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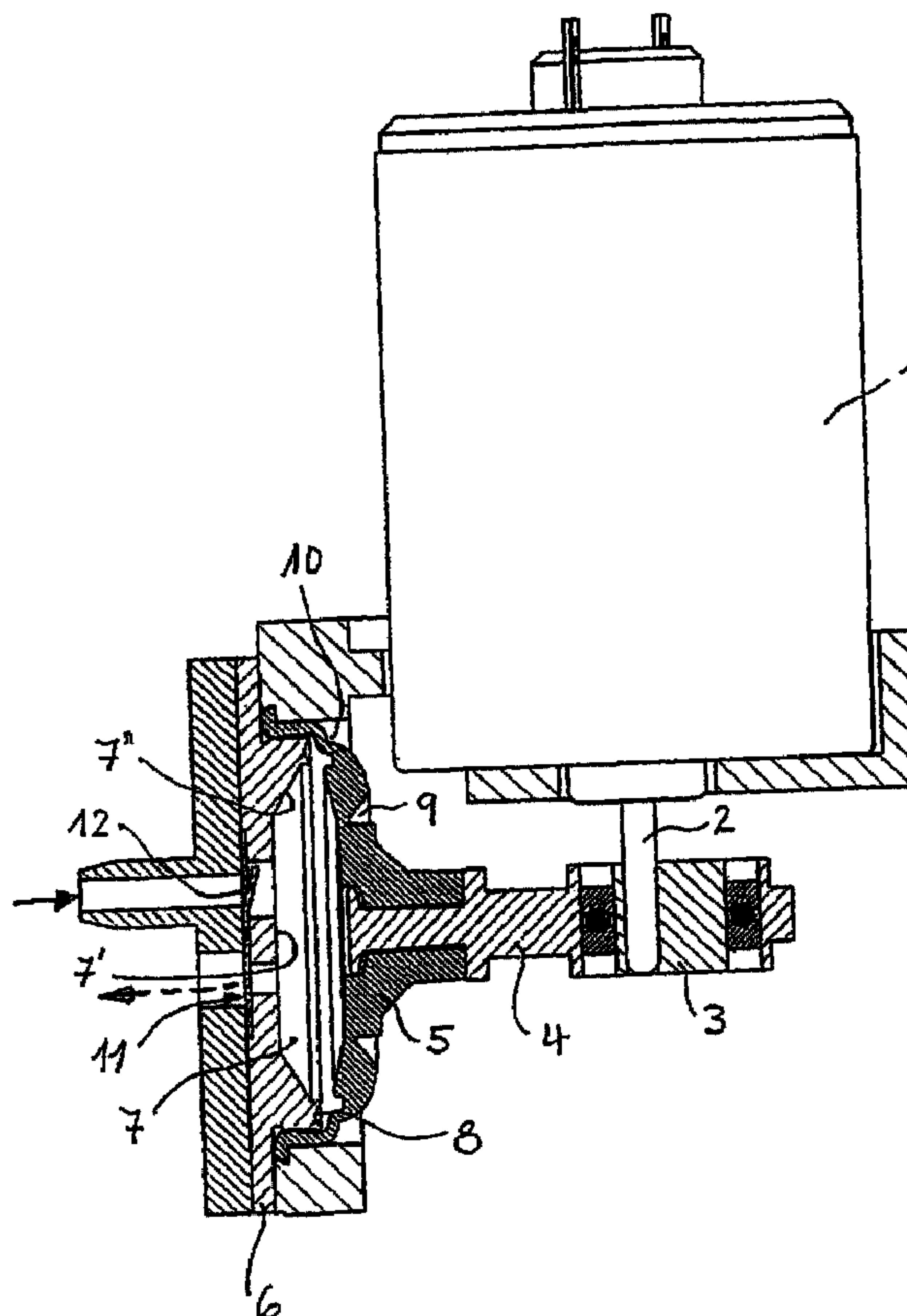
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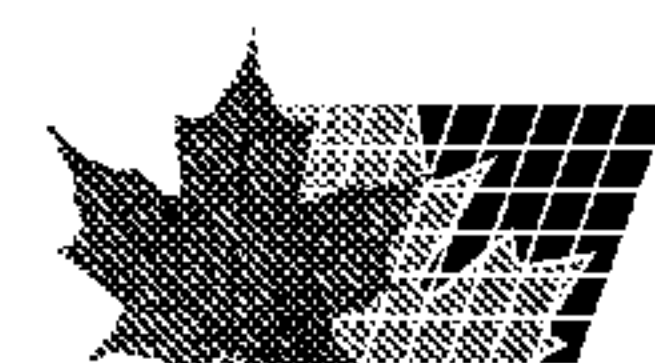
(54) Titre : POMPE A MEMBRANE

(54) Title: DIAPHRAGM PUMP



(57) Abrégé/Abstract:

The diaphragm suction pump has a pump chamber (7) located in a base plate (6), the wall of said chamber extending in a conical manner from a central flat base section (7') to the lateral edge (8). The elastic pump diaphragm (5), which spans the pump



(57) **Abrégé(suite)/Abstract(continued):**

chamber (7), is configured in such a way that it lies tightly against the entire pump chamber wall at the top dead center point of the drive connecting rod (4). The diaphragm (5) consists of a self-supporting elastic material with rear recesses (9; 10), which form hinges that can be elastically pretensioned during the operation of the diaphragm (5).

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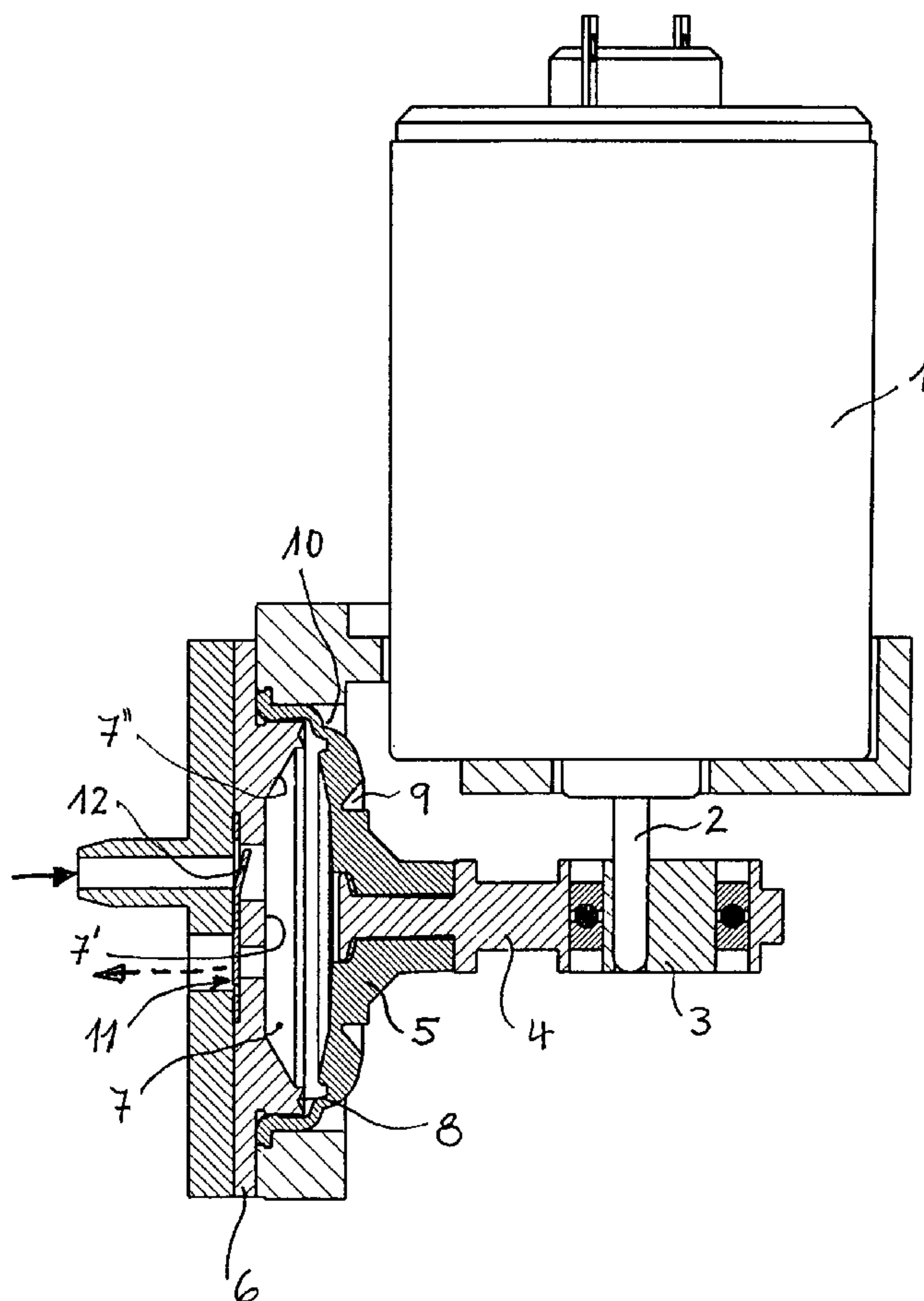
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[Fortsetzung auf der nächsten Seite]

(54) Title: DIAPHRAGM PUMP

(54) Bezeichnung: MEMBRANPUMPE



(57) **Abstract:** The diaphragm suction pump has a pump chamber (7) located in a base plate (6), the wall of said chamber extending in a conical manner from a central flat base section (7') to the lateral edge (8). The elastic pump diaphragm (5), which spans the pump chamber (7), is configured in such a way that it lies tightly against the entire pump chamber wall at the top dead center point of the drive connecting rod (4). The diaphragm (5) consists of a self-supporting elastic material with rear recesses (9; 10), which form hinges that can be elastically pretensioned during the operation of the diaphragm (5).

(57) **Zusammenfassung:** Die Membransaugpumpe weist in einer Grundplatte (6) einen Pumpenraum (7) auf, dessen Wand von einem zentralen ebenen Bodenabschnitt (7') aus sich konisch erweiternd zum Seitenrand (8) erstreckt. Die den Pumpenraum (7) überspannende elastische Pumpenmembran (5) ist so ausgebildet, dass sie sich im ODP des Antriebspleuels (4) an die gesamte Pumpenraumwand dicht anlegt. Die Membran (5) besteht aus engesteifem elastischen Material und weist rückseitige Vertiefungen (9; 10) auf, welche bei Betätigung der Membran (5) elastisch vorspannbare Scharniere bilden.

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

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Diaphragm pump

The present invention relates to a diaphragm pump as suction pump, in particular for generating a vacuum,
5 with an elastic pump diaphragm which is driven by a motor via a crank mechanism by means of a connecting rod and which spans a pump chamber provided in a base plate.

10 Diaphragm pumps of this type are known for a very wide variety of applications. Since today's diaphragm pumps have to manage with relatively large dead spaces in the pump chamber, high-performance diaphragm pumps are not able to be reduced any further in their dimensions.

15 An object of the present invention is to make available a diaphragm pump of the type defined at the outset which can provide maximum performance even with very small dimensions. A high-performance diaphragm pump of
20 this type with reduced dimensions compared to the prior art can therefore be built into devices for which there are increasing demands for miniaturization. It has now been found surprisingly that this object can be achieved according to the invention, in a diaphragm
25 pump of the type defined at the outset, by the features of the characterizing part of claim 1.

By virtue of the special design of the diaphragm, a dead space at the top dead center (TDC), i.e. upon
30 ejection, can be achieved which is practically zero. This was not possible with previous diaphragm pumps.

Particular embodiments of the subject of the invention are defined in the dependent claims. These show that,
35 with expedient arrangement of the pump valves in the base plate, practically no dead space remains.

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Since the diaphragm at the top dead center of the connecting rod bears tightly against the pump chamber wall and therefore no dead space remains there, and in addition the dead spaces up to the actual valves can be
5 kept very small, the pump performs its work immediately upon the working stroke, i.e. as soon as the ram moves together with the diaphragm away from the top dead center.

10 The invention is explained in greater detail below on the basis of an illustrative embodiment shown in the drawing, in which:

Fig. 1 shows a diaphragm pump according to the
15 invention in cross section, with the diaphragm at the bottom dead center, i.e. at the end of the suction stroke, and

Fig. 2 shows a corresponding view with the connecting
20 rod and the diaphragm at the top dead center, i.e. at the end of the ejection stroke.

The drawing shows, purely diagrammatically, a diaphragm pump as a suction pump, in which an electric motor 1
25 drives a connecting rod 4 via a crank mechanism 2, 3, with a pump diaphragm 5 which is arranged at the end of the connecting rod 4 and which spans a pump chamber 7 provided in a base plate 6. The dish-shaped pump chamber 7 has a central base section 7' and turn [sic]
30 7'' which widen conically from the latter and extend as far as the side edge 8. The diaphragm itself is made of elastic material, for example silicone, with a hardness of ca. 80 Shore and is relatively thick compared to conventional diaphragms.

35 The diaphragm 5 has, on its rear face, a circularly extending recess 9, and also an additional concentric groove 10, said groove 9 lying approximately in the area over the transition between the flat base section

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7' of the pump chamber and the wall section 7'' widening conically therefrom. The second groove 10 on the rear face lies in the area over the side edge 8 of the pump chamber 7.

5

The position of the diaphragm shown in Figure 1, at the bottom dead center, corresponds to the position in which the inherently stiff elastic membrane is in the rest position. Upon movement of the ram 4 in the
10 direction of the top dead center, the diaphragm deforms into the recesses 9, 10 in order to bear tightly against the wall of the pump chamber 7 (when the top dead center is reached). In the process, the elastic material is pretensioned, the recesses 9 and 10 forming
15 kinds of hinges.

As can be seen from Figure 2, this design permits tight bearing of the diaphragm against the wall of the pump chamber 7, so that practically no dead spaces remain in
20 the pump chamber at the top dead center.

Upon the suction stroke, i.e. upon removal of the diaphragm from the top dead center, the vacuum is generated, and the movement here is assisted by the
25 elastically pretensioned diaphragm 5, which reduces the energy consumption.

Since practically no dead spaces remain in the pump chamber and, in addition, the connection channels in
30 the base plate to the valves are kept extremely short and are thus of small volume, the diaphragm pump works efficiently immediately after the start of the suction stroke.

35 The valves themselves are arranged in a very thin valve plate 12.

It will be seen from the drawing that the novel diaphragm pump can be kept extremely small, for example

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compared to the drive motor. It is therefore particularly suitable for use in miniaturized devices (e.g. battery-operated breast pumps).

- 5 Figure 2 of the drawing shows the pump diaphragm 5 at the top dead center of the connecting rod 4, i.e. at the end of the ejection stroke. The diaphragm 5 here practically fills the entire pump chamber 7 (no dead space).

10

The hinge-like recesses 9, 10 are "compressed" in this position, so that the outer areas of the diaphragm are elastically pretensioned. By virtue of this pretensioning, the movement of the connecting rod 4
15 back to the bottom dead center is assisted (energy saving).

Patent claims

1. A diaphragm pump as suction pump, with an elastic pump diaphragm which is driven by a motor via a crank mechanism by means of a connecting rod and which spans a pump chamber provided in a base plate, characterized in that the pump chamber wall provided in the base plate extends in a conically widening manner from a central flat base section to the side edge, and the diaphragm spanning the pump chamber is configured and arranged in such a way that it bears substantially tightly against the entire pump chamber wall, and the side edge thereof, at the top dead center (TDC) of the connecting rod, with the result that there is practically no remaining dead space at the TDC of the connecting rod, the diaphragm being made of substantially inherently stiff elastic material of predetermined thickness and configuration, and its deformation, with simultaneous pretensioning, for adaptation to the pump chamber wall and the side edge of the pump chamber upon the connecting rod's stroke in the direction of the TDC, being ensured by at least one circularly extending recess in the rear wall of the diaphragm, which recess forms a hinge that can be elastically pretensioned, the circular recess in the rear wall of the diaphragm lies approximately in the area over the transition between the flat base section of the pump chamber and the conically widening wall section.

2. The diaphragm pump as claimed in claim 1, characterized in that a further circularly extending recess is provided in the rear wall of the diaphragm, which recess is concentric to the first recess in the area over the side edge of the pump chamber.

3. The diaphragm pump as claimed in claim 1 or 2, characterized in that inlet and outlet valves are provided in the base section of the pump chamber, which valves are arranged on the rear face of the thin-walled base plate in the area of said base section so that minimal dead spaces remain between valves and the pump chamber.

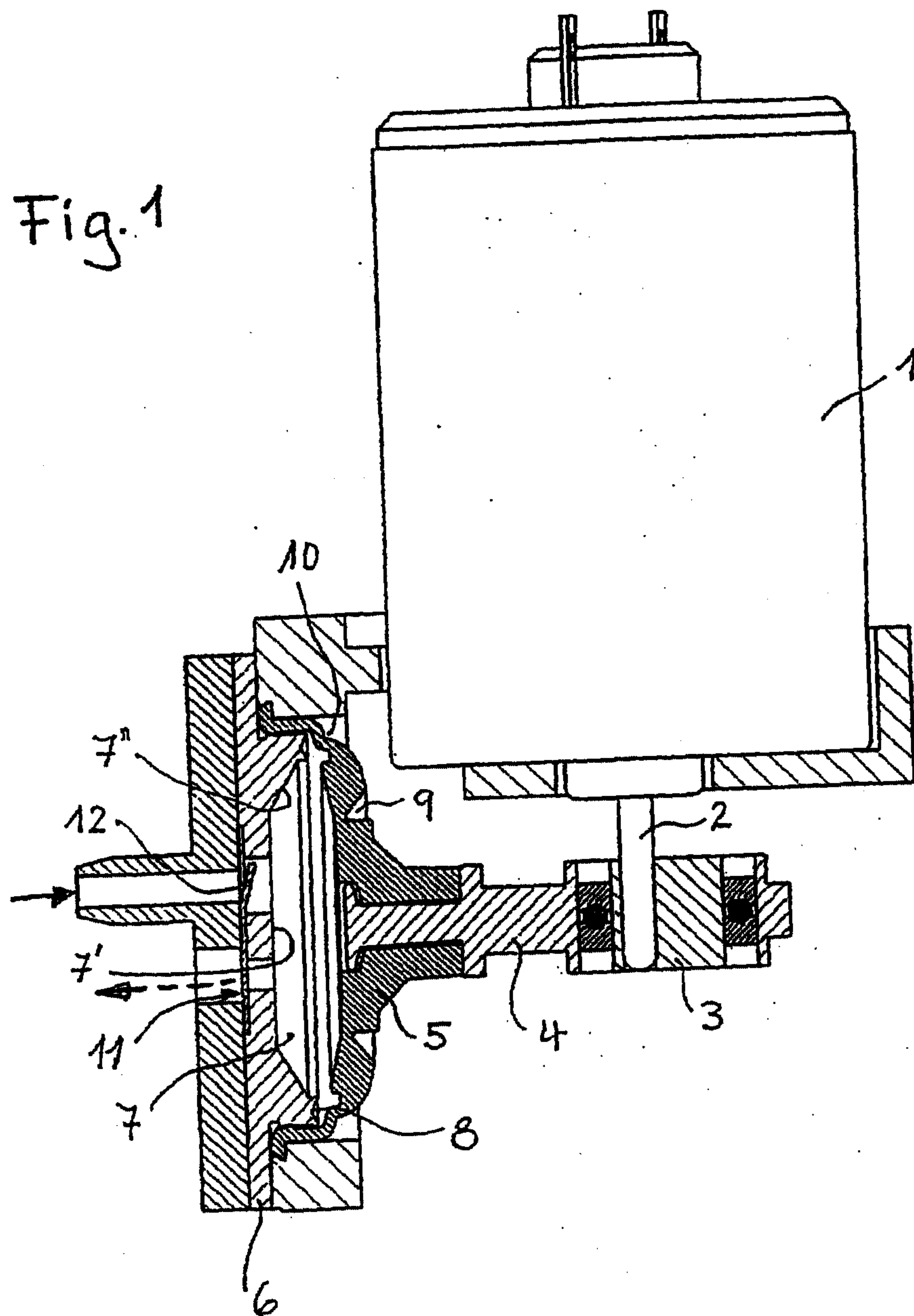
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4. The diaphragm pump as claimed in any one of claims 1 to 4, characterized in that the diaphragm is made of silicone.

5. The diaphragm pump as claimed in claim 4 wherein the diaphragm has a hardness of ca. 80 Shore.

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Fig. 1



2/2

Fig. 2

