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2,958,294

HOSE-TYPE PUMP

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FIG. 1.

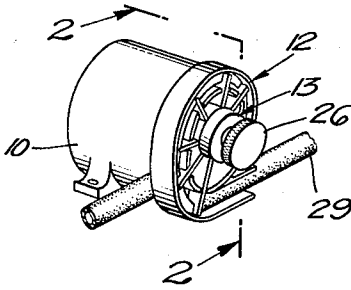


FIG. 2.

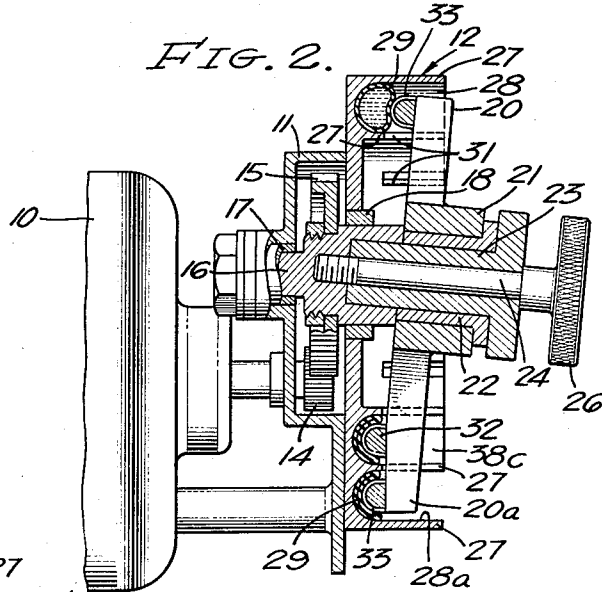


FIG. 2a.

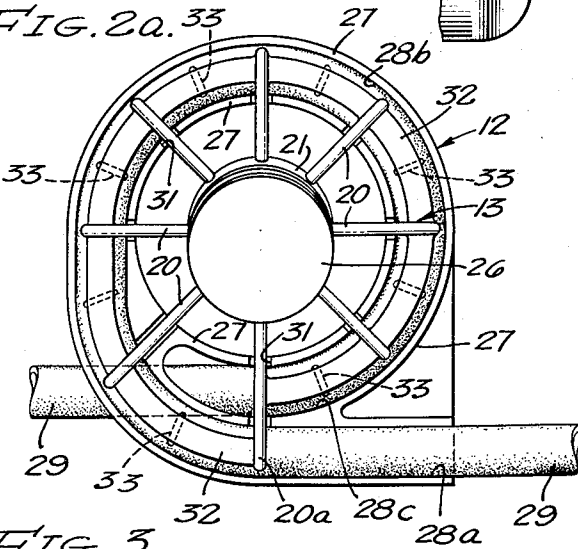


FIG. 3.

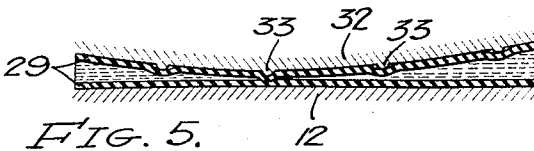


FIG. 5.

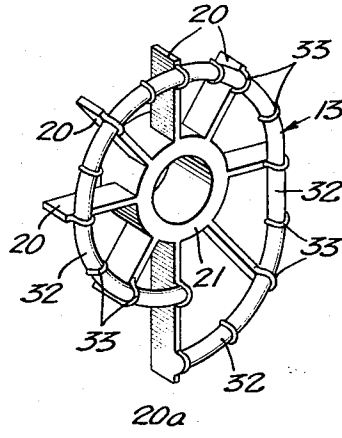


FIG. 4.

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## HOSE-TYPE PUMP

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13 Claims. (Cl. 103—149)

This invention relates to a hose-type pump, and more particularly to pumping means adapted to act against the outer surface of a hose and thereby force fluid there-through.

A relatively large number of hose-type pumps have previously been devised, but are characterized by one or more substantial defects. One of the most important defects of such pumps is that the impeller means tends to effect shifting of the hose along its axis, since this either ruins the pump or makes it necessary to employ special mounting and lubricating means for the hose. Another important defect of large numbers of hose-type pumps is that they do not maintain suction between pumping operations. This makes it necessary for the pump to run for an indeterminate period of time before pumping will commence, so that the pump becomes relatively worthless as a metering device. Other important defects of conventional hose-pumps include cost and complexity of manufacture, the requirement for relatively large amounts of power, and the necessity for frequent adjustment and repair.

In view of the above and other factors characteristic of conventional pumps of the hose type, it is an object of the present invention to provide a simple and economical hose-type pump which does not tend to effect shifting of the hose along its axis or in any direction, which operates to maintain suction for long periods of time between pumping operations, which requires only relatively small amounts of power to operate, and which does not tend to injure or wear the external hose surface.

A further object is to provide a hose-pump which is simple and economical to manufacture and operate, and which permits substitution of hoses for cleaning or other purposes in a simple manner and in a very short period of time.

A further object is to provide an improved hose-pump of the wobble type, characterized by novel pinch means for effecting pumping with a small power requirement and without the necessity for lubricating or holding the hose, yet which effects a substantially perfect seal between pumping operations so that suction is maintained.

These and other objects and advantages of the invention will be more fully set forth in the following specification and claims, considered in connection with the attached drawing to which they relate.

In the drawing:

Figure 1 is a perspective view illustrating a hose-type pump construction in accordance with the present invention;

Figure 2 is an enlarged vertical sectional view taken on line 2—2 of Figure 1;

Figure 2a is a greatly enlarged fragmentary sectional view showing one pinch-element as maintaining the hose in fully pinched and sealed relationship.

Figure 3 is an elevation of the pump, as viewed from the right in Figure 2;

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Figure 4 is a view illustrating the impeller means as disassembled from the remainder of the pump; and

Figure 5 is a schematic illustration of the manner of pumping fluid through the hose with the present apparatus.

Referring to the drawing, the apparatus may be seen to comprise a motor 10 having a gear housing 11 connected thereto, a backup housing 12 suitably mounted on gear housing 11, and a wobble support or impeller 13 mounted in the backup housing for actuation by motor 10 as will next be described. The apparatus also comprises novel hose-engaging elements to be set forth in detail hereinafter.

The motor 10 may be of any conventional type, for example electrical, and is shown as adapted to drive speed-reducing gears 14 and 15 in gear housing 11. The gear 15 is fixedly mounted on a short shaft 16 having a reduced portion suitably journaled in a bushing 17 in the gear housing, and also having a thickened portion suitably journaled in a bushing 18 in the central portion of backup housing 12. These bushings, and the one to be described below, may be replaced by suitable friction-reducing devices, such as roller bearings, if desired.

The wobble support or impeller 13 comprises a spider having a plurality of arms 20 extending radially from a cylindrical hub 21. Hub 21 is mounted around a bushing 22 in such manner that the bushing will rotate inside of the hub, it being pointed out that the spider is held against rotation by the backup housing 12 as will be indicated subsequently. Bushing 22, in turn, is mounted in a hollow shaft 23 the inner end of which is inserted in a recess in shaft 16 at an angle to the axis thereof. This angle is relatively small, for example 5 degrees, but is sufficient to cause the spider to have a substantial wobble action when shafts 16 and 23 are rotated by the motor.

In order to removably support the hollow shaft 23 in short shaft 16, a rod 24 is extended through shaft 23 and is threaded into the bottom of the recess in the short shaft. A hand knob 26 is provided at the outer end of rod 24 and is adapted to bear against the outer end of hollow shaft 23. Shaft 23, in turn, is flanged and bears against a flange on bushing 22, so that it may serve to force the bushing and hub 21 against the shaft 16 when hand knob 26 is tightened. The outer end of shaft 16 is not perpendicular to the axis thereof, but instead is cut off at an angle corresponding to that of shaft 23 and rod 24.

The backup housing 12 is formed, on its side opposite gear housing 11 and motor 10, with ridges 27 which define a channel 28 having the general shape of the numeral 6 or 9. Thus, and referring to Figure 3, the channel starts at a stem portion 28a and extends around a loop portion 28b which terminates at a point 28c located radially inwardly from the stem portion. The arms 20 of the spider have lengths corresponding to the distances of the various portions of channel 28 from shaft 23, so that the outer ends of the arms terminate at the outermost parts of the channel.

The bottom wall of channel 28 is concave so that it may continuously abut one side of an elastomeric hose 29 which is threaded around the various channel portions 28a, 28b and 28c. From portion 28c the hose extends outwardly through an opening, not shown, in the bottom wall of backup housing 12. All portions of the hose and the channel 28 therefore lie in the same plane (perpendicular to the axis of short shaft 16) excepting the portion of the hose which extends, as indicated, through the opening in the bottom of the backup housing. The hose 29 is perfectly tubular, being formed

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of a suitable elastomeric substance such as natural or synthetic rubber.

The ridges 27 which define the channel 28 are formed with notches 31 of sufficient depth to receive the spider arms 20 and permit inward and outward movement of such arms due to the wobble motion produced by the angular relationship of shaft 23 relative to shaft 16. The walls of notches 31 serve as the means to prevent rotation of the spider or wobble support. The hose 29 is thus interposed beneath the bottom wall of channel 28 and the outer portions of spider arms 20, so that it may be progressively compressed and pinched by longitudinal ridge means 32 and transverse pinch means 33 which are suitably mounted on (or formed integral with) the spider.

The ridge means 32 is shown as having a shape corresponding to that of the channel 28, so that the ridge means may be mounted in the channel and abut various portions of hose 29. More specifically, ridge means 32 is a 6 or 9-shaped metal element which is shaped convex to correspond to the concavity of the bottom wall of channel 28. The pinch means 33 comprises a substantial number of beads provided in shaped relation on ridge means 32 transversely of the axis of the ridge means and of the hose 29. Each such transverse bead 33 may be formed integral with the ridge means 32, and preferably comprises a semi-annular element lying in a plane perpendicular to the axis of the ridge means 32 at that point. Ridge means 32 lies in a plane perpendicular to shaft 23.

It is pointed out that the spacing between each two adjacent pinch beads 33 is much greater than the dimension of each bead 33 longitudinally of ridge 32, the illustrated spacing being many times such dimension. This is important, particularly with relation to prevention of creeping of the hose and wear thereon, since the compression effect created in the hose by each bead 33 is independent of the compression effect created therein by each adjacent bead.

Referring to Figure 2a, it is pointed out that the concave wall of channel 28, the pinch beads 33, and the convex wall of ridge means 32 are all substantially concentric about a common point indicated at A. Such concentricity occurs when the ridge means 32 and pinch beads 33 are at their deepest points of penetration into channel 28. The radius of the outermost part of each bead 33 relative to point A is slightly greater, when at such deepest point of penetration into the channel, than a quantity determined by subtracting from the radius of wall 28 relative to point A a quantity slightly less than the combined thickness of both walls of hose 29. It follows that each transverse bead 33 effects compression of the hose walls against the bottom of channel 28, and in a plane transverse to the axis of the hose, to provide a substantially perfect seal preventing loss of suction between pumping operations.

The radius of the convex wall of ridge means 32 relative to point A is determined by subtracting from the radius of wall 28 relative to point A (when the ridge means 32 is at its deepest point of penetration) a quantity somewhat greater than the combined thickness of both hose walls. It follows that the ridge means 32 does not forcibly contact the hose to produce a tight seal, such seal being instead performed by the pinch beads 33. The convex surface of the ridge means 32 operates, however, to provide initial compression of the hose as indicated in a schematic Figure 5, which is important to the maintenance of constant flow. The ridge means 32 also prevents the hose from bulging or ballooning, with consequent decreased fluid flow, increased wear on the hose, and backward creeping of the hose.

It is pointed out that the ridge means 32 and pinch beads 33 extend for at least one full circle, or 360°. Thus, referring to Figures 2 and 3, the ridge means and pinch beads commence at the downwardly pointing spider arm 20a and also end at the same arm. It follows that regardless of the position at which the wobble support

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or spider 13 stops between pumping operations, at least one pinch bead 33 will be pressed in sealing relationship against the hose 29 to provide the above-indicated seal. It is to be understood that the pinch beads 33 are positioned sufficiently close together (such as every 24 degrees) that a seal will occur regardless of the position of the wobble support or spider 13. The provision of pinch beads 33 and ridge means 32 for at least one full revolution, or 360°, also has the beneficial effect of insuring that fluid may not be pumped through the hose in a direction opposite to that desired.

#### Operation

To position the hose 29 in the pump, it is merely necessary to loosen and remove the hand wheel 26 and slide shaft 23 out of the recess in short shaft 16. The entire impeller is thus removed, following which the hose is threaded through the opening in backup housing 12, and is extended around the channel 28. It is not necessary to employ a means for preventing the hose 29 from shifting axially. The shaft 23 is then re-inserted, and hand wheel 26 is tightened to position the impeller for operation.

Upon energization of the motor 10, the resulting wobble action of spider arms 20 (which do not rotate) causes the ridge means 32 and pinch beads 33 to progressively compress the stationary hose 29. As above-indicated, there is always a seal provided by at least one of the pinch beads 33, whereas the portion of the hose 29 in advance of such seal is compressed by the outer convex surface of the ridge means 32. It follows that fluid, either liquid or gas, will be forced ahead of the sealed point and will thus flow through the hose.

It has been discovered that the use of cooperating concave and convex squeezing and pinching elements, to produce the generally lunar hose shape shown in Figure 2a, provides a very efficient pumping operation for both liquids and gases while at the same time preventing substantial wear on the hose. It follows that no lubricant need be employed on the external hose surface. Because actual pinching and sealing is performed only at the pinch beads 33, there is no high-pressure contact of the hose by the convex surface of ridge means 32. The amount of power required to operate the pump is therefore minimized, as is the amount of wear on the hose.

It is pointed out that the maintenance of a perfect seal between pumping operations permits the present apparatus to be employed to meter relatively small amounts of fluids. This is because pumping commences immediately upon commencement of rotation, there being no necessity to operate the apparatus in order to prime the pump. The pump may therefore operate to meter out glassfuls of beverage from a beverage-vending machine.

Various embodiments of the present invention, in addition to what has been illustrated and described in detail, may be employed without departing from the scope of the accompanying claims.

I claim:

1. A hose-type pump, which comprises a backup housing having a channel formed therein and extending in a generally circular path for at least 360°, said channel being adapted to receive an elastomeric hose, wobble means mounted adjacent said backup housing, motor means to cause said wobble means to move in a wobbling manner but without rotating, and means on said wobble means to effect progressive pinching of said hose in a given direction along its axis to thereby force fluid through said hose and result in a seal regardless of the position of said wobble means, said last-named means comprising ridge means mounted on said wobble means and having a shape corresponding generally to that of said channel, and a substantial number of spaced beads or ridges provided on said ridge means in transverse relationship relative to the axis of said hose.

2. In a hose-type pump, means to define a backup surface, a hose formed of elastomeric material and mounted on said backup surface, an actuator mounted on the opposite side of said hose from said backup surface and comprising a body and a plurality of spaced beads or projections, said beads or projections being mounted on said body and each extending transversely to the axis of the adjacent portion of said hose, said beads or projections having relatively small dimensions in a direction longitudinal to said hose and relatively large dimensions in a direction transverse to said hose, each of said beads being spaced from the adjacent beads by distances much greater than said dimension of such beads longitudinally of said hose, and means to effect progressive movement of said actuator toward and away from said backup surface to result in progressive squeezing of said hose by said body and pinching thereof at spaced points by said beads or projections.

3. The invention as claimed in claim 2, in which said beads or projections are disposed sufficiently close to each other that one is always in sealing contact with said hose regardless of the position of said actuator, and sufficiently far apart that the compression effect created in said hose by each bead is independent of the compression effect created in said hose by each adjacent bead.

4. The invention as claimed in claim 2, in which said last-named means effects movement of said actuator sufficiently close to said backup surface that the opposed wall portions of said hose are pinched into sealing contact by said transverse beads or projections but are maintained a short distance apart in the sections between adjacent beads or projections, whereby progressive sealing of said hose is achieved with minimum power requirement.

5. In a hose-type pump, means to define an elongated concave channel, a tubular hose formed of elastomeric material and disposed in said channel, said channel having a size corresponding generally to the outer diameter of said hose whereby said hose may fit relatively closely therein, a convex ridge element having a shape corresponding to that of said channel, means to mount said ridge element longitudinally of said hose on the opposite side of said hose from the bottom wall of said channel and to effect a wobble action of said ridge element in the absence of shifting of said ridge element along the axis of said channel, said last-named means serving to cause said ridge element to squeeze said hose in the absence of compressive engagement between opposite wall portions of said hose, and a plurality of small pinch means spaced substantial distances apart along said ridge element and adapted to effect pinching of said hose at spaced points due to said wobble action, said pinching being sufficient to effect sealing between opposed wall portions of said hose adjacent each pinch means when the same is at its deepest point of penetration into said channel.

6. The invention as claimed in claim 5, in which said pinch means comprise a plurality of narrow beads or ridges provided on the convex surface of said ridge element opposite said hose and extending in a direction transverse to the axis of said hose.

7. The invention as claimed in claim 6 in which each of said beads or ridges is substantially concentric with the adjacent portion of the bottom wall of said channel when said bead or ridge is at its deepest point of penetration into said channel.

8. The invention as claimed in claim 7, in which the radius of the outermost portion of each of said beads or ridges is determined by subtracting from the radius of said adjacent portion of said bottom channel wall a distance slightly less than twice the thickness of the wall of said hose, and in which the radius of the adjacent portion of said ridge element is determined by subtracting from said channel wall radius a distance slightly greater than twice the thickness the wall of said hose,

said radiuses being determined when said bead or ridge is at its deepest point of penetration in said channel.

9. A hose type pump, which comprises a backup housing having a generally 6-shaped channel formed therein and extending for at least 360°, a shaft journaled in said backup housing and encompassed by said channel, said shaft being adapted to rotate about an axis which is generally perpendicular to a plane containing the bottom wall of said channel, means to rotate said shaft, a second shaft fixedly connected to said first-mentioned shaft at a relatively small angle to said axis of said first-mentioned shaft, a spider mounted on said second shaft in such manner as to permit rotation of said second shaft therein, means to prevent rotation of said spider to thus effect a wobble action thereof due to rotation of said first and second shafts, a tubular hose mounted in said channel between the bottom wall of said channel and the outer portion of said spider, ridge means mounted adjacent said hose on said outer portion of said spider and in a plane perpendicular to said second shaft, and a plurality of pinch elements provided on said ridge means to effect pinching of portions of said hose against the bottom wall of said channel due to said wobble action.

10. The invention as claimed in claim 9, in which said channel is a concave bottom wall, in which said ridge means is correspondingly convex, and in which said pinch elements comprises beads provided transversely at spaced points on the convex surface of said ridge means.

11. A hose-type pump, comprising a hose having a wall of predetermined thickness, means to define a backup surface adjacent the exterior surface of one side of said hose, squeezing means disposed longitudinally of said hose adjacent the exterior surface of the other side of said hose, actuating means to rock said squeezing means compressively along said hose through such distances radially of said hose that opposed points on said exterior surfaces of said one side and said other side of said hose remain separated by distances at least equal to the combined thicknesses of said wall at said points whereby compressive and pinching engagement between opposed wall portions is prevented, and a plurality of pinch means to effect pinching compressive sealing engagement between opposed wall portions of spaced-apart short sections of said hose at the same times, respectively, that opposed wall portions of unpinched hose sections adjacent said short sections are relatively close together due to operation of said squeezing means and actuating means, said short pinched sections being spaced apart by distances sufficient to localize the effects of compression of said short sections.

12. The invention as claimed in claim 11, in which said squeezing means is a ridge element extending longitudinally of said hose, and in which said pinch means comprises a plurality of pinch elements provided on said ridge element relatively adjacent said other side of said hose and each having a short dimension longitudinally of said hose, each of said pinch elements being spaced from the adjacent pinch elements by distances many times said short dimension of each pinch element.

13. The invention as claimed in claim 12, in which said backup surface is concave generally correspondingly to the outer surface of said hose, and in which said ridge element and pinch elements are convex and generally concentric with said backup surface when at the deepest points of penetration therein.

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