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RECIPROCATING PUMP

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This invention relates to pumps, and in particular, to novel pump structures of the reciprocating type as employed, for example, for use as hand-operated bilge pumps and the like. The invention further contemplates the provision of a novel check valve structure for use in pumps of the general class described, and having general utility for a plurality of other pump structures.

Many design proposals have been advanced heretofore for small, relatively inexpensive reciprocating pumps. In spite of these proposals, however, there still exists a definite need for a simplified reciprocating pump which is amenable to mass production and characterized by extremely rugged structure and trouble-free operation. Further, with particular reference to pump structures for use as bilge pumps by boating enthusiasts, there is a great demand for such a device which will float in water, whereby it may be easily recovered if accidentally dropped overboard.

It is the principal object of this invention to provide a novel pump structure which satisfies the above enumerated requirements, among others.

A specific object of the invention is the provision of a highly simplified, hand-operated, reciprocating pump which is capable of being readily disassembled for cleaning or storage and reassembled by even non-skilled persons and which, considered as a unit structure, has a specific gravity less than that of water.

A further object of the invention is the provision of a pump which is highly resistant to damage by external blows and which, in turn, will not damage or mar finished surfaces or relatively fragile equipment of the type found on boats, if accidentally contacted therewith, as by dropping.

Still another object of the invention is the provision of a reciprocating pump structure which is highly resistant to corrosion under influence of corrosive media such as salt water and the like.

The invention provides for a reciprocating pump, all parts of which can be readily produced and fabricated by application of conventional techniques now employed in the manufacture of a great many other devices from the natural and synthetic resinous materials commonly referred to as plastics. In this connection, the invention provides a self-contained pump structure which can be fabricated from polyethylene or polypropylene, and homologous plastics, which float in water.

Lastly, the invention has as a specific objective the provision of a unique valve structure for a reciprocating pump, which also possesses utility as a general check valve mechanism, and which is formed integrally with the pump or valve housing and functions solely under action of the inherent resiliency and plastic memory of the material from which said housing is formed.

The above as well as other features and objects of the invention, and the invention itself, may be best understood by reference to the following description of specific embodiments thereof, taken in conjunction with the accompanying drawings, wherein:

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Fig. 1 is a longitudinal sectional view of a hand-operated pump particularly useful as a bilge pump and constructed in accordance with one embodiment of the invention;

Fig. 2 is a bottom plan view of the device of Fig. 1;

Fig. 3 is a view in perspective of the plunger and foot valve units of the device of Fig. 1, illustrated in their typical relative positions;

Fig. 4 is a perspective view of a modified form of foot valve unit useful in the device of Fig. 1; and

Fig. 5 is a similar perspective view of yet another form of foot valve unit capable of being embodied in the device of Fig. 1.

Referring now to the drawings in detail, it will be seen that the embodiment of the invention here illustrated includes a cylindrical, tubular pump body 1 having an open intake end 2 and a similar open opposed end 3. At a point removed from the intake end 2, body 1 is provided with a laterally directed circular discharge opening 4 in which there is mounted, preferably by means of a friction fit, a discharge pipe 5, the periphery of the inner end of pipe 5 generally matching opening 4 in shape and size. At the inlet end of the pump body 1, the walls of the pump body are provided with suitable radially disposed notches 6 in order that the pump body may be placed with its intake end against the bottom of a container with free ingress of liquid to the pump being provided via the notches 6.

As is common practice in pumps of this type, a foot valve assembly 7 is provided at the intake end of the pump body. In accordance with this embodiment of the invention, the foot valve assembly 7 is formed as an integral unit having a smaller cup-shaped portion 8 and a larger cup-shaped portion 9, as shown. The outer diameter of the tubular wall or skirt of portion 9 is such that this element of the foot valve assembly can engage the inner wall of pump body 1, at the intake end of the pump, in a friction fit, or other suitable mounting arrangement, in the manner illustrated in Fig. 1. The cup-shaped portion 8 of the foot valve assembly has an outer diameter distinctly smaller than the inner diameter of the pump body so that there is provided an annular space between portion 8 and body 1.

Portion 8 of the foot valve assembly is provided with one or more check valves 10 constructed to pass liquid from within the foot valve assembly outwardly to the annular space between portion 8 and body 1. As will be hereinafter explained in detail, all parts of the pump, including foot valve assembly 7, are preferably fabricated of polyethylene or polypropylene, materials capable of being deformed and possessing the characteristic commonly referred to as "elastic memory." In this manner, the check valves 10 are formed simply by making diametrically opposed, transverse, diagonally extending slits or mating cuts in the wall of portion 8 of the foot valve assembly, the slits thereby defining movable flaps 10' as best seen by reference to Fig. 3. Thus, the flaps 10' constitute the movable check valve elements while the stationary check valve seats are simply constituted by the mated cut surfaces in the main wall of the portion 8. As also shown in Fig. 3, the flaps 10' are forced outwardly, so that the check valves 10 are open, when the pressure within the pump body 1 is less than the pressure within portion 8 of the foot valve assembly. When such pressure differential is removed, the flaps 10' return to their normally closed position, as seen in Fig. 1, by reason of the elastic memory of the hydrocarbon plastic material from which the foot valve assembly is made. It is thus seen that the foot valve assembly 7 is a simple one-piece unit which may be quickly and easily mounted within the discharge end of the pump body, and which

includes check valve elements formed integrally with the foot valve assembly, whereby the usual problem of assembling several separate valve elements into a final unit in order to form a complete and operable valve, is completely avoided.

Extending through the open end 3 of the pump body, and aligned coaxially with respect to the pump body, is a hand-operated plunger unit 11. This unit comprises an elongated tubular body 12 closed at its outer end 13 and open at its inner end 14. Thus, the interior of the plunger unit is in direct communication with the space within the pump body 1 between the plunger unit and the foot valve assembly. If desired, the tubular body 12 of plunger unit 11 may be closed at any other point intermediate its upper end and the check valves 17 formed therein. For example, a suitable closure such as that indicated by reference numeral 13' (dotted) can be provided immediately above the check valves in lieu of closure 13 at the end of tubular body 12.

At the inner end of the plunger unit, the walls thereof form a return bend 15 directed circumferentially outwardly to terminate in a cylindrical portion 16 coaxial with body 12 and having its outer surface in slidable contact with the inner surface of the pump body 1. Thus, the combination of return bend 15 and cylindrical portion 16 constitutes a piston formed integrally with body 12.

It will be understood that, when the plunger unit 11 is moved outwardly (upstroke) with respect to the pump body at a time when intake end 2 of that body is immersed in liquid, check valves 10 will be opened and the liquid will be drawn into the interior of the pump body. When such outward movement stops, check valves 10 will close and remain loosely seated. Then, upon inward movement (downstroke) of the plunger unit, sealing pressure is applied to the check valves 10 and the liquid flows into the interior of body 12.

At a point removed from its open end 14, the body 12 of plunger unit 11 is provided with integral check valves 17 fashioned in precisely the same manner hereinbefore described with reference to check valves 10 of the foot valve assembly. Thus, assuming that sufficient liquid has been drawn into the pump body, inward motion of the plunger unit will cause check valves 17 to open, so that the liquid escapes into the annular space between body 12 and pump body 1 outwardly of the piston defined by elements 15 and 16. Outward motion of the plunger unit 11 will then cause such liquid to be delivered to the discharge pipe 5. Owing to the relative bulk of the plunger, the inward stroke thereof will displace water, also, causing liquid to be delivered to discharge valve 5. In this manner, a relatively steady stream of water will be maintained at the discharge valve throughout the entire pumping cycle.

The pump body 1, discharge pipe 5, foot valve assembly 7 and plunger unit 11 are fabricated entirely from polyethylene or polypropylene. There are no other parts to this embodiment of the device. Thus, since these plastics have a specific gravity less than water, the pump as a whole is capable of floating in water. Further, from the foregoing explanation, it will be evident that the use of a material having the characteristics of polyethylene or polypropylene allows construction of the critical elements of the pump in the highly simplified manner above described. Thus, a piston constituted by elements 15 and 16, when such elements are of these plastics, is admirably effective because of the tendency of wall portions 16 to remain in sealing contact with the walls of the pump body. Such contact can be assured, for example, by fabricating the piston in such manner that portion 16 thereof flares outwardly, its free end having a normal outer diameter greater than the inner diameter of the pump body. The portion 16 then yields when the plunger unit is inserted in the pump body, but has a continual tendency to exert outward, sealing pressure. A

still further advantageous characteristic of the piston defined by elements 15 and 16, when the material employed is one of the above plastics, is the fact that the piston tends to be self-sealing.

It will be understood that the annular wall of portion 9 of foot valve assembly 7 is also advantageously flared outwardly, considering its normal or relaxed position, with the free end thereof having an outer diameter greater than the inner diameter of the pump body 1. A friction fit between the annular wall of portion 9 of the foot valve assembly and the inner surface of the pump body 1 can thus easily be established simply by forcing the foot valve assembly inwardly into place. Alternatively, these parts may be fused together, or formed with a snap-type interlocking fitting, or simply cemented in place.

In the alternative form 7' of foot valve assembly shown in Fig. 4, two check valve elements 10' are formed by making transverse slits in the wall of portion 8' immediately adjacent end wall 18 of portion 8'. With this unit formed as an integral polyethylene or polypropylene member, it will be obvious that the check valves so provided function in the same general manner hereinbefore described with reference to check valves 10.

Alternatively, the foot valve assembly may be fabricated as illustrated at 7'', Fig. 5. Here, the end wall 18' of the smaller cup-shaped portion of the foot valve unit constitutes a single check valve element, free for movement by reason of an extensive transverse slit formed immediately adjacent element 18', as shown.

While the particular embodiment of the invention illustrated provides many distinct advantages resulting from the special constructions employed and from use of the specific plastics enumerated, it will be understood that the broader aspects of the invention can be attained by means other than the specific embodiment shown. Thus, the simplified construction of plunger unit 11 obviously is advantageous even though a resinous material other than polyethylene or polypropylene be employed. Similarly, the advantage of ease of assembly and disassembly, as well as simplicity of manufacture, can be obtained by constructing the device in the manner illustrated, even though materials other than resinous compositions are employed. For example, it is obvious that the pump body 1 may be of metal, rather than a resinous material. Accordingly, the scope of the present invention is to be limited only in accordance with the appended claims.

What is claimed is:

1. In a reciprocating pump, the combination of a tubular pump body having an open intake end and provided with a discharge opening at a point removed from said intake end, a foot valve unit mounted within said open intake end and comprising a substantially tubular-shaped valved member extending at least partly within said pump body and provided with an exteriorly directed annular shoulder engaging the inner wall of said pump body in a snug friction fit, an elongated plunger extending into said pump body from the end opposite said intake end, a hollow tubular piston member formed of a relatively rigid synthetic resinous material positioned at that end of said plunger which is disposed within said pump body and having a portion of its length slidably engaging the inner surface of said pump body to form a piston surface around the entire circumference of the same, and at least one piston valve provided in the piston member above said piston surface for communicating with the interior of said pump body, said piston valve being formed integrally with said piston member by means of a continuous slit cut through said synthetic resinous material to provide a relatively resiliently-hinged flap piece adapted to be moved outwardly away from the main portion of said hollow tubular piston member under action of fluid pressure against the inside surface of said member, and to be moved into substantially fluid-tight mating contact with the main portion of said piston member under action of fluid pressure against the outside surface of said member.

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2. The reciprocating pump as claimed in claim 1, wherein said elongated plunger and tubular piston member are formed as a unitary synthetic resinous body flared at that end which is disposed within said pump body to form said piston surface, and slit above said piston surface to form said piston valve. 5

3. The reciprocating pump as claimed in claim 1, wherein said tubular-shaped foot valve unit is also formed of a relatively rigid synthetic resinous material, said unit being valved by means of at least one slit cut through said material to provide a relatively resiliently-hinged flap 10 piece the same as that defined for said piston valve.

4. The reciprocating pump as claimed in claim 3,

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wherein all portions of the pump are formed of a plastic selected from the group consisting of polyethylene and polypropylene to impart thereto corrosion resistance and the ability to float in water.

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