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(54) **A diaphragm-plate group for diaphragm pumps**

(57) A diaphragm-plate group for activating a diaphragm pump comprises: a circular membrane (3) made of an elastomer material for delimiting a pump chamber (2), and a circular plate (40) which is able to be moved in alternating motion for activating the membrane (3). The plate (40) is slightly convex with a convexity thereof facing

towards the membrane (3), and the plate (40) exhibits, on a whole surface thereof facing towards the membrane (3) and destined to come into contact therewith, a series of lowered parts (42) for avoiding sticking of the membrane to the plate surface.

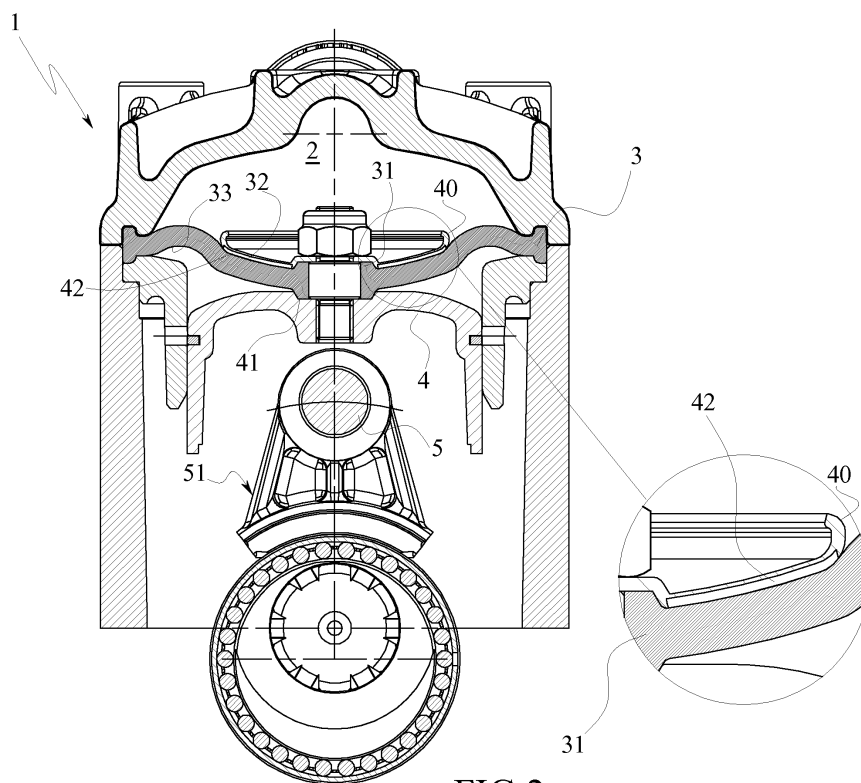


FIG. 2

Description

[0001] The present invention relates to diaphragm pumps, and more in particular to a diaphragm plate group thereof.

[0002] Diaphragm pumps comprise at least a pump chamber, delimited by an elastomer membrane and provided with aspiration and delivery conduits.

[0003] The pumping effect is carried out by means of cyclic deformations of the membrane which respectively reduce and increase the volume of the pump chamber.

[0004] These deformations are very frequent, can reach up to 9 cycles a second, and are impressed on the membrane by a plate on which the membrane rests, activated to move alternately.

[0005] The membrane is substantially flat and it has been found that in flat membranes at present used, the material is stretched in traction, cyclically, by the plate in the alternating motion thereof.

[0006] Further, in the motion thereof the membrane nears the peripheral edge of the plate, risking splitting by continuous friction of a non-perfectly connecting surface. Lastly there is a rubbing between the membrane and the plate in the contact zone between the membrane and the plate, which generates extra wear because the membrane tends to stick to the smooth surface of the plate.

[0007] The membrane is fashioned from a rubber-based material or an electrically nonconductive and chemically-inert thermoplastic elastomer, while the plate is generally made of metal.

[0008] The above phenomena have a negative influence on the duration of the membrane and on the reliability of the pump.

[0009] The aim of the present invention is to obviate the above-mentioned drawbacks with a solution that is simple, reliable and relatively inexpensive.

[0010] The aim is attained by a diaphragm plate group, destined to be used in a diaphragm pump, having the characteristics cited in the independent claim.

[0011] The dependent claims relate to other advantageous characteristics of the invention.

[0012] According to the invention, the plate has a dome-shape, slightly convex and connected on an edge, so as to prevent splits on contact of the membrane with the edge.

[0013] The plate can be advantageously clad with non-stick material, such as for example Teflon (polytetrafluoroethylene).

[0014] The surface of the plate can advantageously comprise, on the face in contact with the membrane, lowered or dropped zones or parts, obtainable directly in the moulding process of the plate.

[0015] The membrane does not come into contact with the plate at the positions of the lowered parts, thus preventing sticking phenomena.

[0016] Preferably the membrane, while maintaining its circular shape, it is not flat but it is shaped to be able to deform without being subjected to traction forces, but on-

ly to bending forces.

[0017] The lowered parts are preferably uniformly distributed on the surface of the plate. They preferably have a radial extension, and occupy at least thirty per cent of the surface of the plate.

[0018] The advantages and constructional and functional characteristics of the invention will emerge from the detailed description that follows, which with the aid of the accompanying tables of drawings illustrates a preferred embodiment given by way non-limiting example.

Figure 1 is a schematic axial section of the pump chamber of the first embodiment of a diaphragm pump according to the invention, configured in a position in which the membrane is positioned in an intermediate point of the travel of the plate.

Figure 2 is a schematic axial section of the pump chamber of the second embodiment of a diaphragm pump according to the invention, configured in a position in which the membrane is positioned in an intermediate point of the travel of the plate.

Figure 3 is a plan view of the elastomer membrane of Figs. 1 and 2.

Figure 4 is a plan view of the activating plate of the membrane of Figs. 1 and 2.

[0019] The figures illustrate a diaphragm pump 1 comprising the pump chamber 2 delimited by the membrane 3, 30 made of an elastomer material.

[0020] The delivery and aspiration valves that are part of the pump chamber are omitted, as they do not relate to the present invention.

[0021] The activating piston 4 is located beneath the membrane 3, 30.

[0022] The piston 4 exhibits a convexity thereof facing towards the membrane 3, 30. The membrane 3 exhibits a hub 31 at the centre thereof.

[0023] In the embodiment of Fig.1 the membrane is flat, while the piston exhibits a lowered part 41 able to receive an end of the hub.

[0024] In the embodiment of Fig.2, the profile of the membrane seen in axial section and in rest position (not deformed) exhibits, at a centre thereof, a first circular concavity 32 facing towards the pump chamber 2 and connected to the hub 31, and a second circular concavity 33 facing in an opposite direction and connected with the edge of the membrane.

[0025] The membrane 3 is blocked between the piston 4 and a profiled plate 40.

[0026] The piston 4 and the profiled plate 40 are blocked together at the hub 31 on a pin 5, which is moved in alternating motion by the crank 51.

[0027] With reference to Fig.1, Fig.2 and Fig.4, lowered parts 42 having a radial extension are illustrated, distributed in a regular fashion on all the convex surface of the plate which comes into contact with the membrane 3, 30.

[0028] The surface of the plate 40 facing towards the membrane 3 is clad with a non-stick material, such as

Teflon (polytetrafluoroethylene) or an equivalent material. The edge of the plate 40 is further slightly rounded so as to exclude cutting effects when it comes into contact with the membrane.

[0029] Observing Fig.2, it can be seen that the deformations of the membrane during the functioning do not induce radially-directed stretches in the membrane, which reduces to a minimum the rubbing between the plate and the membrane during the functioning of the pump.

[0030] The friction between the diaphragm and the plate is reduced by the non-stick cladding of the plate.

[0031] Further, a sticking phenomenon between the membrane and the plate is greatly reduced by the presence of the lowered parts 42, distributed uniformly on the surface of the plate in contact with the membrane, and occupying at least 30% of the surface of the plate.

[0032] Thanks to the peculiar characteristics of the plate/membrane group, the stresses induced in the membrane are practically limited to flexion stresses, while the sticking between the membrane and the plate is excluded by the shape of the plate.

[0033] Thus all the aims of the invention are attained.

[0034] The invention is not limited to the preferred embodiment described above, and any variants and improvements might be brought thereto without its forsaking the scope of protection defined by the following claims.

Claims

1. A diaphragm plate group for activating a diaphragm pump, comprising a pump chamber delimited by a circular membrane made of an elastomer material activated by a circular plate moved in alternating motion, **characterised in that** the plate is slightly convex with a convexity thereof facing towards the membrane, and the plate exhibits, on a whole surface thereof facing towards the membrane and destined to come into contact there-with, a series of lowered parts.
2. The diaphragm plate group of claim 1, **characterised in that** the lowered parts are uniformly distributed on the surface of the plate.
3. The diaphragm plate group of claim 1, **characterised in that** the lowered parts occupy overall a portion of the surface of the plate equal to at least thirty per cent.
4. The diaphragm plate group of claim 5, **characterised in that** at least a radial portion of the plate is occupied by a sole lowered part.
5. The diaphragm plate group of claim 1, **characterised in that** the plate exhibits a rounded peripheral

edge in the axial section of the plate.

6. The diaphragm plate group of claim 1 and claim 2, **characterised in that** the surface of the plate destined to come into contact with the membrane is clad with non-stick material.
7. The diaphragm plate group of claim 6, **characterised in that** the non-stick material is polytetrafluoroethylene.
8. The diaphragm plate group of claim 1, **characterised in that in that** the membrane, viewed in an axial section, exhibits a first central convexity facing towards the plate and a second convexity, concentric to the preceding convexity, facing in an opposite direction and terminating on the edge of the membrane.

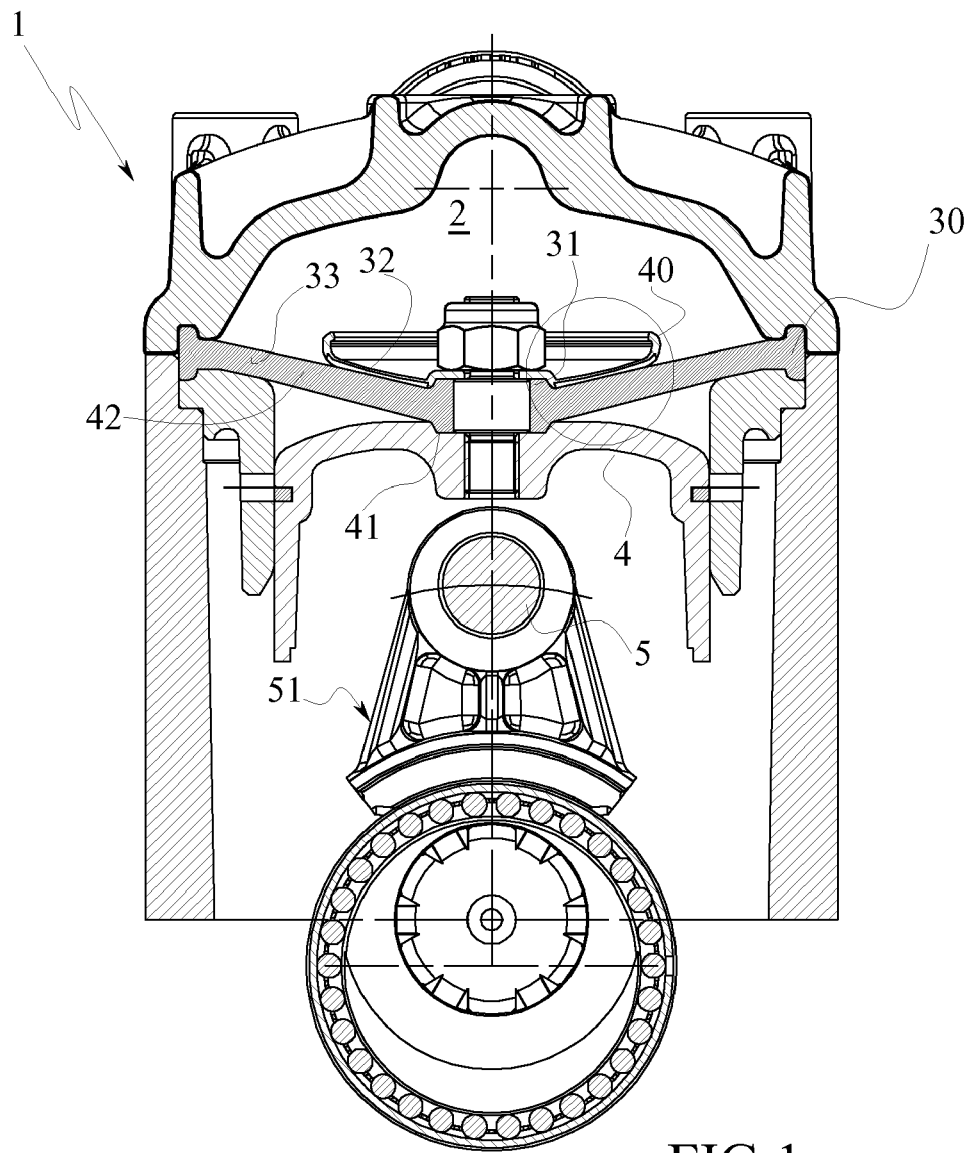
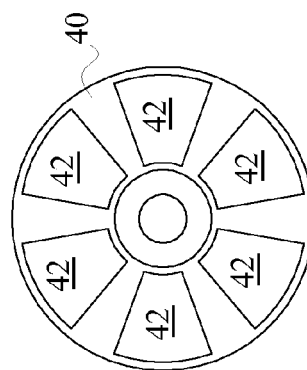
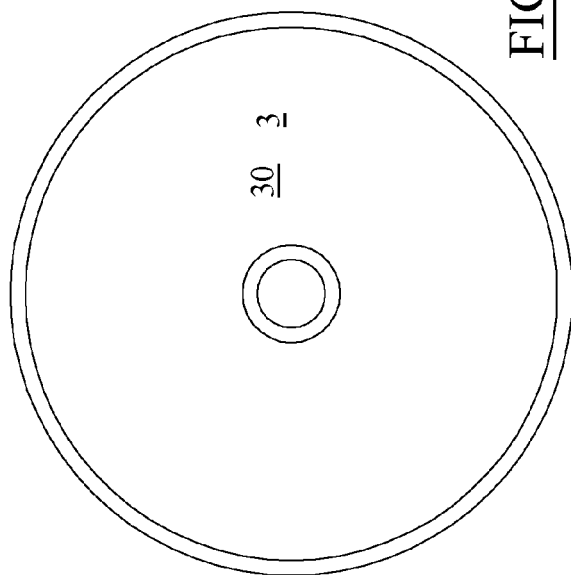
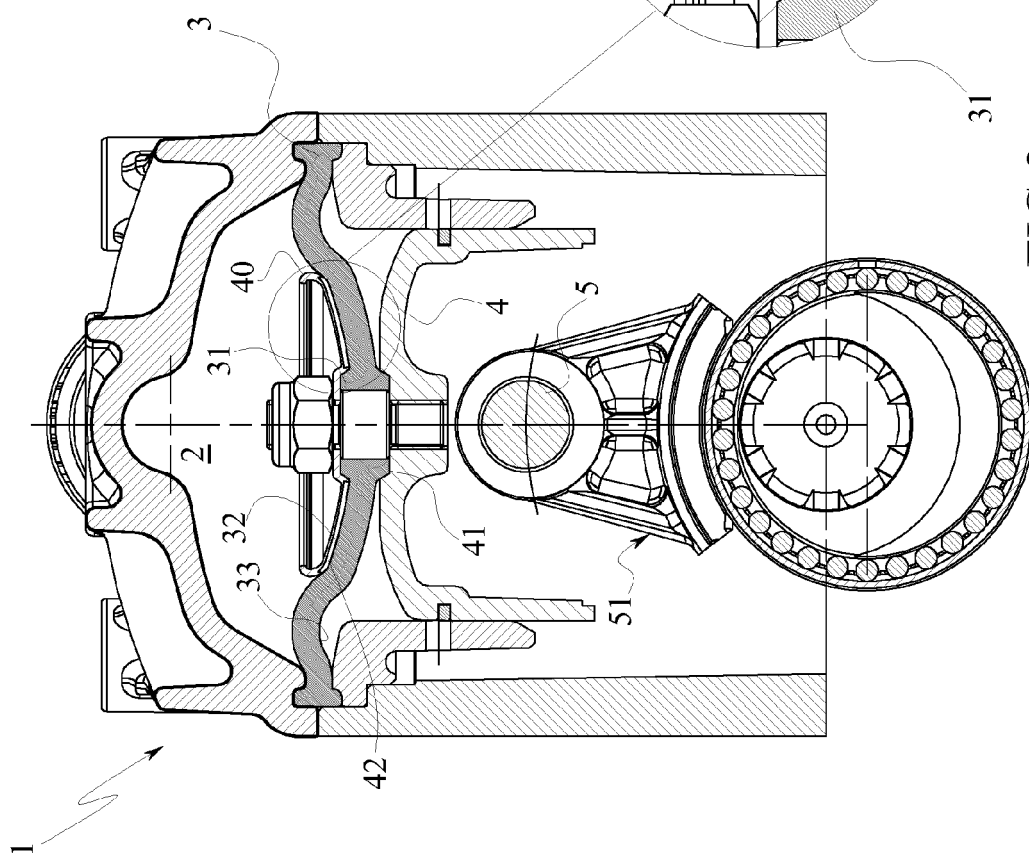


FIG.1





EUROPEAN SEARCH REPORT

Application Number
EP 14 17 9637

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		11 November 2014	Olona Laglera, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 17 9637

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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