Sept. 15, 1953 J. J. LYTH 2,651,997

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Filed May 29, 1950 2 Sheets-Sheet 1

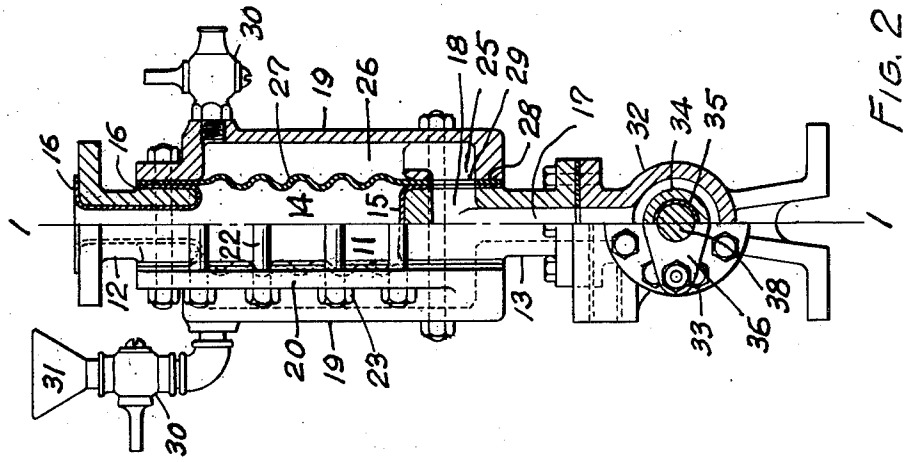

FIG. 2

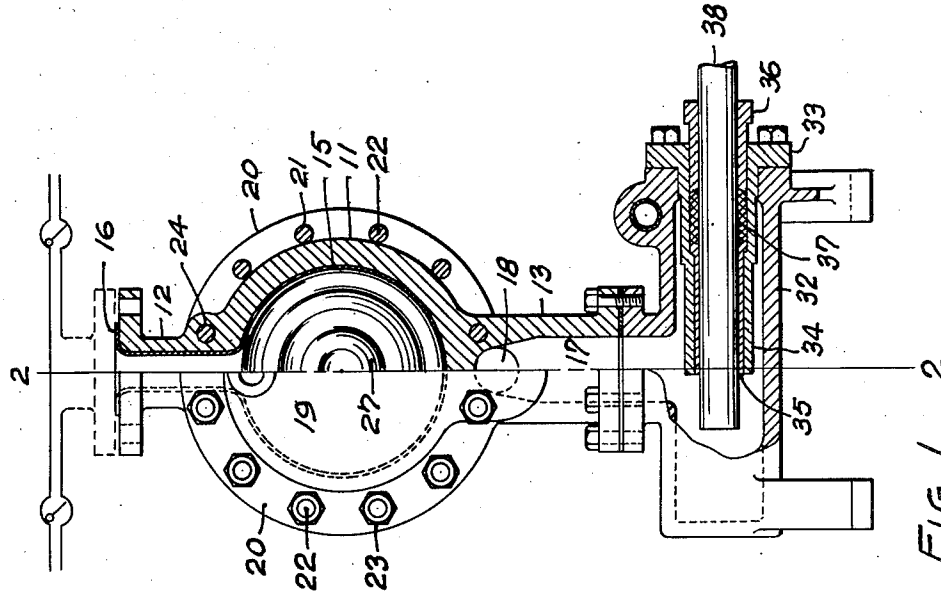

FIG. 1

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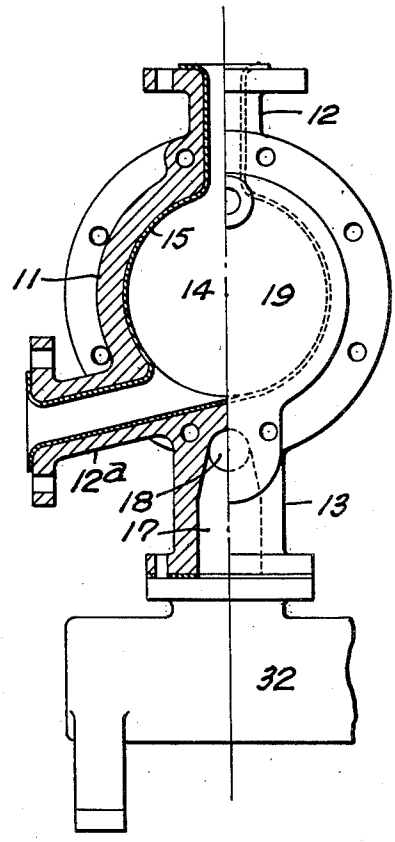

FIG. 3

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9 Claims. (Cl. 103—44)

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This invention relates to pumps and especially to pumps for handling liquids or suspensions which cannot be pumped satisfactorily, or at all, by ordinary pumps because of corrosive or abrasive or clogging effect of the liquid or suspension on the working parts of ordinary pumps, or because the liquid or suspension would be contaminated by the material of ordinary pumps.

Pumps of the above type customarily comprise separate passages for an impelling liquid and for an impelled liquid or suspension, separated by a member movable by the impelling liquid to move the impelled liquid, such member being usually a flexible diaphragm. Pumps of this type heretofore used have a number of practical disadvantages, such as complicated and expensive construction, difficulty in renewing diaphragms, the form and arrangement of the diaphragms, and unbalanced or otherwise faulty transmission of power from the impelling liquid to the impelled liquid.

The primary object of the present invention is to provide a pump of the aforesaid type which is simple and inexpensive in construction; in which the impelled liquid passages are readily accessible for cleaning and the diaphragms for cleaning and renewal without disturbing any of the connections of the pump. A concomitant object is to provide a diaphragm pump in which the diaphragms and the movement of impelled liquid in the pump may be under constant observation. A further object is to provide a pump so constructed that the body thereof may be formed of glass or ceramic material. A still further object is to provide a double diaphragm pump in which the pressure of impelling liquid is applied to the best advantage and equally to both diaphragms. Another object is to provide a diaphragm which will be exceptionally durable. Various other objects and the advantages of the invention may be ascertained from the following description and the accompanying drawings.

Broadly speaking, the invention consists in a pump comprising a chamber for an impelled liquid and chambers for an impelling liquid arranged on opposite sides of the impelled liquid chamber and separated therefrom by circular, circularly corrugated diaphragms, and a plunger pump associated with said impelling liquid chambers in suchwise as to deliver exactly equal flows of liquid to the two chambers, the diaphragms being readily removable for cleaning and replacement; the form of said chambers being such as to permit of making them of glass, ceramic or moulded plastic, and also being such as to prevent the accumulation of air, vapour or solids in the impelled liquid chamber.

In greater detail, the invention consists in the

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features and combinations of features herein disclosed, together with all such modifications thereof and substitutions of equivalents therefor as are within the scope of the appended claims.

In the accompanying drawings which illustrate embodiments of the invention now preferred but to the details of which the invention is not limited:

Fig. 1 is a view of the pump, half in side elevation and half in section on the line 1—1 of Fig. 2.

Fig. 2 is a view of the pump, half in end elevation and half in section on the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 1 illustrating a modification.

Referring more particularly to the drawings, 11 designates a preferably cylindrical or tubular body member, the length of which is preferably materially less than the diameter thereof, having at least one hollow neck 12 communicating with the interior thereof, and a hollow foot 13, the interior of which is completely isolated from the interior of the body. In Fig. 1 the body is shown provided with a single neck 12 leading from the highest point of the body and in Fig. 3 it is shown as having an additional neck 12^a leading from the lowest point of the body. The neck 12 preferably extends vertically upward from the body and, for compactness, the neck 12^a may extend laterally with downward inclination, whereby the distance between the top of the neck 12 and the bottom of the foot 13 may be the same in both forms and permit of interchangeability without altering the elevation of a pipe connected to the neck 12. The interior of the body constitutes an impelled liquid chamber 14. When the liquid to be handled is free from suspended solids which might accumulate in the body, the neck 12 alone may suffice for both ingress and egress of liquid and is located at the uppermost point of the body to permit escape of air or vapour which, if it could accumulate, would seriously interfere with efficient pumping operation, as will be readily understood. For dealing with suspensions from which solid matter might settle in the body, the necks 12 and 12^a provide for separate egress and ingress, respectively, of the suspension, the ingress preferably being at the bottom, as shown, so that incoming suspension will pick up and carry with it any solids tending to settle out; and the egress being preferably at the top, for the reason already given. Obviously, the direction of flow may be reversed if desired.

It will be noted that, except where the neck or necks and the foot attach, the wall of the body is of uniform rectangular cross-section which, combined with the cylindrical form, produces a mass in which little or no undesirable internal stress will be produced on cooling from a high

temperature, such as that incident to a molten or fused state of the material or to the firing of ceramics.

The body may be composed of any material suitable for the service to be required of the pump. The material may be metal, vulcanite, plastic, glass or a ceramic and it is a feature of the invention that the form of the body and its neck or necks and foot is such as to avoid the creation of internal stresses which would adversely affect the strength of the body if moulded of glass or a ceramic. A plastic suitable for use in making the body, known under the trade name "Lucite," has adequate mechanical strength and rigidity, is inert to most acids and alkalis and has the added advantage of being transparent. If transparent plastic or transparent glass is used as the body material, the conditions within the body may be kept under constant observation during operation of the pump.

If desired, the inner surface of the body and its necks 12 and 12a may be provided with a lining 15 of material adapted to resist corrosion by the impelled liquid, or to protect the liquid against contamination by the material of the body. The nature of the lining material will depend on the nature of the liquid to be handled by the pump. Materials such as lead, aluminum, silver, vulcanite, vitreous enamel, wax, plastic or even glass may be used, the selection depending on the natures of the impelled liquid and of the body material. The lining contemplated is in one piece covering the entire interior of the body and neck or necks and extending a suitable distance over the end surfaces of the body and neck or necks, as indicated at 16, so as to protect these surfaces against corrosion by liquid entering between them and elements abutting them.

The interior 17 of the foot 13 tapers upwardly and communicates at its upper end with two equal and oppositely extending passages 18 leading to the ends of the body. The combined cross-sectional areas of the two passages 18 are substantially equal to the maximum cross-sectional area of the foot interior 17.

Dished or cup-shaped concave end caps 19, each of a depth equal to substantially half the length of the body, are provided for the body and have flanges 20 extending radially beyond the body and formed with apertures 21 beyond the circumference of the body. Attaching bolts 22 extend from cap to cap and through the flange apertures 21 and are provided with nuts 23 bearing against the outer, or remote, surfaces of the cap flanges 20, whereby the body may be tightly clamped between the caps. If the spacing of the bolts 22 so requires, the body may be formed with passages 24 adjacent the neck 12 and foot 13, through which certain of the bolts may pass. The caps 19 are provided with ports 25 registering with the body passages 18 and communicating the interiors 26 of both caps with the foot passage 17, these interiors 26 being impelled liquid chambers. The end caps may be formed of any suitable material, such as metal, vulcanite, plastic or glass.

A substantially circular, flexible and elastic diaphragm 27 is provided at each end of the body 11, the peripheral portion of each diaphragm extending between the end of the body and the adjacent surface of the closure cap 19 therefor. These diaphragms are formed with circular corrugations concentric with one another and with the diaphragm. The diaphragm separates the impelled liquid chamber 14 of the body from the impelling liquid chambers 26 of the caps. The peripheral portions of the diaphragms act as gaskets between the caps 19 and the ends of the body 11 to ensure liquid tight joints. To facilitate making of such joints between the caps and body around the passages 18, the diaphragms preferably have radially extending portions 28 formed with openings 29 in register with the passages 18 and ports 25. The diaphragms may be formed of any suitable flexible and elastic material which is inert and impervious with respect to the impelled liquid in chamber 14 and the impelling liquid in chambers 26. Physically suitable materials are rubber and certain of the plastics now readily available on the market. One such plastic is that known under the trade name "Tygon" and has the additional advantage of being transparent.

Each impelling fluid chamber 26 is provided at its highest point with an air vent cock 30 and one of these may have a funnel shaped outlet 31 to facilitate filling the chambers 26 with the impelling fluid.

The structure heretofore described is mounted by means of its foot 13 on a closed reservoir 32 for impelling liquid, the interior 17 of the foot communicating with the interior of the reservoir at the top thereof. One end of the reservoir is closed by a plate 33 having a tubular extension 34 projecting into the reservoir and provided in its inner portion with a replaceable bushing 35 of antifriction material, such as brass or bronze, and in its outer portion with a packing gland 36, also of antifriction material. Packing 37 is compressed between the bushing and gland to make liquid tight contact with a plunger 38 adapted to be reciprocated in the bushing and gland by any suitable mechanism.

When installed, the pump is associated with a conduit for impelled liquid communicating with the chamber 14 through the neck 12, or necks 12 and 12a, and having check valves, one on each side of the pump, to control the direction of liquid flow. With the plunger 38 at midstroke, the reservoir 32, chambers 26 and connecting passages are completely filled with an impelling liquid, such as water, both vent cocks 30 being open and the liquid being introduced through the funnel 31. As the neck passage 17 leads from the highest point of the reservoir, entering water displaces air in the reservoir and in the chambers 26 so that none remains in the system to interfere with the pumping action. When the system is filled, both cocks 30 are closed, and the water becomes a hydraulic transmission between the plunger 38 and the diaphragms.

In operation, when the plunger moves inwardly of the reservoir it forces liquid from the reservoir through the foot passage 17, body passages 18 and cap ports 25 into the chambers 26, thereby displacing liquid therein to force the diaphragms toward one another and into the chamber 14, thus displacing liquid from the chamber 14 into the conduit to which it is connected. When the plunger moves outwardly of the reservoir, it draws back the impelling fluid from the chambers 26 and thereby moves the diaphragms away from one another to draw impelled liquid into the chamber 14. The check valves associated with the pump ensures unidirectional liquid flow in the conduit.

The volumetric displacement of the plunger determines the amount of flexion of the diaphragms and by varying the stroke or the diameter, or both stroke and diameter, of the

plunger, the displacement of the diaphragms may be varied from nothing to a maximum at which the diaphragms are, in their central portions, substantially flattened against one another or against the caps according to the direction of plunger movement. The number and depth of the corrugations are such that at maximum displacement of the diaphragms the corrugations merely tend to be straightened out by flexion and the diaphragms are not subjected to destructive radial tension. The cross-sectional areas of the two passages 18 being equal, and together equalling the cross-sectional area of the foot passage 17, ensures that the flows of impelling liquid to and from the two chambers 26 are always equal, thus ensuring equal displacements of the diaphragms, while the depth of the caps being substantially half the length of the body ensures that the maximum inward and outward displacements of the diaphragms are equal and that the diaphragms cannot be excessively displaced in either direction.

The removal of nuts 23 at either end of the pump releases both caps 19, which may be removed without displacing any of the connections of the pump and will enable easy removal of both diaphragms for cleaning or renewal and also will afford unobstructed access to the chamber 14. This feature is especially important if the pump is used for foodstuffs and must be cleaned at frequent intervals of time.

The removable sleeve 34 permits of very quickly altering the capacity of the pump by substituting a sleeve carrying a plunger of different diameter, complete with packing already in place. Also, in event of leaky packing, a replacement assembly of sleeve, packing and plunger can be inserted more quickly than packing alone can be replaced.

As previously pointed out, the body and caps, or either body or caps, can be made of transparent material, such as glass or plastic, and the diaphragms of transparent plastic, so that the flow of both impelling and impelled liquids and the physical condition of the diaphragms may be under constant observation. This is of importance in cases where the impelled liquid would be detrimentally affected by leaking of impelling liquid thereinto.

Having thus described my invention, I claim:

1. A diaphragm pump comprising a short tubular body; internally concave end caps for said body; flexible diaphragms engaged at their edge portions between the body and the end caps, dividing the space enclosed by the body and end caps into a single inner chamber for impelled liquid defined by said body and both said diaphragms and a pair of substantially equal outer chambers for impelling liquid, each defined by one of said end caps and one of said diaphragms; bolts passing from cap to cap whereby the diaphragms and body are clamped between the end caps; a passage leading into said inner chamber at the highest point thereof; means for admitting impelling fluid under pressure into both said outer chambers simultaneously, whereby said diaphragms are displaced toward one another, with expulson of impelled liquid from the inner chamber, and for withdrawing impelling liquid from both said outer chambers simultaneously, whereby said diaphragms are displaced away from one another with indrawing of impelled liquid into said inner chamber.

2. Structure according to claim 1 in which the means for admitting impelling liquid includes a hollow neck supporting the body from below and providing an upwardly extending impelling liquid passage and a pair of equal branches from the upper end of said passage, leading to the ends of the body; and equal ports at the lowest points of said end caps communicating with said branch passages, whereby equal amounts of impelling liquid are supplied to said outer chambers and equal amounts are withdrawn.

3. Structure according to claim 1 in which the depth of each impelling liquid chamber in the axial direction of the body is substantially half the length of the impelled liquid chamber in the axial direction thereof, whereby maximum inward and outward displacements of the diaphragms are limited to equality.

4. A pump according to claim 1 in which the caps are transparent to permit observation of the diaphragms.

5. A pump according to claim 1 in which the caps and diaphragms are transparent to permit observation of the flow of impelled liquid in the body.

6. A pump according to claim 1 in which the body is transparent to permit observation of the impelled liquid therein and of the diaphragms.

7. A pump according to claim 1 in which the body is composed of material selected from the group of materials consisting of glass and ceramics.

8. In combination with structure according to claim 1, flanges on said caps extending radially outward of the body and apertured for passage of said bolts, whereby the bolts are disposed externally of the body.

9. A diaphragm pump comprising a reservoir for impelling liquid having an opening at its highest point; a substantially cylindrical body of length materially less than its diameter having a hollow neck communicating with the highest point of the body interior; a hollow foot supporting the body on the reservoir, the interior of said foot communicating with the interior of said reservoir through the top opening thereof; passages leading from the interior of the foot to the ends of the body; dished end caps for the body, having ports registering with said passages and flanges projecting radially beyond the body; flexible diaphragms separating the interior of the body from the interiors of said end caps and having peripheral portions entering between the end surfaces of the body and the end caps; bolts passing from cap to cap through the cap flanges and clamping the diaphragms between the body and caps and the caps to the body; the volumes of the chambers defined between the end caps and the diaphragms being substantially equal and together substantially equal to the volume of the body chamber between the diaphragms; and valved openings at the highest points of the end caps whereby the reservoir, passages, and spaces between the end caps and diaphragms may be completely filled with impelling liquid and air completely expelled therefrom.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
225,930	Hoster	Mar. 30, 1880
1,489,143	Nuss	Apr. 1, 1924
1,851,666	Evans	Mar. 29, 1932
2,402,524	Corydon	June 18, 1946