Oct. 31, 1967 G. H. WEBER 3,349,716

PUMPS

Filed March 28, 1966 2 Sheets-Sheet 1

FIG. 4.

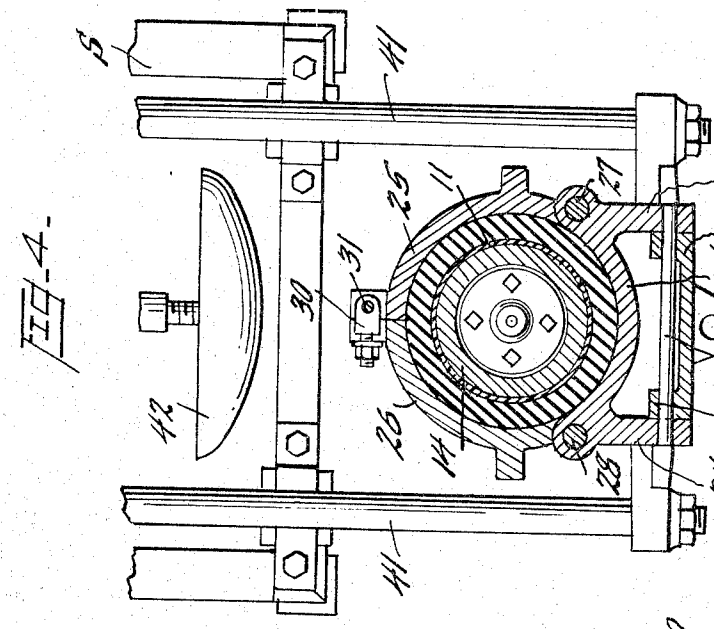

FIG. 5.

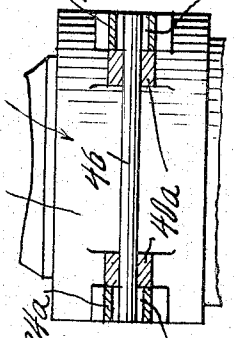

FIG. 7.

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Oct. 31, 1967 G. H. WEBER 3,349,716

PUMPS

Filed March 28, 1966 2 Sheets-Sheet 2

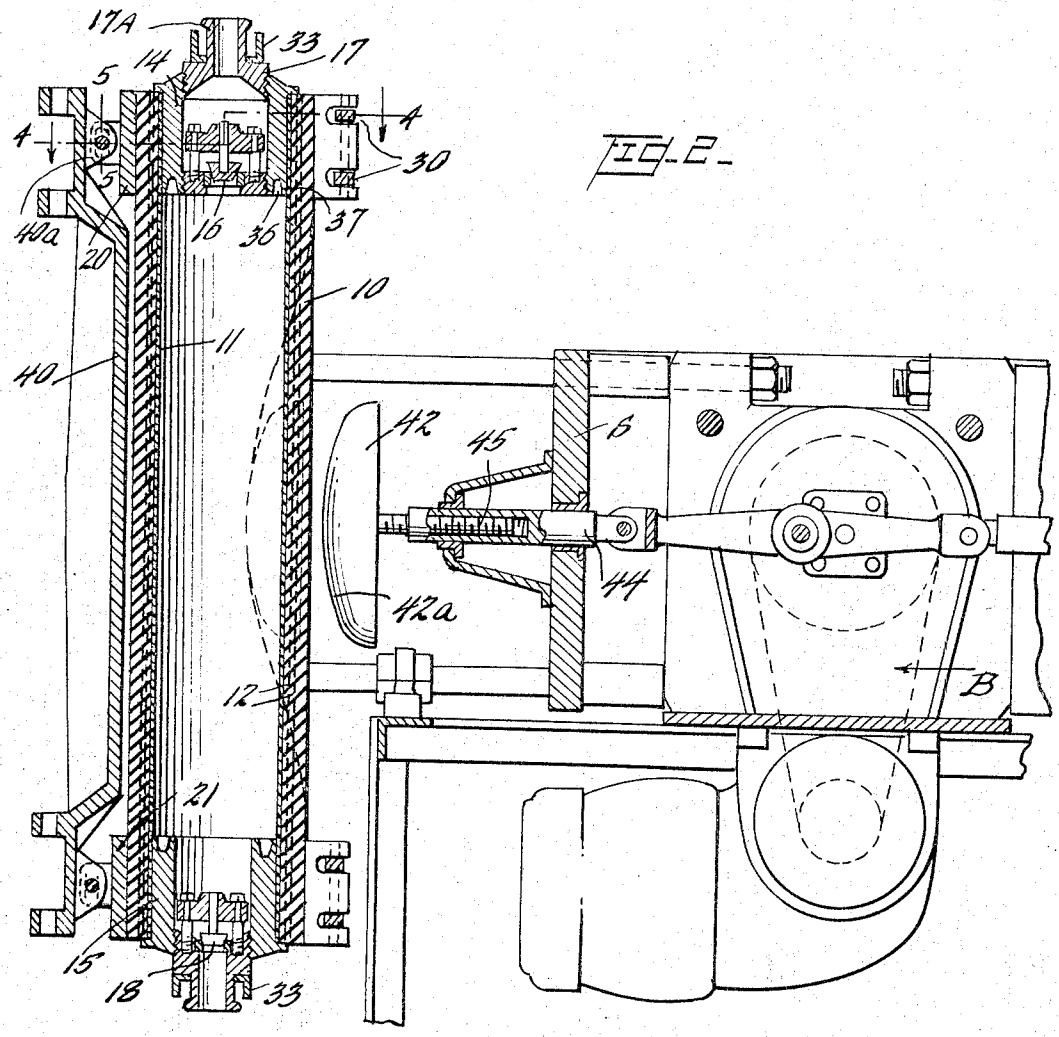

FIG. 2.

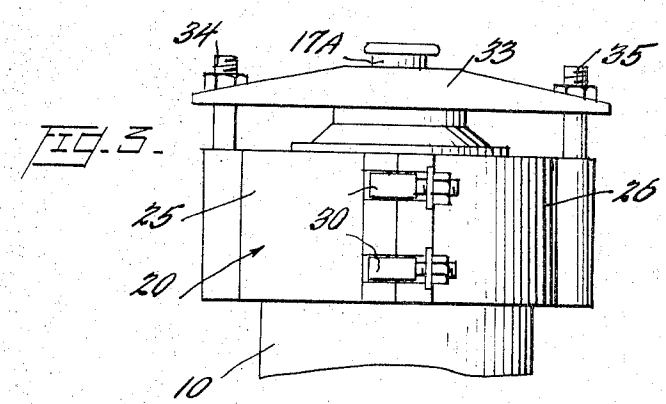

FIG. 3.

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PUMPS

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8 Claims. (Cl. 103—148)

In order to successfully accomplish certain industrial operations, it is necessary to pump liquids of corrosive character and it has been proposed heretofore that this may be done in various ways by especially designed mechanisms. The present invention relates to liquid pumps primarily intended to be used to force corrosive liquids through conduits, is likewise well suited for the pumping of non-corrosive liquids, which comprises an improved relatively simple pumping means which may be constructed at small cost, may be caused to operate over extended periods of time without attention or maintenance, and which requires the expenditure of a minimum amount of power per unit of liquid delivered.

In the conventional fluid pump, the pressure-resisting wall of the pump chamber, into which the liquids are drawn by suction and from which they are ejected under pressure, is contacted by the fluid being pumped and suffers rapid deterioration if the liquid is of corrosive character. In accordance with this invention, the pressure-resisting wall of the pump chamber is protected against contact with the liquid being pumped by a layer or lining of corrosion-resistant material; and, in lieu of a plunger or piston which would, if employed as a pressure-creating means, destroy such a protective lining, I employ as the pressure-resisting wall of the chamber a tube of high tensile strength material but of flexible nature and effect the pumping operation by pressing against and inwardly deflecting a substantial area of the wall of the tube to cause a measured amount of the liquid to be ejected. An important characteristic of the flexible chamber wall is its ability to promptly resume its original shape or position after the externally-applied pressure is relieved, thus creating a negative pressure within the chamber which results in inflow of fluid equal in volume to that previously ejected. The corrosion-resisting lining is caused to adhere to the inner surface of the tubular pump chamber wall which is at all times protected thereby, no contact with the wall surface of the liquid being pumped being possible.

The tube end closures, valves, and other parts of the pump which are contacted by the liquid being pumped are fabricated of corrosion-resistant material. An important feature of the invention is the means by which the tube is supported, this being such as to maintain the tube in a relatively fixed position but permitting self adjustments of its end portions as its midportion is acted upon and distored by the pressure means employed and as the tube returns to initial position after withdrawal of the pressure-applying means. The means for applying external pressure to the midsection of the tube is of novel character, as are other features of the invention, as will hereinafter be made clear.

In the drawings one embodiment of the invention is illustrated by way of example;

FIGURE 1 is a view, partly in side elevation and partly in perspective, of the novel pump;

FIGURE 2 is a vertical section through the apparatus, taken along the axis of the tubular member of the pump and the axis of the pressure-applying means;

FIGURE 3 is a side elevation of a portion of the

means for supporting one end of the tubular member, or pump chamber wall;

FIGURE 4 is a section on line 4—4 of FIGURE 2; and

FIGURE 5 is a section on line 5—5 of FIGURE 2.

The tube which comprises the pressure-resisting wall of the pump chamber is indicated at **10** and the protective liner of corrosion-resistant sheet material at **11**. In the form of the invention illustrated, the wall of the tube **10** is relatively thick, is fabricated of rubber, and is strengthened by the inclusion of one or more tubular layers of fabric **12**. It is capable of withstanding high internal fluid pressures but is nevertheless susceptible of deformation when substantial external pressure is applied and has the ability to resume its original shape and position when the applied pressure is removed. The corrosion-resisting lining material **11** is relatively thin and is attached to the inner surface of the tube **10** by means of any suitable adhesive. The lining material may be chosen in the light of the fluid to be pumped and may comprise polyethylene or sold under the trade name of Teflon. The lining may have little mechanical strength being firmly supported by the tube **10**.

The ends of the tube **10** are closed by closure members **14** and **15** respectively, which are substantially identical in construction. Closure member **14** is formed as a hollow cylinder, the external cylindrical surface of which closely engages the inner face of the end portion of liner **11**, the interior constituting an offtake conduit for liquid expelled from the pump chambers, a non-return valve **16** being suitably supported in position to open when the tube **10** is under pressure and to close when this pressure is relieved. An annular plug **17** closes the outer end of the hollow cylindrical closure member **14** save for a central aperture in communication with a cylindrical extension **17T** to which an offtake conduit may be connected. Closure member **15** is of similar construction except in that the non-return valve **18** functions to prevent escape of liquid from the pump chamber when pressure is applied to the wall thereof.

The ends of tube **10** are encircled by clamping rings generally indicated at **20** and **21**, respectively, which tightly embrace the tube ends, respectively, and force the ends of the liners **11** into close and fluid-tight engagement with the cylindrical surfaces of the closure members **14** and **15**, respectively. Clamping ring **20** comprises a base portion **24** having a cylindrical tube-engaging surface and two similar but oppositely curved segmental portions **25** and **26** which are connected to base **24** by pivots **27** and **28**, respectively. The ends of member **25** and **26** remote from pivots **27** and **28** are normally connected by bolts **30**, pivotally supported at **31**, so that the clamping rings encircle and tightly grip the tube ends as described.

When the clamping ring is so positioned, a bridging member **33** is secured to the pivoted parts **25** and **26** by bolts **34** and **35** which pass through suitable apertures in its ends. At its center the bridging member is provided with an aperture through which the neck **17*a*** of plug **17** passes. The undersurface of the bridging member **33** rests upon the annular outer surface of plug **17** and thus tightly secures the closure member **14** in tube closing position. The tube closure member **15** is similarly secured in position. Removal of these tube closures may be easily effected by removal of the bridging members, as will be apparent.

Escape of fluid from the pump chamber when the tubular member **10** is inwardly deflected may be prevented by

providing the closure members **14** and **15** with means at their inner ends to closely contact the surface of liner **11**, as by providing annular grooves so located that their thin outer walls will be radially deflected outwardly when the fluid in the pump chamber is placed under pressure, into tight engagement with the inner surface of liner **11**. Depending upon the resistance to flow of fluid imposed upon the pump by any conduit connected to offtake neck **17***a*, the fluid pressures within the pumping chamber may be large or small, and pressures of 50 to 60 pounds per square inch, or even higher may be necessary in order to accomplish the desired flow. The annular groove of closure member **14** is indicated by the numeral **36** and the thin outwardly deflectable wall of that groove at **37**. The closure **15** is similarly provided with groove and expandable fin or equivalent means.

Preferably, but not necessarily, the tube **10** is disposed with its longitudinal axis disposed vertically. It is supported upon a suitable stand and that illustrated is advantageous since the vertically disposed rigid plate **40** to which the clamping rings **20** and **21** are attached also functions as an operative member of the pressure-applying means. The weight of plate **40** and tube **10** with its closure means is conveyed to a suitable stand S by horizontal supporting rods **41**. The horizontally reciprocal head **42** for engaging and inwardly deflecting a portion of the wall of tube **10**, and thus distorting the tube and reducing its volume, has its tube-engaging surface symmetrically curved about a horizontal axis, as shown, so as to have a minimum tendency to sharply bend the tube **10** as the head moves on its working stroke, for instance from the position in which it is shown in full lines in FIGURE 2 to the position in which it is shown in dotted lines in that figure and in full lines in FIGURE 1. The face of the pressure head is so shaped that contact with the surface of the tube **10** gradually increases as the pressure head advances on its working stroke. At no time can the wall of the tube be sharply bent or deflected.

In so moving the pressure head will inwardly displace the engaged area of the tube and force the opposite side of the tube to contact backing plate **40** and thus be subjected to a "squeezing" action which reduces the available space within to cause a predetermined amount of liquid to be forced outwardly through the discharge passage in closure member **14**. The distance of travel of pressure head **42** upon its working stroke may be adjusted as desired, for instance the thrust rod **44** upon which pressure head **42** is supported being provided with a threaded bolt upon which the head is mounted so that, by rotating the head, the distance between the face of the pressure head and the stationary driving means may be adjusted as desired. The face of pressure head **42** is identically curved in all planes which include the axis of the shaft upon which it is mounted so that, however it may be adjusted, it will present an identical surface to the tubular member **10** when moved on its working stroke. Any suitable means may be employed to advance and detract the pressure head, such as that shown at B.

Distortion of the tube **10** when subjected to the "squeezing" action brought about by the power driven pressure head in cooperation with the backing plate **40**, is such as to require that the upper and lower ends of tube **10**, with their closure members and clamping rings be given definite, although limited, freedom of movement in order to prevent the development of forces tending to move the tube ends relatively to the clamping rings and thus tends to destroy the protective lining, the heavy fabric-reinforced rubber tube being very difficult if not impossible to secure against movement at its ends when its midportion is distorted by the pressure means. For this reason clamping means **20** is connected to the plate **40** by means which permits the clamping ring to tilt about a horizontal axis (or an axis transverse to the axis of the tube **10**) and also to move vertically. Such a connection is shown in FIGURES 2 and 4. The backing plate **40** is shown to have lugs **40***a* provided with apertures through which a pivot pin **46** extends and by which it is firmly supported. The outwardly extending ends of pin **46** project into vertically extending but relatively short slots **24***b* formed in lugs **24***a* of clamping ring segment **24**. Thus the clamping ring is supported for rocking movement and, to an appreciable but limited extent, also for vertical movement. By this means, or one which functions similarly, forces tending to disturb the relationship of tube and its mounting are prevented from arising. The clamping member **21** at the lower end of the tube may be similarly mounted on the supporting plate but preferably mounted for pivotal movement only, as shown, it being usually only necessary to provide for vertical movement of the uppermost clamping member.

While the tube **10** is shown in the drawings as being truly circular in cross section, it will be understood that tubes which are other than circular in cross section may be employed if desired, lkewise that minor modifications of structure may be utilized while retaining the advantages of the invention.

What I claim is:

1. A fluid pump comprising, in combination, a tube the wall of which may be inwardly deflected upon the application of pressure in a direction generally transverse to its longitudinal axis and which resumes its original shape when the pressure is removed, a closure for each end of the tube, one such closure having a passage through which fluid may be introduced into the tube and the other having a passage through which fluid may escape from the tube, a non-return valve operatively associated with each passage for assuring fluid flow therethrough in one direction only, means for applying pressure to an external surface of said tube intermediate the ends thereof to inwardly deflect the same and to thereafter relieve such pressure to permit the tube to assume its normal shape, and means supporting the tube in position to be acted upon by said pressure applying means, said supporting means permitting self adjustment of an end of the tube and the associated tube end closure as the intermediate portion of the tube is manipulated by said pressure-applying means.

2. The combination set forth in claim **1** in which said pressure-applying means includes a tube-engaging pressure head which, on its working stroke, makes gradually increasing contact with the tube.

3. The combination set forth in claim **1** in which one tube end closure is fitted into one end of the tube and a tube clamp encircles the tube end and tube closure, the tube clamp being mounted for angular movement about an axis disposed laterally of the tube.

4. The combination set forth in claim **1** in which a tube clamp encircles and grips one end of the tube, a supporting member is disposed closely adjacent the tube clamp, and means connects the tube clamp and supporting member whereby the tube clamp is supported for minor rocking movement in the plane of the axis of the tube and minor movement parallel to that axis.

5. The combination set forth in claim **1** in which said pressure-applying means includes a stationary support disposed parallel to the tube and the tube clamp is pivotally connected thereto.

6. The combination set forth in claim **1** in which a tubular liner within and secured to the inner wall of the tube has an end portion disposed between tube closure and the inner face of the tube, the tube clamp encircling the tube end and closure and causing said last mentioned members to tightly grip the end of the liner, for the purpose set forth.

7. The combination set forth in claim **1** in which the end closures, including valves, are fabricated of corrosion-resistant material and the tube is lined with such material.

8. The combination set forth in claim **1** in which the tube is fabricated of rubber with internal strengthening of

fabric, being strongly resistant to deformation and readily assuming original shape after deformation and release.

References Cited

UNITED STATES PATENTS

448,784	3/1891	Lightbody	103—148
1,976,415	10/1934	Scott	103—148
2,648,288	8/1953	Marks	103—148
2,845,874	8/1958	Nangle	103—152
3,048,121	8/1962	Sheesby	102—152
3,171,360	3/1965	Walton	103—152

FOREIGN PATENTS

597,046	1/1948	Great Britain.

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