



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 022 464 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.07.2000 Bulletin 2000/30

(51) Int. Cl.⁷: **F04B 39/10**

(21) Application number: **00300057.7**

(22) Date of filing: **06.01.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **19.01.1999 JP 1048399**

(71) Applicant: **Sanden Corporation**
Isesaki-shi, Gunma 372-8502 (JP)

(72) Inventors:
• **Hashimoto, Kenji,**
c/o Sanden Corporation
Gunma, 372-8502 (JP)
• **Ichikawa, Yoshinobu,**
c/o Sanden Corporation
Gunma, 372-8502 (JP)

(74) Representative: **Haley, Stephen**
Gill Jennings & Every,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

(54) **Compressor valve**

(57) In a fluid suction/discharge apparatus, a recess is formed with a cylinder and extends from a closed end of the cylinder in the axial direction of the cylinder. The recess comprises deep and shallow recess portions both integral with each other. The shallow recess portion has a bottom to receive a flexible end of the suction reed valve in a suction condition. The deep recess por-

tion forms a passage for fluid while the flexible end of the suction reed valve is received on the bottom of the shallow recess portion. With such structure, the passage for the fluid becomes wide, so that the vibration of the suction reed valve can be prevented.

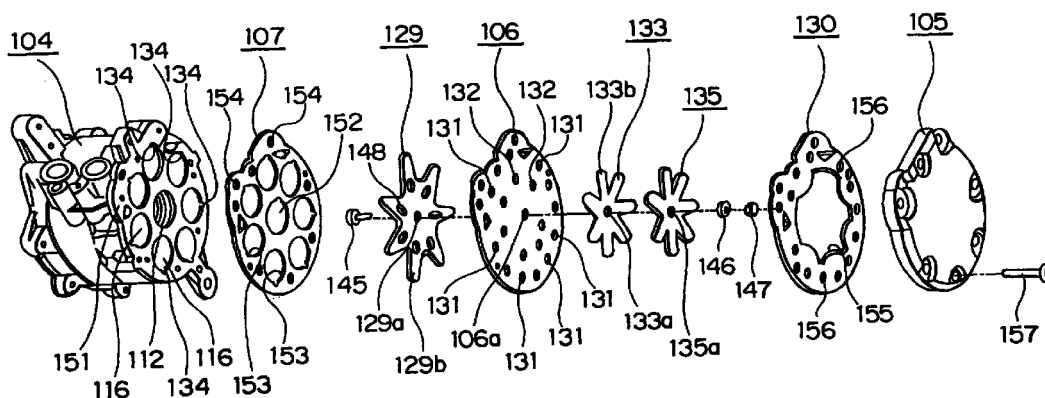


FIG. 2

Description

[0001] This invention relates to a fluid suction/discharge apparatus, such as a fluid compressor, and, in particular, to improvements of a valve mechanism of such an apparatus.

[0002] A fluid suction/discharge apparatus generally includes a cylinder block defining a cylinder bore of a cylinder, which has a closed end. The closed end is formed by a valve plate that is secured to the cylinder block. The valve plate has an inlet port for fluid suction, and an outlet port for fluid discharge. In such an apparatus, a piston is slidably close-fitted into the cylinder, and therefore, can slide in the axial direction of the cylinder. As the piston approaches, or moves towards, the closed end of the cylinder, the fluid is discharged from inside of the cylinder through the outlet port. On the other hand, as the piston leaves, or moves away from, the closed end, the fluid is sucked, or introduced, into the inside of the cylinder through the inlet port.

[0003] In addition, the apparatus further has a suction reed valve disposed on the inner surface of the closed end, and a discharge reed valve disposed on the outer surface of the closed end. The suction reed valve extends along the inner surface over the inlet port, with one end of the suction reed valve fixed to the cylinder, and the other end of the suction reed valve being flexible in the axial direction.

[0004] In detail, the cylinder is integrally formed with a recess in the inner surface thereof. The recess extends from the closed end of the cylinder in the axial direction. The recess has a bottom to receive the flexible end of the suction reed valve in a suction condition.

[0005] The existing apparatus has at least one shortcoming. For example, when the piston moves away from the closed end, the suction reed valve bends, and thereby, the inlet port opens. As the suction reed valve starts to bend, a gap is formed between the suction reed valve and the valve plate. The gap partially opens into the recess, so that the gap and the inlet port form a passage for fluid to flow therethrough into the cylinder. At this time, the introduced fluid passes through the passage, and then, interacts with the bottom of the recess and "bounces" back therefrom. The "bounced" fluid forms an eddy between the bottom and the suction reed valve. This eddy prevents the suction reed valve from touching the bottom, so that the passage for fluid narrows. In addition, the eddy causes the suction reed valve to vibrate. Such vibration results in a jarring noise, which can be annoying to a passenger in a vehicle in which the fluid compressor is used.

[0006] This invention therefore provides a fluid suction/discharge apparatus which can prevent the vibration of the suction reed valve in the suction condition.

[0007] According to the present invention, in a fluid suction/discharge apparatus, a recess, which is formed with a cylinder and extends from a closed end of the cylinder in the axial direction of the cylinder, comprises

deep and shallow recesses that are integral with each other. The shallow recess has a bottom to receive a flexible end of a suction reed valve in a suction condition. The deep recess forms a passage for fluid, while the flexible end of the suction reed valve is received on the bottom of the shallow recess. The passage becomes wide in comparison with an existing apparatus, so that the vibration is reduced or eliminated. The fluid suction/discharge apparatus may be a compressor.

In the Drawings:

[0008]

Fig. 1 is a longitudinal sectional view of an exemplary reciprocal motion type compressor;

Fig. 2 is a perspective view of a disassembled exemplary valve mechanism for use in the compressor shown in Fig. 1;

Fig. 3 is a partially enlarged perspective view of an existing recess included in an existing valve mechanism;

Fig. 4 is a partially enlarged plan view of a suction reed valve and the recess shown in Fig. 3;

Fig. 5 is a partially sectional view for use in describing a movement of the suction reed valve shown in Fig. 2;

Fig. 6 is a partially sectional view for use in describing a problem that occurs in the existing apparatus;

Fig. 7 is a partially enlarged perspective view of a recess included in a valve mechanism according to a preferred embodiment of the present invention;

Fig. 8 is another partially enlarged perspective view of the recess shown in Fig. 7;

Fig. 9A is a plan view of the recess shown in Fig. 7;

Fig. 9B is a sectional view of the recess shown in Fig. 7;

Fig. 10 is a plan view of a suction reed valve of the preferred embodiment;

Fig. 11A is a plan view of a part of the suction reed valve shown in Fig. 10 and the recess shown in Fig. 7;

Fig. 11B is a sectional view of a part of the suction reed valve shown in Fig. 10 and the recess shown in Fig. 7;

Fig. 12 is a partially sectional view for use in describing a movement of the suction reed valve in the suction condition;

Fig. 13 is a plan view of another suction reed valve of another preferred embodiment of the present invention; and

Fig. 14 is a plan view of a part of the suction reed valve shown in Fig. 13 and the recess shown in Fig. 7.

[0009] An explanation will be made with regard to a known mechanism and preferred embodiments of the present invention. The explanations will be made in con-

junction with a reciprocal motion type compressor.

[0010] Reciprocal motion type compressor (herein referred to as a compressor) 101, according to one embodiment of the present invention, is provided in **Fig. 1**. Compressor 101 comprises compressor casing 102 into which front housing 103, cylinder block 104, cylinder head 105, valve plate 106, and so forth, are assembled.

[0011] In compressor casing 102, front housing 103 is arranged on one side of the cylinder block 104, while cylinder head 105 is arranged on the opposite side of cylinder block 104. Valve plate 106 is interposed between cylinder block 104 and cylinder head 105. Cylinder gasket 107 and a head gasket may be fitted in compressor casing 102 as sealing members. Cylinder gasket 107 serves to seal a gap between cylinder block 104 and valve plate 106, while head gasket (not shown) serves to seal a gap between cylinder head 105 and valve plate 106. For the sake of clarity, head gasket is not shown in **Fig. 1**.

[0012] Cylinder block 104 and front housing 103 have through-holes 111 and 112. Driving shaft 108 is inserted into through-holes 111 and 112, and is rotatably supported by front housing 103 and cylinder block 104 via bearings 113 and 114, supporting member 115, etc.

[0013] Front housing 103 defines crank chamber 117 in cooperation with cylinder block 104. In crank chamber 117, rotor 118 is mounted on driving shaft 108 via stopper pin 119. Swash plate 121 is coupled to rotor 118 via a hinge mechanism. Rotor 118 and swash plate 121 may have tabs 124 and 125, respectively. Tab 124 may be fitted with guide pin 124a, while tab 125 may be formed with track-shaped guide hole 125a. Guide pin may be movably engaged with guide hole 125a, and thereby, tabs 124 and 125 and guide pin 124a may comprise the above-mentioned hinge mechanism.

[0014] Driving shaft 108 passes through swash plate 121 so that swash plate 121 abuts driving shaft 108 at an inner periphery thereof, so as to rotate together with driving shaft 108. An inclination of swash plate 121 relative to driving shaft 108 can be changed by means of the hinge mechanism. Wobble plate 122 is slidably mounted on swash plate 121 via bearings 126 and 127. Wobble plate 122 is fitted with guide plate 128 fixedly arranged in cylinder block 104, so as to wobble in a longitudinal direction of guide plate 128. With this structure, wobble plate 122 does not rotate, but wobbles in a direction parallel to driving shaft 108, while swash plate 121 rotates.

[0015] Cylinder block 104 defines a plurality of cylinders 116, in cooperation with valve plate 106, which serves as the closed ends of cylinders 116. Cylinders 116 are equiangularly arranged about a shaft axis of driving shaft 108. Cylinders 116 extend in parallel to driving shaft 108. The direction in which cylinder 116 extends will be referred to as the "axial direction." A plurality of piston rods 123 are coupled to wobble plate 122

through a ball connection. Furthermore, each of piston rods 123 is coupled through the ball connection to a corresponding one of pistons 110 which is slidably close-fitted into respective cylinders 116. When driving shaft 108 rotates, wobble plate 121 wobbles, and thereby, pistons 110 reciprocally move in the axial direction within respective cylinders 116.

[0016] Cylinder head 105 comprises outer wall 141a formed in a bowl-shape or a tray-shape, and inner wall 141b partitioning the interior of cylinder head 105. Inner and outer walls 141a and 141b form discharge chamber 143 and suction chamber 142 in cylinder head 105, cooperating with valve plate 106. Cylinder head 105 further comprises a suction port for supplying the fluid to suction chamber 142, and a discharge port for discharging fluid from discharge chamber 143 to the outside of the compressor, both of which, for simplicity, are not shown in **Fig. 1**.

[0017] As mentioned above, valve plate 106 is secured to cylinder block 104, so as to form closed ends of cylinders 116. Valve plate 106 has inlet ports 131 for fluid suction and outlet ports 132 for fluid discharge. Inlet and outlet ports 131 and 132 correspond to respective cylinders 116. As one piston 110 gets close to the corresponding closed end, the fluid is discharged from inside of corresponding cylinder 116 to discharge chamber 143 through corresponding outlet port 132. Further, as one piston 110 moves away from the corresponding closed end, the fluid is sucked, or introduced, from suction chamber 142 into the inside of corresponding cylinder 116 through its corresponding inlet port 131.

[0018] Suction reed valve member 129 is fitted on a principal surface of valve plate 106 at a side of cylinder block 104, while discharge reed valve member 133 is fitted on the other principal surface of valve plate 106. The principal surface is also referred to as an inner surface of valve plate 106, while the other surface is referred to as an outer surface of valve plate 106.

[0019] Suction reed valve member 129 has a plurality of suction reed valves 129b which extend along the inner surface of valve plate 106 over respective inlet ports 131. Discharge reed valve member 133 has a plurality of discharge reed valves 133b which extend along the outer surface of valve plate 106 over respective outlet ports 133b. Suction reed valves 129b have flexible outer ends, so that each flexible end can bend in a suction condition of cylinder 116, and thereby inlet port 131 can open.

[0020] Referring to **Fig. 2**, seven cylinders 116 are provided, with seven corresponding suction reed valves 129b and discharge reed valves 133b. Accordingly, valve plate 106 has seven inlet holes 131 and seven outlet holes 132. Suction reed valve member 129 and discharge reed valve member 133 radially branch from the center thereof in seven directions. Discharge reed valve stopper 135 is used to receive discharge reed valve 133b in discharge condition. Stopper 135 is

formed as a plate which also radially branches from the center thereof in seven direction.

[0021] At the centers of suction reed valve member 129 and of discharge reed valve member 133, screw holes 129a and 133a are formed, respectively. Likewise, other screw holes 106a and 135a are formed at the centers of valve plate 106 and discharge reed valve stopper 135, respectively.

[0022] Suction reed valve member 129, valve plate 106, discharge reed valve member 133, and discharge reed valve stopper 135 are assembled in this order, with screw holes 129a, 106a, 133a, 135a all fixed by screw 145, washer 146, and nut 147. In this event, suction reed valves 129b close respective inlet ports 131, while discharge reed valves 133b close respective outlet ports 132. Herein, suction reed valve member 129 has seven holes 148, which may be of an oval shape, to communicate cylinders 116 with outlet ports 132.

[0023] Recesses 134 are formed within cylinders 116 at one side of cylinder gasket 107, as illustrated in **Fig. 2**. Recesses 134 extend from surface 151 of cylinder block 104, and may be located on extension lines connecting between the center of through hole 112 and the centers of respective cylinders 116.

[0024] Cylinder gasket 107 has center hole 152 arranged at a center thereof, cylinder holes 153 surrounding center hole 152, and screw holes 154. Center hole 152 is the same size as the cross section of through hole 112, while cylinder holes 153 are the same size as the cross section of cylinders 116 with recesses 134. Head gasket 130 has a large center hole 155, in comparison with cylinder gasket 107, and suction holes 156 which surround large center hole 155 and correspond to inlet holes 131. That is, the number of the illustrated suction holes 156 is seven.

[0025] These components, such as cylinder block 104, cylinder gasket 107, valve plate 106, head gasket 130, and cylinder head 105 are assembled into a valve mechanism and are fixed by screws 157. At this time, the flexible ends of suction reed valves 129b are arranged in respective recesses 134.

[0026] In a known compressor, cylinder 116 is formed with recess 134 which extends from surface 151 to flat bottom 134a located at predetermined depth, as shown in **Fig. 3**. Flat bottom 134a is perpendicular to side-wall 134b of recess 134. Side-wall 134b is integrally formed with beveled or chamfered portions 116a of cylinder 116, though edges 134c and 134d are formed on boundaries between side-wall 134b and beveled portions 116a.

[0027] When an existing valve mechanism is fabricated, flexible end 129d of suction reed valve 129b is arranged in recess 134, as illustrated **Fig. 4**. The other end 129c of suction reed valve 129b is fixedly inserted between cylinder gasket 107 and valve plate 106. Therefore, flexible end 129d can bend toward piston 110, if flexible end 129d is being subjected to high pressure through inlet port 131, and is being released from

pressure created by piston 110. In **Fig. 4**, "P" denotes the center of cylinder 116, and θ_1 denotes an angle between both side edges 134c and 134d of recess 134, viewed from the center P. Furthermore, "I" denotes the extension line between the center of through hole 112 and the center P.

[0028] In principle, the existing valve mechanism with the above structure should have a movement as indicated in **Fig. 5**. That is, in the suction condition, piston 110 moves away from valve plate 106, so that flexible end 129d bends toward piston 110. As the results, inlet port 131 opens, while flexible end 129d is received on flat bottom 134a of recess 134.

[0029] In actuality, the existing valve mechanism may not have such a movement. Specifically, as shown in **Fig. 6**, when piston 110 moves away from valve plate 106, flexible end 129d of suction reed valve 129b bends, and thereby, inlet port 131 starts to open. As flexible end 129d starts to bend, a gap is formed between suction reed valve 129b and valve plate 106. The gap partially opens into recess 134. As a result, the gap and inlet port 131 form a narrow passage for fluid to flow there-through into cylinder 116. Because the passage is narrow, the introduced fluid passes through the passage to be accelerated, and then interacts with bottom 134a of recess 134 to "bounce" back therefrom. The fluid forms an eddy between bottom 134a and flexible end 129d, which prevents flexible end 129d of suction reed valve 129b from touching bottom 134a, so that the passage for fluid becomes narrow. In addition, the eddy "excites" suction reed valve 129b, and causes it to vibrate. Such vibration results in making a jarring noise, which may be annoying to a passenger in a vehicle.

[0030] As discussed above, the embodiments are explained about examples in which the present invention is applied to the exemplary reciprocal motion type compressor, as shown in **Fig. 1**. Accordingly, appearance of the valve mechanism is almost shown in **Fig. 2**, except for recesses and a suction reed valve member. Thus, the explanation will be omitted about the same components as those illustrated in **Figs. 1** and **2**.

[0031] Referring to **Figs. 7** through **9**, recess 10 and beveled, or chamfered, portion 116a are integrally formed with recess 10 at surface 151. Specifically, recess 10 comprises shallow recess 12 and a pair of deep recesses 13 and 14 arranged at both sides of shallow recess 12. Shallow and deep recesses 12, 13, and 14 are integral with each other. Beveled portion 116a is formed, by beveling, at a part of an edge of the cylinder. Beveled portion 116a has a particular shape which is wider as it approaches the recess, and is smoothly integral with deep recesses 13 and 14. Thus, there is no edge on the boundary between deep recesses 13 and 14 and beveled portion 116a.

[0032] Shallow recess 12 has flat bottom 12a to receive flexible end 25 of suction reed valve 22 (shown in **Fig. 10**), in a suction condition. Deep recesses 13 and 14 are adapted to form passages for fluid at both

sides of shallow recess 12 receiving flexible end 25 of suction reed valve 22 in the suction condition.

[0033] Comparing **Fig. 9A** with **Fig. 4**, a profile of recess 10 is larger than that of existing recess 134. That is, a curve line presented by recess 10 is longer than the other curve line presented by existing recess 134, in the plan views. In addition, the curve line of recess 10 is gentler than the curve line of recess 134.

[0034] Specifically, θ_2 denotes an angle between both side edges of entire recess 10, while θ_3 denotes another angle between both side edges of shallow recess 12, in **Fig. 9A**. Recess 10 and existing recess 134 have the following relationship of angles: $\theta_2 > \theta_1 > \theta_3$. Herein, as the angle θ_2 becomes larger and the angle θ_3 becomes smaller, the passage becomes wider, though the greater volume of recess 10 results in the decrease of compression efficiency. Therefore, the angles θ_2 and θ_3 should be determined to meet the requirement of the compressor to be applied with recess 10.

[0035] Recess 10 has a shape symmetrical to the extension line 1 between the center of through hole 112 and the center P, as viewed from the valve plate side. Flat bottom 12a is perpendicular to side wall 11 of shallow recess 12 and is parallel to surface 151 of cylinder block 104. On the other hand, deep recesses 13 and 14 both present smooth curves with no edges. In other words, deep recesses 13 and 14 both have curved planes which smoothly change in a radius direction of cylinder 116 as a depth of the deep recess becomes deeper. An angular separation between beveled portion 116a and side wall 11 of shallow recess 12 is absorbed by the smooth curve presented by deep recesses 13 and 14. Furthermore, deep recesses 13 and 14 become narrower as the depth of the deep recesses are deeper. Note that dotted lines shown in **Fig. 7** merely indicate boundaries between upper and under sides of the level where flat bottom 12a exists. The level is L_1 in depth, as shown in **Fig. 9B**, and is determined to be equal to the level of flat bottom 134a of existing recess 134, in this embodiment. On the contrary, the depth of the deepest part of deep recesses 13 and 14 is L_2 , wherein L_2 is greater than L_1 . The desirable range of the depth L_2 may allow a condition that upper end of piston 110 does not reach the deepest points of deep recesses 13 and 14 if piston 110 arrives at a point closest to valve plate 106.

[0036] Referring to **Fig. 10**, suction reed valve member 20 has center portion 26 which is formed in a circular shape having a predetermined radius, and radially branches from center portion 26 in seven directions. The branches form suction reed valves 22 corresponding to inlet ports 131, respectively. As illustrated, suction reed valve member 20 has oval holes 23 that are formed at starting points of the respective branches, to communicate cylinders 116 with outlet ports 132. Such holes 23 may be track-shaped or may be in an elongated form. At the center of suction reed valve member

20, screw hole 21 is formed, so that suction reed valve member 20 is fixed with valve plate 106, and so forth, by screw 145, washer 146, and nut 147, as shown in **Fig. 2**. Herein, suction reed valve member 20 is entirely formed with elastic member in this embodiment.

[0037] Each of suction reed valves 22 has a shape that is symmetrical to the extension line 1 between the center of through hole 112 and the center P, as viewed from the valve plate side. In detail, suction reed valve 22 tapers with an angle (called a first angle), and further tapers to flexible end 25 of suction reed valve 22 with another angle (called a second angle) that is larger than the first angle. The further tapered portion is called tapered portion 24, and is formed with flexible end 25.

[0038] Flexible end 25 has a tip profile substantially equal to a part of flat bottom 12a of shallow recess 12, as shown in **Fig. 11A**. Because suction reed valve 22 has tapered portion 24, when flexible end 25 is received on flat bottom 12a, deep recesses 13 and 14 are not closed by flexible end 25 but form wide passage for fluid suction, as illustrated in **Fig. 11B**. The other end of suction reed valve 22, namely center portion 26 in this embodiment, is fixedly interposed between valve plate 106 and cylinder block 104, in particular, cylinder gasket 107. And also, oval hole 23 shares a part of its peripheral profile with cylinder 116, as shown in **Fig. 11A**.

[0039] With such structure, when piston 110 moves away from valve plate 106, flexible end 25 of suction reed valve 22 bends, and thereby, inlet port 131 starts to open. Specifically, as flexible end 25 starts to bend, and thereby, slightly moves away from a level of surface 151, a gap is formed between suction reed valve 22 and valve plate 106. The gap partially opens into recess 10. The gap and inlet port 131 form a passage for fluid to flow therethrough into cylinder 116. It should be noted here that the passage is not narrow but wide, because deep recesses 13 and 14 are arranged at both sides of shallow recess 12, as shown in **Fig. 11B**. Therefore, the introduced fluid through inlet port 131 does not result in an eddy between bottom 12a and flexible end 25, but smoothly passes into cylinder 116, as shown in **Figs. 11B** and 12. Further, if the amount of fluid passing through inlet port 131 is large, flat bottom 12a of shallow recess 12 receives flexible end 25 thereon. Even if the amount of the fluid is small, the wide passages formed by deep recesses 13 and 14 cause the fluid velocity to slow down and prevent the occurrence of the eddy.

[0040] Another embodiment of the present invention will be explained with further reference to **Figs. 13** and **14**.

[0041] In this embodiment, the tapered portion of suction reed valve 22A has a pair of cut-away portions 27 which correspond to deep recesses 13 and 14, respectively. Each of cut-away portions 27 has a particular shape, such as an arc, so that flexible end 25 is further tapered in comparison with the foregoing suction reed valve 22 illustrated in **Figs. 10** and **11**. Specifically, edge of cut-away portion 27 forms in common to an

edge of flexible end 25, and locates on a boundary between shallow and deep recesses 12, 13 and 14 other than a radial inner part thereof. The radial inner part of the edge of cut-away portion 27 is arranged to be within cylinder 116.

[0042] Such suction reed valve 22A with cut-away portions allows deep recesses 13 and 14 to form wider passages. Thus, the fluid passing through inlet port 131 is much smoothly introduced into cylinder 116. The particular shape of cut-away portion may be any shape if flexible end 25 does not stick out from flat bottom 12a of shallow recess 12 when flexible end 25 is received on flat bottom 12a.

[0043] While this invention has thus far been described in conjunction with few preferred embodiments thereof, it will now readily be possible for those skilled in the art to put those embodiments into various other manners under the present invention. For example, the number of cylinders may six, eight, any number, though the number of cylinders is seven in the above explanations. The compressor may be of the fixed displacement type.

Claims

1. A fluid suction/discharge apparatus comprising:

a cylinder block defining a cylinder and a recess, said recess being integrally formed with the cylinder and extending from one end of the cylinder in an axial direction of the cylinder; a valve plate secured to the cylinder block to form a closed end of the cylinder and having an inlet port and an outlet port;

a piston slidably received in the cylinder, the piston being slidable in the axial direction; and a flexible suction reed valve having a first and a second end, the first end being secured to the cylinder and extending along an inner surface of the valve plate over the inlet port, the second end of said suction reed valve being received in the recess;

wherein:

the recess comprises a deep recess and a shallow recess that are integral with each other; and

the shallow recess having a bottom adapted to receive the flexible end of the suction reed valve in a suction condition, and the deep recess forming a passage for fluid.

2. The fluid suction/discharge apparatus of claim 1, wherein the deep recess comprises a pair of deep recess portions formed at both sides of the shallow recess.

3. The fluid suction/discharge apparatus of claim 1, wherein:

the deep recess has a curved plane which smoothly changes in a radial direction of the cylinder as a depth of the deep recess increases.

4. The fluid suction/discharge apparatus of claim 1, wherein the cylinder block has a beveled portion formed at a part of an edge of the cylinder and integral with the recess.

5. The fluid suction/discharge apparatus of claim 4, wherein the bevel portion has a width that gradually increases near the recesses.

6. The fluid suction/discharge apparatus of claim 1, wherein the suction reed valve has a cut-away portion at the second end thereof, wherein the cut-away portion increases a size of the fluid passage.

7. The fluid suction/discharge apparatus of claim 1, wherein the fluid suction/discharge apparatus is a compressor.

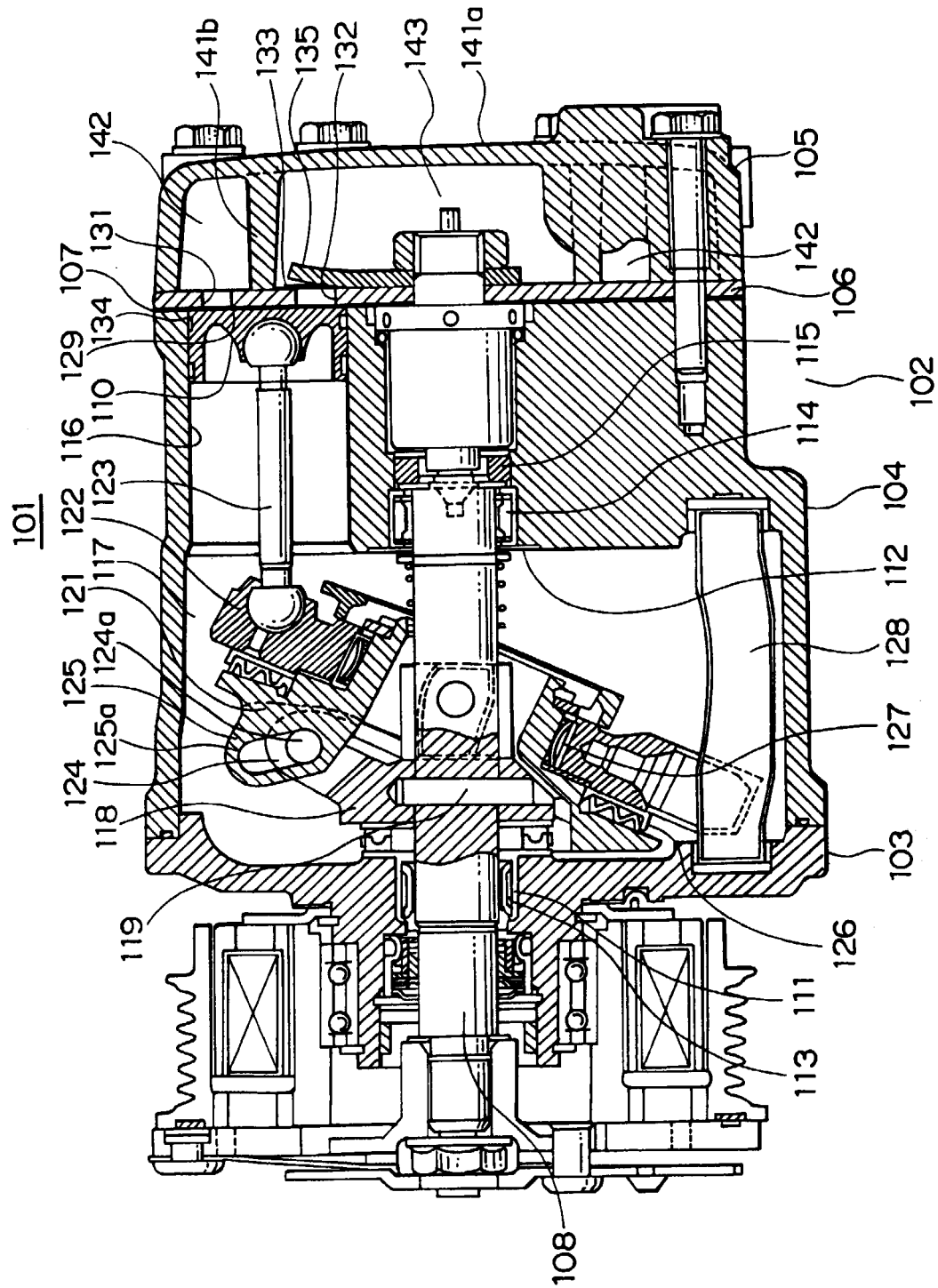


FIG. 1

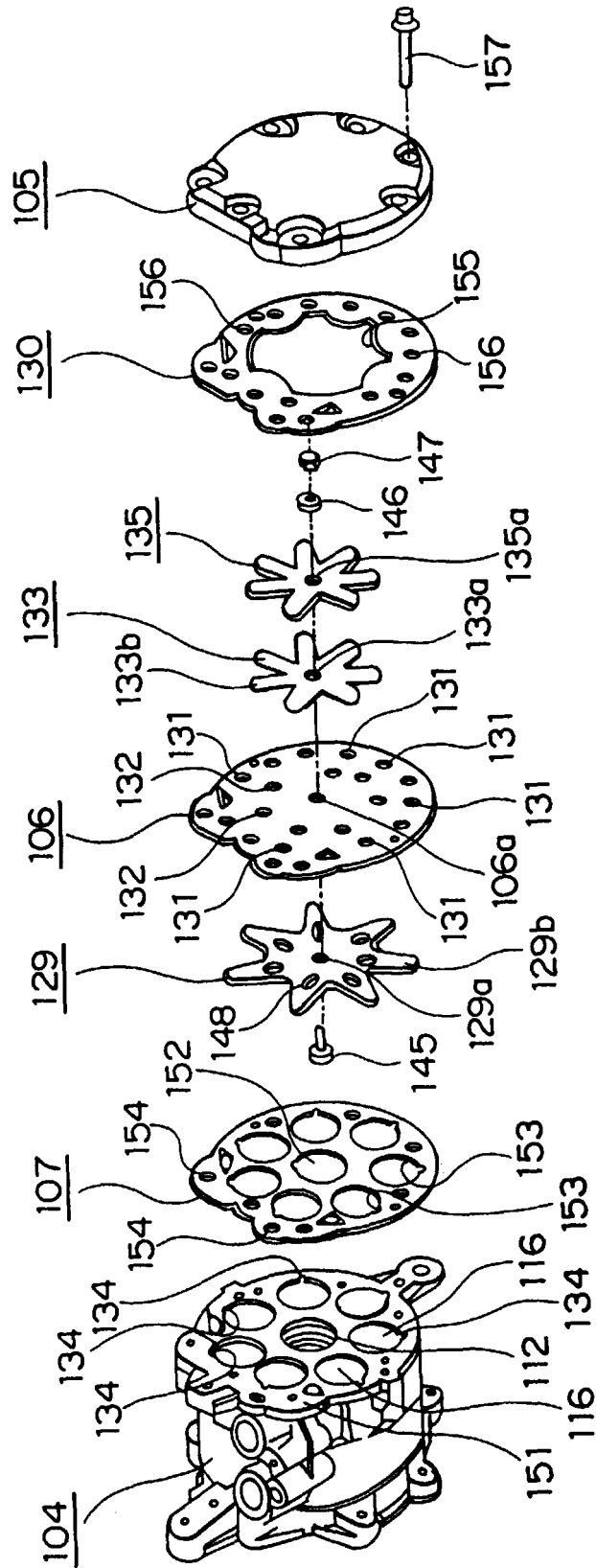


FIG. 2

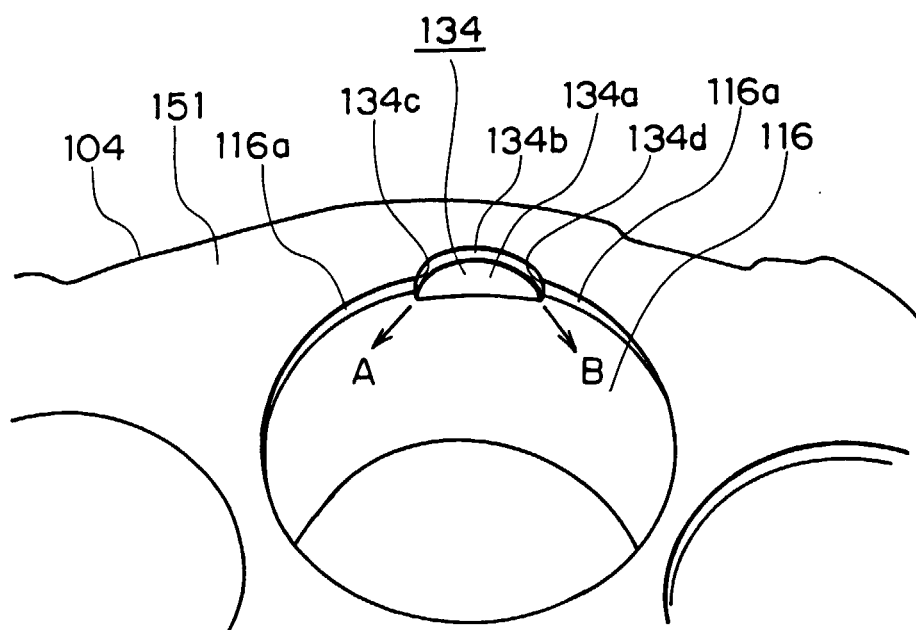


FIG. 3

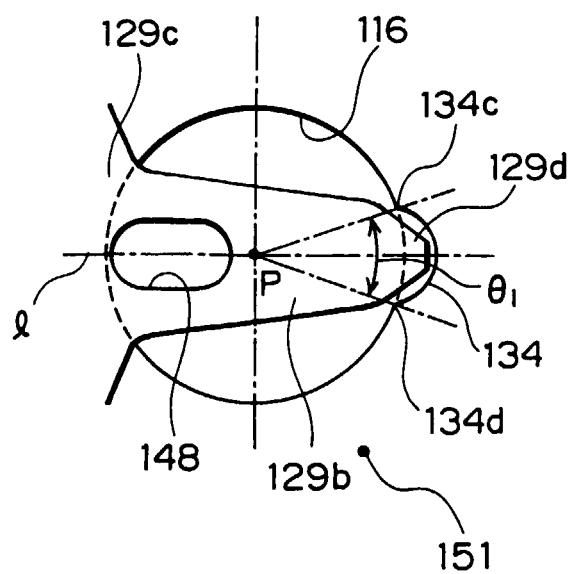


FIG. 4

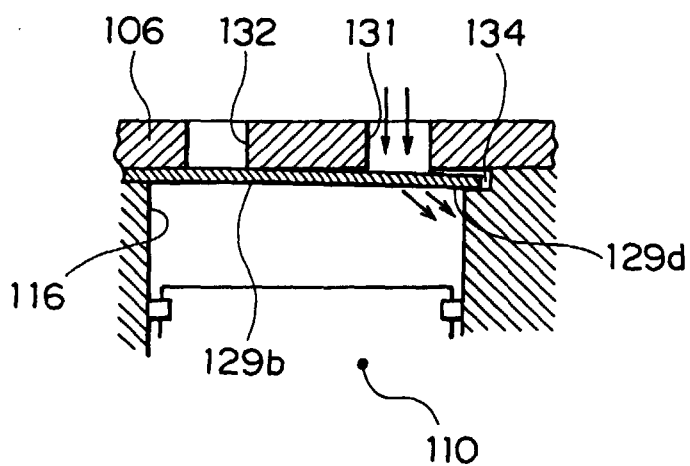


FIG. 5

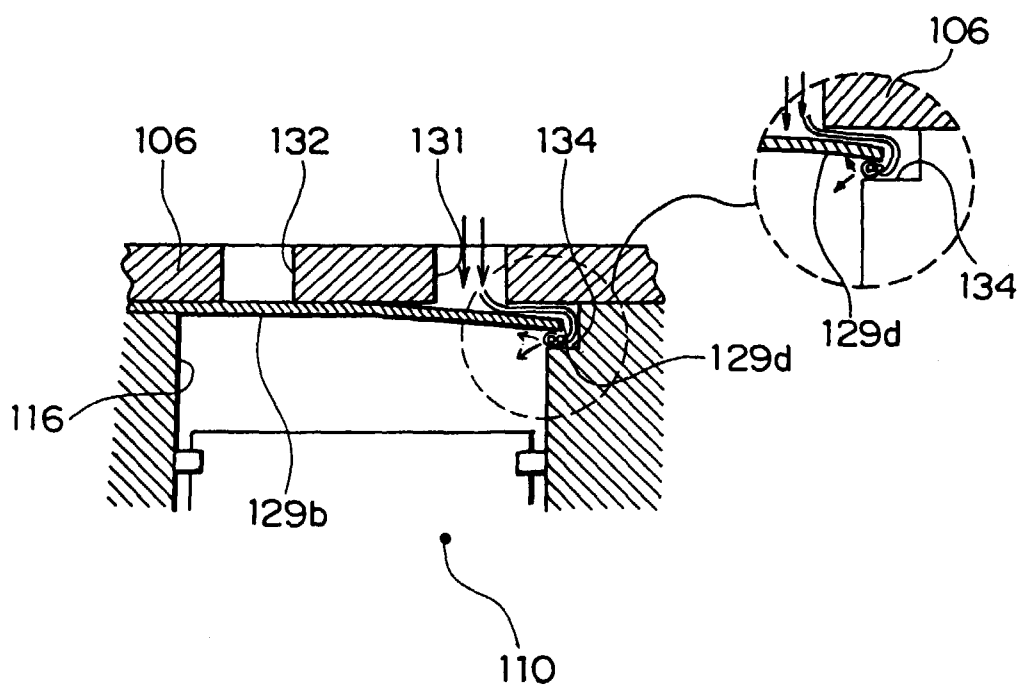


FIG. 6

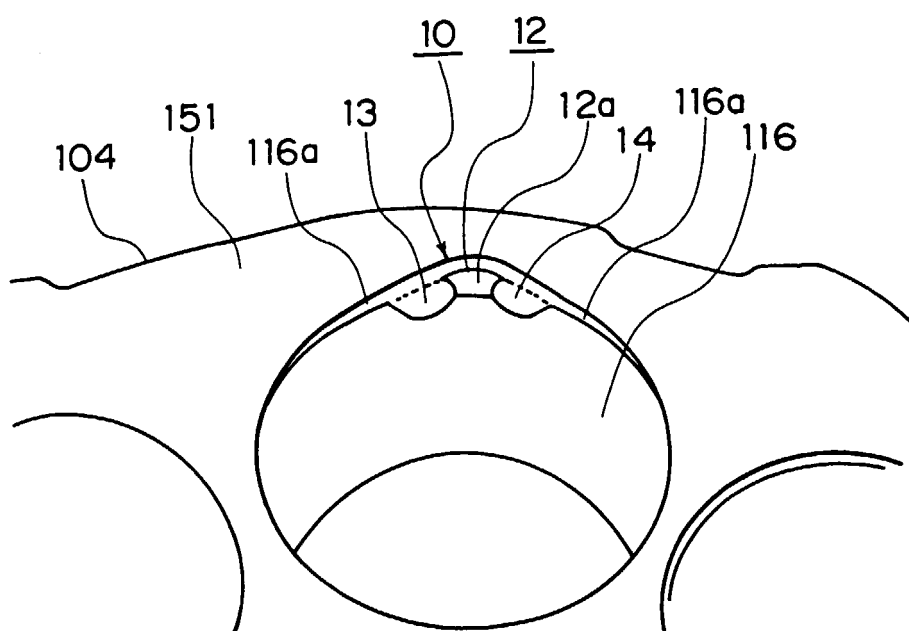


FIG. 7

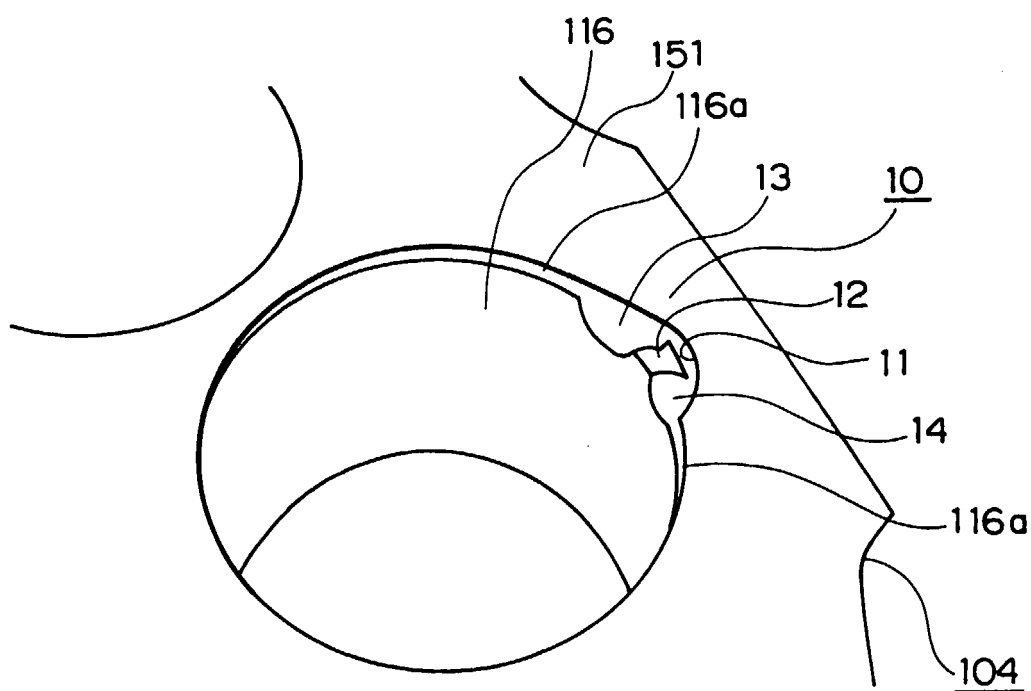


FIG. 8

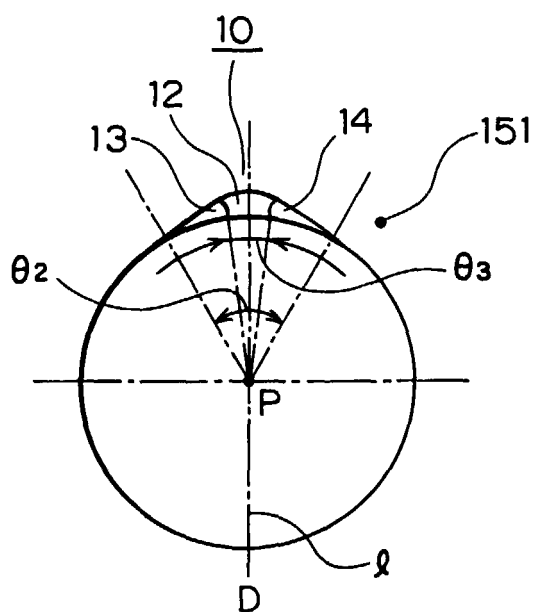


FIG. 9A

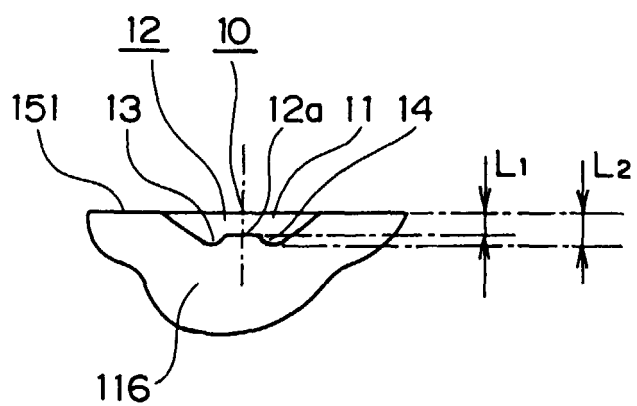


FIG. 9B

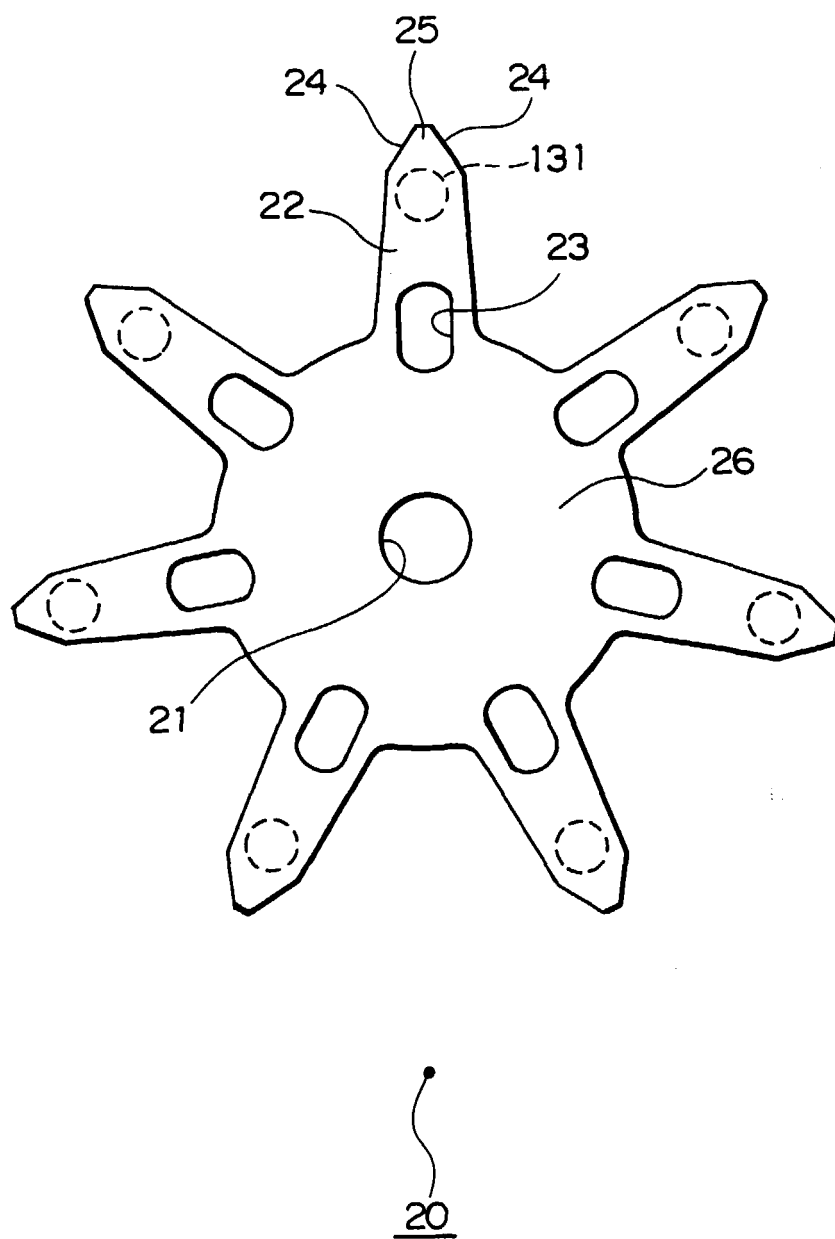


FIG. 10

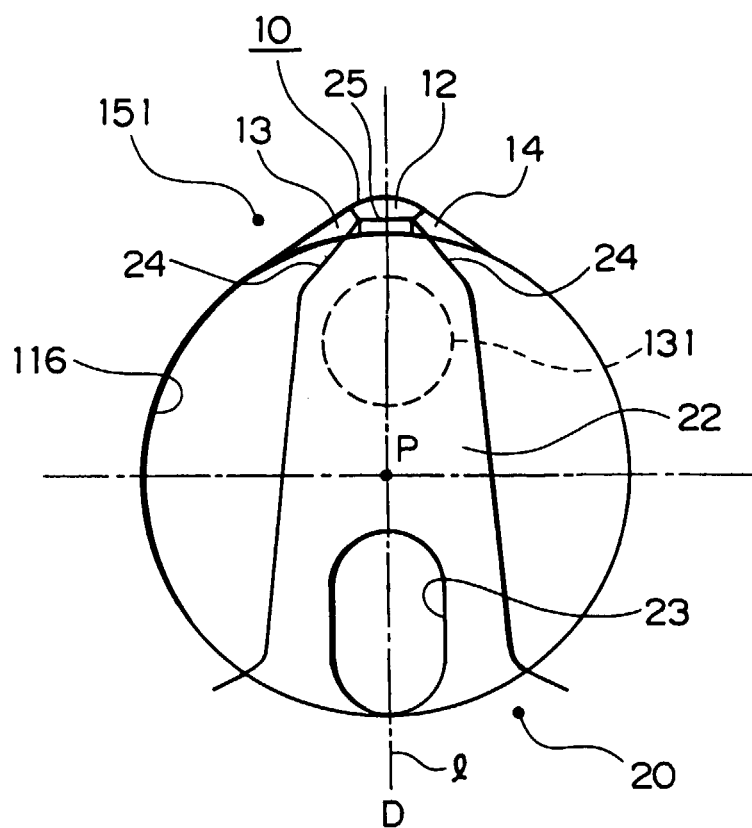


FIG. 1IA

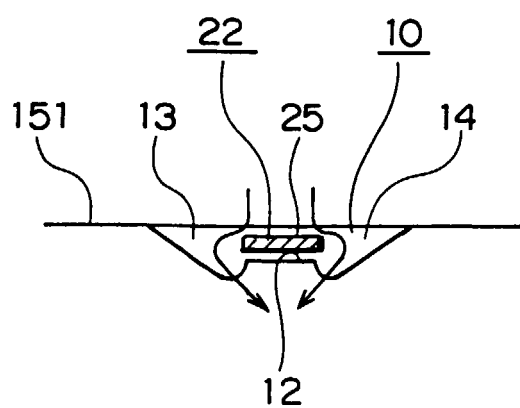


FIG. 1IB

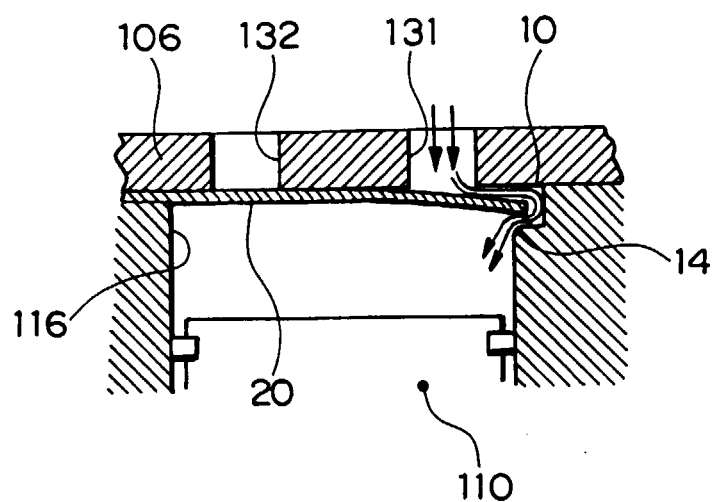


FIG. 12

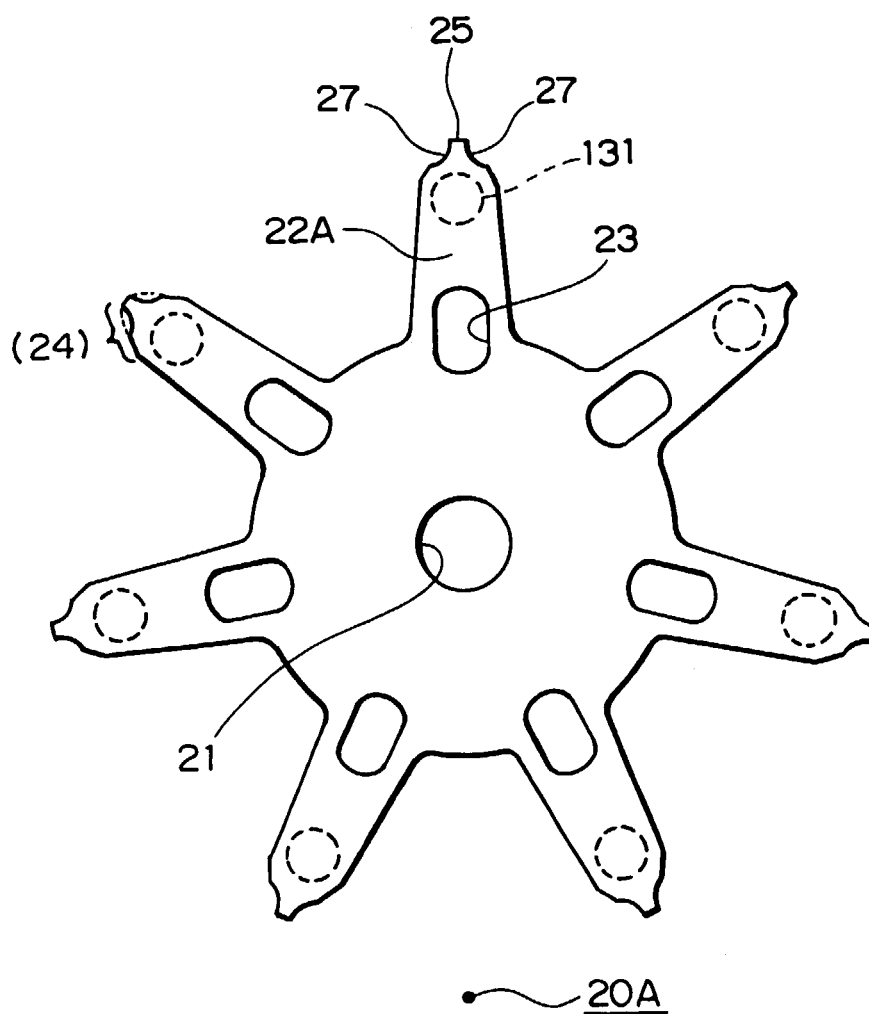


FIG. 13

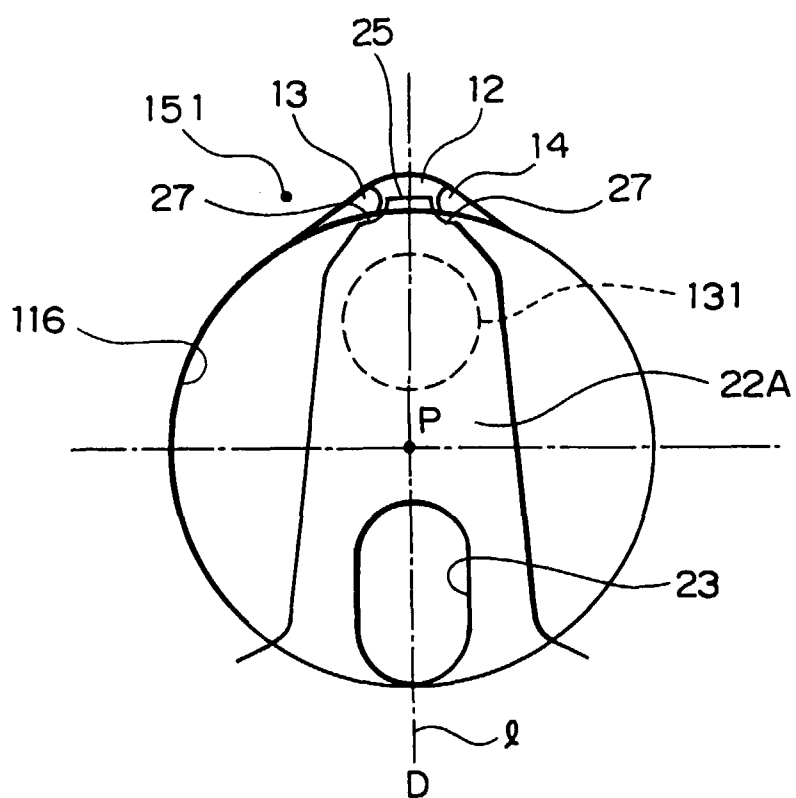


FIG. 14