(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 634 429 A1

(12) # EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
04.09.2013 Bulletin 2013/36

(21) Application number: **12771844.3**

(22) Date of filing: **09.04.2012**

(51) Int Cl.:
F04B 45/04 *(2006.01)* ***F04B 45/047*** *(2006.01)*

(86) International application number:
PCT/JP2012/059647

(87) International publication number:
WO 2012/141125 (18.10.2012 Gazette 2012/42)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **15.04.2011 JP 2011091237**

(71) Applicant: **Techno Takatsuki Co., Ltd.**
Takatsuki-shi
Osaka 569-0095 (JP)

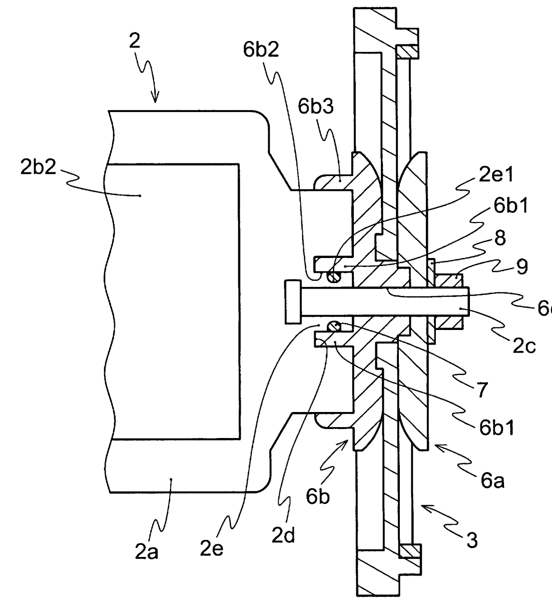
(72) Inventors:
- **ISHII, Hideki**
Takatsuki-shi
Osaka 569-0095 (JP)
- **TAKAMICHI, Tsuyoshi**
Takatsuki-shi
Osaka 569-0095 (JP)

(74) Representative: **Serjeants LLP**
25 The Crescent
King Street
Leicester, LE1 6RX (GB)

(54) **ELECTROMAGNETIC OSCILLATING DIAPHRAGM PUMP**

(57) Provided is an electromagnetic vibrating diaphragm pump capable of preventing fluid such as air from leaking to an oscillator side. A supporting member 2a has a magnet 2b2 provided thereon, and a disc-shaped diaphragm 3 is fixed to mounting screw parts 2c at both ends of the supporting member 2a of the oscillator 2 having the mounting screw parts 2c fixed at both ends of a central axis of the supporting member 2a. This diaphragm 3 is sandwiched by an inner center plate 6b and an outer center plate 6a and is fixed by inserting the mounting screw parts 2c of the oscillator 2 into a through hole 6c provided at the center of the outer and inner center plates 6a, 6b. A cylindrical projecting portion 6b1 is formed at the center of the inner center plate 6b on its oscillator 2 side, and this projecting portion 6b1 is fitted into the concave groove 2d formed at the ends of the supporting member 2a of the oscillator 2 so as to be sealed in an airtight manner with a ring-shaped elastic member 7 inbetween.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to an electromagnetic vibrating diaphragm pump utilized for aeration of septic tanks for home use, oxygen supply for fish culturing tanks, exhalation for whirlpool baths, and other applied equipment, etc. More specifically, it relates to an electromagnetic vibrating diaphragm pump structured to prevent fluid from passing through the fixing part between the end of an oscillator and a diaphragm and leaking into the pump from outside.

BACKGROUND ART

[0002] An electromagnetic vibrating diaphragm pump is structured to comprise diaphragms made of rubber, for example, fixed to both ends of an oscillator having magnets fixed thereto, and electromagnets are provided in a manner to face the magnets on the oscillator. The oscillator and the electromagnets are surrounded by a housing and pump casings covers the outer diaphragms. Additionally, the oscillator oscillates in accordance with the polarity change of the electromagnets changing in accordance with the change in the phase of an AC source applied to the electromagnets such that the diaphragms vibrate so as to repeatedly suction and discharge fluid such as air.

[0003] The oscillator and the diaphragm are fixed in a structure shown in Fig. 7, for example. Namely, in Fig. 7, 103 represents the oscillator and mounting screw parts 103c are firmly attached at both ends of a supporting member 103b having a permanent magnet 103a fixed thereto. While the diaphragm 104 made of rubber member, etc. has a through hole at its center, and is sandwiched between a center plate 107b on its electromagnet side (hereinafter referred to as inner, simply) where a projection fitting into this through hole is formed and a center plate 107a on its pump casing side, opposite to the electromagnet side, (hereinafter referred to as outer, simply). The mounting screw part 103c of the above-mentioned oscillator 103 is inserted into the through hole 110 provided at the center of these inner and outer center plates 107b, 107a, and fastened by a nut 106 from outside with a washer 105 inbetween, to do the fixing work (see Patent Document 1, for example). These outer and inner center plates 107a, 107b are made of metal plates or plastic, and fixed tightly to the oscillator 103 to withstand vibration. Here, the pump casing, although not illustrated, is provided to the outer side of this diaphragm 104. The pump casing comprises a compression chamber adjacent to the diaphragm, a suction chamber provided adjacent to the compression chamber interposed by a suction valve and an exhaust chamber provided adjacent to the compression chamber interposed by an exhaust valve.

PRIOR ART DOCUMENT

Patent Document

[0004] Patent Document 1: JP 2003-035266 A

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] The structure where the mounting screw part 103c of the oscillator 103 is inserted into the through hole 110 of the above described outer and inner center plates 107a, 107b so as to be fixed with the nut 106 is preferred in terms of very easy assembly. However, in some cases, a gap may be formed between the mounting screw part 103c and the through hole 110 of the outer and inner center plates 107a, 107b. Additionally, depending on how tightly the nut 106 is fastened, a gap may be formed between the end of the supporting member 103b and the inner center plate 107b, too. Therefore, there is an issue that fluid such as air suctioned into the compression chamber leaks to the oscillator 103 side where the electromagnet, etc. is arranged, as indicated by arrows a1, a2 in Fig. 7.

[0006] When such liquid leakage causes the amount of fluid discharged from the compression chamber to decrease to less than the amount of fluid suctioned into the compression chamber, the utilization ratio of fluid such as air suctioned into the compression chamber decreases, which is not preferred because it reduces pump efficiency. Moreover, in some cases, dangerous gas such as hydrogen for a hydrogen circulation pump, etc. may be discharged with a pump. It is dangerous to allow such gas to leak to the electromagnet side. Furthermore, because in some cases liquid may be suctioned or discharged, there is a problem that liquid flowing to the electromagnet side causes a short circuit in an electric system such as an electromagnet coil and so on.

[0007] On the other hand, as a method for preventing such liquid leakage, for example, it is possible to seal with a gasket between the washer 105 and the outer center plate 107a. However, if the oscillator 103 is fixed with a gasket inbetween, it becomes difficult to securely seal between the mounting screw part 103c and the through hole 110 of the outer and inner center plates 107a, 107b depending on how tightly the nut 106 is fastened. Moreover, if a gasket is provided between the washer 105 and the outer center plate 107a, the oscillator 103 can be tilted depending on how tightly the nut 106 is fastened, and the tilt, if any, allows the gap between the oscillator 103 and the electromagnet to vary easily, which leads to an issue of difficulty in stabilizing diaphragm pump performance among products.

[0008] Moreover, the issue of fluid leakage of the electromagnetic vibrating pump is not limited only to between the oscillator 103 and the outer and inner center plates 107a, 107b. For example, a conventional electromagnetic vibrating diaphragm pump had a diaphragm support 108 and a partition wall 109a constituting a compression chamber (not illustrated) of a pump casing 109 sandwiching the outer periphery end 104a of a diaphragm 104 as shown in Fig. 8, the outer periphery end 104a of the diaphragm 104 and the partition wall 109a of the compression chamber (not illustrated) of the pump casing 109 assembled by just being placed on each other. Therefore, fluid suctioned into the compression chamber (not illustrated) of a pump leaks out of the pump casing 109 through the gap between a flange 104a of the diaphragm 104 and the partition wall 109a of the pump casing 109, following the order indicated by arrows b1-b3, and thus the amount of the fluid discharged from the compression chamber decreased to less than the amount of fluid suctioned into the compression chamber, to raise an issue of decreasing pump performance.

[0009] The present invention was made in the light of the above conditions, and the object of the present invention is to provide an electromagnetic vibrating diaphragm pump which improves pump efficiency by preventing fluid such as air from leaking out to the oscillator side while stabilizing pump performance among products by maintaining a gap between the oscillator and the electromagnet constantly among products, and does not cause damage to components or harm to human bodies, etc. even when suctioning and discharging liquid or dangerous gas such as hydrogen.

[0010] Moreover, another object of the present invention is to improve the pump efficiency by preventing the leakage of air, etc. from the abutment surface of the pump casing and the diaphragm.

MEANS TO SOLVE THE PROBLEM

[0011] The electromagnetic vibrating diaphragm pump of the present invention comprises an oscillator having two magnets on at least one surface side of a plate-like supporting member made of non-magnetic material and having mounting screw parts fixed to both ends of a central axis of the supporting member, disc-shaped diaphragms fixed to the mounting screw parts at both ends of the supporting member, an electromagnet provided to face the magnets and pump casings fixed to respective outer peripheries of the diaphragms provided at both ends and individually covering the outer side of the diaphragms, wherein the diaphragm is sandwiched by an inner center plate provided on the magnet side of the diaphragm and an outer center plate provided on the side opposite to the magnet side of the diaphragm, the end of the oscillator is inserted into and fixed to a through hole provided at the center of the inner and outer center plates, a cylindrical projecting portion is formed at the center of the inner center plate on the oscillator side, and a concave groove capable of fitting the projecting portion is formed at the end of the supporting member of the oscillator such that the projecting portion and the concave groove are sealed in an airtight manner with a ring-shaped elastic member inbetween.

[0012] It is preferred that a protruding portion holding the side surfaces of both ends of the supporting member constituting the oscillator is formed on the surface of the inner center plate on its oscillator side so as to position the supporting member. The side surface herein includes, in addition to the side surface in the thickness direction of the plate-like supporting member, the side at the end of the planar part of the plate-like supporting member.

[0013] It is preferred that the pump casing has a compression chamber adjacent to the diaphragm, an exhaust chamber connected to the compression chamber via an exhaust valve and a suction chamber connected to the compression chamber via a suction valve, and a rib digging into the diaphragm is formed on a joint surface jointing the diaphragm on the partition wall of the compression chamber.

EFFECTS OF THE INVENTION

[0014] The electromagnetic vibrating diaphragm pump of the present invention is structured such that a cylindrical projecting portion is provided at the center of an inner center plate on its oscillator side and a concave groove capable of fitting the projecting portion is formed at the end of a supporting member of the oscillator, the projecting portion and the concave groove being sealed in an airtight manner with a ring-shaped elastic member inbetween. Therefore, with the groove formed beforehand on an outer periphery of a site where a mounting screw part is fixed at both ends of the supporting member of the oscillator and with an O-ring and the like inserted in this groove, by only press-fitting the mounting screw part into a through hole of the inner center plate, assembly work can be done and also airtight sealing can be ensured. Furthermore, because this sealing is a closely attached sealing in radial direction, of the concave groove formed on the supporting member of the oscillator, the ring-shaped elastic member fitting into the concave groove and the cylindrical projecting portion, the dimension among components such as a gap between the oscillator and the electromagnet is not affected, regardless of the strength of the elasticity. Therefore, it is possible to stabilize pump performance among products. In addition, even when an unexpected external force is applied to the oscillator, for example during assembling stage, it has an effect of preventing damage to the diaphragm because of its absorptive capacity for such a large external force. By providing such ring-shaped elastic member, the amount of fluid discharged from the compression chamber is not less than the amount of fluid suctioned into the compression chamber, and as a result, the decrease of pump performance can be prevented. Furthermore, if the fluid is liquid, it is possible to prevent pump failure due to short-circuited electromagnet coils, etc. when fluid penetrates to the oscillator side from taking place.

[0015] Furthermore, on the surface of the inner center plate on its oscillator side, a protruding portion for holding the side surfaces of both ends of the supporting member is formed such that the oscillator is prevented from rotating with respect to the inner center plate and the positioning of the supporting member can be performed easily, allowing stable operation of the pump. In addition, because the protruding portion of the inner center plate can be served as a guide when inserting the mounting screw part of the oscillator into the through hole formed on the center plates, the supporting member of the oscillator and the inner center plate are assembled easily.

[0016] Furthermore, by forming a rib digging into the diaphragm on the joint surface jointing the diaphragm on the partition wall of the compression chamber of the pump casing, situations are avoided where liquid suctioned into the compression chamber leaks out from the gap produced at the joint between the diaphragm and the pump casing and the amount of fluid discharged from the compression chamber is less than the amount of fluid suctioned into the compression chamber. As a result, it is possible to prevent decreasing of pump performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

(FIG. 1) A sectional explanatory view of one embodiment of the electromagnetic vibrating diaphragm pump of the present invention.

(FIG.2) A schematic explanatory view of the electromagnet and oscillator part of the electromagnetic vibrating diaphragm pump shown in Fig. 1.

(FIG.3) A sectional explanatory view showing the mounting part between the diaphragm and the oscillator of Fig. 1.

(FIG.4) A side view of the end of the oscillator on the inner center plate side.

(FIG.5) A front view of the inner center plate as seen from the oscillator side.

(FIG.6) An enlarged view of a portion A of Fig. 1.

(FIG.7) A sectional explanatory view showing a conventional example of a mounting part of an oscillator and a diaphragm.

(FIG.8) A sectional explanatory view showing a conventional example of a joint portion between a conventional diaphragm and partition wall of a compression chamber.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0018] The embodiments of the present invention will be described below with reference to Figs. 1-6.

[0019] Fig. 1 shows a sectional explanatory view of an electromagnetic vibrating diaphragm pump according to the first embodiment of the present invention, and Fig. 2 shows a schematic explanatory view of an electromagnet and oscillator part of the electromagnetic vibrating diaphragm pump shown in Fig. 1. As shown in Fig. 1, this electromagnetic vibrating diaphragm pump 1 (hereinafter abbreviated as pump) comprises an oscillator 2 having two magnets (permanent magnets) 2b1, 2b2 provided on a plate-like supporting member 2a made of nonmagnetic material and having mounting screw parts 2c fixed at both ends of a central axis of the supporting member 2a, disc-shaped diaphragms 3 fixed to the mounting screw parts 2c at both ends of the supporting member 2a of the oscillator 2, electromagnets 4a, 4b provided to face the magnets 2b1, 2b2, and pump casings 5 fixed to outer peripheries of the respective diaphragms 3 and covering the outer side of the respective diaphragms 3. The mounting screw part 2c is closely attached and fixed, for example by being integrally molded onto the supporting member 2a made of resin during the formation of the supporting member 2a by resin molding, etc.

[0020] The diaphragm 3 is sandwiched by an inner center plate 6b provided on its magnet 2b1, 2b2 side of the diaphragm 3 and an outer center plate 6a provided on the side opposite to the magnet 2b1, 2b2 side of the diaphragm 3, and the mounting screw parts 2c fixed to the oscillator 2 are inserted into the through hole 6c provided at the center of the outer and inner center plates 6a, 6b and then fastened from outside through a washer 8 by a nut 9, such that the supporting member 2a of the oscillator 2 and the diaphragm 3 are fixed to each other.

[0021] As shown in Fig. 3, a cylindrical projecting portion 6b1 is formed at the center of the inner center plate 6b on its oscillator 2 side, a concave groove 2d capable of fitting the projecting portion 6b1 of the inner center plate 6b is formed at the end of the supporting member 2a of the oscillator 2, and the projecting portion 6b1 of the inner center plate 6b and the concave groove 2d of the supporting member 2a of the oscillator 2 are sealed in an airtight manner with an O-ring 7 inbetween as a ring-shaped elastic member.

[0022] As shown in Fig. 2, the electromagnets 4a, 4b comprise E-shaped electromagnet cores 4a1, 4b1 and electromagnet coils 4a2, 4b2 wound around the electromagnet cores 4a1, 4b1. As shown in Fig. 1 and Fig. 2, two magnets 2b1, 2b2 are mounted to the supporting member 2a of the oscillator 2 and these magnets 2b1, 2b2 extend in width direction of the supporting member 2a.

[0023] A plate-like ferrite magnet or rare earth magnet, etc. can be used as these magnets 2b1, 2b2, and the magnets 2b1, 2b2 are individually magnetized. The magnet 2b1, for example, presents north pole on the surface of its electromagnet 4a side and south pole on the surface of its electromagnet 4b side while the magnet 2b2 presents south pole on the surface of its electromagnet 4a side and north pole on the surface of its electromagnet 4b side. On application of AC current to the electromagnets 4a, 4b, either one of the electromagnets 4a, 4b has north pole at its center and south poles on both sides of it, while the other one has south pole at its center and north poles on its both sides, and these north pole and south pole change alternately in accordance with the change in the phase of an AC generator, such that the magnetic action of the magnets 2b1, 2b2 provided on the supporting member 2a of the oscillator 2 causes attraction and repulsion forces between the magnets 2b1, 2b2 so as to allow the oscillator 2 to move in a reciprocating motion in axial direction. Accordingly, the diaphragm 3 vibrates so that the pump 1 suctions and discharges fluid repeatedly. These magnets 2b1, 2b2 also can be tightly fixed to the supporting member 2a, for example by being integrally molded onto the resin of the supporting member 2a during the formation of the supporting member 2a by resin molding, etc..

[0024] A diaphragm 4 can be formed of ethylene propylene rubber (EPDM) or fluoro-rubber, etc. The center plates 6a, 6b can be formed of metal or plastic, etc. Because this diaphragm 4 is sandwiched at its center by the outer center plate 6a and the inner center plate 6b, the through hole 6c communicates with from the outer center plate 6a to the inner center plate 6b through the diaphragm 3.

[0025] As shown in Fig. 1, the pump casing 5 is structured to be divided into a compression chamber 5A on the diaphragm 3 side, a suction chamber 5B and an exhaust chamber 5C by partition walls. A suction valve 5a is provided between the compression chamber 5A and the suction chamber 5B such that when the volume of the compression chamber 5A increases to decrease a pressure, the suction valve 5a opens to allow fluid to flow in from the suction chamber 5B, and when the volume of the compression chamber 5A decreases to increase pressure, the suction valve 5a closes. While an exhaust valve 5b is provided between the compression chamber 5A and the exhaust chamber 5C so that when the volume of the compression chamber 5A decreases to increase pressure, this exhaust valve 5b opens to allow the fluid such as air in the compression chamber 5A to be discharged to the exhaust chamber 5C.

[0026] Next, a method of fixing the outer and inner center plates 6a, 6b sandwiching the diaphragm 3 at its center to the oscillator 2 will be described with reference to Fig. 3. First, a cylindrical projecting portion 6b 1 is formed at the center of the inner center plate 6b on its oscillator 2 side. While, at both ends of the supporting member 2a of the oscillator 2, a circular concave groove 2d terminated at the edges of side surfaces 2a2 (see Fig. 4) in thickness direction of the supporting member 2a at the end is formed such that the above-mentioned projecting portion 6b1 fits around the mounting screw part 2c.

[0027] Moreover, a cylindrical portion 2e is formed because of this concave groove 2d at the center of the end of the supporting member 2a, and a ring-shaped groove 2e1 where a ring-shaped elastic member 7 can be inserted is formed on the outer periphery of the cylindrical portion 2e. With an O-ring 7, as the ring-shaped elastic member, mounted to this ring groove 2e1, the mounting screw part 2c is press fitted and embedded into the through hole 6c extending through the center plates 6a, 6b and the diaphragm 4. Then, the top end of the mounting screw part 2c projecting on the pump casing 5 side (right side of the drawing) is fastened through the washer 8 by the nut 9 so that the supporting member 2a of the oscillator 2 and the diaphragm 3 can be fixed to each other.

[0028] Here, because the O-ring 7 is formed to have a larger diameter than that of the cylindrical portion 2e, it is pressurized more strongly to contact with an inner wall surface 6b2 of the projecting portion 6b1 of the inner center plate 6b, as well.

[0029] With such structure, when fluid (liquid or gas) suctioned into the compression chamber 5A is about to invade from the pump casing 5 side through the gap between the through hole 6c formed on the diaphragm 3 and the outer and inner center plates 6a, 6b and the mounting screw part 2c to the inside of the housing 10 having the oscillator 2 positioned therein, this invasion can be prevented by the O-ring 7. Therefore, the amount of fluid discharged from the compression chamber 5A is not less than the amount of fluid suctioned into the compression chamber 5A, and as a result, it is possible to prevent the decrease of the performance of the pump 1. Additionally, if the fluid is liquid, a failure of the pump 1 due to a short circuit caused by the invasion of the fluid to the oscillator 2 side can be prevented from taking place. Furthermore, because the pressure of the O-ring 7 is only in radial direction perpendicular to axial direction of the oscillator 2, it is not affected by how tightly the mounting screw part 2c is fastened at a screw clamp part, and dimensional variation among members, etc. such as decentralization of oscillator 2 is not caused. Therefore, the performance of the pump 1 can be stabilized among products. Then, with the ring groove 2e1 formed beforehand on the outer periphery of the cylindrical portion 2e of the supporting member 2a of the oscillator 2, only by inserting the O-ring 7 into the ring groove 2e1 and press fitting it into the through hole 6c of the inner center plate 6b, the oscillator 2 and the diaphragm 3 can be assembled, and thus work efficiency during the assembly of the oscillator 2 and the diaphragm 3 is not worsened. Additionally, even when an unexpected external force is applied to the oscillator 2 during an assembling stage of the oscillator 2 and the diaphragm 3 and the like, the diaphragm is not damaged because of absorptive capacity of the O-ring 7 for such a large external force.

[0030] By the way, in this embodiment, as shown in Fig. 5, two U-shaped protruding portions 6b3, 6b4 are formed outside the cylindrical portion 6b1 on the inner center plate 6b in a manner to sandwich the cylindrical portion 6b1, and the protruding portions 6b3, 6b4 are formed in a manner to entirely cover the outer peripheral side surface of the end of the supporting member 2a. These protruding portions 6b3, 6b4 are structured to hold side surfaces excluding the cylindrical portion 2e at both ends of the supporting member 2a of the oscillator 2. Here, the "side surfaces" include a surface 2a1 in the thickness direction of the oscillator 2 and a surface 2a2 at the end of the planar part as shown in Fig. 4. Accordingly, even when the oscillator 2 is about to rotate with respect to the inner center plate 6b, the side surface 2a2 of the supporting member 2a of the oscillator 2 is stuck at the protruding portions 6b3, 6b4 of the inner center plate 6b, and thus the oscillator 2 can be prevented from rotating. Thus, the pump 1 can be operated in a stable manner. Furthermore, the protruding portions 6b3, 6b4 serve as a guide when inserting the mounting screw part 2c of the oscillator 2 into the through hole 6c extending through the diaphragm 3 and the center plates 6a, 6b, so as to make the insertion work easy.

[0031] As shown in Fig. 1 and Fig. 6 which is an enlarged view of the portion A of Fig. 1, the diaphragm 3 has a flange 3a formed on the outer peripheral edge and this flange 3a is sandwiched by a diaphragm support 11 and the partition wall 5A1 of the compression chamber 5A of the pump casing 5 such that diaphragm 3 is fixed.

[0032] In this embodiment, as shown in Fig. 6, a circular rib 5A3 is provided, by integral molding, on the abutment surface 5A2 jointing the flange 3a of the diaphragm 3 on the partition wall 5A1 of the compression chamber 5A, and this circular rib 5A3 digs into the abutment surface 3a1 jointing the partition wall 5A of the pump casing 5 at the flange 3a of the diaphragm 3. Therefore, the sealing between the partition wall 5A1 of the compression chamber 5A of the pump casing 5 and the flange 3a of the diaphragm 3 can be improved. As a result, the amount of fluid suctioned into the compression chamber 5A is prevented from decreasing to less than the amount of fluid discharged from the compression chamber 5A, and it is possible to prevent the decrease of the performance of the pump.

[0033] Additionally, if the circular rib 5A3 is provided on the partition wall 5A of the pump casing 5 as done in this embodiment, the circular rib 5A3 is not affected by the deformation of the diaphragm 3 during the operation of the pump 1, and thus the sealing as a rib is stabilized so that operation status of the pump 1 can be stabilized eventually.

Explanation of Symbols

[0034]

1	Electromagnetic vibrating diaphragm pump
2	Oscillator
2a	Supporting member
2a1, 2a2	Side surfaces
2b1, 2b2	Magnets
2c	Mounting screw part
2d	Concave groove
2e	Cylindrical portion
2e1	Ring-shaped groove
3	Diaphragm
3a	Flange
3a1	Abutment surface
4a, 4b	Electromagnets
4a1, 4b1	Electromagnet cores
4a2, 4b2	Electromagnet coils
5	Pump casing
5A	Compression chamber
5A1	Partition wall
5A2	Abutment surface
5A3	Circular rib
5B	Suction chamber
5C	Exhaust chamber
5a	Suction valve
5b	Exhaust valve
6a	Outer center plate
6b	Inner center plate
6b1	Projecting portion
6b2	Internal wall surface
6b3, 6b4	Protruding portions
6c	Through hole
7	O-ring
10	Housing
11	Diaphragm support

Claims

1. An electromagnetic vibrating diaphragm pump comprising:

an oscillator having two magnets provided on at least one surface side of a plate-like supporting member made of non-magnetic material and having mounting screw parts fixed to both ends of a central axis of the supporting member;
disc-shaped diaphragms fixed to the mounting screw parts at both ends of the supporting member;
an electromagnet provided to face the magnets; and
pump casings fixed to respective outer peripheries of the diaphragms provided at the both ends and individually covering the outer side of the diaphragms,
wherein the diaphragm is sandwiched by an inner center plate provided on the magnet side of the diaphragm and an outer center plate provided on the side opposite to the magnet side of the diaphragm, the end of the oscillator is inserted into and fixed to a through hole provided at the center of the inner and outer center plates, and a cylindrical projecting portion is formed at the center of the inner center plate on the oscillator side, and a concave groove capable of fitting the projecting portion is formed at the end of the supporting member of the oscillator such that the projecting portion and the concave groove are sealed in an airtight manner with a ring-shaped elastic member inbetween.

2. The electromagnetic vibrating diaphragm pump according to claim 1, wherein a protruding portion for holding the side surfaces of both ends of the supporting member constituting the oscillator is formed on the surface of the inner center plate on its oscillator side so as to position the supporting member.

3. The electromagnetic vibrating diaphragm pump according to claim 2, wherein the protruding portions are formed in a manner to entirely cover the outer peripheral side surface of the end of the supporting member.

4. The electromagnetic vibrating diaphragm pump according to any of claims 1-3, wherein the concave groove is a circular concave groove terminated at the edges of side surfaces in thickness direction of the supporting member at the end.

5. The electromagnetic vibrating diaphragm pump according to any of claims 1-4, wherein the pump casing has a compression chamber adjacent to the diaphragm, an exhaust chamber connected to the compression chamber via an exhaust valve and a suction chamber connected to the compression chamber via a suction valve, and a rib digging into the diaphragm is formed on a joint surface jointing the diaphragm on a partition wall of the compression chamber.

6. The electromagnetic vibrating diaphragm pump according to claim 5, wherein the rib is formed to be circular and digs into a flange part formed at the end of the diaphragm in a circular manner so that the partition wall and the diaphragm are jointed.

7. The electromagnetic vibrating diaphragm pump according to claim 6, wherein the mounting screw part is integrally fixed to the supporting member made of resin during the formation of the supporting member by resin molding.

8. The electromagnetic vibrating diaphragm pump according to any of claims 1-7, wherein the diaphragm is formed of ethylene propylene rubber (EPDM) or fluoro-rubber compact.

9. The electromagnetic vibrating diaphragm pump according to any of claims 1-8, wherein the magnets are permanent magnets made of a plate-like ferrite magnet or rare earth magnet.

10. The electromagnetic vibrating diaphragm pump according to claim 9, wherein the magnets are integrally fixed to the supporting member made of resin during the formation of the supporting member by resin molding.

FIG. 1

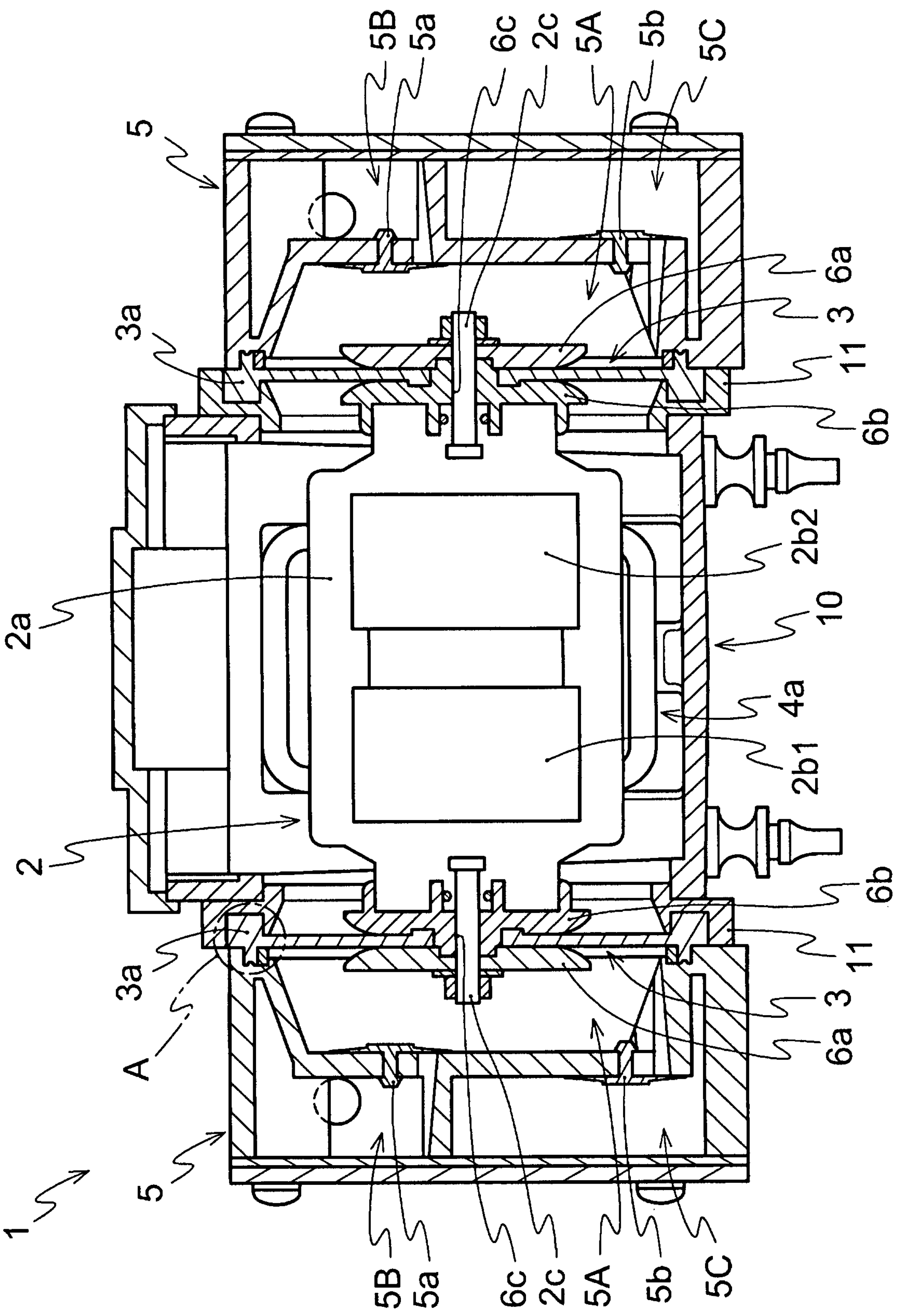


FIG. 2

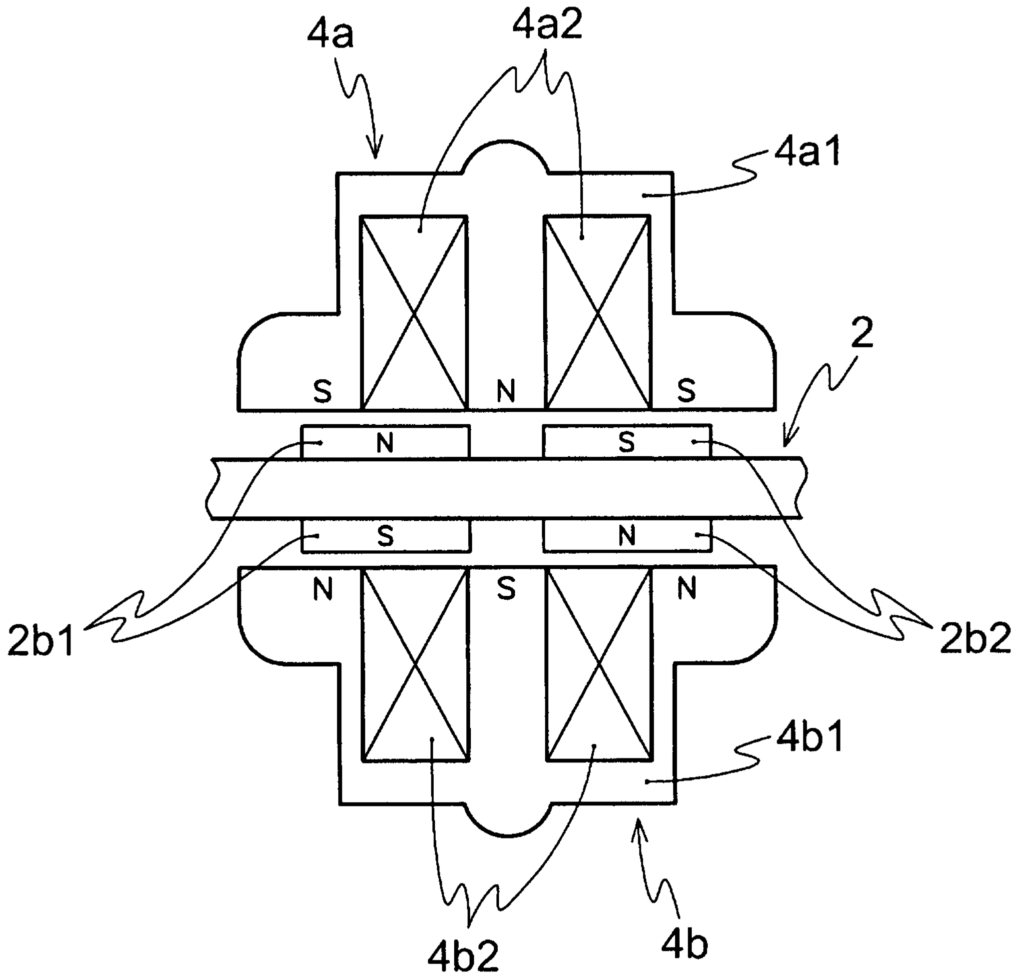


FIG. 3

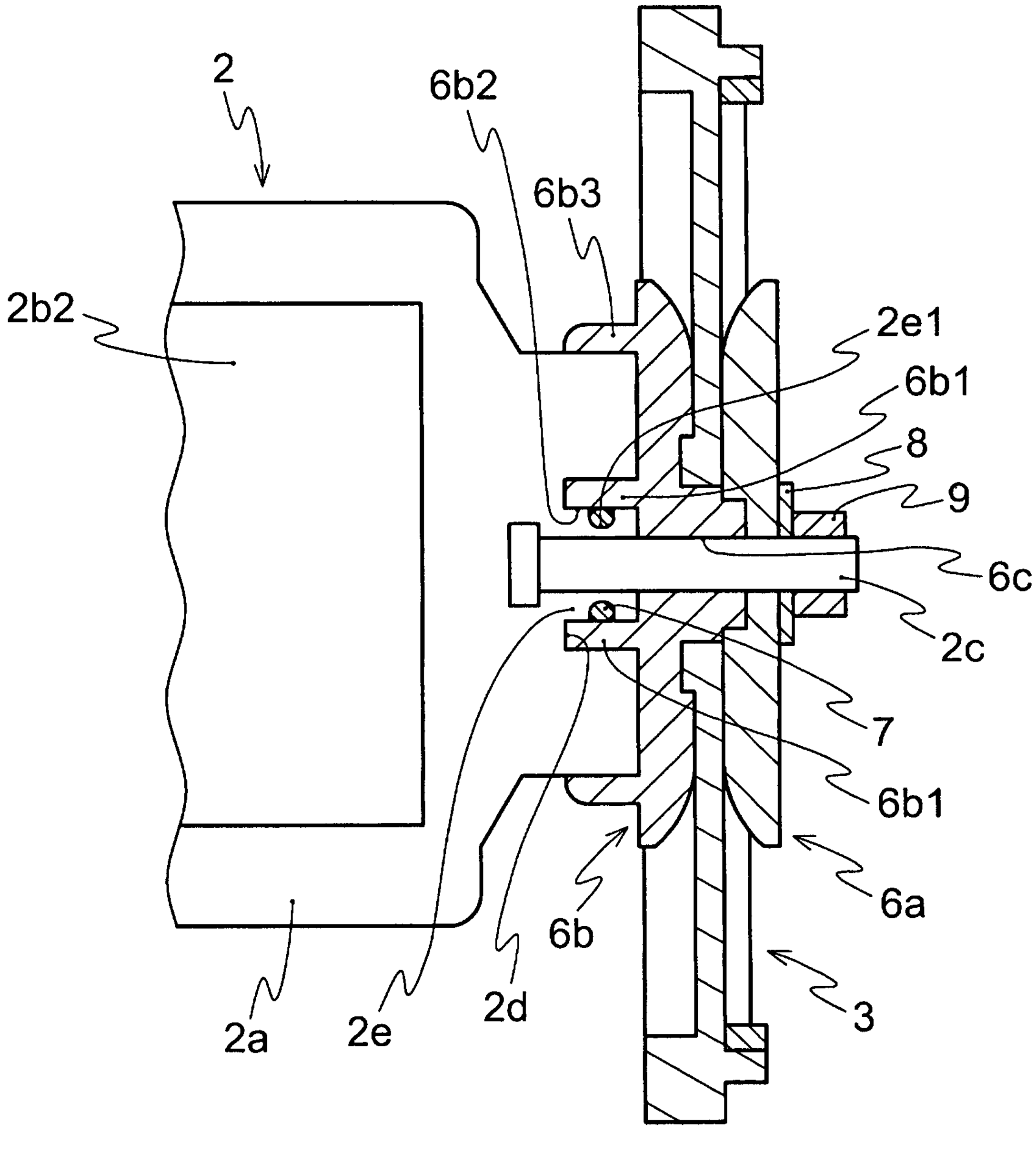


FIG.4

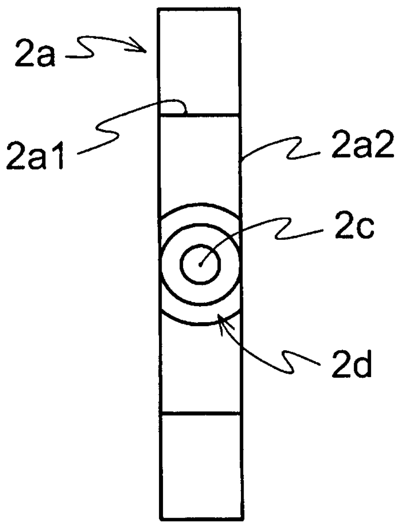


FIG.5

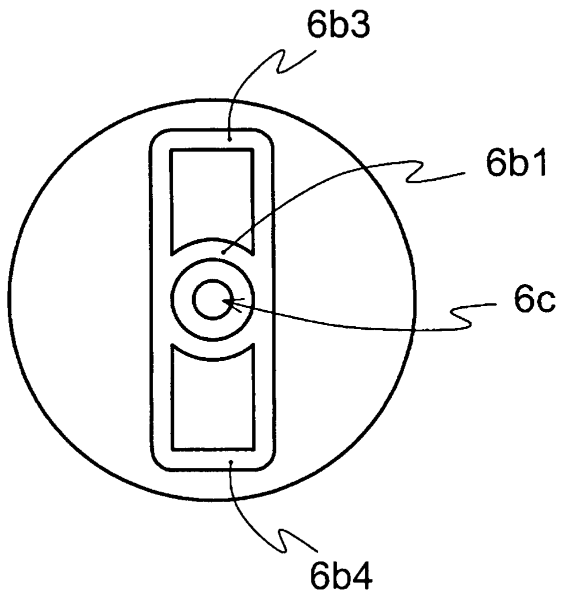


FIG. 6

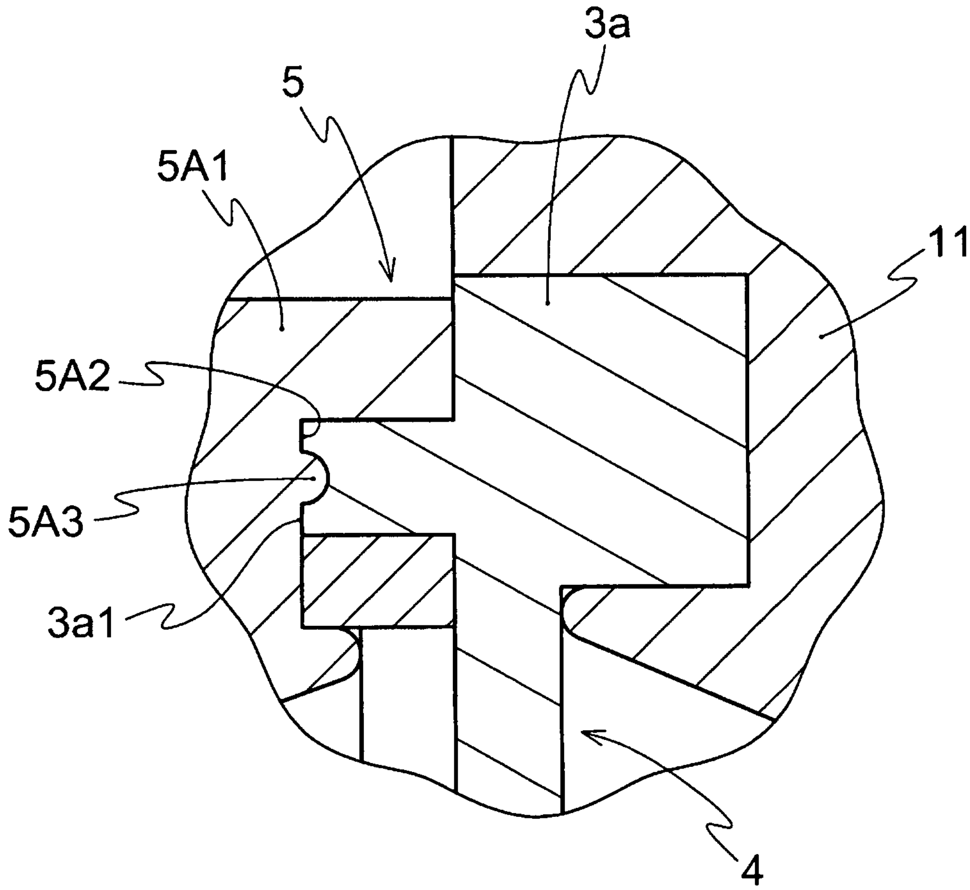


FIG. 7

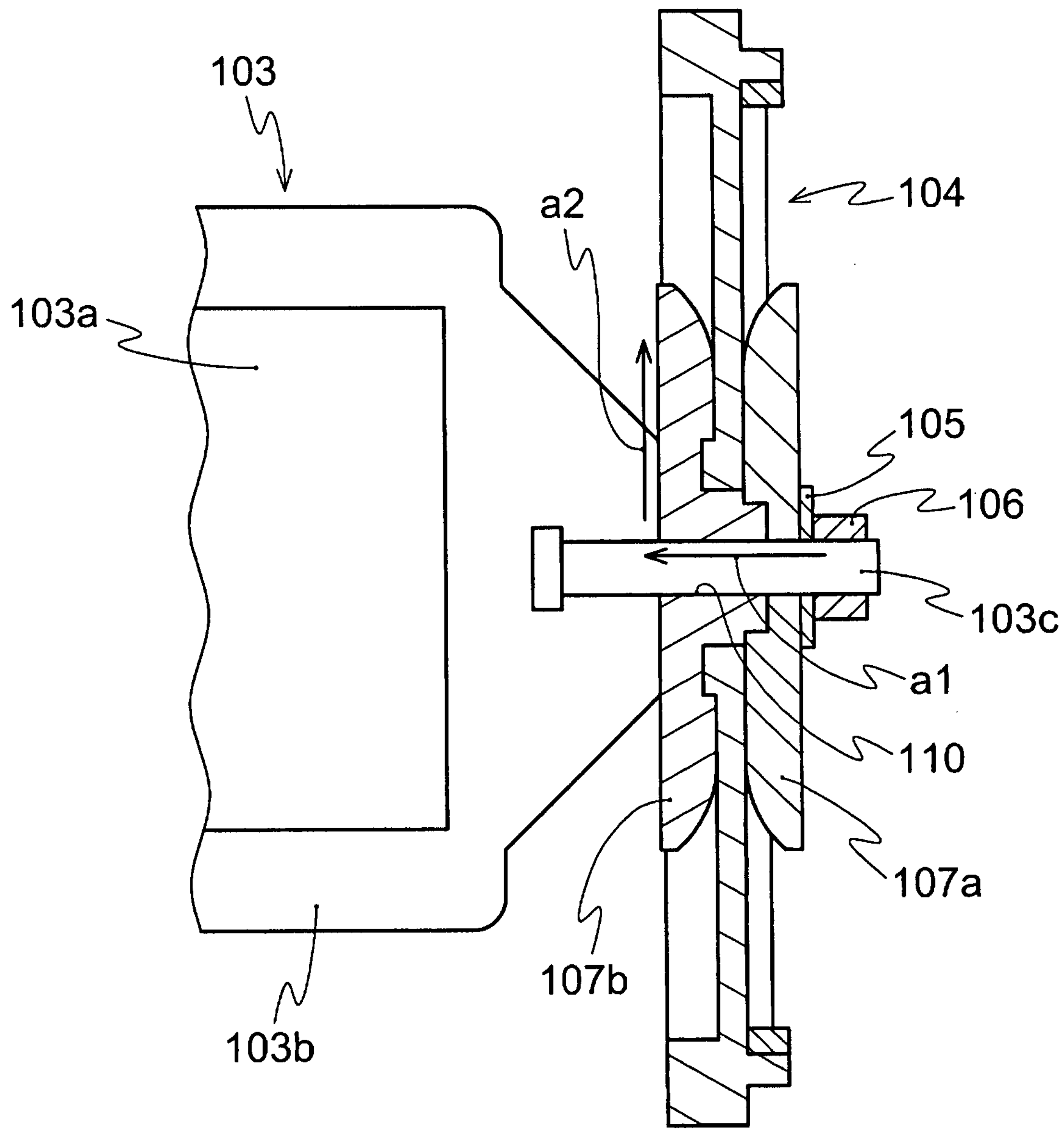
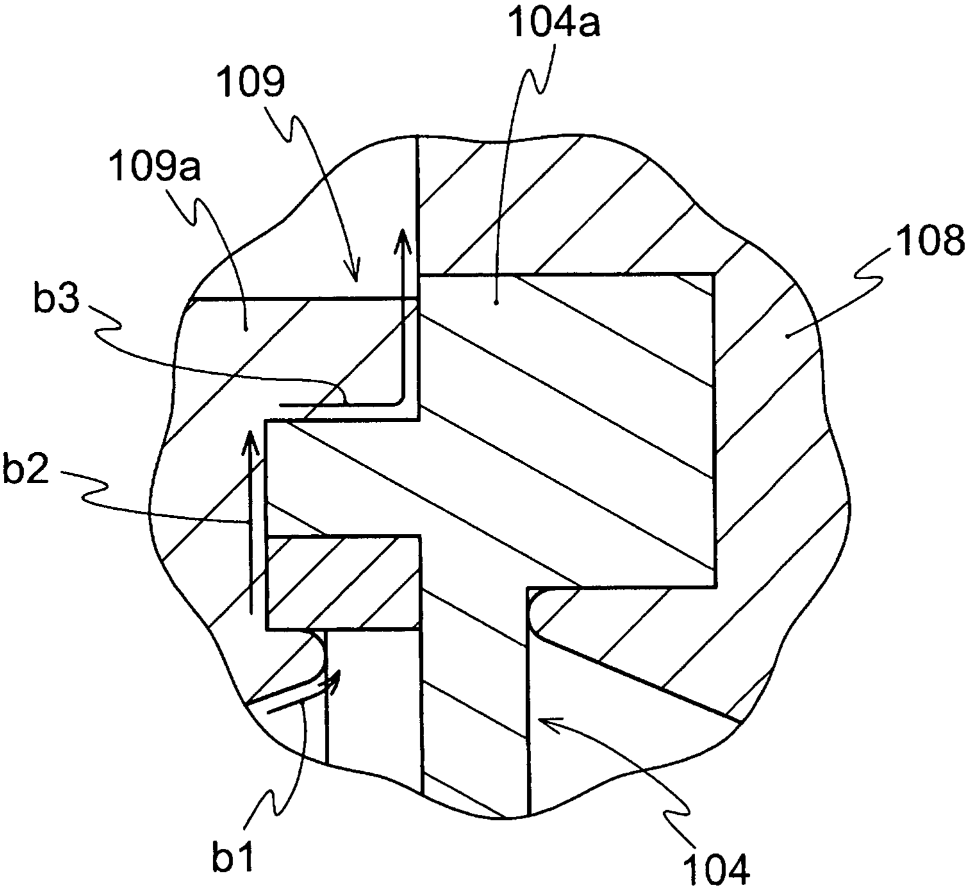


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/059647

A. CLASSIFICATION OF SUBJECT MATTER
F04B45/04(2006.01)i, *F04B45/047*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04B45/04, F04B45/047

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2000-170662 A (The Fujikura Rubber Ltd.), 20 June 2000 (20.06.2000), paragraphs [0018] to [0020], [0025] to [0027]; all drawings (Family: none)	1-3,5-10 4
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 7377/1981(Laid-open No. 120781/1982) (Eritsuhi Betsuka), 27 July 1982 (27.07.1982), specification, page 9, lines 8 to 13; fig. 2 (Family: none)	1-3,5-10 4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 June, 2012 (06.06.12)	19 June, 2012 (19.06.12)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/059647

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-150959 A (Techno Takatsuki Co., Ltd.), 03 July 2008 (03.07.2008), paragraph [0012]; fig. 1 to 5 (Family: none)	2-3,5-10
Y	JP 2005-180224 A (NOK Corp.), 07 July 2005 (07.07.2005), paragraph [0029]; fig. 1 to 2 (Family: none)	5-10
Y	JP 2004-138009 A (Techno Takatsuki Co., Ltd.), 13 May 2004 (13.05.2004), paragraph [0023]; fig. 12 to 13 (Family: none)	7-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003035266 A **[0004]**