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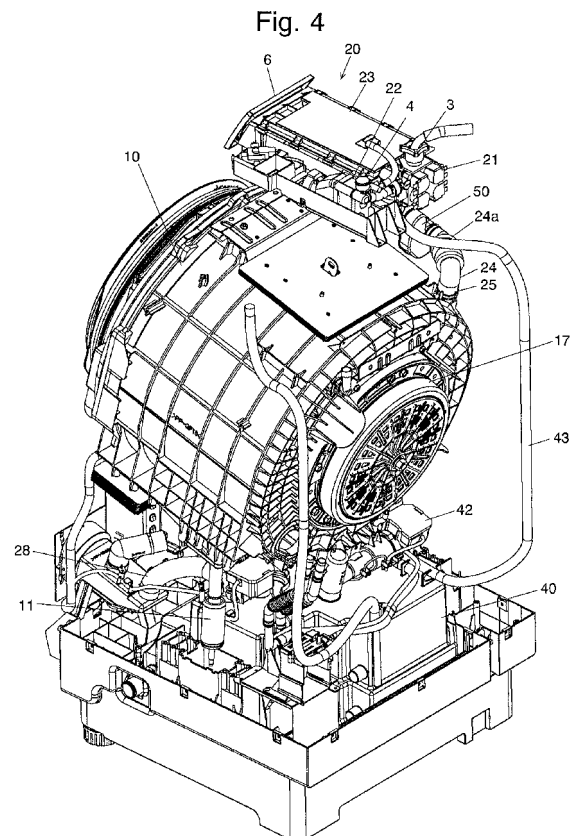
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(54) **DRUM-TYPE WASHING MACHINE**

(57) A water seal trap 50 is fixed to a water-pouring part 23 firmly attached to a housing. A bellows-like connection pipe 24a made of an elastic material, such as rubber, is provided as a segment of a water-pouring pipe 24 connecting the water seal trap 50 and the outer tub 10. Even when the outer tub 10 vibrates during an extracting operation, the vibration is absorbed by the contraction, expansion or bending of the connection pipe 24a, so that the water seal trap 50 does not vibrate with a large magnitude. Therefore, in the water-supplying phase of the final rinsing operation, the water remaining in the water seal trap 50 exhibits a satisfactory sealing effect, so that steam is prevented from flowing from the outer tub 10 to the water-pouring part 23 and leaking to the outside.



Description

TECHNICAL FIELD

[0001] The present invention relates to a drum-type washing machine having a drum that rotates about a horizontal or inclined axis.

BACKGROUND ART

[0002] Drum-type washing machines generally include a drum having a cylindrical circumferential wall. This drum, which is contained in an outer tub enclosed in a substantially box-shaped housing, can rotate about a horizontal or inclined axis. In the washing operation, the drum is rotated with laundry articles loaded inside, and with water stored within the outer tub. In the case where the washing machine also has a drying function, the washing operation may be followed by a drying operation, in which the drum is slowly rotated while hot air is fed into the outer tub. In many drum-type washing machines, the laundry-loading opening for loading or unloading the laundry articles into or out of the drum is located in the front of the housing, and a door for closing the opening is attached to the housing. When the door is open, the inner space of the drum can be observed through an opening provided on the front of the outer tub and the open end of the drum directed forward.

[0003] In a drum-type washing machine having such a construction, a water-pouring part including a detergent container for containing a detergent, softening agent or the like is located in the space above the outer tub, and a water supply line is provided for supplying water from an external tap or similar source through the water-pouring part into the outer tub. If a powder detergent is placed in a predetermined location within the detergent container and a washing operation is initiated, tap water will be introduced into the water-pouring part during the water-supplying phase of the washing operation and guided into the detergent container to wash the detergent away, resulting in detergent-containing water being supplied into the outer tub. Thus, the detergent can be automatically supplied into the tub. Placing a softening agent in another predetermined location within the detergent container will enable the softening agent to be washed away and supplied into the tub by water fed into the water-pouring part during the water-supplying phase of the final rinsing operation.

[0004] As described earlier, the outer tub and the water-pouring part are connected by the water supply line. Therefore, when the outer tub is filled with air containing a large amount of steam emitted from the laundry articles during the drying process, a portion of the steam can flow backward through the water supply line and reach the water-pouring part. If this occurs, the steam may leak through the gap between the detergent container and its holder to the outside of the machine or through other portions. Furthermore, the steam will be condensed on the

walls of the detergent container into water particles, which may drip when the detergent container is pulled open.

[0005] To solve these problems, some conventional drum-type washing machines are provided with a water seal trap located in the water supply line connecting the water-pouring part and the outer tub in order to prevent steam from reaching the water-pouring part during the drying operation. For example, a drum-type washing machine disclosed in Patent Document 1 has a water seal trap consisting of a U-shaped rubber pipeline, which is designed so that water will remain even after the water supply is discontinued. The reason for using a rubber or similar elastic material to create the pipeline is because the water supply line connecting the outer tub and the water-pouring part will undergo expanding, contracting and bending forces when the outer tub significantly oscillates with the vibration of the drum while the water-pouring part is fixed.

[0006] In the previously described washing machine, when an extracting operation is performed by rotating the drum at a high speed, the outer tub oscillates with a large magnitude. This oscillation causes the water seal trap to be strongly expanded, contracted and bent, whereby the seal water may be accidentally discharged from the trap, resulting in an imperfect sealing effect. To address this problem, a drum-type washing machine disclosed in Patent Document 2 supplies water for a predetermined period of time after the extracting operation to assuredly fill the trap with water before the drying operation. However, such an operation is undesirable because it requires an additional water supply at an unsentential point in time and thereby complicates the control process. Moreover, the operation may cause the additionally supplied water to be scattered over the laundry articles that have just been dehydrated through the extracting operation. If this happens, the drying process must be continued for a longer period of time, consuming more power. Thus, it is desirable to construct a reliable water-sealing mechanism between the water-pouring part and the outer tub without such an additional water supply.

[0007] In recent years, improving water-saving performance is regarded as essential for drum-type washing machines. For example, in a drum-type washing machine disclosed in Patent Document 3, a storage tank for collecting cooling water or other water used in the drying operation is located under the outer tub. The collected water can be reused as washing or rinsing water in the next round of washing operations. Such a water-reusing mechanism is expected to significantly improve the water-saving performance.

[0008] However, to reuse the collected water in the next round of washing operations, it is necessary to guide the reused water so that the water can wash the detergent into the outer tub. To meet this requirement, the water passage for guiding water into the detergent container within the water-pouring part needs be structurally more

complex, causing an undesirable increase in the entire size of the water-pouring part.

[0009]

Patent Document 1: Japanese Unexamined Patent Application Publication No. H11-104397

Patent Document 2: Japanese Unexamined Patent Application Publication No. H11-114286

Patent Document 3: Japanese Patent No. 2650339

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0010] The present invention has been achieved to solve the aforementioned problems. Its first objective is to provide a drum-type washing machine in which steam can be assuredly trapped by a water seal trap located in the water supply line connecting the water-pouring part and the outer tub.

[0011] The second objective of the present invention is to provide a drum-type washing machine having a mechanism for collecting water used in a washing or drying operation and for reusing the collected water in the next round of washing operations, in which an automatic detergent-dispensing function is realized while preventing the water-pouring part from being larger.

MEANS FOR SOLVING THE PROBLEMS

[0012] To achieve the first objective, a first aspect according to the present invention provides a drum-type washing machine, including:

a housing;
an outer tub supported by an elastic member in an oscillable manner within the housing;
a drum having a cylindrical circumferential wall, the drum being located within the outer tub and rotatable about a horizontal or inclined axis;
a water supplier for supplying a washing or rinsing water through a water-pouring part into the outer tub, the water-pouring part including a detergent container; and
a hot air supplier for sending drying air into the outer tub,

wherein:

a water seal trap is provided in a water supply line connecting the water-pouring part and the outer tub; the water seal trap is fixed to a section of the washing machine that does not follow an oscillation of the outer tub; and
at least a segment of the water supply line between the water seal trap and the outer tub is elastic.

[0013] In the previous description, the "section of the washing machine that does not follow an oscillation of the outer tub" is any section of the washing machine except the outer tub itself and any other member that is directly fixed to the outer tub without using an elastic connection member (e.g. a rubber part) in between. Typical examples of such sections include the housing itself and any other member that is directly fixed to the housing or connected with the housing via a non-elastic member.

[0014] In a specific mode of the first aspect of the present invention, the water seal trap is fixed to the water-pouring part firmly attached to the housing.

[0015] In the drum-type washing machine according to the first aspect of the present invention, water is stored in the water seal trap during a water-supplying operation. When the water supply is stopped, the water supply line is sealed with the water. Therefore, the steam emitted from the laundry article during the drying operation will be trapped by this seal water and never reach the water-pouring part. When the drum is rotated at a high speed during the extracting operation, the drum will vibrate due to an uneven distribution of the laundry articles contained in the drum. This vibration may cause the outer tub to oscillate with a considerable magnitude. However, the elastic member supporting the outer tub absorbs this oscillation, minimizing the vibration of the housing itself. That is, the housing "does not follow the oscillation of the outer tub." Meanwhile, the vibration is also propagated through the water supply line. However, this vibration is absorbed by the water supply line because at least a segment of the water supply line between the water seal trap and the outer tub is elastic.

[0016] Thus, neither the housing nor the water seal trap will vibrate with a large magnitude, so that the seal water stored in the trap will not be discharged. Therefore, the steam is assuredly prevented from leaking through the water-pouring part or condensing inside that part during the drying operation. Furthermore, unlike conventional models, the present washing machine does not require the aforementioned unessential water-supplying operation to ensure the water-sealing effect. Therefore, its control process is simple, and the problem of laundry articles becoming wet after dehydration will never arise.

[0017] In a preferable mode of the drum-type washing machine according to the first aspect of the present invention, the water seal trap includes a member with a water storage chamber formed inside, the water storage chamber having an inlet port for introducing water from the water-pouring part and an outlet port for sending water to the outer tub, the inner space of the water storage chamber having a partition extending from the upper wall surface downwards and separating the inner space into a first compartment located closer to the water-pouring part and provided with the aforementioned inlet port and a second compartment located closer to the outer tub and provided with the aforementioned outlet port, the two compartments communicating with each other through a communication passage formed between the lower end

of the partition and the lower wall surface of the inner space, the opening of the communication passage being larger than the area of the opening of the inlet port.

[0018] For example, the aforementioned member having a water storage chamber formed inside may be a deformation-resistant synthetic resin molding (e.g. polypropylene resin molding). Generally, the level of the communication passage in a water seal trap is lower than those of the inlet and outlet ports, so that the water flow tends to stagnate at the communication passage. In the previously described construction, the flow rate of the water passing through the communication passage during the water-supplying operation is restricted by the opening area of the inlet port so that the water can smoothly pass through the water storage chamber. This water flow prevents detergents or the like from remaining at around the communication passage, which is located at a relatively low level.

[0019] More preferably, the lower wall surface of the inner space of the first compartment of the water storage chamber may be sloped downward toward the side on which the partition is located.

[0020] In this construction, water that has been introduced from the water-pouring part through the inlet port into the water storage chamber during the water-supplying operation can flow smoothly on the downward-sloped lower wall surface, so that the detergent or the like is more assuredly prevented from remaining at the communication passage.

[0021] In the previous construction, the water seal trap may be positioned so that the downward-sloped lower wall surface parallels along a circular arc on the external surface of the circumferential wall of the outer tub.

[0022] This design enables the water seal trap to be positioned closer to the outer tub, thereby contributing to efficient utilization of space and enabling a reduction of the overall size of the housing.

[0023] To solve the aforementioned second objective, a second aspect according to the present invention provides a drum-type washing machine, including:

- a housing;
- an outer tub located within the housing;
- a drum located within the outer tub, the drum being rotatable about a horizontal or inclined axis;
- a water-pouring part including a detergent container into which a user can place detergent or a similar substance beforehand, the water-pouring part having a detergent-dispensing function by which the detergent or similar substance contained in the detergent container is supplied into the outer tub with water being supplied into the outer tub;
- a water supply valve for controlling a flow of tap water from an external source into the water-pouring part; and
- a bathwater pump for drawing bathwater from an external source and forcing the bathwater to the water-pouring part,

and the washing machine is further provided with:

- a water storage tank capable of storing water discharged from the outer tub; and
- a pressurizing device for feeding the water from the water storage tank to the water-pouring part through a returning line,

and the water-pouring part is provided with:

- a first water passage through which the tap water supplied through the water supply valve is guided into the detergent container; and
- a second water passage which serves not only as a passage through which the bathwater fed by the bathwater pump is to be guided into the detergent container but also as a passage through which the water fed by the pressurizing device is to be guided into the detergent container.

[0024] In the drum-type washing machine according to the second aspect of the present invention, when the bathwater pump is energized in a bathwater-supplying operation, bathwater is drawn from an external source and sent through the second water passage of the water-pouring part into the detergent container. Accordingly, if detergent is placed in a predetermined location within the detergent container beforehand, the detergent will be washed into the outer tub by the bathwater. As another option, the pressurizing device may be energized when water used in the previous washing or drying process is stored in the tank (this water is hereinafter called the "recycled water"). Then, the recycled water is sent through the returning line into the water-pouring part and, as in the bathwater-supplying operation, flows through the second water passage into the detergent container. Again, if detergent is placed in a predetermined location within the detergent container beforehand, the detergent will be supplied into the outer tub. Thus, even if the washing machine has a water-reusing system, the water-pouring part can be adapted for this function with a minimal increase in size, so that the inner space of the housing can be efficiently utilized.

[0025] Recycled water is water that was once used in a washing or drying operation. Therefore, it may contain relatively large foreign matter (e.g. lint). Such foreign matter may not be completely removed even if a filter or similar device is used. Accordingly, in the drum-type washing machine according to the second aspect of the present invention, it is preferable to construct the water-pouring part so that the opening size of a water ejection hole for ejecting water from the second water passage into the detergent container is larger than that of another water ejection hole for ejecting water from the first water passage into the detergent container.

[0026] In this construction, even if lint or other considerably large matter is contained in the water being sent through the returning line, the lint can hardly clog the

water ejection hole for ejecting water from the second water passage into the detergent container. Thus, the water can be smoothly supplied.

[0027] If, as in the previous case, the second water passage is shared by both bathwater-supplying and recycled water-supplying operations, the returning line should be merged with the water supply line at a point between the ejection port of the bathwater pump and the water-pouring part. Therefore, when the pressurizing device is energized while the bathwater pump is not operating, it is possible that a portion of the recycled water will flow back to the ejection port of the bathwater pump. Meanwhile, bathwater pumps generally used are a self-priming type. This type of pump requires priming at the beginning of the pumping sequence. For this purpose, a priming line is provided for introducing tap water into the bathwater pump as priming water. Therefore, if the recycled water flows back to the bathwater pump as described earlier, it is possible that the water will further flow into the priming line and reach the outlet of the water supply valve. If this happens, tap water may be contaminated with the recycled water while, for example, the water supply is stopped.

[0028] To prevent such contamination with the recycled water, it is preferable that the drum-type washing machine according to the second aspect of the present invention include a check valve between the ejection port of the bathwater pump and a point at which the returning line is merged with the water supply line between the aforementioned ejection port and the water-pouring part. This design assuredly prevents the back flow of recycled water to the bathwater pump and thereby eliminates the possibility of the aforementioned contamination of tap water.

[0029] As stated earlier, the drum-type washing machine according to the second aspect of the present invention has a water storage tank under the outer tub. This requires the housing to be taller, so that the level of the water-pouring part provided in the upper section of the outer tub will be accordingly higher. As a result, the detergent container, which is a pull-open type, will be positioned higher, making it more difficult for users to place detergent into it.

[0030] Accordingly, in the drum-type washing machine according to the second aspect of the present invention, it is preferable that the detergent container can be slid open from the front of the housing and, when pulled open, the detergent container is in a front-down position with its front end being at a lower level than when the detergent container is pushed into the housing.

[0031] According to this construction, when the user pulls the detergent container open to place detergent or a softening agent into it, its open top is not directed rightly upward but obliquely upward, making it easier for the user standing in front of the washing machine to look into the detergent container and place the detergent or softening agent into it. Thus, the machine will be more user-friendly.

[0032] In a preferable mode of the previous construction, the detergent container has a projection or recess formed on each sidewall and a guide formed on the water-pouring part, the projection or recess being allowed to slide along the guide so that the detergent container can be pulled open, and the guide being substantially horizontal in its entirety except for its front end being inclined in a front-down manner.

[0033] According to this construction, in the process of pulling the detergent container from the front of the housing (or water-pouring part), the detergent container initially moves approximately horizontally and then becomes tilted forward for the first time when it reaches a vicinity of the fully pulled position. Thus, the container can be smoothly pulled or pushed in a sophisticated manner for the user.

EFFECTS OF THE INVENTION

[0034] In the drum-type washing machine according to the first aspect of the present invention, the water held in the water seal trap will be maintained even if the outer tub oscillates with a large magnitude during the extracting operation. The seal water assuredly prevents steam produced within the outer tub during the drying operation from flowing back into the water-pouring part. Therefore, the steam cannot leak through the water-pouring part or condense into a liquid form and drip from the unit.

[0035] In the drum-type washing machine according to the second aspect of the present invention, the water-pouring part having an automatic detergent-dispensing function can be created in a relatively small size even if the unit is to be included in a system for storing water used in a washing or drying operation and reusing it in the next washing operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

Fig. 1 is a perspective view of a drum-type washing machine according to an embodiment of the present invention.

Fig. 2 is a schematic vertical sectional view of the drum-type washing machine according to the present embodiment, viewed from one side and taken at a position where the water supply and drain passages are located.

Fig. 3 is a schematic vertical sectional view of the drum-type washing machine according to the present embodiment, viewed from one side and taken at a position where the drying passage is located. Fig. 4 is a perspective rear view of the main components contained in the housing of the drum-type washing machine according to the present embodiment.

Fig. 5 is a perspective rear view of the drum-type washing machine according to the present embodi-

ment, with the top panel and other parts removed.
Fig. 6 is a detailed view of the water seal trap and its surroundings of the drum-type washing machine according to the present embodiment.

Fig. 7 is a vertical sectional view of the water seal trap.

Fig. 8 is a top view of the entirety of the water supply unit.

Fig. 9 is a partially sectional, perspective view of the water supply unit, viewed from the back.

Fig. 10 is a schematic vertical sectional view of the rear portion of the water-pouring part.

Fig. 11 is a vertical sectional view of the main section of the water-pouring part including a detergent container.

Fig. 12 is a side view of the detergent container in a fully pulled position.

EXPLANATION OF NUMERALS

[0037]

1	Housing
1b	Laundry-Loading Opening
2	Door
3	Water Supply Hose Connection Port
4	Bathwater Hose Connection Port
6	Detergent Container
61	Tray
61a	Guide Rib
62	Handle
7	Drying Filter Container
10	Outer Tub
101	Side Panel
102, 103	Joint Plate
10a	Tub Opening
11	11Damper
12	12Packing
13	Drum
13a	Drum Opening
14	Main Shaft
17	Motor
20	Water Supply Unit
21	Water Supply Valve
22	Bathwater Pump
223	Priming Hose
23	Water-Pouring Part
231	Case
232	Lid
233	First Water Passage
233a	Water Ejection Hole
234	Second Water Passage
234a	Water Ejection Hole
235	Third Water Passage
236	Merging Chamber
237	Drain Hole
238	Guide Groove
238a	Horizontal Section

238b	Downward-Inclined Section
24	Water-Pouring Pipe
24a	Connection Pipe
24b	Pipe
5 25 ...	Water-Pouring Port
26 ...	Drain Port
27	Drain Valve
28	Drain Pipe
31	Exhaust Port
10 32	Air Duct
33	Fan
34	Fan Motor
35	Heater
36	Air Supply Port
15 40	Water Storage Tank
41	Water Storage Valve
42	Recycled Water Pump
43	Returning Line
50	Water Seal Trap
20 51	Body
511	Partition
512	First Compartment
513	Second Compartment
514	Communication Passage
25 515	Lower Wall Surface
52	Inlet Port
53	Outlet Port

BEST MODE FOR CARRYING OUT THE INVENTION

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[0038] An embodiment of the drum-type washing machine according to the present invention is described with reference to the drawings. Fig. 1 is a perspective view of the drum-type washing machine according to the present embodiment. Fig. 2 is a schematic vertical sectional view of the drum-type washing machine according to the present embodiment, viewed from one side and taken at a position where the water supply and drain passages are located. Fig. 3 is a schematic vertical sectional view of the drum-type washing machine according to the present embodiment, viewed from one side and taken at a position where the drying passage is located. Fig. 4 is a perspective rear view of the main components contained in the housing of the drum-type washing machine according to the present embodiment. Fig. 5 is a perspective rear view of the drum-type washing machine according to the present embodiment, with the top panel and other parts removed.

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[0039] The housing 1, which defines the outward form of the present drum-type washing machine, is roughly box-shaped in its entirety. The front 1a of the housing 1 is directed slightly upward, gently curving from top to center. A substantially circular laundry-loading opening 1b is provided on the front 1a. This opening 1b can be closed by a horizontally swinging door 2 having a window for visually checking the inside area. Located in the upper section of the front 1a, i.e. above the laundry-loading opening 1b, is a horizontally elongated operation panel

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5 with various keys and indicators. On the left side of the panel 5, a drawer-type detergent container 6 is provided, and a drying filter container 7, which is also a drawer type, is located on the right side.

[0040] Located on the top 1c of the housing 1 is a water supply hose connection port 3, to which an end of a water supply hose is to be connected; the other end of this hose is to be connected to a tap. On the right side of the aforementioned port 3 is a bathwater hose connection port 4, to which an end of a bathwater supply hose is to be connected; the other end of this hose is to be immersed in bathwater stored in a bathtub. The water supply hose connection port 3 is formed by directly exposing the water inlet of the water supply valve 21 (which will be described later) on the top. The bathwater hose connection port 4 is formed by directly exposing the water inlet of the bathwater pump 22 on the top.

[0041] Within the housing 1, an outer tub 10, whose circumferential wall is substantially cylindrical, is held in a moderately oscillable manner by dampers 11 supporting it on both sides of the bottom and a spring (not shown) pulling it at the top. The dampers 11 and the spring constitute the elastic member of the present invention. The outer tub 10 has a circular opening 10a directed frontward and facing the laundry-loading opening 1b of the housing 1 (that opening is hereinafter called the "tub opening 10a"). The circumferential rim of the tub opening 10a is linked with that of the laundry-loading opening 1b by a flat cylindrical packing 12 made of an elastic material, such as rubber.

[0042] Within the outer tub 10, a drum 13 having a substantially cylindrical circumferential wall for containing laundry is supported by a main shaft 14, which extends in the back-to-front direction with its front end directed obliquely upward. The drum 13 has a large opening 13a at its front end (this opening is hereinafter called the "drum opening 13a"). When the door 2 is open, it is possible to look down into the drum 13 through the tub opening 10a and the drum opening 13a. In the present embodiment, the inclination angle θ formed by the central axis C of the drum 13 (or the central axis of the main shaft 14) and the horizontal line is approximately 15°. However, this is a mere example and the angle may be determined within a specific range (e.g. from 10° to 30°) according to necessity.

[0043] The main shaft 14, the front end of which is firmly fixed to the rear face of the drum 13, is supported in a rotatable manner by the bearing 16 of a bearing fixation member 15 attached to the rear section of the outer tub 10. The other end of the shaft 14 is protruding from the outer tub 10. Connected to this end is the rotor 172 of a motor 17, which is an outer-rotor brushless DC (direct current) motor. The stator 171 of this motor 17 is fixed to the bearing fixation member 15. The rotor 172 including permanent magnets surrounds the outer circumference of the stator 171 including windings. This arrangement reduces the thickness of the motor 17 in the length direction of the main shaft 14. Supplying a drive current

from a control circuit (not shown) to the stator 171 drives the rotor 172 into rotation. This rotation is transmitted via the main shaft 14 to the drum 13, making it rotate at the same speed as that of the rotor 172.

[0044] Within the upper space of the housing 1, there is a water supply unit 20 including a water supply valve 21, a bathwater pump 22 for supplying bathwater, and a water-pouring part 23. The water inlet of the water supply valve 21 is extended upward to form the aforementioned water supply hose connection port 3. Similarly, the water inlet of the bathwater pump 22 is extended upward to form the aforementioned bathwater hose connection port 4. The water-pouring part 23, which holds the detergent container 6 in a slidable manner, is located in front of the water supply valve 21. Most portions of water supplied through the water supply valve 21 or bathwater pump 22 to the water-pouring part 23 pass through the detergent container 6 and then flow into a water-pouring pipe 24 connected to the bottom of the water-pouring part 23. Through this pipe 24, the water is guided to a water-pouring port 25 at the rear section of the outer tub 10 and then supplied into the tub 10.

[0045] The water thus supplied and stored in the outer tub 10 passes through perforations 13b into the drum 13. Conversely, during an extracting operation, water removed from the laundry articles are scattered through those perforations 13b onto the outer tub 10. The outer tub 10 has a drain port 26 at a rear section of its bottom. This drain port 26 is connected with the inlet of a drain valve 27. When this valve 27 is opened, the water stored in the outer tub 10 is drained through a drain pipe 28 to the outside.

[0046] The drain port 26 is also connected with the inlet of a water storage valve 41. When the water storage valve 41 is opened while the drain valve 27 is closed, the water stored in the outer tub 10 does not flow into the drain pipe 28 but into the water storage tank 40 located at the bottom of the housing 1. Thus, water that has been used for washing can be stored in the tank 40 without being discarded. This tank 40 is connected with the water-pouring part 23 by a returning line 43, and a recycled water pump 42 as the pressurizing device of the present invention is provided in the returning line 43.

[0047] In this drum-type washing machine, after final rinsing is completed, the water used for the rinsing operation is stored in the water storage tank 40. This tank 40 is provided with a purifier (not shown) for cleaning the stored water (recycled water) to suppress the proliferation of bacteria. In the next round of washing operations, if a recycled water supply mode is selected, the recycled water pump 42 is energized to siphon the recycled water from the tank 40 and feed it through the returning line 43 to the water-pouring part 23. Thus, in place of tap water or bathwater, the recycled water is supplied through the detergent container 6 into the outer tub 10. The use of recycled water significantly reduces the amount of water used for washing.

[0048] This drum-type washing machine is also capa-

ble of drying laundry articles after the extracting operation. As shown in Fig. 4, an exhaust port 31 is provided at a lower section on the rear face of the outer tub 10, and an air duct 32 is connected to that port. This duct 32 is extended across the rear, side and top sections of the outer tub 10 and connected to an air supply port 36 provided at an upper front section of the outer tub 10. Along this air duct 32, the following components are provided: a drying filter (not shown) contained in the drying filter container 7, which can be pulled open; a fan 33 driven by a fan motor 34, and a drying heater 35. In addition, a cooling water hose (not shown) is connected to the vertical section of the air duct 32.

[0049] During the drying operation, an air flow generated by the fan 33 is heated by the heater 35 and then directed from the air supply port 36 into the drum 13. While passing through the drum 13, the hot air exchanges heat with the laundry articles, removing water from them, and then flows through the exhaust port 31 into the air duct 32. Inside the vertical section of the air duct 32, water supplied through the cooling water hose is continuously or intermittently flowing down. When the hot air comes in contact with this cooling water, a large amount of steam contained in the hot air is condensed into water particles. The condensed water flows down on the inner wall of the air duct 32 with the cooling water. Upon reaching the outer tub 10, the water is drained through the drain port 26 to the outside. After the steam is removed within the air duct 32, the now dry air passes through the drying filter 32 and is propelled by the fan 33 to the heater 35. Thus, the air is circulated. The drying filter removes lint, dust, pollen or any other matter from the air passing through it.

[0050] As shown in Fig. 5, the housing 1 includes, as its components, a pair of side panels 101 closing the right and left sides and two bridge-like joint plates 102 and 103 spanning the space between the upper ends of both side panels 101. The joint plates 102 and 103 reinforce the housing 1, and a top plate is to be set on the joint plates 102 and 103. The water supply unit 20 (including the water-pouring part 23) and the drying unit (including the fan 33, heater 35 and so on) are screwed to the joint plates 102 and 103 and the upper ends of the side panels 101.

[0051] The constructions and operations characterizing the drum-type washing machine according to the present embodiment are described. Initially, the description will focus on a water seal trap located in the middle of the water-pouring pipe 24 serving as the water supply line connecting the water-pouring part 23 and the outer tub 10. Fig. 6 is a detailed view of the water seal trap and its surroundings, obliquely viewed from the left front. Fig. 7 is a vertical sectional view of the same trap.

[0052] As shown in Fig. 4, the water seal trap 50 is located in the middle of the water-pouring pipe 24. More specifically, the water-pouring pipe 24 includes a bellows-like connection pipe 24a made of an elastic material, such as rubber, in the section between the outlet of

this trap 50 (which will be later called the "outlet port 53") and the water-pouring port 25 of the outer tub 10. On the other hand, the outlet of the water-pouring part 23 and the inlet of the trap 50 (which will be later called the "inlet port 53") are connected by a rigid pipe 24b. The connecting directions of the two pipes 24a and 24b to the water seal trap 50 are substantially parallel to each other. The trap 50 is indirectly fixed to the housing 1 since, as stated earlier, the water supply unit 20 including the water-pouring part 23 is firmly screwed to the side plate 101 and the joint plate 103, each forming a portion of the housing 1, and the pipe 24b is rigid. When the outer tub 10 oscillates, the oscillation will be absorbed by the connection pipe 24a, which can be elastically expanded or contracted. Therefore, the water seal trap 50 will not follow the oscillation of the outer tub 10.

[0053] The water seal trap 50 has a body 51 shallow in the front-back direction and made of synthetic resin. The body 51 consists of two members 51a and 51b heat-welded (or vibration-welded) to each other to form a water storage chamber inside. The inlet port 52 is formed on the front side of the upper section of the first member 51a, while the outlet port 53 is formed on the back side of the upper section of the second member 51b and at a level lower than the inlet port 52. The water storage chamber 53 inside the body 51 has a partition 511 extending from the upper wall to form a first compartment 512 closer to the inlet port 52 and a second compartment 513 closer to the outlet port 53. The two compartments 512 and 513 communicate with each other through a communication passage 514 formed between the lower end of the partition 511 and the lower wall of the body 51. Thus, within the body 51, a substantially U-shaped passage is formed between the inlet port 52 and the outlet port 53, with the communication passage 514 as the bottom section.

[0054] During the water-supplying operation, the water coming from the water-pouring part 23 flows rearward through the pipe 24b and then enters the body 51 of the trap 50 through the inlet port 52. As explained earlier, the connecting direction of the pipe 24b to the inlet port 52 is substantially parallel to that of the connection pipe 24a to the outlet port 53. Therefore, after entering the body 51, the water flow changes its direction approximately downward and then passes through the aforementioned U-shaped passage within the body 1 to reach the outlet port 53, at which the water flow is redirected by approximately 90°. Similar to the water flowing into the trap 50, the water at this moment is directed rearward and directed into the connection pipe 24a. When the water supply is off, some water remains in the communication passage 514 (for example, up to the water storage level shown in Fig. 7) since the lower end of the partition 514 is below the lower ends of both inlet and outlet ports 52 and 53. The remaining water perfectly seals the passage, enabling the water seal trap 50 to function as intended.

[0055] The cross-sectional area of the communication passage 514 is larger than the opening area of the inlet port 52. Accordingly, the amount of water flowing into the

body 51 is restricted by the opening area of the inlet port 52 rather than the cross-sectional area of the communication passage 514. Therefore, the water can pass through the communication passage 514 without being significantly impeded. Furthermore, within the communication passage 514, the lower wall surface 515 of the first compartment 512 is sloped downward along the water flow direction. Therefore, during the water-supplying operation, the water that has come from the inlet port 52 flows down the sloped surface and flushes through the communication passage 514 to reach the outlet port 53. If a powder detergent is contained in the water, the flush of water conveys the powder detergent to the outlet port 53, scarcely leaving the detergent in the communication passage 514.

[0056] As described earlier, since the water seal trap 50 is fixed to the water-pouring part 23, the trap 50 barely vibrates even if the outer tub 10 oscillates with a large magnitude during the extracting operation or similar operation. Therefore, the water stored in the water storage chamber will not be accidentally discharged through the outlet port 53. Thus, the passage is assuredly sealed, so that a back flow of steam from the outer tub 10 during the drying operation cannot reach the side where the water-pouring part 23 is located. The water seal trap 50 is positioned so that the inclined lower wall surface 515 of the body 51 is oriented along a circular arc on the external circumferential surface of the outer tub 10, leaving a minimal clearance for allowing the outer tub 10 to oscillate without causing a collision. This positioning saves space for installing the trap 50.

[0057] Next, the characteristic structures of the water-pouring part 23 are described. Fig. 8 is a top view of the entirety of the water supply unit 20. Fig. 9 is a partially sectional, perspective view of the water supply unit 20, viewed from the back. Fig. 10 is a schematic vertical sectional view of the rear portion of the water-pouring part 23. Fig. 11 is a vertical sectional view of the main section of the water-pouring part 23 including a detergent container 6. Fig. 12 is a side view of the detergent container 6 in a fully pulled position.

[0058] The detergent container 6 is an integrally molded part entirely made of a synthetic resin. It includes a tray 61 having a full-open top and a front handle 62 having a curved face coinciding with the shape of the housing 1. Though not shown in the drawings, the inner space of the tray 61 is separated into three sections: a powder detergent section for containing a powder detergent, a liquid detergent section for containing a liquid detergent, and a softening agent section for containing a softening agent.

[0059] The water-pouring part 23, which holds the detergent container 6 in a slidable manner, includes a case 231 with its front and top sides open and a lid 232 closing the open top of the case 231. The lid 232 is provided with a plurality of passages through which water that has been externally supplied into the water-pouring part 23 is to be guided into the tray 61 of the detergent container 6. Specifically,

there are three passages: a first water passage 233 through which water supplied from the water supply valve 21 is guided into the powder detergent section or liquid detergent section inside the tray 61 in the washing operation, a second water passage 234 through which water fed by the bathwater pump 22 or recycled water pump 42 is guided into the powder detergent section or liquid detergent section inside the tray 61, and a third water passage through which water supplied from the water supply valve 21 is guided into the softening agent section inside the tray 61 in the water-supplying phase of the final rinsing operation.

[0060] The first water passage 233 has a large number of water ejection holes 233a. When water is introduced into the first water passage 233, the water passes through those holes 233a into the tray 61. The second water passage 234 also has several water ejection holes 234a, so that water introduced into the second water passage 234 will pass through those holes 234a into the tray 61. The third water passage 235 also has a similar structure. It should be noted that the area of each water ejection hole 234a of the second water passage 234 is significantly larger than that of each water ejection hole 233a of the first water passage 233. As will be later explained, the recycled water sent from the recycled water pump 42 may contain lint or similar foreign matter, some of which can clog the water ejection holes 234a. Enlarging these holes will effectively prevent this situation. By contrast, the first and third water passages 233 and 235 receive tap water, which contains no foreign matter. Accordingly, the area of each of the water ejection holes 233a and 235a is made small.

[0061] The bathwater pump 22 is a self-priming type pump, which cannot start the siphoning of water if its internal chamber is not filled with water at the beginning of its operation. Accordingly, a priming hose 221 is provided to connect the first water passage 233 and the bathwater pump 22 to introduce tap water as priming water. Even in a bathwater-supplying operation, the water supply valve 21 is initially opened for a predetermined period of time to send tap water to the bathwater pump 22 so that the pump 22 can begin the siphoning action.

[0062] As described earlier, the second water passage 234 serves not only as a passage through which recycled water fed by the recycled water pump 42 (i.e. the water stored in the water storage tank 40) is introduced into the detergent container 6, but also as a passage through which bathwater siphoned from an external source and ejected by the bathwater pump 22 is introduced into the detergent container 6. Owing to this design, the water-pouring part 23 is approximately equal in volume to that of conventional drum-type washing machines that do not have the function of using recycled water. Accordingly, the installation space will not increase.

[0063] To supply one or both of the recycled water and bathwater to the commonly used second water passage 234, a system shown in Figs. 9 and 10 has been adopted. That is, the case 231 of the water-pouring part 23 has

two connection ports 231a and 231b vertically arranged on its rear wall. The first connection port 231a is connected with the ejection port of the bathwater pump 22 by a bathwater supply pipe 222. The second connection port 231b is connected with the ejection port of the recycled water pump 42 by the returning line 43. These two lines meet together in a merging chamber 236 formed behind the rear wall of the case 231, and the second water passage 234 originates from this merging chamber 236. This chamber 236 has a drain hole 237 at its bottom so that no water will remain in the chamber 236 when neither the bathwater pump 22 nor the recycled water pump 42 is operating.

[0064] As explained previously, the bathwater supply pipe 222 and the returning line 43 communicate with each other via the merging chamber 236, while the ejection port of the bathwater pump 22 and the passage of the priming hose 221 communicate with each other via the internal chamber of the pump 22. Accordingly, a check valve 223 is provided in the middle of the bathwater supply pipe 222 to prevent recycled water from flowing into the bathwater pump 22. The check valve 223 is open when water is being sent from the bathwater pump 22 through the bathwater supply pipe 222 to the water-pouring part 23 by siphoning and ejecting actions of the bathwater pump 22, while the valve 223 is closed when the bathwater pump 22 is not operating. When the water supply valve 21 is open and the first water passage 233 of the water-pouring part 23 is allowed to communicate with an external water tap, if the pressure at the water tap should become negative due to a stoppage of water supply, the recycled water, which is undrinkable, would flow back through the bathwater pump 22 and water supply valve 21 to the water tap. The check valve prevents this situation.

[0065] Due to the presence of the water storage tank 40 under the outer tub 10, the housing 1 of the drum-type washing machine according to the present embodiment is 100 to 200 mm taller than generally used conventional drum-type washing machines. Accordingly, the position of the detergent container 6 in a pulled-open state is also higher. This may be inconvenient for users (particularly somewhat shorter users) in placing detergent or a softening agent into the tray 61 of the detergent container 6. To address this problem, the water-pouring part 23 of the present drum-type washing machine is constructed as follows: The guide groove 238, which is formed at the joint section between the lid 232 and each sidewall of the case 231, is approximately horizontal in its entirety (horizontal section 238a) except for a section in the vicinity of the front end being inclined in a front-down manner (downward-inclined section 238b).

[0066] The detergent container 6 has a horizontal guide rib 61a extending outward at the upper end of each sidewall of the tray 61. The rib 61a can slide back and forth along the guide groove 238 so that the detergent container 6 can be pulled open. When a user pulls the detergent container 6, the rib 61a initially slides along the

horizontal section 238a, so that the container 6 moves approximately horizontally. After reaching the vicinity of the fully pulled position, the guide rib 61a is held by the downward-inclined section 238b of the guide groove 238, making the container 6 incline frontward in its entirety, as shown in Fig. 12. In this position, the open top of the tray 61 is not directed rightly upward but inclined slightly forward, making it easier for the user standing in front of the washing machine to look into the tray 61. Thus, the detergent container 6 can be smoothly opened or closed in a sophisticated manner for the user since it moves approximately horizontally all the way through until it becomes inclined forward immediately before the fully pulled position.

[0067] It should be noted that the previous embodiment is a mere example of the present invention. Any changes, modifications or additions made to the embodiment within the spirit of the present invention should be included in the scope of the patent claims of this patent application.

Claims

1. A drum-type washing machine, comprising:

a housing;
an outer tub supported by an elastic member in an oscillable manner within the housing;
a drum having a cylindrical circumferential wall, the drum being located within the outer tub and rotatable about a horizontal or inclined axis;
a water supplier for supplying a washing or rinsing water through a water-pouring part into the outer tub, the water-pouring part including a detergent container; and
a hot air supplier for sending drying air into the outer tub,

wherein:

a water seal trap is provided in a water supply line connecting the water-pouring part and the outer tub;
the water seal trap is fixed to a section of the washing machine that does not follow an oscillation of the outer tub; and
at least a segment of the water supply line between the water seal trap and the outer tub is elastic.

2. The drum-type washing machine according to claim 1, wherein the water seal trap is fixed to the water-pouring part firmly attached to the housing.

3. The drum-type washing machine according to claim 1 or 2, wherein the water seal trap includes a member with a water storage chamber formed inside, the wa-

ter storage chamber having an inlet port for introducing water from the water-pouring part and an outlet port for sending water to the outer tub, the inner space of the water storage chamber having a partition extending from an upper wall surface downwards and separating the inner space into a first compartment located closer to the water-pouring part and provided with the aforementioned inlet port and a second compartment located closer to the outer tub and provided with the aforementioned outlet port, the two compartments communicating with each other through a communication passage formed between a lower end of the partition and a lower wall surface of the inner space, an opening of the communication passage being larger than an area of an opening of the inlet port.

4. The drum-type washing machine according to claim 3, wherein the lower wall surface of the inner space of the first compartment of the water storage chamber may be sloped downward toward the side on which the partition is located.

5. The drum-type washing machine according to claim 4, wherein the water seal trap is positioned so that the downward-sloped lower wall surface is oriented along a circular arc on the external surface of the circumferential wall of the outer tub.

6. A drum-type washing machine, comprising:

a housing;
 an outer tub located within the housing;
 a drum located within the outer tub, the drum being rotatable about a horizontal or inclined axis;
 a water-pouring part including a detergent container into which a user can place detergent or a similar substance beforehand, the water-pouring part having a detergent-dispensing function by which the detergent or similar substance contained in the detergent container is supplied into the outer tub with water being supplied into the outer tub;
 a water supply valve for controlling a flow of tap water from an external source into the water-pouring part; and
 a bathwater pump for drawing bathwater from an external source and forcing the bathwater to the water-pouring part,

wherein:

a water storage tank capable of storing water discharged from the outer tub; and
 a pressurizing device for feeding the water from the water storage tank to the water-pouring part through a returning line,

and the water-pouring part is provided with:

a first water passage through which the tap water supplied through the water supply valve is guided into the detergent container; and
 a second water passage which serves not only as a passage through which the bathwater fed by the bathwater pump is to be guided into the detergent container but also as a passage through which the water fed by the pressurizing device is to be guided into the detergent container.

7. The drum-type washing machine according to claim 6, wherein the water-pouring part is constructed so that an opening size of a water ejection hole for ejecting water from the second water passage into the detergent container is larger than that of another water ejection hole for ejecting water from the first water passage into the detergent container.

8. The drum-type washing machine according to claim 6, wherein a check valve is provided between an ejection port of the bathwater pump and a point at which the returning line is merged with the water supply line between the aforementioned ejection port and the water-pouring part.

9. The drum-type washing machine according to claim 6, wherein the detergent container can be slid open from the front of the housing and, when pulled open, the detergent container is in a front-down position with its front end being at a lower level than when the detergent container is pushed into the housing.

10. The drum-type washing machine according to claim 9, wherein the detergent container has a projection or recess formed on each sidewall and a guide formed on the water-pouring part, the projection or recess being allowed to slide along the guide so that the detergent container can be pulled open, and the guide being substantially horizontal in its entirety except for its front end being inclined in a front-down manner.

Fig. 1

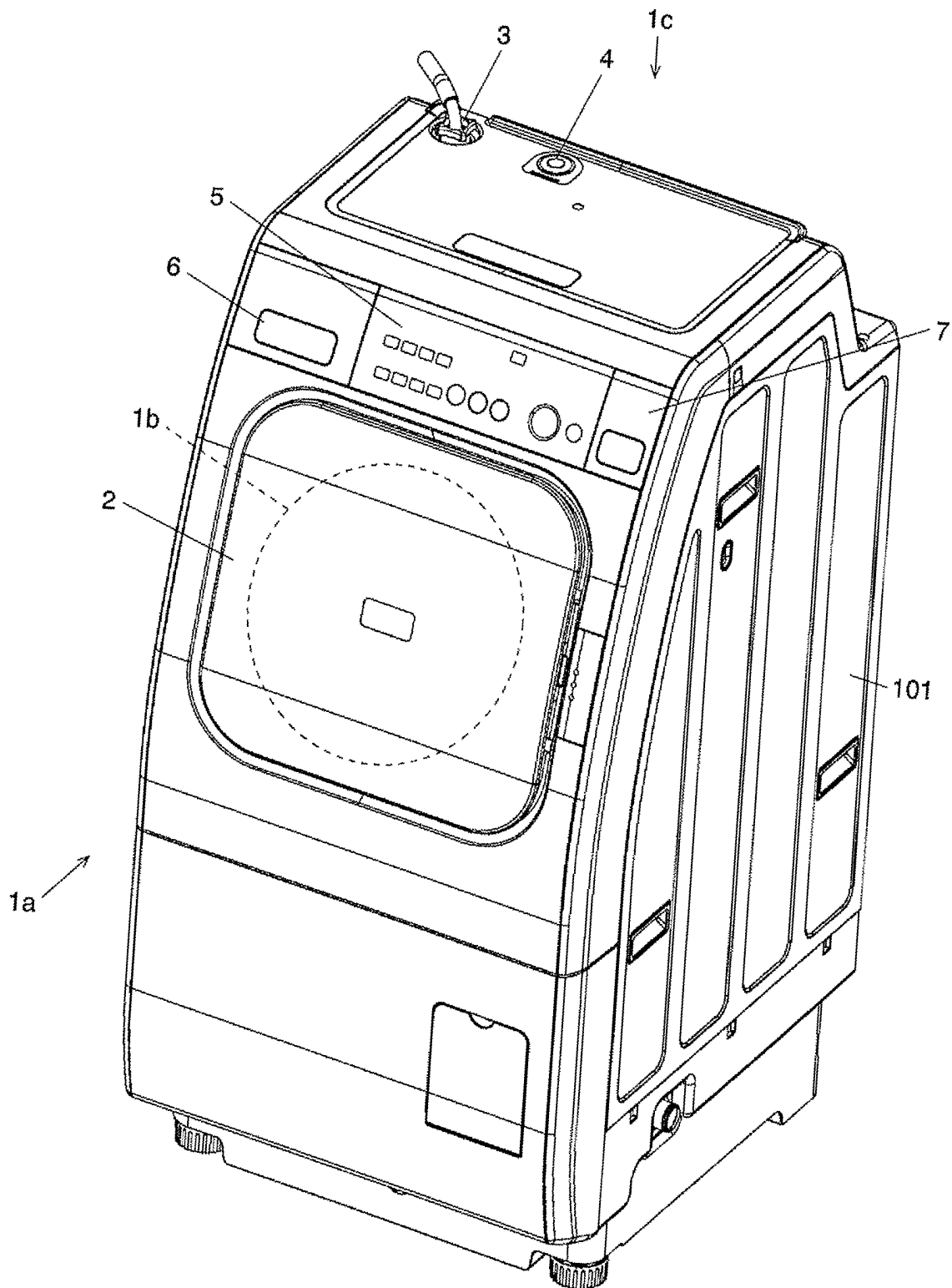


Fig. 2

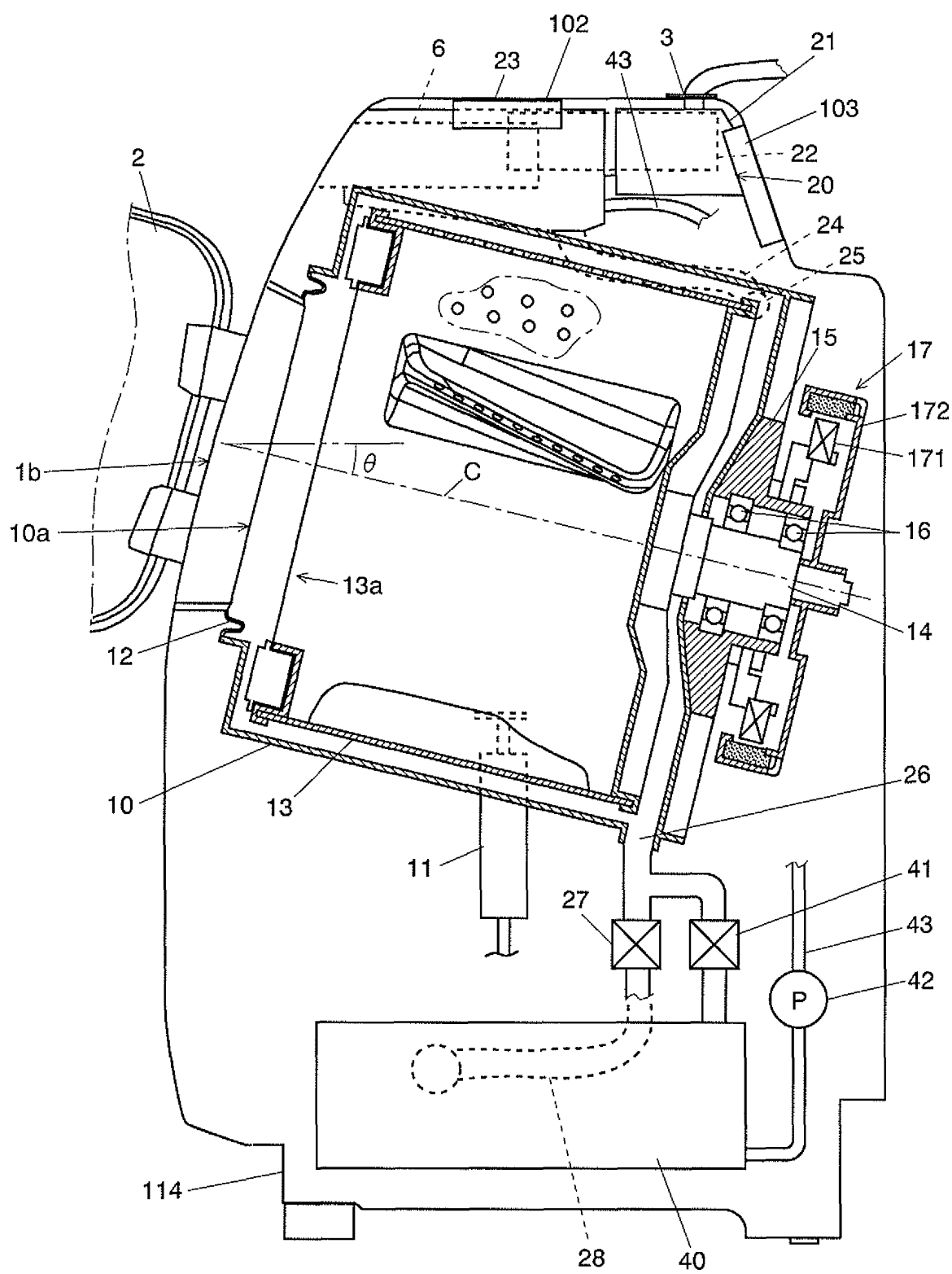


Fig. 3

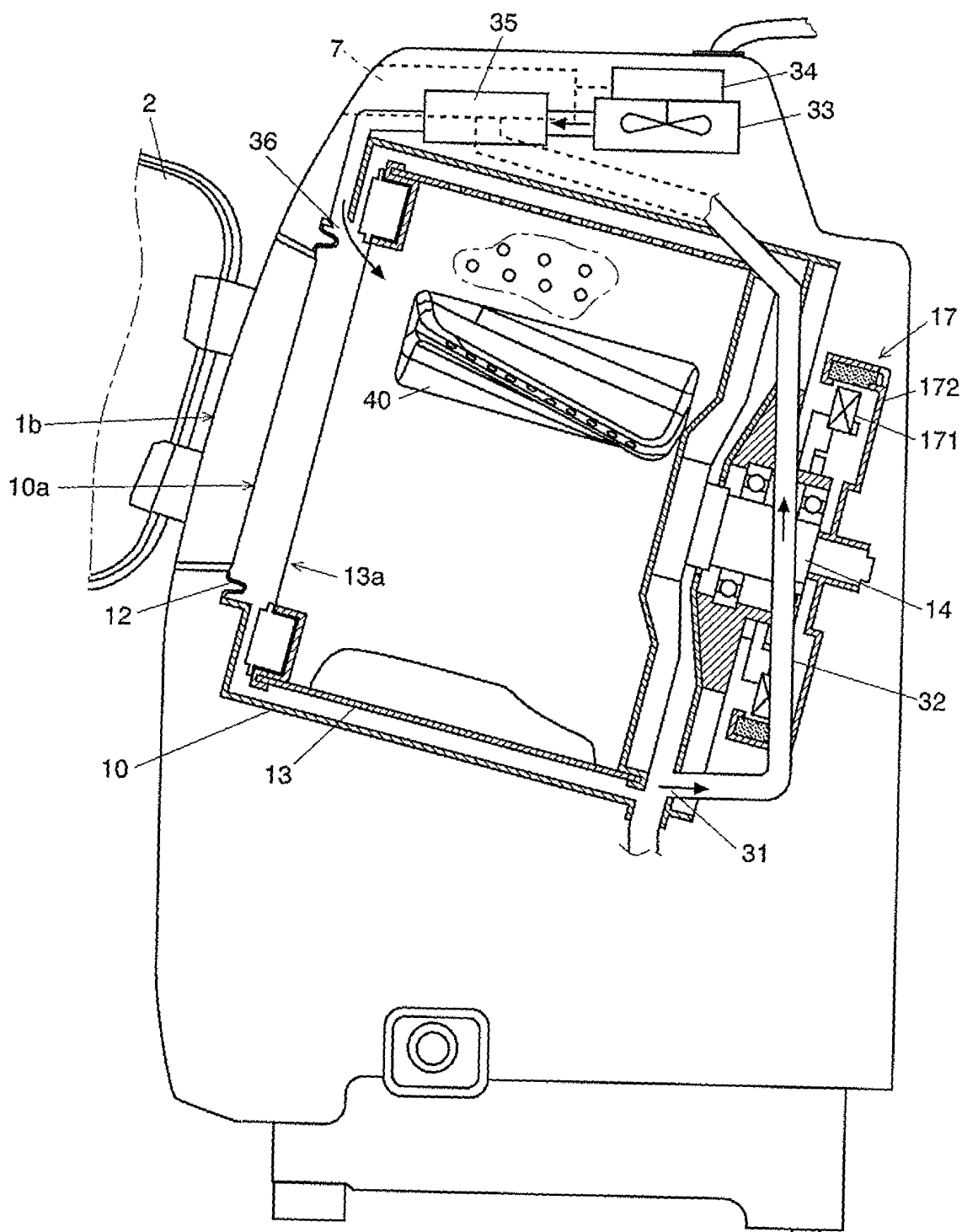


Fig. 4

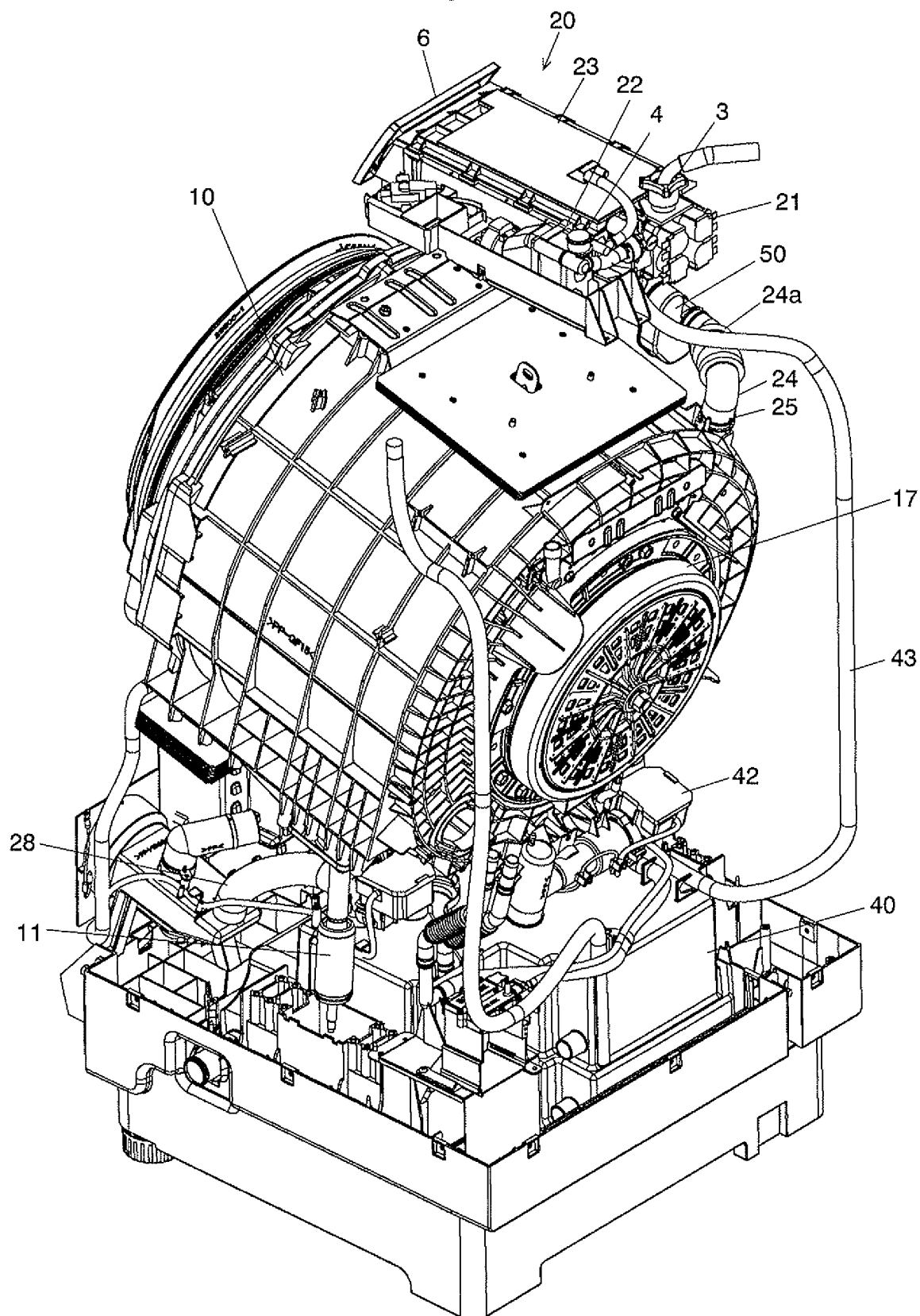


Fig. 5

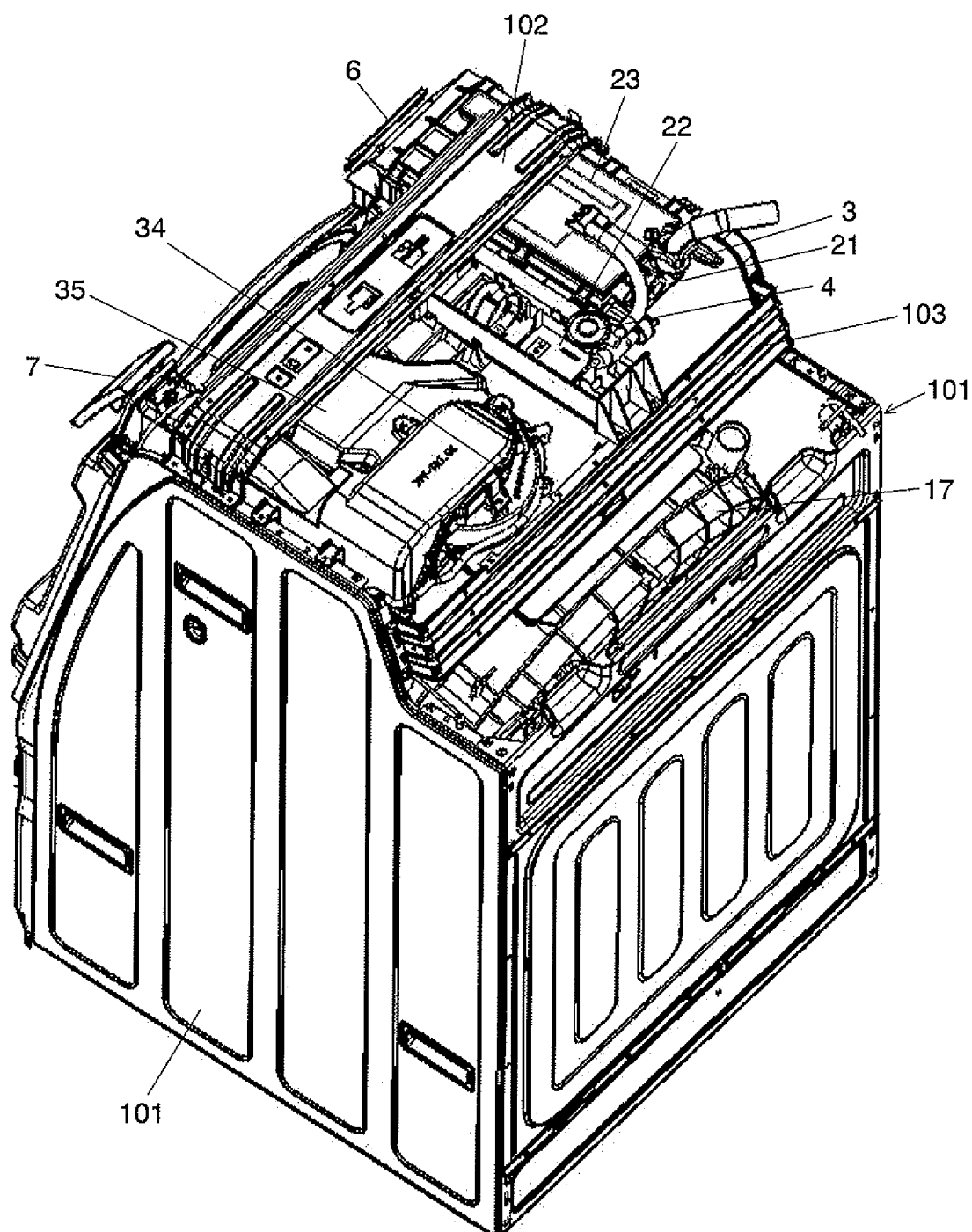


Fig. 6

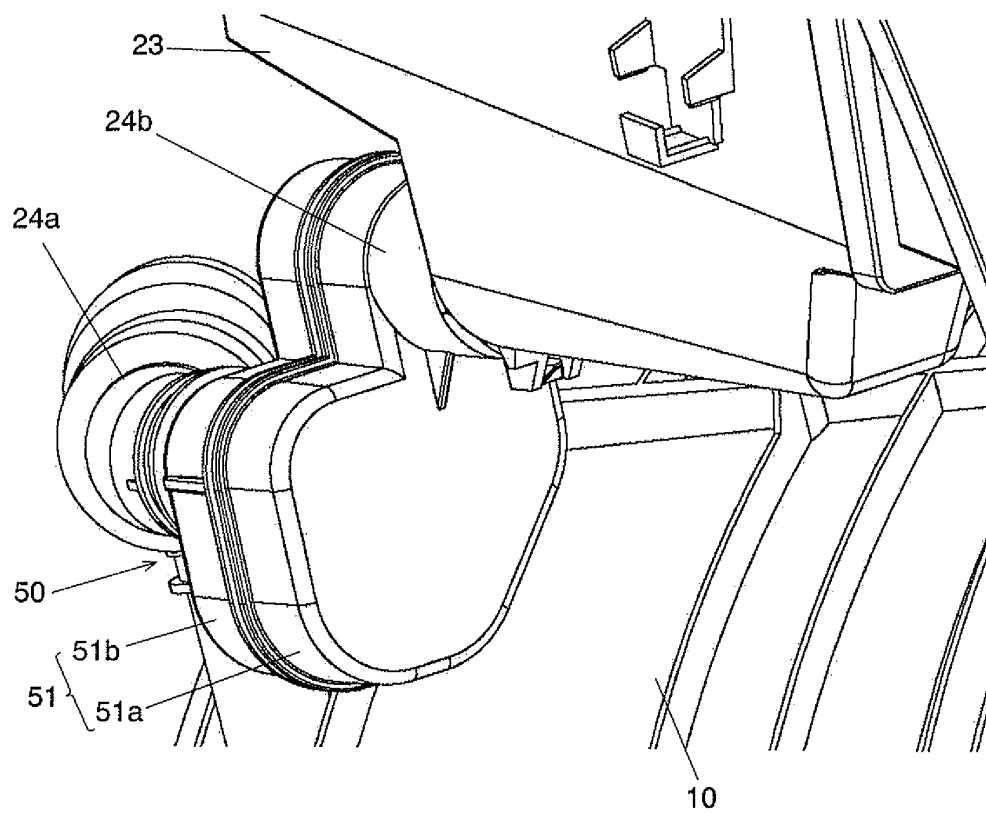


Fig. 7

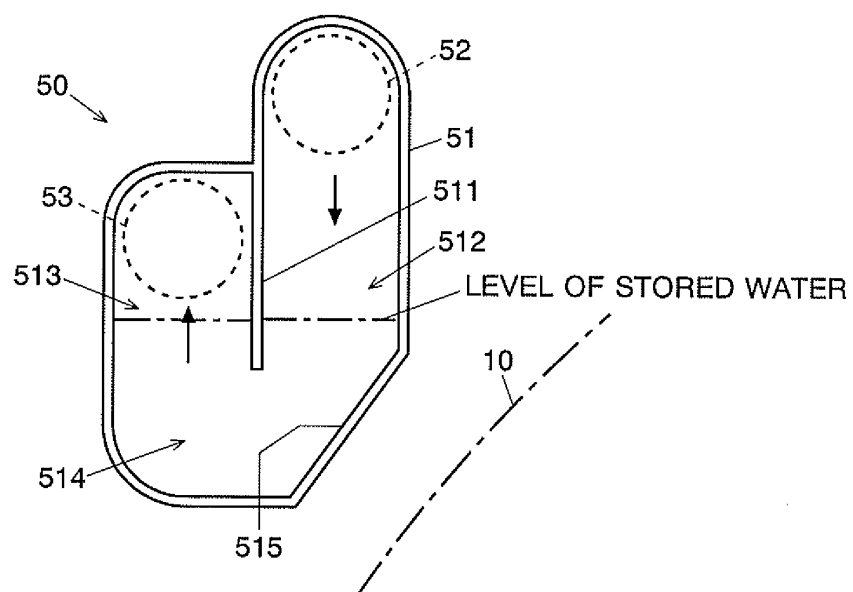


Fig. 8

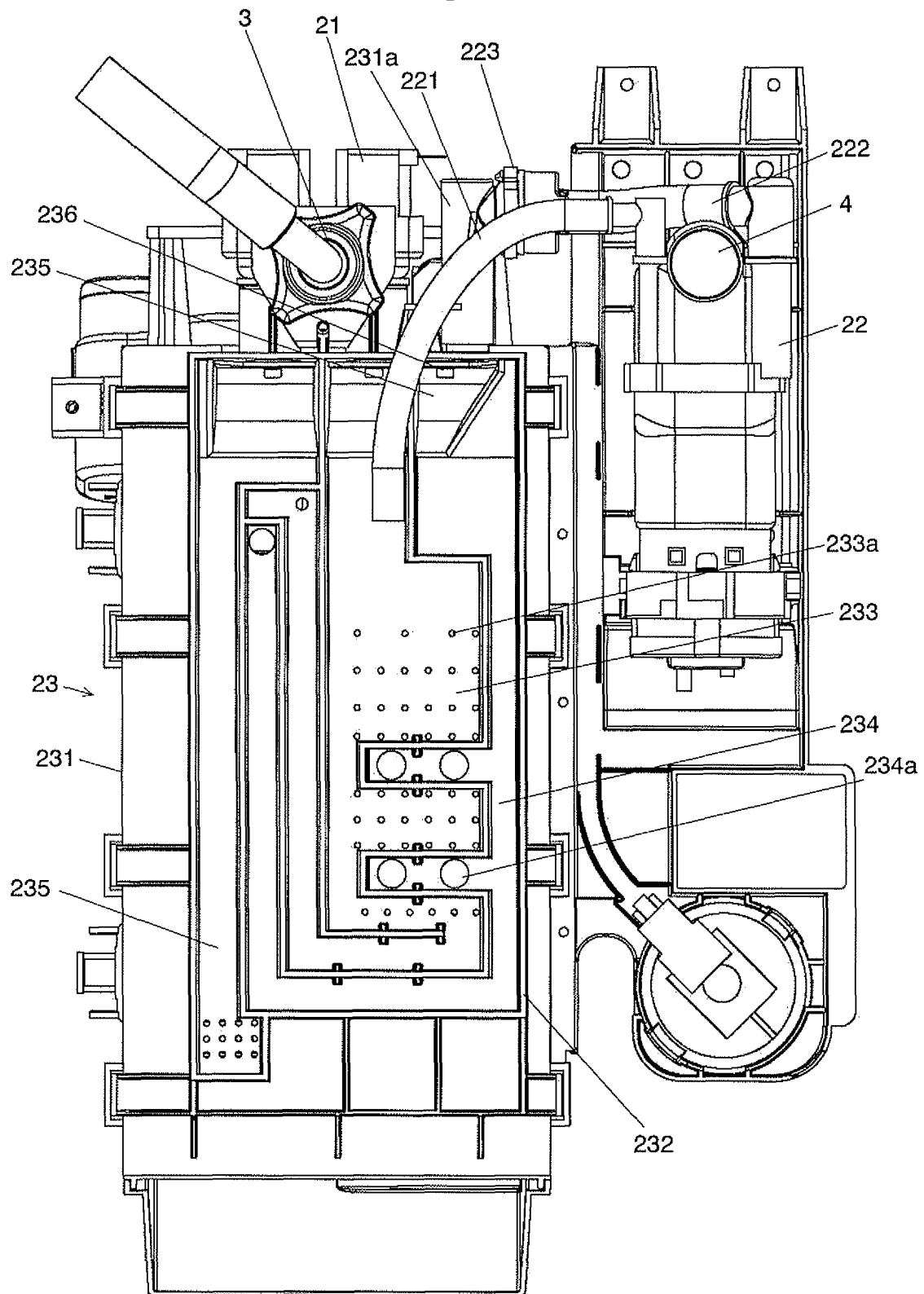


Fig. 9

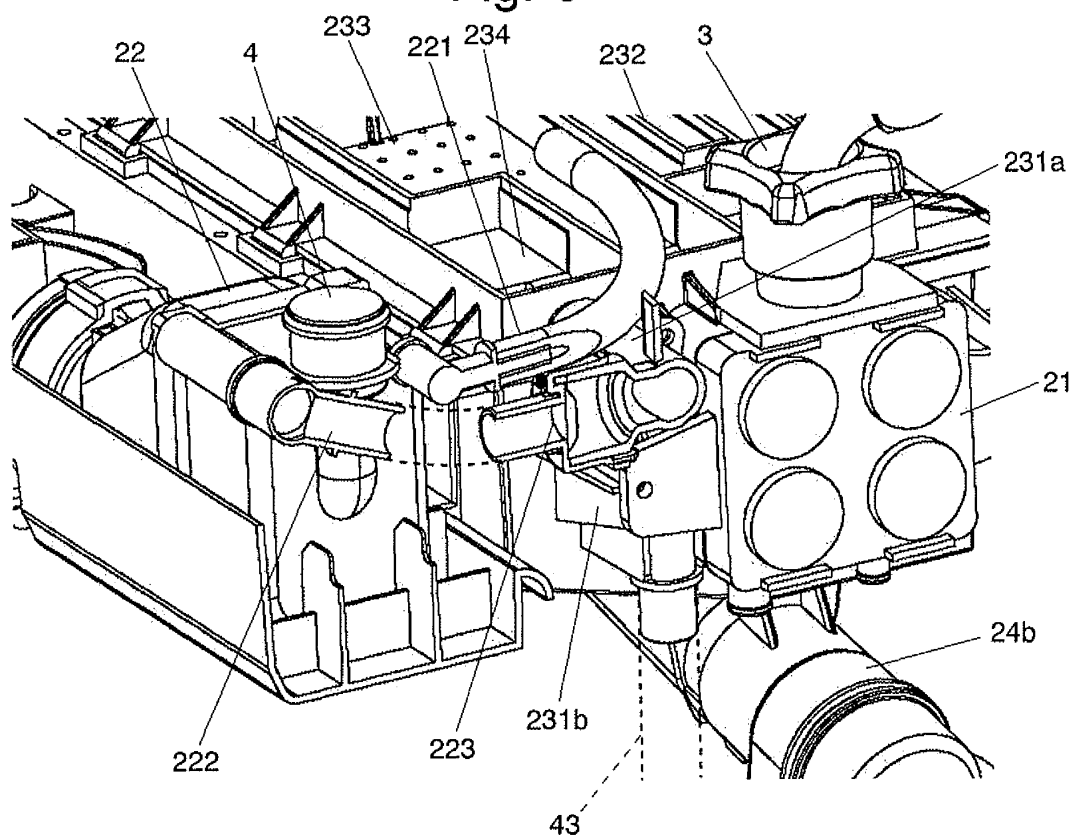


Fig. 10

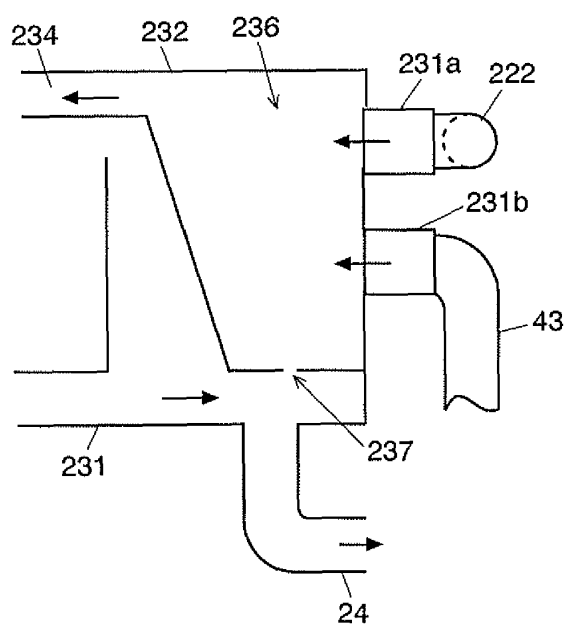


Fig. 11

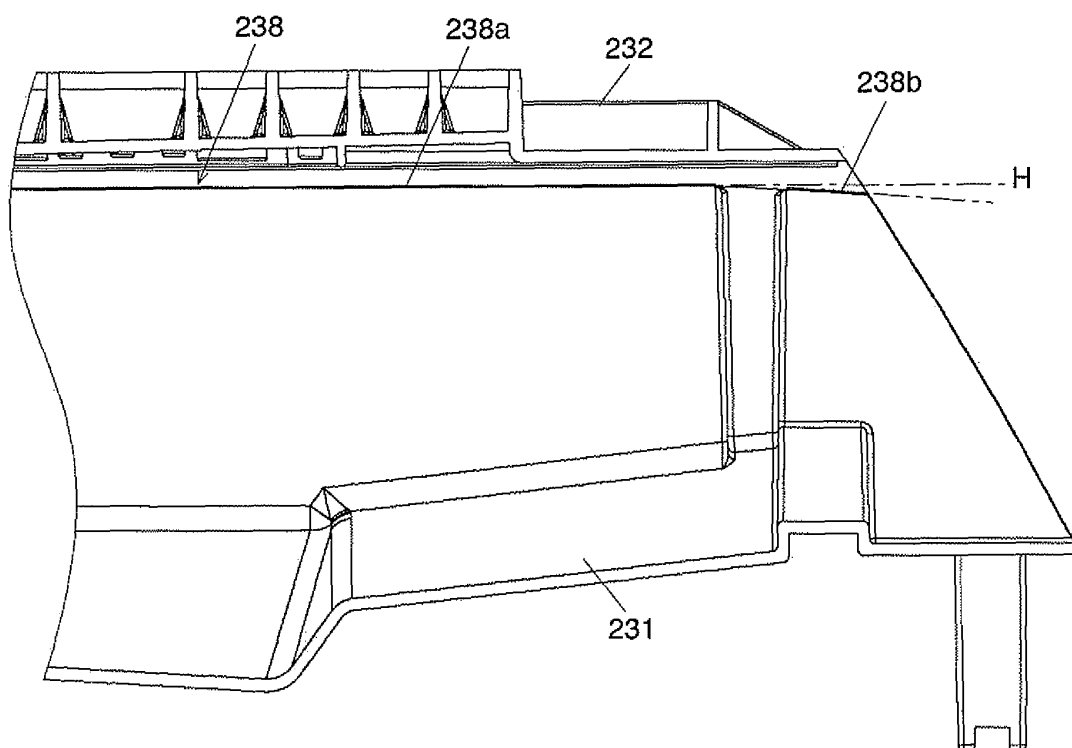
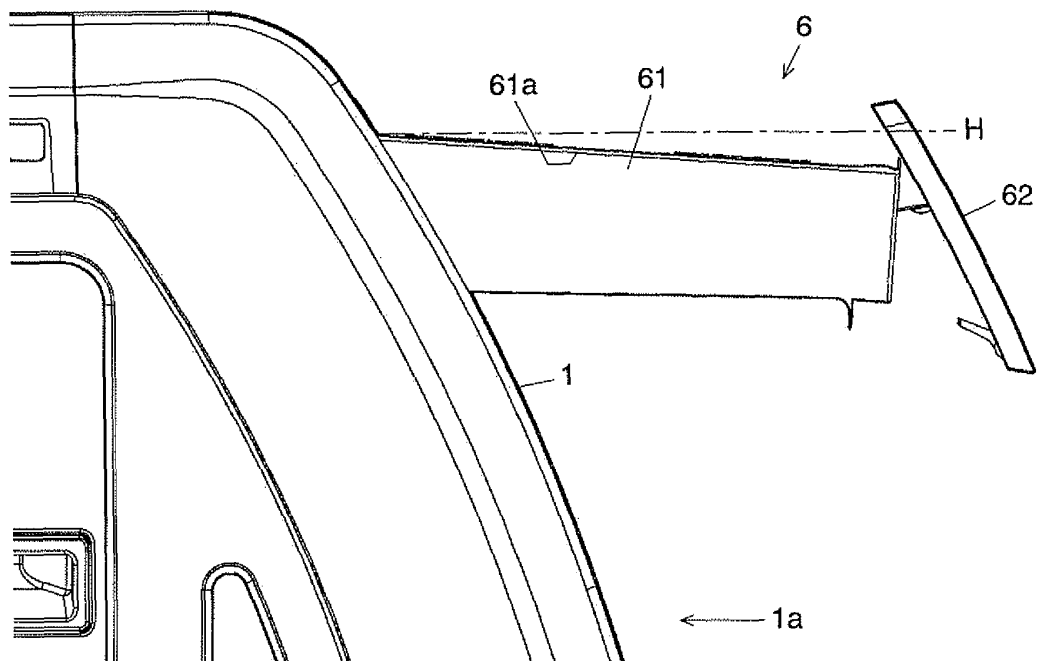


Fig. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/323565

A. CLASSIFICATION OF SUBJECT MATTER

D06F39/08 (2006.01) i, D06F25/00 (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)

D06F39/08, D06F25/00

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 1996-2007

Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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.
Y	JP 10-272277 A (Matsushita Electric Industrial Co., Ltd.), 13 October, 1998 (13.10.98), Full text; all drawings (Family: none)	1-5
Y	JP 2-136167 A (Toshiba Corp.), 24 May, 1990 (24.05.90), Full text; all drawings (Family: none)	1-5
Y	JP 11-114286 A (Matsushita Electric Industrial Co., Ltd.), 27 April, 1999 (27.04.99), Full text; all drawings (Family: none)	1-5

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

13 February, 2007 (13.02.07)

Date of mailing of the international search report

20 February, 2007 (20.02.07)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/323565

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 62257/1986 (Laid-open No. 172765/1987) (Matsushita Electric Industrial Co., Ltd.), 02 November, 1987 (02.11.87), Fig. 1 (Family: none)	3-5
Y	JP 10-231549 A (Director General, Agency of Industrial Science and Technology), 02 September, 1998 (02.09.98), Full text; all drawings (Family: none)	4, 5
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 178525/1983 (Laid-open No. 84416/1985) (Matsushita Electric Industrial Co., Ltd.), 11 June, 1985 (11.06.85), Figs. 1, 3 (Family: none)	4, 5

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/323565

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The matter common to the inventions of independent claims 1 and 6 is a drum-type washing machine in which detergent or the like received in a detergent container is supplied into an outer tub together with water supplied into the outer tub. However, a drum-type washing machine in which detergent or the like received in a detergent container is supplied into an outer tub together with water supplied into the outer tub is a well-known matter (see JP 2-136167 A, for example). As a result, the common matter does not avoid the prior art and there is no technical relationship between the independent claims 1 and 6 which relationship includes one or more of the same or corresponding "special technical features." (continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1 - 5

Remark on Protest
the

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee..
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/323565

Continuation of Box No.III of continuation of first sheet (2)

Accordingly, there is no technical relationship within the meaning of PCT Rule 13.2 between the group of claims 1-5 and that of claims 6-10.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H11104397 B [0009]
- JP H11114286 B [0009]
- JP 2650339 B [0009]