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(54) **Pump having one inlet and two outlets**

(57) A pump delivers fluid by closing one of the two outlets (12,13) and opening the other operating a switch

valve (2) in accordance with forward rotation or reverse rotation of a pump motor. Furthermore, the switch valve (2) utilizes viscosity of the fluid for the operation.

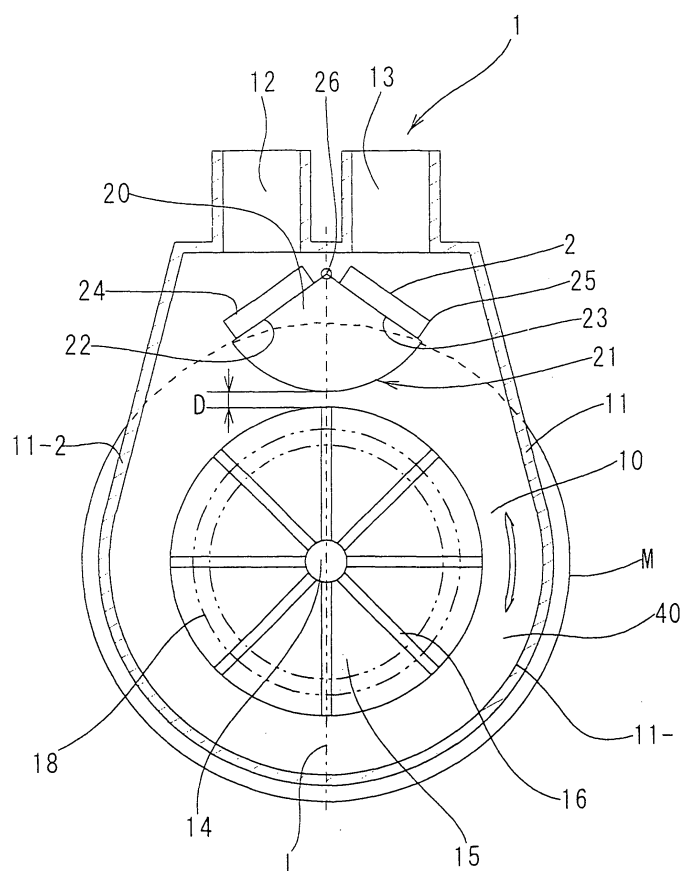


Fig. 1

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Description

[0001] The present invention relates to a pump that is used in a dishwasher or other machines handling liquid. Particularly, the present invention relates to a pump that has one inlet and two outlets communicating a pump chamber, and delivers fluid from one of the two outlets in accordance with a rotation direction of an impeller that is placed in the pump chamber.

[0002] Usually, a pump that is used in a dishwasher is required to have a function of supplying washing water into a dishwashing bath and a function of draining waste water after dishwashing. Conventionally, there is a dishwasher having one pump that has the two functions, in which a pump motor is switched between forward rotation and reverse rotation, so that a transportation path of fluid using the pump is switched between a washing water supplying pipe and a waste water draining pipe.

[0003] This type of pump is disclosed in Japanese unexamined patent publication No. 10-43121, as shown in Fig. 7, for example. This pump has two outlets 112, 114 including the washing water outlet and the waste water outlet in a pump casing 101 that houses an impeller 103 that is rotated by a motor 105. The pump also has one inlet 106 that is common to the two outlets. The pump further has a switching valve device 115 for opening and closing one of the washing water outlet and the waste water outlet selectively. This switching valve device 115 includes a slidable valve plate 104 that closes the waste water outlet when opening the washing water outlet, while opens the waste water outlet when closing the washing water outlet. This valve plate is provided with a forward flow pressure receiving surface 119 for receiving water flow when the motor rotates forwardly and a reverse flow pressure receiving surface 121 for receiving water flow when the motor rotates reversely. When the motor rotates forwardly, the forward flow pressure receiving surface 119 of the valve plate 104 is pressed by water flow from the impeller so that the valve plate slides. Then, one of the washing water outlet and the waste water outlet is closed while the other is opened. When the motor rotates reversely, the action opposite to the above-explained action is performed.

[0004] However, in the above-mentioned structure in which a sliding valve element is provided with the forward flow pressure receiving surface 119 and the reverse flow pressure receiving surface 121, when operating the switch valve device inside the pump in accordance with the forward rotation or the reverse operation of the motor so that the open/close states of two outlets are switched, the position of the pressure receiving surface moves in the stage where the valve element is moved to slide by the water flow. Therefore, the pressure that the pressure receiving surface receives from water flow is continuously changing. For this reason, the sliding movement of the valve element may be unstable, malfunction of the switching operation may occur easily, and switching of two outlets may not be performed

smoothly. In addition, the switching may be performed insufficiently, the two outlets may open insufficiently, and both the outlets may deliver water. Furthermore, the structure of the switch valve device 115 may be complicated, which may cause increase of cost.

[0005] An object of the present invention is to provide a pump that has one inlet and two outlets for delivering fluid from one of the two outlets in accordance with an operation direction of a pump motor, i.e., forward rotation or reverse rotation and that can switch one of the two outlets securely and smoothly.

[0006] Another object of the present invention is to provide a pump in which a structure of a switch valve for opening one of the two outlets and closing the other can be simplified.

[0007] Still another object of the present invention is to provide a pump having high reliability with a stable switching operation of the two outlets.

[0008] The above objects are solved by a pump having the features of claim 1. Some preferred embodiments are defined in the dependant claims.

[0009] Referring now to the attached drawings which form a part of this original disclosure:

Fig. 1 is a cross section of a pump according to an embodiment of the present invention.

Fig. 2 is a cross section of the pump shown in Fig. 1, which is at a start of a pump forward operation.

Fig. 3 is a cross section of the pump shown in Fig. 1, which is in the state of the pump forward operation.

Fig. 4 is a cross section of the pump shown in Fig. 1, which is in the state of a pump reverse operation.

Fig. 5 is a perspective view showing a switch valve shown in Fig. 1.

Fig. 6 is a perspective view showing another example of the switch valve shown in Fig. 1.

Fig. 7 is a cross section of an prior art pump, shown by Japanese unexamined patent publication No. 10-43121.

[0010] An embodiment of a pump according to the present invention will be explained with reference to the drawings.

[0011] Figs. 1-4 are plan views showing a pump chamber 10 of a pump 1 according to this embodiment. Fig. 1 shows a pump stop state. Fig. 2 shows a start of a pump forward operation. Fig. 3 shows a pump forward operation. Fig. 4 shows a pump reverse operation.

[0012] The pump 1 includes a pump casing 11 that defines the pump chamber 10 and a reversible motor M

that is placed below the pump casing 11. The casing 11 comprises a circumference wall portion 11-1 having a cylindrical shape, a part of which is swelled in the circumferential direction, an upper wall portion (not shown) that closes an upper face opening of the circumference wall portion 11-1 and a lower wall portion 11-2 that closes a lower face opening of the circumference wall portion 11-1. A rotation shaft 14 of the motor M passes through the lower wall portion 11-2 of the casing 11 substantially at the middle portion and is led into the pump chamber 10. A portion of the casing 11 where the rotation shaft 14 of the lower wall portion 11-2 penetrates is shielded so as to prevent water in the pump chamber 10 from leaking while securing that the rotation shaft 14 can rotate. The pump chamber 10 houses an impeller 15 having a plurality of vanes 16 substantially in a radial manner. The distal end of the rotation shaft 14 that is led into the pump chamber 10 is linked to the rotation center of the impeller 15, so that the motor M can rotate the impeller 15. The impeller 15 is arranged coaxially with a cylindrical wall portion of the circumference wall portion 11-1. Between the impeller 15 and the swelled portion of the circumference wall portion 11-1, there is a space larger than that between the impeller 15 and the cylindrical wall portion.

[0013] The swelled portion of the circumference wall portion 11-1 of the casing 11 is provided with a first outlet 12 and a second outlet 13 arranged in parallel and opening to the pump chamber 10. In addition, the position of the upper wall portion of the casing 11 corresponding to the impeller 15 is provided with an inlet 18 (shown by a dot-dashed line). The rotation shaft 14 of the motor (M) is located on a pump center line (L) that passes the center of the two outlets 12 and 13 and the center of the pump chamber, and substantially at the center of the pump chamber 10. A channel 40 is formed between the rim of the impeller 15 and the circumference wall of the casing 11.

[0014] A switch valve 2 for closing one of the first outlet 12 and the second outlet 13 and opening the other is provided between the rim of the impeller 15 and each of the two outlets 12 and 13 in the pump chamber 10, i.e., in the above-mentioned relatively large space. This switch valve 2 includes a sector valve element 20 having an arc circumference surface 21 and valve lid portions 24 and 25 that are arranged at both end surfaces 22 and 23 of the arc circumference surface 21 of the valve element 20. A pivot shaft 26 is provided at the cross line between two end surfaces of the sector and is disposed on the pump center line (L) in a rotative manner. The sector valve element 20 can swing along with the arc circumference surface 21 facing the impeller 15. Regardless of a rotation position of the valve element 20, a distance (D) is constantly maintained between the arc circumference surface 21 and the rim of the impeller 15.

[0015] The valve lid portion 24 is disposed at the end surface 22 of the sector valve element 20 facing the first outlet 12, while the valve lid portion 25 is disposed at the

end surface 23 facing the second outlet 13. When the valve element 20 swings in one direction or in the other direction, the valve lid portion 24 and the valve lid portion 25 close the first outlet 12 and the second outlet 13, respectively. The sector shape of the valve element 20 is set so that the valve lid portion 25 opens the second outlet 13 largely when the valve lid portion 24 closes the first outlet 12, while the valve lid portion 24 opens the first outlet 12 largely when the valve lid portion 25 closes the second outlet 13.

[0016] The pump 1 having the above-mentioned structure works as follows. When the impeller 15 is driven by the motor (M) and rotates, fluid is sucked into the pump chamber 10 through the inlet 18. In accordance with the rotation direction of the impeller 15, a spiral flow of the fluid is generated in the channel 40 in the forward or reverse rotation direction, when the fluid flows in the pump chamber 10.

[0017] At start of the forward operation of the pump 1, as shown in Fig. 2, the motor (M) rotates the impeller 15 in the clockwise direction as shown by the arrow a1. A part 42 of the fluid 41 flowing in the pump chamber 10 flows into the space between the circumference surface 21 of the switch valve 2 and the impeller 15. The arc circumference surface 21 receives the fluid 42, and viscosity of the fluid 42 generates a torque, which is transmitted to the entire of the switch valve 2. Then, the switch valve 2 is swung around the pivot shaft 26 as shown by the arrow b1 in the direction of closing the second outlet 13. In this operation, the channel 43 to the first outlet 12 is gradually opened, and it starts to deliver the fluid 41 through the outlet 12. Since the distance (D) between the arc circumference surface 21 and the rim of the impeller 15 is maintained at a constant value during the operation of the switch valve 2, the torque due to the viscosity of the fluid 42 is generated continuously, so that the switching operation of the switch valve 2 can be performed smoothly.

[0018] When the pump 1 moves to a full operation, the switch valve 2 closes the second outlet 13 completely by the valve lid portion 25 as shown in Fig. 3. The major portion 44 of the fluid 41 flowing in the pump chamber 10 is delivered from the pump chamber 10 through the first outlet 12. Since a partial flow 45 of the fluid 41 flows into the space between the circumference surface 21 of the switch valve and the impeller 15, the torque is generated continuously. In addition, since the fluid 44 pushes the valve lid portion 24 and flows into the first outlet 12, the switch valve 2 keeps the state where the outlet 13 is closed, so that the delivering operation is performed only through the first outlet 12.

[0019] In addition, the distance (D) between the arc circumference surface 21 and the rim of the impeller 15 can be a small gap that is sufficient for the fluid turning in the pump chamber 10 to flow into the space between them so as to generate a torque of the fluid. Therefore, when the switch valve 2 closes the channel to the second outlet 13 almost completely in the forward opera-

tion, quantity of flow in the direction to the outlet 13 can be controlled to a minimum value necessary for generating the above-mentioned torque, so that quantity of delivering flow through the first outlet 12 can be secured and the delivering efficiency can be improved.

[0020] When the operation of the pump 1 is stopped, the switch valve 2 becomes the state leaning to the second outlet 13 side as shown in Fig. 3. In this case, it is possible to apply a force to the switch valve 2 to be always in the state as shown in Fig. 1. In addition, if the pump 1 is positioned horizontally so that the switch valve 2 is located directly above the impeller 15, the switch valve 2 will fall to the position as shown in Fig. 1 due to a weight thereof when the operation is stopped. In any case, since there is a certain distance (D) between the circumference surface 21 of the switch valve 2 and the impeller 15, new fluid can be led to the arc circumference surface 21 by restarting the operation so that the restart can be performed easily.

[0021] When the pump 1 is in the reverse operation, the switch valve 2 performs the action as shown in Fig. 4, in the direction opposite to the case of Fig. 2 or 3. The switch valve 2 closes the first outlet 12, and fluid 46 in the pump chamber 10 is delivered only through the second outlet 13.

[0022] The above-explained switch valve 2 is made of a resin or a metal such as an aluminum alloy. The valve lid portions 24 and 25 can be made of an elastomer material such as a rubber or a urethane, though they are preferably light to be easily moved by fluid.

[0023] Therefore, according to the above-explained pump 1 of the present invention, a torque due to viscosity of fluid that is generated between the arc circumference surface 21 of the switch valve 2 and the impeller 16 is utilized for operating the switch valve 2 having a simple structure with a sector valve element 20. Accordingly, a pump can be realized that has little possibility of trouble such as a malfunction or an operational error of the switch valve 2. In accordance with the operation direction of the pump 1, one of the outlets is closed while fluid is delivered only through the other outlet, so that high reliability can be realized.

[0024] In addition, since the structure and the principle of operational of switch valve are simple, a complicated structure as the conventional one is not required. Since electric means such as a solenoid valve are not required, the structure of the pump itself can be simplified, so that cost reduction of the pump can be realized.

[0025] Furthermore, the arc circumference surface 21 of the switch valve 2 can be processed by machine on the surface, e.g., projections and depressions of a stripe pattern as shown in Fig. 5 can be formed. This uneven portion 27 of the circumference surface 21 enhances friction with fluid so as to receive the fluid easily and to generate a torque easily due to viscosity of the fluid. Thus, the operation of the switch valve 2 can be secured and performed smoothly. This uneven portion 27 can be formed by a knurl process if the circumference surface

21 is made of a metal, for example. Alternatively, if circumference surface 21 is made of a resin, the uneven portion 27 can be formed by injection modeling.

[0026] If the above-mentioned uneven portion is formed to have plural steps, it is preferable to form the uneven portion 28 like a hound's tooth check as shown in Fig. 6. Thus, distribution of the viscosity torque of the fluid that is generated on the arc circumference surface 21 can be equalized, the operation of the switch valve 2 can be stabilized, and switching between opening and closing of the outlet can be performed more smoothly.

Claims

1. A pump comprising one inlet (18), two outlets (12, 13), a pump chamber housing (11) an impeller (15) that is fixed to a rotation shaft (14) of a motor (M), and a switch valve (2) for delivering fluid through one or the other of the two outlets (12, 13) in accordance with switching of the rotation direction of the impeller (15) between forward and reverse, wherein

the switch valve (2) is disposed between the impeller (15) and the two outlets (12, 13) and includes a sector valve element (20) and valve lid portions (24, 25), the sector valve element (20) can swing along with an arc circumference surface (21) facing a circumference surface of the impeller (15), the two valve lid portions (24, 25) are formed on both end surfaces (22, 23) of the valve element (20), and the one of the both end surfaces (22, 23) closes one of the two outlets (12, 13) in a manner permitting open and close state thereof while the other of the both end surfaces (22, 23) close the other of the two outlets (12, 13) in a manner permitting open and close state thereof, and

a part of a spiral flow of liquid generated by the rotation of the impeller (15) affects the cylindrical circumference surface so as to perform switching operation of the switch valve (2).

2. The pump according to claim 1, wherein the switch valve (2) closes one of the two outlets (12, 13) while it opens the other.
3. The pump according to claim 1 or 2, wherein the pump chamber (10) is defined by a pump casing (11) including a circumference wall portion having a shape of a cylindrical wall that is partially swelled outward in the circumference direction and an end wall portion that closes both end surfaces of the circumference wall portion, the two outlets (12, 13) are formed in the state of parallel to the swelled portion of the circumference wall portion, and the inlet (18) is formed at the end wall portion.
4. The pump according to anyone of claims 1 to 3,

wherein the sector valve element (20) has a pivot shaft (26) at the cross line between two end surfaces of the sector, and the pivot shaft (26) is arranged on a center line that connects a middle point between the two outlets (12, 13) and a rotation center of the impeller (15). 5

5. The pump according to anyone of claims 1 to 4, wherein the arc circumference surface of the sector valve element (20) is provided with at least one, in particular a plurality of uneven portions (27, 28) along the arc of the arc circumference surface for enhancing friction with fluid of the spiral flow. 10
6. The pump according to claim 5, wherein at least one uneven portion (27, 28) of the arc circumference surface of the sector valve element is divided into plural steps along the axis direction of the valve element, and a projection and a depression of a step are adjacent respectively to a depression and a projection of a neighboring step in the axis direction. 15 20
7. The pump according to anyone of claims 1 to 6, wherein at least one of the valve lid portions (24, 25) of the switch valve (2) is made of an elastomer selected from a group including a rubber and a urethane. 25

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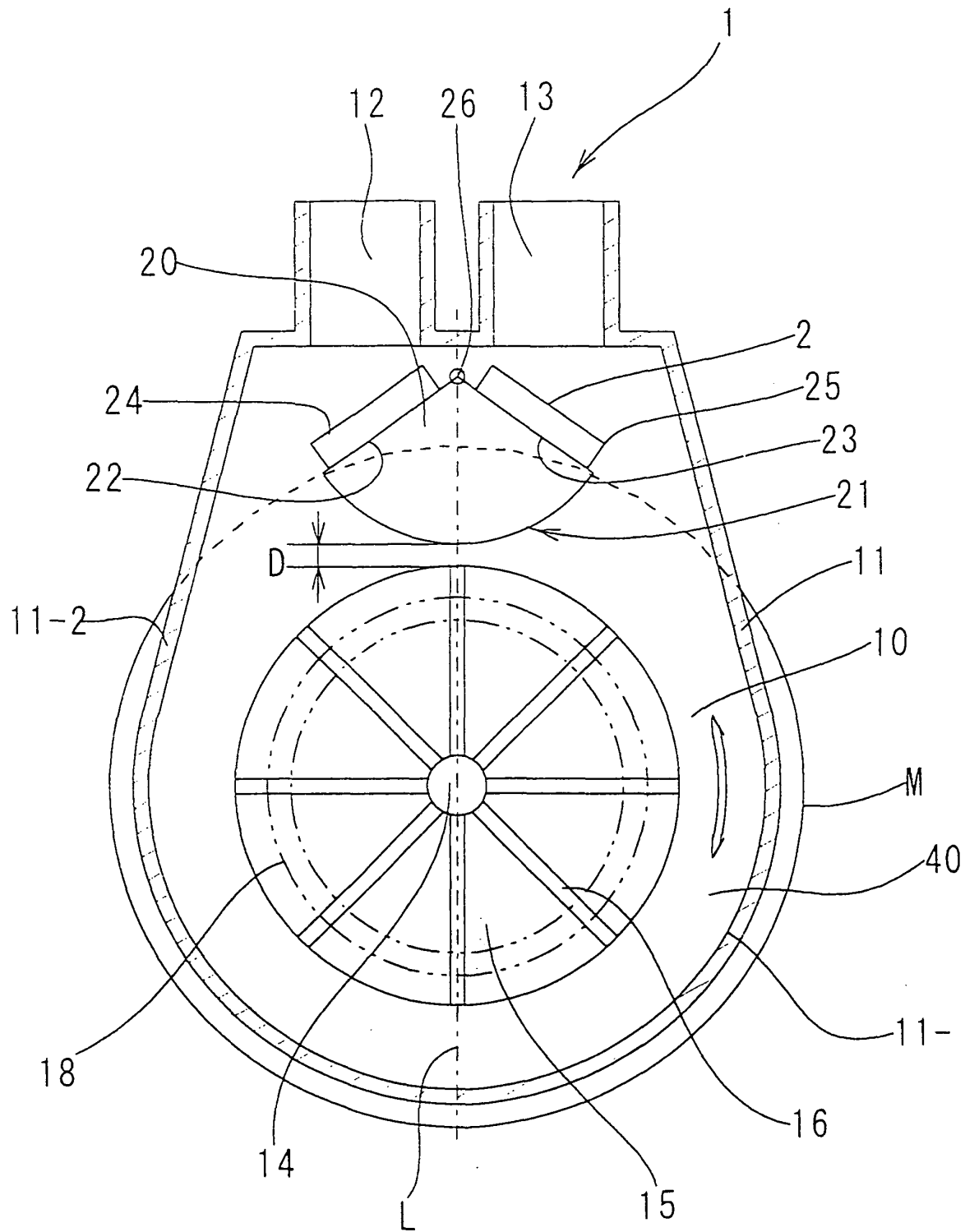
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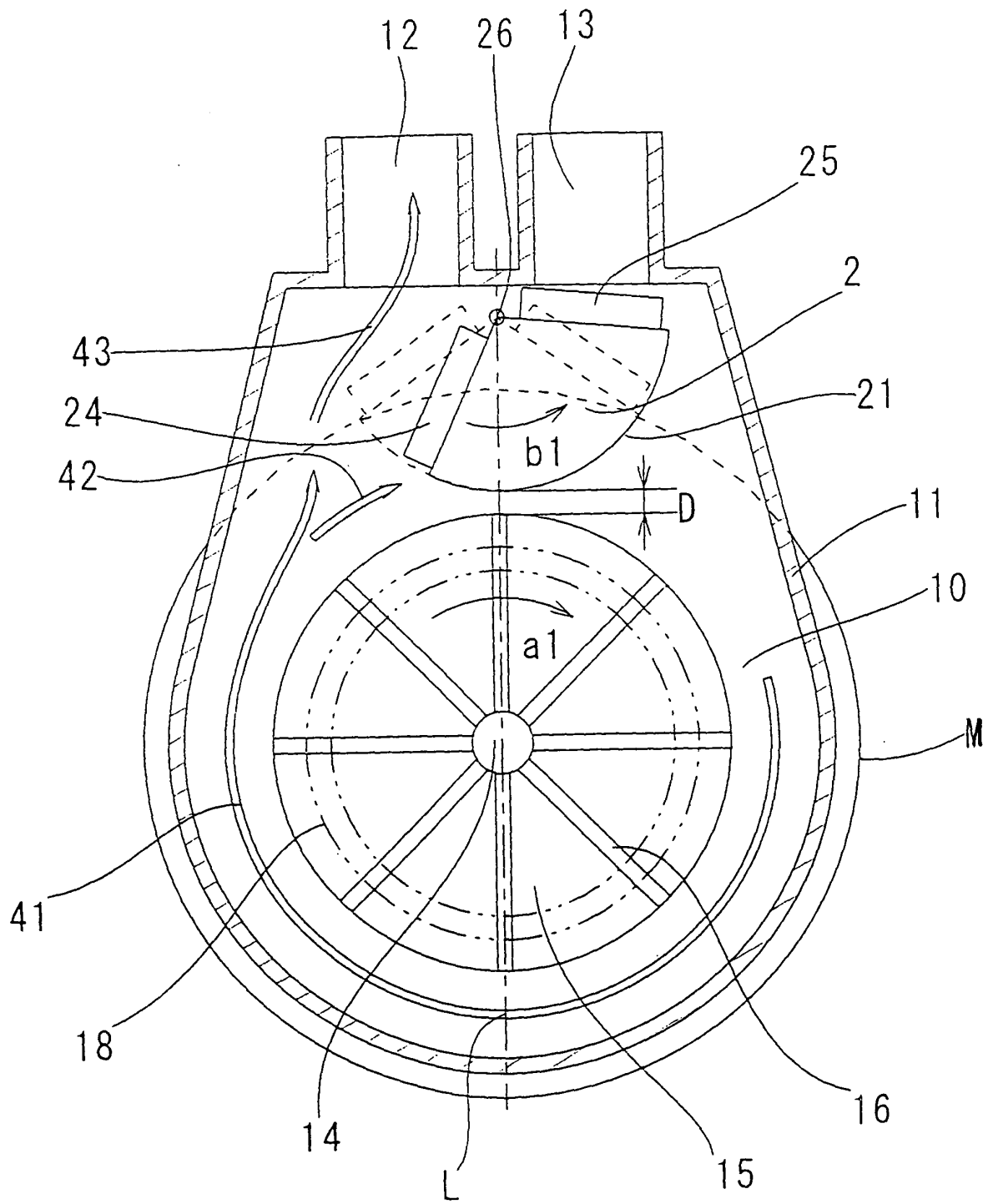
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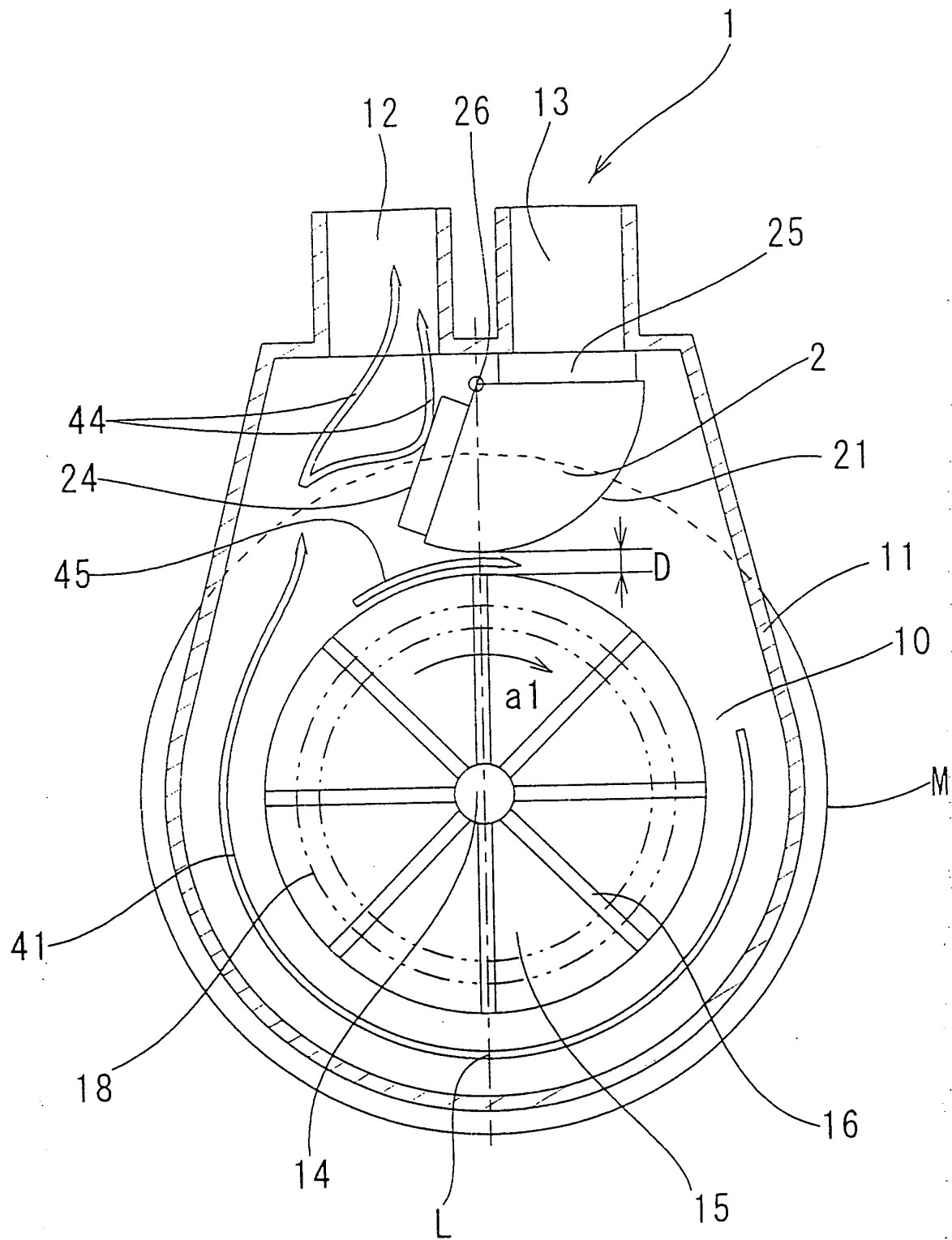
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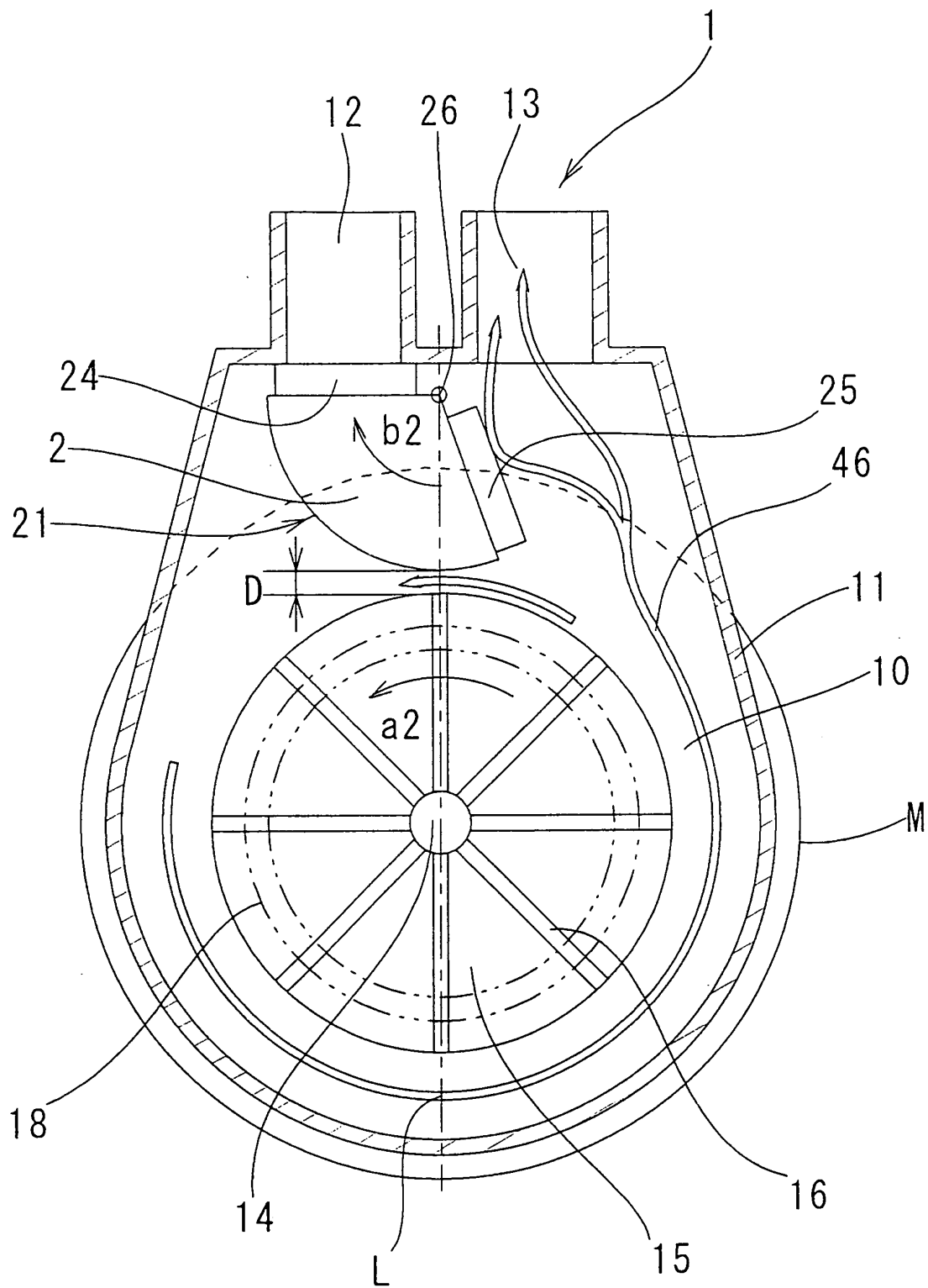
F i g . 1



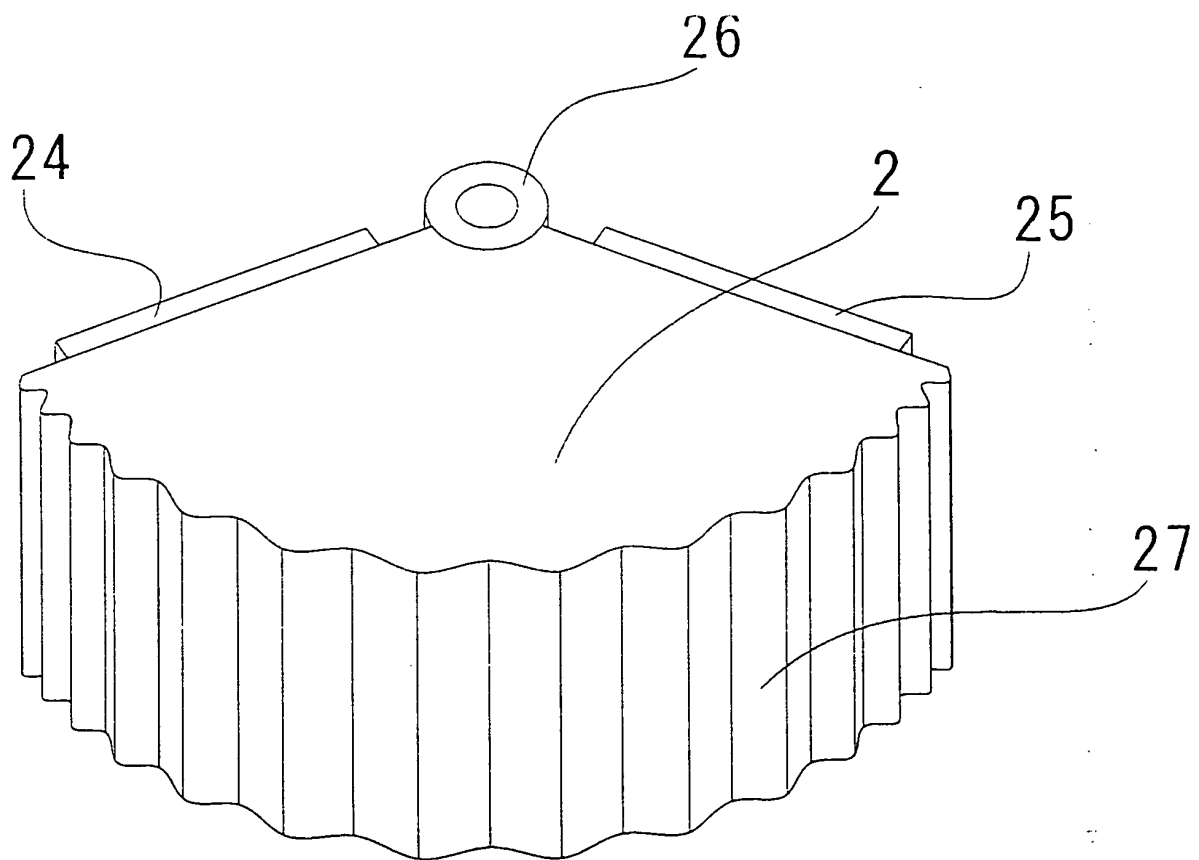
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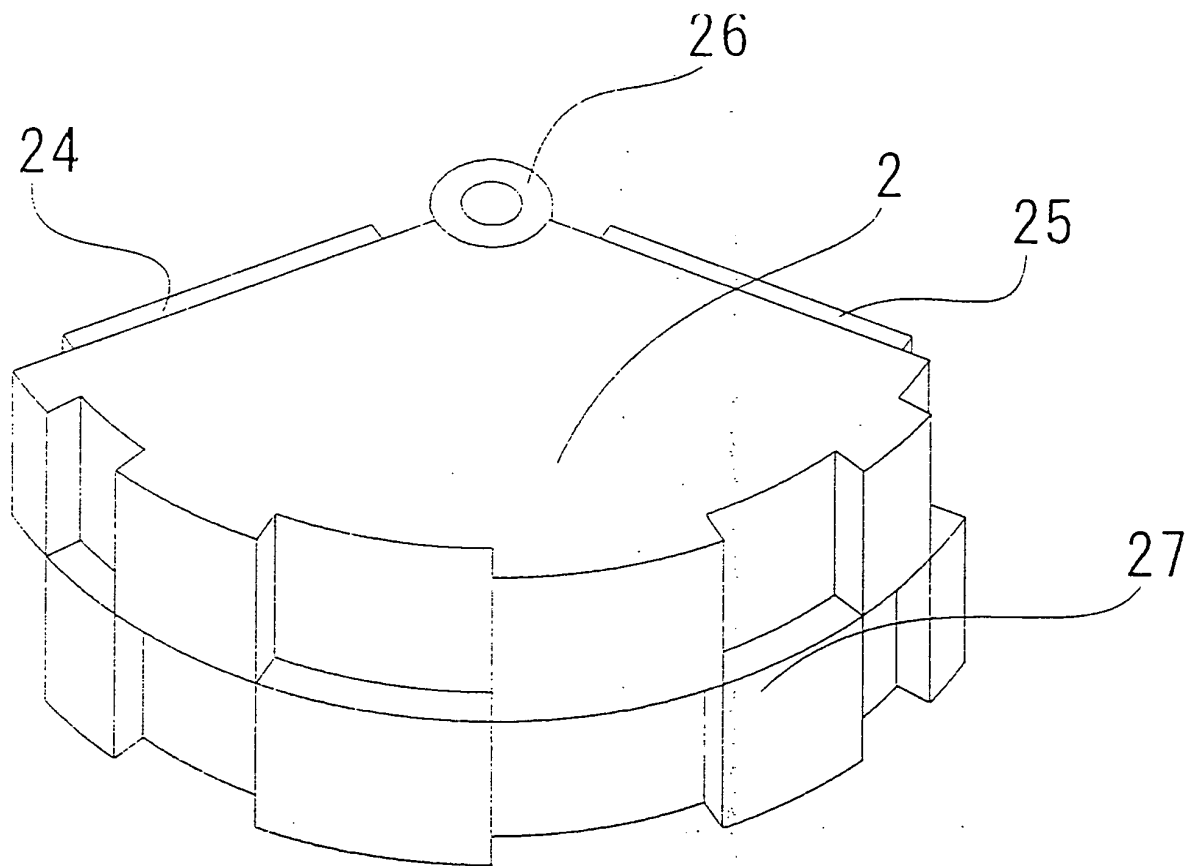
F i g . 3



F i g . 4



F i g . 5



F i g . 6

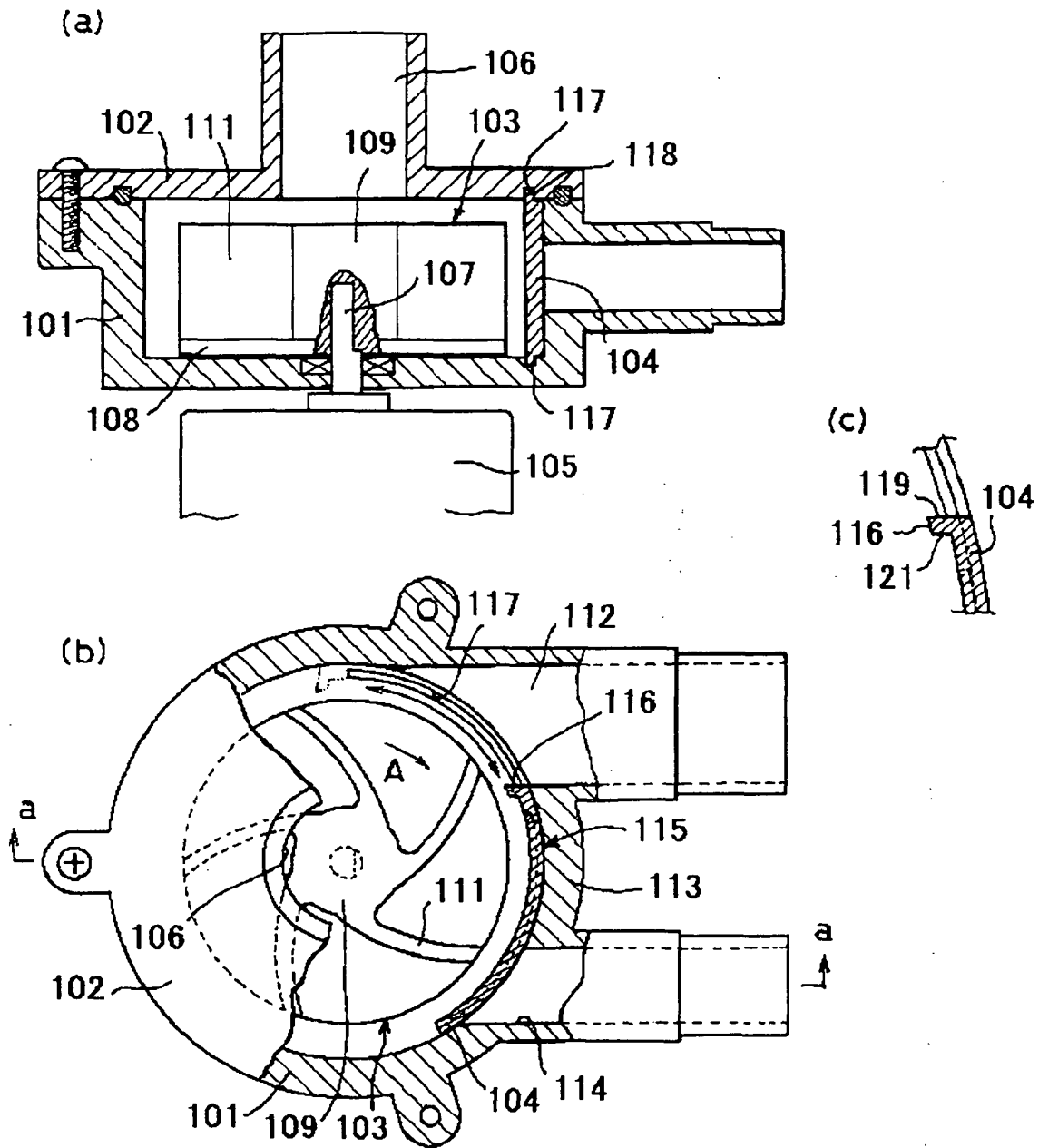


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 03 02 1749

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 13 November 2003	Examiner Giorgini, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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