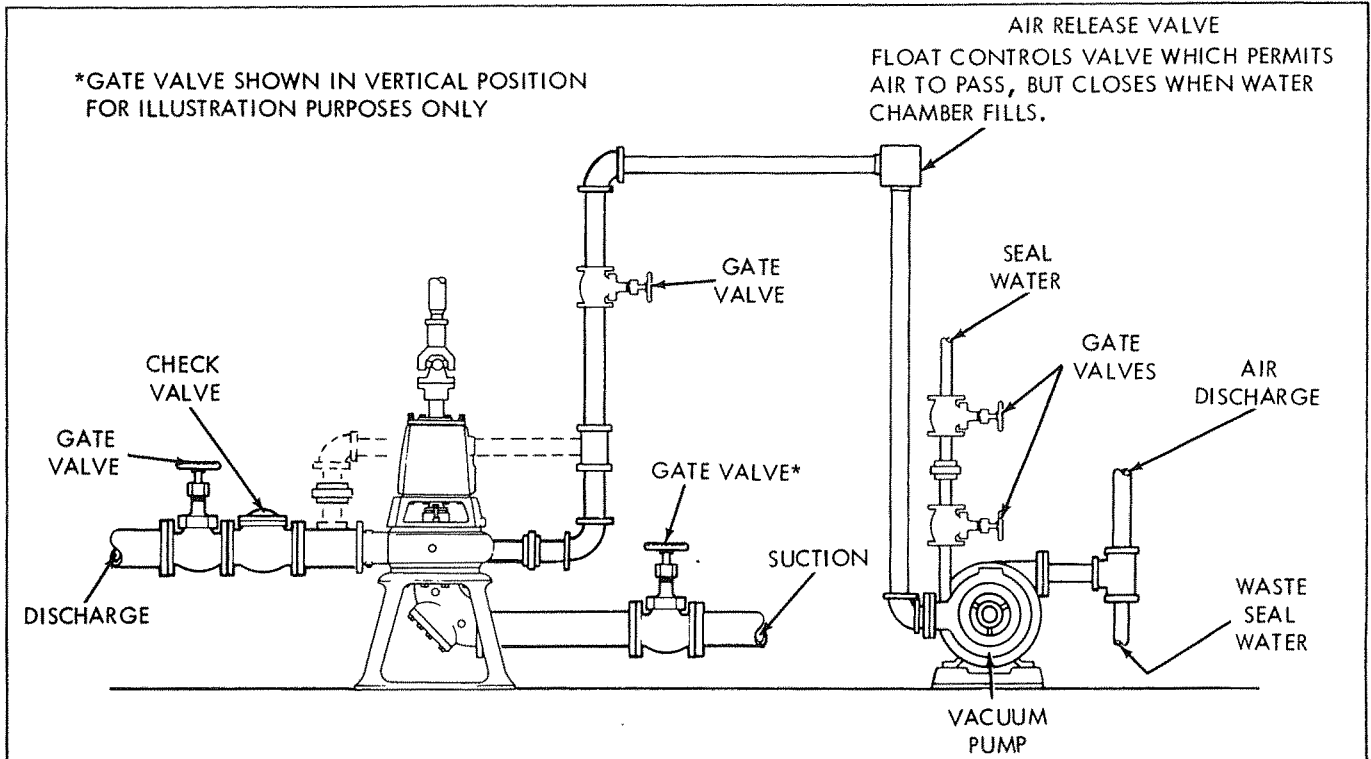


FIGURE 24. PRIMING BY VACUUM PUMP

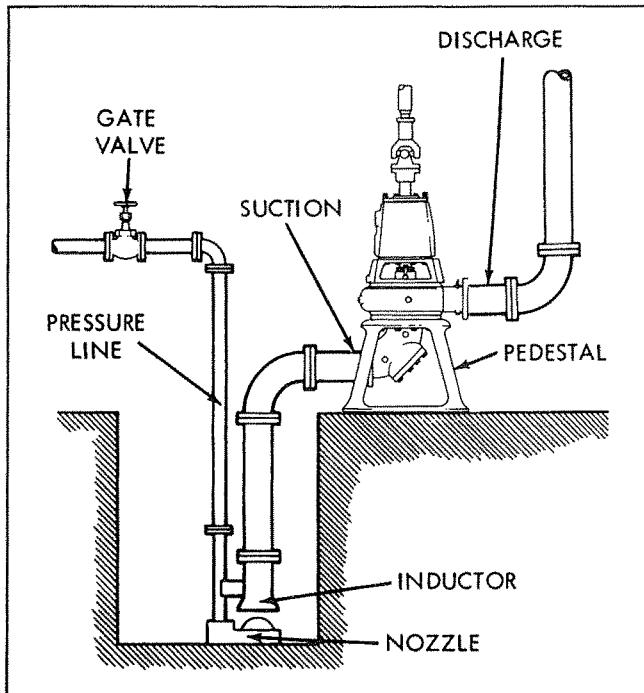


FIGURE 25. PRIMING BY INDUCTOR

suction piping. The nozzle and inductor are connected to a high pressure liquid supply such as a city water service.

The pump is primed by opening the valve in the pressure line, which allows the liquid to flow through the nozzle into the inductor. The velocity of the high pressure liquid drives the liquid into the suction piping and up to the pump, priming it.

**ELECTRICAL SYSTEM.** If your pump is equipped with an electrical drive motor, the motor should be wired in accordance with the wiring diagram found on the motor name plate. Be sure the voltage, frequency, and phase of your power supply corresponds with the name plate data. It is advisable to provide a separate switch and overload protection for your pump motor to protect against power failure in an other area. Conversely if the pump motor develops electrical problems, it will be isolated from other equipment.

**PRESTARTING INSTRUCTIONS.** Before starting your pump, check the direction of rotation to make sure it is the same as the arrow on the pump casing. Rotation can be checked by closing the switch momentarily and then opening it and observing the direction of rotation of the flexible coupling or driveshaft.

**CAUTION**

Do not operate your pump without liquid. The pump seals or packings depend on the liquid being pumped for lubrication.

Be sure the pump is primed and that no air exists in the suction piping and pump casing.

Check the various valves to make sure that they are open or closed as required by your specific application. On flooded suction applications, the gate valve has been open during the priming operation, and should remain open at starting. The gate valve in the discharge line should be closed, as your pump will require much less power starting against a closed valve than it will with the valve open.

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## WARRANTY

Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller; however, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid. Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated. If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B., Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing. The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced, whichever is greater. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired. Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired. Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

The above warranty shall not apply to any equipment which may be separately covered by any alternate or special warranties.

**PERFORMANCE:** In the absence of Certified Pump Performance Tests, equipment performance is not warranted or guaranteed. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy under Hydraulic Institute procedures.

**LIABILITY LIMITATIONS:** Under no circumstances shall the Seller have any liability under the Order or otherwise for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, regardless of the cause of such damages or losses. In any event, Seller's aggregate total liability under the Order or otherwise shall not exceed the contract price.

**ACTS OF GOD:** Seller shall in no event be liable for delays in delivery of the equipment or other failures to perform caused by fires, acts of God, strikes, labor difficulties, acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond Seller's control.

**COMPLIANCE WITH LAW:** Seller agrees to comply with all United States laws and regulations applicable to the manufacturing of the subject equipment. Such compliance shall include: The Fair Labor Standards Acts of 1938, as amended; Equal Employment Opportunity clauses of Executive Order 11246, as amended; Occupational Safety and Health Act of 1970 and the standards promulgated thereunder, if applicable. Since compliance with the various Federal, State, and Local laws and regulations concerning occupational health and safety, pollution or local codes are affected by the use, installation and operation of the equipment and other matters over which Seller has no control, Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty, or otherwise. It is incumbent upon the Buyer to specify equipment which complies with local codes and ordinances.



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