March 23, 1965 E. H. SCHIEVE 3,174,434

SUMP PUMP

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FIG-1

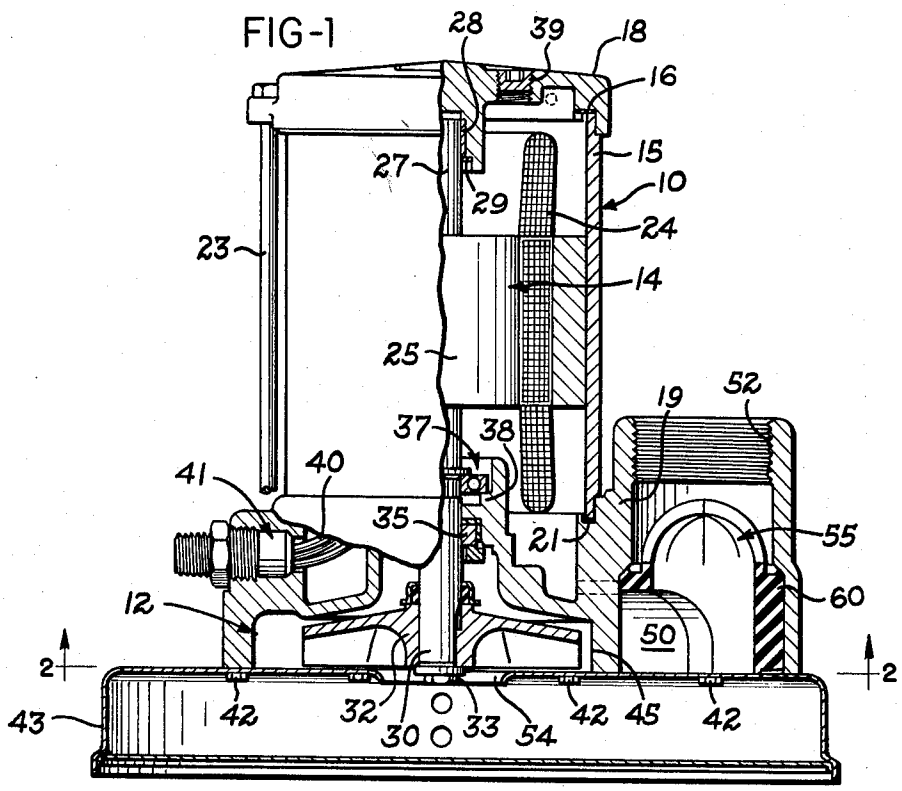
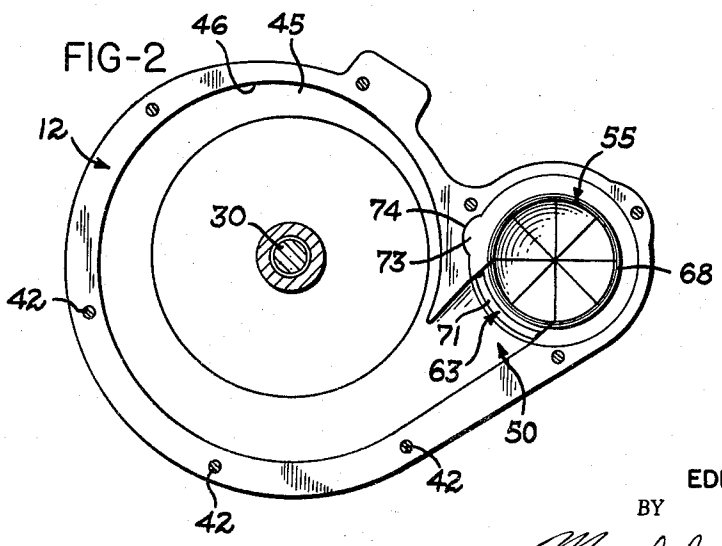


FIG-2



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FIG-3

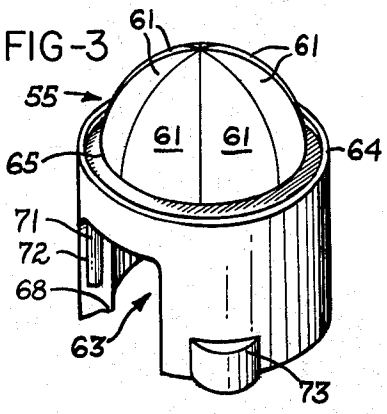


FIG-4

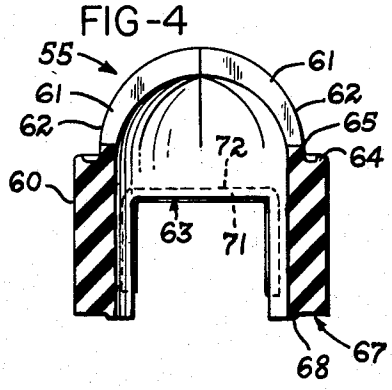


FIG-5

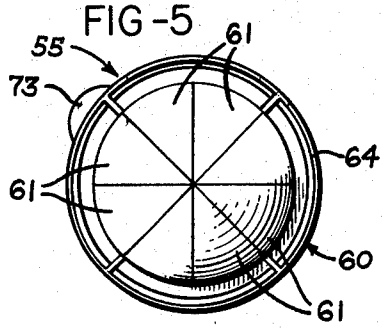


FIG-6

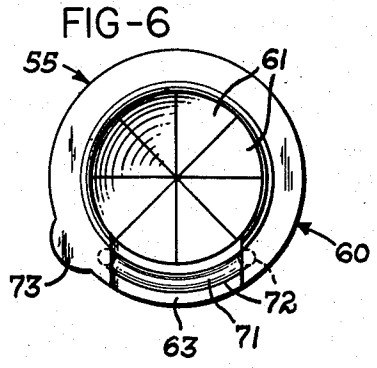
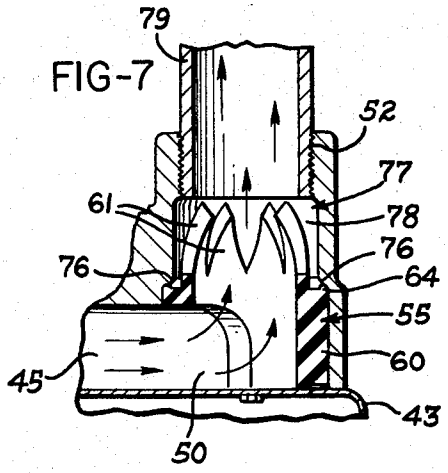


FIG-7



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United States Patent Office 3,174,434 Patented Mar. 23, 1965

3,174,434

SUMP PUMP

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Filed June 24, 1963, Ser. No. 289,827
3 Claims. (Cl. 103—103)

This invention relates to sump pumps and more particularly to an improved sump pump and an improved check valve therefor.

In the use of sump pumps of the type to which this invention relates, a standpipe is usually affixed to the pump to carry water from the area of the sump to a point removed therefrom. Once the pump has ceased to operate because of the withdrawal of liquid from the sump, the liquid in the standpipe tends to discharge into the sump by flowing backwards through the pump. To remedy this situation, check valves have been employed in the standpipe or in the pump structure itself to prevent back flow of fluid while allowing it to flow into the standpipe during operation of the pump. Generally, these check valves are of the movable poppet type and are relatively expensive. Further such valves are generally somewhat larger in diameter than the diameter of the standpipe itself in order to reduce the friction losses which occur as fluid moves through the valve.

Often, the fluid passing through the pump or other fluid handling equipment may have solid matter such as sand and the like suspended therein. In valves of the type including a movable poppet, sand may become trapped between the seat and the poppet thereby allowing leakage when the valve should be closed and in a sealing position.

Check valves which operates on a flapper valve principle have also been employed and have the advantage that they are less expensive than poppet valves and simple in operation. However, valves of this type generally include multiple parts which may be difficult to install by the user of the pump, and with some valve or pump constructions it is possible to install the flapper valve such that it retards the flow when the pump is running but allows flow when the pump is not running. Additionally, these valves may be so constructed that the movable flapper seats against a rigid non-flexible surface so that trapping of small particles of sand may occur. When such a situation arises, the particles are not easily removed since they are not in the stream or flow. A structure of this type is shown in Patent No. 3,021,788.

A primary object of this invention is to provide an inexpensive, improved one-piece check valve which may be easily and correctly assembled into fluid handling equipment.

It is also an object of this invention to provide an improved and inexpensive check valve which may be easily assembled into a pump and which allows substantially unobstructed flow when the valve is in the open position.

Another objection of this invention is to provide an improved sump pump including a volute and utilizing a check valve which provides non-turbulent flow during operation of the pump.

A further object of this invention is to provide an improved check valve for fluid handling equipment wherein the check valve is so constructed that the sealing surfaces of the valve are in the flow stream thereby substantially eliminating entrapment of particles such as sand and the like.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

FIG. 1 is a view partly in section and partly in elevation of a pump constructed in accordance with the present invention;

FIG. 2 is a view in section taken along the lines 2—2 of FIG. 1;

FIG. 3 is a view in perspective of a check valve constructed in accordance with the present invention;

FIG. 4 is a view in a section of the check valve shown in FIG. 3;

FIG. 5 is a plan view of the check valve shown in FIG. 3;

FIG. 6 is a view looking into the bottom of the check valve shown in FIG. 3; and

FIG. 7 is a sectional view illustrating the mode of operation of the check valve constructed in accordance with the present invention.

Referring to the drawings, which illustrate preferred embodiments of the present invention, FIG. 1 shows a representative form of a pump which includes a motor section generally designated 10 and a pump section generally designated 12. A motor 14 is positioned within an outer shell 15 which is sealed by a gasket 16 to an upper motor housing 18. The lower end of the outer shell 15 is sealed to a lower housing 19 by means of gasket 21, the upper housing, the outer shell and the lower housing being held together in sealed relation by a plurality of through bolts 23, one of which is shown. The upper housing, the outer shell and the lower housing alternatively may be joined together by the use of an epoxy cement, or other suitable means well known in the art.

The motor 14 includes a stator 24 supported by shell 15, and a rotor 25 which is carried by the shaft 27, the one end of the shaft being supported in the upper housing by a bearing 28 and retainer 29. The end of the shaft 30 which passes through the lower housing is splined or flatted to receive an impeller 32 which is secured to the shaft by a lock screw and washer assembly 33 and seal 35 is provided for preventing flow of fluid between the lower housing and the shaft. A bearing and tolerance ring assembly generally designated 37 support the shaft on a shoulder 38 formed around the opening in the lower housing. The upper housing includes a threaded opening 39 through which oil may be inserted for cooling and lubricating the bearing 37.

Lead wires 40 coming from a switch (not shown) for the motor assembly pass through a liquid tight seal 41 provided in the lower housing. Any suitable switch such as a pressure switch or float switch may be utilized to energize the motor in response to the presence of liquid above a predetermined level.

Mounted on the lower housing by bolts 42 is a base 43 which forms a closure assembly for a volute chamber 45 provided in the lower housing. Referring to FIG. 2, the volute chamber is preferably in the form of an eccentric spiral as defined by the interior face 46 of the lower housing, and terminates in a chamber 50 which is preferably cast in the lower housing, chamber 50 including a threaded portion 52 for receiving a discharge pipe. The flow of liquid is from the sump through multiple perforations in the side wall of the base 43 and thence through the opening 54 in the upper wall of the base 43 which forms the inlet to the volute chamber in which the impeller is positioned, and then through chamber 50 into the discharge pipe. Received within the chamber 50 is a check valve 55 which opens in response to operation of the pump and which closes in response to a reduction of pressure in the volute 45 to prevent flow of fluid through the discharge pipe and through the volute into the sump when the pump is shut off.

Referring to FIGS. 3 to 6, the check valve 55 constructed in accordance with the present invention includes a hollow cylindrical body portion 60 and a plurality of

sealing members 61 preferably formed integrally with the body 60 with the inside surface of each sealing member where it joins the body constituting an extension of the inner surface thereof. Each sealing member is preferably thinner in section than the section of the body portion so that the outside vertically extending surface portions 62 are spaced from the plane of the outer surface of the body. In the closed and sealing position as shown in FIG. 3, the sealing members define generally a sphere with each sealing member being received in wedged sealing relationship with the adjoining member. A passageway 63 may be provided in the body portion 60 to provide flow of fluid from the volute through the check valve, although it is understood that passageway 63 need not be present in instances where flow through the check valve is in an axial direction.

The body portion 60 preferably includes an annular sealing lip 64 at the top thereof and preferably radially spaced from the junction 65 of the sealing elements 61 and the body 60 so as to be positioned along the outer surface at the top of the body thereby eliminating any interference with the movement of the sealing members to the open or closed position. Similarly, the end portion 67 of the body spaced from the sealing members is also provided with an annular sealing lip 68 which functions to prevent flow of fluid between the lower portion of the body 60 and that surface to which the body is sealed, specifically the closure or base 43 as shown in FIG. 1

In accordance with the present invention, the check valve 55 is a one-piece construction of a resilient material such as natural or synthetic rubber or flexible and compressible fluorinated elastomers which may be easily molded to the configuration shown by conventional molding techniques. In instances in which passageway 63 is utilized, it is desirable to provide a reinforcing element 71 received within a groove 72 formed in the body and which generally surrounds the opening whereby the reinforcing element prevents inward buckling of that portion of the body exposed to the flow of liquid. If desired, the reinforcing element may be embedded in the body during formation thereof. The body 60 preferably includes a raised locating tab 73 proportioned to interfit within a locating recess 74 provided within the chamber 50 as shown in FIG. 2, and it is understood that other locating means may be provided as will be apparent to those skilled in the art.

The check valve is proportioned to be received in sealing relation within the chamber 50 with seal ridge 64 being received within an annular shoulder 76 (FIG. 7) provided in the lower portion of the chamber. The upper portion 77 of the chamber is of a diameter slightly larger than the outer diameter of the sliding members when in the fully opened position thereby providing an annular space 78 between the outer surface of the sealing member and the wall of the upper portion of the chamber when the valve is in the open position. The small space 78 thereby allows further movement of the resilient sealing members out of the path of fluid flow and thus tends to reduce the friction losses through the valve. Further, in the open position, the sealing elements are in a plane generally coinciding with the plane of the body and the outer diameter of the sealing members corresponds generally to the diameter of the discharge pipe 79 thereby substantially eliminating the presence of any annular shoulder or projection which would tend to interfere with flow or to provide an obstruction in which particles of sand and the like may collect.

One feature of the present invention is the design and configuration of the sealing members 61 which are preferably relatively thin in section at 65 where they join the body 60 and which gradually increase to a maximum thickness in section in the portions thereof generally indicated at 80 which are exposed to greater forces due to the pressure of the liquid acting on the check valve. In the closed position, the effect of pressure is greatest in those areas where the downward force is perpendicular to a line tangent to the surface. Since the effects of pressure are greatly reduced in the area 65, the thickness of the seal member at this particular point may be reduced to provide for relatively easy pivotal or swinging movement from the open to the closed position and vice versa. By providing sealing members with thicker sections in the areas exposed to the greatest force, there is less tendency of the pressure on the spherical-shaped dome to cause collapse of the sealing members, and further, as the pressure increases, the sealing members are urged more tightly into engagement due to the wedge-like action of the several members forming the sphere. In the event that particles of sand and the like should become trapped between the sealing faces of the individual seal elements, the resilient nature thereof allows the seal face to deform around the particle and thus, in cooperation with the wedge-like fit, a tight seal is established even with small particles between the sealing faces.

As will be noted from FIGS. 3 to 6, the sealing members are in the path of flow and meet at a common point which is spaced from the body 60. This feature of the construction is of importance in maintaining the check valve self-cleaning, especially in instances in which the fluid may have sand or other particles suspended therein. As the seal members move apart during operation of the check valve, the liquid flows between the mating seal faces to remove any particles which may have become lodged there.

Although eight sealing elements are shown, it is preferred that there be at least three sealing elements proportioned to interfit in wedged sealing relationship and preferably having a common point of intersection which is in the path of flow. Other constructions which may be used include tetrahedrons, although a sphere is preferred because of the greater wedging action which occurs in the closed position.

Generally, any conventional check valve when positioned in the flow of liquid will be expected to reduce the flow of liquid. However, tests utilizing the check valve of this invention indicate there is an increase in pump efficiency when compared to the efficiency of a pump without a check valve of the present invention. This apparent anomalous result may be explained on the basis that the check valve cooperates with the pump to reduce the turbulence otherwise present as the fluid flows from the volute into the standpipe.

Referring to FIG. 7, it can be seen that the direction of flow of liquid changes from a generally horizontal plane to a generally vertical plane as it flows from the volute 45 into the standpipe 79, and such a flow pattern is generally used in pumps since it allows compact construction. The presence of a check valve having multiple sealing members in the path of fluid apparently has the effect of reducing the turbulence which would take place as the flow changes direction.

Another factor which may contribute to the unexpected efficiency of the pump is the fact that the friction loss through the check valve 55 is low and thus eliminates the necessity of employing standpipes having portions of increased diameter to compensate for the losses generally occurring through poppet type check valves. The relatively low friction loss is due to the fact that there are a plurality of easily pivoted or movable sealing members which may be readily moved out of the path of fluid flow. Actual tests of a pump with and without a check valve of the type herein disclosed have shown that pump efficiency is increased slightly by the use of the check valve of this invention.

As shown in FIG. 7, the effect of utilizing multiple sealing members and the relatively thin section of each member at the point where it joins the body has the advantage of requiring less force to move each seal member to the open position. Further, the unitary structure of the check valve and the provision of locating means in

the chamber with corresponding locating means 73 on the body facilitates easy assembly of the check valve into the chamber. The check valve and the chamber are so constructed that it is virtually impossible to install the valve in a position in which it would be in the closed position during operation of the pump and open during inoperative periods of the pump.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparaus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a pump including a housing having a volute, outlet means located in a plane generally perpendicular to said volute for flow of fluid from said volute and a closure assembly for said volute, the improvement comprising chamber means communicating with said volute and said outlet means and forming that portion of the fluid path in which the direction of fluid flow is changed, one-piece check valve means received in said chamber means for allowing flow of fluid from said volute and preventing flow to said volute, said check valve including a hollow cylindrical body received within said chamber means, said body including seal means received in sealing engagement with said closure assembly and said chamber for preventing flow of fluid between the wall of said chamber and said body, said body including locating means and a port through the wall thereof adapted to communicate with said volute, said chamber including means cooperating with said locating means on said body for positioning and maintaining said port aligned with said volute, reinforcing means cooperating with said body to prevent distortion thereof in the areas surrounding said port, a plurality of sealing members integral with said body and generally defining a sphere when in sealing relationship with the common point of intersection of said sealing member being located in the path of fluid flow, said sealing members being movable into sealing engagement with each other in response to a reduction in the pressure in said volute to prevent flow of fluid thereto, and including surface portions exposed to the pressure in said outlet means, and said surface portions of said sealing members being thicker than the remaining portions of said seal members whereby the force on said exposed portions tends to force said sealing members into close interfitting sealing engagement.

2. In a fluid handling system, a check valve for preventing flow of fluid in one direction while allowing substantially unobstructed flow in the reverse direction, said check valve comprising a hollow cylindrical body of resilient material, a plurality of segmented separate members integral with said body and defining interfitting sealing elements spaced radially inwardly from the outside surface of the cylindrical body, said body portion including means defining a passageway through the cylindrical surface of said body whereby fluids may enter therethrough, said sealing elements including seal faces received in wedged sealing relationship and defining a

sphere-shaped dome with the common point of intersection of said sealing elements being spaced from said body, each said sealing element having a thickness cross-section at its junction with the body which is less than the thickness cross-section thereof at said common point of intersection, said sealing elements being of a resilient fluid impermeable material for movement to an open position generally in a plane coinciding with the plane of said body to allow flow through the separated sealing surfaces, and means on the outer surface of said body providing a locating projection adapted to be received in a locating recess of a housing for maintaining said valve properly oriented in said fluid handling system.

3. In combination a pump comprising a housing having means defining a volute and an outlet means for flow of fluid from said volute, chamber means in said housing disposed relative to said volute to receive flow from said volute, means in said chamber defining a locating recess, check valve means received in said chamber means for allowing flow of fluid from said volute and preventing flow to said volute, said check valve including generally axially extending body means received in sealing relation within said chamber means for preventing flow of fluid between the wall of said chamber and the body means, said body means of said valve being axially arranged with respect to the axially extending wall portion, passage means in the wall of said body means for allowing flow of fluid from said volute through said check valve means, said body means including locating means proportioned to interfit said locating recess for maintaining said passage means aligned with said outlet means of said volute, a plurality of resilient sealing members mounted in sealing relationship on said body means for movement to a plane generally coinciding with the plane of said body means in response to flow of fluid from said volute, said sealing members being movable into sealing engagement with each other in response to a reduction in the pressure in said volute to prevent flow of fluid thereto, and means affixed to said housing and forming a closure for said volute, said outlet means and said chamber means, whereby removal of said closure means permits access to said check valve for removal thereof.

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