Sept. 21, 1954 N. R. ANDERSON 2,689,586

DIAPHRAGM

Filed Aug. 1, 1949 3 Sheets-Sheet 1

FIG. 1

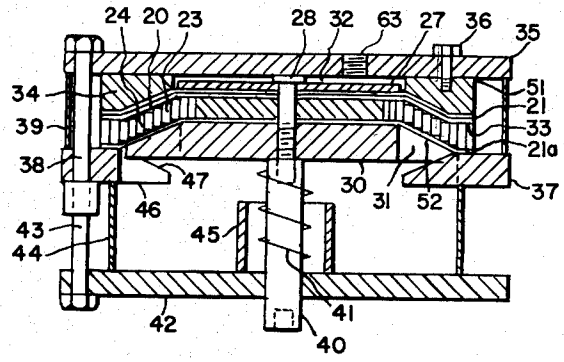


FIG. 4

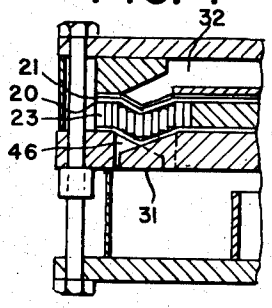


FIG. 2

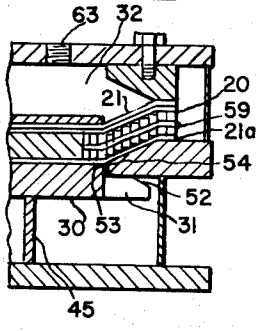
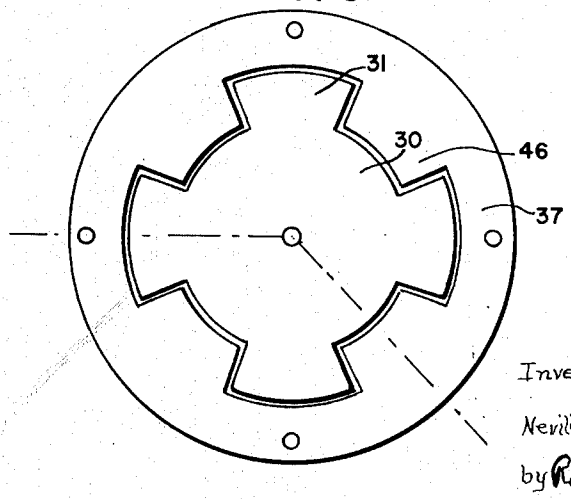


FIG. 3



Inventor
Neville Rupert Anderson
by Royal E. Burnham,
Attorney

Sept. 21, 1954 N. R. ANDERSON 2,689,586

DIAPHRAGM

Filed Aug. 1, 1949 3 Sheets-Sheet 2

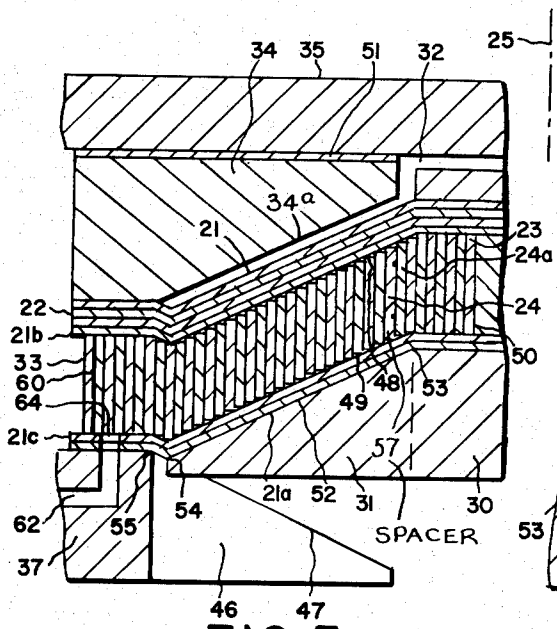


FIG. 5

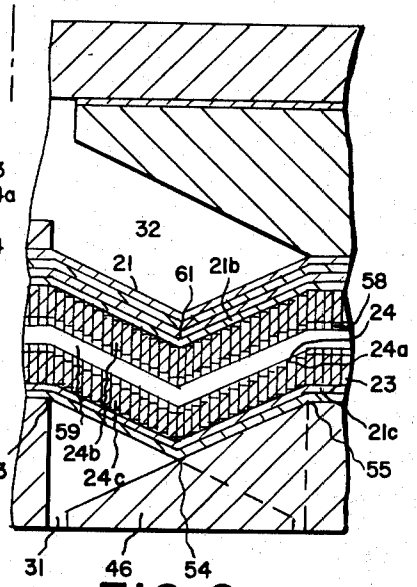


FIG. 6

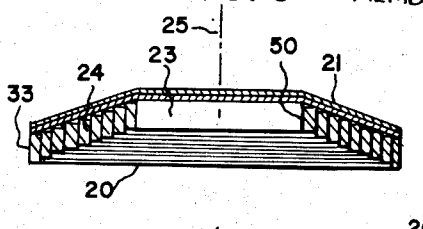


FIG. 9

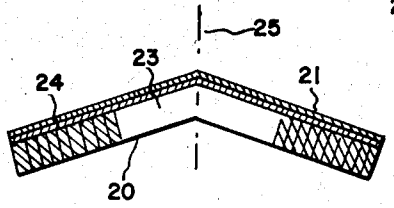


FIG. 10

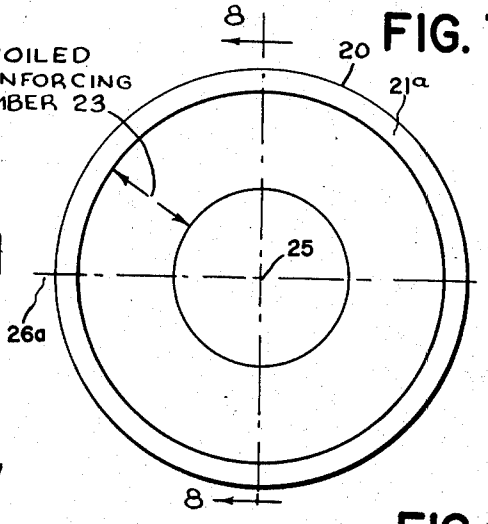


FIG. 7

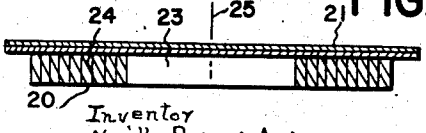


FIG. 8

Inventor
Neville Rubert Anderson
by Royal E. Burnham,
Attorney

Sept. 21, 1954 N. R. ANDERSON 2,689,586

DIAPHRAGM

Filed Aug. 1, 1949 3 Sheets-Sheet 3

FIG. 11

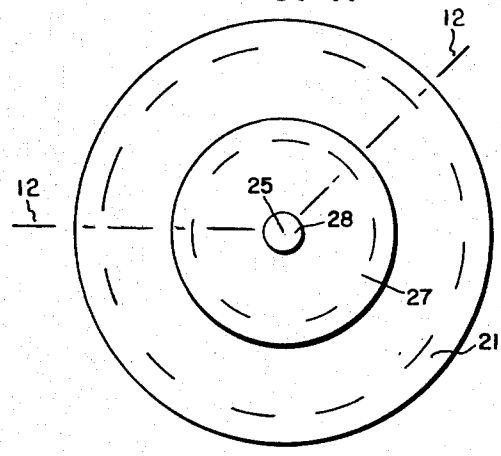


FIG. 12

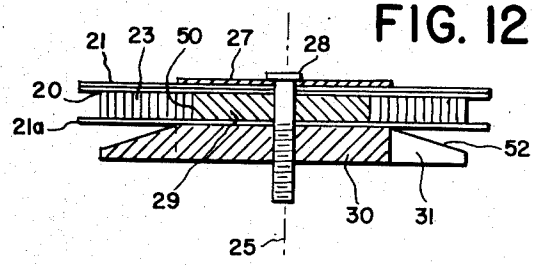
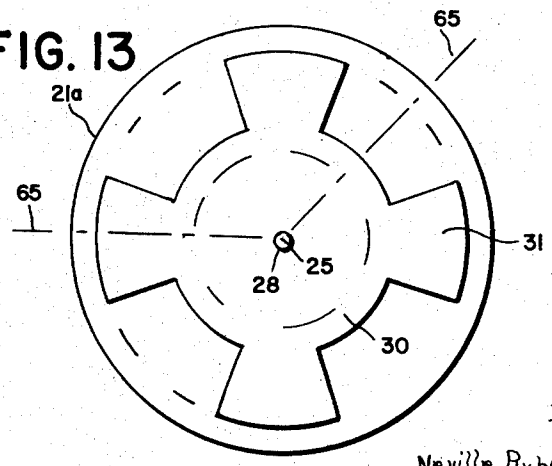


FIG. 13



Inventor

Neville Rupert Anderson

by Royal E. Burnham,

Attorney

Patented Sept. 21, 1954

2,689,586

UNITED STATES PATENT OFFICE

2,689,586

DIAPHRAGM

Neville Rupert Anderson, Edgecliff,
New South Wales, Australia

Application August 1, 1949, Serial No. 107,863

14 Claims. (Cl. 137—788)

1

This invention has reference to improvements in or relating to expansible chambers of the diaphragm type. It provides an arrangement in which considerable force can be exerted by a flexible and preferably fluid-impervious surface member of comparatively light construction; as, for example, rubber sheet or the like, which is supported by a separately formed reinforcing member of comparatively great strength. This member comprises a coil having a plurality of closely pitched turns of relatively rigid strip material; as, for example, strip metal. According to the invention, the bottom side of the coil (that is, the side farthest away from the pressure fluid acting on the diaphragm) is supported from radially-disposed coacting fixed and axially-movable fingers, preferably by means of a lower surface member or a cushion of flexible material.

To prevent adjacent turns of the coils from becoming dislodged, and thus preventing the fingers or cushion from properly functioning, relative axial movement between adjacent turns located between the marginal edges of the coil may be limited to an amount small compared with the relative movement permitted in an axial direction between the said edges, by flexible binding passing through some or all of the turns. In one preferred construction, turns of the coil are in a sealed up zone between the surface members; and, as most of the air is excluded from the said sealed-up zone, the said surface members tend to cling to the reinforcing member, thus promoting proper cushioning between the fingers and the turns.

Other objects and improvement are apparent in the following description, when read in connection with the accompanying drawing, of which

Fig. 1 is a vertical section of a power head of a fluid-operated press, riveter, or the like, in which a diaphragm in accordance with this invention is installed;

Fig. 2 is a part vertical section of a power head similar to that of Fig. 1, with parts in different positions and with another form of diaphragm in accordance with this invention;

Fig. 3 is a plan of the center piece and yoke appearing in Figs. 1, 2, and 4;

Fig. 4 is a part vertical section of the power head shown in Fig. 1, but with the diaphragm and cooperative parts in different positions;

Fig. 5 is an enlarged section of parts appearing in the left-hand part of Fig. 1;

Fig. 6 is an enlarged view of a part of Fig. 2,

2

but with the diaphragm in a different position;

Fig. 7 is a plan view of one form of the diaphragm;

Fig. 8 is a section on line 8—8, with bottom surface member 21*a* deleted, Fig. 7;

Fig. 9 is a view similar to Fig. 8, but with the inner edge of the diaphragm moved axially with relation to its outer edge;

Fig. 10 is a view similar to Fig. 8, but showing the diaphragm as it appears when bent along the line 8—8;

Fig. 11 is a plan view of certain parts shown by Fig. 12;

Fig. 12 is a section on line 65—65, Fig. 11;

Fig. 13 is a view of parts seen when looking upwardly on the assembly of parts shown by Fig. 12.

The principle involved in this invention is simple and will be understood by reference to Figures 7, 8, 9 and 10 in which the diaphragm 20 comprises a surface member 21 and a reinforcing member 23 and optionally a surface member 21*a*.

The surface member 21 comprises flexible material preferably impervious to fluid pressure, such as for instance one or more thicknesses of sheet rubber insertion 22, as shown in the enlarged view Figure 5.

The term "rubber insertion" as used herein, means rubber, whether flat or of curved surface, in which has been molded cotton fabric or other relatively non-stretchable material.

The reinforcing member 23 comprises relatively rigid coiled strip or box strapping, wound so as to have a plurality of closely pitched turns 24, as shown in the enlarged view Figure 5, coiled about the central axis 25 to form a spiral somewhat resembling a clock spring, as shown in Figure 7, the said turns 24 being loosely coiled, that is to say, movable turn by turn in an axial direction; the turns 24 are referred to as being closely pitched in relation to one another because between the points 53 and 55 one turn tends to keep the adjacent turn located in position radially, either by coming in contact with one another or by pressing on one another through spacers, such as for instance spacers 57.

The diaphragm 20 possesses considerable strength and rigidity against folding, as indicated in Figure 10, about a substantially radially disposed line, such as line 26*a* shown in Figure 7; yet the diaphragm 20 possesses considerable flexibility in a substantially axial direction, as indicated in Figure 9.

One method of utilizing this feature is to assemble the diaphragm 20 as shown in Figures 11,

12 and 13, in which the inner edge 50 of the reinforcing member 23 is clamped to the surface member 21 by a washer 27 having a centre set screw 28 passing through a centre disc 29 and screwing into a centre piece or grid 30.

The centre piece 30 has radially disposed centre piece or grid fingers 31 with inclined centre piece or grid surfaces 52, a lower surface member 21*a* or cushion of flexible material being clamped between the said centre piece 30 and the reinforcing member 23.

In Figures 1, 2 and 4 the assembled diaphragm as described with reference to Figures 11, 12 and 13 is shown forming the flexible wall of an expansible fluid tight diaphragm chamber 32 of a pressure fluid operated press or riveter, the said chamber having a pressure fluid inlet 63.

The surface member 21 is clamped to the outer edge 33 of the reinforcing member 23 by a distance piece 34 attached to the chamber head 35 by a gasket 51 and set screws 36, and the lower surface member 21*a* is clamped to the said outer edge 33 by a yoke 37. The yoke 37 is attached to the chamber head 35 by bolts 38, an enclosing barrel 39 being provided between the said yoke 37 and the said head 35.

Distance piece 34 is shown having an inclined surface 34*a* which the surface member 21 may contact so as to reduce the volume of the chamber 32 to a minimum when such is desired, the surface 34*a* being oppositely inclined to the surface 47 of the yoke 37.

The centre set screw 28 attaches the centre piece 30 to the press mandrel 40, the expansible chamber 32 being contracted, as shown in Figure 1, by a compression spring 41 situated between the centre piece 30 and the press head 42.

The press head 42 is secured to the yoke 37 by bolt extensions 43, a lower barrel 44 acting as a distance piece.

The spring 41 is surrounded by a collar 45 limiting the downward movement of the centre piece 30, and hence the stroke of the diaphragm 20, as indicated in Figure 2 showing the expansible chamber 32 fully expanded.

The chamber head 35 may be made integral with the distance piece 34 in which case the set screws 36 may be omitted; the yoke 37 may be made integral with the lower barrel 44, press head 42 and collar 45; the mandrel 40 may be made integral with the yoke 30, the term mandrel including any shape of member for transmitting considerable force.

Referring to Figure 3, the outwardly projecting centre piece fingers 31 of the centre piece 30 are situated between inwardly projecting yoke fingers 46 of the yoke 37.

The centre piece fingers 31 have inclined centre piece surfaces 52 on the side facing the lower surface member 21*a*, as shown in Figure 2, and the yoke fingers 46 of the yoke 37 have inclined yoke surfaces 47 on the side facing the lower surface member 21*a*, as shown in Figure 1.

Referring to Figure 5, which is an enlarged view of portion of Figure 1, in which the expansible chamber 32 is contracted. When fluid pressure is admitted to the chamber 32, thrust from said fluid is transmitted through the surface member 21 onto the top sides 48 of turns 24 of the reinforcing member 23. Thrust from the reinforcing member 23 is transmitted through the bottom sides 49 of the turns 24 to the lower surface member 21*a*.

Some of the thrust from the lower surface member 21*a*, namely that between the points 53 and 54 Figure 5, is transmitted to the centre piece 30 through the inclined centre piece surfaces 52 of the centre piece fingers 31, and some of the thrust from the said lower surface member 21*a*, namely that between the points 54 and 55 Figure 5, is transmitted to the yoke 37 through the inclined yoke surfaces 47 of the yoke fingers 46.

When the expansible chamber 32 is fully contracted, the distance between points 54 and 55 is small, as shown in Figure 5. When the expansible chamber 32 expands, as shown in Figure 4 and the enlarged view Figure 6, the centre piece fingers 31 move downwards between the yoke fingers 46, thereby transferring turn by turn the support of the reinforcing member 23 from the centre piece fingers 31 to the yoke fingers 46.

When the expansible chamber 32 is fully expanded, the distance between points 53 and 54 is small. Figure 2 shows the expansible chamber 32 fully expanded.

Referring to Figure 1, it will be understood that some thrust from the pressure fluid is transmitted to the press mandrel 40 through the washer 27, in addition to the thrust transmitted to the said mandrel 40 through the centre piece fingers 31.

Referring to Figure 5, the reinforcing member 23 is sealed from atmosphere by a sealing medium 60, such as for example rubber solution on sticky tape applied externally or as spacers or separators between turns 24 adjacent to the outer edge 33. The exclusion of most of the air from within the sealed zone formed by the sealing medium 60 and the surface members 21*b* and 21*c* causes the said members 21*b* and 21*c* to tend to cling to the reinforcing member 23, as for instance adjacent to the point 61 in Figure 6, and thereby limit relative movement between adjacent turns 24 and 24*a*, and in consequence bind the said turns against coming apart.

Air may be removed from the sealed zone containing the reinforcing member 23 by a vacuum pump applied, for example, to a hole 64 in the surface member 21*c* during assembly of the diaphragm, the said hole 64 being subsequently sealed with a sealing medium 60.

Alternatively, under some circumstances the hole 64 may communicate with the passage 62 to which suction may be applied by any suitable means.

The sealed zone containing the reinforcing member 23 may contain liquid or lubricant.

Referring to Figure 6, the reinforcing member 23 may contain holes 58, and any siutable binding, such as flexible leather cord 59, may project through the said holes 58, the said binding limiting the relative movement between adjacent turns 24 and 24*a*.

The cord 59 may be contained within the sealed zone described with reference to Figure 5, or the said cord 59 may project to outside the reinforcing member 23, as shown in Figure 2.

Referring to Figure 5, it will be understood that adjacent turns 24 and 24*a* may comprise different lengths of strip, and not necessarily of the same material.

Adjacent turns 24 and 24*a* may be separated by coil spacers 57, as for instance wire mesh, to which the surface members 21*b* and 21*c* may be secured in any suitable manner.

In Figure 6, the adjacent turns 24 and 24*a* are shown in sliding contact with one another, the said adjacent turns sliding relatively to one an-

other in an axial direction when passing from the centre piece or grid fingers **31**, namely, the axially movable fingers, to the yoke fingers **46**, namely, the fixed fingers, as the chamber **32** expands.

The turns **24** and **24***a* are referred to as being loosely coiled between the points **53** and **55** because, between those points, the said turns **24** and **24***a* are sufficiently free to move relatively to one another in an axial direction to permit transfer from the centre piece fingers **31** to the yoke fingers **46**, as indicated near the point **61**.

The turns **24** and **24***a* in Figure 6 are, however, referred to as being closely pitched in relation to one another because, between the points **53** and **55** one turn tends to keep the adjacent turn located in position radially either by coming in contact with one another or by pressing on one another through spacers, such as for instance spacers **57** in Fig. 5.

It will be understood that, as the turns **24** and **24***a* are wound about the central axis **25**, they are referred to as being radially disposed turns.

Referring to Figure 5, the inner marginal edge of the coil comprises those turns located nearer the central axis **25** than the point **53**, and the outer marginal edge of the coil comprises those turns located further away from the axis **25** than the point **55**. The said marginal edges may be of non-flexible construction, such as, for example, exists when adjacent turns are tightly wound or cemented together by the sealing medium **63**.

The reinforcing member **23** is separately formed, that is to say, the said reinforcing member is not formed as an integral part of the surface members **21**, **21***b* and **21***c*.

Between the points **53** and **55**, the turns **24** are not directly attached to the surface members **21***b* and **21***c*; in consequence, between the said points **53** and **55**, there is some independence of axial movement between the said turns **24** and the said surface members **21***b* and **21***c* while the turns **24** are transferring from the centre piece fingers **31** to the yoke fingers **46**, as indicated near the point **61** in Figure 6; hence the said surface members **21***b* and **21***c* may readily accommodate themselves to the changing shape of the reinforcing member **23**, as shown in Figure 6, while the chamber **32** is expanding or contracting; in other words, the coil of turns **24** between the points **53** and **55** is in co-operative relation with the surface members **21***b* and **21***c*.

Referring to Figure 5, it will be understood that the closely pitched turns **24** provide closely pitched top sides **48** for effectively supporting the comparatively lightly constructed surface member **21***b* and, therefore, permitting the said lightly constructed surface member **21***b* to withstand appreciable pressure and accordingly transmit considerable force to or from the reinforcing member **23**. The depth of the closely pitched turns **24**, namely, the distance between the top side **48** and the bottom side **49**, provides comparatively great strength permitting the distribution of considerable force to or from the fingers **31** and **46**.

The peripheral portion of the diaphragm extends from the point **53** in a direction away from the central axis **25** and the center of the diaphragm extends from the point **53** into the said central axis.

I claim:

1. In a pressure chamber, a diaphragm comprising oppositely disposed fluid impervious flexible sheets and between said sheets arcuate reinforcing strips in edge contact therewith, oppositely disposed rings having substantially parallel surfaces clamped against the peripheral portion of said diaphragm and oppositely inclined diaphragm contact surfaces inside thereof, a center shaft, a plate thereon disposed against one side of said diaphragm, and a member on said shaft disposed against the opposite side of diaphragm and having near its periphery a diaphragm contacting surface of an inclination corresponding to that of one of said rings, the said rings and said plate and member pressing said diaphragm sheets against the reinforcing strips therebetween.

2. In a pressure chamber, a diaphragm comprising oppositely disposed fluid impervious flexible sheets and between said sheets rigid continuous arcuate reinforcing strips in edge contact therewith in an area extending from near the perimeter of the diaphragm toward the center, oppositely disposed rings having substantially parallel surfaces clamped against the peripheral portion of the diaphragm and oppositely inclined surfaces to contact with the diaphragm inside thereof, a center shaft, a plate thereon disposed against one side of said diaphragm, a member on said shaft disposed against the opposite side of said diaphragm and having near its periphery a diaphragm-contacting surface of inclination corresponding to that of one of said rings, the said rings and said plate and member on the shaft pressing said diaphragm sheets against the reinforcing strips therebetween, the said diaphragm containing a sealing medium interposed between some of said reinforcing strips to deter separation thereof, there being spacers between some of said strips, and cords disposed through holes in some of said strips to limit relative axial movement thereof.

3. In a pressure chamber, a diaphragm comprising oppositely disposed fluid impervious flexible sheets and between said sheets rigid continuous arcuate reinforcing strip in edge contact therewith in an area extending from the perimeter of the diaphragm toward the center, oppositely disposed rings having substantially parallel surfaces clamped against the peripheral portion of said diaphragm and oppositely inclined surfaces to contact with the diaphragm inside thereof, a center shaft, a plate thereon disposed against one side of said diaphragm, and a member on said shaft disposed against the opposite side of said diaphragm and having near its periphery a diaphragm-contacting surface of inclination corresponding to that of one of said rings, the said rings and said plate and member on the shaft pressing said diaphragm sheets against the reinforcing strip therebetween.

4. In a pressure chamber, a diaphragm comprising oppositely disposed fluid impervious flexible sheets and between said sheets arcuate reinforcing strips in edge contact therewith, oppositely disposed annular clamp members held against the peripheral portion of said diaphragm and one of said members having inwardly extending fingers with inclined bearing surfaces to contact said diaphragm in its peripheral portion, a mandrel or the like attached to the center of said diaphragm, and a member thereon in contact with said diaphrgam and having radial fingers movable between the fingers of one of said clamp members.

5. In a pressure chamber, a diaphragm comprising a flexible surface member, a reinforcing member therefor comprising closely pitched

turns of relatively rigid strip material loosely coiled about a central axis to form a spiral, a grid to which the inner edge of said reinforcing member is clamped, said grid having outwardly projecting fingers to support said coil on flexure of said diaphragm in one direction, a yoke to which the outer edge of said reinforcing member is clamped, and inwardly projecting fingers on said yoke to support said reinforcing member at termination of flexure in the opposite direction.

6. In a pressure chamber, a diaphragm comprising a flexible impervious surface part oppositely disposed to a cushion of flexible material and between said part and said cushion a coil of strip reinforcement in edge contact therewith, oppositely disposed members clamped against said diaphragm at the outer marginal edge of said coil, one of said members having inclined cushion contacting surfaces pointing inwardly from said outer marginal edge, a centre piece to which the inner marginal edge of said coil is clamped, said centre piece having inclined cushion contacting surfaces pointing outwardly from said inner marginal edge.

7. In a pressure chamber, a diaphragm comprising oppositely disposed fluid impervious flexible sheets and between said sheets a reinforcing member therefor comprising closely pitched turns of relatively rigid strip material loosely coiled about a central axis to form a spiral, a grid to which the inner marginal edge of said reinforcing member is clamped, said grid having outwardly projecting fingers to support said coil on flexure of said diaphragm in one direction, a yoke to which the outer marginal edge of said coil is clamped, said yoke having inwardly projecting fingers to support said coil on flexure of said diaphragm in the opposite direction, the said outer marginal edge having a sealing medium to deter entrance of air between adjacent turns of said coil.

8. In a pressure chamber, a diaphragm comprising oppositely disposed flexible sheets and between said sheets a reinforcing member therefor comprising a spiral coil of strip material, a grid to which the inner marginal edge of said coil is clamped, said grid having outwardly projecting fingers to support said coil on flexure of said diaphragm in one direction, a yoke to which the outer marginal edge of said coil is clamped, said yoke having inwardly projecting fingers to support said coil on flexure of said diaphragm in the opposite direction, the said outer marginal edge being connected to the said inner marginal edge by a binding passing through radially disposed holes in said coil to limit relative movement between adjacent turns of said coil.

9. In a pressure chamber, a diaphragm comprising a flexible fluid impervious surface member having oppositely disposed portions and between said portions a reinforcement therefor in edge contact with the inside faces thereof, said reinforcement comprising a spiral coil of metal strip, and radially disposed coacting fixed and axially movable fingers clamped to the outside face of the bottom portion of said surface member.

10. In a pressure chamber, a diaphragm comprising a flexible fluid impervious surface part oppositely disposed to a cushion of flexible material and between said part and said cushion a separately formed coil of strip reinforcement in edge contact therewith, and radially disposed coacting fixed and axially movable fingers clamped to the said cushion.

11. In a pressure chamber, a diaphragm comprising a flexible fluid impervious surface member having oppositely disposed portions and between said portions a reinforcement therefor comprising arcuate strip material in edge contact therewith, an air-tight seal joining said portions together near the periphery of said diaphragm, a partial vacuum between said portions to pull same in against said strip, and coacting fixed and axially-movable fingers clamped to the bottom of the diaphragm.

12. In a pressure chamber, a diaphragm comprising a flexible fluid impervious surface member having oppositely disposed portions and between said portions a reinforcement therefor comprising a coil of relatively rigid strip material in edge contact therewith, liquid or the like filling voids in said coil, a seal near the periphery of the diaphragm to deter escape of said liquid, and coacting fixed and axially-movable fingers clamped to the bottom of the diaphragm.

13. In a pressure chamber, a diaphragm comprising a flexible impervious surface part oppositely disposed to a cushion of flexible material and between said part and said cushion a coil of strip reinforcement having different strips in some adjacent turns, a grid to which the inner edge of said reinforcement is clamped, said grid having outwardly projecting fingers to support said cushion on flexure of said diaphragm in one direction, a yoke to which the outer edge of said reinforcement is clamped, and inwardly projecting fingers on said yoke to support said cushion at termination of flexure in the opposite direction.

14. In a pressure chamber, a diaphragm comprising a flexible fluid impervious surface member having oppositely disposed portions and between said portions a reinforcement therefor comprising a coil of relatively rigid strip material, spacers between some of the turns of said coil, and coacting fixed and axially-movable fingers clamped to the bottom of the diaphragm.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
768,984	George	Aug. 30, 1904
832,708	Thomson	Oct. 9, 1906
945,992	Stevens	Jan. 11, 1910
1,034,323	Tanner	July 30, 1912
1,445,844	Meuser	Feb. 20, 1923
1,599,899	Kettering	Sept. 14, 1926
2,166,493	Hill	July 18, 1939

FOREIGN PATENTS

Number	Country	Date
251,645	Germany	of 1912