Sept. 22, 1931. R. B. CARTER, JR 1,824,465

PUMPING SYSTEM

Filed Dec. 27, 1929 2 Sheets-Sheet 1

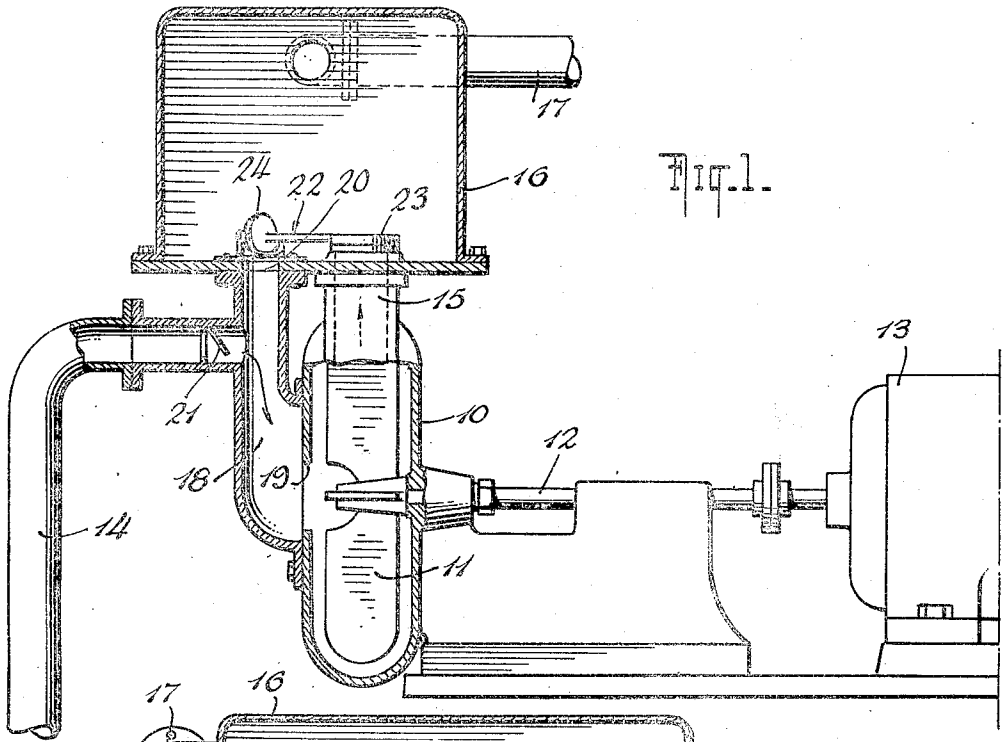


Fig. 1.

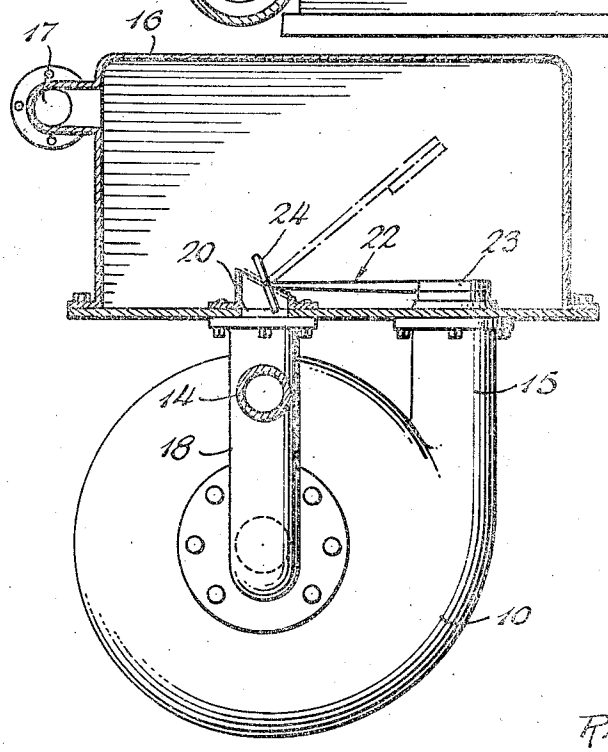


Fig. 2.

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Fig. 3.

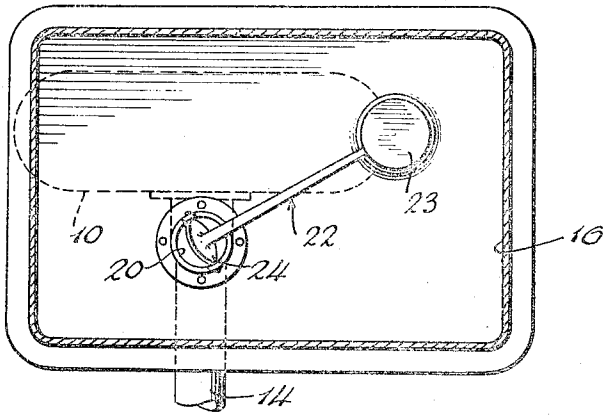


Fig. 4.

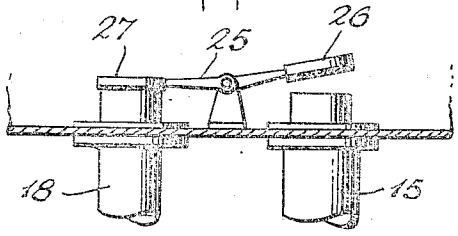


Fig. 5.

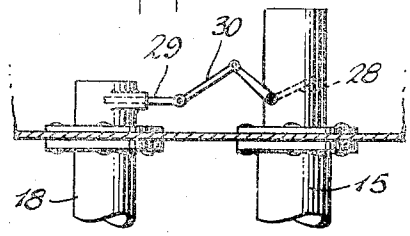
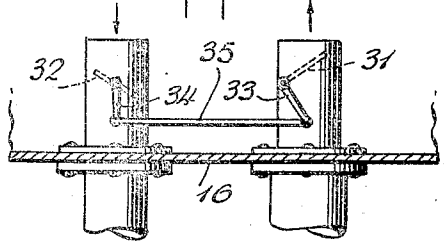


Fig. 6.



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UNITED STATES PATENT OFFICE

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PUMPING SYSTEM

Application filed December 27, 1929. Serial No. 416,971.

This invention relates to improvements in pumping systems, and has particular reference to a self-priming centrifugal pump.

In centrifugal pumps of known construction, difficulty has been experienced, after the pump has been primed, in securing satisfactory expulsion of liquid should air or gas enter the pump chamber during operation.

To overcome this difficulty, the present invention provides a pump which will efficiently operate to quickly expel air and gas from the system while it is being primed and thereafter continuously pump liquid while discharging a further accumulation of air or gas.

A feature of the invention is to automatically control the flow of liquid through the system and the expulsion of air or gas therefrom by providing a valved by-pass arrangement between the pump chamber and a discharge tank which will become effective, when air or gas from the suction line enters said chamber, to permit said air or gas to pass into the tank and thus be discharged from the system.

The inventive idea involved is capable of receiving a variety of mechanical expressions, some of which, for purposes of illustration, are shown in the accompanying drawings, in which:—

In the drawings—

Figure 1 is a fragmentary view, partly in elevation and partly in section, of a pumping system constructed in accordance with the invention;

Figure 2 is a sectional view taken at right angles to Figure 1;

Figure 3 is a horizontal section through the discharge tank of the system showing the valve mechanism therein in plan view; and

Figures 4, 5 and 6 are elevations of different forms of valve mechanisms which may be employed in the system.

In carrying out the invention there is utilized a centrifugal pump of a known type which comprises a housing 10 forming a chamber in which the impeller 11 is designed to rotate, being driven through the shaft 12 by an electric motor 13 or any other suitable driving means. The operation of the pump is adapted to draw a column of liquid from any source upwardly through the suction pipe or line 14 into the impeller chamber from whence it is forced through the discharge duct 15. In self-priming centrifugal pumps, one of the problems encountered is to effect the discharge of air or gas entering the pump from the suction pipe while maintaining the pump in continuous operation. This problem has been satisfactorily solved by the present construction which also enables the use of an impeller, the edges of which may be spaced from the walls of its chamber to a greater degree than is customary with pumps of this character, thereby permitting the freer passage of solid or semi-solid materials through the pump and into the discharge duct 15 thereof.

To effect the desired results, the invention contemplates the provision of a discharge tank 16 supported above the pump and communicating with the impeller chamber through the duct 15. The liquid and other substances pumped from the suction line 14 is caused to flow into the tank 16 from whence the same will be carried outwardly through the discharge pipe 17. There is further provided an auxiliary chamber, constituting a by-pass 18, secured to the pump housing 10 and surrounding the inlet opening 19 therein, and also connected with the discharge tank 16 through a port 20 in the bottom thereof, which, in order to secure the quickest priming of the pump, is preferably, though not necessarily, of a cross-sectional area not less than that of the suction line 14 at its point of entry into the by-pass, and which will permit of a flow into said by-pass from the tank 16 at least equal to the maximum capacity of the pump, that is, the capacity which the pump will attain when obtaining, at the suction inlet, a sufficient supply of liquid under zero vacuum. Said by-pass 18 may thus form a communication between the pump housing and the discharge tank which may allow of an unrestricted flow of liquid through the port 20 to the pump. The upper end of the suction pipe 14 is also connected to the by-pass 18 so that the liquid from the pipe will flow di-

rectly into the same and from thence into the pump housing, the flow from the pipe into said by-pass being controlled by a valve 21 which opens inwardly toward said by-pass under pressure of the liquid from the suction pipe.

A valve mechanism, generally indicated by the numeral 22, is provided for the purpose of controlling the flow of liquid from the discharge tank into the pump through the by-pass, and also the escape of air or gas from the pump and by-pass during the priming and operation of the former. As shown in Figures 1 to 3, this valve mechanism comprises a flow-actuated member in the form of a disk 23 controlling the communication between the duct 15 and tank 16 and a valve 24 for closing and opening the port 20. The valve 24 is so arranged that when the disk 23 is in approximately the position shown in Figure 1, said valve is open and when said disk is raised by the pressure of the flow of liquid thereagainst, as indicated in dotted lines in Figure 2, the valve 24 is closed. The same results are obtained by the valve mechanisms shown in Figures 4, 5 and 6. In Figure 4 the valve lever 25 is pivoted intermediate its ends and is provided with a disk 26 and a valve 27 at the opposite ends thereof. The disk 26 is under the control of the liquid flowing from the pump into the discharge tank and the valve 27 controls the passage of the liquid from said tank to the by-pass 18. In Figure 5 the disk 28, which is controlled by the passage of the liquid through the discharge duct 15, is pivoted while the valve 29, which performs the same function as the valves 24 and 27, is slidably mounted, said disk 28 and valve 29 being connected by a toggle arrangement 30. In Figure 6 both the disk 31 and valve 32 are pivoted and carry cranks 33 and 34 joined by a link 35 to effect the alternate opening and closing of the valve 32.

In operation, the impeller chamber of the pump, the discharge tank 16 and by-pass 18 are first filled with liquid, the check valve 21 being at this time closed, by reason of pressure of the liquid thereagainst, so as to prevent the liquid from flowing down into the suction line 14. The motor 13 is now started, thus rotating the impeller 11. The liquid in the impeller chamber is discharged upwardly through the duct 15 and the pressure created by the flow of said liquid against the disk 23 raises the same, at the same time moving the valve 24 to its closing position. The rotation of the impeller 11 draws the liquid in the by-pass 18 into the impeller chamber and creates a suction at the juncture of the pipe 14 with said by-pass, thus causing the valve 21 to open whereby air or gas from the pipe 14 is drawn into the by-pass 18 and thence into the impeller chamber. Upon the entry of the air or gas into said chamber, the impeller will stop pumping liquid upwardly into the discharge tank and the cessation of flow will then permit the disk 23 to drop thereby opening the valve 24. The disk 23 may be made to close the duct 15, as shown, or it may leave the duct partially open when in its lowermost position. The valve 24 now being opened, allows the liquid from the tank to flow down into the by-pass 18. During the opening of said valve some of the air or gas in said by-pass and pump housing will pass upwardly through the duct 15 and port 20 and enter the discharge tank 16 and the remaining air or gas will pass upwardly through the liquid in the by-pass 18 and into said tank. At the same time liquid will flow from the tank 16 into said by-pass to refill the same. As soon as all of the air or gas has been expelled into the tank, the impeller 11 will again start to pump the liquid and create pressure sufficient to once more raise the disk 23 and close the valve 24. Sufficient suction is now again created to open the valve 21 and permit another volume of air or gas to enter the by-pass 18. Thus it will be apparent that this priming operation is automatically and rapidly repeated until all of the air or gas is expelled from the suction pipe 14 and from the pump and that said operation is controlled by the liquid flowing into and out of the impeller chamber. The liquid then continuously flows through the system with the valve 24 in closed position and during the operation of the pump, should any accumulation of air or gas again enter the by-pass 18 from the pipe 14, the same will be expelled in the manner accomplished during the priming of the pump.

What is claimed is:

1. In a self-priming pumping system, a pump having an impeller chamber provided with a discharge outlet, a suction line from which liquid, air and gas is drawn to said chamber, a by-pass for establishing connection between said outlet and chamber, and means controlled by the velocity of the flowing liquid from said chamber, for by-passing the discharged liquid back into the chamber through said by-pass when air and gas enters said chamber, said means including a balanced valve.

2. In a self-priming pumping system, a pump having an impeller chamber, a discharge tank communicating with said chamber, a by-pass between said tank and chamber, and a balanced butterfly valve mechanism controlled by the velocity of the flow of liquid from said chamber into said tank for opening and closing communication between said tank and chamber through said by-pass.

3. In a self-priming pumping system, a pump having an impeller chamber, and a discharge line leading from said chamber, a discharge tank in the discharge line and communicating with said chamber, a by-pass

between said tank and chamber permitting unrestricted flow from all portions of the discharge line to the impeller chamber, and means actuated solely by the velocity of flow and located between said tank and chamber for controlling communication between said tank and chamber through said by-pass.

4. In a self-priming pumping system, a pump having an impeller chamber, a discharge tank in the discharge line from said impeller chamber, a by-pass connecting said tank and said chamber, a suction line opening into said by-pass, and means for controlling the by-passing of liquid from said tank to said chamber, said means comprising a disk valve, a disk element, and an arm connecting the two, said disk element actuated by the flow from the impeller chamber to open and close said valve.

5. In a self-priming pumping system, a pump having an impeller chamber, a discharge tank disposed above the impeller chamber and positioned in the discharge line from said chamber, a by-pass connecting said tank and said impeller chamber, a suction line opening into said by-pass, mechanism within said tank for controlling the by-passing of liquid back to the impeller chamber, said mechanism comprising a balanced disk valve for opening and closing said by-pass, a disk element positioned in the discharge line of flow from said impeller chamber, an arm connecting said element and said valve for actuating the latter to close the by-pass when the element is raised by the flow from the impeller chamber and to open the by-pass when the element lowers due to lack of flow from the impeller chamber.

6. In a self-priming pumping system, a pump having an impeller chamber, a discharge tank having ports, one of which establishes communication between said chamber and tank and the other between said tank and a by-pass which connects the tank and the impeller chamber, and a flow controlled mechanism including an element arranged adjacent the first-named port and operated by the flow therethrough from the impeller chamber to move toward closing and opening positions relative to said port, said mechanism further including a valve under the control of said element for opening the first-named port when the element moves toward closing position and closing the first-named port when the element moves toward opening position.

In testimony whereof, I have affixed my signature.

RALPH B. CARTER, JR.