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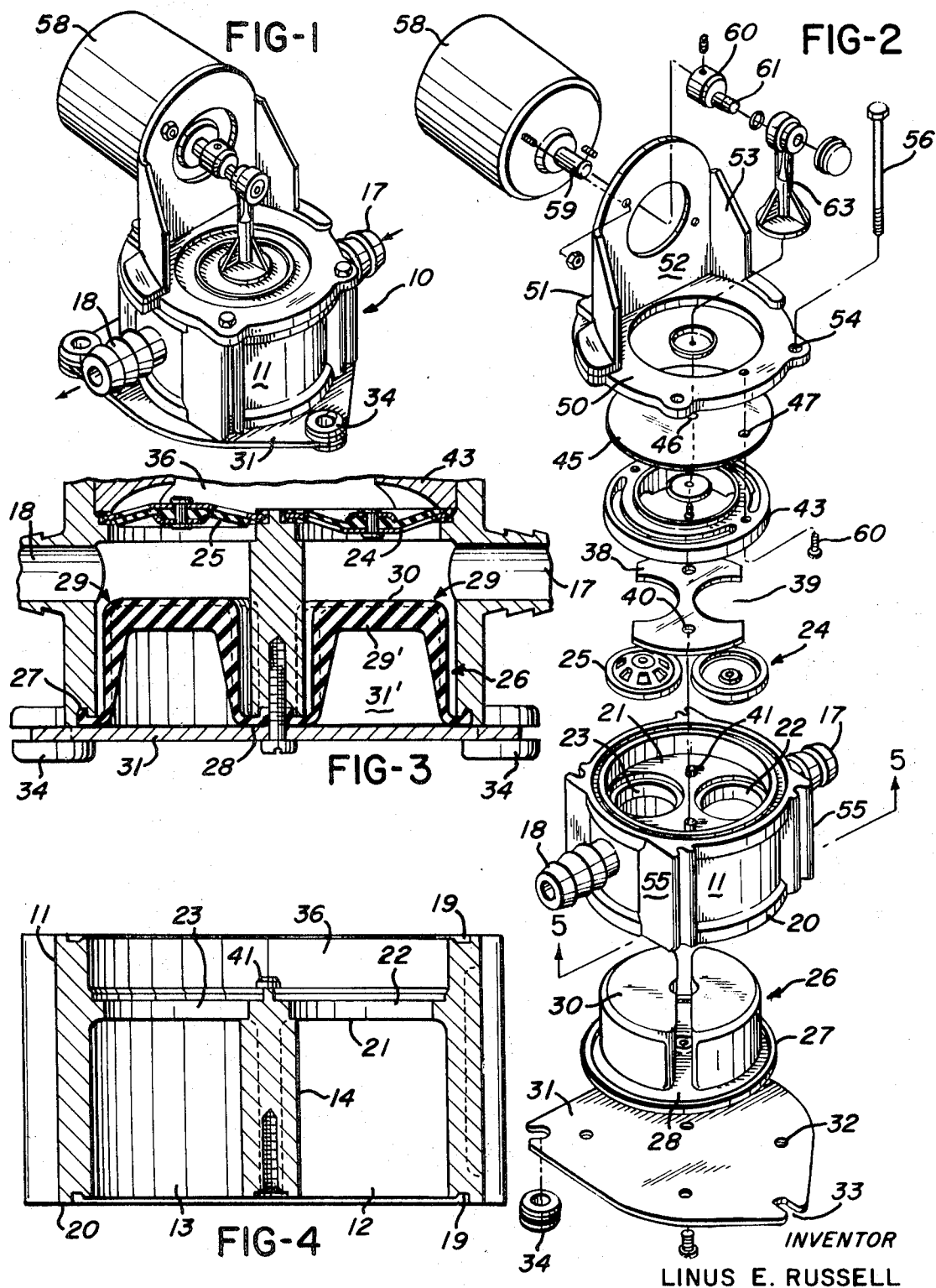
L. E. RUSSELL

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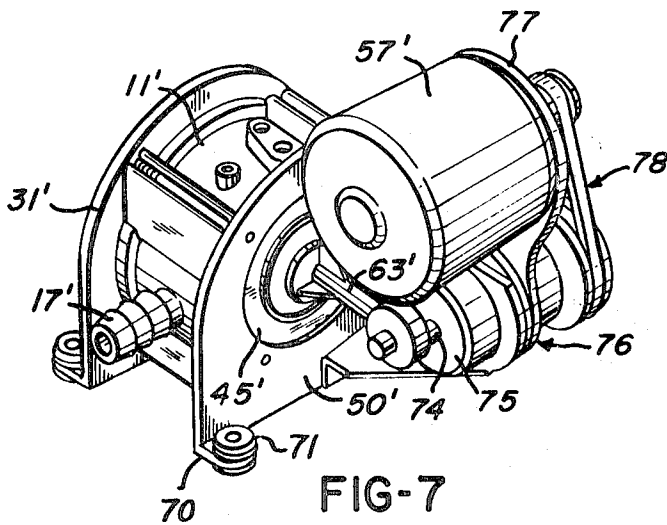
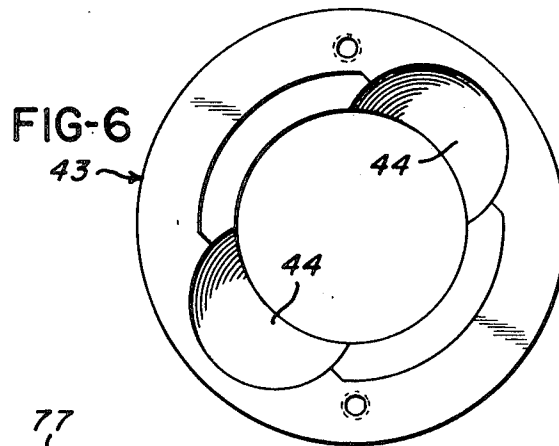
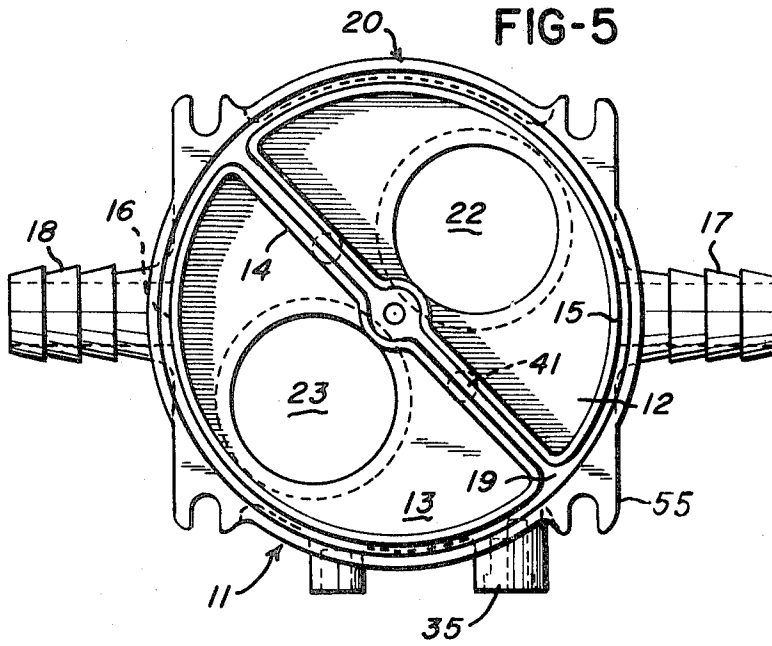
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BY *Jerome P. Bloom*

ATTORNEY



INVENTOR
LINUS E. RUSSELL

BY *Jerome P. Bloom*

ATTORNEY

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Linus E. Russell, Springfield, Ohio, assignor to Peters and Russell, Inc., Springfield, Ohio
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3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a simple, small, relatively quiet and economical, high efficiency fluid pump. It is distinguished by a pump housing constituted by a tube section compartmented by a diametral plate angled to the line of flow and capped by end plates simply interconnected, one of which mounts thereon an eccentric drive for a diaphragm type pumping element bridging an opening in the housing.

This invention relates, accordingly, to improvements in pumps and will be illustrated, more particularly, by preferred embodiments in the nature of diaphragm type pumps.

BACKGROUND

The pump art is old and highly developed. However, it has through the years proven quite difficult to produce a pump which is both efficient and economical. As a matter of fact, there are so many loss factors inherent in pumping structure that irrespective of cost the pump is generally distinguished by a relatively low operating efficiency. Also, noise continues to be a factor in pump operation. While this has been alleviated to some degree in certain pumps, the problem still plagues the industry, particularly in respect to inexpensive pumps.

SUMMARY OF THE INVENTION

The present invention is directed to the solution of the above noted problems and produces ancillary benefits. It provides for a pump structure which can readily be assembled and disassembled, producing a reduction in the cost of manufacture and lending ease and speed to maintenance procedures, if any should be required. Component parts are simple in configuration, minimal in number and optimally disposed, enabling a relatively high degree of efficiency in use and minimal cost for the finished unit. The direct minimal flow path achieved in the invention pump is a distinct factor in achieving the relatively high efficiency under which the pump operates in a relatively quiet manner.

It is therefore a primary object of the invention to provide a pump which is economical to manufacture, more efficient and satisfactory in use, adaptable to a wide variety of applications and unlikely to malfunction.

Another object of the invention is to provide a simply constructed pump involving a minimal number of parts which can be quickly assembled or disassembled, as needs require.

A further object of the invention is to provide a fluid pump distinguished by relatively high efficiency and quiet operation.

An additional object of the invention is to provide a pump distinguished by a pump housing constituted by a tube section compartmented by a diametral plate angled to the line of flow through said pump and capped by end plates which are simply interconnected.

Another object of the invention is to provide an improved diaphragm type pump possessing the advantageous structure features, the inherent meritorious characteristics and the means and mode of operation herein described.

With the above and other incidental objects in view as

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will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the drawings in which preferred embodiments but not the only forms of embodiment of the invention are illustrated,

FIG. 1 is a perspective view of a preferred embodiment of the invention;

FIG. 2 is an exploded view of the portion of the pump constituting its housing and the motor mounting pump base;

FIG. 3 is a cross-sectional view of the bladder component shown in FIG. 2 and its orientation in the pump housing;

FIG. 4 is a cross-section of the tubular housing segment shown in FIG. 2;

FIG. 5 is a plan view of the pump housing taken on line 5—5 of FIG. 2;

FIG. 6 is a bottom view of the diaphragm ring illustrated in FIG. 2; and

FIG. 7 illustrates a modification of the pump unit illustrated in FIGS. 1 through 6.

Like parts are indicated by similar characters of reference throughout the several views.

The improved pump here illustrated in FIGS. 1 through 6 of the drawings is distinguished by a pump housing 10 the body of which is constituted by a tube section 11 compartmented into two chambers 12 and 13 by an integrally formed diametral plate 14. Plate 14 is angled to the line of flow through the pump, being interposed between two diametrically opposite apertures in the tube wall. One aperture forms an inlet 15 and the other an outlet 16. Rimming the inlet 15 is a radially projected tubular adapter 17. Rimming the outlet 16 and projected radially outward of the tube 11, coaxial with adapter 17, is an adapter 18. The external surface of each adapter is stepped in order to frictionally couple thereto a hose or other conduit medium, on installation in a fluid transfer system.

Referring to FIG. 4 of the drawings, it may be there seen that each of tube section 11 has formed therein an identical groove 19. To the inner-side of each groove 19 the tube wall is foreshortened.

Note that the plate 14 forms a wall segment which has a depth only about two-thirds that of the tube 11. It extends from a plane immediately adjacent and spaced from the one end 20 of the tube wall, which plane includes an aforementioned foreshortened end portion of the wall. The interiorly projected extremity of the plate 11 has formed integral therewith and perpendicular thereto a disc-like plate portion 21. The plate portion 21 extends transverse to the tube and has its peripheral portion integrally joined with the tube wall. Formed in the plate portion 21 on a line perpendicular to the plate portion 14 are two apertures 22 and 23. The aperture 22 disposes on the inlet side of the plate 14 while the aperture 23 disposes on its outlet side. As seen in FIG. 4 of the drawings, the uppermost surface of the plate portion 21 is stepped in rimming relation to each of the apertures 22 and 23. In the one instance this step serves to seat an inlet valve assembly 24 and in the other instance an outlet valve assembly 25. Each valve assembly includes a multi-apertured plate and a flexible disc co-extensive with the plate, the connection between these elements being limited to their centers.

Again, with reference to FIG. 2 of the drawings, as there illustrated, the end 20 of the tube 11 may be considered as its bottom. This bottom is bridged and sealed

by a formed flexible diaphragm in the nature of a bladder 26. Noting FIG. 3 of the drawings, the bladder 26 includes a ring-like beaded flange 27 at its outer periphery which forms its base. Common to the plane of the flange 27 is a thin diametral strip 28 which has a central aperture. The strip 28 divides the diaphragm in half just as the plate 14 divides the interior of the tube 11 into two equal chambers below the plate 21. Intermediate the strip 28 and the circular flange 27, the bladder 26 is contoured to form a hemicylindrical dome 29 to either side of the strip. In application of the bladder, the bead on flange 27 fits into the groove 19 in the end 20 of the tube 11 and a bead longitudinally of the strip 28 seats into a complementary groove in the lowermost edge of the plate 14 while the central aperture in strip 28 aligns with a threaded recess in the abutted surface of plate 14. The base of the tube and each of the chambers 12 and 13 is thereby bridged and sealed. Moreover one of the hollow dome formed bladder portions 29 projects interiorly of each of the chambers 12 and 13. To the hollowed inner side of each dome portion 29 the bladder is formed with reinforcing ribs 29' which are arranged in a plane centrally of and in a sense perpendicular to the strip 28. Note that the tops 30 of the dome formed portions 29 are flat and define a plane substantially common to which are peripheral edge portions of inlet 15 and outlet 16. It is provided in this manner that the top portions 30 of the bladder 26 provide essentially what constitutes a resilient bottoming floor for fluid inflow to chamber 12 and fluid outflow from chamber 13.

The flange 27 and the strip 28 are abutted in back by a base plate 31 which forms thereby, with each of the domes 29, a sealed air filled chamber 31'. The base plate 31 projects peripherally of the bladder and the abutted end of the tube 11 to fix the position of the bladder 26. A central aperture in plate 31 receives therethrough a screw which is threadedly engaged through the central aperture in strip 28 and into the threaded recess in the bottom of plate 14. The plate 31 is so connected to the tube 11.

Take particular note that the base plate 31 is peripherally extended about the bottom of the tube 11 and includes, in equidistant spaced relation thereabout four threaded apertures 32. It also includes three relatively projected portions in the peripheral edge of each of which is a notch 33. Frictionally engaged in each of these notches is the body of a resilient mounting grommet 34, each of which has a tubular form, to provide a central through aperture for a mounting bolt or like fixing device. The grommets 34 have a circumferential groove to accommodate their insertion in the notches 33, to be held thereby to the base plate in an obvious manner.

Formed on a side portion of the tube 11 to communicate with the chamber 13 are relatively projected bosses 35 in which are defined apertures opening to this chamber. These bosses may serve to mount a pressure switch unit, where such is necessary.

Accordingly, it will be seen that the lower portion of the tube 11, as it is oriented in FIGS. 1 through 6 of the drawings, is so contained and formed to provide two side-by-side hemi-cylindrical chambers at the base of each of which is a vertically projected resiliently flexible floor structure 30 in substantially bridging relation thereto, at a level with the line of flow to or from the chambers, as the case may be. The openings in the plate 21 forming the tops of the chambers are normally sealed by one-way valve units which provide for a one-way flow between the chambers.

The plate 21 together with its inset valve units defines a floor to a pocket 36 which is defined thereby in the uppermost end of the tube 11. As will be seen, this pocket will provide for a pumping chamber offering a passage for movement of fluid between the chambers 12 and 13. Note should be taken that the valve assemblies are suitably contained at adjacent upper surface portions

of their outer peripheries by a flat suitably contoured retainer plate 38. The plate 38 consists of a disc having diametrically opposite peripheral notches 39. On a diameter between these notches are symmetrically positioned apertures 40 which receive therethrough, in the positioning of the plate, tits 41 which project upwardly from the plate 21 in line with the upper edge of the plate 14.

Concentrically slip fit in the upper end of the tube 11 to seat over and on outer peripheral limits of the valve assemblies and plate 38 is a diaphragm ring 43. The outer periphery of the ring 43 is in bearing contact with the inner surface of the tube 11. Formed in the seating bottom surface of the ring 43, at diametrically opposite portions of its inner periphery, are contoured recesses 44 having the form of segments of a spherical surface. The recesses 44 are so contoured and they are so positioned as to provide surfaces immediately curving upwardly of, about, and over the diametrically opposite remote extremities of the inlet and outlet valves from points most adjacent and over, respectively, the inlet 15 and the outlet 16.

Immediately superposed over the diaphragm ring 43 and the adjacent end of the tube 11 is a diaphragm 45. The latter includes on a diameter thereof a central aperture 46 and equidistantly spaced therefrom, in opposite directions, a pair of additional apertures 47 which align with a pair of similar apertures in the ring 43. The diameter of the diaphragm 45 is larger than the diameter of the ring 43 and the interior diameter of the tube 11. As a matter of fact, it is sufficiently large enough that the outer peripheral portions of the diaphragm will project over and into the groove 19 in the tube end. On interconnection of the diaphragm 45 and the ring 43, as will be further described, the pumping portion of the diaphragm will fall over the opening defined by the interior dimension of the ring 43. Fixed over the diaphragm 45 to cap it and the end of the tube 11 remote from the base plate 31 is an annular plate 50. The latter has threaded apertures which respectively align with the aligned pairs of apertures in the diaphragm 45 and ring 43. Each set of aligned apertures mutually receive therethrough a screw 60 the head of which abuts the ring 43 and the threaded extremity of which fixes in the plate 50. Thus, one may on removal of plate 50 lift therewith the diaphragm and the diaphragm ring to expose the valves 24 and 25. The advantage for assembly and maintenance is believed obvious.

One edge portion 51 of the outer periphery of the plate 50 is truncated to form thereon a straight edge. Superposed on the outer surface of the annular plate 50, with a flanged base substantially parallel to the plate edge 51 and adjacent thereto, is a perpendicularly projected motor mounting plate 52. The latter has divergent wing portions 53 the bases of which are flanged and seat to almost diametrically opposite surface portions of the plate 50, adjacent its outer periphery. As the motor mounting plate 52 is disposed, it rises immediately of the central aperture in the plate 50, adjacent the peripheral edge portion thereof which is rearmost when viewed in FIGS. 1 and 2 of the drawings.

It should be noted that both the plate 50 and the base plate 31 have four rectangularly positioned apertures, the apertures 32 in the plate 31 being threaded. On mounting of the base plate and the annular plate 50 these apertures are positioned in direct alignment. Formed at positions spaced 90 degrees apart on the outer surface of the tube 11 are guides 55 which align with the respectively aligned apertures in the plates 31 and 50. As may be seen from the drawings, bolts 56 are projected through the upper aperture 54 in the annular plate 50 to have the heads thereof abut the plate 50 and the bodies thereof project through the related guides on the exterior of the tube 11. The threaded extremities of the bolts are threadedly engaged in the aligned apertures 32 in the base plate 31.

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In this manner, as may be readily seen, the simple interconnection of the plates 31 and 50 establish a fixed containment not only of the diaphragm 45 but of the tube 11 and the portions of the pump which are interiorly contained. It may therefore be readily seen that the pump unit as provided in the illustrated embodiment of the invention may be easily assembled and disassembled with a minimum of effort. The handling of the parts require no special capabilities or knowledge. The advantages of this in commercial application should be readily apparent. The parts are simply related and simply constructed so that one may be able to readily reach and replace any one or more parts from available spares.

Looking further to FIGS. 1 and 2 of the drawings, it may be there seen that in a general area common to that of the aperture defined by the annular plate 50, which aperture exposes a bridging portion of the diaphragm 45, the plate 52 has a central aperture through which projects a hub-like extension of a motor unit 58. This unit includes mounting portions suitably bolted to the outermost surface of the plate 52 with a stabilizing gasket (not shown) therebetween. From the hub portion of the motor 58 projects its drive shaft 59 which projects into a cavity in an eccentric 60. A set screw is provided to suitably fix the eccentric to the motor drive shaft. From the surface of the eccentric outermost from the plate 52 projects an eccentrically positioned control pin 61. The latter projects interiorly of and is suitably contained to bear in the upper end of a connecting rod 63. The base of the rod 63 is suitably fixed to the center of the exposed portion of the diaphragm 45, spaced within the inner periphery of the annular plate 50.

Looking to FIG. 1 of the drawings, it may therefore be seen that on drive of the motor mounting to the plate 52 the rod 63 will be eccentrically reciprocated to flex the exposed portion of the diaphragm 45 within the inner limits of the ring 43, in a plane generally common to the inlet 15 and the outlet 16 in the input and output chambers of the pump.

Thus, the simple and optical efficiency enabled by the economical pump here described may be readily recognized. When one desires to initiate the operation of the pump, this may be effected by any suitable manual or automatically acting means. As the rod 63 is eccentrically moved to lift up on the portion of the diaphragm most adjacent the inlet 15, a suction will be produced at said inlet which is passed through the flapper portion of the inlet valve to the input chamber. Irrespective of the orientation of the pump an inflow to the chamber 12 will immediately find a resilient floor, as provided by the flat at the top 30 of the dome portion 29. Moreover, as the inflow occurs, it will be immediately faced by an angular wall defined by the plate 14. The relation of the dome 29 to this angular surface provided by the plate 14, as it resiliently supports the inflow, is such that they work together to induce a swift accelerated swirling flow off the plate 14 and around the arcuate portion of the wall of chamber 12. This flow is caused to move upward of the floor, the resiliency of the floor contributing energy to the movement and damping any tendency of the flow to pulsate and knock. The bladder dome 29 produces reactive energy which relieves the power requirements for operating the diaphragm through the medium of the connecting rod 63. The inlet valve 24 will have its flapper portion lifted in the course of the insuction and the inflow is swift. Moreover, as the inflow moves past the inlet valve assembly to the pumping chamber 36 and is directly exposed to the diaphragm 45, the eccentric will rock the diaphragm oppositely to push the flowing fluid to and through the outlet valve and into the output chamber 13. In respect to the flow pattern within the pumping chamber, particular attention is directed to the function of the recesses 44 in the bottom of the diaphragm ring 43. The recesses contoured to the form of segments of a sphere will in effect contain the inflow to the pumping chamber and

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direct it across the pumping chamber during the lateral pushing by the diaphragm on eccentric flexing thereof. As the flow moves to the portion of the pumping chamber over the outlet valve, it may be seen that it will move directly on to the surface of recess 44 and be guided thereby directly to and through the outlet valve in a contained fashion. As the flow enters the output chamber, again there is an angular surface provided by the plate 14 as well as an arcuate surface by the rest of the chamber wall. This will cause a smooth quiet downward spiralling of the flow to the floor defined by the top of the domed portion 29 of the bladder 26. The resiliency of the surface provided at the top of the dome portion 29 of the bladder is enhanced by the air pocket thereunder to insure a smooth flow pattern and to provide reactant energy which may be applied to the swirling flow to expedite its discharge through the outlet.

All in all, the structure providing the simple and direct flow path and the simple and economical pump just described tends to minimize frictional losses not only by a reduction of the flow path but by maintaining the flow in an optimal quiet and swiftly moving pattern. The advantages thus achieved by the invention are believed self-evident and produce a distinct advance in the art of rendering pumps more economical, more efficient in use and easier to fabricate and maintain with less likelihood of malfunction.

FIG. 7 of the drawings shows a modification of the pump unit as revealed in FIG. 1 where the body of the pump and the pumping chambers are provided as just described and similarly clamped between plates. In the case of FIG. 7, similar parts are identified by similar numerals. The only difference here is that the pump body is turned on its side. Thus, here we have the pump body in the form of the tube 11' capped by end plates 31' and 50'. Each of the plates 31' and 50' have in identical peripheral portions thereof right angled flange type mounting brackets 70. These brackets, as is obvious from FIG. 7, are projected perpendicular to and oppositely from the respective plates. Note that each bracket is notched to frictionally contain a mounting grommet 71 such as the grommet 34 previously described. Of course, the grommets serve for projection therethrough of bolts to secure the pump in any desired position of use and in a fixed relation to a supporting structure.

In the case of FIG. 7, there is some modification of the mount of the motor unit 57' which powers the pump. In this case, the connecting rod 63', which relates to the operating diaphragm 45' as in the first described embodiment, mounts to an eccentric on the end of a stub type shaft 74 rotatable in bearings 75 supported in a housing fixed to a motor mounting plate 76. It may be seen that there is extended in a fixed relation to the plate 76 an extension 77 to which the motor 57' mounts to one side of the pump unit. The motor drive shaft is in this instance connected to the stub shaft 74 by a belt and pulley arrangement 78. Details of this last arrangement may be conventionally effected and are believed obvious from the drawings. They are not further described since the specifics thereof, to the extent not described, are well apparent and within the skill of one versed in the art with the present drawings before them.

In summary, it has been here shown how one may achieve a pump which is not only economical but so characterized by its structure to inherently provide a relatively unexpected operating efficiency. All the objectives of the invention are clearly evidenced and the advantages are achieved as set forth in the introduction hereto. It is of particular significance that one may on a simple disengagement of screws 56 lift from the pump the annular plate 50 the powered operating elements and the diaphragm and diaphragm retainer, leaving the interior of the pumping chamber exposed for inspection and maintenance. Note that this can be accomplished without any disturbance of

the balance of the pump, or the related plumbing, mounting or electrical connections.

There is yet another and unobvious feature of the invention. The use of the tube 11 and plates 31 and 50 as described enables that the tube 11 be fabricated of plastic. By making the plates 31 and 50 of steel or material of like strength, on application thereof to cap the tube 11 and their drawing together by bolts 56 the tube 11 is placed under axial compression to endow it with physical characteristics of strength, and resistance to flow or distortion, beyond the natural capabilities of the inexpensive plastic material employed. Thus one may produce at low cost a high quality pump housing.

Of course, the invention is shown in its preferred embodiments and there obviously may be modification without departing from the particular inventive concept here presented.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

Having thus described my invention, I claim:

1. A pump comprising a body segment open at at least one end and including an internal construction forming separated inlet and outlet chambers and a pumping chamber in common communication with said inlet and outlet chambers, said construction including a transverse wall intermediate the ends of said segment between which wall and said one end of said segment is formed the pumping chamber, said inlet and said outlet chambers being positioned between said wall and the opposite end of said segment and communicating with said pumping chamber through respectively separated openings in said wall, pump means in a closing relation to said one end of said segment, inlet and outlet openings in said segment communicating with respective inlet and outlet chambers adjacent said transverse wall, floor means in each of said inlet and outlet chambers including resilient dome-like structures rising from the said opposite end of said segment substantially to said inlet and said outlet, valve means controlling flow through the said separated openings in said transverse wall in response to operation of said pump means, said opposite end of said segment being open, said floor means being in a closing relation to said opposite end of said segment and further including plate means common to said inlet and outlet chambers clamping said dome structures to said opposite end of said segment, said dome structures being comprised of separated bulbous portions rising into respective inlet and outlet chambers and being a unitary one-piece device in which said structures include semi-cylindrical portions in opposing relation to one another and separated by a transverse channel, said segment further including another cross wall perpendicular to the first said wall, one

edge thereof merging with the first said wall and the opposite edge terminating substantially in the plane of the said opposite end of said segment, said other wall cooperating in the defining of said inlet and outlet chambers and being received in the said channel between said semi-cylindrical dome structures.

2. A pump according to claim 1 wherein the said opposite edge of said other wall seats in the bottom of said transverse channel, characterized by fastener means extending from the exterior of said segment at said opposite end thereof through said plate means and through the bottom of said channel into said other wall.

3. A pump comprising a body segment open at at least one end and including an internal construction forming separated inlet and outlet chambers and a pumping chamber in common communication with said inlet and outlet chambers, said construction including a transverse wall intermediate the ends of said segment between which wall and said one end of said segment is formed the pumping chamber, said inlet and said outlet chambers being positioned between said wall and the opposite end of said segment and communicating with said pumping chamber through respectively separated openings in said wall, pump means in a closing relation to said one end of said segment, inlet and outlet openings in said segment communicating with respective inlet and outlet chambers adjacent said transverse wall, floor means in each of said inlet and outlet chambers including resilient dome-like structures rising from the said opposite end of said segment substantially to said inlet and said outlet, valve means controlling flow through the said separated openings in said transverse wall in response to operation of said pump means, said pump means including a diaphragm in closing relation to said one end of said segment, means for reciprocating said diaphragm, and a plate between said diaphragm and said transverse wall having a side facing said wall contoured for a directed flow through said pumping chamber between said separated openings in said wall, the one said side of said plate being formed with circumferentially spaced apart contoured recesses, said plate being angularly oriented to place a contoured recess in a partly superposing relation to each of the separated openings in said wall.

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CARLTON R. CROYLE, Primary Examiner

R. E. GLUCK, Assistant Examiner