

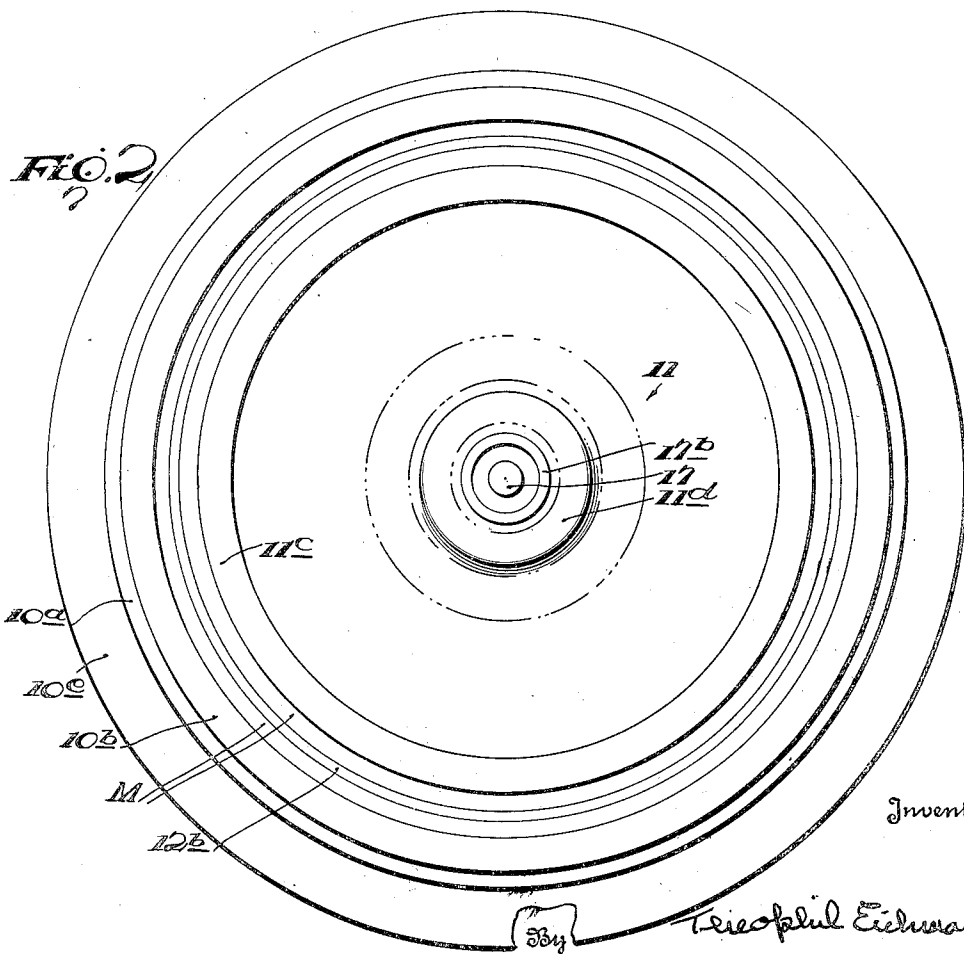
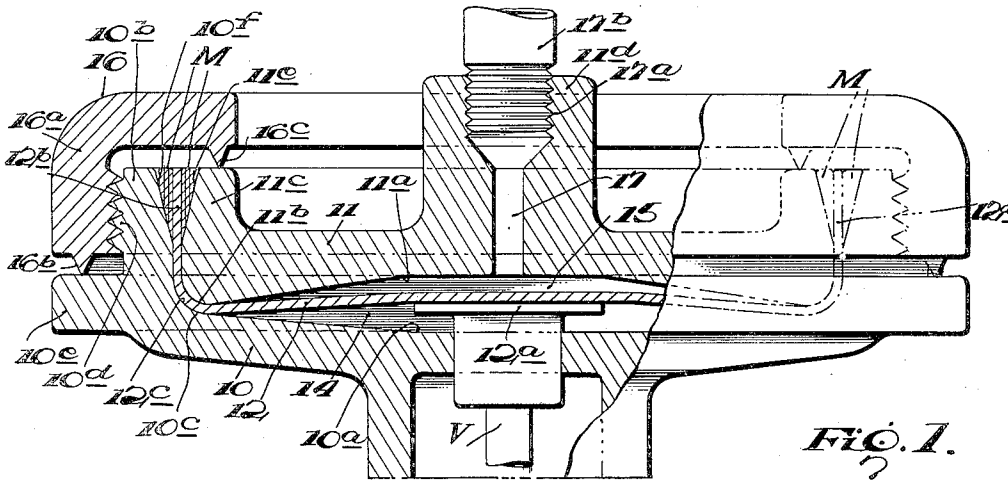
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DIAPHRAGM CHAMBER

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DIAPHRAGM CHAMBER

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This invention relates to diaphragm chambers; and the nature and objects of the invention will be readily recognized and understood by those skilled in the art in the light of the following explanation and detailed description of the accompanying drawings illustrating what I now believe to be the preferred embodiment or mechanical expression of the invention from among the various other embodiments, forms, arrangements, constructions, and combinations, of which the invention is capable and adapted within the spirit and scope thereof as defined by the appended claims.

The invention is particularly directed to the improvement of the design, mounting and construction of fluid pressure operated and controlled diaphragms of the types in which the diaphragm is mounted in a pressure fluid chamber for flexing and control by fluctuations in pressure of the fluid in such chamber. With pressure fluid controlled diaphragm mechanisms or units now in general use, and particularly those such as are widely used in connection with thermally controlled regulating valves of refrigerating plants and systems, considerable difficulties are encountered in maintaining the mounting and connection of the flexible diaphragms in and with the associated structure making up the pressure fluid forming chamber in which the diaphragm is located, in gas tight condition over extended periods of time under operating conditions.

It is a primary object of my present invention to overcome such difficulties by providing a design, construction and mounting of a fluid pressure controlled diaphragm and of the pressure fluid chamber forming structure or casing which mounts and secures the diaphragm in operative position in the pressure chamber, by which the pressure fluid chamber will be effectively sealed and maintained gas tight under operating conditions over extended periods of time without requiring attention or maintenance.

It is a further object of the invention to provide such a design, construction and mounting of a flexible pressure fluid actuated and controlled diaphragm, which will be mechanically and structurally simple and capable of ease of manufacture and assembly.

With the foregoing and other objects and results in view, my invention consists in certain novel features in construction of parts and elements and in the combinations thereof, all as will be more fully referred to and explained hereinafter.

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Referring to the accompanying drawings, in which similar reference characters refer to corresponding parts and elements throughout the several figures thereof:

Fig. 1 is a transverse or diametrical section through a flexible diaphragm and its associated mounting and fluid pressure chamber forming structure or casing.

Fig. 2 is a top plan view of the structure of Fig. 1.

The example embodiment of a pressure controlled diaphragm mechanism or unit of my invention which has been selected and illustrated herewith for purposes of explanation, is of a type designed and intended for use primarily with a thermally regulated valve of a refrigerating system. This example has been selected because the disadvantages which my invention has overcome are met with in a high degree under the particular conditions of operation and use of such types of pressure controlled diaphragm mechanisms. It is to be understood, however, that it is not intended or desired to limit or restrict my invention to the particular embodiment of the illustrated example or to use with thermally regulated valves of refrigerating systems, as the invention is inherently capable of and is intended for embodiment in pressure controlled diaphragm structures and mechanisms generally irrespective of any specific use thereof.

In the particular example of the invention illustrated herewith, referring now to the accompanying drawings, the diaphragm mechanism or structure is formed of a unit which includes a generally circular casing section 10, of dished, cup-like or concave form into which there is nested and secured a casing section 11 of circular form having a concave inner surface to form with section 10, a diaphragm receiving space within and between the casing sections, in and across which is mounted and secured a flexible diaphragm 12 which divides the space within the casing into the chambers 14 and 15 at opposite sides, respectively, of the diaphragm. The sections 10 and 11 of the casing, together with the diaphragm 12, are secured and maintained in assembled unit forming relation by a cap member 16 of general ring or annulus form, which is removably secured to casing section 10 and engages with and over casing section 12 to maintain such section in nested, assembled relation in and with section 10.

Casing section 10, in this instance, is of dished or cup-like form to provide the generally concave inner wall surface 10a, and the annular

peripheral edge wall 10b therearound extending from the concave surface side and concentric with the axis, of section 10. The inner surface of the annular edge wall 10b is joined with and merges into the concave surface 10a of section 10, by a rounded or smoothly curved surface 10c, which surface 10c forms an annular groove-like seat extending completely around and surrounding the inner concave surface 10a of the section 10. The outer side of the peripheral edge wall 10b is provided with external screw threading 10d therearound for threaded engagement by the cap member 16. A flange 10e is formed extending radially outwardly from and completely around casing section 10 adjacent the inner end of wall 10b, being in this example, a substantially radially outward continuation of the casing section 10. In this instance, casing section 10 is formed with an axial bore therethrough in which there is reciprocally mounted for operative association with the diaphragm 12, an actuating rod or member V for a regulating valve (not shown), of a refrigerating system, or other element to be actuated by diaphragm 12.

The casing section 11 which in assembled position is fitted and received in casing section 10, as will be clear by reference to Fig. 1, is of circular form having an external diameter slightly less than the internal diameter of the surrounding peripheral edge wall 10b of casing section 10. Casing section 11 at the inner side thereof facing concave surface 10a of section 10, is of depressed form to provide the concave surface 11a, which with the facing concave surface 10a of section 10, defines and forms the space within the casing in which diaphragm 12 is mounted between the casing sections 10 and 11.

In this example, casing section 11 is provided with the inner edge 11b of its periphery formed rounded or curved on a radius of curvature substantially that from which the curvature of surface 10c of section 10 is generated, so as to provide such rounded surface 11b as substantially a complement of the rounded surface 10c. The rounded inner peripheral edge 11b of section 11 thus provides an annular rib or shoulder completely therearound. An end flange or wall 11c extends axially from and around the peripheral portion of section 11, at the outer side thereof opposite the inner, concave chamber forming surface 11a. A central, axially disposed boss 11d is provided extending from the outer side of the section 11, and a pressure fluid duct or passage 17 is formed extending axially through the boss 11d and casing section 11 in communication at its inner end with the chamber 15 within the casing. The duct 17 is provided with an internally threaded counterbore 17a in the outer end thereof, into which may be threaded the externally threaded end of a tube 17b, which, in the example shown, leads to the usual heat responsive element (not shown), for the purpose of causing variations in fluid pressure in the chamber 15 for controlling and actuating the diaphragm 12 in the usual manner familiar in the art.

The outer side of the end flange or wall 11c of casing section 11, is formed to provide the inwardly inclined or sloping surface 11e extending completely therearound, and the opposite and facing portion of the peripheral edge wall 10b of the casing section 10 is formed to provide the outwardly sloping surface 10f extending completely therearound. Thus, with casing section 11 in assembled, nested position in section 10,

there is formed and provided an outwardly diverging annular space completely around and between the walls 10b and 11c of the casing sections.

The diaphragm 12 of this example is of the flexible type formed of a metal or other suitable material of the required dimensions and characteristics, as well understood in this art. In accordance with my invention, this diaphragm is mounted and secured in position between and extending completely across the space formed within the assembled casing sections 10 and 11, so that the diaphragm is subjected at one side thereof to variations in fluid pressure within the chamber 15 to cause flexing of the diaphragm toward and from chamber 14 to thereby reciprocate the valve actuating member V. In this instance, diaphragm 12 may be provided with a disk 12a on the side thereof within chamber 14, which is engaged and operatively associates the diaphragm 12 with the actuating member V.

The diaphragm 12 has its peripheral edge portion bent substantially at right angles to the plane of the body of the disk to provide the axially disposed attaching flange 12b therearound. The flange 12b is joined and merged with the body of the disk 12 by a rounded or curved wall portion 12c which extends completely around the disk and which is formed on a radius of curvature substantially that of the radius upon which is generated the curved surface forming the annular groove-like seat of casing section 10 and the curved surface forming the annular shoulder 11b around the casing section 11. Such curved wall portion 12c of the disk 12 thus forms in effect, an annular rib or shoulder around the periphery of the body of the disk. The disk 12 is mounted and positioned in the casing section 10 between that section and the casing section 11 with the curved wall rib or shoulder 12c thereof received and seated in the annular groove-like seat 10c which presents a curved surface substantially complementary to shoulder 12c.

The casing section 11 is nested in casing section 10 and the diaphragm 12, with the annular curved surface rib or shoulder 11b thereof seated and engaged in the concave side of the annular shoulder 12c, of diaphragm 12, so that, the shoulder 12c may be tightly and securely engaged by and between casing sections 10 and 11 with the annular peripheral flange 12b of the diaphragm 12 extending outwardly through and being located in the outwardly diverging space formed around and between the casing sections by the inclined walls 10f and 11e of the peripheral flanges 10b and 11c of casing section 10 and 11, respectively. The diaphragm 12 so mounted and assembled with the casing sections 10 and 11, thus extends completely across the space between the opposite concave surface of the sections to divide such space into the pressure fluid chamber 15 and the chamber 14 in which is located the actuating member V in operative association with the diaphragm. Preferably, although not essentially, the diaphragm 12 is arched by centrally displacing the same laterally in a direction outwardly toward and into the pressure fluid chamber 12, as will be clear by reference to Fig. 1 of the drawings.

The peripheral flange 12b of the diaphragm is anchored in and between the flanges 10b and 11c of the casing sections by casting a fusible mass M of a suitable material, such for example as lead or tin, in the outwardly diverging annular space between surfaces 10f and 11e, with such

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mass M being securely connected as by a fusing weld, with the flange 12b of the diaphragm and with the flanges 10b and 11c of the casing sections 10 and 11 at opposite sides of flange 12b. In this manner the diaphragm is sealed in assembled position with the casing sections 10 and 11, so that there is provided a gas tight and a substantially leakproof pressure fluid chamber 15. The largest diameter of the casing section 11 and the inner diameter of the flange 10b of the casing section 10, are so relatively dimensioned that the outwardly bent edge flange 12b of the diaphragm 12 is clamped and engaged between the casing sections 10 and 11 close to the bending line from which the diaphragm flexes in operation.

The casing sections 10 and 11 with the diaphragm 12 secured in sealed position therebetween, are finally attached in such assembled position by means of the cap member or ring 16. The cap member 16 is provided with an internally threaded flange 16a therearound which fits over and threads onto the externally threaded peripheral flange 10b of casing section 10 with the body of the cap member in mounted and assembled position extending over and around the outer edges of the flanges 10b and 11c of the casing sections. Cap 16 is formed centrally open and unobstructed and the boss 11d of section 11 extends into and is accessible through such opening. An annular sealing rib 16b is formed around and extends outwardly from the inner edge of flange 16a of cap member 16, being formed to provide a relatively narrow or thin outer contact edge. A generally similar annular sealing rib 16c having a thin contact edge, is formed on and extends from the inner side of the body of cap member 16 in position for substantially sealing engagement with the outer edge of the flange 11c of the casing section 11. It is here pointed out that, if desired, additional sealing ribs of this character may be provided, say for example such as a rib similar to rib 16c, but located extending from the body of cap member 16 in position to engage the outer edge of flange 10b of the casing section 10. In this manner, the joint and sealing connection between the casing section flanges and the attaching flange 12b of diaphragm 12 may be sealed therearound at both sides thereof.

The cap member 16 is screwed tightly down on casing section 10 into position as shown in Fig. 1 of the drawings, with sealing rib 16b in substantial sealing engagement with flange 10c of section 10, and with sealing rib 16c tightly engaged against and in substantial sealing contact with the outer edge of flange 11c of casing section 11. Casing section 11 is thus forced and held in position tightly clamping diaphragm 12 in position between the casing sections. The pressure exerted by the cap member 16 on the casing section 11 causes the diaphragm 12 to be clamped in a substantially leakproof and gas tight manner, not only at and around the bending line from which the diaphragm flexes in operation by the pressure variations in chamber 15, but also in front of or outwardly from and around such bending line.

In the foregoing manner, the diaphragm 12 is tightly clamped and secured in and between the casing sections 10 and 11 in front or outwardly of and beyond and around the bending or flexing line for the diaphragm, which together with the fusible weld formed between the flange 12b of the diaphragm and the opposite facing surfaces of the flanges 10b and 11c of the casing sections, provides a durable, substantially leak-proof and

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gas-tight anti-corrosion seal for the diaphragm chamber between the casing sections. And, in addition, by the arrangement and mounting of the cap member 16 relative to the casing sections 10 and 11, with the sealing ribs 16b and 16c thereof engaged with adjacent surfaces, respectively, of the sections at opposite sides of the connection between the diaphragm and the casing sections, there is provided a seal against penetration of air to the anchoring mass M, so that, possibility of corrosion is substantially eliminated or reduced to a minimum.

It will also be evident that the various changes, modifications, substitutions and eliminations might be resorted to without departing from the spirit and scope of my invention and, hence, I do not wish to limit my invention in all respects to the exact and specific disclosures hereof, except as may be required by specific intended limitations thereto included in any of the appended claims.

What I claim is:

1. In a pressure fluid actuated diaphragm structure, in combination, a casing including a casing section having a laterally disposed peripheral flange therearound and a casing section nested within said first mentioned section, said sections being formed to provide opposed, spaced inner surfaces forming a diaphragm chamber within the casing, a diaphragm mounted in position clamped around a peripheral portion thereof between the adjacent peripheral portions of said casing sections and being positioned extending across said chamber, said diaphragm being formed with an annular peripheral flange therearound extending axially therefrom, said diaphragm flange being positioned between the peripheral flange of said first mentioned casing section and a peripheral portion of the said casing section nested therewithin, the outer portions of the inner side of the peripheral flange of said first mentioned casing section being inclined radially outwardly of the section, the outer portion of the outer side of the peripheral portion of said nested section being inclined outwardly and radially inwardly to form an outwardly flaring annular space between said peripheral flange and said peripheral portion of the nested section, and an anchoring mass in said outwardly flaring space between the peripheral flange of said first mentioned section and the peripheral portion of said nested section attaching the flange of said diaphragm to the adjacent surfaces, respectively, of said casing sections to form a substantially leak-proof joint and gas-tight seal between and around the diaphragm flange and said adjacent surfaces of the casing sections.

2. In a pressure fluid actuated diaphragm structure, in combination, a casing formed of casing sections having opposed, spaced inner surfaces forming a diaphragm chamber therewithin, each of said sections being provided with an axially extending peripheral flange therearound with the flange of one section positioned within and concentric with the flange of the other section, a flexible diaphragm mounted in position between said sections extending across said chamber, said diaphragm being tightly clamped around a peripheral portion thereof between said casing sections and being formed with a laterally disposed peripheral flange therearound extending and being positioned between the peripheral flanges of said sections, an anchoring mass between said concentric casing flanges, over said diaphragm flange to join said diaphragm flange

to the adjacent surfaces, respectively, of said casing flanges to form a substantially leakproof and gas-tight seal between said casing flanges and said diaphragm flange, and removable means for securing said casing sections and said diaphragm together in assembled relation with the diaphragm tightly clamped in position between said casing sections.

3. In a pressure fluid actuated diaphragm structure, in combination, a casing including a section having a laterally disposed peripheral flange therearound and being formed at the inner side of said flange with an annular seat forming groove joining said flange with the body of said section, a second casing section nested within said first mentioned section and being formed with an annular peripheral shoulder portion therearound aligned with said seat groove of said first mentioned section, a flexible diaphragm secured between said casing sections and in position extending across the chamber formed therewithin, said diaphragm being formed with a peripheral shoulder portion therearound seated in said seat groove of said first mentioned section and being clamped between said first mentioned section and the annular shoulder of said second section, said diaphragm being formed with an annular peripheral flange extending axially from and around the outer side of said annular shoulder and extending and being positioned between the peripheral flange of said first mentioned casing section and the adjacent peripheral portion of said second casing section, an anchoring mass cast in the spaces between opposite sides of said diaphragm flange and the adjacent surfaces, respectively, of the peripheral portions of said second casing and the peripheral flange of said first mentioned casing section to form a substantially leakproof and gas-tight joint between the diaphragm flange and said casing sections, and an annular cap member removably secured to one of said casing sections and being engaged with the other of said sections to secure the casing sections and said diaphragm together in assembled relation.

4. In combination, a casing including casing sections having opposed, spaced inner surfaces forming a diaphragm chamber therewithin, a flexible diaphragm having its peripheral portion clamped between adjacent peripheral portions, respectively, of said casing sections and being positioned extending across said chamber, said diaphragm being formed with a peripheral flange extending axially from one side thereof and being extended and positioned between adjacent peripheral portions, respectively, of said casing sections, an anchoring mass of fusible material cast between and joined with the opposite sides of said peripheral flange of said diaphragm and the adjacent surfaces, respectively, of said peripheral portions of said casing sections to form a substantially gas-tight seal therewith, and a cap member removably attached to one of said casing sections and being engaged with the other of said sections to securely clamp said sections with said diaphragm therebetween in assembled position.

5. In combination, a casing including casing sections having opposed spaced inner surfaces forming a diaphragm chamber within said casing, a flexible diaphragm having its peripheral portion clamped between adjacent peripheral portions, respectively, of said casing sections and being positioned extending across said chamber, the peripheral portion of said diaphragm at the outer side of the portion thereof clamped between

said sections being extended and positioned around and between adjacent peripheral portions, respectively, of said casing sections, an anchoring mass between the outer peripheral portions of said diaphragm and the adjacent surfaces, respectively, of the peripheral portions of said casing sections, a cap member removably threaded on and around one of said casing sections and being extended over and engaging the other of said sections to securely clamp said sections with said flexible diaphragm therebetween in assembled position.

6. In combination, a casing formed of casing sections having opposed inner surfaces forming a diaphragm chamber within said casing, a flexible diaphragm clamped around the peripheral portion thereof between the adjacent opposed peripheral portions of said casing sections and being positioned extending across said chamber, said diaphragm being formed with a peripheral flange therearound extending axially therefrom at the outer side of the peripheral portion of the diaphragm clamped between said sections, said diaphragm flange being positioned between adjacent concentric peripheral portions, respectively, of said casing sections, an anchoring mass between and joined to the opposite sides of said peripheral flange of the diaphragm and the adjacent surfaces, respectively, of said adjacent peripheral portions of the casing sections to form a substantially gas-tight seal therewith and therebetween, and a cap member removably threaded on one of said sections and being extended over the other of said sections in engagement therewith to tightly clamp said sections and said flexible diaphragm therebetween in assembled position, said cap member being formed with sealing ribs engaging said sections at opposite sides, respectively, of said anchoring mass.

7. In combination, a casing including a casing section having a laterally disposed peripheral flange therearound and a second section having a laterally disposed peripheral flange therearound nested within and concentric with the flange of said first section, said sections being formed to provide opposing, spaced inner surfaces forming a diaphragm chamber within the casing, a flexible diaphragm mounted in position with a peripheral portion thereof clamped between the adjacent peripheral portions, respectively, of said casing sections and being positioned extending across said chamber, said diaphragm being formed with an annular peripheral flange therearound extending axially therefrom, said diaphragm flange being positioned between the concentric flanges of said casing sections, a mass of fusible material cast between opposite sides of said diaphragm flange and adjacent surfaces, respectively, of said section flanges and being joined therewith to form a substantially gas-tight seal closing the space between said flanges, a ring-like cap member removably threaded on and secured over the outer side of the peripheral flange of said first mentioned casing section, and said cap member being extended over and engaging the outer edge of the peripheral flange of said second mentioned casing section to thereby secure said sections with said diaphragm clamped therebetween in assembled position.

8. In combination, a casing including a casing section having a laterally disposed peripheral flange extending from one side thereof and a second section having a laterally disposed peripheral flange extending laterally from one side thereof, said sections being positioned with the

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flange of said second section nested within and substantially concentric with the flange of said first section and said sections being also formed to provide opposed, spaced inner surfaces forming a diaphragm chamber within the casing, a flexible diaphragm mounted in position extending across said chamber and having a peripheral portion thereof clamped between the adjacent peripheral portions, respectively, of said casing sections, said diaphragm being provided with an annular peripheral flange extending axially therefrom, said diaphragm flange being positioned between the concentric flanges of said casing sections, an anchoring mass formed between said peripheral section flanges around and joining said diaphragm flange with adjacent surfaces of said section flanges to provide a gas-tight joint therebetween, a ring-like cap member removably secured on the exterior of the peripheral flange of said first mentioned casing section and being extended radially inwardly over and across

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the outer side of the peripheral flange of said second mentioned section, and said cap member being provided with an annular sealing rib having a narrow outer edge in sealing engagement with the adjacent outer side of the peripheral flange of said second mentioned section.

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