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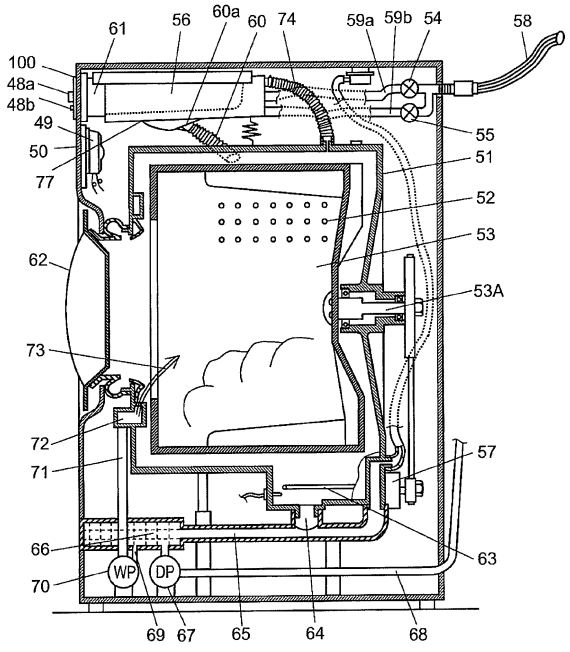
(54) DRUM-TYPE WASHING MACHINE

(57) A front-loading-type washing machine of the invention is equipped with a water tub, a detergent supply device, a first water supply valve that supplies washing water to the detergent supply device, a water supply connecting pipe that connects the water tub and the detergent supply device and is equipped with a backflow preventing portion, a water tub air vent pipe that connects the water tub and the detergent supply device, and a control device that controls at least steps of washing, rinsing, and spin-drying. The detergent supply device has a first water supply passage that guides the washing water from the first water supply valve, and a water tub air vent connecting portion that is connected to the water tub air vent pipe, and the first water supply passage and the water tub air vent connecting portion are configured to communicate with each other.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a detergent supply device of a front-loading-type washing machine.

BACKGROUND ART

[0002] In the related art, a detergent supply device of a front-loading-type washing machine, which makes the pressure of washing water to be supplied constant in order to prevent formation of detergent bubbles from increasing due to the pressure of washing water during water supply being high and low, is suggested (for example, refer to PTL 1).

[0003] Hereinafter, the configuration of the detergent supply device of the front- loading- type washing machine of the related art shown in PTL 1 will be described using Figs. 6 and 7.

[0004] Fig. 6 is an exploded perspective view showing the configuration of the front-loading-type washing machine of the related art.

[0005] As shown in Fig. 6, the front-loading-type washing machine of the related art is equipped with bottomed cylindrical water tub 11 that is installed inside main body 10 in order to contain washing water, and washing tub 12 that is a bottomed cylindrical rotary drum installed rotatably inside water tub 11. The wall surface of washing tub 12 is formed with a plurality of spin-drying holes 12A. Drive motor 13 that rotates washing tub 12 in normal and reverse directions in order to perform washing, rinsing and spin-drying steps is provided below water tub 11.

[0006] Water supply device 20 that supplies washing water to the inside of water tub 11, detergent supply device 15 that supplies detergents in a water supply step, and connecting pipe 24 that guides the water, which has passed through detergent supply device 15, to the inside of water tub 11 are provided above water tub 11.

[0007] Water supply device 20 is constituted by a plurality of water supply valves 21 (21a to 21d) that are connected to an external water supply hose (not shown) and control water supply, and a plurality of water supply pipes 23 (23a to 23d) that connect water supply valves 21 and detergent supply device 15 to each other.

[0008] Detergent supply device 15 has box-shaped housing 30 that is formed with opening portion 34 having an opening in the front surface thereof, and detergent case 35 that is detachably combined with the inside of housing 30 through opening portion 34 of housing 30. Detergent supply device 15 is provided at an upper front surface portion of main body 10 in order to operate detergent case 35 like a drawer outside main body 10.

[0009] Fig. 7 is a plan view showing a channel configuration within the detergent case of the detergent supply device of the front-loading-type washing machine. Fig. 7 is a view when the detergent supply device 15 is viewed from above.

[0010] As shown in Fig. 7, detergent case 35 of detergent supply device 15 is constituted by at least rinsing agent loading portion water supply channel 45, rinsing agent loading portion water supply portion 43, rinsing agent loading portion 35c, and bleaching agent loading portion 35d.

[0011] Rinsing agent loading portion water supply channel 45 is formed with pressure regulating holes 45a. In a case where high-pressure washing water flows through rinsing agent loading portion water supply channel 45, a large amount of washing water falls into bleaching agent loading portion 35d through pressure regulating holes 45a. In a case where low-pressure washing water flows, a relatively small amount of washing water falls into bleaching agent loading portion 35d through pressure regulating holes 45a.

[0012] Accordingly, the pressure of the washing water that reaches rinsing agent loading portion water supply portion 43 is regulated within a predetermined range while passing through rinsing agent loading portion water supply channel 45. For this reason, the pressure of the washing water jetted to rinsing agent loading portion 35c is also regulated within a predetermined range. This prevents the fullness of detergent bubbles, which are generated by the supply of high- pressure washing water, within detergent case 35. As a result, the washing water containing detergents is smoothly supplied to prevent an occurrence of leak from other than a predetermined channel or the like.

[0013] For this reason, detergent supply device 15 of the related art functions effectively, for example, in a case where water supply valve 21c is opened to supply a large amount of washing water into detergent supply device 15 via water supply pipe 23c from the outside of the washing machine at a pressure equal to or higher than a predetermined pressure. However, in a case where the detergent bubbles are filled into detergent case 35 on any other conditions (for example, the detergent bubbles generated within water tub 11 has flowed back to detergent supply device 15), there is a problem in that a water supply channel from detergent supply device 15 to water tub 11 is blocked, and the washing water flows out of other than the predetermined channel during water supply.

[0014] Particularly, in recent years, to improve a cleaning effect and to effectively utilize the washing water in addition to stirring of laundry by the rotation of washing tub 12, a circulating water stream system, which circulates the washing water with a pump to spray the washing water to the laundry, enters the mainstream. Since the circulating water stream system circulates the washing water while taking a lot of air into the washing water, a large amount of detergent bubbles are generated within water tub 11. For this reason, the pressure within water tub 11 is increased by the detergent bubbles, and the generated detergent bubbles flows back into detergent case 35. As a result, the water supply channel from detergent supply device 15 to water tub 11 is blocked, and

the washing water flows out of, other than the predetermined channel, during water supply.

Citation List

Patent Literature

[0015]

PTL 1 Japanese Patent Unexamined Publication No. 2006-626

SUMMARY OF THE INVENTION

[0016] A front-loading-type washing machine of the invention includes a water tub that rotatably supports a rotary drum; a detergent supply device that supplies washing water containing detergents into the water tub; a first water supply valve that supplies the washing water to the detergent supply device; a water supply connecting pipe that connects the water tub and the detergent supply device and is equipped with a backflow preventing portion; a water tub air vent pipe that connects the water tub and the detergent supply device; and a control device that controls steps of washing, rinsing, and spin-drying at least. The detergent supply device has a first water supply passage that guides the washing water from the first water supply valve, and a water tub air vent connecting portion that is connected to the water tub air vent pipe, and the first water supply passage and the water tub air vent connecting portion are configured to communicate with each other.

[0017] Thereby, even in a case where detergent bubbles are generated within the water tub, the air within the water tub can be evacuated from the water tub air vent pipe. Thus, a rise in pressure within the water tub can be prevented. As a result, it is possible to prevent an occurrence of such problems that the washing water supplied during water supply or detergent supply flows out of other than predetermined passages or overflows from the detergent supply device.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

Fig. 1 is a longitudinal sectional view of a front-loading-type washing machine in an embodiment of the invention.

Fig. 2 is an exploded perspective view of a detergent supply device of the front-loading-type washing machine.

Fig. 3 is an exploded plan view of the detergent supply device of the front-loading-type washing machine.

Fig. 4 is a block diagram illustrating a control circuit of the front-loading-type washing machine.

Fig. 5 is an association chart illustrating the step operation of the front-loading-type washing machine.

Fig. 6 is an exploded perspective view showing the configuration of a front-loading-type washing machine of related art.

Fig. 7 is a plan view showing the channel configuration of a detergent supply device of the front-loading-type washing machine of related art.

DESCRIPTION OF EMBODIMENTS

[0019] Hereinafter, an embodiment of the invention will be described, referring to the drawings. In addition, the invention is not limited by the present embodiment.

(Embodiment)

[0020] Fig. 1 is a longitudinal sectional view of a front-loading-type washing machine in the embodiment of the invention.

[0021] As shown in Fig. 1, the front-loading-type washing machine of the present embodiment is equipped with at least water tub 51, detergent supply device 56, water supply connecting pipe 60 that connects water tub 51 and detergent supply device 56, water supply valve 54 for prewashing that is a first water supply valve, water tub air vent pipe 74, and control device 49.

[0022] Water tub 51 is swingably provided inside main body 50, and stores washing water. Rotary drum 53 in which a plurality of water passing holes 52 are formed in a wall surface is rotatably provided inside water tub 51. Rotary drum 53 is rotated in normal and reverse directions around rotating shaft 53A, which is set in the horizontal direction, by motor 57 attached to a lower portion of water tub 51 on the back side.

[0023] Openable and closable lid body 62 that allows laundry, such as clothing, to be taken into and out of rotary drum 53, is provided in the front surface of main body 50 so as to face an opening portion of rotary drum 53.

[0024] Control device 49 is provided above lid body 62. If a control method is input via input setting unit 48a of operation panel 100 provided at a front upper portion of main body 50, the input information is displayed on display unit 48b of operation panel 100.

[0025] Water supply valve 54 for prewashing, water supply valve 55 for main washing that is a second water supply valve, first water supply pipe 59a, second water supply pipe 59b, detergent supply device 56, water supply connecting pipe 60, and water tub air vent pipe 74 are provided above water tub 51.

[0026] One end of water supply valve 54 for prewashing and one end of water supply valve 55 for main washing are connected with water supply hose 58 outside the front-loading-type washing machine. The other end of water supply valve 54 for prewashing and the other end of water supply valve 55 for main washing are connected with detergent supply device 56 via first water supply pipe 59a and second water supply pipe 59b.

[0027] Detergent case 61 that stores, for example, a detergent, a softening agent, a finishing agent, or the like inside detergent supply device 56 is housed so as to be drawable from main body 50. Lower case 77 (will be described below in Fig. 2) of detergent supply device 56 is connected to water supply connecting pipe 60 that guides the passed washing water to the inside of water tub 51.

[0028] Check valve 60a is provided in water supply connecting pipe 60 as a backflow preventing portion so as to prevent detergent bubbles, air and washing water from water tub 51 from flowing back and entering detergent supply device 56 side. In the present embodiment, check valve 60a is illustrated as an examples a backflow preventing portion. However, the invention is not limited to this. As the backflow preventing portion, for example, a configuration, which is constituted by a general U-shaped trap, always accumulates water in the U-shaped portion, and prevents detergent bubbles, air, and washing water from water tub 51 from flowing back and entering detergent supply device 56 side, may be adopted. This can prevent detergent bubbles, air and washing water from water tub 51 from flowing back and entering the detergent supply device 56 side.

[0029] Water tub air vent pipe 74 constituted by a flexible hose is provided in a rear upper portion of detergent supply device 56 so as to be connected to upper case 76 (will be described below in Fig. 2) of detergent supply device 56. Water tub air vent pipe 74, for example, evacuates the air within water tub 51 pressurized by the formation of detergent bubbles during a washing step. Thereby, the air within water tub 51 can be evacuated from water tub air vent pipe 74, and a rise in the pressure within water tub 51 by the formation of the detergent bubbles within water tub 51 can be prevented. As a result, it is possible to prevent occurrence of such problems that the washing water supplied during water supply or detergent supply flows out of other than predetermined passages or overflows from detergent supply device 56.

[0030] Heating heater 63 including, for example, a sheathed heater or the like is provided in the horizontal direction at the bottom within water tub 51 to heat the washing water within water tub 51. Drainage cylinder 64 for drainage of washing water is provided below heating heater 63.

[0031] Drain pipe 65, filter 66, drain pump (DP) 67, and circulating pump (WP: Water Pump) 70 are provided at the bottom of water tub 51.

[0032] Drainage cylinder 64 is connected to drain pipe 65 provided below water tub 51, and communicates with drainage discharge pipe 68 from drain pump 67 through filter 66 from which lint or foreign matter is removed. The washing water within water tub 51 is discharged to the exterior of the front-loading-type washing machine by driving drain pump 67.

[0033] Filter 66 communicates with circulating pump 70 via suction pipe 69. Circulating pump 70 communicates with discharge port 72, which is provided in the vicinity of below lid body 62, via circulating water discharge pipe 71. As control device 49 drives circulating pump 70, the washing water inside rotary drum 53 constitutes circulating water 73 that is suctioned from drainage cylinder 64 and is sprayed on laundry within rotary drum 53 from discharge port 72. This improves the cleaning effect on the laundry.

[0034] Detergent supply device 56 of the embodiment will be described below using Figs. 2 and 3, referring to Fig. 1.

[0035] Fig. 2 is an exploded perspective view of the detergent supply device of the front-loading-type washing machine in the embodiment of the invention. Fig. 3 is an exploded plan view of the detergent supply device of the front-loading-type washing machine.

[0036] As shown in Fig. 2, detergent supply device 56 is constituted by drawable detergent case 61 that stores, for example, a detergent, a softening agent, a finishing agent, or the like, water pouring lid body 75 formed from, for example, polypropylene resin or the like, upper case 76, and lower case 77.

[0037] Upper case 76 is provided at the top surface of lower case 77, and is heat-welded to water pouring lid body 75 by heating. Thereby, upper case 76 and water pouring lid body 75 are water-tightly sealed, and water passing space 79 is configured between upper case 76 and water pouring lid body 75.

[0038] Here, the front- loading- type washing machine of the embodiment controls a washing step in two steps of a prewashing step and a main washing step, and improves washing performance. That is, water is supplied in each step of the prewashing step and the main washing step, and the detergent loaded into detergent case 61 is dissolved in the washing water. At this time, if the detergent loaded into detergent case 61 is altogether dissolved in the washing water at the prewashing step before the main washing step, laundry is cleaned by the washing water that does not contain the detergent, in the main washing step. In order to prevent this, detergent case 61 is equipped with prewashing detergent storage portion 81 that stores a detergent dedicated to the prewashing step, and main washing detergent storage portion 80 that stores a detergent dedicated to the main washing step, and communication port 82. Drain port 80a that communicates with communication port 82 is formed behind main washing detergent storage portion 80, and drain port 81a that communicates with communication port 82 is formed behind prewashing detergent storage portion 81.

[0039] As shown in Figs. 2 and 3, upper case 76 is formed with water passage 89 having a number of water pouring ports 78, water supply passage 83 for a prewashing detergent that is a first water supply passage, water supply passage 84 for a main washing detergent that is a second water supply passage, and water supply passages 92 that are the openings for communicating with communication port 82 of detergent case 61.

[0040] Water supply passage 83 for a prewashing detergent communicates with prewashing supply water dis-

charge cylinder 93 connected to water supply valve 54 for prewashing, which is the first water supply valve, and first water supply pipe 59a. Water supply passage 84 for a main washing detergent communicates with water supply discharge cylinder 94 for main washing connected to water supply valve 55 for main washing, which is the second water supply valve, and second water supply pipe 59b.

[0041] As for detergent supply device 56 configured as described above, a specific flow of the washing water that flows through the inside of detergent supply device 56 will be described below using Fig. 3, referring to Fig. 2.

[0042] Portion of the washing water that is supplied from first water supply pipe 59a and second water supply pipe 59b connected to upper case 76 circulates through communication port 82 of detergent case 61 from water supply passages 92, and is supplied to water tub 51 via water supply connecting pipe 60 connected to lower case 77.

[0043] The remaining washing water is supplied from water passing space 79 via water pouring ports 78 of water passage 89 to main washing detergent storage portion 80 or prewashing detergent storage portion 81 of lower detergent case 61. At this time, the detergent loaded into detergent case 61 is washed away while being dissolved in the washing water, passes through water supply connecting pipe 60, which is connected to lower case 77, from communication port 82 via drain ports 80a and 81a, and is supplied to water tub 51.

[0044] That is, in the water supply, the washing water is supplied to water tub 51 through water supply connecting pipe 60 by two flows of a flow of the washing water from water supply passages 92, and a flow of the washing water in which a detergent is dissolved through water pouring ports 78. In the water supply for the prewashing step, the washing water is further supplied even from water tub air vent pipe 74 to water tub 51.

[0045] Specifically, as shown in Fig. 3, first, control device 49 opens water supply valve 54 for prewashing at the time of the start of the prewashing step, and discharges the washing water from prewashing supply water discharge cylinder 93 to water passing space 79 within upper case 76. The washing water supplied from water supply passage 83 for a prewashing detergent flows forward through water supply passage 83 for a prewashing detergent as shown by arrow A, and makes a U- turn to left and right and diverges in detour 85 as shown by arrow E. Then, the washing water falls widely into the inside of prewashing detergent storage portion 81 (refer to Fig. 2) of lower detergent case 61 from water pouring ports 78 while flowing into left passage 86 and right passage 87 that constitute water passage 89 formed with a number of water pouring ports 78. The fallen washing water washes away the prewashing detergent loaded into prewashing detergent storage portion 81 of detergent case 61 from drain port 81a to communication port 82 (refer to Fig. 2) while dissolving the detergent, passes through water supply connecting pipe 60 connected to lower case 77 (refer to Fig. 2), and is supplied to water tub 51.

[0046] At this time, portion of the washing water that has flowed into left passage 86, as shown by arrow C, reaches water tub air vent connecting portion 91 of water tub air vent pipe 74 connected to upper case 76. Then, the washing water flows into water tub air vent pipe 74, and is supplied into water tub 51.

[0047] After the completion of the prewashing step, control device 49 opens water supply valve 55 for main washing at the start of the main washing step, and discharges the washing water from main washing supply water discharge cylinder 94 to water supply passage 84 for a main washing detergent within upper case 76. The washing water supplied from water supply passage 84 for a main washing detergent flows forward through the passage as shown by arrow B, and makes a U-turn to left and right and diverges in detour 88 as shown by arrow D. Then, the washing water falls widely into the inside of main washing detergent storage portion 80 (refer to Fig. 2) of lower detergent case 61 from water pouring ports 78 while flowing into left passage 90 and right passage 95 that constitute water passage 89 formed with a number of water pouring ports 78. The fallen washing water washes away the main washing detergent loaded into main washing detergent storage portion 80 of detergent case 61 in advance from drain port 80a to communication port 82 (refer to Fig. 2) while dissolving the detergent, passes through water supply connecting pipe 60 connected to lower case 77 (refer to Fig. 2), and is supplied to water tub 51.

[0048] As described above, the washing water supplied from water supply hose 58 is supplied to water tub 51 from water supply connecting pipe 60 or water tub air vent pipe 74 via detergent case 61.

[0049] Hereinafter, the configuration of control device 49 of the embodiment will be described with reference to Fig. 4.

[0050] Fig. 4 is a block diagram illustrating the control circuit of the front-loading-type washing machine.

[0051] As shown in Fig. 4, control device 49 is constituted by at least input setting unit 48a, display unit 48b, control unit 47 constituted by, for example, a microprocessor or the like, and power switching unit 46.

[0052] First, control unit 47 of control device 49 displays input information on display unit 48b of operation panel 100 if a control method of the front- loading- type washing machine is input via input setting unit 48a of operation panel 100 (refer to Fig. 1) . Then, control unit 47 of control device 49 automatically controls the loads of motor 57, water supply valve 54 for prewashing, water supply valve 55 for main washing, heating heater 63, drain pump 67, and circulating pump 70 via power switching unit 46 according to input mode setting or a control program. Thereby, control device 49 controls a series of steps, such as washing, rinsing, and spin- drying.

[0053] Control device 49 performs a control so as to drive circulating pump 70 always or for a predetermined time, in the prewashing step and main washing step of

the washing step. Thereby, in the prewashing step and the main washing step, the washing water within water tub 51 can be circulated, and circulating water 73 can be sprayed onto the laundry. As a result, the washing water containing the detergent can be made to permeate into the laundry, thereby enhancing the cleaning effect on the laundry.

[0054] The operation and functions of the front-loading-type washing machine configured as described above will be described using Fig. 5, referring to Figs. 1 to 3.

[0055] Fig. 5 is an association chart illustrating the step operation of the front-loading-type washing machine.

[0056] As shown in Fig. 5, first, if the operation of the front-loading-type washing machine starts, water supply in a prewashing step (S101) is started. At this time, the washing water supplied from water supply hose 58 by opening water supply valve 54 for prewashing passes through water supply passage 83 for a prewashing detergent, dissolves a detergent for the prewashing step, which is stored within prewashing detergent storage portion 81 of detergent case 61, and is supplied into water tub 51 via water supply connecting pipe 60 (S103). Then, washing in the prewashing step (S101) is started, and stirring (S104) that rotates rotary drum 53 in the normal or reverse directions, and driving of circulating pump 70 are performed (S105). Thereby, circulating water 73 shown in Fig. 1, which is washing water, can be sprayed onto laundry, such as clothing, by a circulating water stream of the washing water by circulating pump 70 while processing a washing step. As a result, the washing water containing the detergent can be made to permeate into the laundry by the spraying of the circulating water 73, thereby enhancing the cleaning effect of the laundry.

[0057] At this time, due to the circulating water stream, detergent bubbles may be generated in large quantities within water tub 51, and the pressure inside water tub 51 may be raised.

[0058] Then, water supply in the main washing step (S102) that is the next step is started in a state where the pressure of water tub 51 is raised, water supply valve 55 for main washing is opened, and the washing water is supplied to water supply passage 84 for a main washing detergent of upper case 76 from second water supply pipe 59b (S107) . However, for the reason shown below, the washing water supplied from water supply passage 84 for a main washing detergent, and the main washing detergent stored within main washing detergent storage portion 80 of detergent case 61 does not flow to water supply connecting pipe 60 smoothly, and tends to overflow from the front of detergent case 61. This is because check valve 60a is not opened since the pressure within water tub 51 presses check valve 60a of water supply connecting pipe 60.

[0059] Thus, as described above, in the embodiment, the pressure within water tub 51 that has risen due to the generated detergent bubbles is reduced by including water tub air vent pipe 74 to release air of water tub 51 to the outside via water tub air vent pipe 74. This prevents the washing water to be supplied during water supply or during detergent supply from flowing out of other than predetermined passages (water passing space 79, water supply passage 83 for a prewashing detergent, water supply passage 84 for a main washing detergent, detour 85, and detour 88) or overflowing from detergent supply device 56. As a result, the washing water can be smoothly supplied into water tub 51 from water supply connecting pipe 60 connected to detergent supply device 56.

[0060] However, if detergent bubbles are generated in large quantities, the detergent bubbles may permeate into water supply connecting pipe 60 and water tub air vent pipe 74. At this time, although check valve 60a is provided in water supply connecting pipe 60 so as to prevent the washing water or the detergent bubbles from flowing back to and entering the inside of detergent supply device 56 side, water tub air vent pipe 74 is not provided with a backflow preventing portion.

[0061] Thus, during the prewashing step (S101) and even after the supply of the prewashing detergent into water tub 51 is completed, the operation of water supply valve 54 for prewashing is continued continuously or for a predetermined time (S106) . At this time, like arrow C in Fig. 3, the washing water flows toward water tub air vent pipe 74 from left passage 86, and the detergent bubbles that have permeated into water tub air vent connecting portion 91 and water tub air vent pipe 74 are diluted and removed. This prevents permeation of the detergent bubbles into detergent supply device 56 and formation of detergent bubbles. As a result, air in water tub 51 is circulated via water tub air vent pipe 74, and a rise in pressure within water tub 51 is prevented.

[0062] Thereby, in the water supply operation (S107) of the main washing step (S102) that is the next step, the supplied washing water and the main washing detergent solution do not flow out of other than the predetermined passages, or do not overflow out of detergent case 61.

[0063] In the main washing step (S102), the washing water supplied from water supply hose 58 by opening water supply valve 55 for main washing passes through water supply passage 84 for a main washing detergent, dissolves a detergent for the main washing step, which is stored within main washing detergent storage portion 80 of detergent case 61, and is supplied into water tub 51 via water supply connecting pipe 60 (S107).

[0064] Then, stirring (S112) that rotates rotary drum 53 and driving of circulating pump 70 are driven (S109) . Thereby, circulating water 73, which is washing water, can be sprayed onto the laundry, such as clothing, by a circulating water stream by the operation of circulating pump 70 while advancing the washing step. As a result, the washing water can be uniformly scattered onto the laundry, thereby enhancing the cleaning effect on the laundry. At this time, even during the operation of the circulating water stream (S109), the operation of water supply valve 54 for prewashing is continued continuously or for a predetermined time (S108) . Thereby, the deter-

gent bubbles within water tub air vent pipe 74 are diluted and removed, and deposition of the detergent bubbles into water tub air vent pipe 74 is prevented. As a result, in the rinsing step (S111) that is the next step, supplied rinsing water does not overflow out of detergent case 61 even in a case where water supply operation (S110) of the rinsing water is performed.

[0065] Further, in a spin- drying step, the washing water within water tub 51 is drained by drain pump 67. Then, high- speed rotation of rotary drum 53 is performed by motor 57 to spin- dry the laundry within water tub 51.

[0066] As described above, in the embodiment, the detergent bubbles generated within water tub 51 is prevented from flowing into detergent supply device 56 from water supply connecting pipe 60 by backflow preventing portion 60a, and water supply valve 54 for prewashing is controlled to always remove the detergent bubbles in water tub air vent pipe 74 and prevent deposition of the bubbles. Thereby, even in a case where detergent bubbles are generated within water tub 51, a rise in pressure within water tub 51 can be controlled by evacuating the air within water tub 51 with water tub air vent pipe 74. As a result, it is possible to prevent the washing water supplied during water supply or detergent supply from flowing from other than the predetermined passages or overflows from detergent supply device 56.

[0067] In addition, in the embodiment, a configuration in which the washing step has the prewashing step and the main washing step is illustrated as an example. However, the invention is not limited to this. For example, the prewashing step may be executed only in a case where laundry is severely dirty. This further improves washing efficiency, such as reduction of washing time.

[0068] In the embodiment, a configuration in which detergents are loaded into two detergent storage portions of prewashing detergent storage portion 81 and main washing detergent storage portion 80 of detergent case 61 before the start of the washing step is illustrated as an example. However, the invention is not limited to this. For example, a configuration in which detergents are automatically loaded in respective steps of the prewashing step and the main washing step may be adopted. This can make the detergent containing portions into one to reduce the size of the detergent containing portion.

INDUSTRIAL APPLICABILITY

[0069] According to the front-loading-type washing machine of the invention, the water supply valve for prewashing can be controlled to remove the detergent bubbles within the water tub air vent pipe and prevent the deposition thereof. Thus, the invention is useful for applications, such as apparatuses in which detergent bubbles or the like are apt to be generated, or washing machines or the like other than the front-loading-type washing machine.

REFERENCE NUMERALS IN THE DRAWINGS

[0070]

48a: INPUT SETTING UNIT
48b: DISPLAY UNIT
49: CONTROL DEVICE
51: WATER TUB
52: WATER PASSING HOLES
53: ROTARY DRUM
54: WATER SUPPLY VALVE FOR PREWASHING (FIRST WATER SUPPLY VALVE)
55: WATER SUPPLY VALVE FOR MAIN WASHING (SECOND WATER SUPPLY VALVE)
56: DETERGENT SUPPLY DEVICE
57: MOTOR
59a: FIRST WATER SUPPLY PIPE
59b: SECOND WATER SUPPLY PIPE
60: WATER SUPPLY CONNECTING PIPE
60a: CHECK VALVE (BACKFLOW PREVENTING PORTION)
61: DETERGENT CASE
62: LID BODY
63: HEATING HEATER
66: FILTER
67: DRAIN PUMP
68: DRAINAGE DISCHARGE PIPE
69: SUCTION PIPE
70: CIRCULATING PUMP
71: CIRCULATING WATER DISCHARGE PIPE
72: DISCHARGE PORT
73: CIRCULATING WATER
74: WATER TUB AIR VENT PIPE
79: WATER PASSING SPACE
80: MAIN WASHING DETERGENT STORAGE PORTION
81: PREWASHING DETERGENT STORAGE PORTION
82: COMMUNICATION PORT
83: WATER SUPPLY PASSAGE FOR PREWASHING DETERGENT (FIRST WATER SUPPLY PASSAGE)
84: WATER SUPPLY PASSAGE FOR MAIN WASHING DETERGENT (SECOND WATER SUPPLY PASSAGE)
91: WATER TUB AIR VENT CONNECTING PORTION
92: WATER SUPPLY PASSAGE
100: OPERATION PANEL

Claims

1. A front-loading-type washing machine comprising:

a water tub that rotatably supports a rotary drum;
a detergent supply device that supplies washing water containing detergents into the water tub;

a first water supply valve that supplies the washing water to the detergent supply device;
a water supply connecting pipe that connects the water tub and the detergent supply device and is equipped with a backflow preventing portion;
a water tub air vent pipe that connects the water tub and the detergent supply device; and
a control device that controls at least steps of washing, rinsing, and spin-drying,
wherein the detergent supply device has a first water supply passage that guides the washing water from the first water supply valve, and a water tub air vent connecting portion that is connected to the water tub air vent pipe, and
wherein the first water supply passage and the water tub air vent connecting portion are configured to communicate with each other.

2. The front-loading-type washing machine of Claim 1, wherein the washing step has a prewashing step and a main washing step, and
wherein in the prewashing step, the control device make a control so as to operate the first water supply valve to start water supply, and so as to continue the water supply even after detergents are supplied to the water tub from the first water supply passage.

3. The front-loading-type washing machine of either Claim 1 or 2, further comprising:

a second water supply valve that supplies the washing water to the detergent supply device,
wherein the detergent supply device has a second water supply passage that is connected to the second water supply valve,
wherein the washing step has a prewashing step and a main washing step, and
wherein, in the main washing step, the control device makes a control so as to operate the second water supply valve to start water supply and so as to operate the first water supply valve to start water supply after the detergents are supplied to the water tub from the second water supply passage.

4. The front-loading-type washing machine of Claim 3, wherein the detergent supply device has a prewashing detergent storage portion and a main washing detergent storage portion, and
wherein the detergents are loaded via the prewashing detergent storage portion in the prewashing step and via the main washing detergent storage portion in the main washing step, respectively.

FIG. 1

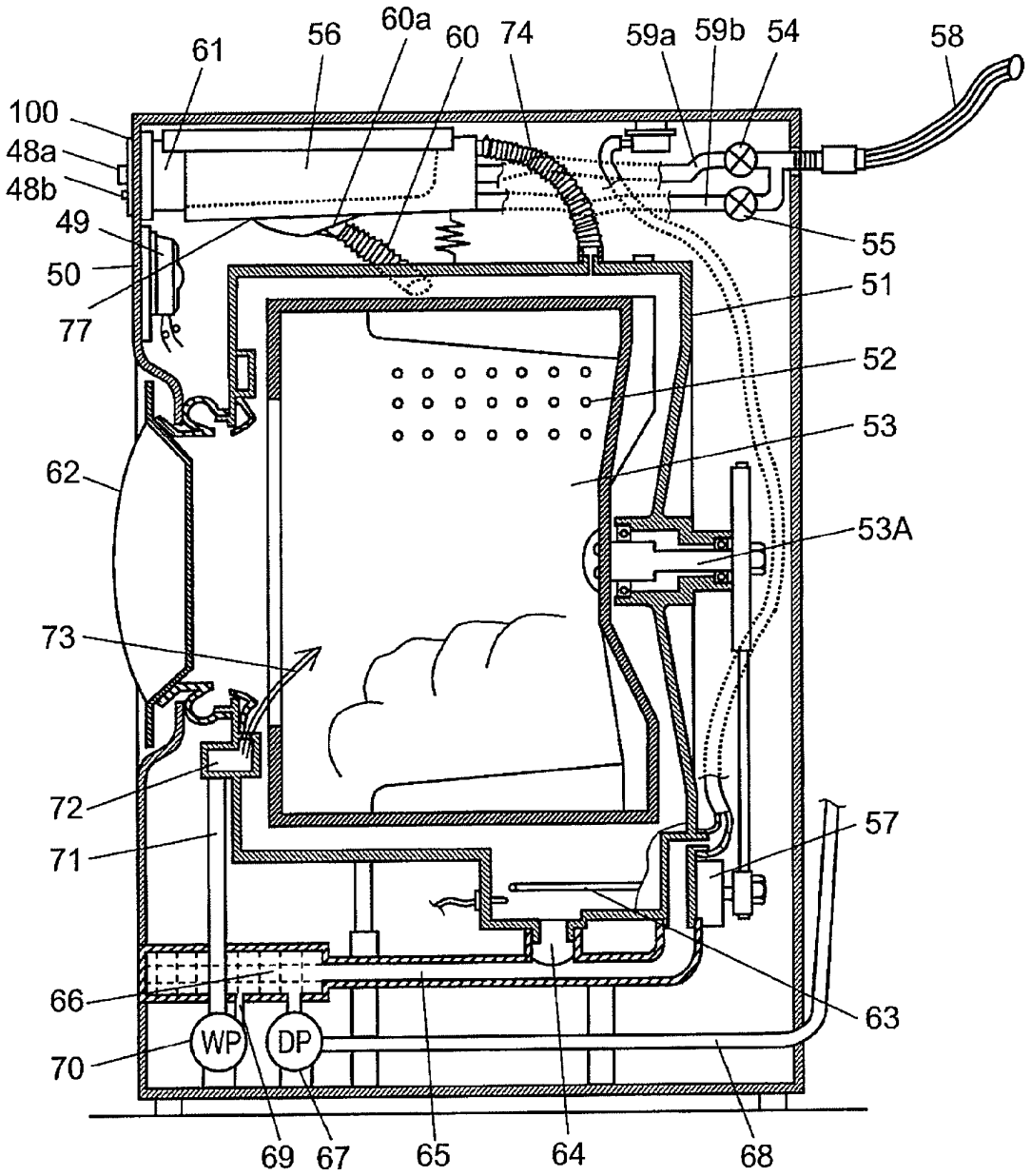
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FIG. 2

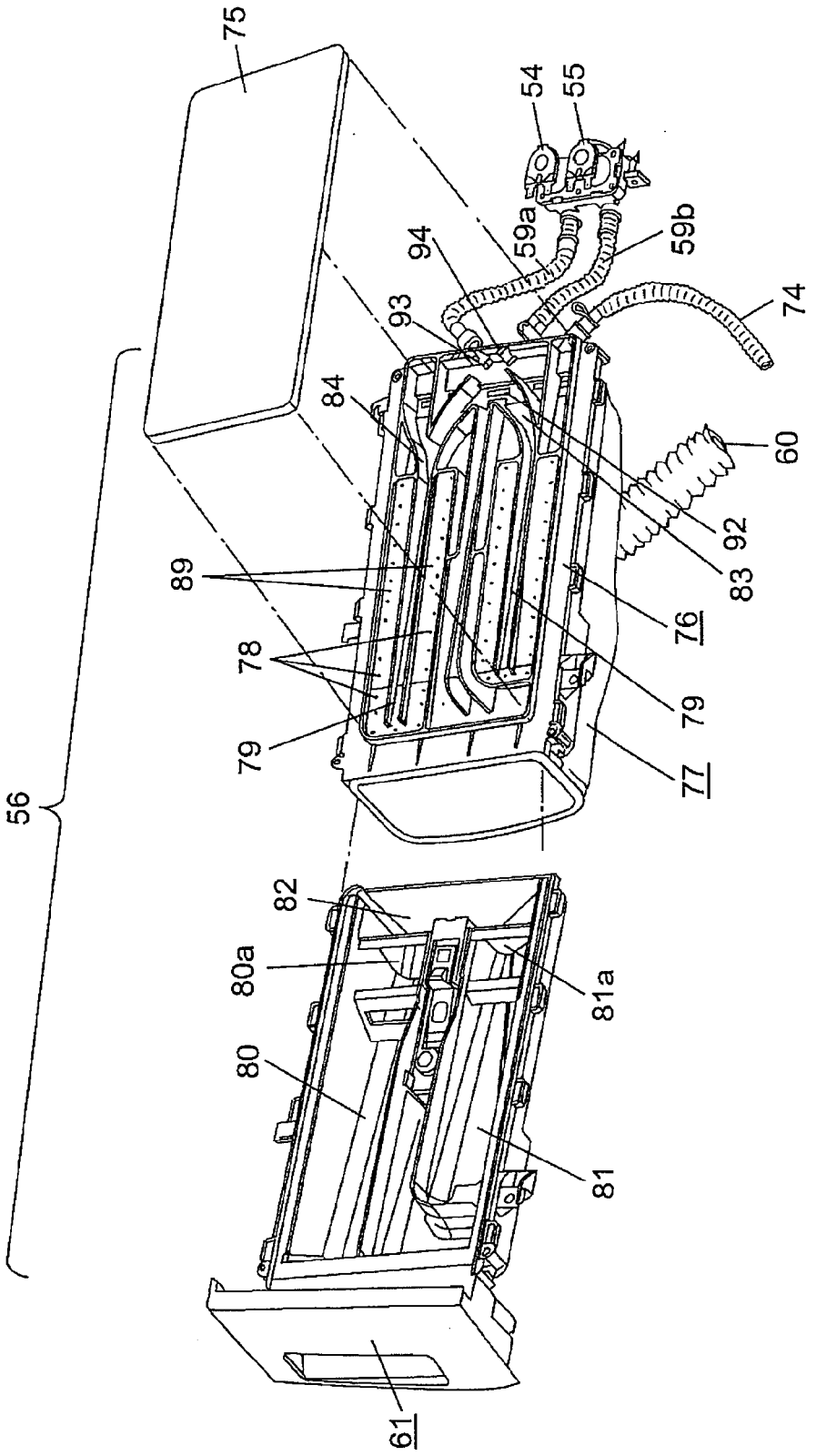
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FIG. 3

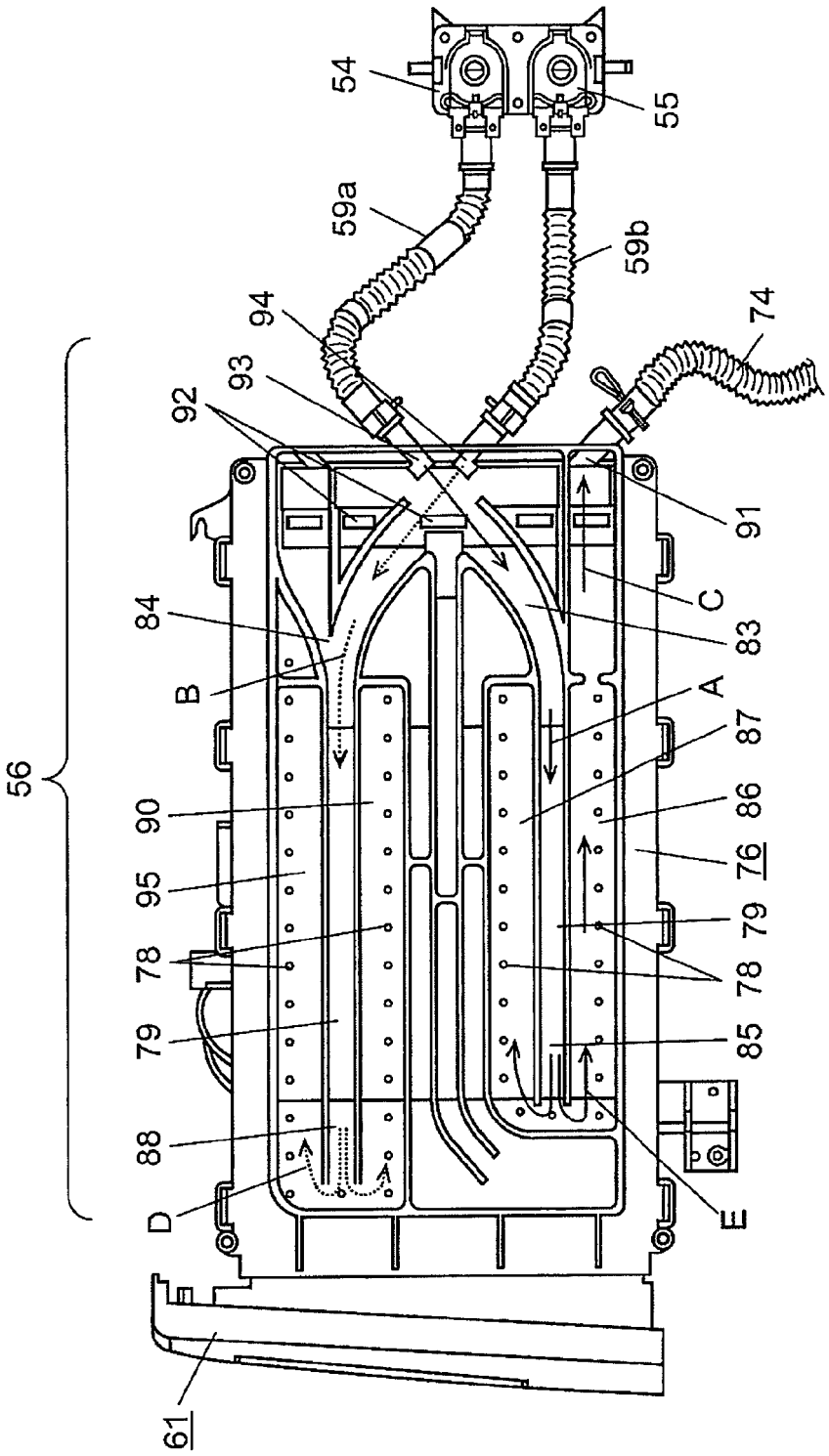
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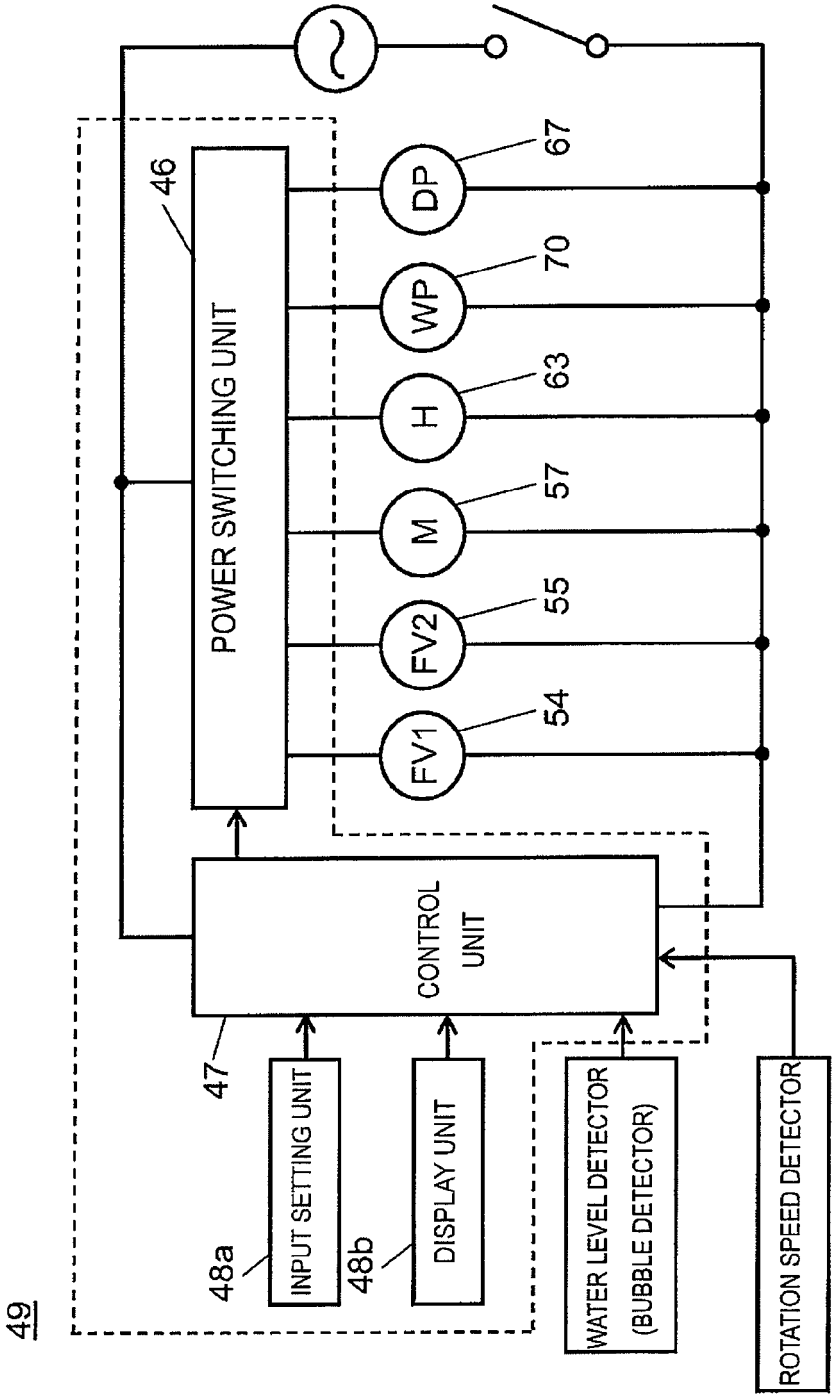
FIG. 4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POWER SWITCHING UNIT
46
DP
67
WP
70
H
63
M
57
FV2
55
FV1
54
CONTROL UNIT
47
INPUT SETTING UNIT
48a
DISPLAY UNIT
48b
WATER LEVEL DETECTOR (BUBBLE DETECTOR)
ROTATION SPEED DETECTOR

FIG. 5

	PREWASHING STEP (S101)				MAIN WASHING STEP (S102)		RINSING STEP (S111)				SPIN-DRYING STEP	
	WATER SUPPLY	WASHING	DRAIN	SPIN DRYING	WATER SUPPLY	WASHING	DRAIN	SPIN DRYING	WATER SUPPLY	RINSING	DRAIN	SPIN DRYING
ROTARY DRUM 53		STIRRING (S104)		HIGH SPEED ROTATION		STIRRING (S112)		HIGH SPEED ROTATION		STIRRING		HIGH SPEED ROTATION
CIRCULATING PUMP 70		OPERATION (S105)				OPERATION (S109)						
WATER SUPPLY VALVE 55 FOR MAIN WASHING					OPERATION (S107) DETERGENT LOADING				OPERATION (S110)	OPERATION		
WATER SUPPLY VALVE 54 FOR PREWASHING	OPERATION (S103) DETERGENT LOADING	OPERATION (S106) BUBBLE REMOVAL				OPERATION (S108) BUBBLE REMOVAL						
DRAIN PUMP 67			OPERATION				OPERATION				OPERATION	

FIG. 6

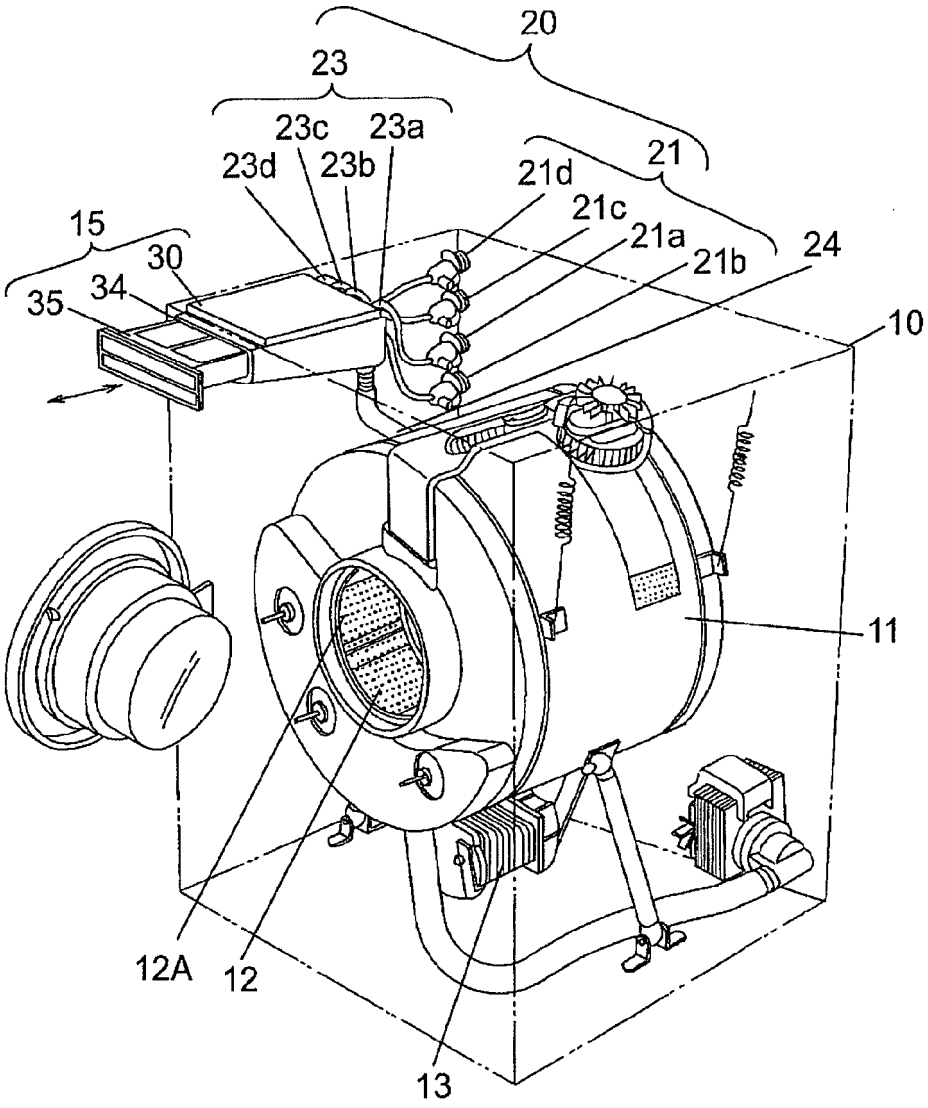
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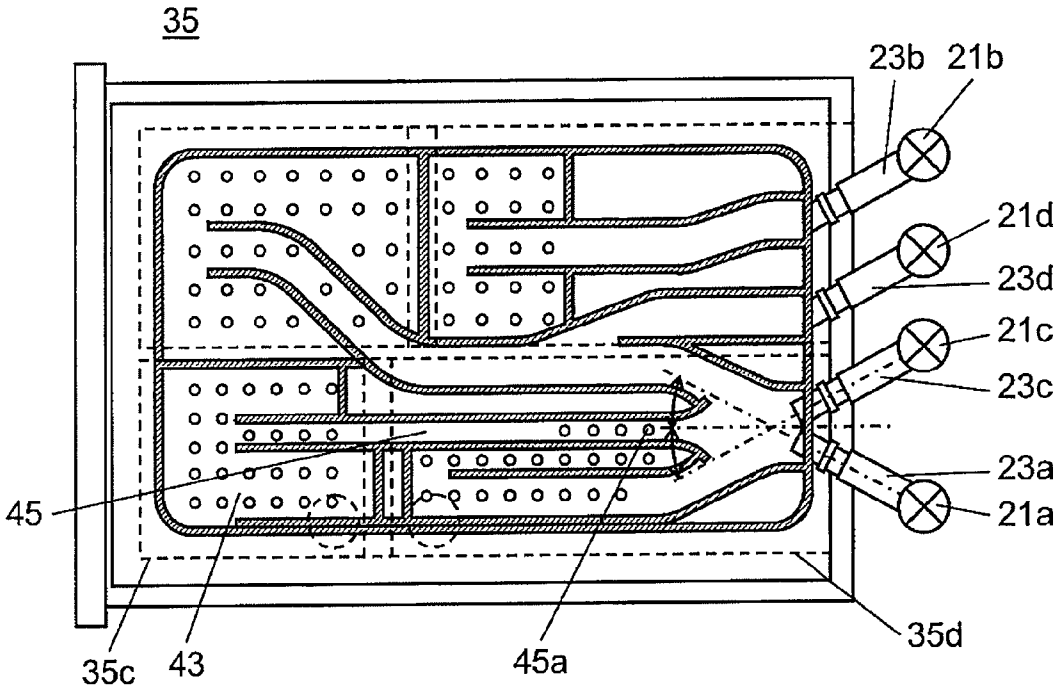
FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/001140

A. CLASSIFICATION OF SUBJECT MATTER
D06F39/02(2006.01)i, *D06F39/08*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F39/02, D06F39/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2007-68801 A (Matsushita Electric Industrial Co., Ltd.), 22 March 2007 (22.03.2007), entire text; all drawings & CN 1928193 A & CN 200946205 Y & SG 130995 A	1 2-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 21690/1983(Laid-open No. 127573/1984) (Sanyo Electric Co., Ltd.), 28 August 1984 (28.08.1984), entire text; all drawings (Family: none)	1-4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 April, 2012 (17.04.12)	01 May, 2012 (01.05.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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Patent documents cited in the description

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