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FLEXIBLE DIAPHRAGM

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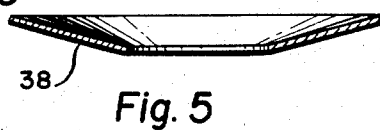
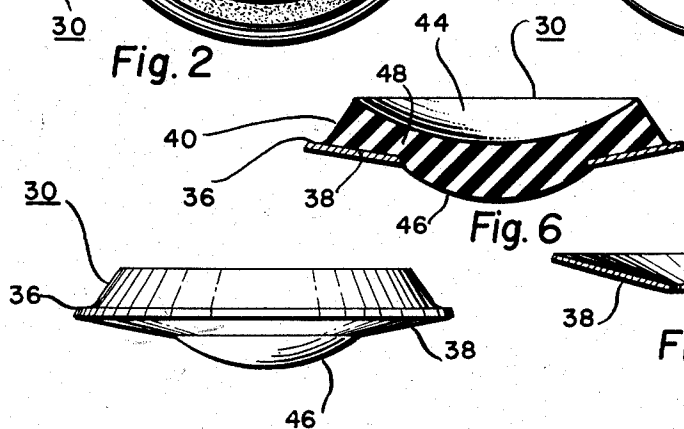
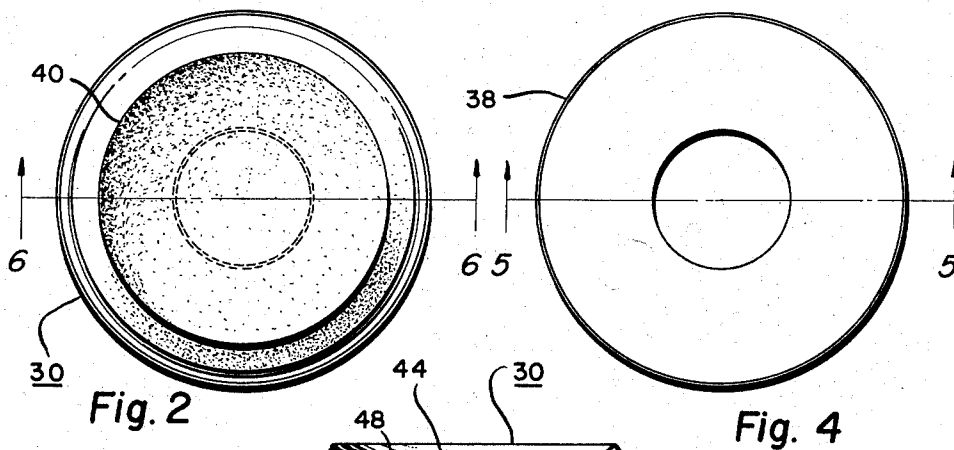
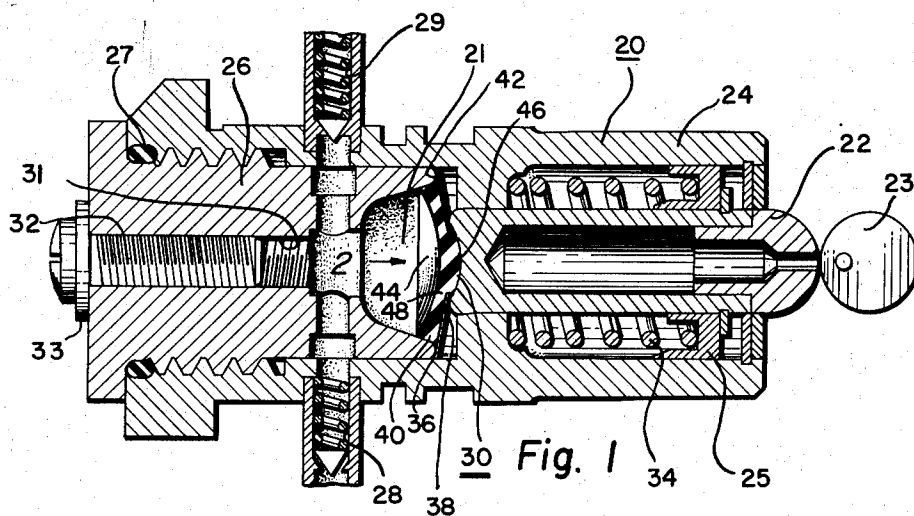


Fig. 3

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FLEXIBLE DIAPHRAGM

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This invention relates to flexible diaphragms and more particularly to a diaphragm that forms a flexible wall of a pump.

It is an object of the present invention to provide a flexible diaphragm that has the marginal edges thereof shaped to form a seal with portions of a pump when the edge is pressed into sealing engagement by a metallic spring member that is intimately attached to the edge and body of said diaphragm.

Another object of the present invention is to bond a metallic spring annulus to one side of a flexible diaphragm so the annulus will constantly maintain the center portions of the diaphragm in contact with an actuating means and marginal edges thereof in sealing contact with wall portions of a chamber of a pump wherewith it is associated.

A further object of the present invention is to provide a pump with a flexible diaphragm that acts as a flexible wall for a chamber to vary the volume thereof when the diaphragm is flexed by a reciprocating plunger that simultaneously contacts a central portion of the diaphragm and an annular metallic spring member that extends to the marginal edges of the diaphragm so that said edges will be pressed into sealing engagement with wall portions of the chamber by the annular member that is coextensively bonded to the portions of the diaphragm which it contacts.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Figure 1 in section shows a pump embodying a diaphragm according to the present invention.

Figure 2 is a plan view of the diaphragm taken in the direction of arrow 2 in Figure 1.

Figure 3 is an elevational view of the diaphragm in Figure 2.

Figure 4 is a plan view of metallic spring member.

Figure 5 is a view along line 5—5 of Figure 4.

Figure 6 is a sectional view along line 6—6 of Figure 2.

In the drawing the flexible diaphragm 30 shown forms a flexible wall for a chamber 21 of a pump 20, and when flexed will vary the volume of a chamber 21 as a plunger 22, wherewith diaphragm 30 is in constant contact, is reciprocally moved by a suitable means such as an eccentric cam 23. The chamber 21 is formed between parts 24 and 26 of the pump 20. These parts are sealed relative to each other by an O-ring seal 27 that is compressed when part 26 is threaded into the threaded portions of part 24.

The pump 20 has valved inlet 28 and outlet 29 passages which permit a fluid to enter and exit under pressure, from chamber 21 as the diaphragm 30 is flexed. This change in volume of chamber 21 will accomplish a pumping action whereby a predetermined quantity of

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fluid is expelled through outlet 29 for each flexure cycle of the diaphragm 30.

A clean out passage 31, formed in part 26, may be used to bleed any air from chamber 21. This passage 31 is closed and sealed by a member 32 which forces a washer 33 into sealing contact with part 26 as the threads on member 32 are tightened in a threaded portion in part 26.

The plunger 22 is constantly maintained in contact with an actuating mechanism 23 by a spring 34 that has one end seated against a spring seat formed on part 24 and the other end biased against a spring seat 25 that is operatively carried by the plunger 22.

The diaphragm 30, in the preferred embodiment, is preferably circular in shape, although any suitably sided polygonal shaped member might be used for a circular object is merely a polygonal object with an infinite number of sides. The diaphragm 30 is formed of a flexible material with a portion of the marginal edge curved to provide a feathered edge 36. This edge 36 is maintained in tight sealing engagement with a curved surface portion 42 of chamber 21 by a metal annular member 38 which tightly forces the feathered edge 36 and an inclined outer marginal edge portion 40 of the diaphragm 30 into pressure contact with other portions of the curved surfaces 42.

The face 44 of diaphragm 30 adjacent the chamber 21 is preferably concave in shape to aid the flexing action of the diaphragm 30. The diaphragm 30 also has a central enlarged convex or bulged portion 46 on the side of the diaphragm 30 remote from face 44. The enlarged portion 46 preferably has its outer surface rounded so that it will conform to the end of plunger 22 and preferably is of sufficient size to embed a portion of the annular spring member 38 in the material of the diaphragm 30.

Metallic member 38 is made of springy material and is preferably of frusto-conical shape. The contacting portions of member 38 are bonded to both the marginal edge 36 and an intermediate portion 48 of a diaphragm. The portion 48 is thinner than the central portion 46 of diaphragm 30 and substantially thicker than edge portion 36 and is located therebetween so the diaphragm 30 will have a proper flexing action when it is moved by the plunger 22, which simultaneously engages the central portion 46 of diaphragm 30 and the inner annular portions of the metallic member 38.

The annular metallic spring member 38 may be of the Belleville spring type or of any other suitable construction so that it will properly flex when the plunger 22 exerts its flexing movement against member 38 and the enlarged portion 46 of diaphragm 30. It is to be noted, the travel of plunger 22 while it may be adjusted is limited so the shape of the metallic member 38 will not substantially invert during the travel of plunger 22. This condition will cause the flexible portions of the diaphragm 30 to closely follow the reciprocating movement of plunger 23 and thereby achieve the pumping action on the fluids in cylinder 21.

From the above it is manifest that the material of the diaphragm may be of any suitable flexible material such as leather, impregnated cloth or suitable elastomers as synthetic rubbers such as butadiene styrene copolymers, butadiene acrylonitrile copolymers or natural rubbers, or suitable mixtures of the above, etc., and the member 38 may be of any suitable well known springy material such as Phosphor bronze, a springy organic plastic, etc., as the present invention is not limited to the materials used as any material suitable for use in the spring and/or diaphragm may be employed, any of which are well known to those skilled in the art. The shape of the spring member may be other than is shown, i. e.

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of a solid disc-like construction having finger-like embossments extending either from the outer or inner peripheral portions, provided always that the spring member 33 applies the force as exerted by the plunger 22 to the marginal edges 36 and 40 of the diaphragm 30 against the wall portions of chamber 21 so that a positive sealing pressure is maintained between the wall of chamber 21 and sealing portions of the diaphragm 30.

Further the metallic backing member 38 may be separated from the plunger 22 by the material of diaphragm 30. This construction is within the scope of the present invention providing that the metal portions adjacent the center of the member 38 are within the axial projection of plunger 22, so that the pressure applied by the plunger 22 during the pumping stroke will be applied through member 38 on the marginal edge 36 of diaphragm 30 and will be greatest when the fluid pressure in chamber 21 is at a maximum so that a metered amount of fluid under a substantially high pressure will be expelled without loss through outlet 29 of the pump.

It is apparent, the volume discharged by pump 20 during each pumping cycle may be varied as when the length of stroke of plunger 22 is changed providing the distance traveled by the plunger is within the limits dictated by the inherent characteristics of spring member 38. Thus if the spring member 38 is of the type that will return to its original shape when forced into an inverted position, the travel of the plunger must not exceed the point where the spring will fail to constantly maintain the diaphragm 30 in engagement with the plunger 22.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a pump having an elastomeric diaphragm, a frusto-conically shaped spring metal annulus surrounding a central portion of the diaphragm and having at least one surface coextensively bonded to the peripheral portions of elastomeric material forming said diaphragm and movable therewith and constantly resisting movement of said diaphragm from a normal position.

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2. An article of manufacture comprising: an elastomeric disc shaped body having marginal edges of a predetermined shape, and a flexible metallic annulus of frusto-conical shape providing a backing for said body and extending to the marginal edges thereof and bonded to said body at the juxtaposed surface portions thereof.

3. An article of manufacture including: a disc shaped elastomeric body having marginal edges of a predetermined thickness, a central portion of greater thickness than the marginal edges, and an intermediate portion joining the marginal edges and the center position, said intermediate portion having a thickness intermediate the thickness of said edges and center portion and blending into the surfaces thereof, and a metallic spring annulus constructed and arranged to extend to the marginal edges of said body and apertured at the center portion thereof to embrace the center portion of said body and coextensively bonded to the body at the juxtaposed surfaces thereof.

4. A flexible wall for a chamber, comprising in combination: an elastomeric disc shaped body portion having a marginal edge with surface portions curved to provide a feathered edge, a central portion having a curved surface and of a greater thickness than the marginal edge portions, and a portion intermediate said central and marginal edge portions having a thickness intermediate said portions and blending into the curved surface portions thereof, and a metallic spring annulus having portions thereof extending to the feathered edge portions of said body and bonded to the intermediate and feathered edge portions of said body at the juxtaposed surface portions thereof.

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