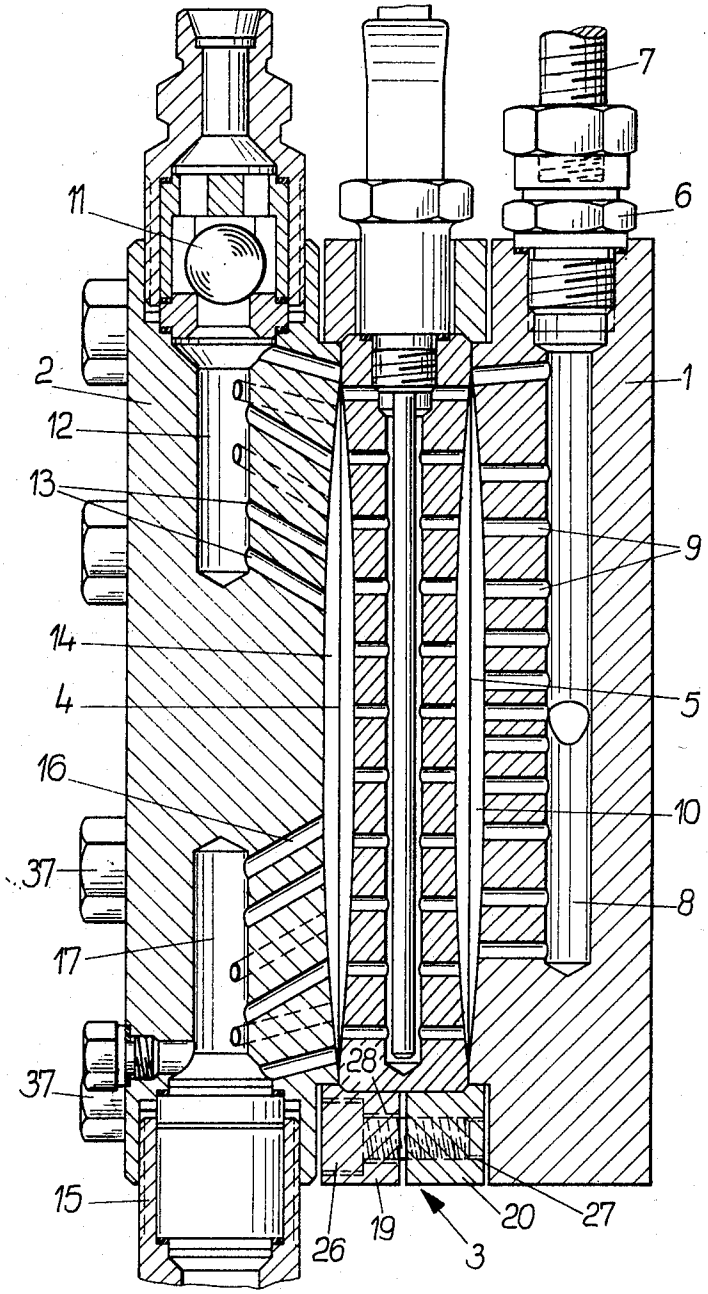
March 11, 1969 F. ORLITA 3,431,823

DIAPHRAGM ASSEMBLY FOR A DIAPHRAGM PUMP

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Fig.1



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DIAPHRAGM ASSEMBLY FOR A DIAPHRAGM PUMP

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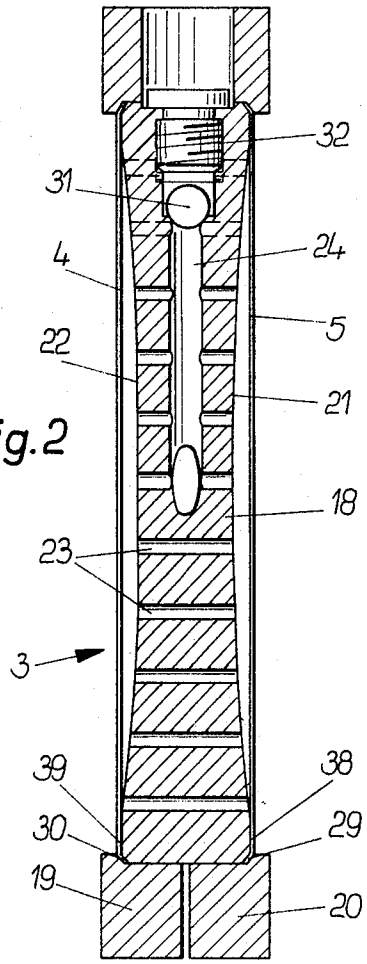


Fig.2

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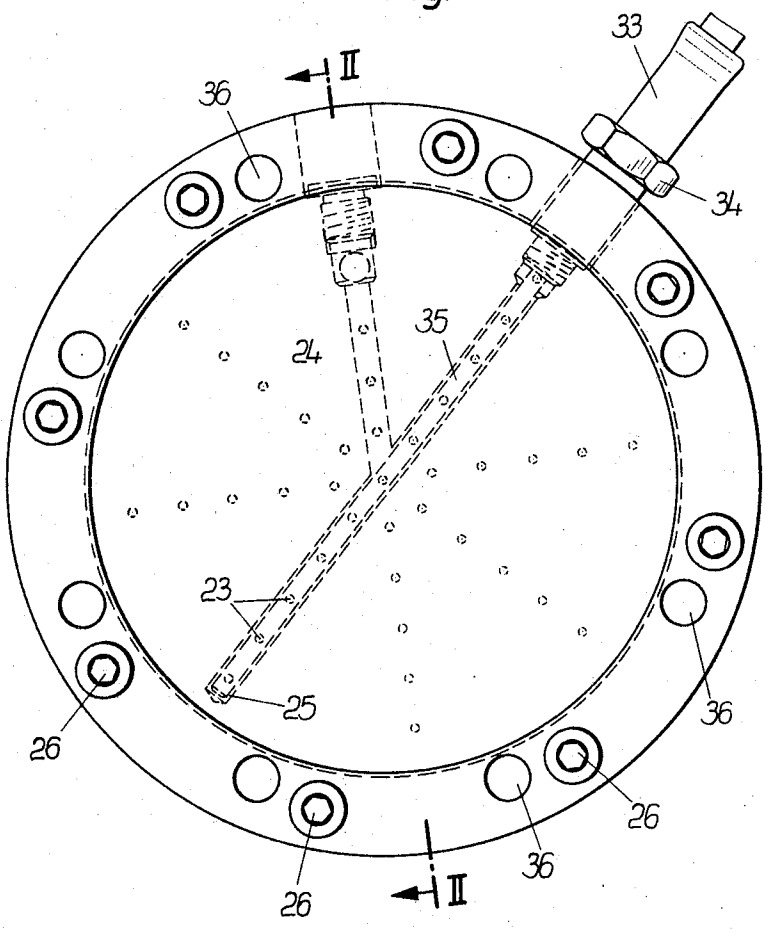
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DIAPHRAGM ASSEMBLY FOR A DIAPHRAGM PUMP

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Fig. 3



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DIAPHRAGM ASSEMBLY FOR A DIAPHRAGM PUMP

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ABSTRACT OF THE DISCLOSURE

A diaphragm assembly for a diaphragm pump having a support member and a pair of axially aligned ring members disposed at opposite ends of the support member. Diaphragm members are disposed between the axial ends of the support member and the opposing faces on the ring members. Screws are provided for securing the ring members together to thereby clamp the diaphragms between the axial ends of the support member and the opposing faces on the ring members. This construction defines a unitary, flexible walled chamber which is insertable as a unit into the pump body of a diaphragm pump.

This invention relates to dosing or metering diaphragm pumps comprising two diaphragms disposed at either side of a diaphragm support having bores therethrough between which a transmissive buffer fluid is enclosed.

Diaphragm pumps of this type are known. The pulsing oil flow of an oil pump acts on one of the diaphragms, thereby moving the diaphragm. The displaced diaphragm pushes the buffer fluid through the passage holes against the inner side of the other diaphragm whose outer side acts in conjunction with the fluid to be conveyed. The arrangement of two diaphragms offers the possibility to make the one diaphragm of great mechanical strength, and the other diaphragm situated at the conveying side, particularly resistant to chemical attack for example. By virtue of the buffer fluid, it is possible to verify whether both diaphragms are still perfectly tight. If one diaphragm breaks, either oil from the pulsing oil flow, or fluid to be conveyed, penetrates into the buffer fluid. This may be established by means of an electrode monitoring the condition of the fluid, e.g. the pH value. In known diaphragm pumps comprising two diaphragms, the diaphragms are thrust by parts of the pump case against the diaphragm bearer and are assured of support only in the assembled state of the pump. The buffer fluid cannot be poured in until after assembly of the pump. Filling raises difficulties since metering the correct quantity of liquid and bleeding the apparatus are possible only with difficulty. This derives in particular from the fact that the static head of the buffer fluid causes the diaphragms to bulge out slightly, so that a little more fluid than necessary enters between the diaphragms. This, in particular, causes the diaphragm facing towards the fluid which is to be conveyed, to be exposed to greater stresses. This phenomenon occurs in thin diaphragms in particular.

The main object of the present invention is to provide a pump diaphragm assembly and a pump of the type herein set forth incorporating said assembly so that filling the assembly with buffer fluid may be performed accurately whereby the diaphragms do not bulge either inwards or outwards. Replacement of the diaphragms is also to be facilitated in the pump incorporating such an assembly.

According to the present invention a pump diaphragm assembly comprises a diaphragm support, a plurality of transverse bores in said support communicating with the exterior of said support, a diaphragm disposed over each side of said support, a releasable thrust ring on each side of said support and securing means for securing said rings to said support and said diaphragms between said rings and support, and a transmissive buffer fluid chamber formed between said diaphragms and in said bores.

In a pump of this kind using such an assembly a buffer fluid may be poured into the assembly even before their insertion into the pump. The bulging-out of the diaphragms during filling is prevented, e.g. by placing plates on the diaphragms at either side of the diaphragm bearer, against which the diaphragms may bear during filling with pressure fluid. The venting of the space for the buffer fluid is also facilitated, since the structural unit comprising the diaphragm bearer, the diaphragms and thrust rings, may be handled easily and placed in different positions, thus facilitating the ascent of the air bubbles. The structural unit may moreover be inserted easily into the pump.

In a simple form of embodiment of the invention, the thrust rings are pressed against each other by means of screws, preferably by means of recessed hex-head screws countersunk into one of the rings, which are screwed into tapped holes of the other ring. This provides a construction in which no fastening elements project laterally beyond the thrust rings.

The edges of the diaphragm bearer are preferably chamfered, as are the thrust rings. The diaphragms are then clamped between the chamfers of the diaphragm bearer and of the thrust rings. A narrow marginal area is employed for clamping. Approximately the entire diaphragm surface is exploited as a working surface with a fastening method of this nature.

The venting of the buffer fluid space is facilitated by incorporating a rising closable venting bore, which intersects several through bores. During filling, the air can now flow through the through bores into the venting bore and emerge into the surroundings through the venting bore. The venting bore is not absolutely necessary however, e.g. if assembly is performed within the buffer fluid itself, which is easily feasible since the individual parts are easily handled.

According to an advantageous development of the invention, an electrode is arranged in a bore traversing the diaphragm bearer diametrically and intersecting several passage bores, in order to indicate the condition of the buffer fluid, this venting or filling bore leading into the electrode bore, in the case in which a venting or filling bore is incorporated. Conjoint action of the two bores additionally and substantially facilitates the filling of the buffer fluid space.

Passage bores for traversal by the clamping screws are preferably wrought in alignment with each other in both thrust rings, by means of which the parts of the case adjacent to the diaphragm bearer are drawn against the diaphragm bearer. With a configuration of this kind of the thrust rings, the pump diameter need not be increased to correspond to the thrust rings.

The pump is preferably so constructed that the parts of the case adjacent to the diaphragm bearer thrust the diaphragms against the diaphragm bearer by means of annular surfaces. The clamping rings merely serve the purpose, in this case, of ensuing adequate retention of the diaphragms on the diaphragm bearer during the filling action; during operation this retention is assured by the parts of the case.

In order that the invention may be more fully under stood, one embodiment in accordance therewith will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a diametrical vertical cross section through a diaphragm pump;

FIG. 2 is a cross section through the unassembled

structural unit forming the diaphragm assembly and comprising the diaphragm support, the diaphragms and thrust rings, the cross section being taken through the venting bore, that is to say along line II—II in FIG. 3; and

FIG. 3 is a side view of the structural unit of FIG. 2.

Referring to FIG. 1 the pump comprises case parts **1** and **2**, between which is clamped the structural unit indicated generally at **3** and having diaphragms **4** and **5**. A connector stub **6** to which a pressure oil pipe **7** is connected, is arranged on the case part **1**. The pressure pipe **7** connects a space **10** on one side of the diaphragm **5** through a bore **8** in the case part **1** and a number of transverse bore **9**. A buffer fluid is present between the diaphragm **5** and the diaphragm **4**.

The pressure valve, indicated generally at **11**, is arranged in the case part **2** and is connected to a space **14** to the left of the diaphragm **4** in FIG. 1 through a case bore and oblique bores **13**. A suction connector **15** is also connected to the space **14** through oblique bores **16** which open into a case bore **17**.

The pumping action is effected by a pulsing flow of oil entering through the pipe **7**, which acts on the diaphragm **5**. The displacements of the diaphragm **5** are transmitted to the diaphragm **4** by the buffer fluid present between the diaphragm **5** and the diaphragm **4**, the diaphragm **4** thus undergoing displacements corresponding to diaphragm **5**. The space **14** is thereby increased and reduced, so that a pumping action is engendered therein, which draws in the fluid to be pumped, e.g. a chemically corrosive liquid, through the connector **15** and forces the same through the connector **11** into the pressure pipe connected thereto.

Referring to FIGS. 2 and 3 these show in detail the structural unit **3** which comprises a diaphragm support **18**, the diaphragms **4** and **5**, and thrust rings **19** and **20**. As shown in FIG. 2, the diaphragm support **18** has concave sides **21** and **22**, which are interconnected by transverse bores **23**. Two radial bores are incorporated moreover, namely a venting bore **24** and an electrode bore **25**. The electrode bore diametrically traverses approximately the entire diaphragm bearer and in doing so intersects several of the passage bores **23**. The venting bore **24** extends only as far as the center and then opens into the electrode bore **25**; this bore also intersects several passage bores **23**.

The components of the structural unit **3** are held together by the two thrust rings **19** and **20** which are drawn towards each other by recessed hexagonally headed screws **26** for which purpose tapped holes **27** are formed in the thrust ring **20**, and passage holes **28** with countersunk portions or conterbores for the screw heads are formed in the thrust ring **19**.

The edges of the diaphragm support **18** are chamfered at **29** and **30** and corresponding chamfers are formed on the trust rings **19** and **20**. In the area of these chamfers, the diaphragm is pressed by the thrust rings **19, 20** against the diaphragm support **18**. The venting bore **24** may be shut off by a ball **31** and a plug **32**.

The outside of the diaphragm support **18** has two flat faces **38** and **39** which abut the corresponding plane surfaces of the case parts **1** and **2**, so that these case parts press the diaphragms **4** and **5** against the diaphragm bearer.

The electrode, indicated generally at **33**, comprises a screw-threaded plug **34**, which is of similar form to that of an internal ignition engine sparking plug, an electrode pin **35** and a plastic sleeve in the form of a tube or hose surrounding the electrode pin **35**, which plastic sleeve is perforated to ensure access of the buffer fluid to the electrode. The thrust rings also have passage bores **36** formed in them in register with each other, which allow the case screws **37** to pass therethrough, the heads of which are shown in FIG. 1.

The pump is assembled in the following manner. The

diaphragms **4** and **5** are initially placed on the diaphragm support **18**. The thrust rings **19** and **20** are pushed thereon laterally over the diaphragm support and drawn towards each other by the screws **26**, after which the diaphragms **4, 5** are held fast by their rims. Having unscrewed the electrode **33**, buffer fluid is poured in through the electrode bore. The air is displaced from the space between the diaphragms **4** and **5** and rises upwards through the venting bore, from which it escapes to the outside. When the buffer fluid space has been completely filled and bled through the vent bore **24**, flat plates are pressed into close contact with the diaphragms. The plates are moved inwards until they bear against the diaphragm support **18** through the diaphragms. The diaphragms which had previously been caused to bulge outwards slightly, are thereby pressed flat again, causing surplus fluid to escape through the venting bore. The liquid is forced out by reduction in volume of the buffer fluid space by the contact pressure of the flat plates. After the plates have been pressed home fully, the venting bore is shut. The correct quantity of buffer fluid is then enclosed in the space between the diaphragms **4** and **5**. After this operation, the structural unit **3** as a whole is inserted between the case parts **1** and **2** and the case parts are drawn towards each other by the screws **37**. The screws **37** then traverse the passage holes **36** and are screwed into tapped holes of the case part **1**, as shown in FIG. 1 for the bottom screw.

If a diaphragm is punctured, the buffer fluid mixes either with the propelling liquid (in the case of puncture of the diaphragm **5**) fed in through the bore **8**, or with the fluid which is to be pumped (in the case of puncture of the diaphragm **4**). This causes a change in the chemical nature of the buffer fluid, e.g. in its pH value, which is transmitted to a measuring instrument by the electrode **33**. The condition of the buffer fluid represents a reliable indication as to whether the diaphragms are still undamaged or not. Replacement of a broken or punctured diaphragm may be carried out very easily, since the unit as a whole may be removed from the pump, after which new diaphragms may easily be fitted. The insertion of the reassembled structural unit can also be carried out easily and quickly. Several structural units **3** may be kept in stock so that rapid replacement of punctured diaphragms is possible thus causing only short operational stoppages. Simple insertion also represents an advantage if the pump is installed in a room exposed to radioactive radiation.

I claim:

1. A diaphragm assembly for a diaphragm pump, said pump having a pump body with an operating chamber therein, said operating chamber being separable into two components, comprising in combination:

an axially elongated support member having a pair of axially facing ends and at least one axial opening through the center portion thereof;

first and second annular ring members axially aligned at opposite ends of said support member, said first and second ring members having opposing clamping surfaces thereon;

first and second diaphragm members, said first diaphragm member being disposed between said clamping surface on said first ring member and one axial end of said support member and the second diaphragm member being disposed between said clamping surface on said second ring member and the other axial end of said support member;

releasable means directly interconnecting said first and second ring members for securing said ring members together to thereby clamp said first and second diaphragm members between said first and second ring members and said axial ends on said support member and to thereby define a unitary, flexible walled transmissive buffer fluid chamber;

means independent of said means securing said first and

second ring members together, releasably securing said unitary flexible walled chamber in said separable operating chamber in said pump body whereby said flexible walled chamber can be pre-assembled and filled with transmissive buffer fluid prior to an installation in said pump body.

2. The diaphragm assembly defined in claim 1, wherein said first and second ring members include a set of axially aligned, circumferentially spaced holes adjacent the periphery thereof, said holes in said first ring member being countersunk on the axial side thereof opposite said clamping surface, said holes in said second ring member being threaded; and

including a plurality of screws having enlarged heads and an elongated screw portion receivable in said set of holes, said enlarged heads being received in said countersunk holes and said screw portion threadedly engaging the threads in said threaded holes whereby said first and second ring members are secured together.

3. The diaphragm assembly defined in claim 1, wherein the edges between the peripheral surface and said axially facing ends on said support member are chamfered; and

wherein said clamping surfaces on said first and second ring members are chamfered whereby said first and second diaphragm members are clamped between said chamfered surfaces on said first and second ring members and said support member.

4. The diaphragm assembly defined in claim 1, wherein said support member has a plurality of axial openings therein adjacent the center thereof; and

including a closable venting bore in said support member communicable with said plurality of axial openings.

5. The diaphragm assembly defined in claim 4, wherein said support member includes means defining a further bore, said further bore having a first electrode mounted therein, said further bore communicating with said closable venting bore; and

wherein said support member defines a second electrode whereby the chemical nature of said transmissive buffer fluid in said unitary, flexible walled chamber can be measured.

6. The diaphragm assembly defined in claim 1, wherein said first and second ring members include a set of axially aligned, circumferentially spaced holes; and

wherein said means releasably securing said unitary, flexible walled chamber in said operating chamber comprises elongated means releasably securing said two components of said operating chamber together, said elongated means being receivable in said set of openings in said first and second ring members to thereby secure said unitary, flexible walled chamber in said operating chamber of said pump body.

7. The diaphragm assembly defined in claim 6, wherein said two components of said operating chamber have opposing surfaces which engage the diaphragm members to urge same against said axial ends of said support member.

8. A diaphragm assembly for a diaphragm pump, said pump having a pump body with an operating chamber therein, said operating chamber being separable into two components, comprising in combination:

an axially elongated support member having a pair of axially facing ends and a plurality of radially spaced, axial openings in the center thereof;

first and second annular ring members axially aligned at opposite ends of said support member and having an outer peripheral dimension greater than said support member, said first and second ring members having opposing clamping surfaces thereon and means defining a plurality of first and second sets of circumferentially spaced, axially aligned openings adjacent the periphery thereof, said first set of openings in said first ring member being countersunk on the axial side thereof opposite said clamping surface and said first set of holes in said second ring member being threaded;

first and second diaphragm members, said first diaphragm member being disposed between said clamping surface on said first ring member and one axial end of said support member and said second diaphragm member being disposed between said clamping surface on said second ring member and the other axial end of said support member;

a plurality of screws having enlarged heads and elongated screw portions receivable in said first set of openings in said first and second ring members, said enlarged heads being recessed in said countersunk holes in said first ring member and said screw portions threadedly engaging the threads in said threaded holes for securing said first and second ring members together to thereby clamp said first and second diaphragm members between said clamping surfaces on said first and second ring members and the axial ends of said support member and to thereby define a unitary, flexible walled transmissive buffer fluid chamber;

a plurality of fasteners releasably securing said two components of said pump body together, said fasteners being releasably received in said second set of openings in said first and second ring members for releasably securing said unitary, flexible walled chamber in said operating chamber whereby said flexible walled chamber can be preassembled and filled with transmisive buffer fluid prior to an installation in said pump body.

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