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MOUNTING FOR A PRESSURE RESPONSIVE DIAPHRAGM

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Fig. 1.

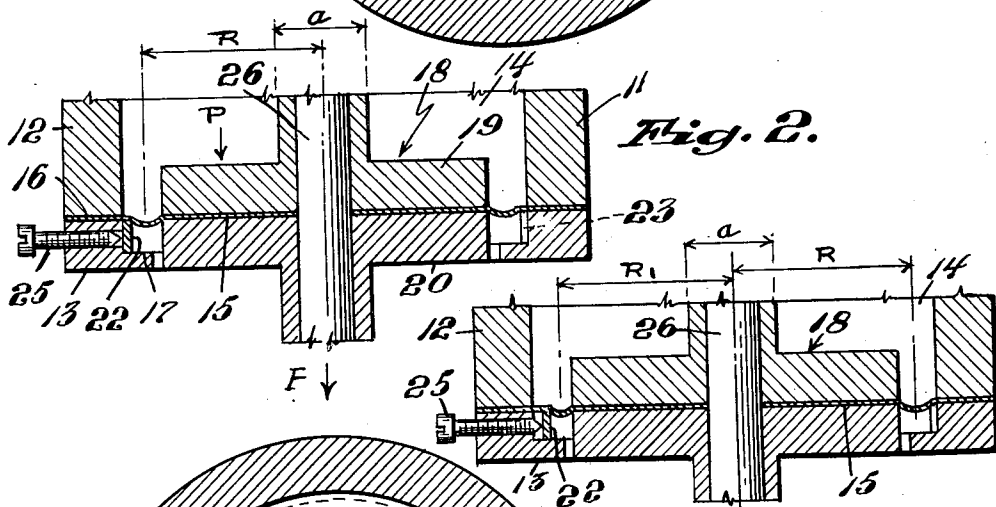
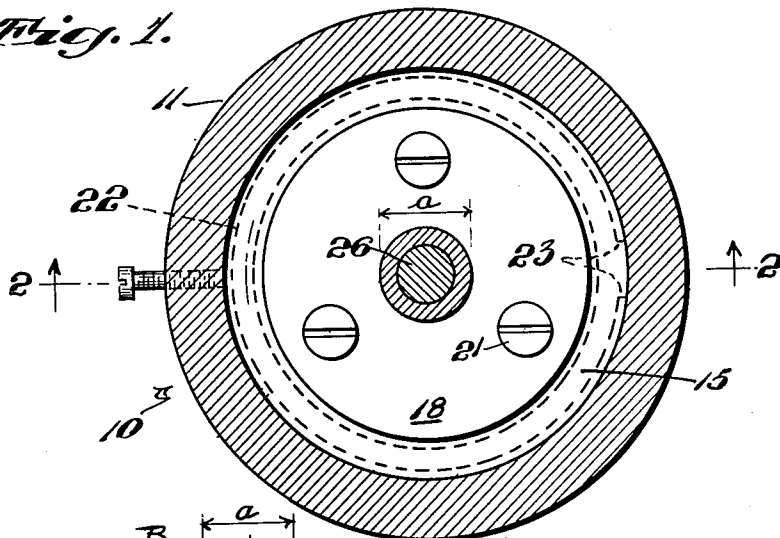


Fig. 2.

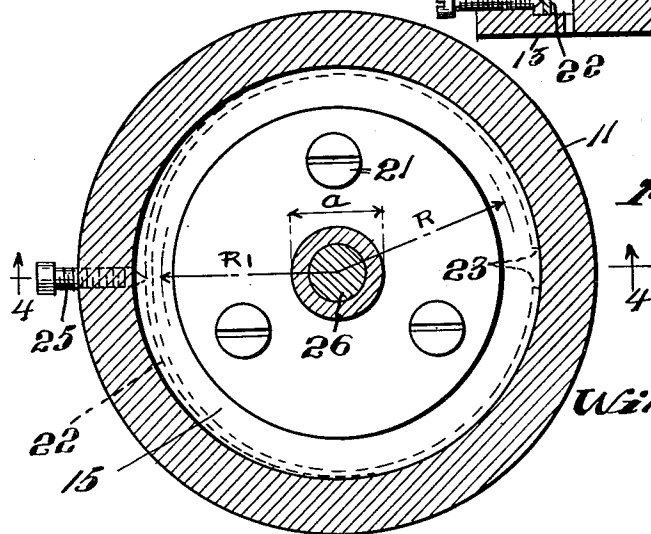


Fig. 3.

Fig. 4.

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MOUNTING FOR A PRESSURE RESPONSIVE DIAPHRAGM

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5 Claims. (Cl. 137—790)

This invention relates to improvements in the manner of mounting a flexible diaphragm so as to provide for changing the effective area thereof.

A pressure responsive diaphragm is usually stretched across an opening to a chamber and/or the like in which a pressure may be introduced to act against the diaphragm, the diaphragm being secured at its peripheral edge to the sides of the opening. The effective area of the diaphragm is roughly the surface area which extends inwardly of the mounting means that is exposed to the pressure within the chamber and is therefore a fixed area. In certain devices or apparatus in which pressure responsive diaphragms are employed, as by way of example a pressure-force transducer, it is desirable to have available some means for changing the effective surface area of one or more of the diaphragms so as to regulate the force resulting from the pressure acting on the diaphragm, this being particularly desirable at the time of calibration of the apparatus.

An object of the invention is to provide means manually operable for changing the effective area of a diaphragm.

A more specific object of the invention is to provide a support for the diaphragm which may be deformed in a manner so as to change the effective area of the diaphragm.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a plan sectional view of a fragmentary portion of an apparatus having a pressure responsive diaphragm mounted in a manner embodying my invention;

Figure 2 is a sectional view taken substantially along line 2—2 of Figure 1;

Figure 3 is a plan sectional view similar to Figure 1 but showing a different relation of parts; and

Figure 4 is a sectional view taken substantially along line 4—4 of Figure 3.

The manner of securing the diaphragm of the present invention in position across an opening to a chamber may be a usual manner, such as by securing the marginal edge of the diaphragm to the edges of the opening over which the diaphragm is stretched. According to one embodiment of the invention a deformable resilient member which in the present instance is in the form of an annulus, preferably a split annulus, is positioned to engage the side of the diaphragm opposite to that exposed to the working pressure applied thereon. The annulus is resilient and of a size to normally engage all of its circumferential surface against the walls defining the opening over which the diaphragm is stretched. The annulus is supported against movement in the direction of flexing of the diaphragm and forms an annular boundary which supports the diaphragm and may be considered as enclosing the effective area of the diaphragm exposed to the pres-

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sure within the chamber. Means are provided which may be extended into engagement with the annulus to deform the same inwardly and thus reduce the area of the annulus. Thus, the effective area enclosed within the deformed member and exposed to the pressure in the chamber may be reduced so as to regulate the force resulting from the pressure acting on the diaphragm.

Referring to the drawing for a more detailed description of the invention, 10 designates generally an apparatus in which a diaphragm is employed for transmitting a fluid pressure to a rectilinear force. Only so much of the apparatus is shown as is believed necessary for a clear understanding of the invention. The apparatus comprises a generally cylindrical hollow body 11 which may be formed in two parts 12, 13 as shown and provides an annular chamber 14 in which a fluid pressure may be introduced in any appropriate manner (not shown). The chamber 14 will be hereinafter referred to as a pressure chamber. A flexible diaphragm 15 extends across the lower end portion of the chamber with its peripheral margin 16 interposed between parts 12, 13 and there secured in position. The part 13 has an inwardly extending flange which forms an annular shoulder or ledge 17. The fluid pressure applied on the diaphragm is transmitted to the work (not shown) by means of stem 26 secured to a member 18 which is shown as being made in two similar parts 19, 20 which are oppositely disposed and between which the central portion of the diaphragm is interposed. Cap screws 21 secure the parts 19, 20 to each other and to the diaphragm to move therewith. Thus, as the diaphragm 15 is flexed, member 18 will move therewith in a rectilinear direction.

In accordance with the present invention a resilient split ring 22 having a normal outer diameter the same as the chamber 12 is positioned to rest against the ledge 17 and is of a width to engage the under side of the diaphragm (see Figure 2). The free ends 23 of the ring 22 are spaced from each other a substantial distance as shown (see Figure 1). The body part 13 at a point thereon substantially diametrically across from the split ends of the ring 22 has a screw threaded bore there-through in which there is received a screw 25 which has a conical end and which may be advanced to engage against the adjacent portion of the ring 22. The chamber side of the diaphragm is exposed to pressure introduced into the chamber and the other side of the diaphragm may be exposed to atmosphere or any other reference pressure.

Normally the ring 22 engages the inner side wall of the chamber 14 in the fashion of a liner and determines the outer peripheral limits of the effective area of the diaphragm to pressure contained within the chamber 14, since the liner determines the outermost flexure line of the diaphragm. That is, the effective area on the chamber side of the diaphragm is that surface area inwardly of the inner edge of ring 22.

It is usually assumed as an approximation that the effective area of the above described diaphragm assembly may be computed using the formula πR^2 minus the area πa^2 of stem 26 held by member 18 where R is the distance from the center of the diaphragm to a point centrally on the free or flexure section of the diaphragm 15. The force F developed by a pressure P acting on the chamber side of the diaphragm is $P\pi(R-a)^2$.

From the above it will be apparent that the effective area on the diaphragm may be changed or reduced from the maximum by deforming the ring 22 inwardly. In Figures 3 and 4 the screw 25 is shown as having been advanced to engage and deform the ring 22 inwardly, thus reducing the area contained within the inner edges of the ring 22. R₁ is now less than R. The effective

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area of the diaphragm is now smaller than $\pi R^2 - \pi a^2$, since the average radius is somewhere between R and R_1 , the radius to a point half way out on the free section of the diaphragm at a location of greatest separation of the ring from the said wall. Thus, the effective area of the diaphragm may be varied by adjusting the screw 25.

In one application of the apparatus, the work coupled to the stem 26 may be coupled to a force producing device such as a pneumatic transmitter. In such an application, let it be assumed that the transmitter is producing a force which will oppose the force exerted on the diaphragm 15 by the fluid in chamber 14, represented by F (Figure 2). With this situation it will be apparent that the forces may be made equal for any given pressure in chamber 14 by merely changing the effective area of diaphragm 15 through movement of screw 25.

I claim:

1. An apparatus having a pressure chamber, a flexible pressure responsive diaphragm closing said chamber at one end thereof and exposed to the pressure within said chamber to be flexed thereby, a deformable support extending into engagement with said diaphragm at the peripheral margin thereof, said support defining the outer peripheral limits of the effective area of the diaphragm, and means for deforming said support so as to change the area enclosed thereby whereby to change the effective area of said diaphragm.

2. An apparatus as set forth in claim 1 wherein said support is an annulus.

3. An apparatus as set forth in claim 1 wherein said

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support is an annulus and said means for deforming said annulus is a screw threaded member.

4. An apparatus as set forth in claim 1 wherein said support is a split annulus and said means for deforming said annulus is a screw threaded member.

5. An apparatus having a pressure chamber, a flexible pressure responsive diaphragm closing said chamber at one end portion thereof and exposed to the pressure within said chamber, a member secured to said diaphragm and movable therewith, a deformable flexible support extending into engagement with said diaphragm at the outer peripheral margin thereof, said support defining the outer peripheral limits of the effective area of said diaphragm and means for deforming said support so as to change the area enclosed thereby whereby to change the effective pressure applying surface area of said diaphragm so as to regulate the force transmitted by said member in response to the pressure applied on said diaphragm.

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