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F. W. STALKER

FLUID PRESSURE DIAPHRAGM

Filed Dec. 7, 1923

Fig. 1

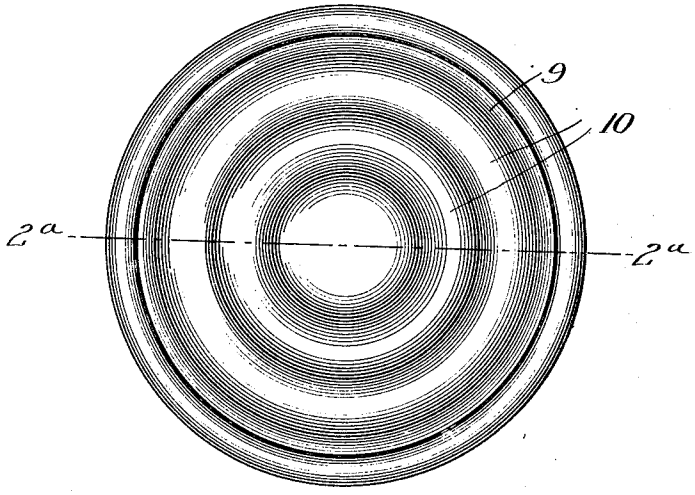
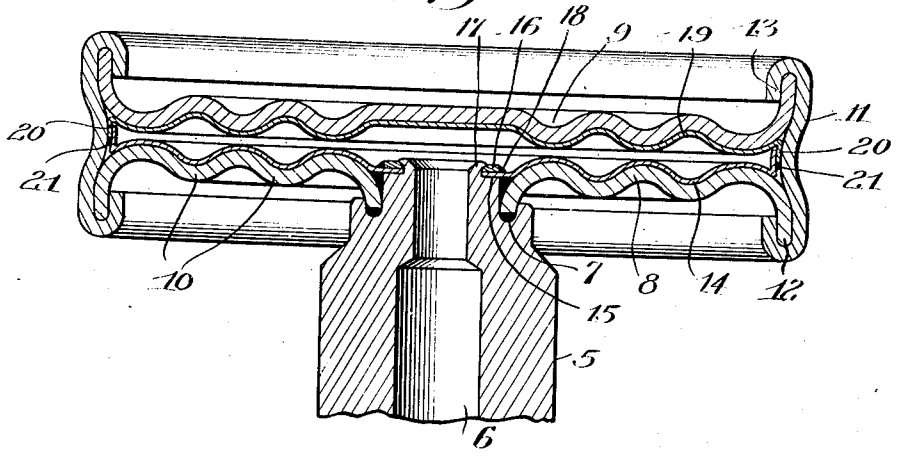


Fig. 2



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UNITED STATES PATENT OFFICE.

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FLUID-PRESSURE DIAPHRAGM.

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To all whom it may concern:

Be it known that I, FREDERICK W. STALKER, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Fluid-Pressure Diaphragms; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference numerals marked thereon.

This invention relates to fluid pressure diaphragms of the variety adapted for use, for example, in fluid pressure and thermostatic apparatus for operating measuring, regulating or other mechanism, the chief object of the invention being to provide a practical efficient and durable diaphragm of this type adapted for use with a wide range of pressures without permanent distortion, leakage or other defects commonly experienced in such devices.

To these and other ends the invention resides in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a plan view of a diaphragm embodying the present invention;

Fig. 2 is an enlarged sectional elevation of the same on the line 2^a—2^a in Fig. 1.

Similar reference numerals throughout the several views indicate the same parts.

This invention provides a fluid pressure diaphragm comprising, generally speaking, an inner pressure containing capsule or envelope of relatively light or thin material adapted to be effectively sealed at its joints combined with an outer capsule of relatively heavy and strong material constructed to resist fatigue and other deteriorating effects and to continuously and uniformly support throughout the expansive movement of the lighter inner container to the interior of which the pressure is applied. Referring more particularly to the drawings, the preferred embodiment of the invention herein disclosed by way of illustration comprises a tubular support 5, such for example as the end of a stem or pipe having a central bore 6 adapted to be connected in communication with a fluid pressure system or with a thermometer bulb for transmitting fluid pressure to the interior of the diaphragm.

The support 5 adjacent its end is preferably channeled or grooved in a longitudinal direction as at 7 to form an annular seat the bottom of which has a curvature with a radius approximately one-half the thickness of the material of one of an outer pair of spaced discs 8 forming the supporting diaphragm. Disc 8 has therein a central opening the periphery of which is rolled to provide a flange extending longitudinally of the support and located in said seat 7 as shown. The disc is further effectively secured at this point to the support by soldering the same thereto with a fusible metal. Corresponding to disc 8 is a second disc 9 which however is unattached to the support and has a free expanding and contracting movement. This pair of outer supporting discs 8 and 9 are preferably constructed of a relatively heavy weight of sheet brass or bronze and each disc is formed with concentric corrugations 10 as shown to provide the necessary material for lateral expansion as well understood in the art. The peripheries of discs 8 and 9 are secured together in spaced relation, preferably by means of a ring 11 the opposite margins of which are rolled into engagement with the peripheries of the respective discs. In the present instance the latter are flanged divergently outwardly as at 12 and the margins of ring 11 are rolled over these flanges as at 13. These connections between the supporting discs and ring 11 are preferably not soldered, the flanges of the discs forming fulcrums on which they rock during expansion. A further advantage of this form of connection is that the temper of the disc is not injured by a soldering or heating process.

The pressure containing envelope comprises preferably an inner pair of discs of relatively light flexible brass or bronze sheet, one of which discs 14, is formed adjacent its center with an opening, the periphery of which is located on an annular seat 15 in the nature of a radially extending surface or shoulder as shown. This disc is effectively secured in fluid tight relation on its seat by placing over the disc a ring or washer 16 and rolling over the latter as at 17 a flange formed by counter-boring the inner end of the support. The washer and disc are soldered together by a low melting fusible al-

loy as at 18, so that a strong joint is thus formed between the disc and support capable of resisting high pressures which, in fact tend to seal the joint. This joint is not, however, subjected to any substantial stress or distortion in use.

A second inner disc 19 is provided similar in construction to the disc 14 but unattached to the support and therefore free to expand and contract laterally. Both discs 14 and 19 are formed with concentric corrugations, as shown, nesting in those of the supporting discs 8 ad 9 respectively. The peripheries of the inner discs are preferably turned toward each other in overlapping relation as at 20 and soldered together as at 21 with a low melting alloy which effectually seals this joint.

While each of the inner discs is substantially in contact throughout with the corresponding outer supporting disc, it is preferred to provide a slight excess of material in the inner disc, as for example, by forming each outwardly extending corrugation thereof on a radius slightly smaller than that of the inner surface of the corresponding portion of the outer disc. Such excess material is of course flattened against the outer disc under the application of pressure in use and results in a slight compressive stress in the inner disc, thereby insuring the latter against any tensile stress.

The method of assembly consists preferably in soldering outer disc 8 on the support as described after which inner disc 14 is located on its seat 15, washer 16 placed thereon and the flange support 17 then spun over the washer which latter is then soldered to the disc as described. Inner disc 19 is then placed in position and soldered to disc 14, the joint between the two being at this time readily visible and accessible for efficiently accomplishing the operation. The joint thus formed is then preferably tested by pressure applied interiorly to the envelope with the latter immersed in a suitable liquid to develop any leaks until this step in the assembly is perfected. Ring 11 is then assembled with one of the outer discs and spun over the other in a chucking fixture, thereby completing the assembly.

The attachment of outer disc 8 to the support is of such a character as to effectually prevent any relative movement of these parts, the connection between which is thoroughly secured and sealed by the fusible metal placed in the curved bottom 7 of the seat and above the disc margin. The attachment of inner disc 14 to the support is of an efficient nature thoroughly sealing the connection under any applied pressure and the peripheral connection of the inner discs to each other is likewise efficiently accomplished, the flexible material of which these discs are made, as well as the conformation thereof, lending themselves to the perfection of these operations. The outer discs fulcrum at their peripheries in the substantially formed ring 11 and as the connection with the latter does not require to be soldered by reason of the provision of the inner pressure container, the material of the outer disc at this portion is left with its original temper and strength and therefore develops a minimum degree of fatigue in use.

The invention thus provides a diaphragm in which the pressure is carried by an inner envelope supported throughout its area by a substantial and complete outer envelope. This combination permits of the construction of the inner diaphragm in the most efficient manner with regard to rendering it fluid tight and without restrictions of considerations of strength. On the other hand, the outer diaphragm is manufactured in the most advantageous manner with a view to providing support and strength unhindered by limitations having to do with the retention of fluid pressure. The combination of the two therefore provides as described for both aspects of the problem and presents an ideal structure. By reason of these advantages, sheet metal of ordinary commercial quality may be economically employed to afford diaphragms of high efficiency.

I claim as my invention:

1. A capsular diaphragm comprising an outer pair of resilient supporting discs of relatively heavy sheet metal having their peripheries secured together, and an inner pair of resilient pressure containing discs of relatively light sheet metal having their peripheries in fluid tight connection with each other and backed and supported throughout by said outer discs.

2. A capsular diaphragm comprising a tubular support, an outer pair of resilient discs of relatively heavy sheet metal having their peripheries secured together with an opening adjacent the center of one of said discs the edges of which are secured to said support, and an inner pair of discs of relatively light sheet metal having their peripheries in fluid tight connection with each other with an opening in one of said discs the edges of which are in fluid tight attachment to said support to provide an inner pressure containing envelope backed and supported by said outer discs.

3. A capsular diaphragm comprising a support, an outer pair of resilient discs of relatively heavy sheet metal connected at their peripheries and formed with concentric corrugations, one of said discs being attached to said support, and an inner pair of resilient discs of relatively light sheet metal having their peripheries in fluid tight attachment to each other and formed with concentric corrugations to provide an inner

pressure containing envelope adapted for connection with a fluid pressure system and continuously supported during expansion by said outer discs.

4. A capsular diaphragm comprising a tubular support, an outer pair of resilient discs of relatively heavy sheet metal connected at their peripheries and formed with concentric corrugations and with an opening in one of said discs the edges of which are secured to said support, and an inner pair of resilient discs of relatively light sheet metal in fluid tight attachment with each other at their peripheries and formed with concentric corrugations nested in those of the respective outer discs and with an opening in one of said inner discs the edges of which are in fluid tight attachment to said support about the bore thereof, to provide an inner pressure containing envelope adapted for connection with a fluid pressure system and continuously supported during expansion by said outer discs.

5. A capsular diaphragm comprising a tubular support, an outer pair of resilient discs of relatively heavy sheet metal formed with concentric corrugations, a ring for securing the peripheries of said discs together, one of said discs having an opening therein with its edges embracing and secured to said support, and an inner pair of resilient discs of relatively light sheet metal having their peripheries in fluid tight attachment to each other and formed with corrugations nested in those of the respective outer discs with an opening in one of said inner discs the edges of which embrace and are secured in fluid tight relation to said support about the bore thereof.

6. A capsular diaphragm comprising a tubular support formed adjacent an end thereof with a pair of peripheral seats, an outer pair of resilient supporting discs of relatively heavy sheet metal formed with concentric corrugations, a ring having its opposite margins rolled in engagement with the peripheries of said outer discs, respectively, to secure the same together, one of said discs having the periphery of an opening therein located on and secured to one of said seats, and an inner pair of resilient discs of relatively thin sheet metal having their peripheries secured together in fluid tight relation and formed with concentric corrugations nested in those of said outer discs, respectively, to form an inner pressure containing envelope continuously and uniformly supported during expansion by said outer discs, one of said inner discs having the periphery of an opening therein located on and secured in fluid tight relation to the other of said seats for connection through said support with a fluid pressure system.

FREDERICK W. STALKER.