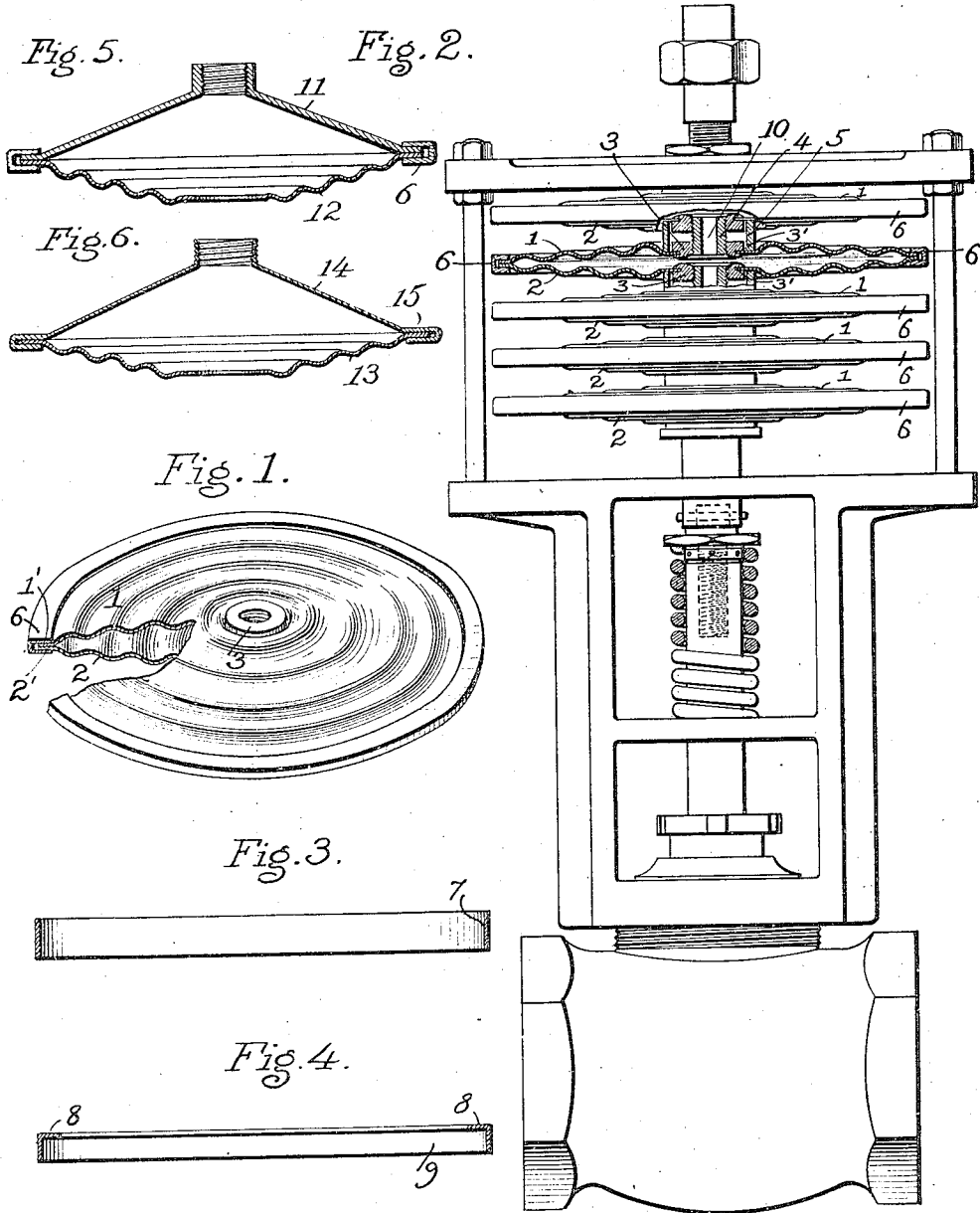


FLEXIBLE METALLIC DIAPHRAGM.
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To all whom it may concern:

Be it known that I, WILLIAM B. HODGE, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented certain new and useful Improvements in Flexible Metallic Diaphragms; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates primarily to metallic diaphragms and consists in improvements by means of which their life is largely increased and their manufacture greatly simplified, as will be fully disclosed in the following specification and claims.

In the accompanying drawings which form part of this specification:—Figure 1 is a perspective of a pair of diaphragm-plates with a section cut away to show the construction more clearly. Fig. 2 is a side elevation partly in section showing a series of diaphragms connected together and mounted on a conventional globe-valve body, and on a reduced scale. Fig. 3 a transverse section of the outside band used to join the diaphragm plates together. Fig. 4 is a like view showing this same band with the first spinning operation completed and ready to receive the diaphragms prior to the finishing spin. Fig. 5 is a vertical transverse section of a modified form of construction and Fig. 6 is a like view of another modification.

Reference being had to the drawings and the designating characters thereon, 1 indicates a sheet of metal in which is spun alternate concentric grooves and ridges forming an undulatory or corrugated surface. 2 a similar sheet placed opposite to sheet 1. These plates are preferably cut into circular shape, the outer edge at 1' and 2' being flat. The center part of the plate is also flat. Through the center of these plates is drilled a circular opening into which fits a shouldered bushing 3. This bushing has its inside edge or flange 3' spun over the edge of the opening in the diaphragm as shown in Fig. 2. This spinning operation is accompanied with considerable pressure and the bushing 3 being of soft metal, the shoulder 3' is spun over sufficiently far to not only clamp the plate tight, but also to form a

practically air tight joint. Bushing 3 has an opening drilled through it which is internally screw threaded. Plate 2 is provided with a similarly spun and threaded bushing.

Each pair of plates 1 and 2 constitute a diaphragm inclosing an expansion chamber and a series of diaphragms are built up by screwing into the bushing 3 of each diaphragm a hollow nipple 4. The diaphragms are held at an appropriate distance apart by means of an annular band 5 which tends to support the plates of the diaphragms so that the entire expansive strain is not exerted on the bushing 3.

The outer or peripheral edges of each pair of plates 1 and 2, are held together with a channeled U-shaped band 6, which consists preferably of a section of tubing whose inside diameter is a little greater than the outside diameter of the corrugated plates to be used, as shown in Fig. 3 and indicated by the numeral 7. This band 7 is held in a lathe chuck and one end spun over in a form of a shoulder or flange 8, as shown in Fig. 4. The pair of corrugated diaphragm-plates are then placed opposite each other and against the shoulder produced by spinning over the flange 8, and while held in that position the opposite edge 9 is spun down inwardly, forming the finished U-shaped band 6. The stiffness of the metal composing this U-shaped band 6 must be considerably greater than that of the diaphragms and of sufficient strength to resist any expansion and contraction. Fluid under pressure is introduced through the opening 10 into the interior of the diaphragm. The extent of expansion depends upon the number of corrugations, the diameter, the thickness and nature of the material and elements of that sort.

Corrugated metallic diaphragms are well known in the art, but up to the present time have been constructed with their outside edges either soldered together or the one diaphragm plate made a little larger than the other so that the outside edge of the large one can be spun around over the edge of the smaller. This lap edge construction is sometimes soldered and sometimes not. All constructions of this type, however, lack permanency, because in continued action as the diaphragms alternately expand and con-

tract, great strain is put either on the soldered joint or on the spun over edge, and all such diaphragms after more or less service become crystallized and crack, either where they are spun over or where they are soldered. Such a crack, allows the fluid on the inside to escape and vitally effects the working of the device. Part of this is undoubtedly due to the dead, non-yielding character of solder and also to the fact that any metal when continuously bent somewhat beyond its limit of elasticity gradually becomes crystallized and sooner or later breaks. In addition to that the spinning operation naturally thins the metal to some extent and inasmuch as the greatest strain in spinning occurs at the outer edge, the metal is naturally thinnest at that place, and as the pressure strain is also greatest at the outside edge, they usually give way there first. To eliminate this liability to breakage and to do away largely with soldering, my method of construction has been devised, from which it will be seen that the diaphragms are not held rigidly nor are their edges weakened by having been spun over. The extremities of each being flat at 1', 2', the two lie together very closely and the heavy band 6 being spun down holds the two flat parts or surfaces together firmly, and while these parts are held rigidly in contact by the band 6, yet it does not prevent them from sliding over each other or from sliding back and forth across the inside of the U-shaped channel whenever fluid pressure is applied between the diaphragm-plates. In other words, this U-shaped channel band 6 gives a perfectly firm and tight support to the two plates and yet does not interfere with a slight movement of the diaphragms either upon each other or against the edge of the band. It will further be noticed that as the fluid pressure inside the diaphragms increases, the outer edges of the diaphragms are pressed more securely and firmly against the inside of the band 6 and the joint at that point made tighter thereby. In other words, the greater the interior pressure, the greater is the outward pressure of the diaphragm-plates against the inside of the edge of the channel 6, so that as the interior pressure increases the liability to leakage increases. By this construction, therefore, we secure what may be termed a flexible sliding joint operating to tighten as the interior pressure increases.

The U-shaped channel-band 6 being made of rigid heavy metal is not affected by the expansion and contraction of the diaphragm-plates 1, 2, but merely acts as a means to hold them in place and the fatal effects of cracking and splitting common to soldered or spun joints is entirely eliminated.

In Fig. 5 is shown a modified form of the device, in which the frame or body 11 is

rigid, preferably a casting, and a flexible diaphragm 12 constructed with all the essential features of the diaphragms 1, 2 is provided with a peripheral sliding or expansion joint and inclosed by a U-shaped member 6.

In Fig. 6, the flexible diaphragm 13 is secured to the rigid member 14, by means of a U-shaped member 15 formed integral with the rigid member and spun or bent to inclose the sliding joint on the periphery of the device.

This method of construction is adapted to flat metallic diaphragms, as well as to corrugated diaphragms. Corrugated diaphragms usually will have a somewhat larger amplitude of movement than flat ones, but the above described method of holding the outside edge by means of the channeled band is used as efficiently with flat diaphragms as with corrugated ones.

Having thus fully described my invention, what I claim is:—

1. A device of the class described provided with a peripheral sliding joint.
2. A device of the class described having a peripheral sliding joint and provided with an inclosing member.
3. A plurality of metallic members provided with a peripheral expansible joint.
4. A plurality of metallic members separable at their peripheries and a clamping member inclosing the extremities of the members.
5. A plurality of metallic members forming a fluid chamber, and a clamping member inclosing the peripheries of said members.
6. A plurality of metallic members secured at their extremities by a continuous U-shaped member.
7. A plurality of metallic members secured at their extremities by a continuous U-shaped member of greater resisting material than the aforesaid members.
8. A plurality of metallic members whose extremities are detached and an inclosing member adapted to tighten the peripheral joint under pressure.
9. A plurality of metallic members provided with a fluid operated flexible joint at their peripheries.
10. A plurality of metallic members provided with an inclosing member in which the extremities of the former members are free to move.
11. A plurality of opposing metallic members having an expansion joint at their peripheries and a concentric tubular bushing to which the members are flexibly connected.
12. A plurality of pairs of metallic diaphragms having expansion joints at their peripheries, tubular bushings, and connecting nipples.

13. A plurality of pairs of metallic diaphragms having expansion joints at their peripheries, tubular bushings, connecting nipples, and annular diaphragm supporting-members.

14. A plurality of pairs of metallic diaphragms having members at their boundaries in parallel planes, and a member inclosing

the aforesaid members and in which they are free to move under pressure.

In testimony whereof I affix my signature, in presence of two witnesses.

WILLIAM B. HODGE.

Witnesses:

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