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(11) **EP 1 240 863 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.09.2002 Bulletin 2002/38

(51) Int Cl.7: **A47L 15/42, A47L 15/23**

(21) Application number: **02001971.7**

(22) Date of filing: **04.02.2002**

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

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(30) Priority: **07.02.2001 IT MI010238**

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(54) **Bypass valve for washing machine and relative methods of application**

(57) A bypass valve (1, 1') for a domestic washing machine which is characterised in that it comprises: a chamber (3, 3') for collecting a flow of liquid, extending in an axial direction and provided with an inlet way (5, 5'), and a first and a second outlet way (7, 7', 9, 9'); a ferromagnetic stem (13, 13') which can be actuated to move by a coil (15, 15') with electromagnetic control

along the axis of the coil (15, 15'), which axis of the coil (15, 15') is oriented in the axial direction of the collecting chamber (3, 3'); and an actuator (21, 21') mobile integrally with the ferromagnetic stem (13, 13') between two operating positions at which it provides selective sealing in respect of one or the other of the two outlet ways (7, 7', 9, 9') of the bypass valve (1, 1').

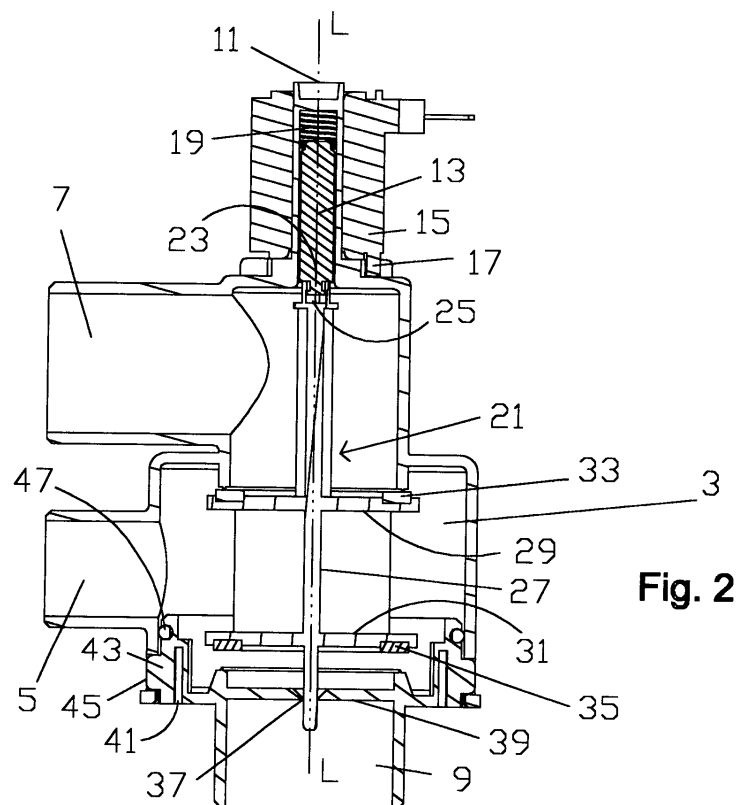


Fig. 2

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Description

[0001] The present invention relates to a bypass valve in a washing machine for the selective feed of water in two separate directions.

[0002] As regards machines for washing laundry, in some of them it is known that a jet of water is used from the top of the tub in such a way as to spray the laundry with greater efficacy and improved results. In other laundry washing machines recycling of the water of the last warm rinse is known, which water is temporarily stored in a storage tank to be reused for the prewash of the next cycle, or the water of the first rinse, reused for the second and final rinse. In order to perform these functions the washing machine is generally provided with a pump in addition to the drain pump.

[0003] As regards however dishwasher machines, in some of them, in order to reduce water consumption, common use is made of a sprayer at the top. In these cases the dishwasher machine comprises, in addition to the circulation pump, also a device for aiming the water alternatively at one of the sprayers. This switching device may be formed in some cases by a lever assembly. In other cases this switching device is formed by a system of balls which, according to how the circulation pump acts, move in appropriate housings to block the passage of the water: this system is not always reliable as it is linked to the proper working of the circulation pump.

[0004] In general, in washing machines, in order to send a flow in two alternative directions two physically separate solenoid valves or a double solenoid valve with a double opening mechanism controlled by two electromagnetic coils can be used. These solutions are however bulky and expensive. In the case of use of two separate solenoid valves assembly is also extremely complicated in that it requires the use of a pipe and a clip for each inlet and outlet of the valves.

[0005] The object of the present invention is that of remedying the disadvantages suffered by the traditional systems used in washing machines for diverting a flow of water in two separate directions, in particular the object of the present invention is that of providing a system to be used in a washing machine for diverting a flow of water selectively in two separate directions, which system is simple, economical, compact and reliable.

[0006] These and other objects are achieved in accordance with the present invention by a bypass valve for a domestic washing machine which is characterised in that it comprises: a chamber for collecting a flow of liquid, extending in an axial direction and provided with an inlet way, a first and a second outlet way; a ferromagnetic stem which can be actuated to move by a coil with electromagnetic control along the axis of the coil which is oriented in the axial direction of the collecting chamber; and an actuator mobile integrally with the ferromagnetic stem between two operating positions at which selective sealing is provided in respect of the two outlet

ways of the bypass valve.

[0007] Thanks to the bypass valve of the present invention it is possible in laundry washing machines or dishwasher machines to divert selectively a flow of water in two separate directions without the need for a pump in addition to that for draining or without using two solenoid valves or a double valve controlled by two coils with electromagnetic control.

[0008] The limited number of components of the bypass valve, the possibility of snap assembly of the components of the bypass valve and the simplicity of the design allow costs to be reduced and performances to be optimised.

[0009] These and other advantages will be made clearer from the following reading of the preferred embodiments of the invention, to be read by way of a non-limiting example of the more general principle claimed.

[0010] The following description refers to the accompanying drawings, in which:

Figure 1 is a perspective view of a preferred embodiment of the bypass valve of the present invention;

Figure 2 is a side elevation view sectioned along the axis of the bypass valve of Figure 1;

Figure 3 is a side elevation view sectioned along the axis of the bypass valve of a further embodiment of the present invention;

Figure 4 is a diagram of a first method of controlling the washing water of a dishwasher machine via a bypass valve in accordance with the present invention;

Figure 5 is a diagram of a first method of controlling the washing water of a laundry washing machine via a bypass valve in accordance with the present invention;

Figure 6 is a diagram of a second method of controlling the washing water of a dishwasher machine via a bypass valve in accordance with the present invention.

[0011] With reference to Figures 1 and 2, the bypass valve 1 has an inlet way 5, a first outlet way 7 and a second outlet way 9, communicating one with the other through a collecting chamber 3 which extends preferentially in an axial direction, denoted in Figure 2 by the line L-L.

[0012] According to the application the valve 1 may in any case also be arranged differently from how it is illustrated here, for example with a horizontal axis.

[0013] The bypass valve 1 is shaped in such a way that, with reference to the axial direction of the collecting chamber 3, one of its outlet ways is placed upstream of

its inlet way 5 while the other of its outlet ways is placed downstream of its inlet way 5.

[0014] The axes of the three ways of the valve 1 are contained in the main plane of the valve 1 but their orientation may vary according to needs, the arrangement illustrated being advantageous for reasons mainly of bulk.

[0015] More specifically, the axis of the upper outlet way 7 and of the inlet way 5 are parallel, orthogonal to the axis of the collecting chamber 3 and arranged on the same side as the latter, while the axis of the lower outlet way 9 extends from the lower wall of the collecting chamber 3 in the axial direction of the collecting chamber 3.

[0016] From the central portion of the upper wall of the collecting chamber 3 a sleeve 11, closed above and in direct communication below with the interior of the collecting chamber 3, extends in one single part axially and towards the exterior of the same collecting chamber 3. The internal surface of the sleeve 11 serves to guide the axial sliding of a ferromagnetic stem 13 through the collecting chamber 3, while the external surface of the sleeve 11 serves to support a coil 15 with electromagnetic control of the known type, in turn intended to control the axial movement of the ferromagnetic stem 13.

[0017] For attachment of the coil 15 to the valve 1, the base of the coil 15 has a finger 17 which can be deformed in such a way that it can be removably snap-inserted in a corresponding housing (not shown) provided on the external side of the upper wall of the collecting chamber 3, alternatively the coil 15 is restrained by teeth (not shown) situated at the top of the stem 11.

[0018] The ferromagnetic stem 13 is integral with an actuator 21 below, capable of providing alternative sealing in respect of one or the other outlet way 7 and 9 of the valve 1.

[0019] The actuator 21 is composed of two coaxial gate disks 29 and 31 made integral by a rod 27 which traverses them orthogonally at their centre.

[0020] Seal gaskets 33 and 35 respectively are attached on the operating side of the disks 29 and 31 respectively.

[0021] The rod 27 of the actuator 21 and the ferromagnetic stem 13 of the coil 15 are snap-joined axially thanks to the engaging of a flange 23 formed at the lower end of the ferromagnetic stem 13 in a counterpart housing 25 formed at the upper end of the rod 27.

[0022] The lower gate 31 acts directly on the internal side of the outlet way 9 of the valve 1, while the upper gate 29 acts on a section of the collecting chamber 3 which connects the inlet way 5 to the outlet way 7 of the valve 1.

[0023] To assist axial sliding of the ferromagnetic stem 13 - actuator 21 assembly, the lower free end of the rod 27 of the actuator 21 slides in an axial guide hole 37 formed in a diametric rib 39 of the outlet way 9 of the valve 1.

[0024] In the sleeve 11 an elastic element is inserted,

in this case formed by a helical spring 19, capable of polarising the actuator 21 at rest, that is to say without energisation of the coil 15 and without flow through the valve 1, in a predefined operating position. The operating position at rest illustrated here for the actuator 21 provides sealing in respect of the lower outlet 9.

[0025] Naturally, according to the application, it could be foreseen to polarise the actuator 21 at rest in the opposite operating position.

[0026] This elastic polarisation element, as will be made clearer hereinbelow, is optional in the case of orientation of the bypass valve now shown, and becomes useful for example in the case wherein the bypass valve 1 is made to function in an overturned or horizontal position.

[0027] The collecting chamber 3 of the valve 1 in the present case is composed of a separate upper part and a lower part, snap and seal-joined one to the other, with the lower part which in the connection acts as a male element and the upper part as a female element.

[0028] The upper part of the collecting chamber 3 comprises the inlet way 5, the outlet way 7 and the sleeve 11 for supporting the coil 15, while the lower part of the collecting chamber 3 substantially only comprises the outlet way 9.

[0029] In the zone of engaging between the two parts of the collecting chamber 3, the lower part has in proximity of its lateral edge axial vents 41 which ensure high deformability in a radial direction, and on its lateral edge enlargements 43, while the upper part has counterpart housings 45 for the enlargements 43. Sealing of the coupling between the upper part and the lower part of the collecting chamber is finally ensured by an O-ring 47.

[0030] The function of diversion of a flow of water by the bypass valve of the present invention takes place downstream of the so-called "air break" (device of the washing machine which prevents the return to the system of dirty water) and is therefore performed for low pressures and high flow rates. This has enabled the assembly of components without hot welding or by melting of material and has enabled the use also of different materials for the upper part or main body and the lower part or plug defining the collecting chamber. In particular it must be possible to make the upper part of the collecting chamber, having to support the coil which is subject to heating, with plastic materials having a high melting or softening point.

[0031] Figure 3 illustrates a second preferred embodiment wherein, for the sake of brevity, the parts in common with the previous embodiment will not be described again but only denoted by the same reference numeral followed by an apostrophe.

[0032] In the present embodiment the actuator 21' is illustrated in the operating position opposite that of Figure 2, that is to say with sealing in respect of the lower outlet way 9'.

[0033] The present embodiment differs from the previous one due to the fact that the lower and upper parts

of the collecting chamber 3' are now joined one to the other by welding, due to the fact that the inlet way 5' and the upper outlet way 7' are now on a diametrically opposite side in relation to the axis of the collecting chamber 3', and above all due to the presence, inside the collecting chamber 3', of a capillary passage 49 which maintains in constant fluid communication the two outlets of the bypass valve for the reason which we will see hereinbelow.

[0034] The bypass valve of the present invention can be used in several methods of controlling the washing water of a washing machine.

[0035] First of all we will consider all the applications of Figures 4 and 5 respectively, wherein the bypass valve of the present invention is used in a domestic dishwasher machine in place of the drain pump and respectively in a domestic laundry washing machine for recirculation of the water downstream of the drain pump so as to spray from above the laundry contained in the washing tub.

[0036] In Figure 4 the dishwasher machine comprises a basin 50 of the washing tub, a circulation pump 51 which takes water from the basin 50, and a bypass valve 1' in accordance with the preferred embodiment of Figure 3. The bypass valve 1' has the inlet 5' connected to the delivery of the circulation pump 51, the upper outlet 7' connected to the drain line 59 of the dishwasher machine and the lower outlet 9' connected to the feed line 57 of the lower 53 and upper 55 sprayers of the dishwasher machine.

[0037] In Figure 5 the laundry washing machine comprises a washing tub 60, a drain pump 61 which takes the water from the washing tub 60, and a bypass valve 1' in accordance with the preferred embodiment of Figure 3. The bypass valve 1' has the inlet 5' connected to the delivery of the drain pump 61, the upper outlet 7' connected to the drain line 65 of the dishwasher machine and the lower outlet 9' connected to the feed line 63 of the washing tub 60.

[0038] The actuator 21' with the two disks 29' and 31' enables the upper outlet 7' to be opened and the lower outlet 9' to be closed and vice versa. In any case the inlet 5' remains open.

[0039] We will consider for the time being the function of draining of the water.

[0040] When the circulation pump 51 of the dishwasher or the drain pump 61 of the laundry washing machine starts up, the actuator 21' remains in a rest condition polarised by the spring 19' during closure of the lower outlet 9'. The slight pressure at the delivery of the pump, of the order of 0.3 bar, acts on the actuator 21' with a high force due to the vast area whereon it is applied, and therefore contributes to maintaining the outlet 9' closed. Therefore with the actuator 21' at rest the laundry washing or dishwasher machine performs draining.

[0041] During this phase the coil with electromagnetic control 15' must not be energised.

[0042] In this function moreover the capillary passage

49 serves if, at the end of draining, immediate switching to the function of recirculation of the water is required. In fact, given that the drain pipe performs an upward bend to avoid emptying the tub directly during feeding of the water, at the end of draining with the pump at a standstill water may remain in the pipe, which water has not succeeded in overcoming the peak of the pipe. This quantity of water exercises a small but not negligible pressure on the upper disk 29' of the actuator 21' and would block switching if the capillary passage 49 were not to intervene to make it flow out towards the other outlet 9'.

[0043] We will now consider the function of recirculation of the water.

[0044] Given that, as mentioned, the pump creates at the delivery a maximum pressure of the order of 0.3 bar, and given that the force which said pressure exerts on the actuator is higher than the force whereby the energised ferromagnetic stem 13' pulls the actuator 21', switching to the recirculation function is not possible with the pump in motion. Therefore in order to switch the flow towards the lower outlet 9', the coil 15' first has to be energised in order to pull the actuator 21' and then the pump actuated. However after switching and restart of the pump, again thanks to the delivery pressure of the pump, it is not strictly necessary to maintain the coil 15' energised throughout recirculation since the actual delivery pressure of the pump maintains the actuator 21' in a raised position. Given that the time of switching of the bypass valve is of the order of hundredths of a second while the pump takes at least one second to create the delivery pressure, to perform the function of recirculation it is possible to energise the bypass valve before or at most simultaneously with the pump.

[0045] In this function the utility of the capillary passage 49 is apparent above all in the case of use of the valve in particularly dirty environments, wherein the dirt may prevent perfect sealing in respect of the outlets of the valve. If the water were to seep through the gasket 33' of the upper disk 29', a level of water could be created above the disk 29' itself which would jeopardise sealing in respect of the upper outlet 7' even further. In this situation the capillary passage 49 instead intervenes and discharges towards the lower outlet 9' the seeped water, restoring that pressure differential at the ends of the upper disk 29' suitable for maintaining correct sealing in respect of the upper outlet 7'. In this case the best application is obtained by arranging the bypass valve with axis horizontal and draining downwards.

[0046] Optionally, in the capillary passage of a bypass valve in accordance with the present invention, a check valve is integrated for only unidirectional compensation of the pressure between the two outlet ways of the valve.

[0047] The bypass valve of the present invention is used in a domestic laundry washing machine for recovery of the water downstream of the drain pump identically to that provided for recirculation, with the sole difference that one of the two outlets of the valve is to be

connected to a temporary storage tank rather than to the washing drum.

[0048] Referring now to Figure 6, the bypass valve of the present invention, for example a valve in accordance with the embodiment of Figure 3, can be used in a domestic dishwasher machine for alternative feeding to the upper 69 and lower 67 sprayers of the washing tub. In this case the delivery of the circulation pump 71 is connected to the inlet 5' of the valve 1', the upper outlet 7' of the valve 1' feeds the upper sprayer 69 while the lower outlet 9' of the valve 1' feeds the lower sprayer 67. Advantageously it can be decided to arrange the valve with vertical axis and energise the actuator 21' to raise it, then allowing it to drop into the lower switching position through the effect of gravity and of the residual water column remaining between the upper outlet 7' and the upper sprayer 69 at the time of de-energisation of the circulation pump 71.

[0049] Again referring to Figure 6, in the case wherein the actuator 21' is deliberately lacking the lower gate 21', the valve 1' enables opening and closure only of its upper outlet way 7', while the lower outlet way 9' remains always open. In this case the dishwasher machine may perform washing with both sprayers 67 and 69, alternated with washing with the lower sprayer 67 alone, or it can perform washing with only the lower sprayer, for example for a half load washing program.

Claims

1. A bypass valve (1, 1') for a domestic washing machine which is **characterised in that** it comprises: a chamber (3, 3') for collecting a flow of liquid, extending in an axial direction and provided with an inlet way (5, 5'), and a first and second outlet way (7, 7', 9, 9'); a ferromagnetic stem (13, 13') which can be actuated to move by a coil (15, 15') with electromagnetic control along the axis of the coil (15, 15'), which axis of the coil (15, 15') is oriented in the axial direction of the collecting chamber (3, 3'); and an actuator (21, 21') mobile integrally with the ferromagnetic stem (13, 13') between two operating positions at which it creates selective sealing in respect of one or the other of the two outlet ways (7, 7', 9, 9'); of the bypass valve (1, 1').
2. A bypass valve (1, 1') according to the previous claim, **characterised in that** an outlet way of the valve is placed upstream of the inlet way (5, 5') of the valve and the other outlet way of the valve is placed downstream of the inlet way (5, 5') of the valve with reference to the axial direction of the collecting chamber (3, 3').
3. A bypass valve (1, 1') according to the previous claim, **characterised in that** the coil (15, 15') with electromagnetic control is arranged at one axial end of the collecting chamber (3, 3'), and **in that** one of the outlet ways (9, 9') of the valve (1, 1') is arranged at the other axial end of the collecting chamber (3, 3').
4. A bypass valve (1, 1') according to the previous claim, **characterised in that** the axis of the inlet way (5, 5') of the valve (1, 1') and the axis of the outlet way (7, 7') of the valve (1, 1') closest to the coil (15, 15') with electromagnetic control are arranged transversely to the axial direction of the collecting chamber (3, 3').
5. A bypass valve (1) according to the previous claim, **characterised in that** the axis of the inlet way (5) of the valve and the axis of the outlet way (7) of the valve (1) closest to the coil (15) with electromagnetic control are coplanar and **in that** the inlet way (5) of the valve (1) and the outlet way (7) of the valve (1) closest to the coil (15) with electromagnetic control are arranged on the same side in relation to the axis of the collecting chamber (3).
6. A bypass valve (1') according to claim 4, **characterised in that** the axis of the inlet way (5') of the valve (1') and the axis of the outlet way (7') of the valve (1') closest to the coil (15') with electromagnetic control are coplanar and **in that** the inlet way (5') of the valve (1') and the outlet way (7') of the valve (1') closest to the coil (15') with electromagnetic control are arranged on the opposite side in relation to the axis of the collecting chamber (3').
7. A bypass valve (1, 1') according to any one of claims 2 to 6, **characterised in that** the wall of the collecting chamber (3, 3') which forms the axial end wherein the coil (15, 15') with electromagnetic control is arranged provides a sleeve (11, 11') which extends in one single part axially and towards the outside of the collecting chamber (3, 3') and which is closed above and is below in direct communication with the interior of the collecting chamber (3, 3'), said sleeve (11, 11') having the internal surface suitable for guiding axial sliding of the ferromagnetic stem (13, 13') through the collecting chamber (3, 3') and the external surface designed to support the coil (15, 15') with electromagnetic control.
8. A bypass valve (1, 1') according to the previous claim, **characterised in that** in the sleeve (11, 11') an elastic element (19, 19') is inserted, capable of polarising the actuator (21, 21') at rest, that is to say without energisation of the coil (15, 15') and without flow through the bypass valve (1, 1'), in a predefined operating position of the two possible ones.
9. A bypass valve (1, 1') according to claims 7 or 8, **characterised in that** the electromagnetic control

coil (15, 15') can be removably engaged with snap means at the axial end of the collecting chamber (3, 3') traversed by the ferromagnetic stem (13, 13').

10. A bypass valve (1, 1') according to any one of claims 2 to 9, **characterised in that** said actuator (21, 21') is composed of two coaxial gate disks (29, 29', 31, 31') made integral by a rod (27) which traverses them orthogonally at their centre. 5
11. A bypass valve (1, 1') according to the previous claim, **characterised in that** the seal gaskets (33, 33', 35, 35') are provided on the operating side of the gate plates (29, 29', 31, 31'). 10
12. A bypass valve (1, 1') according to claims 10 or 11, **characterised in that** the rod of the actuator and the ferromagnetic stem (13, 13') of the coil (15, 15') are snap-joined axially. 15
13. A bypass valve (1, 1') according to the previous claim, **characterised in that** in order to assist axial sliding of the ferromagnetic stem-actuator assembly, the collecting chamber (3, 3') provides in its interior an axial hole (37) for guiding the free end of the rod (27) of the actuator (21). 20 25
14. A bypass valve (1, 1') according to any one of claims 7 to 13, **characterised in that** the collecting chamber (3, 3') is formed by two parts which can be reciprocally and removably coupled with snap and sealing means, wherein on one side the inlet way (5, 5') of the valve, the sleeve (11, 11') for supporting the coil with electromagnetic control and the outlet way (7, 7') of the valve adjacent to the coil (15, 15') with electromagnetic control are formed, and on the other side the outlet way (9, 9') of the valve opposite the coil (15, 15') with electromagnetic control is formed. 30 35 40
15. A bypass valve (1, 1') according to any one of claims 7 to 13, **characterised in that** the collecting chamber (3, 3') is formed by two axial parts which can be reciprocally coupled by welding, wherein on one side the inlet way (5, 5') of the valve, the sleeve (11, 11') for supporting the coil with electromagnetic control and the outlet way (7, 7') of the valve adjacent to the coil (15, 15') with electromagnetic control are formed, and on the other side the outlet way (9, 9') of the valve opposite the coil (15, 15') with electromagnetic control is formed. 45 50
16. A bypass valve (1') according to any one of the previous claims, **characterised in that** the collecting chamber of the valve provides in its interior a capillary passage (49) which places in direct fluid communication the two outlet ways (7', 9') of the valve (1') to compensate pressure between the two outlet 55

ways (7', 9') of the valve (1').

17. A bypass valve according to the previous claim, **characterised in that** in the capillary passage (49) a check valve is integrated for only unidirectional compensation of the pressure between the two outlet ways (7', 9') of the valve (1').
18. A method of functioning of a bypass valve (1') for a domestic washing machine comprising: a chamber (3') for collecting a flow of liquid, extending in an axial direction and provided with an inlet way (5') feed by pump means (51, 61), and a first and a second outlet way (7', 9'); a ferromagnetic stem (13') which can be actuated to move by a coil (15') with electromagnetic control along the axis of the coil (15') which is oriented in the axial direction of the collecting chamber (3'); and an actuator (21) mobile integrally with the ferromagnetic stem (13') between two operating conditions at which selective sealing is created in respect of the two outlet ways (7', 9') of the bypass valve (1'); **characterised in that** before switching of the actuator (21'), energisation of said pump means (51, 61) is interrupted and reactivated simultaneously or subsequent to energisation of the coil (15') with electromagnetic control.
19. A method according to the previous claim, **characterised in that** energisation of the coil (15') with electromagnetic control is interrupted after switching of the actuator (21'), and **in that** the new operating position of the actuator (21') is maintained by the action of the delivery pressure of the pump means (51, 61) on the actuator.
20. A method according to the previous claim, **characterised in that** the valve (1') is arranged with vertical axis and **in that** switching of the actuator (21') from the raised position to the lowered position takes place through the action of the actual weight of the actuator (21') and through the action on the actuator (21') of the weight of the water which, with the pump (51, 61) at a standstill, may possibly flow back towards the outlet way (9') closed by the actuator (21') and without energisation of the coil (15') with electromagnetic control.
21. Method for use of a bypass valve (1') in accordance with any one of claims 1 to 17 for the control of washing water of a laundry washing machine, **characterised in that** the bypass valve (1') has the inlet way (5') connected to the drain pump (61), an outlet way (7') connected to the drain and the other outlet way (9') connected to the tub for spraying the laundry from above.
22. Method for use of a bypass valve (1') in accordance with any one of claims 1 to 17 for the control of the

washing water of a laundry washing machine, **characterised in that** the bypass valve (1') has the inlet way connected to the drain pump, an outlet way connected to the drain and the other outlet way connected to a storage receptacle for its subsequent use. 5

23. Method for use of a bypass valve (1') in accordance with any one of claims 1 to 17 for the control of the washing water of a dishwasher machine, **characterised in that** the bypass valve (1') has the inlet way (5') connected to the circulation pump (51), an outlet way (7') connected to the drain and the other outlet way (9') connected to the sprayers (53, 55). 10

24. Method for use of a bypass valve (1') in accordance with any one of claims 1 to 17 for the control of the washing water of a dishwasher machine, **characterised in that** the bypass valve (1') has the inlet way (5') connected to the circulation pump (51), an outlet way (9') connected to the lower sprayer (67) and the other outlet way (7') connected to the upper sprayer (69) of the washing tub. 15 20

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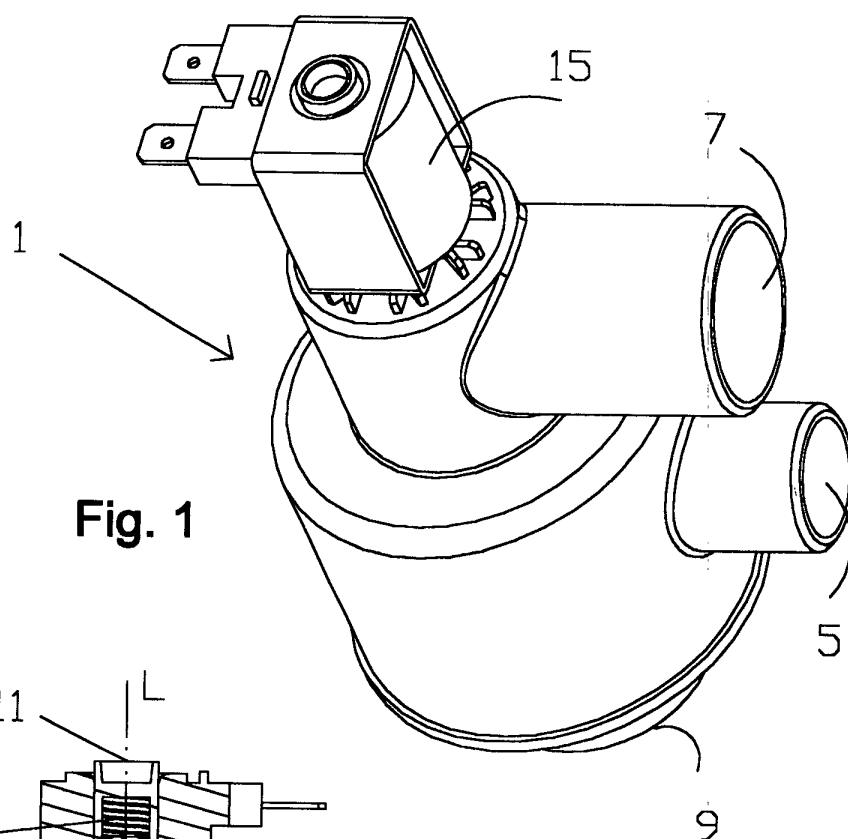


Fig. 1

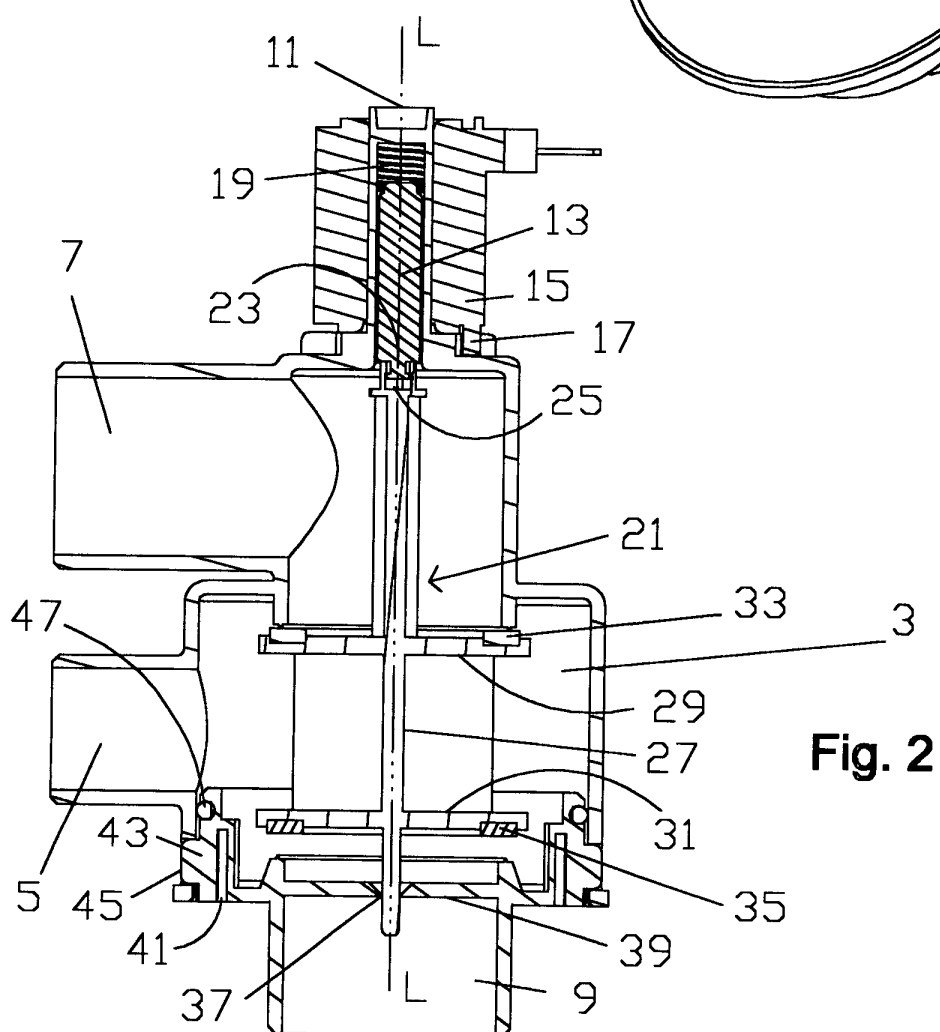
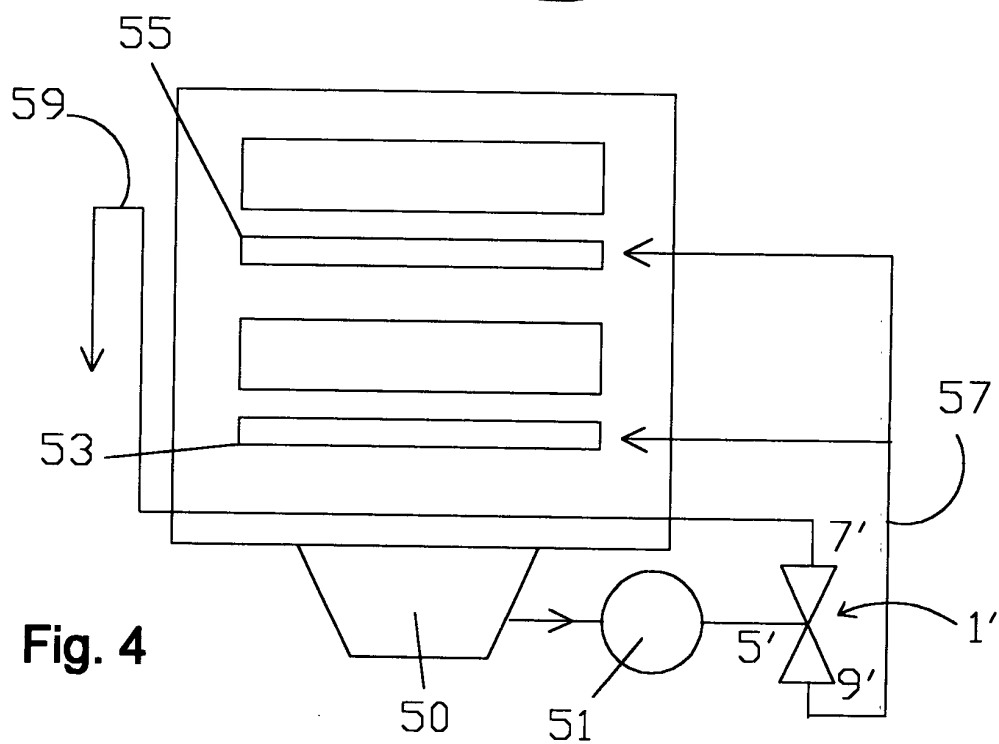
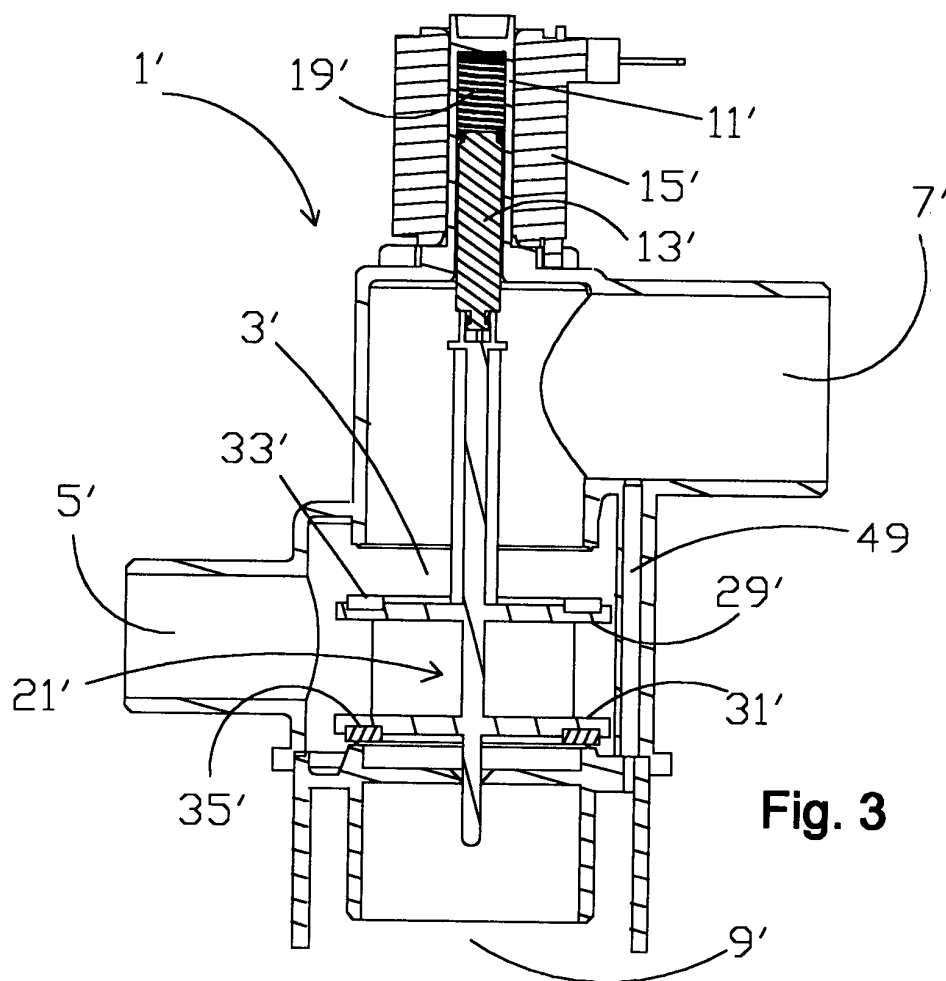


Fig. 2



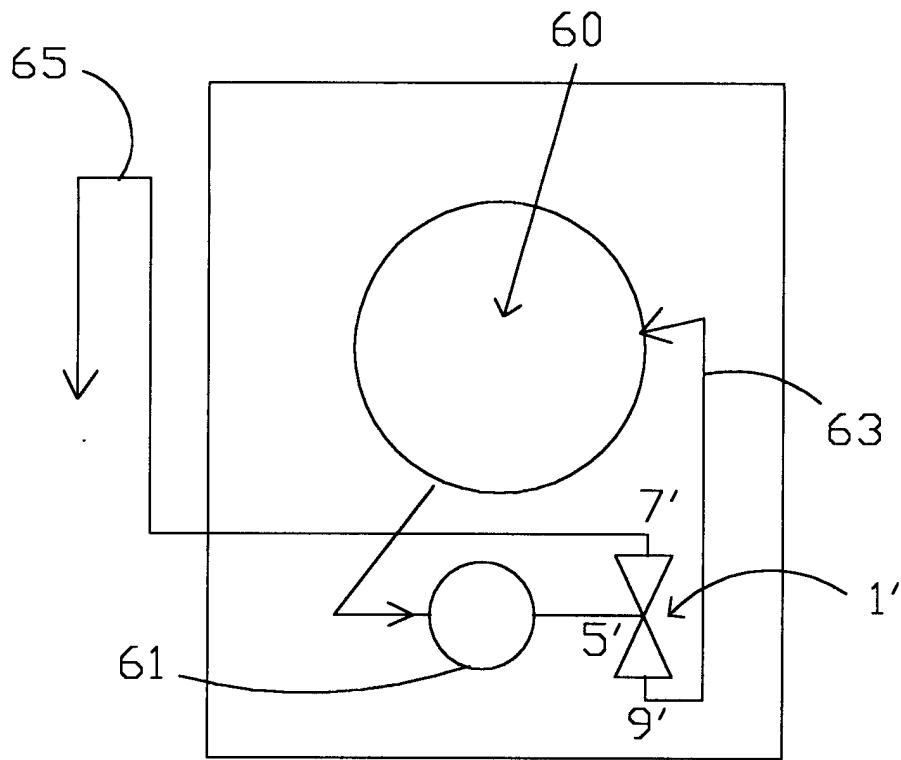


Fig. 5

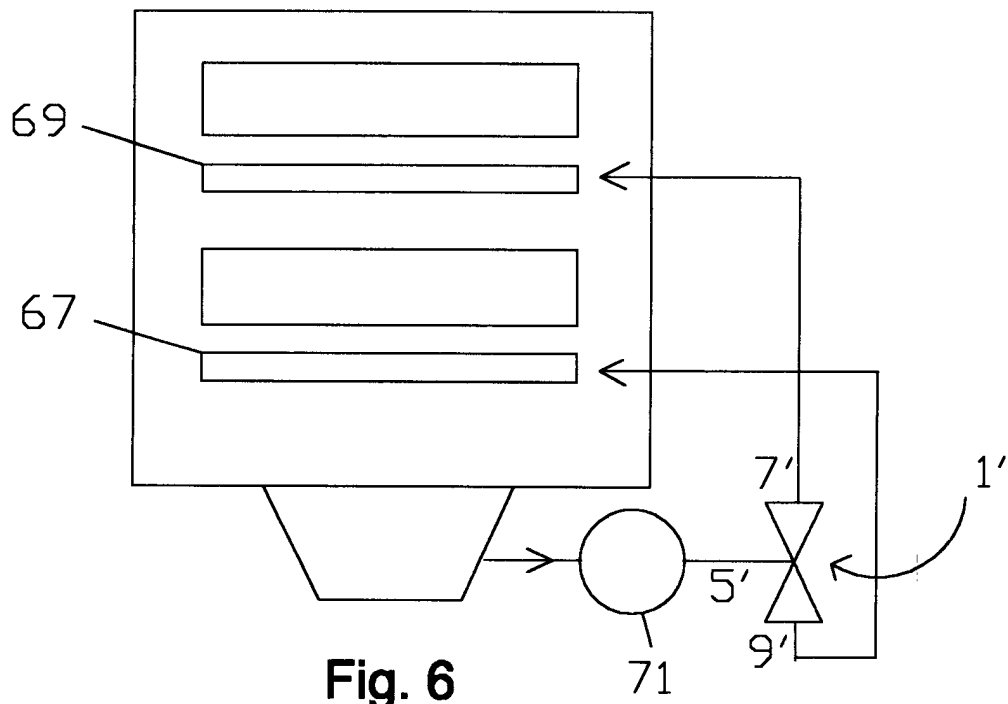


Fig. 6