This invention relates to control valves for pumps.

This invention has utility when incorporated in connection with pumps having lift. The lift may approximate a constant range for suction intake or supply. This condition may prevail when the delivery head or pressure may be set up over a relatively wide range for discharge. The control valve hereunder is adaptable to respond in widely diverse capacity installations. In the instance of a motor driven rotary pump, the valve device is desirably located in the pump flow or delivery line or duct. Oppositely effective similar valve areas are provided in thereby caring for automatic compensation of pressure to take care of proper valve operation at the attained working condition for the pump. The device in its operations, is designed to close as the pump starts. The closing is desirably for a brief interval. The valve normally is to remain open at other times.

Referring to the drawings:

Fig. 1 is a side elevation of a horizontal, direct connected, rotary pump installation, with the valve device hereof somewhat out-of-proportion as enlarged, parts being broken away.

Fig. 2 is a detail view in plan of the control device over the pump, the view being turned 90° counterclockwise from looking directly down on Fig. 1.

Fig. 3 is a view in medial section through the valve device, on the line III—III, Fig. 1.

Fig. 4 is a detail view of a fragmentary section of the valve device housing as to connections, being on the line IV—IV, Fig. 3 and Fig. 5 is a fragmentary view of the pump and connections, looking from the left of Fig. 1.

A duct or riser pipe 1 is herein shown. The pipe 1 has a suction connection 2. The connection 2 is axially of a rotary pump 3. The pump 3 is on a base 4. The base 4 is carried by a platform 5. An electric motor is directly connected to the pump 3. The motor is in a continuation of the pump housing extending oppositely from the connection 2. A discharge line 6 from the pump 3 may extend for a distance down along the pipe 1. The line 6 is for pressure liquid supply to the ejector, and serves as an auxiliary or booster pump or means in series with the pump 3. The ejector may be of the Venturi type. The booster pump serves to force liquid up the pipe 1 to within the suction influence or lift of the pump 3. A practical working design or constant for such suction influence or lift may be 20 ft. or less. A line 6 from the pump 3 extends to a nozzle 8 of the ejector (Fig. 5).

In addition to the ejector supply line 6 from the pump 3, there is a regular discharge line or pipe 7 for directing the delivery flow from the pump into a housing 8 of the valve device hereof. The pump discharge liquid, after passing from the housing 8, flows by a line 9 to a T-fitting 10. With a valve 11 open, there may be a take-off flow to more or less remote places, as a watering tank or tanks for stock, irrigation, and the like. Alternatively, with a valve 12 open, the flow may be to a storage tank 13. This storage tank 13 may be of water for household purposes. With the tank 13 designed to provide a delivery pressure, there may be a volume of compressed air in the tank above the water. Appropriate to the maintenance of this function, the intake or suction side of the pump 3 may have a connection 14 extend by way of a T-fitting 15 to a line 16. The pump 3 provides suction to operate a diaphragm pump 16 for air replenishment in the tank 13. A pressure gauge 19 is an indicator of the pressure in the tank 13. This is a visible check for the pressure in the installation.

The housing 8 may have a bushing 20 to adapt to the pipe 7. The housing 8 has therein a chamber 21 for the flow incoming by way of the pipe 7. This chamber 21 has aligned ports, in one of which is a cylindrical valve seat 22, and in the other a cylindrical sleeve guide 23. Flow from the chamber 21 by way of the valve seat 22 is to a chamber 24. A bushing 25 may be required in the connection to the water flow-off line 9. A valve stem 26 thereon a piston 27 in the guide 23. On the stem 26, and in the chamber 24, is a poppet valve or disk 28. The disk 28 against the seat 22 is adapted to close off the chamber 24 from communication with the chamber 21. The valve stem 26, remote from the piston 27, extends through a valve guide or opening 29 in a bushing or gland 30. The bushing 30 provides a partition in the housing 8 for separating a chamber 31 from the chamber 24.

In the chamber 31, about the stem 28, is a compression helical spring 32. The spring 32 acts on a disk 33 fixed terminally on the valve stem 26 remote from the piston 27.

The piston 27 and the poppet valve 28 are of such relative diameters as to approximate similar effective pressure reaction areas in opposite directions from the chamber 21. Accordingly, the action of the spring 32 is normally to hold the balanced valve device in open position, that is, with the disk 28 off its seat 22. At this fully
open position for the valve 28, a disk 33 outwardly flexes a diaphragm 34. A gasket 35 seats the diaphragm 34 with the housing 8. A closure or head 36 limits the outward flexing of the diaphragm 34. In the disclosure herein, a port 37, with a terminal nozzle 38, maintains atmospheric pressure at all times for the side of the diaphragm 34 away from the chamber 31.

Upon occasion there might be attention given to clean out or drain the chamber 24. Accordingly, at a port 39 (Fig. 4), a plug 40 may be removed. From the chamber 31, a bushing 41 may have a duct 42 extend to a diaphragm or air pump, as a supplemental feature; that is from the line 46 instead of from the T-fitting 15.

A bushing 43 mounts a duct 44 to connect the chamber 31 to the fitting 15 and thereby exposes the chamber 31 to the intake suction of the pump 3. Priming may be accomplished by removing a plug 45 and pouring liquid, as water, therethrough. In connection with the normal operation, to maintain a given head, pump chamber 24 may have a duct 46 (Fig. 1) therefrom to a pressure operated switch device 47 adapted automatically to cut in and out the motor in the extension from the pump housing 33.

The valve device, when the pump is at rest, has the spring 48 held the valve disk 28 off the seat 22. The spring 39 is designed to deflect sufficiently, through the action of atmospheric pressure on the diaphragm 34, which pressure is supplied by way of the vent or nozzle 38. There is resulting travel of the stem 25 sufficient to allow the disk 28 to seat when suction in the chamber 31 reaches any value exceeding 20 ft. of liquid to be pumped. That is, the valve 28 is closed when the pump 3 is required to lift from a depth exceeding 20 ft.

When the pump 3 or the pipe 1, 6, are to be filled with the liquid, charged thereinto, the plug 45 is removed. The plug 45 may then be replaced and the pump started. The starting of the pump 3 may be through the operation of the switch device 47, or otherwise, as by manual control at the intake 8. For illustration, the spring 48 develops a lift or suction which may reach a momentary value of 28 ft. Such is at once transmitted to the chamber 31. This drop in pressure on one side of the diaphragm 34 results in the atmospheric pressure, supplied through the nozzle 38, acting on the opposite side of the diaphragm 34. This pressure compresses the spring 32 and shifts the stem 25 to close the valve 28 at the seat 22. This seals off the discharge line 7. However, as the pump discharge line 6 is to an ejector or booster pump, which may be submerged in the liquid to be pumped, this device through the action of the pressure developed by the pump 3, immediately forces liquid up the pipe 1 to within suction influence of the pump 3. Such suction being in the range of 20 ft. or less, of the liquid to be pumped, the suction in the chamber 31 is therefore reduced and the spring 32 will unseat the valve disk 28 to permit flow into the chamber 24. The diaphragm 34 does not resist this operation, inasmuch as air is not entrapped in the chamber on the side of the diaphragm 34 toward the head 36, since the air may escape through the nozzle 38.

The operation of the valve 28 to and from its seat 22 is not influenced by the pump 3 net discharge pressure. This valve 28 is controlled only by the suction pressure of the pump 3. A constant suction is maintained on the pump 3, regardless of the depth to the liquid or of the quantity of the liquid being pumped. This is a desirable achievement. The maximum efficiency of the pump system is attained where the deep valve is closed, the ejector is doing as little work as possible, that is, forcing the liquid to be pumped, only to and not beyond the suction limit of the pump 3. Thereby a maximum of liquid is left available for delivery through the pipe 3.

The disclosure herein has its utilities primarily grouped about the balanced valve feature (Fig. 3). The installation may be with various types of water actuated pumps. The ejector type shown in applicant's Patent 2,319,509 May 18, 1943, of which this application is a continuation in part, is a disclosure of one type of water actuated pump.

The vent 35 functions herein to leave the control sensitive for immediate and direct response. The selection of the spring 32 to operate in the assembly at 20 ft. lift for the second or rotary pump 3 in the series of this installation, means that at once the water comes within such 20 ft. lift range for the pump 3, the spring 32 opens the valve 28. This establishes a normal or standard working condition for the pump 3 to operate efficiently. The vent 35 controls the valve so it may open for the pump 3 to commence and continue its delivery flow. This mode of operation is at the adopted lift range, herein adopted as 20 ft. With such problem worked out, there is reliable operation on such schedule with the appurtenances regarded as being the capacity for the pump, and accordingly with different developed pressures from such pumps. It is the purpose that the balanced valve and the vent feature, in the control unit hereof, achieve efficient pump operation with entire absence of need to adjust or alter the installation.

What is claimed and it is desired to secure by Letters Patent is:

1. An Impeller pump having a discharge therefrom, a suction intake thereeto, a supply extension for the intake including an ejector, a line from the discharge to operate the ejector, said discharge having a delivery duct, a reciprocable valve in said duct, a spring normally holding the valve open to provide an unobstructed passage for the pump discharge and maintained against disturbance at normal atmospheric pressure, a chamber provided with a diaphragm, there being a port to the chamber for supplying atmospheric pressure to the side of the diaphragm opposing the spring, a connection from the intake to the chamber opposite side of the diaphragm from said port, adapted in the interval of pump starting for suction actuation of the diaphragm to close the valve, a piston movable with the valve, and a guide for the piston having, at closed position of the valve, communication with opposite sides of the valve.

2. An impeller pump for liquid having a discharge therefrom, a suction intake thereeto, a supply extension for the intake including an ejector pump of full response to the capacity of the impeller pump, a line from the discharge to operate the ejector, said discharge having a delivery duct, a valve in said duct, a spring normally holding the valve open to provide an unobstructed passage for the pump discharge at atmospheric pressure, a chamber for the spring, a diaphragm in the chamber, there being a port to the chamber for supplying atmospheric pressure to the side of the diaphragm opposing the spring, a connection from the intake to the chamber
be opposite side of the diaphragm from said port, adapted in the interval of pump starting, for suction actuation of the diaphragm to close the valve during the starting of the pump and responsive to pump discharge liquid fully to open the valve, a piston movable with the valve, and an open ended cylinder for the piston having one end thereof in communication with the intake side of the valve and the other end in communication with the discharge side of the valve.

3. An impeller pump having a discharge therefrom, a suction intake thereto, a supply extension for the intake including an ejector, a line from the discharge to operate the ejector, said discharge having a delivery duct, a poppet valve in said duct, means fixed with the valve and exposed to the delivery duct pressure to and from the valve, whether the valve be opened or closed, a spring normally holding the valve open to provide an unobstructed passage for the pump discharge and maintained against disturbance at normal atmospheric pressure, a chamber provided with a diaphragm to oppose the spring, and a connection from the intake to the chamber, adapted in the interval of pump starting for suction actuation of the diaphragm to close the valve.

4. An impeller pump having a discharge therefrom, a suction intake thereto, a supply extension for the intake including an ejector, a line from the discharge to operate the ejector, said discharge having a delivery duct, a valve housing in said duct providing a pair of ports, a poppet valve in said housing operable to open and close one of said ports, a piston connected to the valve and maintaining the other port closed, a spring normally holding the valve open to provide an unobstructed passage for the pump discharge and maintained against disturbance at normal atmospheric pressure, a chamber provided with a diaphragm to oppose the spring, and a connection from the intake to the chamber, adapted in the interval of pump starting for suction actuation of the diaphragm to close the valve.

5. An impeller pump having a discharge therefrom, a suction intake thereto, a supply extension for the intake including an ejector, a line from the discharge to operate the ejector, said discharge having a delivery duct, a valve housing in said duct providing a pair of ports and a chamber, a poppet valve in said housing cooperating with one of said ports as a valve seat to open and close the same, a piston connected to the valve to move therewith but maintain the other port closed, a spring normally holding the valve open to provide an unobstructed passage for the pump discharge and maintained against disturbance at normal atmospheric pressure, a diaphragm in the chamber of the housing to oppose the spring, and a connection from the intake to chamber, adapted in the interval of pump starting for suction actuation of the diaphragm to close the valve.

6. An impeller pump for liquid having a discharge therefrom, a suction intake thereto, a supply extension for the intake including an ejector pump of full response to the capacity of the impeller pump, a duct from the discharge to operate the ejector, a delivery duct from the discharge, a valve in the delivery duct, a spring tending to hold the valve toward an open position to provide an unobstructed passage for the pump discharge, a diaphragm connected to act upon the valve in opposition to the spring, a chamber for the diaphragm, there being a port to the chamber for supplying atmospheric pressure to the side of the diaphragm opposing the spring, a connection from the intake to the chamber opposite side of the diaphragm from said port adapted in the interval of pump starting for suction actuation of the diaphragm to locate the valve toward closing position during the starting of the pump and responsive to pump discharge liquid fully to open the valve, a cooperating piston and cylinder coaxial with the valve, one thereof having connection to the valve and being reciprocable therewith and having at closed position of the valve having passage means providing communication with opposite sides of the valve.

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