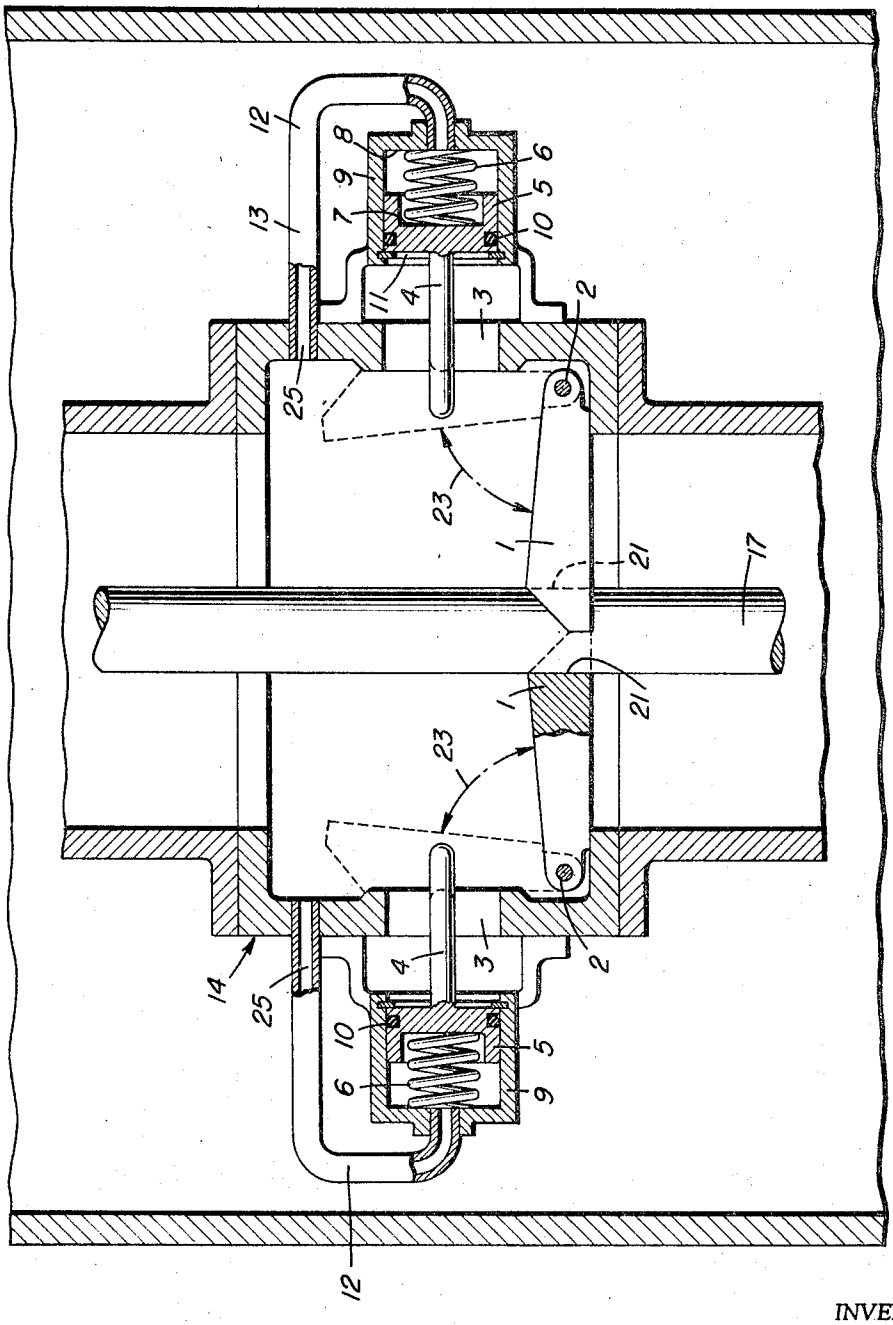
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VALVE STRUCTURE FOR SELF-PRIMING PUMPS

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VALVE STRUCTURE FOR SELF-PRIMING PUMPS

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ABSTRACT OF THE DISCLOSURE

A valve structure for an automatically recycling self-priming pump to be mounted in the pump discharge pipe. An aperture is formed in the housing of the valve to divert a portion of the pumpage to the outside of the discharge pipe to a well which feeds the pump inlet. A two-position flapper valve is contained within the housing of the valve structure and occupies either a position closing the pump discharge or a position closing the aperture. A piston and cylinder arrangement is provided with a projecting piston rod extending through the aperture to contact the flapper valve when it is seated against the aperture as during normal pumping. A coil spring biases the piston to urge the rod against the flapper valve, and a tube connects the cylinder with the interior of the valve housing for pressure equalization. When the system is operating normally, the flapper valve is up, seated on the aperture. When the pump loses its prime, the forces on opposite sides of the flapper valve are equalized via the tube communicating with the cylinder, and the coil spring forces the piston and piston rod to unseat the flapper valve so that it moves to its position closing the discharge colume. In this position, the aperture is unblocked, and liquid in the pump discharge column downstream of the flapper valve can flow through the aperture and back to the pump inlet to reprime.

This invention relates to a valve structure for self-priming pumps. More particularly, the invention relates to a pressure balancing arrangement of structures and parts within a self-priming pump that provides an automatic recycling system.

The invented valve includes means whereby the above-mentioned pressure balancing operation is performed within a pump valve housing due to combined area correlation of structures with a cylinder with biased piston arrangement acting on a flapper-type valving system.

Flapper-type valving systems for self-priming pumps are known in the art. However, to my knowledge, up to the present, such valve structures as shown by the art present several inconveniences in performance. The most important inconvenience is that under certain circumstances the flapper valves end up operating as check valves impeding the flow of the pump recycling fluid. This situation results as the consequence of a movement of the flappers to allow flowing of a pumpage because said displacement causes the flappers to then obstruct the pump recycling means. When this happens a pressure differential is created within the valve housing resulting in the formation of a vacuum or negative pressure which causes the flappers to perform as check valves, thereby precluding the passage of recycling liquid when needed to drain back into the suction well.

An apparent solution to the foregoing has been to provide resilient means capable of acting on the flapper valves to bias said flappers out of such inoperative check valve position. However, the foregoing solution is practically devoid of its intended merits, the principal inconvenience being that, obviously, a series of specific resilient means settings must be provided to meet each possible condition

of pressure differential within a pump. Accordingly, the foregoing solution has been incapable of providing an automatic recycling system and, additionally has been of a clearly burdensome economic nature.

My invented valve overcomes the above-mentioned inconveniences by providing a pressure balancing arrangement for the actuation of the flappers under all pressure ranges. Accordingly, a principal object of the invention is to provide an automatic recycling system for a self-priming pump.

Another object of the invention is to provide a pressure rebalancing arrangement to obtain efficient automatic recycling in a flapper-type valve self-priming pump.

A still further object of the invention is to overcome the need for making use of several valve setting means in automatic recycling systems by providing a pressure balancing arrangement automatically operating at all pressure differentials.

Another object of the invention is to increase the operating performance of self-priming pumps, as well as to make such apparatus more economical.

Further objects and advantages of the invention will be apparent to those skilled in the art to which the invention pertains from the following description of the preferred embodiment thereof, and with reference to the accompanying drawing in which:

The figure is a side elevation in transverse sectional view of the invented valve structure.

It will be noted from said figure that the structures therein disclosed appear in pairs at both sides of a valve housing shown by the numeral **14**. Accordingly, any reference to a numeral indicates a reference to an identical one illustrated at the opposite portion of said valve housing.

The above-mentioned valve housing should be, preferably, of a circular shape. However, this circumstance is not at all limitative of the shape that may be imparted to such structure. In fact, other shapes and configurations may be adopted without affecting the operability of the invention or any of its principles.

The valve housing may be formed of a unitary body construction or, electively, by means of half sections in symmetry coupled together in such a way that the housing is rendered substantially fluid-tight. The valve housing defines a passageway free of obstructions for a fluid flow, and because of this circumstance, liquid flow turbulence is avoided.

Numeral **3** shows an opening extending transversely through a sidewall portion of the valve housing **14**. Numeral **1** shows a hinged flapper valve arrangement capable of being swingably displaced from a horizontal to an upright position about a hinge **2** on a portion of said housing **14** and adjacent the above-mentioned sidewall opening **3**, said swinging movement being shown by arrows **23**.

The above-mentioned opening **3** in valve housing **14** may be of any desired configuration. However, the shape of said opening must be of an area equal to the effective area of actuating piston **5**.

As shown in the drawing, each flapper valve **1** is sloped to progressively increase in cross-sectional thickness value in the direction of the free end. The free end of each of said valves **1** includes a notch **21** that will be described hereinafter as the specification advances.

From the drawing, it will be noted that when flapper valves **1** pivot as indicated by said arrows **23** the following occurs: In the horizontal position, said valves close the above-mentioned passageway defined by valve housing **14**. and when the flapper valves are moved to a substantially upright position, each valve will close sidewall opening **3** of housing **14**. Accordingly, when said flapper valve

means close the above-mentioned passageway means, aperture 3 of the housing will be open, and vice versa.

An actuator-type cylinder shown by numeral 9 is directly mounted on the outside of said valve housing 14, said cylinder 9 being in hydraulic communication with the housing, as shown by numeral 25, by means of a duct 12 extending within a tubing 13 and engaging cylinder 9 at the end remote from the valve housing. Numeral 5 shows a piston displaceable within the cylinder, provided with piston rod 4 and having its free end penetrating into the above-mentioned opening 3 on housing 14, the other end of piston rod 4 being secured to the head of piston 5.

A spring 6, positioned between the back surface 7 of piston 5 and the inner face 8 of the cylinder, maintains said piston 5 under bias in an extended position as shown in the drawing.

Numeral 10 shows an O ring encircling the periphery of piston 5 providing effective sealing means between piston and cylinder 9. A spring-type ring, shown by numeral 11, limits the outward displacement of piston 5.

A pump shaft extending through the valve housing is shown by numeral 17. The above-mentioned notches 21 on flappers 1 will contact said shaft 17 in coinciding engagement when closing the housing passageway, and provide an efficient closing effect to pumpage flow.

From an operational standpoint, the following is to be noted in regard to the described parts and structures:

As shown in the drawing, hinged flapper valves 1 are positioned closing the flow path of a liquid being pumped. The movement flow of the pumpage against the flappers will cause these means to rotate about their respective hinges 2 and out of the flow path. Each flapper will then be upwardly displaced to a position, shown by dotted lines in the drawing, closing opening 3 on the valve housing.

A pressure balance is maintained inside of the housing and inside cylinder 9, this being due, as above disclosed, to the fact that the area of opening 3 and the effective area of actuating piston 5 are equal and, additionally, to the circumstance that cylinder 5 is hydraulically connected to the inside of said housing.

A negative pressure or vacuum can develop during suction. This negative pressure will act equally on piston 5 of actuator cylinder 9 and on opening 3 obstructed by flappers 1. However, since the effective areas of the piston and flapper opening engagement are the same, the force exerted on each by the vacuum formed in said suction well will be the same, and a balance will exist as far as suction is concerned.

Similarly, when a positive pressure is present in the discharge housing and the flapper has been actuated to a closing position, the pressure exerted against flapper 3 will be equal to the pressure on cylinder 9, and, consequently, a balance of forces will result. Because the mentioned effective areas are the same, the actuating forces will oppose each other and, accordingly, result in the above-mentioned balance.

The foregoing shows that the pressure balancing device of the invention effectively operates whether positive or negative pressures are involved. In fact, each of the elements affected by such pressures are arranged as to areas and position so that the forces on each will be equal and opposite to the other.

The device of the invention is also capable of effectively operating under a situation of unbalanced forces such as created by the velocity effect of the pumpage on the flapper valves and a spring force due to the bias of spring 6 on piston 5.

Two alternative situations should be contemplated. These situations are created by the presence or absence of velocity pumpage flow.

When there is a velocity flow in the valve chamber, the force exerted on the flapper will be powerful enough to overcome the unbalanced opposing force exerted by spring 6 on piston 5. This will cause piston rod 4 to be retracted from opening 3 in the housing, being pushed outwardly therefrom by contact with the back surface of flapper 1 when the flapper is moved to an upright position obstructing opening 3 in housing 14.

When, on the other hand, there is no velocity, the said unbalanced spring force will be sufficient to operatively move flapper 1 away from the face of opening 3. This displacement will break the seal created by the obstruction of opening 3 and allow liquid to drain into the suction well for recycling purposes.

The dimension of the invented valve as herein disclosed, as well as the combined utilization of the various means described, can be readily determined by those skilled in the art without departing from the fundamental principles of the invention. Such is the case, also, with possible modifications and adaptations of the structures. Consequently, although a specific embodiment has been illustrated and described in detail, it is understood that the invention is not limited to those details except as may be required by the scope of the appended claims.

What I claim is:

1. A valve structure for automatically recycling self-priming pump comprising a valve housing defining a passageway for a pump, at least one aperture through a sidewall of the housing which, responsive to loss of prime in the pump, serves to divert a downstream portion of pumpage to the outside of said valve housing and thence to the inlet of the pump to which the valve structure is adapted to be connected, a two-position flapper valve means within said housing operative in its priming position to close said passageway and to open said at least one aperture, and in its normal pumping position to open said passageway and to close said at least one aperture by seating thereon, cylinder with biased piston means mounted outside said housing and including a part projecting through said aperture in contact with said flapper valve means in said normal pumping position, and means hydraulically communicating the interior of the valve housing with the interior of the cylinder with biased piston means to balance the forces exerted on said flapper valve means so that when the flapper valve means is in said normal pumping position and the pump loses its prime, the cylinder with biased piston means will unseat the flapper valve means and it will move to its priming position.

2. A valve structure for automatically recycling self-priming pumps as in claim 1, wherein the area of said aperture is equal to the effective working area of said cylinder and biased piston means.

3. A valve structure for automatically recycling self-priming pumps as in claim 2, wherein said flapper valve means, aperture, and cylinder with biased piston means are in two sets positioned on opposite sides of the valve housing.

4. A valve structure for automatically recycling self-priming pumps as in claim 3, wherein said flapper valve means is pivotally hinged to the sidewall of the housing adjacent said aperture in said wall.

5. A valve structure for automatically recycling self-priming pumps as in claim 1, wherein said means hydraulically communicating is a tubing extending from said cylinder with biased piston means to said housing downstream said aperture.

6. A valve structure for automatically recycling self-priming pumps as in claim 5, wherein the bias of said cylinder with biased piston means is provided by a coil spring.

7. A valve structure for automatically recycling self-priming pumps as in claim 5, wherein the part projecting from said cylinder with biased piston means is an extending piston rod.

8. A valve structure for automatically recycling self-priming pumps as in claim 5, wherein said cylinder with biased piston means includes a cylinder open at one end, a piston slidably mounted therein, a spring biasing said piston toward the open end of the cylinder, said projecting

part comprising a piston rod attached to the piston and projecting from the open end of the cylinder through said aperture into contact with said flapper valve means, an "O" ring encircling the periphery of the piston, and a ring mounted adjacent the open end of the cylinder to limit the outward displacement of the piston.

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