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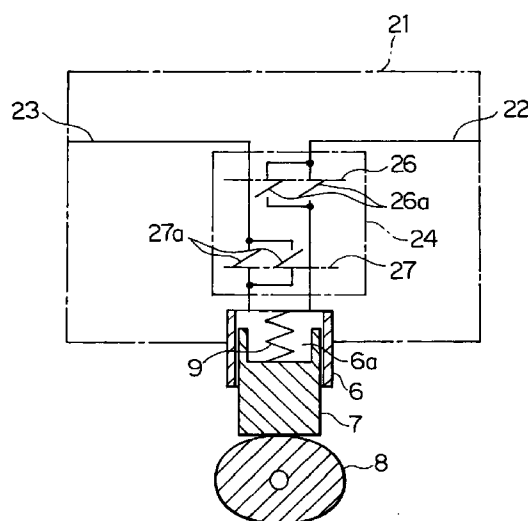
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(54) **Fuel supply pump**

(57) In a fuel supply pump, a laminated valve structure for opening and closing a suction passage and a discharge passage is provided in a pump body. The laminated valve structure includes first and second reed valves and a valve plate disposed between the first and second reed valves, and is provided with two suction holes and two discharge holes. The first reed valve has two suction side movable valve elements for opening and closing the suction holes. The second reed valve has two discharge side movable valve elements for opening and closing the discharge holes.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention:

[0001] The present invention relates to a fuel supply pump, which is for example, a high pressure fuel supply pump employed in direct fuel injection type internal-combustion engines.

Description of the Related Art:

[0002] Fig. 16 is an explanatory view showing an example of the construction of a conventional fuel supply pump. In the figure, a pump body 1 is provided with a suction passage 2 and a discharge passage 3. Also, a bypass passage 4 is provided between the suction passage 2 and the discharge passage 3. A bypass valve 5 is provided at the middle of the bypass passage 4.

[0003] A cylinder 6 is connected with the pump body 1. A fuel pressurizing chamber 6a communicated with the suction passage 2 and the discharge passage 3 is provided in the cylinder 6. A plunger 7 for sucking and discharging fuel into and out of the fuel pressurizing chamber 6a is provided slidably in the cylinder 6. The plunger 7 is slid and reciprocated against the cylinder 6 by the rotation of a cam 8 as a drive means. Further, the plunger 7 is pressed against the cam 8 by a spring 9. A laminated valve structure 10 for opening and closing the suction passage 2 and the discharge passage 3 is provided in the pump body 1.

[0004] Fig. 17 is a sectional view of the laminated valve structure 10 in Fig. 16. In the figure, the laminated valve structure 10 includes a reed valve 11 and first and second valve holders 12 and 13 joined with both surfaces of the reed valve 11, and is mounted on the cylinder 6 directly. Further, the laminated valve structure 10 is provided with a suction hole 10a communicated with the suction passage 2, and a discharge hole 10b communicated with the discharge passage 3.

[0005] Furthermore, Fig. 18 is a plan view showing the reed valve 11 in Fig. 17, Fig. 19 is a plan view showing the first valve holder 12 in Fig. 17, and Fig. 20 is a plan view showing the second valve holder 13 in Fig. 17.

[0006] The first and second valve holders 12 and 13 are provided with the suction hole 10a and the discharge hole 10b respectively. The reed valve 11, having a configuration like a disc and disposed between the first and second valve holders 12 and 13, has a suction side movable valve element 11a for opening and closing the suction hole 10a, and a discharge side movable valve element 11b for opening and closing the discharge hole 10b. Also, the first and second valve holders 12 and 13 are provided with recesses 12a and 13a to allow for the movement of the suction side and discharge side movable valve elements 11a and 11b.

[0007] Next, the operation will be described. The

plunger 7 is reciprocated in the cylinder 6 by the rotation of the cam 8. When the plunger 7 goes down, since the suction hole 10a is opened by the suction side movable valve element 11a and the discharge hole 10b is closed by the discharge side movable valve element 11b, fuel from the suction passage 2 is introduced into the fuel pressurizing chamber 6a. When the plunger 7 goes up, since the suction hole 10a is closed by the suction side movable valve element 11a and the discharge hole 10b is opened by the discharge side movable valve element 11b, fuel remaining in the fuel pressurizing chamber 6a is discharged into the discharge passage 3.

[0008] Furthermore, when starting an engine, since the rotational speed of the cam 8 is very slow and the speed of the downward motion of the plunger 7 is also slow, the inflow resistance at the suction side movable valve element 11a becomes larger, so it is difficult to suck fuel into the fuel pressurizing chamber 6a. Therefore, the fuel is made to flow from the suction passage 2 to the discharge passage 3 through the bypass passage 4 by opening the bypass valve 5 when starting the engine. Such a method is also disclosed in, for example, Japanese Patent Laid-Open No. 7-83134.

[0009] In the conventional fuel supply pump constructed as described above, since the bypass passage 4 and the bypass valve 5 are provided in the pump body 1 for discharging fuel when starting the engine, the arrangement of the passages in the pump body 1 becomes complicated, thereby preventing the reduction of the total pump size and the cost. Further, the reed valve 11 and the entire pump grow larger if the function of the bypass valve 5 is added to the movable valve elements 11a and 11b of the reed valve 11.

SUMMARY OF THE INVENTION

[0010] The present invention has been achieved with a view toward solving the problems described above, and it is an object of the present invention to provide a fuel supply pump which is capable of securing the fuel discharge volume required at the time of starting an engine and reducing the fuel pump's total size.

[0011] To this end, according to one aspect of the present invention, there is provided a fuel supply pump, comprising: a pump body having a suction passage and a discharge passage; a cylinder provided at the pump body and having a fuel pressurizing chamber which is connected between the suction passage and the discharge passage; a plunger provided slidably in the cylinder for sucking fuel from the suction passage into the fuel pressurizing chamber and discharging fuel from the fuel pressurizing chamber into the discharge passage; a drive means for sliding and reciprocating the plunger; a first reed valve provided in the pump body having a suction side movable valve element for opening and closing the suction passage; and a second reed valve provided in the pump body having a discharge side movable valve element for opening and closing the dis-

charge passage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is an explanatory view showing the construction of a fuel supply pump according to a first embodiment of the invention;

Fig. 2 is a sectional view of a laminated valve structure in Fig. 1;

Fig. 3 is a plan view showing a second valve holder in Fig. 2;

Fig. 4 is a plan view showing a second reed valve in Fig. 2;

Fig. 5 is a plan view showing a valve plate in Fig. 2;

Fig. 6 is a plan view showing a first reed valve in Fig. 2;

Fig. 7 is a plan view showing a first valve holder in Fig. 2;

Fig. 8 is a sectional view of a laminated valve structure of a fuel supply pump according to a second embodiment of this invention;

Fig. 9 is a sectional view of a laminated valve structure of a fuel supply pump according to a third embodiment of this invention;

Fig. 10 is a plan view showing a second valve holder in Fig. 9;

Fig. 11 is a plan view showing a second reed valve in Fig. 9;

Fig. 12 is a plan view showing a valve plate in Fig. 9;

Fig. 13 is a plan view showing a first reed valve in Fig. 9;

Fig. 14 is a plan view showing a first valve holder in Fig. 9;

Fig. 15 is an explanatory view showing the construction of a fuel supply pump according to a fourth embodiment of the invention;

Fig. 16 is an explanatory view showing an example of the construction of a conventional fuel supply pump;

Fig. 17 is a sectional view of a laminated valve structure in Fig. 16;

Fig. 18 is a plan view showing a reed valve in Fig. 17;

Fig. 19 is a plan view showing a first valve holder in Fig. 17; and

Fig. 20 is a plan view showing a second valve holder in Fig. 17.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The embodiments according to the present invention will now be described with reference to the accompanying drawings.

First Embodiment

[0014] Fig. 1 is an explanatory view showing the construction of a fuel supply pump according to a first embodiment of the invention. In the figure, a pump body 21 is provided with a suction passage 22 connected with a fuel tank (not shown) and a discharge passage 23 connected with an injector (not shown). Fuel is supplied from the fuel tank to the suction passage 22 by a low pressure fuel supply pump (not shown). A cylinder 6 is connected with the pump body 21. A fuel pressurizing chamber 6a communicated with the suction passage 22 and the discharge passage 23 is provided in the cylinder 6. A plunger 7 is provided slidably in the cylinder 6 for sucking fuel into the fuel pressurizing chamber 6a and discharging fuel remaining in the fuel pressurizing chamber 6a.

[0015] The plunger 7 is slid and reciprocated against the cylinder 6 by the rotation of a cam 8 as a drive means. Further, the plunger 7 is pressed against the cam 8 by a spring 9. A laminated valve structure 24 for opening and closing the suction passage 22 and the discharge passage 23 is provided in the pump body 21.

[0016] Fig. 2 is a sectional view of the laminated valve structure 24 in Fig. 1. In the figure, the laminated valve structure 24 is mounted on the cylinder 6 directly and includes a valve plate 25, first and second reed valves 26 and 27 joined with both surfaces of the valve plate 25, and first and second valve holders 28 and 29. The first reed valve 26 is disposed between the valve plate 25 and the first valve holder 28, and the second reed valve 27 is disposed between the valve plate 25 and the second valve holder 29.

[0017] Furthermore, the laminated valve structure 24 is provided with two suction holes 24a and two discharge holes 24b. The suction passage 22 and the discharge passage 23 are connected in the pump body 21 by end portions of the suction holes 24a and the discharge holes 24b respectively. The other end portions of the suction holes 24a and the discharge holes 24b are communicated with the fuel pressurizing chamber 6a.

[0018] Fig. 3 is a plan view showing the second valve holder 29 in Fig. 2, Fig. 4 is a plan view showing the second reed valve 27 in Fig. 2, Fig. 5 is a plan view showing the valve plate 25 in Fig. 2, Fig. 6 is a plan view showing the first reed valve 26 in Fig. 2, and Fig. 7 is a plan view showing the first valve holder 28 in Fig. 2.

[0019] The valve plate 25 having a disc-like configuration and disposed at the center of the laminated valve structure 24 is provided with the suction holes 24a and the discharge holes 24b. The first reed valve 26 has two suction side movable valve elements 26a for opening and closing the suction holes 24a respectively, and discharge holes 24b. The second reed valve 27 has the suction holes 24a, and two discharge side movable valve elements 27a for opening and closing the discharge holes 24b respectively.

[0020] The first valve holder 28 is provided with the suction holes 24a, the discharge holes 24b, and a common recess 28a to allow for the movement of both suction side movable valve elements 26a. The second valve holder 29 is provided with the suction holes 24a, the discharge holes 24b, and a common recess 29a to allow for the movement of both discharge side movable valve elements 27a.

[0021] Next, the operation will be described. The plunger 7 is reciprocated in the cylinder 6 by the rotation of the cam 8. When the plunger 7 goes down, since both suction holes 24a are opened by the suction side movable valve elements 26a respectively, and both discharge holes 24b are closed by the discharge side movable valve elements 27a respectively, fuel from the suction passage 22 is introduced into the fuel pressurizing chamber 6a. When the plunger 7 goes up, since both suction holes 24a are closed by the suction side movable valve elements 26a respectively, and both discharge holes 24b are opened by the discharge side movable valve elements 27a respectively, fuel remaining in the fuel pressurizing chamber 6a is discharged into the discharge passage 23.

[0022] In this fuel supply pump, since the laminated valve structure 24 is provided with two suction holes 24a and two discharge holes 24b, and also has two suction side movable valve elements 26a and two discharge side movable valve elements 27a, it is possible to increase the flow rate of fuel and secure the volume of fuel required when starting an engine even without the bypass valve. Additionally, since the valve elements 26a and 27a are provided in the first and second reed valves 26 and 27 separately, it is possible to form two suction side movable valve elements 26a and two discharge side movable valve elements 27a without increasing the diameter of the laminated valve structure 24. Therefore, the arrangement of the fuel passages in the pump body 21 can be simplified and total size of the pump can be reduced by omitting the bypass valve.

[0023] Further, since the reed valves 26 and 27 are disposed between the valve plate 25 and the valve holders 28 and 29, the mechanical strength of the laminated valve structure 24 is ensured. Furthermore, since the valve holders 28 and 29 are provided with the recesses 28a and 29a to allow for the opening and closing action of the valve elements 26a and 27a, their movements can be stabilized.

[0024] It should be noted that the constituent parts of the laminated valve structure 24 may be composed of the same material, for example, stainless steel (hardened tempered stainless steel). In this case, sufficient, corrosion resistance and fatigue strength can be secured and costs can be reduced.

[0025] Further, it is possible to form three or more suction holes and discharge holes respectively. Moreover, it is also possible to form only one suction hole and one discharge hole each having a large diameter. However, when a plurality of suction and discharge holes each

having smaller diameters are formed rather than one suction hole and one discharge hole each having a large diameter, the movable valve elements are reduced in size, thereby improving their opening and closing performance.

Second Embodiment

[0026] Next, Fig. 8 is a sectional view of a laminated valve structure of a fuel supply pump according to a second embodiment of this invention. In the figure, a laminated valve structure 31 includes a valve plate 32, the first and second reed valves 26 and 27, and the first and second valve holders 28 and 29. Further, the laminated valve structure 31 is provided with two suction holes 31a and two discharge holes 31b. The other constructions are the same as in the first embodiment.

[0027] In this fuel supply pump, since the valve plate 32 has the same thickness as the reed valves 26 and 27, the thickness of the laminated valve structure 31 can be reduced thereby reducing the size of the entire pump.

Third Embodiment

[0028] Next, Fig. 9 is a sectional view of a laminated valve structure of a fuel supply pump according to a third embodiment of this invention. In the figure, a laminated valve structure 33 includes a valve plate 34, first and second reed valves 35 and 36 joined to both surfaces of the valve plate 34, and first and second valve holders 37 and 38. The first reed valve 35 is disposed between the valve plate 34 and the first valve holder 37, and the second reed valve 36 is disposed between the valve plate 34 and the second valve holder 38. Further, the laminated valve structure 33 is provided with two suction holes 33a and a discharge hole 33b.

[0029] Fig. 10 is a plan view showing the second valve holder 38 in Fig. 9, Fig. 11 is a plan view showing the second reed valve 36 in Fig. 9, Fig. 12 is a plan view showing the valve plate 34 in Fig. 9, Fig. 13 is a plan view showing the first reed valve 35 in Fig. 9, and Fig. 14 is a plan view showing the first valve holder 37 in Fig. 9.

[0030] The valve plate 34 is provided with two suction holes 33a, and a discharge hole 33b having a larger diameter than that of the suction hole 33a. The first reed valve 35 has two suction side movable valve elements 35a for opening and closing the suction holes 33a respectively, and discharge hole 33b. The second reed valve 36 has the suction holes 33a, and a discharge side movable valve element 36a for opening and closing the discharge hole 33b. The discharge side movable valve element 36a extends in a direction perpendicular to the suction side movable valve elements 35a.

[0031] The first valve holder 37 is provided with a communicating hole 37a for communicating the suction holes 33a with the discharge hole 33b, and to allow for

the movement of the suction side movable valve elements 35a. The second valve holder 38 is provided with the suction holes 33a, the discharge hole 33b, and a recess 38a to allow for the movement of the discharge side movable valve element 36a. The other constructions are the same as in the first embodiment.

[0032] In this fuel supply pump, since one discharge hole 33b is disposed between two suction side movable valve elements 35a, the diameter of the laminated valve structure 33 can be reduced thereby reducing the size of the entire pump.

Fourth Embodiment

[0033] As in the first embodiment, two reed valves 26 and 27 are assembled as the laminated valve structure 24 and mounted on the cylinder 6; however, it is also possible, as shown in Fig. 15 for example, that the first reed valve 26 is disposed at the inlet side of the suction passage 22 in the pump body 21, and the second reed valve 27 is disposed at outlet side of the discharge passage 23 in the pump body 21.

Claims

1. A fuel supply pump, comprising:

a pump body 21 having a suction passage 22 and a discharge passage 23;
 a cylinder 6 provided at said pump body 21 and having a fuel pressurizing chamber 6a which is connected between said suction passage 22 and said discharge passage 23;
 a plunger 7 provided slidably in said cylinder 6 for sucking fuel from said suction passage 22 into said fuel pressurizing chamber 6a and discharging fuel from said fuel pressurizing chamber 6a into said discharge passage 23;
 a drive means 8 for sliding and reciprocating said plunger 7;
 a first reed valve 26, 35 provided in said pump body 21 having a suction side movable valve element 26a, 35a for opening and closing said suction passage 22; and
 a second reed valve 27, 36 provided in said pump body 21 having a discharge side movable valve element 27a, 36a for opening and closing said discharge passage 23.

2. A fuel supply pump according to Claim 1, further comprising a valve plate 25, 32, 34 disposed between said first and second reed valves 26, 35, 27, 36, wherein a laminated valve structure 24, 31, 33 is composed of said valve plate 25, 32, 34, said first reed valve 26, 35 and said second reed valve 27, 36, said laminated valve structure 24, 31, 33 is provided with a suction hole 24a, 31a, 33a for sucking fuel from said suction passage 22 into said fuel

pressurizing chamber 6a and a discharge hole 24b, 31b, 33b for discharging fuel from said fuel pressurizing chamber 6a into said discharge passage 23, said suction hole 24a, 31a, 33a is opened and closed by said suction side movable valve element 26a, 35a of said first reed valve 26, 35, and said discharge hole 24b, 31b, 33b is opened and closed by said discharge side movable valve element 27a, 36a of said second reed valve 27, 36.

3. A fuel supply pump according to Claim 2, wherein said laminated valve structure 24, 31, 33 further includes first and second valve holders 28, 37, 29, 38, said first reed valve 26, 35 is disposed between said valve plate 25, 32, 34 and said first valve holder 28, 37, and said second reed valve 27, 36 is disposed between said valve plate 25, 32, 34 and said second valve holder 29, 38.

4. A fuel supply pump according to Claim 3, wherein said first and second valve holders 28, 37, 29, 38 are provided with recesses 28a, 37a, 29a, 38a to allow for the movement of said suction side and discharge side movable valve elements 26a, 35a, 27a, 36a.

5. A fuel supply pump according to any one of Claims 2 to 4, wherein said suction hole 24a, 31a, said discharge hole 24b, 31b, said suction side movable valve element 26a and said discharge side movable valve element 27a comprise two suction holes 24a, 31a, two discharge holes 24b, 31b, two suction side movable valve elements 26a, and two discharge side movable valve elements 27a respectively.

6. A fuel supply pump according to any one of Claims 2 to 4, wherein said suction hole 33a and said suction side movable valve element 35a comprise two suction holes 33a and two suction side movable valve elements 35a respectively, said discharge hole 33b and said discharge side movable valve element 36a are composed of one discharge hole 33b and one discharge side movable valve element 36a respectively, said discharge hole 33b having a larger diameter than each of said suction holes 33a, and said discharge hole 33b being disposed between said suction side movable valve elements 35a.

7. A fuel supply pump according to any one of Claims 2 to 6, wherein said valve plate 25, 32, 34 is composed of the same material as said first and second reed valves 26, 35, 27, 36.

8. A fuel supply pump according to any one of Claims 2 to 7, wherein said valve plate 32 and said first and second reed valves 26, 27 have the same thickness.

FIG. 1

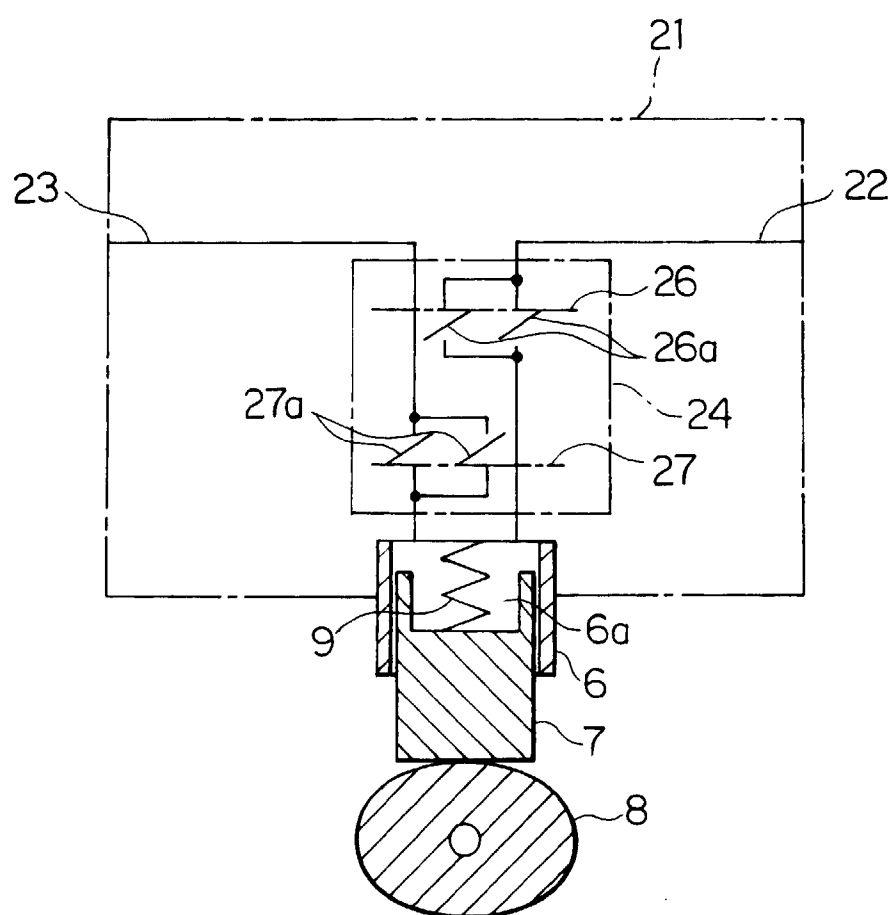


FIG. 2

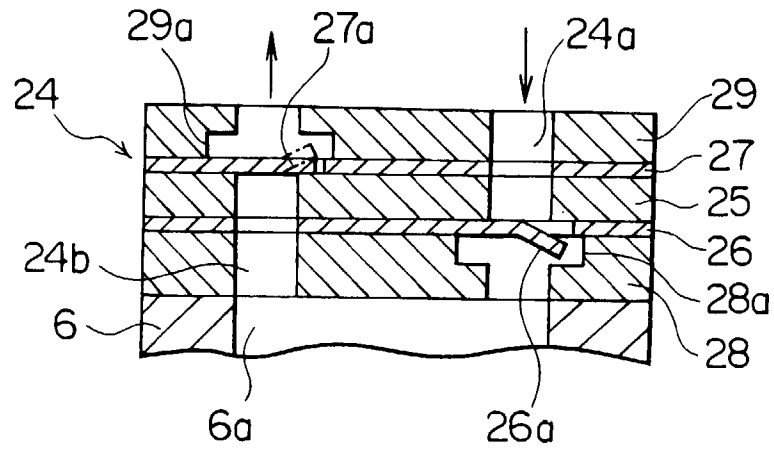


FIG. 3

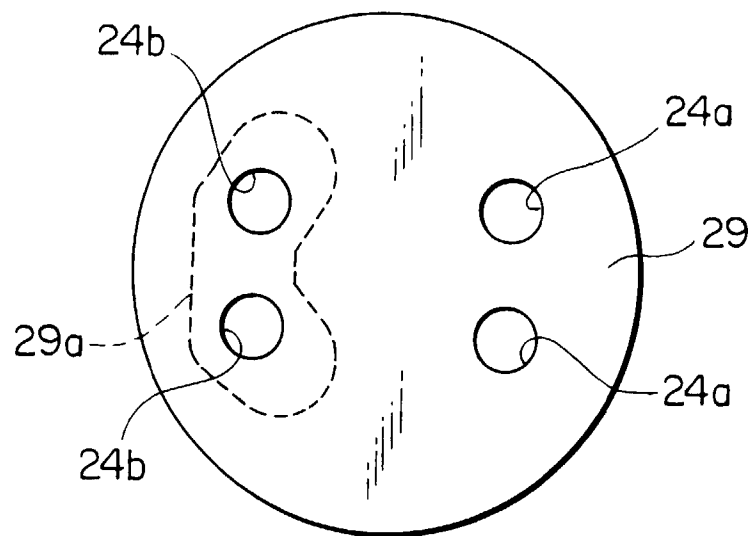


FIG. 4

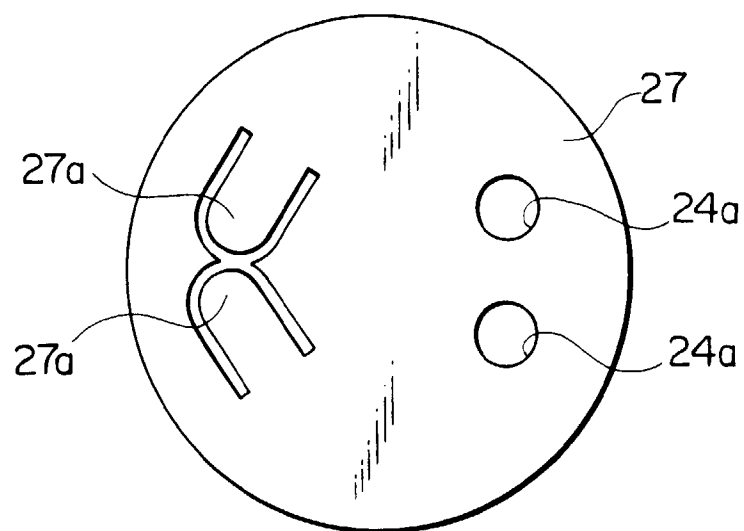


FIG. 5

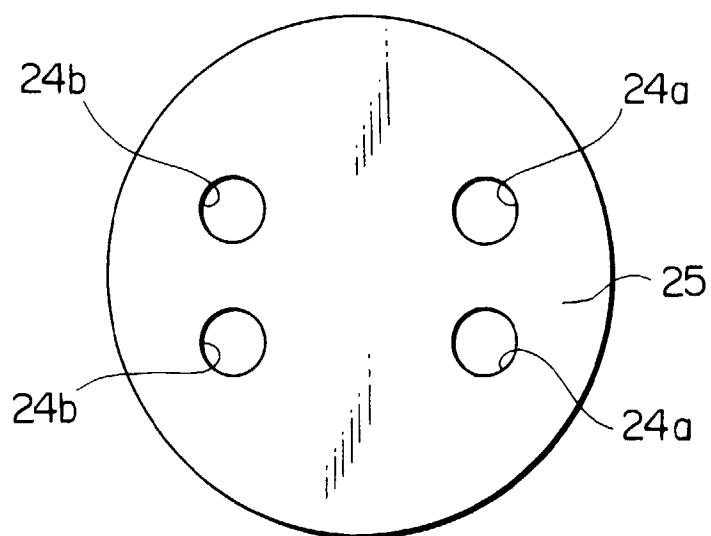


FIG. 6

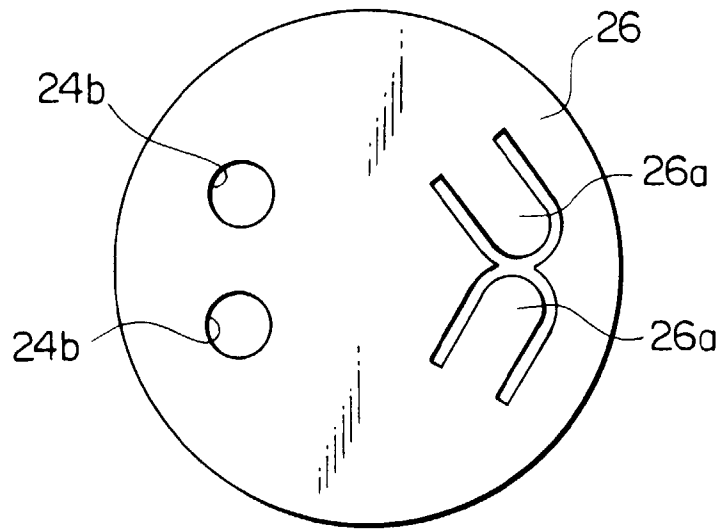


FIG. 7

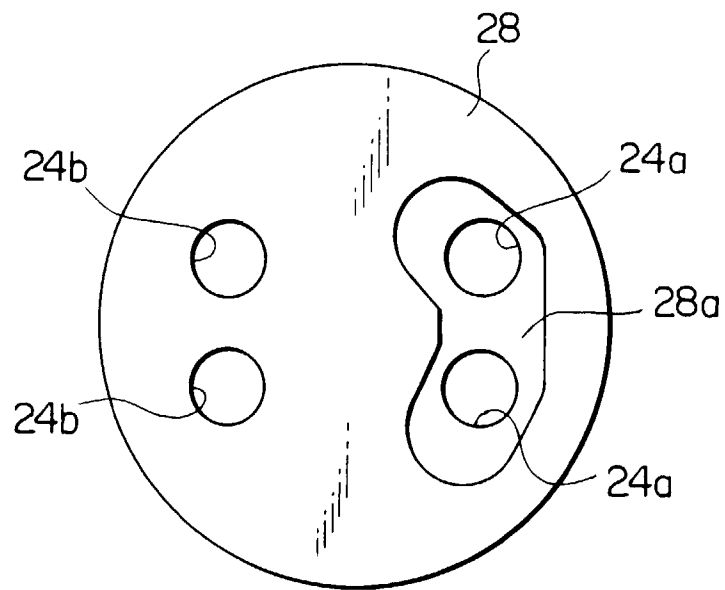


FIG. 8

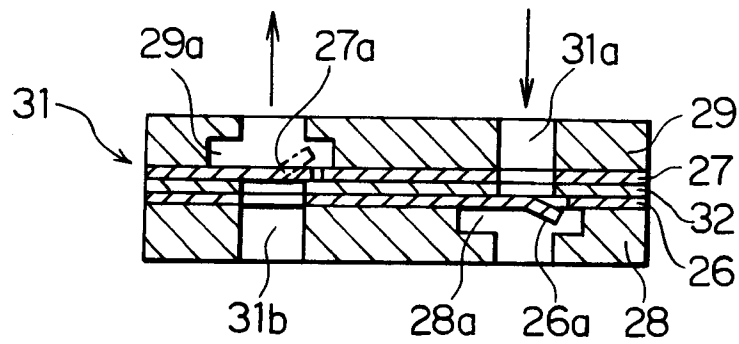


FIG. 9

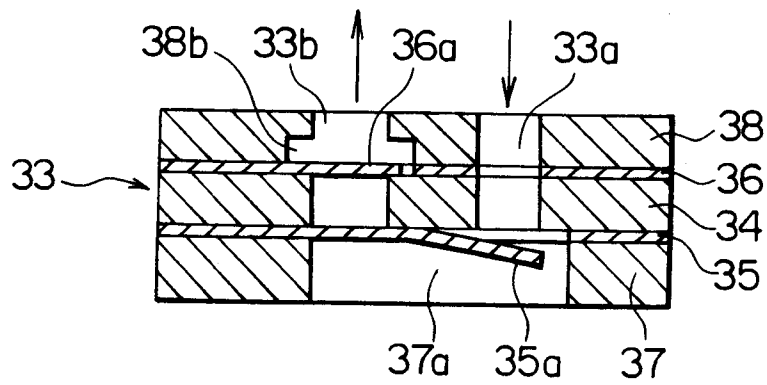


FIG. 10

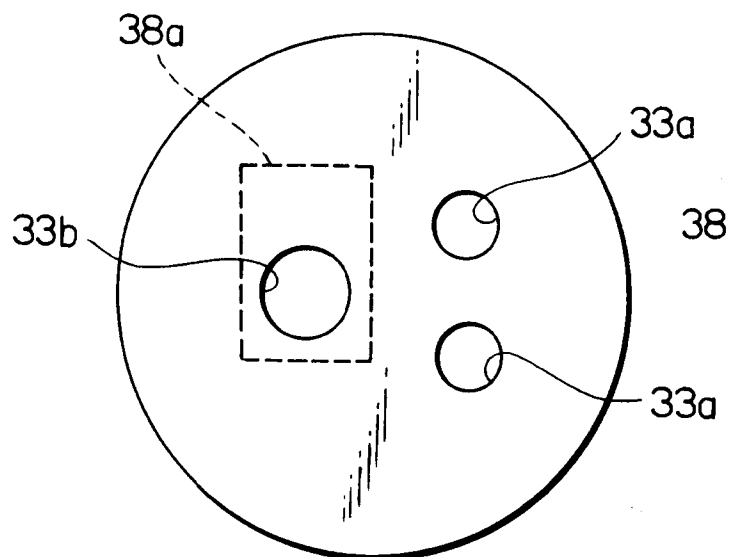


FIG. 11

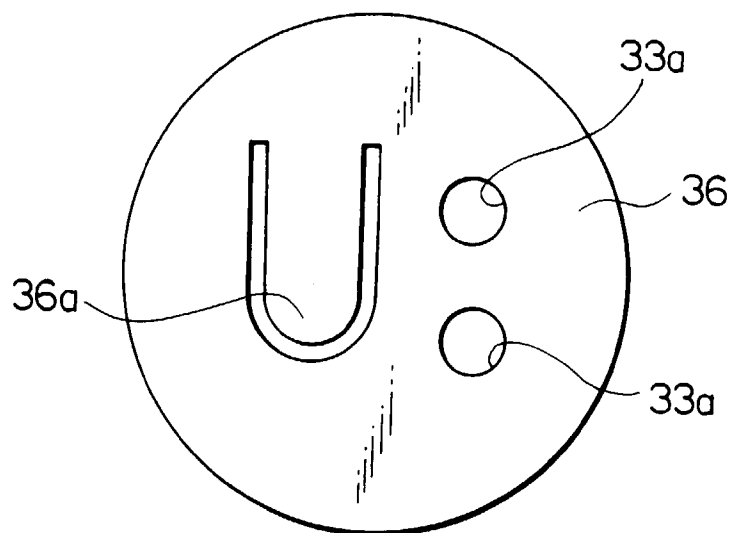


FIG. 12

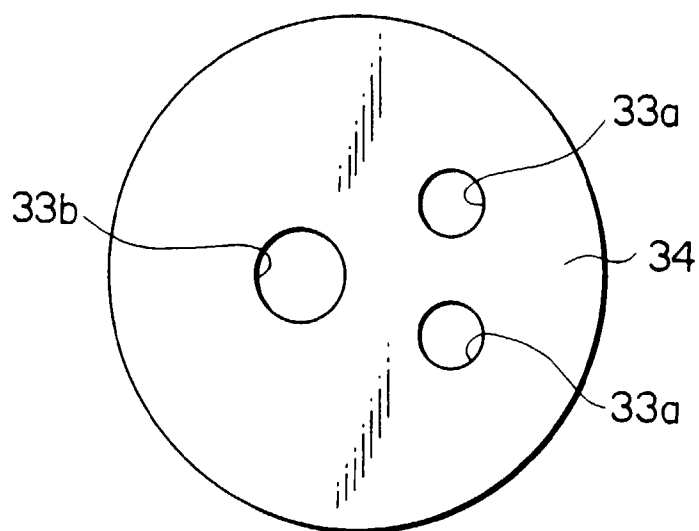


FIG. 13

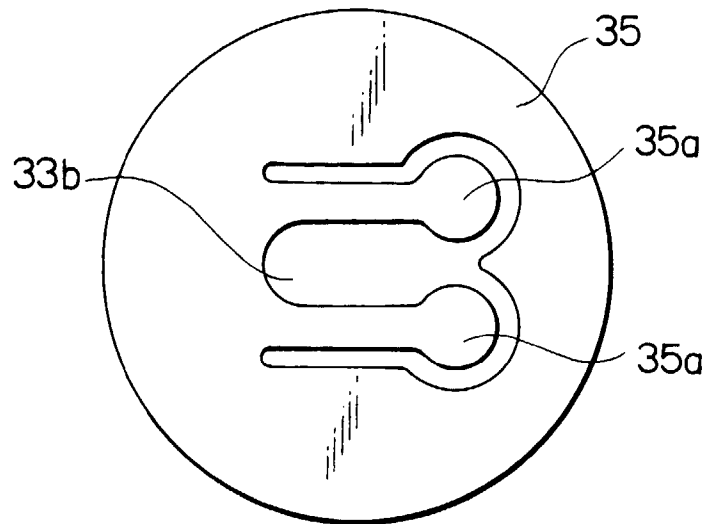


FIG. 14

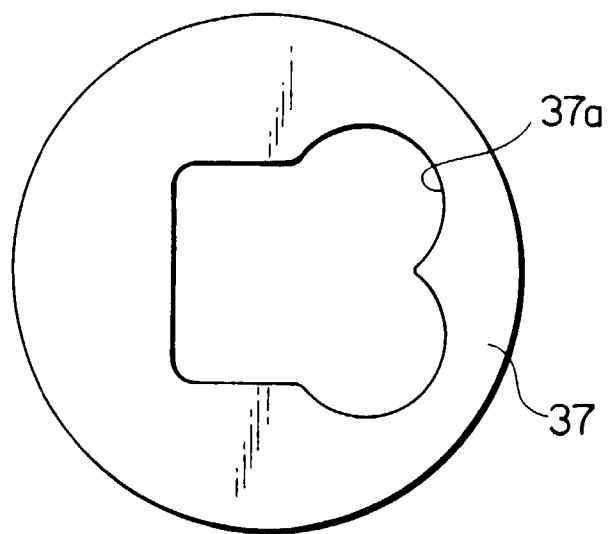


FIG. 15

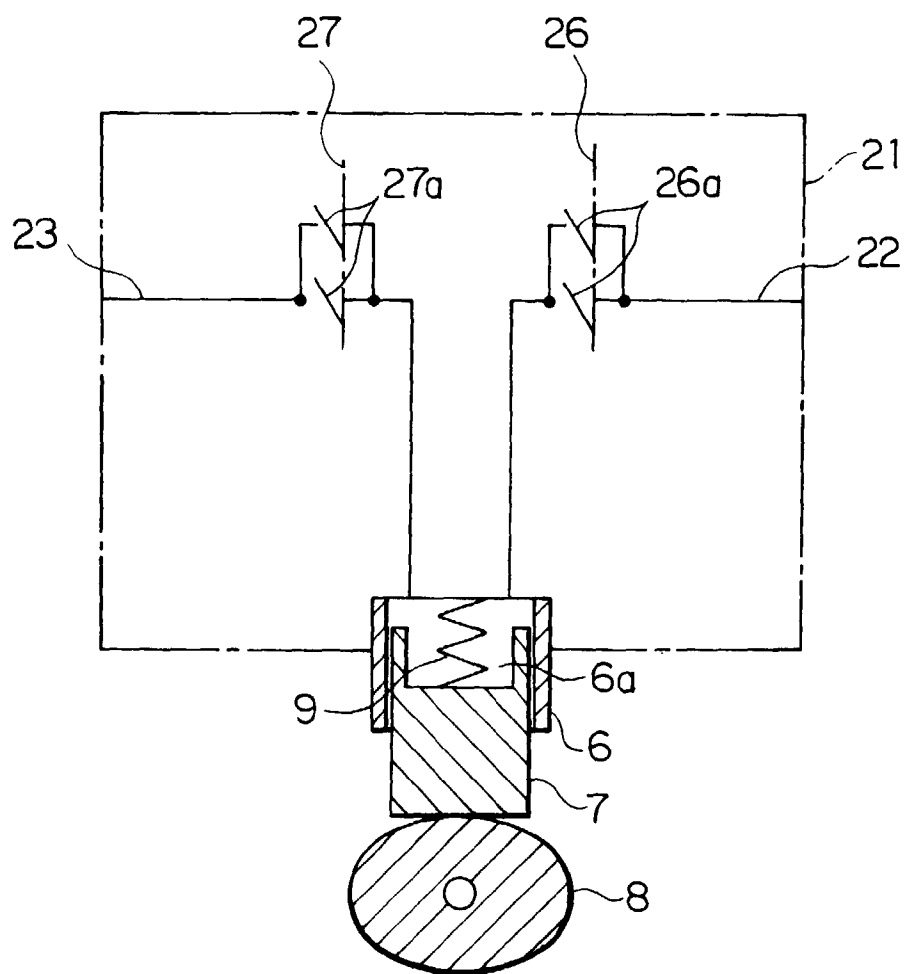


FIG. 16

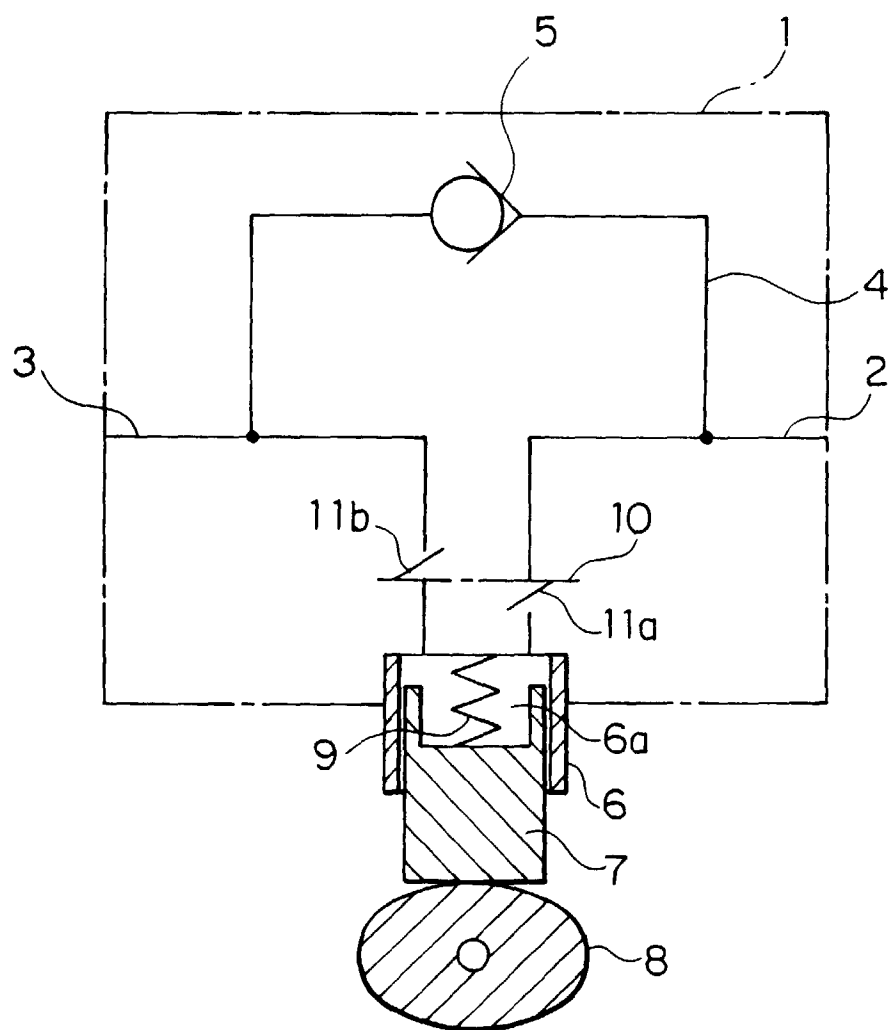


FIG. 17

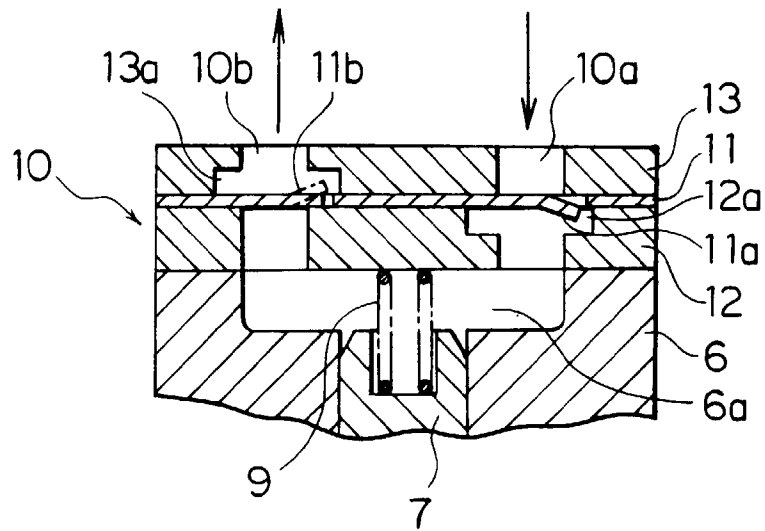


FIG. 18

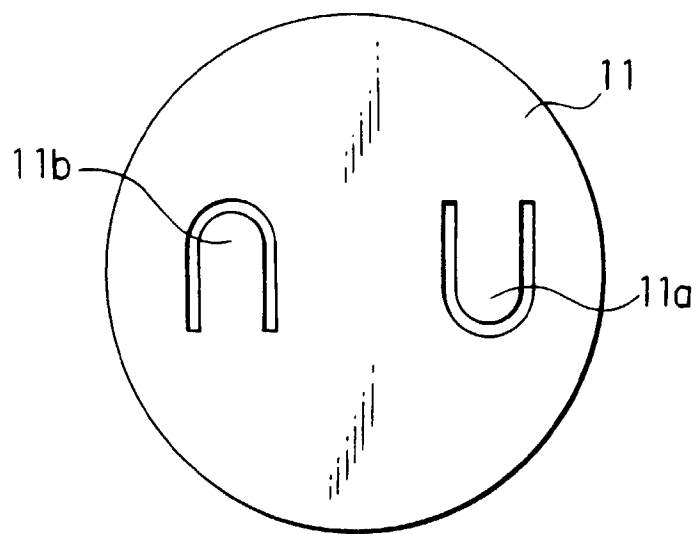


FIG. 19

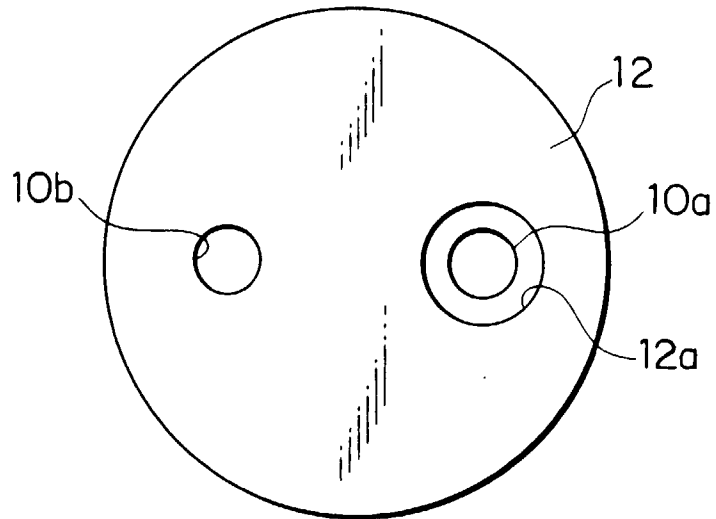


FIG. 20

