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L. E. RUSSELL

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PUMP DIAPHRAGM

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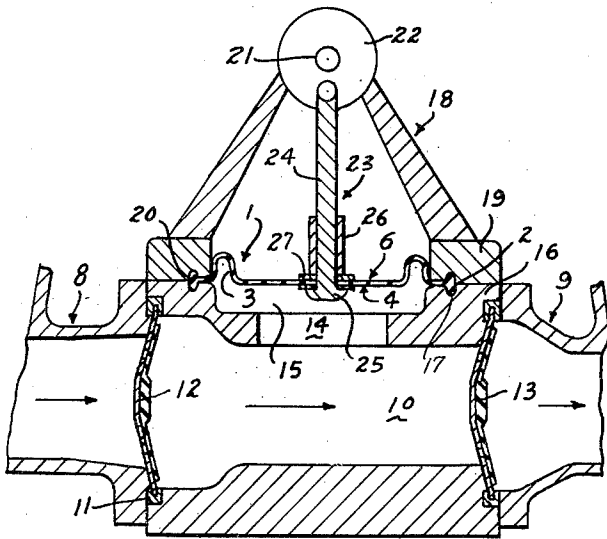


Fig-1

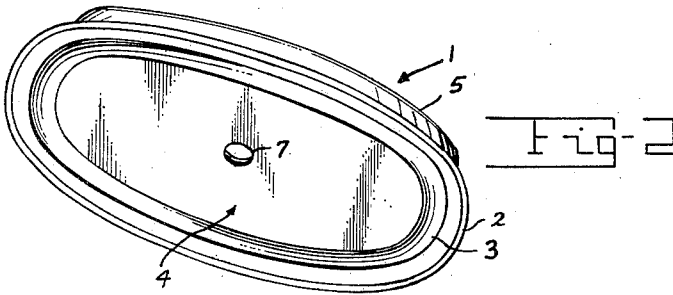


Fig-2

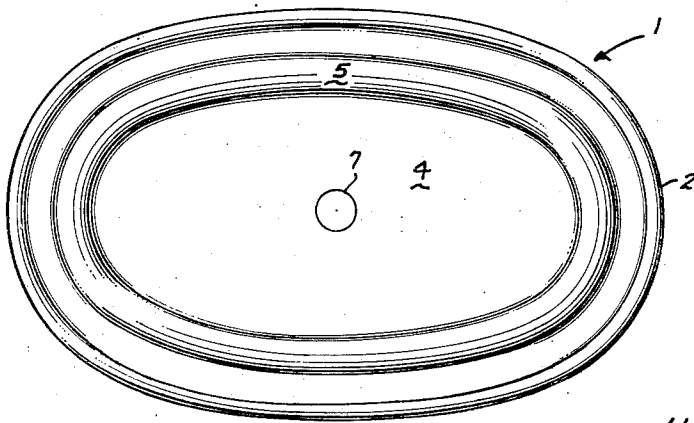


Fig-3

INVENTOR.
LINUS E. RUSSELL
BY *Tom Walker*
ATTORNEY

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PUMP DIAPHRAGM

Linus E. Russell, Springfield, Ohio, assignor to Peters & Russell, Inc., Springfield, Ohio, a corporation of Ohio
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This invention relates to diaphragm pumps and more particularly to improvements in their diaphragms.

Pump diaphragms, which are normally circular in configuration, are subject to rough usage. They are conventionally operated under the influence of a reciprocating eccentric arm which repetitively inflicts both tension and torsion. Stresses and strains result which rapidly fatigue the diaphragms, reducing their efficiency and necessitating their frequent replacement. This creates a pump maintenance problem and adds to operating costs.

The present invention is directed to providing improvements in pump diaphragms substantially extending their operating life. Thereby reducing pump maintenance and maintenance cost. Such improvements also stabilize pump efficiency.

The preferred embodiment of the invention described herein provides a diaphragm which is flexible and has a generally elliptical form. The nature of this diaphragm and its preferred orientation in a pump is such as to minimize the effects of tension and torsion consequent to eccentric reciprocation thereof under the influence of the conventional operating rod utilized in the diaphragm type pump.

A primary object of the invention is to provide improvements in pump diaphragms rendering them economical to fabricate, more efficient and satisfactory in use, adaptable to a great variety of applications and highly resistant to deterioration under normal operating conditions.

Another object of the invention is to provide a novel pump diaphragm which has an elliptical form.

A further object of the invention is to provide an improved diaphragm which reduces maintenance problems when used in diaphragm pumps.

Another object of the invention is to provide a pump diaphragm that minimizes the effects of tension and torsion thereon in operation.

A further object of the invention is to provide a pump diaphragm possessing the advantageous structural features, the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above and other incidental objects in view as 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 accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

FIG. 1 is a fragmentary cross sectional view partly diagrammatic of an improved pump incorporating a diaphragm according to the invention;

FIG. 2 is perspective view of a diaphragm as shown in FIG. 1; and

FIG. 3 is a plan view of the diaphragm in FIG. 1.

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

The improved diaphragm 1 shown in the drawings is formed of a flexible material such as rubberized fabric. It is generally flat and has an elliptical configuration. A bead 2 is formed on the outer peripheral edge of the diaphragm. The diaphragm is contoured to provide an elliptical recess 3 in its operating face 4 generally uni-

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formly spaced from the bead 2, immediately inward thereof. The formation of the recess 3 provides a displacement of an elliptical portion of the diaphragm to cause it to form an elliptical fold 5 projected relative diaphragm face 6 opposite its operating face 4. An aperture 7 centrally of the diaphragm affords means for fixing it to an operating rod, as will be described.

The diaphragm 1 is shown in FIG. 1 of the drawings in application to a fluid pump. Only so much of the pump apparatus is illustrated as is necessary to describe the functional aspects of the invention. As shown, an inlet pipe 8 and an outlet pipe 9 are coaxially connected by a section of conduit 10. A seal element 11 is confined between appropriately contoured abutting end faces of pipe 8 and conduit 10. The seal 11 anchors the periphery of a conventional one way flap valve 12 so it bridges the opening of the pipe 8 to conduit 10. This flap valve 12 is arranged to admit fluid from pipe 8 to conduit section 10 and prevent reverse flow of the fluid. A similar but oppositely functioning valve assembly 13 is similarly peripherally confined between appropriately formed abutting ends of conduit section 10 and outlet pipe 9.

A central aperture 14 is provided in a recessed portion 15 of the upper section of conduit section 10, as shown in FIG. 1. This portion 15 is defined by a uniform projection or shoulder 16, the outermost surface of which is flat. An elliptical recess 17 is provided in the projected surface of the shoulder 16 which receives the portion of bead 2 projected from face 4 of the diaphragm 1. The diaphragm 1 is thereby seated to bridge the space defined by the shoulder 16. A bracket 18 having a base 19 is provided with an elliptical recess 20 in the under surface of its base which is similar to the recess 17. The bracket is fixed over the shoulder 16 to receive the upper portion of the bead 2 in its recess 20. The diaphragm 1 is thus clamped in bridging relation to the projected shoulder 16 of the conduit section 10 above and in spaced relation to the aperture 14. As shown in FIG. 1 of the drawings, the diaphragm at rest is under a negligible stress with its minor axis in the direction of indicated flow through the pump and its major axis at right angles thereto. The bracket 18 includes arms which converge upwardly of its base 19 to connect to bearing means for a drive shaft 21. A plate 22 is fixed about the shaft 21 adjacent and parallel to the plane of the minor axis of the diaphragm 1 as shown in the drawings.

An operating rod assembly 23, eccentrically and pivotally connected to plate 22 at one end, is suitably connected at its other end to the diaphragm and arranged to operate in a plane including the minor axis of the diaphragm. The assembly 23 shown includes a rod element 24 having an expanded head 25 to one end abutting the flat operating face 4 of the diaphragm. This rod element 24 is projected upwardly through the aperture 7 in the diaphragm to be contained by and fixed to a tubular element 26. The inner periphery of the diaphragm 1 defining aperture 7 is confined between two washers 27 which are in turn clamped between the tubular element 26 and the expanded head 25 of the rod 24. The rod assembly 23 is thus eccentrically connected to shaft 21 which is driven by means (not shown) for reciprocation of the assembly 23 in a manner well known in the art. Tension is developed in the minor axis of the diaphragm in consequence thereof while torsion is developed in its major axis. Specific details of the reciprocating drive means have not been shown since they form no significant part of the present invention.

On eccentric reciprocation of the diaphragm 1, it will function in the upward movement thereof to draw fluid from the inlet pipe 8 through the valve assembly 12 and into the conduit section 10. Downward movement of the diaphragm will force this fluid through the valve assem-

bly 13 and out the pipe section 9. In the process of eccentric reciprocation, the diaphragm 1 is subjected to cyclic tensioning along its minor axis and simultaneous torsion along its major axis in a manner believed obvious. As contrasted to convention, use of the elliptical diaphragm and the orientation of its minor axis in the plane of operation of its reciprocating rod assembly minimizes applied stress resulting from tension. The relatively substantial length of the major axis of the diaphragm 1 and its orientation minimizes the effects of applied torsion in operation. Further stress and strain on the diaphragm on eccentric movement thereof is alleviated by extension and contraction of portions of its outwardly projecting elliptical fold 5. This fold, as arranged immediately adjacent to bead 2, absorbs and accommodates effects of applied tension and torsion to a substantial degree and in a critical area.

The invention diaphragm so formed has the noted superior features particularly enhanced by orientation in a pump as illustrated. It will last a great deal longer than a conventional diaphragm and avoids fatigue and distortion which would reduce its operating efficiency. Its use saves time and money and eliminates the inconvenience of frequent pump shut down for change of a deteriorated diaphragm.

The invention in its simplicity provides a definite advance and improvement in diaphragm pumps.

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 present form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

I claim:

1. A pump, including a body providing a chamber having communicating inlet and outlet openings, said body further providing a partition defining one wall of said chamber, said partition having an opening therein and a shoulder in outwardly facing projecting relation to said opening, said shoulder having an outwardly facing groove of elliptical contour therein, bracket means including a base conforming in contour to and seated on said shoulder, said base having an opposing mating groove therein, said bracket means further including outwardly directed arms, a crank rotatably supported by said arms, a rod connected at one end to said crank and inwardly directed therefrom toward said body centrally of said shoulder, and a flexible elliptical diaphragm stretched across said body on said shoulder and formed with a peripheral bead received in the opposing mating grooves of said shoulder and said base, said diaphragm having a central planar portion in which is an aperture through which said diaphragm receives and is connected to the other end of said rod, and said diaphragm being further formed with an outwardly directed fold having inner and outer walls and corresponding in contour to said bead and spaced therefrom toward the center of the diaphragm to lie within the area bounded by the said base of said bracket means, the inner wall of said fold merging with said central planar portion.

2. A pump according to claim 1, characterized in that the outer wall of said fold is in immediately adjacent contacting relation to said base with said base providing back-up support for said fold.

3. A pump, including a body providing a chamber having communicating inlet and outlet openings, said body further providing a partition defining one wall of said chamber, said partition having an opening therein and a shoulder in outwardly projecting relation to said opening, crank support means in aligned relation to said shoulder and including a base seated on said shoulder, a crank supported by said support means for rotation about an axis intersecting the area bounded by said shoulder, an elliptical diaphragm disposed in said area, the periphery of said diaphragm being received and held between said shoulder and said base and said diaphragm being so oriented relative to the axis of rotation of said crank as to place the major axis of the diaphragm in the plane of said axis of rotation, an actuating rod extending from said crank to said diaphragm and connected to said diaphragm at the point of intersection of the major and minor axes thereof, the central portion terminating within the area bounded by said shoulder in an outwardly directed fold, said fold being in immediately adjacent contacting relation on its one side to said base, said base having a thickness greater than the depth of said fold, the flexing of said diaphragm incident to reciprocation thereof in response to rotation of said crank taking place about the major axis of the diaphragm, the flexing being absorbed in a yielding of said fold while reacting against said base.

4. In a pump, means defining a chamber in said pump, means defining an inlet to and an outlet from said chamber, means defining an opening to said chamber, a relatively flat elliptical diaphragm formed with a central planar portion and having a peripheral bead fixed to said means defining the opening to said chamber whereby to seal said opening and means connected for eccentric reciprocation of said diaphragm to draw fluid into and disperse it from said chamber, said means including crank means rotatable about an axis parallel to the major axis of the diaphragm, said diaphragm having a continuous fold formed therein intermediate said central planar portion and said bead and the minor axis thereof being in the plane of operation of said diaphragm, reciprocating means whereby to minimize stress and strain imposed on said diaphragm in reciprocation thereof, said diaphragm flexing about the major axis of the diaphragm in response to rotation of the said crank means.

5. A pump, including a body providing a chamber having communicating inlet and outlet openings, said body further providing a partition defining one wall of said chamber, said partition having an opening therein, a flexible elliptical diaphragm having a central planar portion terminating in an outwardly directed fold, means clamping the periphery of said diaphragm beyond said fold to said body, said means supporting said fold, a crank rod projecting perpendicularly outward from said diaphragm and connected thereto at the mid point of said central planar portion, and rotatable crank means for said crank rod.

6. A pump according to claim 5 characterized in that said diaphragm is oriented relatively to said crank means to place said crank means in an axis in transverse overlying relation to the said mid point of said central planar portion.

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