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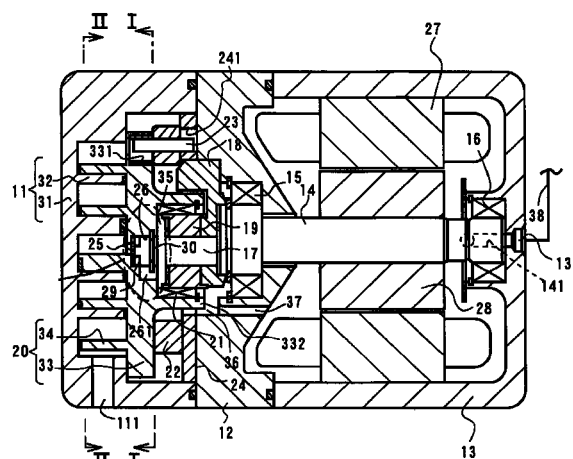
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(54) **Discharge valve for a compressor**

(57) An opening and closing device for a compressor gas passage, such as a compressor discharge passage, includes a valve body which moves between an opened position in which gas flows through the passage and a closed position in which gas flow is stopped.

In a scroll type compressor, a discharge port of the compressor, which leads to the discharge passage, has an accommodation chamber formed therearound in the base plate of the movable scroll. The valve body is floatably and movably accommodated in the accommodation chamber, to move in the direction of gas flow. The valve body has guide pieces which protrude in the direction of valve movement from respective equally spaced locations along the circumference of the valve body. The valve body moves between a valve-closed position in which it closes the discharge port, contacting the bottom surface of the discharge port and the accommodation chamber and a valve-opened position in which it opens the discharge port, contacting a circular clip which limits its movement.

Fig. 1



EP 1 085 211 A2

Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to an opening and closing device for a gas passage in a compressor.

2. DESCRIPTION OF THE RELATED ART

[0002] In a compressor according to Japanese Unexamined Patent Publication No. 6-264875, a discharge port is opened and closed by a flapper type discharge reed valve and the opening degree of the valve is restricted by a retainer. The flexible discharge valve opens the discharge port when the difference between the pressure in the front area of the valve and the pressure in the rear area of the valve exceeds the elasticity of the valve. The gas has to be compressed so that its pressure exceeds the elasticity to open the valve. Such gas compression causes power loss of the compressor.

[0003] Float type valves, which are disclosed in Japanese Unexamined Utility Model Publication No. 5-981, Japanese Unexamined Patent Publications No. 5-10257, No. 5-33764, No. 5-33769 and No. 11-182469 have movable valve bodies in gas passages between the opened position in which gas flow is permitted and the closed position stopping gas flow. These valves solve the problem of power loss caused by the flapper type flexible discharge valve.

[0004] As for the float type valve, there is a clearance between an inner circumferential wall and the valve body in the gas passage. The clearance is necessary to move the valve body smoothly between the closed position and the opened position. The lighter in weight the valve body is, the more quickly it responds to the change in the pressure differential. Therefore, the thickness of the valve body is selected to be as thin as possible. However, the thinner the thickness of the valve body is, the more it tends to tilt, due to the clearance. It also becomes more difficult for the valve body to return quickly to the original closed position. That is, if the valve body is made thinner to improve the response, it tends to tilt, so that it actually becomes more difficult to improve the response.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to improve the response of a movable valve body in a compressor provided as an opening and closing device for a gas passage having the movable valve body mounted for movement between the opened position in which gas flows through the valve and the closed position in which gas flow is stopped.

[0006] To achieve the above object, the compressor according to the present invention has a mechanical

guide to permit movement of the valve body between the opened position in which gas flows through the valve, and the closed position in which gas flow is stopped, the valve movement being substantially parallel to the flow of the gas.

[0007] In the compressor according to the present invention, tilting of the valve body is prevented, and the response of the valve body is improved as an opening and closing device for the gas passage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a cross-sectional view illustrating a compressor having an opening and closing device according to the present invention, and Fig. 1(a) is an enlarged view of the device in its opened and closed position in the compressor;

Fig. 2(a) is an enlarged perspective view illustrating a valve body according to a first embodiment of the present invention;

Fig. 2(b) is an enlarged perspective view illustrating a valve body according to a second embodiment;

Fig. 2(c) is an enlarged perspective view illustrating a valve body according to a third embodiment;

Fig. 2(d) is an enlarged perspective view illustrating a valve body according to a fourth embodiment;

Fig. 2(e) is an enlarged perspective view illustrating a valve body according to a fifth embodiment;

Fig. 3 is a cross-sectional view as seen from line I-I in Fig. 1, and Fig. 3(a) is an enlarged showing of the valve body in the compressor;

Fig. 4 is a cross-sectional view as seen from line II-II in Fig. 1;

Fig. 5(a) is a partial cross-sectional view to show that the valve body according to the present invention does not tend to tilt;

Fig. 5(b) is a partial cross-sectional view to show how a conventional valve body tends to tilt.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0009] An embodiment of a scroll-type compressor having a valve opening and closing device according to the present invention will now be described.

[0010] As shown in Fig. 1, a center housing 12 is secured to a stationary scroll 11, and a motor housing 13 is secured to the opposite end of the housing 12. A drive shaft 14 is rotatably supported by the center housing 12 and the motor housing 13 via radial bearings 15 and 16 respectively. An eccentric shaft 17 is integrally formed with the drive shaft 14.

[0011] A balance weight 18 and a bushing 19 are supported on the eccentric shaft 17. A movable scroll member 20 facing the stationary scroll member 11 is rotatably supported by the bushing 19 via a needle bearing 21. The needle bearing 21 is accommodated in a boss 332 which is a protrusion on the back of a base plate 33 of the movable scroll member 20. A stationary scroll base plate 31 and a stationary scroll wall 32 of the stationary scroll member 11, and the movable scroll base plate 33 and a movable scroll wall 34 of the movable scroll member 20, form closed spaces S_0 and S_1 as shown in Fig. 4. The movable scroll member 20 orbits about the axis of the drive shaft 14 as the eccentric shaft 17 rotates with the shaft 14, to which it is attached, and the balance weight 18 cancels the centrifugal force generated by the orbital movement of the movable scroll member 20. The eccentric shaft 17 and the bushing 19, which are integrally rotated with the drive shaft 14, and the needle bearing 21 arranged between the eccentric shaft 17 and the boss 332 of the movable scroll member 20, constitute an orbital movement mechanism.

[0012] An orbiting ring 22 is arranged between the movable scroll base plate 33 and the center housing 12. A plurality (four in the present embodiment) of columnar pins 23, which prevent the rotation of the orbiting ring 22, extend completely through the ring 22 and are secured to it. An annular pressure receiving plate 24 is arranged between the center housing 12 and the ring 22. As shown in Fig. 3, the same number of holes 241 as pins 23 are arranged circumferentially in the pressure receiving plate 24. And the same number of holes 331 as the pins 23 are arranged circumferentially in the movable scroll base plate 33. Both the holes 241 and 331 are arranged at equiangular spacing distances from each other. The end portions of the pins 23 are inserted into the holes 241 and 331.

[0013] A stator 27 is fixed on an inner peripheral wall of the motor housing 13, and a rotor 28 is supported on the drive shaft 14. The stator 27 and the rotor 28 constitute a motor. When the stator 27 is energized, the rotor 28 and the drive shaft 14 integrally rotate.

[0014] The movable scroll member 20 orbits about the axis of the shaft 14 as the eccentric shaft 17, which is integrally formed with the drive shaft 14, rotates. The refrigerant gas introduced through an inlet 111 flows

into the space between the stationary scroll base plate 31 and the movable scroll base plate 33, from the radially outer side of both scroll members 11 and 20. The peripheral surfaces of the pins 23 slide along the peripheral surfaces of the holes 331 and 241 as the movable scroll member 20 orbits. There is a following relation expressed by:

$$D=d+r$$

where D is the diameter of the holes 331 and 241, d is the diameter of the pins 23 and r is the orbiting radius of the bushing 19. According to this relation, the orbiting radius of the movable scroll member 20 is r and the orbiting radius of the ring 22 is half of the orbiting radius r , i.e., $r/2$, of the movable scroll member 20.

[0015] The ring 22 tends to self-rotate. But the self rotation does not occur, because more than three pins 23 are contacting the inner peripheral surfaces of the holes 241 which are arranged at fixed positions. And the movable scroll member 20 also tends to self-rotate. However, that does not occur either, because the inner peripheral surfaces of the holes 331 in the movable scroll base plate 33 are contacting more than three pins 23 on the ring 22 which does not self-rotate. That is, the movable scroll member 20 and the ring 22 do not self-rotate, but they orbit. The closed spaces S_1 and S_0 shown in Fig. 4 diminish their capacities when the movable scroll member 20 orbits, and converge toward the inner ends 321 and 341 of the scroll walls 32 and 34 of the scroll members 11 and 20.

[0016] A discharge port 25 is formed in the movable scroll base plate 33. The discharge port 25 is communicated with the final closed space S_0 . A cylindrical accommodation chamber 26 is formed on the back of the movable scroll base plate 33. The accommodation chamber 26 is communicated with the discharge port 25. A valve body 29 as shown, for example, in Fig. 2(a) is floatably and movably accommodated in the accommodation chamber 26. The valve body 29 comprises a disk shaped base plate 291 and a plurality of guide pieces 292 (four guide pieces in this embodiment). The guide pieces 292 are integrally and circumferentially formed on the base plate 291 at equal intervals with each other. The guide pieces 292 protrude from the back 293 of the base plate 291 so that they are perpendicular to the base plate 291. The outer surfaces of the guide pieces 292 correspond with the periphery of the base plate 291 in the direction of the axis of the valve body 29. That is, the outer surfaces of the plurality of the guide pieces 292 conform to the circumference of a circle whose center is the axis L of the base plate 291. The diameter of the base plate 291 is slightly smaller than that of the accommodation chamber 26.

[0017] An annular groove 262 is formed on the inner wall of the accommodation chamber 26, and a circular clip 30 is inserted in the groove 262. As shown in Fig. 3 and 3(a), a plurality of gas passages 261 are

formed on the circular inner wall of the accommodation chamber 26. The valve body 29 is floatably and movably accommodated in the accommodation chamber 26 and is moved between the valve-closed position and the valve-opened position. At the closed position the valve body 29 contacts the step between the discharge port 25 and the accommodation chamber 26, namely, the bottom surface 263 of the accommodation chamber 26, and closes the discharge port 25 as shown in Fig. 1(a) in solid lines. At the opened position of the valve, the tips of the guide pieces 292 of the valve body 29 contact the circular clip 30 and open the discharge port 25 as shown in dotted lines in Fig. 1(a). That is, the accommodation chamber 26, the valve body 29 and the circular clip 30 provide an opening and closing device for the gas passage or port 25.

[0018] The refrigerant gas is compressed in accordance with decreasing capacity of the closed spaces S1 and S0 as the movable scroll member rotates. The compressed refrigerant gas is discharged from the final closed space S0 through the discharge port 25 and the gas passages 261 to the space 35 surrounded by the boss 332. The space 35 is communicated with the space 36 outside the boss 332 via the gap of the needle bearing 21. The space 36 is communicated with the inside of the motor housing 13 through a passage 37. The refrigerant gas in the motor housing 13 is discharged out to an external refrigerant circuit 38, through a passage 141 inside the drive shaft 14 and an outlet 131 on the end wall of the motor housing 13.

[0019] The invention has the following effects.

[0020] Fig. 5(a) is a partial cross-sectional view showing that the valve body 29 of the invention does not tilt. Fig. 5(b) is a partial cross-sectional view showing that a conventional prior art valve body 29A, without guide pieces 292, tends to tilt. Tilting of the valve body 29 is prevented by the guide pieces 292. This is because the outer circumferential surfaces 295 of each guide piece 292, which correspond to a circle whose center is the axis L of the base plate 291, and the outer circumferential surface 296 of the base plate 291, contact the inner circumferential surface 264 of the accommodation chamber 26 when the valve body 29 tends to tilt. The guide pieces 292 are formed on the valve body 29 to extend in the direction of movement of the valve body 29, so that they are slidable on the inner circumferential surface 264 of the accommodation chamber 26 in the gas passage. The guide pieces 292 and the inner circumferential surface 264 of the accommodation chamber 26 provide a mechanical guide for moving the valve body 29 in the direction of gas flow.

[0021] It will be noted that the longer the lengths of the guide pieces 292 in the direction of the axis L of the base plate 291, the more effectively the valve body 29 is prevented from tilting. However, in this case the whole weight of the valve body 29 increases, so that the length of the guide pieces 292 should be selected with consideration given to the relation between the weight and the

strength of the valve body and its guide pieces and the diameter (or the area) of the valve body.

[0022] Moreover, the present invention may be adapted in the following embodiments:

(1) Two or more than two guide pieces 292 may be formed on the valve body 29.

(2) Tapered shape guide pieces may be formed on the valve body, as in Fig. 2(b).

(3) Semi-circular shaped guide pieces may be formed on the valve body, as in Fig. 2(c).

(4) A cylindrical guide, as shown in Fig. 2(d), may be formed as a guide instead of separate guide pieces.

(5) A spherical part 297 may be formed centrally on the base plate 291 to protrude toward the discharge port 25, and into the discharge port 25 when the valve body is moved to the valve-closed position so that the spherical part 297 will close the port 25, as in Fig. 2(e). This embodiment includes the guide piece or pieces of any of the other embodiment.

(6) The present invention may be applied as an opening and closing device which opens and closes a suction port through which gas is introduced to a compressor.

(7) The present invention may also be applied to the discharge and/or suction ports of a piston type compressor which compresses gas using reciprocating pistons.

[0023] According to the present invention as described in detail, the compressor has mechanical guide to guide the movement of the valve body between the opened position of the valve to permit flow of gas therethrough and the closed position in which gas flow is stopped, the movement of the valve body being substantially parallel to the direction of gas flow. Accordingly, the invention performs with splendid effect to improve the response of a movable valve body as the opening and closing device for a gas passage.

[0024] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein but may be modified within the scope of the appended claims.

[0025] An opening and closing device for a compressor gas passage, such as a compressor discharge passage, includes a valve body which moves between an opened position in which gas flows through the passage and a closed position in which gas flow is stopped.

[0026] In a scroll type compressor, a discharge port of the compressor, which leads to the discharge passage, has an accommodation chamber formed therearound in the base plate of the movable scroll. The valve body is floatably and movably accommodated in the accommodation chamber, to move in the direction of gas flow. The valve body has guide pieces which protrude in the direction of valve movement from respective equally spaced locations along the circumference of the

valve body. The valve body moves between a valve-closed position in which it closes the discharge port, contacting the bottom surface of the discharge port and the accommodation chamber and a valve-opened position in which it opens the discharge port, contacting a circular clip which limits its movement. 5

Claims

1. An opening and closing device for a gas passage opening in a compressor, comprising a movable valve body mounted for movement between a valve-opened position in which gas flows to the gas passage opening and a valve-closed position in which gas flow is stopped, and a mechanical guide to guide said movement of the valve body in direction substantially parallel to the direction of gas flow. 10
2. The opening and closing device according to claim 1, wherein said mechanical guide comprises: 20
 - guide pieces formed on said valve body each having a length extending in the direction of said movement of the valve body; and 25
 - means defining a valve accommodation chamber having an inner circumferential surface surrounding said gas passage opening, wherein the guide pieces are slidably received on the inner circumferential surface of the accommodation chamber. 30
3. The opening and closing device according to claim 2, wherein at least two of said guide pieces are formed on said valve body. 35
4. The opening and closing device according to claim 3, wherein said valve body has a disk-like shape, and each of said guide pieces has substantially equal width, extending along the circumference of the disk-like shaped valve body. 40
5. The opening and closing device according to claim 3, wherein said valve body has a disk-like shape, and each of said guide pieces has a tapered shape extending in the direction of its length from the circumference of said disk shaped valve body. 45
6. The opening and closing device according to claim 3, wherein said valve body has a disk-like shape, and each of said guide pieces has a semi-circular shape extending in the direction of its length from the circumference of said disk shaped valve body. 50
7. The opening and closing device according to claim 1, wherein said mechanical guide comprises: 55

a cylindrical shaped guide formed on said valve

body having length extending in said direction of valve body movement; and
means defining a valve-accommodation chamber having an inner circumferential surface surrounding said gas passage opening, wherein the guide are slidably received on the inner circumferential surface of the accommodation chamber.

8. The opening and closing device according to claim 7, wherein said valve body comprises a base plate having a spherical protrusion located centrally on said base plate and protruding toward said valve-closed position.
9. The opening and closing device according to claim 2, wherein said valve body comprises a base plate having a spherical protrusion located centrally on said base plate and protruding toward said valve-closed position.
10. The opening and closing device according to claim 1, wherein said compressor is a scroll type compressor comprising a stationary scroll member having a base plate and a stationary scroll wall formed on said stationary scroll base plate, and a movable scroll member having a base plate and a movable scroll wall formed on said movable scroll base plate, both said stationary and movable scroll members facing each other with said movable scroll wall engaging said stationary scroll wall, said movable scroll member being movable orbitally without self-rotation, with respect to said stationary scroll member; and a closed space being formed between said movable scroll wall of the movable scroll member and said stationary scroll wall, the closed space moving progressively whereby the capacity of the closed space diminishes in accordance with the orbital movement of said movable scroll member; and said gas passage opening being discharge passage of said compressor formed through said movable scroll base plate, said opening and closing device being on, and movable with respect to said movable scroll base plate for opening and closing said discharge passage.

Fig. 1

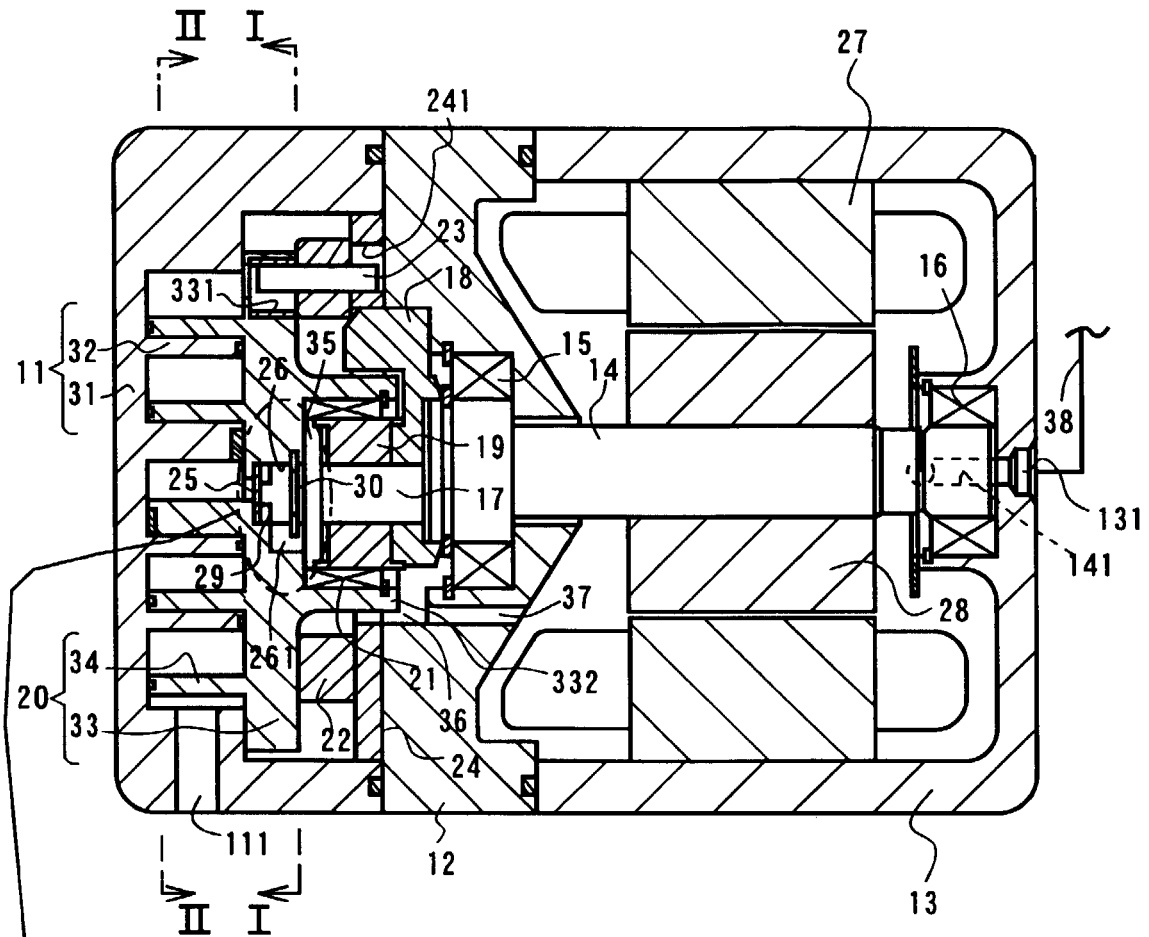


Fig. 1 (a)

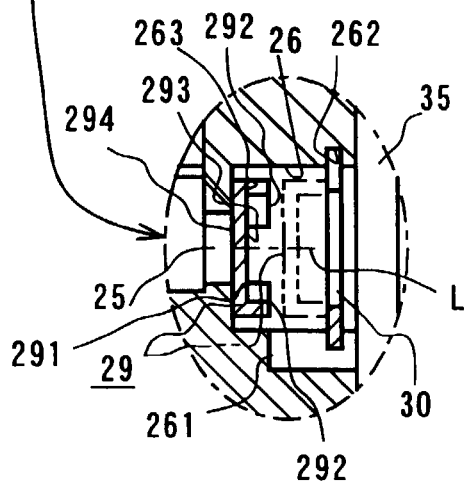


Fig. 2 (a)

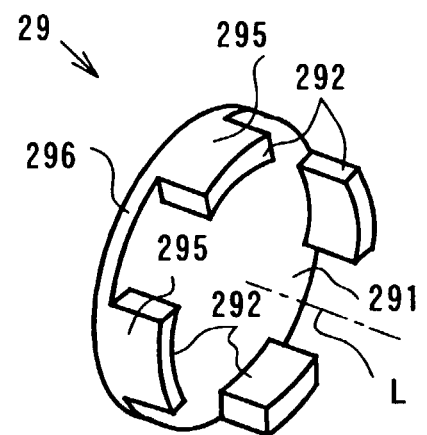


Fig. 2(b)

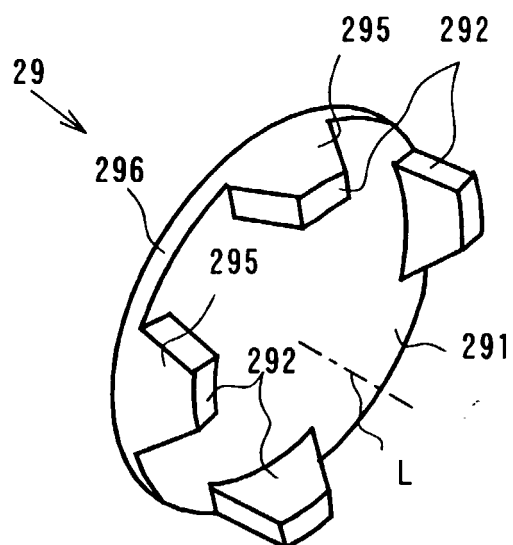


Fig. 2(c)

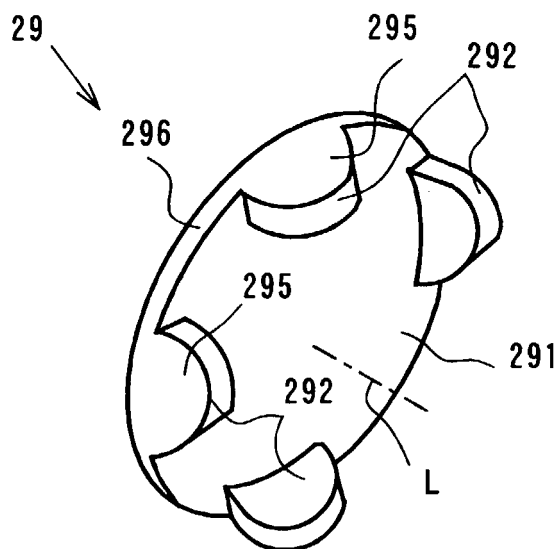


Fig. 2(d)

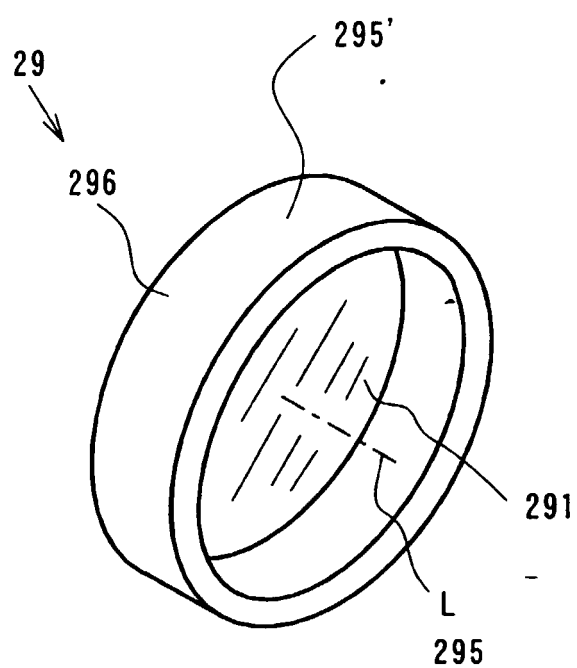


Fig. 2(e)

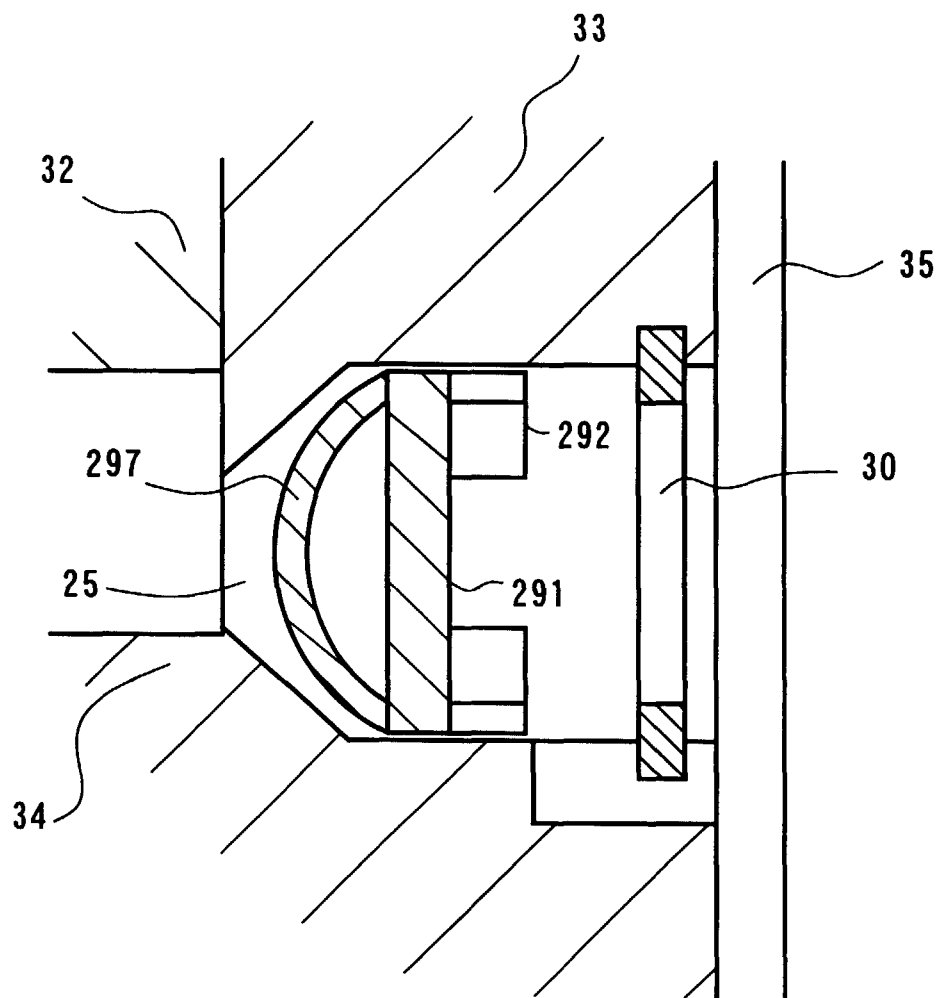


Fig. 3

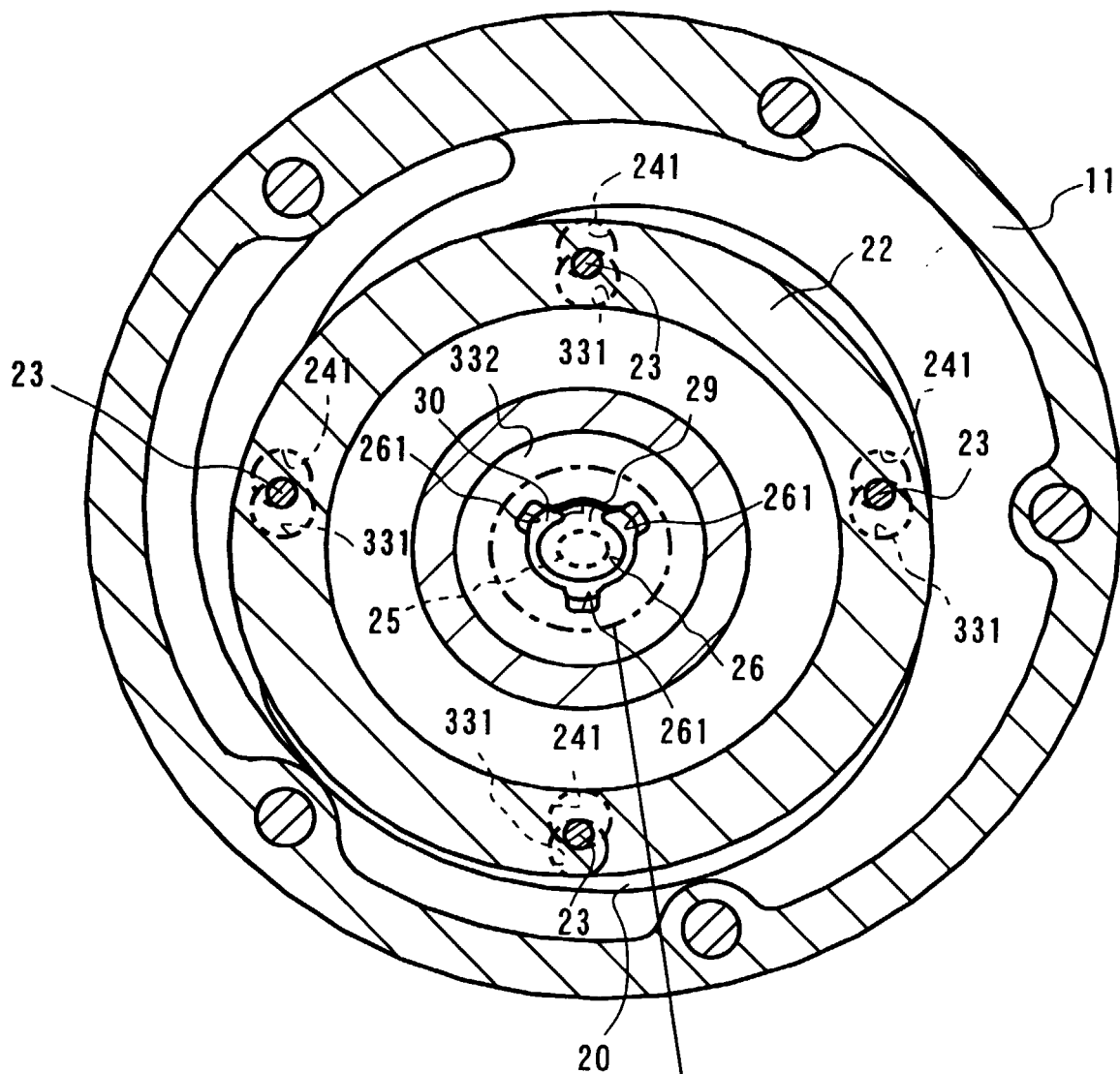


Fig. 3 (a)

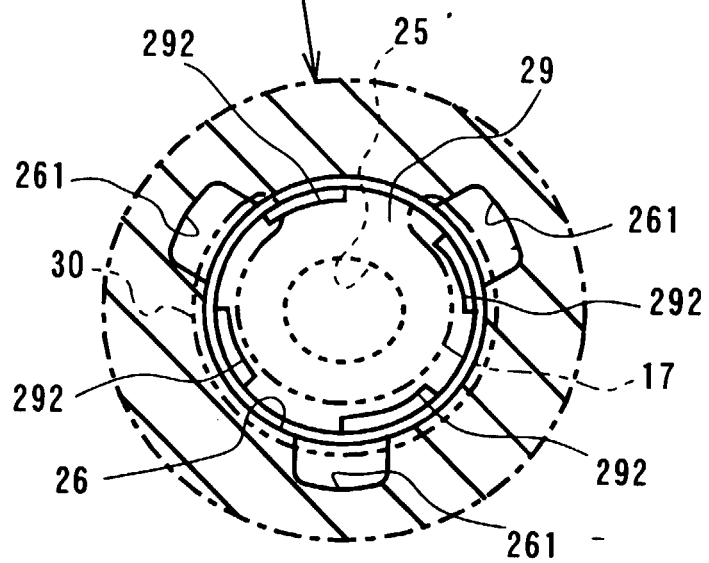


Fig. 4

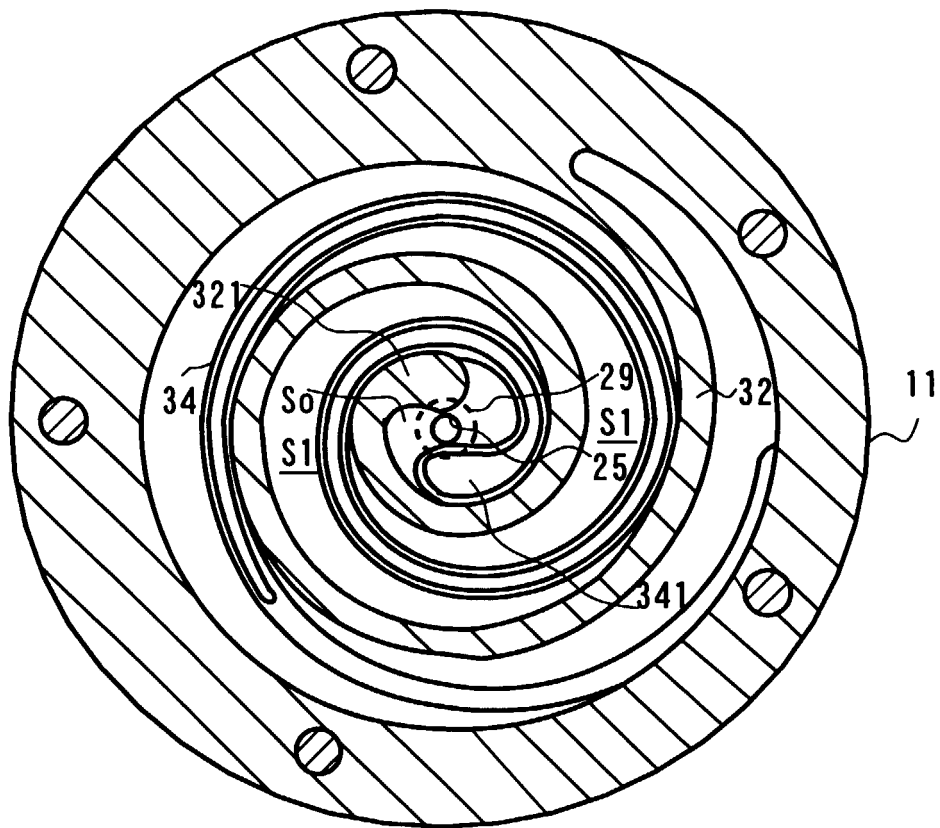


Fig. 5(a)

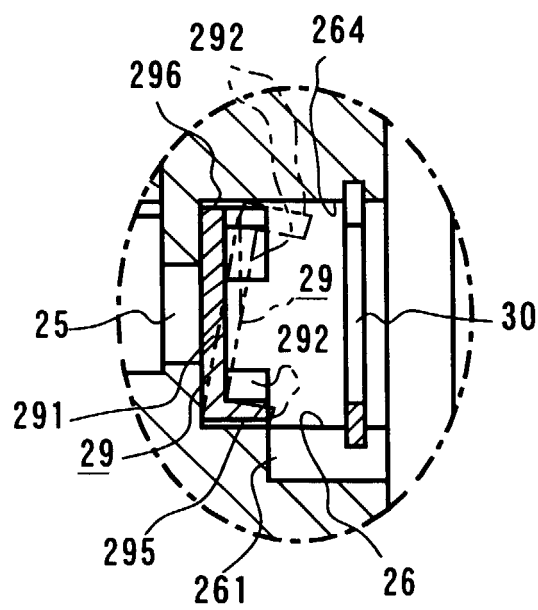


Fig. 5(b)

PRIOR ART

