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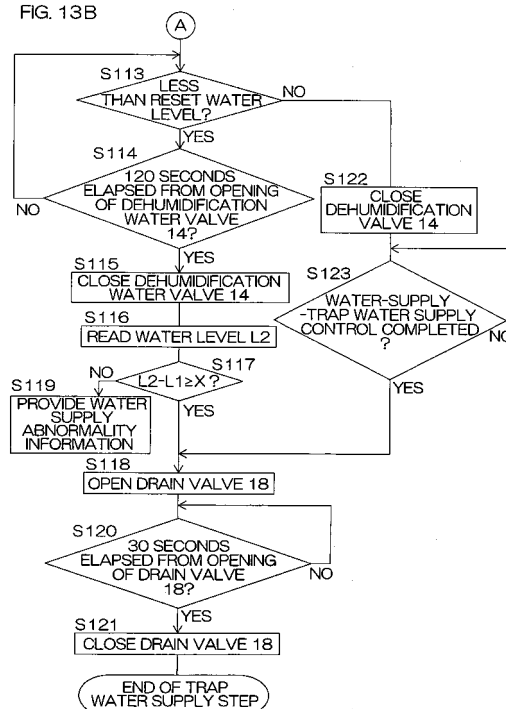
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(54) **WASHING MACHINE**

(57) The present invention provides a washing machine configured such that a gas having a cleaning function is prevented from leaking to the outside. The washing machine performs an ozone cleaning step for cleaning dry laundry by supplying ozone to the laundry prior to a washing step. Before the start of the ozone cleaning step, a dehumidification water valve (14) is opened to once retain dehumidification water in a bottom of an outer tub (7). Then, water is retained in an overflow trap (45) by utilizing the dehumidification water, whereby a flow passage extending from the outer tub (7) to the outside is sealed with the water. Further, a detergent valve (55) or a finishing agent valve (56) is opened to retain water in a water supply trap (24), whereby a flow passage extending from the outer tub (7) to the outside is sealed with the water.

FIG. 13B



Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine and, more specifically, to a washing machine having a gas generating function.

BACKGROUND ART

[0002] Washing machines capable of cleaning laundry contained in a washing tub by supplying ozone to the laundry are conventionally known. One example of such washing machines hitherto proposed includes a washing tub, and an ozone generator which supplies ozone to the washing tub (see, for example, Patent Document 1). Patent Document 1: Japanese Unexamined Patent Publication No. 2002-320792

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0003] In the washing machine disclosed in Patent Document 1, the ozone is supplied as a sterilizing component into the washing tub for the cleaning of the laundry in a water draining step after a washing step.

The ozone has a characteristic odor, and it is unfavorable that the ozone is inhaled into a human body. Therefore, it is desirable to prevent the ozone from leaking to the outside of the washing machine. If the ozone is supplied into the washing tub in the water draining step with a drain valve being open in the washing machine disclosed in Patent Document 1, the supplied ozone is liable to leak to the outside through a drain pipe.

[0004] Further, a common washing machine generally includes an overflow tube for draining excess water above a predetermined water level from the washing tub to the outside, and a detergent containing portion provided in the midst of a water supply tube through which water is supplied into the washing tub. Where the ozone generator is provided in the washing machine, it is necessary to prevent the ozone from leaking to the outside through these tubes.

In view of the foregoing, it is a principal object of the present invention to provide a washing machine which, when a gas having a cleaning function and containing a disinfecting component or a sterilizing component such as ozone is supplied to laundry, prevents the gas from leaking to the outside.

MEANS FOR SOLVING THE PROBLEMS

[0005] According to an inventive aspect as set forth in claim 1, there is provided a washing machine, which includes: a treatment tub in which laundry and water are contained, and washing, dehydrating and other operations are performed; water supply means which supplies

water to the treatment tub; a drain passage through which the water contained in the treatment tub is drained to the outside; an overflow passage through which excess water is drained if the amount of the water contained in the treatment tub is not less than a predetermined amount, the overflow passage being connected to the drain passage; a drain trap provided as a part of at least one of the drain passage and the overflow passage for retaining water; gas supply means which generates a laundry cleaning gas and supplies the gas into the treatment tub; and water supply control means which controls the water supply means to retain water in the drain trap before the gas is supplied into the treatment tub.

[0006] According to an inventive aspect as set forth in claim 2, the washing machine of claim 1 further includes a drain valve provided in the drain passage upstream of a junction of the overflow passage and the drain passage for opening and closing the drain passage, and the water supply control means closes the drain valve and controls the water supply means to retain a predetermined amount of water in the treatment tub, and then opens the drain valve to retain water in the drain trap.

[0007] According to an inventive aspect as set forth in claim 3, the washing machine of claim 2 further includes a water level sensor which detects a water level in the treatment tub, and the water supply control means opens the drain valve to retain water in the drain trap if the water level sensor detects that the water level reaches a predetermined water level.

According to an inventive aspect as set forth in claim 4, the water supply control means performs a water supply error process if the water level sensor does not detect that the water level reaches the predetermined water level in the washing machine of claim 3.

[0008] According to an inventive aspect as set forth in claim 5, the washing machine of claim 3 or 4 is configured such that, if a difference between a first water level detected by the water level sensor after a lapse of a first predetermined water supply period from start of water supply to the treatment tub and a second water level detected after a lapse of a second predetermined water supply period is not less than a predetermined threshold, the water supply control means opens the drain valve to retain water in the drain trap.

[0009] According to an inventive aspect as set forth in claim 6, in the washing machine of any of claims 1 to 5, the water supply means includes a water supply passage through which water is introduced into the treatment tub, a detergent containing portion provided in the water supply passage for containing a detergent and a finishing agent to be dissolved in the supplied water, and a water supply trap provided in the water supply passage downstream of the detergent containing portion for retaining the supplied water, and the water supply control means retains water in the water supply trap before the gas is supplied into the treatment tub.

[0010] According to an inventive aspect as set forth in claim 7, in the washing machine of claim 6, the water

supply passage includes a bypass water supply passage which bypasses the detergent containing portion to supply water into the treatment tub, and the water supply control means supplies water through the bypass water supply passage to retain the water in the water supply trap.

According to an inventive aspect as set forth in claim 8, there is provided a washing machine, which includes: a treatment tub in which laundry and water are contained, and washing, dehydrating and other operations are performed; a drain passage through which the water contained in the treatment tub is drained to the outside; an overflow passage through which excess water is drained if the amount of the water contained in the treatment tub is not less than a predetermined amount, the overflow passage being connected to the drain passage; a drain trap provided as a part of at least one of the drain passage and the overflow passage for retaining water; gas supply means which generates a laundry cleaning gas and supplies the gas into the treatment tub; an air circulation duct having opposite ends, one of which is connected to a lower portion of the treatment tub and the other of which is connected to a portion of the treatment tub other than the lower portion, and configured to circulate air flowing out of the treatment tub from the one end thereof to introduce the air into the treatment tub from the other end thereof; dehumidification water supply means connected to the air circulation duct, and configured to supply dehumidification water into the air circulation duct for dehumidifying the air flowing through the air circulation duct; and water supply control means which controls the dehumidification water supply means to supply water into the drain trap from the air circulation duct through the lower portion of the treatment tub to retain water in the drain trap before the gas is supplied into the treatment tub.

[0011] According to an inventive aspect as set forth in claim 9, the washing machine of claim 8 further includes a drain valve provided in the drain passage upstream of a junction of the overflow passage and the drain passage for opening and closing the drain passage, and the water supply control means closes the drain valve and controls the dehumidification water supply means to retain a predetermined amount of water in the treatment tub, and then opens the drain valve to retain water in the drain trap.

EFFECTS OF THE INVENTION

[0012] According to the inventive aspect of claim 1, the water is retained in the drain trap provided as a part of at least one of the drain passage and the overflow passage before the laundry cleaning gas is supplied into the treatment tub, whereby a part of a passage extending from the treatment tub to the outside through the overflow passage and the drain passage is sealed with the water retained in the drain trap. As a result, even if the laundry cleaning gas is thereafter supplied into the treatment tub, the gas is prevented from leaking to the outside of the

washing machine through the passage extending from the treatment tub to the outside through the overflow passage and the drain passage. Even if a gas such as ozone having a characteristic odor is supplied, the odor is prevented from wafting to the outside.

[0013] According to the inventive aspect of claim 2, the drain valve provided in the drain passage upstream of the junction of the overflow passage and the drain passage is closed to once retain the predetermined amount of water in the treatment tub, and then the drain valve is opened to drain the water from the treatment tub to retain the water in the drain trap. Therefore, even if the drain trap is provided in the drain passage upstream of the junction of the overflow passage and the drain passage, for example, the predetermined amount of the water is caused to flow into the drain passage at a time and further flow toward the overflow passage, i.e., toward the drain trap, from the junction. As a result, the water is reliably retained in the drain trap. This arrangement ensures an efficient water draining operation without the need for provision of a drain trap having a complicated shape on the drain passage side.

[0014] According to the inventive aspect of claim 3, if the water level sensor detects that the water level in the treatment tub reaches the predetermined water level, the drain valve is opened to retain the water in the drain trap. Therefore, a water level corresponding to the amount of the water to be retained in the drain trap is preliminarily set in the water level sensor, whereby the water is reliably retained in the drain trap.

According to the inventive aspect of claim 4, if the water level sensor does not detect that the water level in the treatment tub reaches the predetermined water level, i.e., if the amount of water contained in the treatment tub is insufficient for retaining the water in the drain trap, the drain valve is not opened, but the water supply error process is performed. Even if it is impossible to retain the water in the treatment tub and hence in the drain trap, for example, due to malfunction of the water supply means or the dehumidification water supply means, the cleaning gas is prevented from being erroneously supplied into the treatment tub and leaking to the outside.

[0015] According to the inventive aspect of claim 5, if the difference between the first water level (L1) detected after a lapse of the first water supply period from the start of the water supply to the treatment tub and the second water level (L2) detected after a lapse of the second water supply period is not less than the predetermined threshold (X), i.e., $L2 - L1 \geq X$, the drain valve is opened to retain the water in the drain trap. Only a small amount of water is required for retaining the water in the drain trap and, therefore, a high precision water level sensor is required for precisely measuring the small amount of water. That is, a water level sensor capable of precisely measuring a very low water level is required. However, the amount of the water to be used for retaining the water in the drain trap is not particularly limited, as long as it is not less than the aforementioned small amount (because an excess

amount of water above the capacity of the drain trap is drained to the outside through the drain passage). Therefore, it is merely necessary to judge whether the amount of the water contained in the treatment tub is above the predetermined amount. With the aforementioned arrangement, it is judged whether the difference between the two water levels is above the predetermined threshold (which is, for example, approximately equivalent to the water amount required for retaining the water in the drain trap). Even if the water level is below a reset water level (which is the lowermost water level precisely detectable by the water level sensor), it is possible to judge whether a small amount of water is retained in the treatment tub without the use of the high precision water level sensor. Thus, the water can be reliably retained in the drain trap. Without the need for the high precision water level sensor, this arrangement does not lead to a cost increase.

[0016] According to the inventive aspect of claim 6, the water supply trap is provided in the water supply passage downstream of the detergent containing portion, and the water is retained in the water supply trap before the laundry cleaning gas is supplied into the treatment tub, whereby a part of a passage extending from the treatment tub to the outside through the water supply passage and the detergent containing portion is sealed with the water retained in the water supply trap. As a result, even if the laundry cleaning gas is thereafter supplied into the treatment tub, the gas is prevented from leaking to the outside of the washing machine through the passage extending from the treatment tub to the outside through the water supply passage and the detergent containing portion. Even if a gas such as ozone having a characteristic odor is supplied, the odor is prevented from wafting to the outside.

[0017] According to the inventive aspect of claim 7, the water is supplied into the water supply trap through the bypass water supply passage which bypasses the detergent containing portion for the water supply to the treatment tub, and retained in the water supply trap. Therefore, even if a user puts the detergent or the finishing agent in the detergent containing portion for an ordinary washing process after the cleaning process with the cleaning gas, the water is supplied into the water supply trap with the detergent containing portion being bypassed. Therefore, washing water which contains the detergent or the finishing agent is prevented from being supplied into the water supply trap. Thus, the detergent component and the finishing agent component are prevented from being retained in the water supply trap.

[0018] According to the inventive aspect of claim 8, the dehumidification water is supplied into the air circulation duct from the dehumidification water supply means, and further supplied into the drain trap from the air circulation duct through the lower portion of the treatment tub and retained in the drain trap. This makes it possible to retain the water in the drain trap without supplying water from an upper portion of the treatment tub. As a result, even

if the laundry cleaning process is performed to clean the laundry with the cleaning gas without the use of water prior to the washing process, it is possible to retain the water in the drain trap while preventing the laundry preliminarily contained in the treatment tub from being wetted with water.

[0019] According to the inventive aspect of claim 9, as according to the inventive aspect of claim 2, the drain valve provided in the drain passage upstream of the junction of the overflow passage and the drain passage is closed to once retain the predetermined amount of water in the treatment tub, and then opened to drain the water from the treatment tub to be retained in the drain trap. Therefore, even if the drain trap is disposed in the overflow passage upstream of the junction of the overflow passage and the drain passage, the predetermined amount of water is caused to flow out into the drain passage at a time and further flow from the junction toward the overflow passage, i.e., toward the drain trap, through the junction. As a result, the water is reliably retained in the drain trap. This arrangement ensures the efficient water draining operation without the need for the provision of a drain trap having a complicated shape on the drain passage side.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

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

Fig. 2 is a perspective view of major portions of the drum-type washing machine 1 as seen from the rear upper right side.

Fig. 3 is a plan view of the major portions of the drum-type washing machine 1 shown in Fig. 2.

Fig. 4 is a vertical sectional view of the drum-type washing machine 1 taken along a lateral vertical plane and viewed from the front side.

Fig. 5A is a vertical sectional view of the drum-type washing machine 1 taken along an anteroposterior vertical plane and viewed from the right side with its opening 4 covered with an outer lid 2A.

Fig. 5B illustrates the drum-type washing machine of Fig. 5A with its opening 4 uncovered with the outer lid 2A.

Fig. 6 is a sectional view of a detergent container 80 fitted in a detergent container accommodating chamber 81 as viewed from the right side.

Fig. 7 is a perspective view showing the appearance of a component of a water supply unit 82.

Fig. 8 is a sectional view taken along an A-A plane in Fig. 6.

Fig. 9 is a perspective view illustrating an outer tub 7, a drying unit 3 and peripheral components as seen from the rear upper right side.

Fig. 10 is a right side view illustrating the outer tub

7, the drying unit 3 and the peripheral components shown in Fig. 9.

Fig. 11 is a block diagram showing the electrical construction of the drum-type washing machine 1, illustrating components related to the present invention. Fig. 12 is a flow chart showing a control sequence to be performed by a control section 40 when the drum-type washing machine 1 starts a predetermined washing process.

Fig. 13A is a flow chart showing the first half of a water supply control operation to be performed in a trap water supply step.

Fig. 13B is a flow chart showing the second half of the water supply control operation to be performed in the trap water supply step.

Fig. 13C is a flow chart showing a control operation to be performed for supplying water into a water supply trap 24 in the trap water supply step.

DESCRIPTION OF REFERENCE CHARACTERS

[0021]

- 1: Drum-type washing machine
- 3: Drying unit
- 7: Outer tub
- 8: Detergent containing portion
- 10: Drum
- 14: Dehumidification water valve
- 17: Water supply hose
- 18: Drain valve
- 20: Drain hose
- 24: Water supply trap
- 31: Air duct member
- 33: Guide hood
- 36: Dehumidification water supply port
- 37: Overflow tube
- 40: Control section
- 42: Ozone generator
- 43: Introduction tube
- 45: Overflow trap
- 47: Water level sensor
- 55: Detergent valve
- 56: Finishing agent valve
- 80: Detergent container
- 81: Detergent container accommodating chamber
- 522: Finishing agent tap water supply passage
- 535A: Lower water spouts

BEST MODE FOR CARRYING OUT THE INVENTION

[0022] With reference to the drawings, embodiments of the present invention will hereinafter be described more specifically.

Construction of Drum-Type Washing Machine

[0023] Fig. 1 is a perspective view of a so-called top

open drum-type washing machine 1 which is an exemplary washing machine according to one embodiment of the present invention. Description of the geometry of the drum-type washing machine 1 is based on directional arrows shown on an upper right part of Fig. 1. Fig. 2 is a perspective view of major portions of the drum-type washing machine 1 as seen from the rear upper right side. Fig. 3 is a plan view of the major portions of the drum-type washing machine 1 shown in Fig. 2. Fig. 4 is a vertical sectional view of the drum-type washing machine 1 taken along a lateral vertical plane and viewed from the front side. Fig. 5A is a vertical sectional view of the drum-type washing machine 1 taken along an anteroposterior vertical plane and viewed from the right side with its opening 4 covered with an outer lid 2A. Fig. 5B illustrates the drum-type washing machine of Fig. 5A with its opening 4 uncovered with the outer lid 2A.

Housing

[0024] As shown in Fig. 1, the drum-type washing machine 1 includes a housing 2 which defines an outer casing thereof. A top wall of the housing 2 has an arc shape as seen in side section, and extends forwardly downward from an anteroposteriorly generally middle position continuously to a front wall in a gradually curved manner. The housing 2 has an opening 4 provided in an anteroposteriorly and laterally middle portion of the top wall thereof for loading and unloading laundry into/from the housing 2. The opening 4 has a generally rectangular shape elongated anteroposteriorly, and is covered and uncovered with an outer lid 2A. A pair of guide rails 21L, 21R are provided on a portion of the top wall of the housing 2 formed with the opening 4 as extending along a left edge and a right edge of the opening 4, and the outer lid 2A is anteroposteriorly slidable along the guide rails 21L, 21R.

[0025] The outer lid 2A is biased rearward in an opening uncovering direction by springs 38 (see Fig. 5A). During the operation of the drum-type washing machine 1, an outer lid lock mechanism 49 (see Fig. 5A) provided in the housing 2 (e.g., on a front edge of the opening 4) engages the outer lid 2A to lock the outer lid 2A in a closed state. A detergent containing portion 8 which contains a detergent and a finishing agent to be used for washing the laundry is provided in an anteroposteriorly generally middle portion of the top wall of the housing 2 on the left side of the opening 4. The specific structure of the detergent containing portion 8 will be described later in detail with reference to Figs. 6 to 8. An operation/display section 6 for various settings and indications (e.g., an error indication) for the operation of the drum-type washing machine 1 is provided in a front half portion of the top wall of the housing 2 on the right side of the opening 4.

[0026] A lid opening button 6A to be operated to disengage the outer lid 2A from the aforementioned outer lid lock mechanism 49 (see Fig. 5A) for opening the outer

lid 2A is provided on the operation/display section 6. When the lid opening button 6A is pressed with the outer lid 2A being closed, the outer lid 2A is disengaged from the outer lid lock mechanism 49 (see Fig. 5A). Then, the outer lid 2A is slid rearward of the opening 4 by a biasing force of the springs 38 (see Fig. 5A), thereby uncovering the opening 4. A handle 2C is provided on a front edge of the outer lid 2A. When the opening 4 is uncovered, the opening 4 can be covered with the outer lid 2A by holding the handle 2C and sliding the outer lid 2A forward over the opening 4. With the opening 4 being uncovered, the handle 2C abuts against a rear edge of the opening 4 to prevent the outer lid 2A from sliding further rearward.

[0027] A housing portion 15 of a laterally elongated and generally rectangular box shape having an open top as shown in Fig. 2 is provided unitarily with the housing 2 inwardly of (or below) a rear portion of the top wall of the housing 2 on the rear side of the opening 4. The inside of the housing portion 15 is partitioned into a first chamber 27, a second chamber 28 and a third chamber 29 (as designated from the left side) by a partition wall 16L and a partition wall 16R which respectively have upper edges continuous to the guide rails 21L and the guide rail 21R. Since the partition walls 16L and 16R are continuous to the guide rails 21L and 21R, respectively, as described above, the sliding of the outer lid 2A (see Fig. 1) is guided by the guide rails 21L, 21R as well as the upper edges of the partition walls 16L, 16R. As shown in Figs. 5A and 5B, the outer lid 2A constantly covers an upper portion of the second chamber 28 whether the opening 4 is covered or uncovered. With the outer lid 2A being open as shown in Fig. 5B, the outer lid 2A except for a second chamber covering portion which covers the upper portion of the second chamber 28 is accommodated along a rear wall of the housing 2 below the housing portion 15.

[0028] As shown in Fig. 2, a tap water supply valve 2B is disposed in the first chamber 27, and a bath water pump 2D is disposed in the third chamber 29. The tap water supply valve 2B and the bath water pump 2D each have a water supply port exposed at corresponding positions from the top wall of the housing 2 as shown in Fig. 1. Therefore, tap water can be supplied into the washing machine by connecting the tap water supply valve 2B to external water supply equipment (e.g., a tap water faucet) via a water supply hose not shown. Similarly, bath water can be supplied into the washing machine by connecting a water supply hose (not shown) to the bath water pump 2D with one end of the water supply hose being submerged in a bath tub.

[0029] Further, the tap water supply valve 2B is a triple valve which unitarily includes a detergent valve 55 (see Fig. 11), a finishing agent valve 56 (see Fig. 11) and a dehumidification water valve 14 (see Fig. 11) to be described later.

The detergent valve 55 (see Fig. 11) and the finishing agent valve 56 (see Fig. 11) are respectively connected to a detergent tap water inlet port 511 (see Fig. 6) and a finishing agent tap water inlet port 512 (see Fig. 6) of the

detergent containing portion 8 to be described later, for example, via rubber packings or the like. Therefore, the tap water can be supplied into the detergent containing portion 8 by opening these valves.

[0030] A supply pipe (not shown) connected to a dehumidification water supply port 36 (see Fig. 10) at one end thereof is connected to the dehumidification water valve 14 at the other end thereof. Therefore, the tap water can be supplied into an air duct member 31 (to be described later) by opening the dehumidification water valve 14.

On the other hand, a bath water supply hose (not shown) connected to a bath water inlet port 513 (to be described later and see Fig. 6) of the detergent containing portion 8 at one end thereof is connected to the bath water pump 2D at the other end thereof. Therefore, the bath water can be supplied into the detergent containing portion 8 by driving the bath water pump 2D.

[0031] As shown in Fig. 3, the second chamber 28, the first chamber 27 and the third chamber 29 are isolated from each other by the partition wall 16L and the partition wall 16R, and the upper portion of the second chamber 28 is constantly covered with the outer lid 2A (see Fig. 1). Therefore, even if the water happens to leak from either of the tap water supply valve 2B and the bath water pump 2D, there is no possibility that leaking water flows into the second chamber 28.

Outer Tub and Drum

[0032] As shown in Fig. 4, an outer tub 7 is accommodated below the housing portion 15 (see Fig. 2) in the housing 2. The outer tub 7 includes a generally cylindrical peripheral wall 7A having opposite end faces closed by end face walls (a left end face wall 7L and a right end face wall 7R), thereby having a liquid-tight and air-tight structure. The outer tub 7 is disposed with its axis extending laterally (generally horizontally). A lower portion of the peripheral wall 7A of the outer tub 7 is supported by a plurality of dampers 5 (see Fig. 5A).

[0033] A drum 10 in which the laundry is contained is disposed in the outer tub 7. The drum 10 includes a generally cylindrical peripheral wall 10C having opposite end faces closed by end face walls (a left end face wall 10L and a right end face wall 10R), and is disposed with its axis extending laterally (generally horizontally). In the present invention, the outer tub 7 and the drum 10 cooperatively function as a washing tub.

[0034] Rotation shafts 11L and 11R extending along the axis of the drum 10 are attached to the left and right end face walls 10L and 10R, respectively, of the drum 10. The rotation shafts 11L and 11R are rotatably attached to the left and right end face walls 7L and 7R, respectively, of the outer tub 7. A drum-driving motor 12 of a so-called DD (direct drive) type is connected to the left rotation shaft 11L. By rotatively driving the motor 12, the drum 10 connected to the rotation shaft 11L is rotated about its axis at the same rotation speed as that of the

motor. Three baffles 10B which lift the laundry within the drum 10 during the rotation of the drum 10 are provided on an interior surface of the peripheral wall 10C of the drum 10 in equiangularly spaced relation (e.g., in 120-degree spaced relation) along the inner periphery of the peripheral wall 10C as projecting inward and extending laterally.

[0035] As shown in Fig. 5A, the peripheral wall 10C of the drum 10 has an opening 22 through which the laundry is loaded into or unloaded from the drum 10. The peripheral wall 7A of the outer tub 7 has an opening 23 provided in opposed relation to the opening 4 of the housing 2. The opening 22 of the drum 10 is covered and uncovered with a drum lid 25 which is pivotal outward, and the opening 23 of the outer tub 7 is covered and uncovered with an intermediate lid 26 which is pivotal outward. With the outer lid 2A, the intermediate lid 26 and the drum lid 25 being open, the laundry can be loaded into and unloaded from the drum 10 through the opening 4 of the housing 2, the opening 23 of the outer tub 7 and the opening 22 of the drum 10.

[0036] For loading or unloading the laundry into/from the drum 10, the drum lid 25 is permitted to be opened only when the opening 22 of the drum 10 is located in opposed relation to the opening 23 of the outer tub 7. Therefore, as shown in Fig. 4, a drum position fixing device 9 is attached to a lower portion of the left end face wall 7L of the outer tub 7. The drum position fixing device 9 is adapted to engage the motor 12 during the stop of the drum-type washing machine 1 so that the rotational position of the drum 10 is fixed at a position at which the opening 22 of the drum 10 (see Fig. 5A) is opposed to the opening 23 (see Fig. 5A) of the outer tub 7.

[0037] As shown in Fig. 5A, a water supply hose 17 (water supply passage) communicating with the inside of the detergent containing portion 8 is connected to a rear portion of the peripheral wall 7A of the outer tub 7. By opening the detergent valve 55 (see Fig. 11) or the finishing agent valve 56 (see Fig. 11) or by driving the bath water pump 2D (see Fig. 1), the tap water or the bath water (hereinafter referred to generally as "water") is supplied from the tap water supply valve 2B or the bath water pump 2D (see Fig. 1) into the outer tub 7 through the detergent containing portion 8 (see Fig. 1) and the water supply hose 17. The water supply hose 17 is, for example, a flexible bellows hose, and functions to supply the water into the outer tub 7 as well as to prevent vibrations occurring in the outer tub 7 during the rotation of the drum 10 from being conducted to the housing 2. As shown in Fig. 2, the water supply hose 17 is connected to an outer tub water supply port 88 provided in the peripheral wall 7A of the outer tub 7. In the present invention, a flow passage extending from the detergent valve 55 and the finishing agent valve 56 to the outer tub water supply port 88 through the water supply hose 17 functions as water supply means.

[0038] A water supply trap 24 is provided between the water supply hose 17 and the detergent containing por-

tion 8 (downstream of the detergent containing portion 8). The water supply trap 24 temporarily retains the water flowing from the detergent containing portion 8 to the water supply hose 17 to isolate the detergent containing portion 8 and the water supply hose 17 from each other by sealing with the retained water, thereby preventing air communication between the outer tub 7 and the outside. A method for the water supply to the water supply trap 24 will be described later in detail with reference to Fig. 13C.

[0039] As shown in Fig. 4, a drain port 19 is provided in a lower right portion of the peripheral wall 7A of the outer tub 7. A drain valve 18 is provided upstream of a junction of a drain hose 20 (drain passage) and an overflow tube 37 (overflow passage) to be described later, and connected to the drain port 19. By supplying water into the outer tub 7 with the drain valve 18 being closed, the water is retained in the outer tub 7. The drum 10 has a multiplicity of water communication perforations 10A formed in substantially the entire peripheral wall 10C thereof except for the opening 22 thereof. The water supplied into the outer tub 7 also flows into the drum 10 through the water communication perforations 10A. By opening the drain valve 18, the water retained in the outer tub 7 is drained outside the washing machine through the drain port 19 and the drain hose 20. One end of the overflow tube 37 (see Fig. 2) is connected to an intermediate portion of the drain hose 20. As shown in Fig. 2, the other end of the overflow tube 37 is connected to the right end face wall 7R of the outer tub 7 at a predetermined height level. When the water is retained to the predetermined height level or higher in the outer tub 7, excess water is forcibly drained outside the washing machine through the overflow tube 37 and the drain hose 20 (see Fig. 4). An overflow trap 45 (drain trap) is provided between the overflow tube 37 and the drain hose 20 (see Fig. 4). The overflow trap 45 has a V-shaped portion 95 projecting downward, and temporarily retains water flowing through the overflow tube 37 and/or the drain hose 20 (see Fig. 4) in the V-shaped portion 95, thereby preventing air communication between the outer tub 7 and the outside through the overflow tube 37 and/or the drain hose 20 by the retained water. A method for the water supply to the overflow trap 45 will be described later in detail with reference to Figs. 13A and 13B.

Detergent Containing Portion

[0040] Fig. 6 is a sectional view of the detergent container 80 fitted in a detergent container accommodating chamber 81 as viewed from the right side, and Fig. 7 is a perspective view showing the appearance of a component of a water supply unit 82. Fig. 8 is a sectional view taken along an A-A plane in Fig. 6.

In Fig. 8, a cylindrical portion 431 and a cap 432 to be described later are also shown in section for convenience of description.

[0041] As shown in Fig. 6, the detergent containing

portion 8 includes a detergent container 80 which contains a powdery detergent, a liquid detergent, a liquid brightener and a finishing agent, a detergent container accommodating chamber 81 formed integrally with the housing 2 for accommodating the detergent container 80 in a removable manner, a water supply unit 82 provided in the housing 2 for supplying water into the detergent container 80, and a detergent lid 94 which covers an upper portion of the detergent container accommodating chamber 81 in which the detergent container 80 is accommodated. In the present invention, the detergent container 80 functions as a detergent containing portion.

[0042] The detergent container accommodating chamber 81 is anteroposteriorly elongated, and has a bottom recessed as inclined rearwardly downward. The detergent container accommodating chamber 81 has an outlet port 81A provided at a lower edge of a rear wall thereof and connected to the inside of the washing machine.

The water supply unit 82 is disposed on a left wall of the detergent container accommodating chamber 81, and includes anteroposteriorly elongated thin planar primary member 82A and secondary member 82B which are combined with each other in a laterally opposed relation. Hollow water flow passages are defined between the two members 82A and 82B (see Fig. 8).

[0043] More specifically, as shown in Fig. 7, complicated ribs which define the water flow passages are provided in the primary member 82A located on the right side. With the primary member 82A and the secondary member 82B combined with each other, a detergent tap water flow passage 521 which communicates with a detergent tap water inlet port 511 opening in a rear end portion of the primary member 82A, a bath water flow passage 523 which communicates with a bath water inlet port 513 opening at a position obliquely rearwardly upward of the detergent tap water inlet port 511, and a finishing agent water flow passage 522 which communicates with a finishing agent tap water inlet port 512 opening in front of the detergent tap water inlet port 511 are defined in the water supply unit 82. A first water spout 534 and second water spouts 531 are provided in this order in a water flowing direction in the detergent tap water flow passage 521. An auxiliary water spout 536 is provided at a distal end of the detergent tap water flow passage 521 with respect to the water flowing direction. A third water spout 533 and fourth water spouts 532 are provided in this order in the water flowing direction in the bath water flow passage 523. Fifth water spouts 535 are provided in the finishing agent flow passage 522. The fifth water spouts 535 include two lower water spouts 535A provided along a lower edge of the finishing agent water flow passage 522, and an upper water spout 535B provided above the lower water spouts 535A.

[0044] As described above, the detergent valve 55 (see Fig. 11) and the finishing agent valve 56 (see Fig. 11) are connected to the detergent tap water inlet port 511 and the finishing agent tap water inlet port 512, re-

spectively. Therefore, the tap water from the tap water supply valve 2B can be selectively supplied to the detergent tap water inlet port 511 and the finishing agent tap water inlet port 512 by properly opening and closing these valves. The one end of the bath water supply hose (not shown) is connected to the bath water inlet port 513. The other end of the bath water supply hose (not shown) is connected to the bath water pump 2D. The bath water can be supplied to the bath water inlet port 513 by driving the bath water pump 2D.

[0045] As shown in Figs. 6 and 8, the detergent container 80 is of a box shape anteroposteriorly elongated and having an open top. The detergent container 80 is partitioned into a powdery detergent container portion 85 which contains a powdery detergent, a liquid detergent container portion 86 which contains a liquid detergent and a liquid brightener (a liquid agent to be charged together with the detergent for the washing operation), and a softener (a liquid agent to be charged for a final rinsing operation).

[0046] The powdery detergent container portion 85 has openings formed in a left wall thereof in opposed relation to the second water spouts 531 and the fourth water spouts 532 with the detergent container 80 fitted in the detergent container accommodating chamber 81 (though not shown, these openings are each provided like an opening 50 opposed to the upper water spout 535B as shown in Fig. 8). The inside of the powdery detergent container portion 85 communicates with the detergent tap water flow passage 521 and the bath water flow passage 523. Therefore, the tap water from the detergent tap water flow passage 521 or the bath water from the bath water flow passage 523 can be supplied into the powdery detergent container portion 85. On the other hand, no opening is provided in opposed relation to the auxiliary water spout 536 in the left wall of the powdery detergent container portion 85. Therefore, water flowing out through the auxiliary water spout 536 bypasses the powdery detergent container portion 85, but is directly supplied into the detergent container accommodating chamber 81.

[0047] The powdery detergent container portion 85 has a bottom wall gradually inclined rearwardly downward, and a detergent outlet port 412 provided at a lower portion of a rear wall thereof. When the powdery detergent is contained in the powdery detergent container portion 85 and the tap water or the bath water flows into the powdery detergent container portion 85, the water flows out together with the powdery detergent into the detergent container accommodating chamber 81 through the detergent outlet port 412. In this case, the detergent thus flowing out is powdery, so that the powdery detergent flowing down into the detergent container accommodating chamber 81 is liable to remain undissolved on the bottom wall of the detergent container accommodating chamber 81. Particularly, where the powdery detergent flows forward of the deter-

gent outlet port 412 in the detergent container accommodating chamber 81, it is difficult for the water flowing out of the detergent outlet port 412 to push the detergent toward the outlet port 81A. Even in this case, the powdery detergent remaining on the bottom wall of the detergent container accommodating chamber 81 is caused to smoothly flow out of the outlet port 81A by supplying the water from the auxiliary water spout 536 to a front end of the detergent container accommodating chamber 81 with the provision of the auxiliary water spout 536 in the water supply unit 82 as described above.

[0048] The liquid detergent container portion 86 has openings formed in a left wall thereof in opposed relation to the first water spout 534 and the third water spout 533 with the detergent container 80 fitted in the detergent container accommodating chamber 81 (though not shown, these openings are each provided like the opening 50 opposed to the upper water spout 535B as shown in Fig. 8). The inside of the liquid detergent container portion 86 communicates with the detergent tap water flow passage 521 and the bath water flow passage 523. Therefore, the tap water from the detergent tap water flow passage 521 or the bath water from the bath water flow passage 523 can be supplied into the liquid detergent container portion 86.

[0049] As shown in Fig. 8, the opening 50 is provided in a left wall of the finishing agent container portion 87 in opposed relation to the upper water spout 535B with the detergent container 80 fitted in the detergent container accommodating chamber 81. The inside of the finishing agent container portion 87 communicates with the finishing agent water flow passage 522. Therefore, when the tap water is supplied in an amount sufficient to fill the finishing agent water flow passage 522, the tap water flows out of the upper water spout 535B to be supplied into the finishing agent container portion 87 through the opening 50. If a smaller amount of tap water is supplied, more specifically, if the water level of the supplied tap water is lower than the height of the upper water spout 535B, the tap water flows out only from the lower water spouts 535A because the opening 50 is located above the lower water spouts 535A. Therefore, the tap water bypasses the finishing agent container portion 87, but is directly supplied into the detergent container accommodating chamber 81. In the present invention, a flow passage including the finishing agent water flow passage 522, the lower water spouts 535A and the detergent container accommodating chamber 81 functions as a bypass water supply passage.

[0050] As shown in Fig. 6, the liquid detergent container portion 86 and the finishing agent container portion 87 each include a cylindrical portion 421, 431 provided upright on a bottom wall thereof and having a vertically extending center through-hole, and a cylindrical cap 422, 432 covering an upper portion of the cylindrical portion 421, 431 except for a proximal portion. A small gap is defined between an inner peripheral surface of the cap 422, 432 and an outer peripheral surface of the cylindrical

portion 421, 431, and the inside and the outside of each of the liquid detergent container portion 86 and the finishing agent container portion 87 communicate with each other through the gap and the through-hole of the cylindrical portion 421, 431. Thus, when water is retained to a predetermined level or higher in the liquid detergent container portion 86, the water flows out together with the liquid detergent into the detergent container accommodating chamber 81 through the through-hole of the cylindrical portion 421 by the siphon effect.

Similarly, when water is retained to a predetermined level or higher in the finishing agent container portion 87, the water flows out together with the finishing agent into the detergent container accommodating chamber 81 through the through-hole of the cylindrical portion 431 by the siphon effect.

Drying Unit

[0051] Fig. 9 is a perspective view illustrating the outer tub 7, a drying unit 3 and peripheral components as seen from the rear upper right side, and Fig. 10 is a right side view illustrating the outer tub 7, the drying unit 3 and the peripheral components shown in Fig. 9.

[0052] As shown in Fig. 9, the drum-type washing machine 1 is capable of performing a drying process for drying the laundry, and a drying unit 3 having a drying function is attached to an outer surface of the right end face wall 7R of the outer tub 7.

The drying unit 3 includes an air duct member 31 which sucks air from the outer tub 7 and guides the air upward, a fan 32 which supplies the air from the air duct member 31 into the outer tub 7, a guide hood 33 which guides the air fed by the fan 32 into the outer tub 7, and a pair of heaters 34A, 34B (see Fig. 10) which heat the air to be fed into the outer tub 7. In the present invention, the air duct member 31 and the guide hood 33 cooperatively function as an air circulation duct for introducing the air or airstream flowing therethrough into the outer tub 7. The fan 32 is disposed in an upper portion of the air duct member 31 with its generally upper half portion accommodated in the second chamber 28 (see Fig. 3) of the housing portion 15, and is rotatively driven by a blower motor 35. The heaters 34A, 34B (see Fig. 10) are laterally juxtaposed in the guide hood 33.

[0053] Referring to Fig. 4, an air outlet port 71 having a generally rectangular shape as seen from the front side is provided in a lower rear portion, e.g., a laterally generally middle portion, of the peripheral wall 7A of the outer tub 7. The air duct member 31 has a drain hole 30 (see Fig. 10) provided in a lower end portion thereof. The air outlet port 71 and the drain hole 30 (see Fig. 10) are connected to each other through a laterally extending connection pipe 72, so that the inside of the air duct member 31 communicates with the inside of the outer tub 7. When the fan 32 (see Fig. 9) is rotatively driven, the air duct member 31 located upstream of the fan 32 with respect to an air flowing direction has a negative internal

pressure. Therefore, air in the outer tub 7 is taken into the drying unit 3 (air duct member 31) through the air outlet port 71 and the connection pipe 72.

[0054] The outer tub 7 has an opening 7B provided in a center portion of the right end face wall 7R thereof, and the guide hood 33 (see Fig. 10) has an air blowing port 41 (see Fig. 10) provided in an lower end portion thereof. Since the air blowing port 41 and the opening 7B (see Fig. 10) of the outer tub 7 communicate with each other, the inside of the guide hood 33 (see Fig. 10) communicates with the inside of the outer tub 7.

Thus, as shown in Fig. 9, the air taken into the air duct member 31 out of the outer tub 7 is fed into the guide hood 33 by the fan 32 and then blown into the outer tub 7 from the air blowing port 41, whereby the air is circulated in an air circulation passage defined by the air duct member 31, the fan 32 and the guide hood 33 (i.e., the drying unit 3), and the outer tub 7. Further, the drum 10 has an opening 10D provided in a center portion of the right end face wall 10R thereof in opposed relation to the opening 7B of the outer tub 7, so that the air circulated in the air circulation passage is also supplied to the laundry in the drum 10.

[0055] During the drying process, for example, the air circulated in the air circulation passage is heated by the heaters 34 and supplied into the drum 10 from the air blowing port 41 (see Fig. 10) through the opening 7B of the outer tub 7 and the opening 10D of the drum 10, while the drum 10 is rotated. Thus, an operation such that the laundry is lifted by the baffles 10B in the drum 10 and allowed to naturally fall from a certain height is repeatedly performed. Therefore, the heated air is evenly applied to the laundry, whereby the laundry is properly dried.

[0056] It is possible to supply lower temperature air into the drum 10 by energizing one of the heaters 34 (the heaters 34A and 34B) shown in Fig. 10 to drive the heaters 34 at a lower level (e.g., at about 700 W) and to supply higher temperature air into the drum 10 by energizing both of the heaters 34 to drive the heaters 34 at a higher level (e.g., at about 1400 W). It is also possible to supply intermediate temperature air (heated at a level between the lower level and the higher level) into the drum 10 by energizing both of the heaters 34A, 34B and performing AC half-wave control on one of the heaters (controlling the driving of one of the heaters by utilizing AC in each alternate half cycle) to drive the heaters 34 at an intermediate level (e.g., at about 1000 W).

[0057] Referring again to Fig. 9, the drain hole 30 is provided in the lower end portion of the air duct member 31 as described above. The air duct member 31 includes a first air duct member 311 and a second air duct member 312 integrally provided with each other, the first air duct member 311 being connected to the right end face wall 7R of the outer tub 7 at the lower end portion thereof and having an upper end portion extending upward along the right end face wall 7R of the outer tub 7, the second air duct member 312 being connected to the upper end portion of the first air duct member 311 and projecting left-

ward to be opposed to the peripheral wall 7A of the outer tub 7. The first air duct member 311 has a planar shape having a laterally measured thickness that is smaller than an anteroposteriorly measured thickness. On the other hand, the second air duct member 312 has a planar shape having an anteroposteriorly measured thickness that is smaller than a laterally measured thickness.

[0058] Referring to Fig. 10, the dehumidification water supply port 36 for supplying water into the first air duct member 311 is provided in a left side wall of the first air duct member 311 at a position slightly below a junction between the first air duct member 311 and the second air duct member 312. The supply pipe (not shown) connected to the dehumidification water valve 14 (see Fig. 11) at one end thereof as described above is connected to the dehumidification water supply port 36 at the other end thereof from the outer side. By opening the dehumidification water valve 14 (see Fig. 11), cooling water (tap water) is caused to flow at a predetermined flow rate (e.g., at about 0.5 liter per minute) into the first air duct member 311 through the supply pipe and the dehumidification water supply port 36. In the present invention, a flow passage extending from the dehumidification water valve 14 (see Fig. 11) to the dehumidification water supply port 36 functions as water supply means and dehumidification water supply means. During the drying process, the cooling water is supplied into the first air duct member 311 from the dehumidification water supply port 36 with the dehumidification water valve 14 (see Fig. 11) being open. Thus, the first air duct member 311 functions as a heat exchanger for cooling air containing moisture (water vapor) emanated from the laundry to condense the water vapor.

Ozone Generator

[0059] Referring to Fig. 9, the drum-type washing machine 1 includes an ozone generator 42 which generates ozone as one example of a laundry cleaning gas, and an introduction tube 43 which permits communication between the ozone generator 42 and the air duct member 31 for introducing the ozone generated by the ozone generator 42 into the air duct member 31. Exemplary processes for the cleaning of the laundry with the use of the gas include washing, deodorization, sterilization and aromatization (for imparting the laundry with comfortable fragrance). In the present invention, the ozone generator 42 and the introduction tube 43 function as gas supply means.

[0060] Referring to Fig. 2, the ozone generator 42 is accommodated in the second chamber 28 in the housing portion 15 of the housing 2. More specifically, the ozone generator 42 is disposed on the left side of the fan 32 in the second chamber 28 in adjacent relation to the tap water supply valve 2B with the intervention of the partition wall 16L. The ozone generator 42 is located at a higher level than the outer tub 7, the air duct member 31 and the guide hood 33.

[0061] The ozone generator 42 includes an ozone plate (not shown) which actually generates the ozone. When a high voltage is applied to the ozone plate, silent discharge occurs, whereby ozone is generated in air present around the ozone plate.

The introduction tube 43 is connected to a left end portion of the ozone generator 42 at one end thereof, and connected to a left wall of the second air duct member 312 of the air duct member 31 at the other end thereof, whereby the inside of the ozone generator 42 communicates with the inside of the aforementioned air circulation passage including the air duct member 31, i.e., the drying unit 3. The introduction tube 43 is moderately bent downward from the one end thereof, then bent in a middle portion thereof to extend further downward, and further bent to form a passage extending to the other end thereof. Therefore, the air containing the ozone generated by the ozone generator 42 flows down through the introduction tube 43 to be supplied into the air duct member 31. When the fan 32 is rotatively driven, the air duct member 31 has a negative internal pressure as described above. This promotes the supply of the ozone to the air duct member 31 from the ozone generator 42.

Washing Process in Drum-Type Washing Machine

[0062] Fig. 11 is a block diagram showing the electrical construction of the drum-type washing machine 1, illustrating components related to the present invention.

[0063] As shown in Fig. 11, the drum-type washing machine 1 includes a control section 40, for example, including a microcomputer and serving as water supply control means.

The control section 40 includes the microcomputer, for example, including a CPU 51, a ROM 52, a RAM 53 and a timer 54. Operations to be performed in a washing step, a rinsing step, a dehydrating step, a drying step and other steps by the drum-type washing machine 1 are controlled by the control section 40.

[0064] The operation/display section 6 (see Fig. 1) is connected to the control section 40. The user operates the operation/display section 6 to cause the drum-type washing machine 1 to perform a desired operation. The motor 12, the blower motor 35, the heaters 34, the detergent valve 55, the finishing agent valve 56, the bath water pump 2D, the dehumidification water valve 14, the drain valve 18, the outer lid lock mechanism 49, the ozone generator 42 and a water level sensor 47 are connected to the control section 40 via a load drive section 48.

[0065] Fig. 12 is a flow chart showing a control sequence to be performed by the control section 40 when the drum-type washing machine 1 starts a predetermined washing process.

Control operations to be performed by the control section 40 when the drum-type washing machine 1 performs the respective steps will hereinafter be described with reference to Figs. 11 and 12.

Washing Step

[0066] When the operation of the drum-type washing machine 1 is started, a first washing step is first performed (Step S1). Upon the start of the first washing step, the detergent valve 55 is opened or the bath water pump 2D is driven, whereby water is supplied into the outer tub 7 through the detergent tap water flow passage 521 or the bath water flow passage 523. At this time, the powdery detergent and the liquid detergent preliminarily put in the powdery detergent container portion 85 and the liquid detergent container portion 86 shown in Fig. 6 are dissolved in the supplied water. The detergent-containing water flows out from the outlet port 81A, and is supplied into the outer tub 7 through the water supply trap 24 and the water supply hose 17 to be retained in the outer tub 7. After the completion of the water supply to the outer tub 7, first intermittent control (e.g., 10-second ON and 3-second OFF) in which the motor 12 is rotated at 45 rpm alternately in a forward direction and in a reverse direction with a predetermined interval, second intermittent control (e.g., 10-second ON and 3-second OFF) in which the motor 12 is rotated at 30 rpm alternately in the forward direction and in the reverse direction with a predetermined interval, and third intermittent control (e.g., 10-second ON and 3-second OFF) in which the motor 12 is rotated at 60 rpm alternately in the forward direction and in the reverse direction with a predetermined interval are repeatedly performed in a predetermined sequence. In the first intermittent control, an operation (so-called tumbling operation) such that the laundry present in the drum 10 is lifted by the baffles 10B and caused to naturally fall from a certain height is repeatedly performed to achieve so-called beat-washing. In the second intermittent control, the laundry present on the bottom of the drum 10 is tumbled by the baffles 10B to achieve so-called rub-washing. In the third intermittent control, the drum 10 is rotated with the laundry kept adhering on the peripheral wall 10C of the drum 10. The water retained in the outer tub 7 is absorbed by the laundry when the laundry comes to the bottom of the outer tub 7, and dirt of the laundry is removed together with the water from the laundry when the water absorbed by the laundry is extracted from the laundry by a centrifugal force. After the aforementioned operations are performed for a predetermined period (e.g., 6 minutes), the first washing step is completed. Upon the completion of the first washing step, the water retained in the outer tub 7 is drained from the outer tub 7, so that the laundry remains in the drum 10 with the water and the detergent component being contained therein. Then, a second washing step is performed (Step S2).

[0067] Upon the start of the second washing step, the drum 10 is rotated, while steam is supplied into the outer tub 7 from the drying unit 3 shown in Fig. 4 to warm the laundry. Thus, the water contained in the laundry is warmed, and a part of the laundry containing the warmed water is rubbed with the other part of the laundry or with

the interior surface of the drum 10, or bumped against the interior surface of the drum 10 by the rotation of the drum 10. In this manner, a so-called steam cleaning operation is performed.

After the aforementioned operation is performed for a predetermined period (e.g., 14 minutes), the second washing step is completed. The steam is generated by atomizing the cooling water supplied into the first air duct member 311 from the dehumidification water supply port 36 shown in Fig. 10 and heating the atomized water by the heaters 34 to evaporate the water. In the second washing step, there is no need to supply the water into the outer tub 7, so that the water consumption can be reduced as compared with a case in which the laundry is washed in water contained in the outer tub 7 by rotating the drum 10. Upon the completion of the second washing step, an intermediate dehydrating step is performed (Step S3).

Intermediate Dehydrating Step

[0068] Upon the start of the intermediate dehydrating step, the drum 10 shown in Fig. 4 is rotated at a higher speed (e.g., at 300 to 1000 rpm), whereby the water contained in the laundry is extracted from the laundry in the drum 10 by a centrifugal force, then spun out toward the outer tub 7 through the water communication perforations 10A of the drum 10, and drained from the drain port 19. In the intermediate dehydrating step, the detergent component as well as the water contained in the laundry is extracted from the laundry. Upon the completion of the intermediate dehydrating step, a rinsing step is performed (Step S4).

Rinsing Step

[0069] Upon the start of the rinsing step, water is supplied into the outer tub 7 by opening the detergent valve 55 or by driving the bath water pump 2D, and then the drum 10 is rotated with a predetermined amount of water being retained in the outer tub 7. Thus, the laundry is tumbled in the drum 10 for rinsing. After a lapse of a predetermined period, the drum 10 is once stopped. Then, the water is drained from the outer tub 7, and water is supplied again into the outer tub 7 for rinsing the laundry again. After this operation is performed a plurality of times (e.g., twice), the rinsing step is completed. In the final rinsing step (e.g., the second rinsing step), water is supplied into the outer tub 7 by opening the finishing agent valve 56 as well as the detergent valve 55. Thus, the softening agent preliminarily put in the finishing agent container portion 87 is dissolved in the supplied water, and the softening agent-containing water flows out from the outlet port 81A to be supplied into the outer tub 7. Thus, the laundry is rinsed with this water. At the end of the water supply in the final rinsing step, a part of the supplied water is retained in the water supply trap 24, so that the outer tub 7 is isolated from the detergent con-

taining portion 8 by sealing with the retained water. After the completion of the rinsing step, a final dehydrating step is performed (Step S5).

5 Final Dehydrating Step

[0070] Upon the start of the final dehydrating step, the drum 10 is rotated at a higher speed (e.g., at 300 to 1000 rpm), whereby the water contained in the laundry is extracted from the laundry in the drum 10 by a centrifugal force and drained through the drain hose 20. At the end of the water draining in the final dehydrating step, a part of the drained water is retained in the V-shaped portion 95 of the overflow trap 45 shown in Fig. 2, whereby the overflow tube 37 and the drain hose 20 are isolated from the outside, i.e., the outer tub 7 is isolated from the outside, by sealing with the retained water. After the completion of the final dehydrating step, a drying step is performed (Step S6).

20 Drying Step

[0071] Upon the start of the drying step, the drum 10 is rotated to tumble the laundry therein, while the air heated by the heaters 34 shown in Fig. 10 is fed into the outer tub 7 from the drying unit 3. Thus, the heated air is evenly applied to the laundry in the drum 10, whereby the laundry is dried.

[0072] In the drying step, the blower motor 35 shown in Fig. 10 is driven (e.g., at 4500 rpm), and the heaters 34 (34A, 34B) are energized to be driven at the higher level. In the drying step, the air containing moisture emanated from the laundry in the drum 10 flows into the air duct member 31 (first air duct member 311) from the outer tub 7 through the air outlet port 71 (see Fig. 4) and the connection pipe 72 (see Fig. 4), then heated by the heaters 34, and fed again into the outer tub 7 (drum 10). In the drying step, the dehumidification water valve 14 is opened to supply the cooling water into the first air duct member 311 from the dehumidification water supply port 36, whereby the moisture-containing air is cooled by the cooling water in the first air duct member 311 and the water contained in the air is condensed through the heat exchange.

Therefore, when the air flowing into the first air duct member 311 passes through the first air duct member 311, the water is removed from the air, which is in turn heated by the heaters 34 and fed again into the outer tub 7 (drum 10). The water is condensed on the interior surface of the first air duct member 311 through the heat exchange, and flows down on the interior surface. The water flowing on the interior surface of the first air duct member 311 reaches the bottom of the first air duct member 311, and flows out together with the cooling water from the drain hole 30. Then, the water flows into the outer tub 7 through the connection pipe 72 and the air outlet port 71, and is drained from the drain port 19.

[0073] Before the end of the drying step, a so-called

cool-down operation is performed for a predetermined period for cooling the dried laundry to a predetermined temperature by supplying unheated air into the drum 10. During the cool-down operation, the ozone generator 42 is turned on to generate ozone. The generated ozone flows into the air duct member 31 through the introduction tube 43, whereby the ozone is fed together with the air flowing through the aforementioned air circulation passage into the outer tub 7 (drum 10) and applied onto the laundry. Thus, a dirt component, an odor component and a bacterial component remaining in the laundry are oxidized by the supplied ozone, so that the laundry can be cleaned, deodorized and sterilized. During the supply of the ozone to the outer tub 7, the detergent valve 55, the finishing agent valve 56, the dehumidification water valve 14 and the drain valve 18 are closed, and the bath water pump 2D is inactive. Further, water is trapped in the water supply trap 24 during the water supply in the washing step, and trapped in the overflow trap 45 during the water draining. Thus, the outer tub 7 is kept air-tight, thereby eliminating the possibility that the ozone leaks outside the washing machine. During the supply of the ozone to the outer tub 7, as shown in Fig. 9, the control section 40 causes the outer lid lock mechanism 49 to lock the outer lid 2A (see Fig. 1) in the closed state until all the supplied ozone is consumed by an oxidation reaction and the ozone concentration is reduced to a level that exerts no influence on a human body.

Trap Water Supply Step

[0074] The drum-type washing machine 1 is capable of performing an ozone cleaning step (also referred to as "air-wash step" because the laundry is washed with the ozone-containing air) for cleaning the laundry (e.g., for sterilization and deodorization) by supplying ozone without the use of the water, in addition to the washing step, the rinsing step, the dehydrating step and the drying step described above.

[0075] Where the ozone cleaning step is performed in addition to the ordinary washing operation, for example, the ozone cleaning step precedes the washing step, i.e., the rinsing step and the final dehydrating step. Further, where a course in which the laundry is not washed but deodorized (which may be referred to as "air-wash course" because of its image) is selected, the ozone cleaning step is performed. Therefore, when the ozone cleaning step is started, there is a possibility that no water is retained in the water supply trap 24 (see Fig. 2) and the overflow trap 45 (see Fig. 2). In order to keep the outer tub 7 air-tight as described above prior to the ozone cleaning step, a trap water supply step is performed for retaining the water in the water supply trap 24 and the overflow trap 45 by properly opening and closing the detergent valve 55, the finishing agent valve 56, the dehumidification water valve 14 and the drain valve 18 before the start of the ozone cleaning step. Where the ozone cleaning step is performed in addition to the ordinary

washing operation, the ozone cleaning step may be performed during the cool-down operation in the drying step or may be performed before the washing step as well as during the cool-down operation. As the ozone supply period increases, the cleaning of the laundry is promoted. The ozone cleaning function of the drum-type washing machine 1 makes it possible to clean laundry that cannot be wetted with water.

[0076] Referring to Figs. 13A, 13B and 13C, water supply control to be performed in the trap water supply step will be described.

Fig. 13A is a flow chart showing the first half of a water supply control operation to be performed in the trap water supply step, and Fig. 13B is a flow chart showing the second half of the water supply control operation to be performed in the trap water supply step. Fig. 13C is a flow chart showing a control operation to be performed for supplying water into the water supply trap 24 in the trap water supply step.

[0077] Upon the start of the trap water supply step, a water-supply-trap water supply control for supplying water to the water supply trap 24 is started (Step S101). Referring to Fig. 13C, the water-supply-trap water supply control will be described. The water-supply-trap water supply control is a control operation to be performed for retaining water in the water supply trap 24 by properly opening and closing the detergent valve 55 or the finishing agent valve 56. Upon the start of the water-supply-trap water supply control, a number n is set to $n=0$ (Step S201). Here, the number n is a number of times of repetition of a process sequence of Steps S203 to S206 to be described later. In turn, it is judged whether a condition of $n \geq 8$ is satisfied (Step S202). In the first judgment in Step S202, the number n is $n=0$ as described above, so that the condition of $n \geq 8$ is negated (No in Step S202). The finishing agent valve 56 is opened for 0.1 second (Step S203), and then closed (Step S204). Since the valve opening period of the finishing agent valve 56 is very short on the order of 0.1 second, a very small amount of water flows into the finishing agent water flow passage 522 from the finishing agent tap water inlet port 512. Therefore, the water flows at a height level lower than the upper water spout 535B of the finishing agent water flow passage 522; and flows out from the lower water spouts 535A into the water supply trap 24 through the detergent container accommodating chamber 81 while bypassing the finishing agent container portion 87. That is, the water is supplied into the water supply trap 24 through the bypass water supply passage which bypasses the finishing agent container portion 87. As a result, tap water not containing the finishing agent can be retained in the water supply trap 24. Thereafter, the finishing agent valve 56 is kept closed for 10 seconds (Step S205). A time period required for almost all the water in the finishing agent water flow passage 522 to flow out from the lower water spouts 535A is 10 seconds. Therefore, the valve closing period is not particularly limited to 10 seconds. As long as this condition is satisfied, the

valve closing period may be not less than 10 seconds or not greater than 10 seconds. Thus, a process sequence of Steps S203 to S205 is performed once, so that the number n is set to $n=n+1$ (Step S206). Since the number n is set to $n=0$ (Step S201) immediately after the start of the water-supply-trap water supply control, the number n is now set to $n=1$ in Step S206. Then, the judgment/process sequence of Steps S202 to S206 is repeated until the condition of $n \geq 8$ is satisfied. If it is thereafter judged that the condition of $n \geq 8$ is satisfied (Yes in Step S202), the water-supply-trap water supply control is completed. That is, the process sequence of Steps S202 to S206 is repeated eight times to retain the water in the water supply trap 24, whereby a flow passage between the outer tub 7 and the detergent containing portion 8 is sealed with the water.

Thus, even if the ozone is supplied into the outer tub 7, the ozone is prevented from leaking to the outside through the passage extending from the outer tub 7 to the outside through the water supply hose 17, the water supply trap 24 and the detergent containing portion 8. The water-supply-trap water supply control is started by the operation in Step S101 shown in Fig. 13A, and performed parallel to a judgment/process sequence subsequent to the Step S102 to be described later. The judgment in Step S202 is based on the condition of $n \geq 8$. However, the number n is not particularly limited, as long as the water can be retained in an amount sufficient to seal the flow passage between the outer tub 7 and the detergent containing portion 8 with the water. For example, the period in Step S203 may be shorter than 0.1 second, and the condition may be set to $n \geq 9$.

Alternatively, the period in Step S203 may be slightly greater than 0.1 second, and the condition may be set to $n \geq 7$. Where the external water supply equipment (tap water faucet or the like) has a higher water supply capability, the number n may be less than 8.

[0078] Referring again to Fig. 13A, the description will be continued. At the start of the water-supply-trap water supply control shown in Fig. 13C, the drain valve 18 is opened as described above (Step S102), and it is judged whether 30 seconds have elapsed from the opening of the drain valve 18 (Step S103). If the elapsed time does not reach 30 seconds (No in Step S102), the drain valve 18 is kept open for 30 seconds. Where the drum-type washing machine 1 is continuously driven, water adheres, for example, to the inner peripheral surface of the outer tub 7 at the start of the trap water supply step. If the water remains in the outer tub 7, the water gathers in the bottom of the outer tub 7 with time. Therefore, there is a possibility that the water gathering in the outer tub 7 be erroneously detected as the water supplied from the dehumidification water supply port 36 in a judgment step subsequent to Step S103. However, the drain valve 18 is opened for 30 seconds as described above, so that the gathering water can be substantially drained. Therefore, the reliability of the judgment subsequent to Step S103 is improved. After a lapse of 30 seconds from the

opening of the drain valve 18 (Yes in Step S103), the water level in the outer tub 7 is detected by the water level sensor 47, and it is judged whether the water level is less than a reset water level (Step S104). The reset water level herein means a minimum water level which can be precisely measured by the water level sensor 47. That is, if the water level in the outer tub 7 is not less than the reset water level, the water level sensor 47 can more precisely measure the water level as compared with a case in which the water level is less than the reset water level.

[0079] If the water level in the outer tub 7 is less than the reset water level (Yes in Step S104), the drain valve 18 is closed (Step S105), and a water level L1 detected in the outer tub 7 at this time is read (Step S106). Then, the dehumidification water valve 14 is opened (Step S107). As the water to be retained in the overflow trap 45, the dehumidification water supplied from the dehumidification water supply port 36 with the dehumidification water valve 14 being open is further supplied to the outer tub 7 through the air duct member 31 to be retained in the bottom of the outer tub 7.

[0080] On the other hand, if it is judged in Step S104 that the water level in the outer tub 7 is not less than the reset water level (No in Step S104), it is judged whether a draining operation is consecutively performed five times (Step S108). That is, it is judged whether a process sequence including Steps S104, S108, S110, S111, S112 and S104 is consecutively repeated four times in the trap water supply step. If this operation is the fifth draining operation (Yes in Step S108), drain abnormality information is provided, for example, by sounding a buzzer (not shown) or displaying an error indication number on the operation/display section 6 (Step S109). That is, if it is judged five consecutive times in Step S104 that the water level in the outer tub 7 is not less than the reset water level, the aforementioned abnormality information is provided based on an assumption that the drain valve 18 malfunctions, that a drainage failure occurs, that the laundry is wet and water contained in the laundry continuously drips into the bottom of the outer tub 7 to increase the water level in the outer tub 7, or that the water level sensor 47 malfunctions. If this operation is not the fifth draining operation (No in Step S108), the drain valve 18 is opened (Step S110), and it is judged whether 10 seconds have elapsed from the opening of the drain valve 18 (Step S111). If the elapsed time does not reach 10 seconds (No in Step S111), the drain valve 18 is kept open for 10 seconds. After a lapse of 10 seconds from the opening of the drain valve 18 (Yes in Step S111), the drain valve 18 is closed (Step S112), and it is judged again whether the water level in the outer tub 7 is less than the reset water level (Step S104). If the water level is less than the reset water level (Yes in Step S104), the drain valve 18 is closed (Step S105), and Steps S106 and S107 are performed in the aforementioned manner.

[0081] Referring to Fig. 13B, it is judged whether the water level in the outer tub 7 is less than the reset water

level (Step S113) after the dehumidification water valve 14 is opened in Step S107. If the water level is not less than the reset water level (No in Step S113), it is judged that a water supply abnormality does not occur, and the dehumidification water valve 14 is closed (Step S122). Then, it is judged whether the aforementioned water-supply-trap water supply control (see Fig. 13C) is completed (Step S123). If the water-supply-trap water supply control is not completed (No in Step S123), the machine is kept standby until the completion of the water-supply-trap water supply control. If it is thereafter judged that the water-supply-trap water supply control is completed (Yes in Step S123), the process goes to Step S118.

[0082] On the other hand, if it is judged in Step S113 that the water level in the outer tub 7 is less than the reset water level (Yes in Step S113), it is judged whether a predetermined first period, e.g., 120 seconds, has elapsed from the opening of the dehumidification water valve 14 or the start of the water supply from the dehumidification water supply port 36 (Step S114). If the elapsed time does not reach 120 seconds (No in Step S114), the dehumidification water valve 14 is kept open for 120 seconds. If the time elapsed from the opening of the dehumidification water valve 14 reaches 120 seconds (Yes in Step S114), the dehumidification water valve 14 is closed (Step S115), and a water level L2 detected in the outer tube 7 at this time is read (Step S116). Then, it is judged whether a difference between the water levels L1 and L2 satisfies a condition of $L2-L1 \geq X$ (Step S117). If the water level difference does not satisfy the condition of $L2-L1 \geq X$ (No in Step S117), water supply abnormality information is provided (a water supply error process is performed), for example, by sounding a buzzer (not shown) or displaying an error indication number on the operation/display section 6 (Step S119). Here, X is the amount of water (predetermined threshold) required to be retained in the overflow trap 45 for sealing the flow passage between the outer tub 7 and the outside with the water, and is preliminarily stored in the control section 40. That is, if the condition of $L2-L1 \geq X$ is not satisfied, there is a possibility that the water is not retained in the outer tub 7 due to malfunction of the dehumidification water valve 14.

Therefore, even if the drain valve 18 is opened in this state, the overflow trap 45 fails to seal the flow passage between the outer tub 7 and the outside with water. Therefore, the ozone supplied into the outer tub 7 in the ozone cleaning step is liable to leak through the flow passage extending from the outer tub 7 to the outside through the overflow tube 37 and the drain hose 20. However, the leak of the ozone can be prevented by providing the water supply abnormality information.

[0083] On the other hand, if the condition of $L2-L1 \geq X$ is satisfied (Yes in Step S117), the drain valve 18 is opened (Step S118), and it is judged whether 30 seconds have elapsed from the opening of the drain valve 18 (Step S120). If the elapsed time does not reach 30 seconds (No in Step S120), the drain valve 18 is kept open for 30

seconds. If the elapsed time from the opening of the drain valve 18 reaches 30 seconds (Yes in Step S120), the drain valve 18 is closed (Step S121), and the trap water supply step is completed.

[0084] Where the process goes to Step S118 after it is judged in Step S113 that the water level in the outer tub 7 is not less than the reset water level (No in Step S113) and it is judged that the water-supply-trap water supply control is completed (Yes in Step S123), the drain valve 18 is opened in the same manner as described above (Step S118). After a lapse of 30 seconds from the opening of the drain valve 18 (Yes in Step S120), the drain valve 18 is closed (Step S121), and the trap water supply step is completed.

[0085] After the predetermined amount of water is retained in the outer tub 7, the water is thus caused to flow out into the drain hose 20 at a time by opening the drain valve 18, whereby the water flows to the downstream side of the drain hose 20 (to the outer side) as well as to the upstream side of the overflow tube 37 (to the overflow trap side) around the junction of the drain hose 20 and the overflow tube 37. As a result, the water flowing to the overflow tube side is retained in the V-shaped portion 95 of the overflow trap 45.

Effects

[0086] As described above, the trap water supply step is performed to retain the water in the overflow trap 45 before the start of the ozone cleaning step, whereby a part of the passage extending from the outer tub 7 to the outside through the overflow tube 37 and the drain hose 20 is sealed with the water retained in the overflow trap 45. Therefore, even if the ozone cleaning step is thereafter performed, the ozone is prevented from leaking to the outside of the drum-type washing machine 1 through the passage extending from the outer tub 7 to the outside through the overflow tube 37 and the drain hose 20. Thus, the ozone odor is prevented from wafting to the outside.

[0087] The water supplied from the dehumidification water supply port 36 through the air duct member 31 and retained in the bottom of the outer tub 7 is used as the water to be retained in the overflow trap 45. That is, there is no need to supply water through the water supply hose 17 (see Fig. 2) connected to the upper portion of the outer tub 7. Therefore, even if the dry laundry is preliminarily loaded in the drum 10 prior to the ozone cleaning step, it is possible to retain the water in the overflow trap 45 without wetting the laundry.

[0088] After the predetermined amount of water is retained in the outer tub 7, the water to be retained in the overflow trap 45 is caused to flow out into the drain hose 20 at a time with the drain valve 18 being open, whereby the water flows to the downstream side of the drain hose 20 (to the outer side) as well as to the upstream side of the overflow tube 37 (to the overflow trap side) around the junction of the drain hose 20 and the overflow tube 37. As a result, the water flowing to the overflow tube

side is reliably retained in the V-shaped portion 95 of the overflow trap 45. With this arrangement, the water draining process can be efficiently performed without the need for provision of the V-shaped overflow trap 45 on the drain hose side.

[0089] As described above, the drain valve 18 is opened, for example, when the water level sensor 47 judges that the condition of $L2-L1 \geq X$ is satisfied (Yes in Step S117 in Fig. 13B). Therefore, a value corresponding to the amount of water to be retained in the overflow trap 45 is set in the water level sensor 47, whereby the water can be reliably retained in the drain trap. Further, if the water level sensor 47 judges that the condition $L2-L1 \geq X$ is not satisfied, the drain valve 18 is not opened, but the water supply abnormality information is provided (Step S119 in Fig. 13B). Therefore, the leak of the ozone to the outside can be prevented, which may otherwise occur when the ozone cleaning step is erroneously performed with the outer tub 7 communicating with the outside through the drain hose 20 or the like with no water retained in the overflow trap 45 due to the malfunction of the dehumidification water valve 14.

[0090] A small amount of water is required for retaining the water in the overflow trap 45 and, therefore, a high precision water level sensor would be required to precisely measure such a small amount of water. That is, a water level sensor capable of precisely measuring even a small amount of water would be required. However, the amount of water to be used for retaining the water in the overflow trap 45 is not particularly limited, as long as the amount is not less than the aforementioned small amount (because an excess amount of water greater than the capacity of the drain trap 45 is drained to the outside through the drain hose 20). Therefore, it is merely necessary to judge whether the amount of the water retained in the outer tub 7 is greater than the predetermined level. To this end, it is judged whether a difference between the two water levels is greater than the predetermined threshold (which is approximately equivalent to the water amount required for retaining the water in the overflow trap 45), i.e., whether the condition of $L2-L1 \geq X$ is satisfied. Thus, even if the water level is less than the reset water level, it is possible to judge whether the small amount of water is retained in the outer tub 7 without the use of the high precision water level sensor. Therefore, the water can be reliably retained in the overflow trap 45. Without the need for the high precision water level sensor, this arrangement does not lead to a cost increase.

[0091] Further, as shown in Fig. 13C, the water-supply-trap water supply control is performed for retaining water in the water supply trap 24 as well as in the overflow trap 45 before the start of the ozone cleaning step. Therefore, a part of the passage extending from the outer tub 7 to the outside through the water supply hose 17 and the detergent containing portion 8 is sealed with the water retained in the water supply trap 24. Therefore, even if the ozone cleaning step is thereafter started, the ozone is prevented from leaking to the outside of the drum-type

washing machine 1 through the passage extending from the outer tub 7 to the outside through the water supply hose 17 and the detergent containing portion 8. Thus, the ozone odor is prevented from wafting to the outside.

[0092] Where the water is retained in the water supply trap 24, as shown in Fig. 13C, the finishing agent valve 56 is controlled to be opened for a very short period, e.g., 0.1 second, to supply only a small amount of water to the finishing agent water flow passage 522, and this operation is repeated a plurality of times (e.g., eight times). Therefore, the water supplied at a time flows at a height level lower than the upper water spout 535B of the finishing agent water flow passage 522, and further flows out from the lower water spouts 535A. Thus, the water bypasses the finishing agent container portion 87, but is supplied into the water supply trap 24 through the detergent agent container portion 81. That is, the water is supplied to the water supply trap 24 through the bypass water supply passage which bypasses the finishing agent container portion 87. In addition, this operation is repeated a plurality of times (e.g., eight times), so that the water can be reliably retained in the water supply trap 24. Since the water is supplied through the bypass water supply passage, tap water not containing the finishing agent is retained in the water supply trap 24. Therefore, the finishing agent is prevented from being retained in the water supply trap 24.

Modifications

[0093] The present invention is not limited to the embodiments described above, but various modifications may be made within the purviews of the appended claims.

[0094] Although the overflow trap 45 is provided in the overflow tube 37 upstream of the junction of the drain hose 20 and the overflow tube 37, the overflow trap 45 may be provided downstream of the junction in the drain hose 20. Further, overflow traps 45 may be provided upstream and downstream of the junction. In this case, it is necessary to check if water is reliably retained in the overflow traps. Therefore, the water supply control (see Figs. 13A and 13B) should be performed based on the water level detected by the water level sensor 47 as in the embodiments described above.

[0095] In order to prevent the laundry from being wetted, the dehumidification water valve 14 is opened to supply the dehumidification water into the overflow trap 45. If no laundry is contained in the outer tub 7, for example, the detergent valve 55 may be opened to supply the water from the top of the outer tub 7 through the water supply hose 17 without the possibility of the wetting of the laundry.

[0096] In the water-supply-trap water supply control, the water is retained in the water supply trap 24 by opening the finishing agent valve 56 a plurality of times (e.g., eight times). However, where the user selects the air wash course, water may be retained in the water supply trap 24 by opening the detergent valve 55 or by opening

the detergent valve 55 and the finishing agent valve 56, because neither the detergent nor the finishing agent is contained in the detergent containing portion 8.

[0097] The gas supply means is not limited to the ozone generator 42, but may be adapted to generate a gas effective for cleaning, deodorizing, sterilizing or disinfecting the laundry or to generate a gas effective for aromatizing the laundry.

The axis of the drum 10 is not necessarily required to extend laterally, but may extend anteroposteriorly. In this case, the direction of the axis of the drum is not limited to a generally horizontal direction, but the axis of the drum may be inclined at an angle smaller than a predetermined angle (e.g., up to about 30 degrees) with respect to the horizontal direction. Further, the axis of the drum may extend vertically.

[0098] The drum-type washing machine 1 is of a so-called top open type in which the upper lid 2A is provided on the top wall of the housing 2, but may be of a so-called front open type in which a lid is provided on the front wall. In the embodiments described above, the drum-type washing machine 1 having the drying function has been described as an example of the drum-type washing machine. The present invention is applicable to a drum-type washing machine having no drying function and to a vortex-type washing machine employing a pulsator.

Claims

1. A washing machine comprising:

a treatment tub in which laundry and water are contained, and washing, dehydrating and other operations are performed;
 water supply means which supplies water to the treatment tub;
 a drain passage through which the water contained in the treatment tub is drained to the outside;
 an overflow passage through which excess water is drained if an amount of the water contained in the treatment tub is not less than a predetermined amount, the overflow passage being connected to the drain passage;
 a drain trap provided as a part of at least one of the drain passage and the overflow passage for retaining water;
 gas supply means which generates a laundry cleaning gas and supplies the gas into the treatment tub; and
 water supply control means which controls the water supply means to retain water in the drain trap before the gas is supplied into the treatment tub.

2. A washing machine as set forth in claim 1 further comprising:

a drain valve provided in the drain passage upstream of a junction of the overflow passage and the drain passage for opening and closing the drain passage;

wherein the water supply control means closes the drain valve and controls the water supply means to retain a predetermined amount of water in the treatment tub, and then opens the drain valve to retain water in the drain trap.

3. A washing machine as set forth in claim 2 further comprising:

a water level sensor which detects a water level in the treatment tub;
 wherein the water supply control means opens the drain valve to retain water in the drain trap if the water level sensor detects that the water level reaches a predetermined water level.

4. A washing machine as set forth in claim 3, wherein the water supply control means performs a water supply error process if the water level sensor does not detect that the water level reaches the predetermined water level.

5. A washing machine as set forth in claim 3 or 4, wherein, if a difference between a first water level detected by the water level sensor after a lapse of a first predetermined water supply period from start of water supply to the treatment tub and a second water level detected after a lapse of a second predetermined water supply period is not less than a predetermined threshold, the water supply control means opens the drain valve to retain water in the drain trap.

6. A washing machine as set forth in any of claims 1 to 5, wherein the water supply means includes:

a water supply passage through which water is introduced into the treatment tub;
 a detergent containing portion provided in the water supply passage for containing a detergent and a finishing agent to be dissolved in the supplied water; and
 a water supply trap provided in the water supply passage downstream of the detergent containing portion for retaining the supplied water, wherein the water supply control means retains water in the water supply trap before the gas is supplied into the treatment tub.

7. A washing machine as set forth in claim 6, wherein the water supply passage includes a bypass water supply passage which bypasses the detergent containing portion to supply water into the treatment tub, wherein the water supply control means supplies wa-

ter through the bypass water supply passage to retain water in the water supply trap.

8. A washing machine comprising:

a treatment tub in which laundry and water are contained, and washing, dehydrating and other operations are performed; 5
 a drain passage through which the water contained in the treatment tub is drained to the outside; 10
 an overflow passage through which excess water is drained if an amount of the water contained in the treatment tub is not less than a predetermined amount, the overflow passage being connected to the drain passage; 15
 a drain trap provided as a part of at least one of the drain passage and the overflow passage for retaining water;
 gas supply means which generates a laundry cleaning gas and supplies the gas into the treatment tub; 20
 an air circulation duct having opposite ends, one of which is connected to a lower portion of the treatment tub and the other of which is connected to a portion of the treatment tub other than the lower portion, and configured to circulate air flowing out of the treatment tub from the one end thereof to introduce the air into the treatment tub from the other end thereof; 30
 dehumidification water supply means connected to the air circulation duct, and configured to supply dehumidification water into the air circulation duct for dehumidifying the air flowing through the air circulation duct; and 35
 water supply control means which controls the dehumidification water supply means to supply water into the drain trap from the air circulation duct through the lower portion of the treatment tub to retain water in the drain trap before the gas is supplied into the treatment tub. 40

9. A washing machine as set forth in claim 8 further comprising:

a drain valve provided in the drain passage upstream of a junction of the overflow passage and the drain passage for opening and closing the drain passage; 45
 wherein the water supply control means closes the drain valve and controls the dehumidification water supply means to retain a predetermined amount of water in the treatment tub, and then opens the drain valve to retain water in the drain trap. 50
 55

FIG. 1

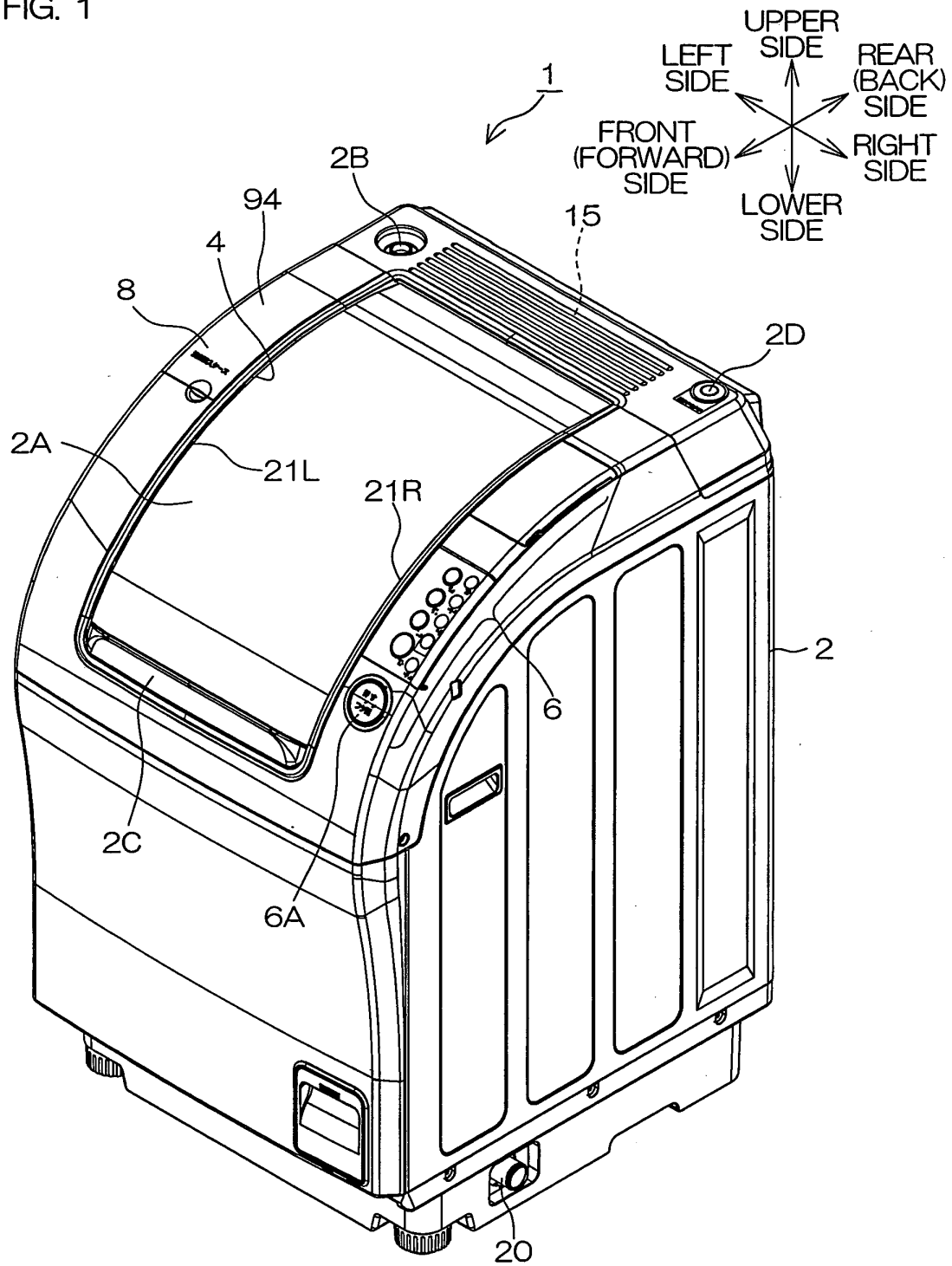
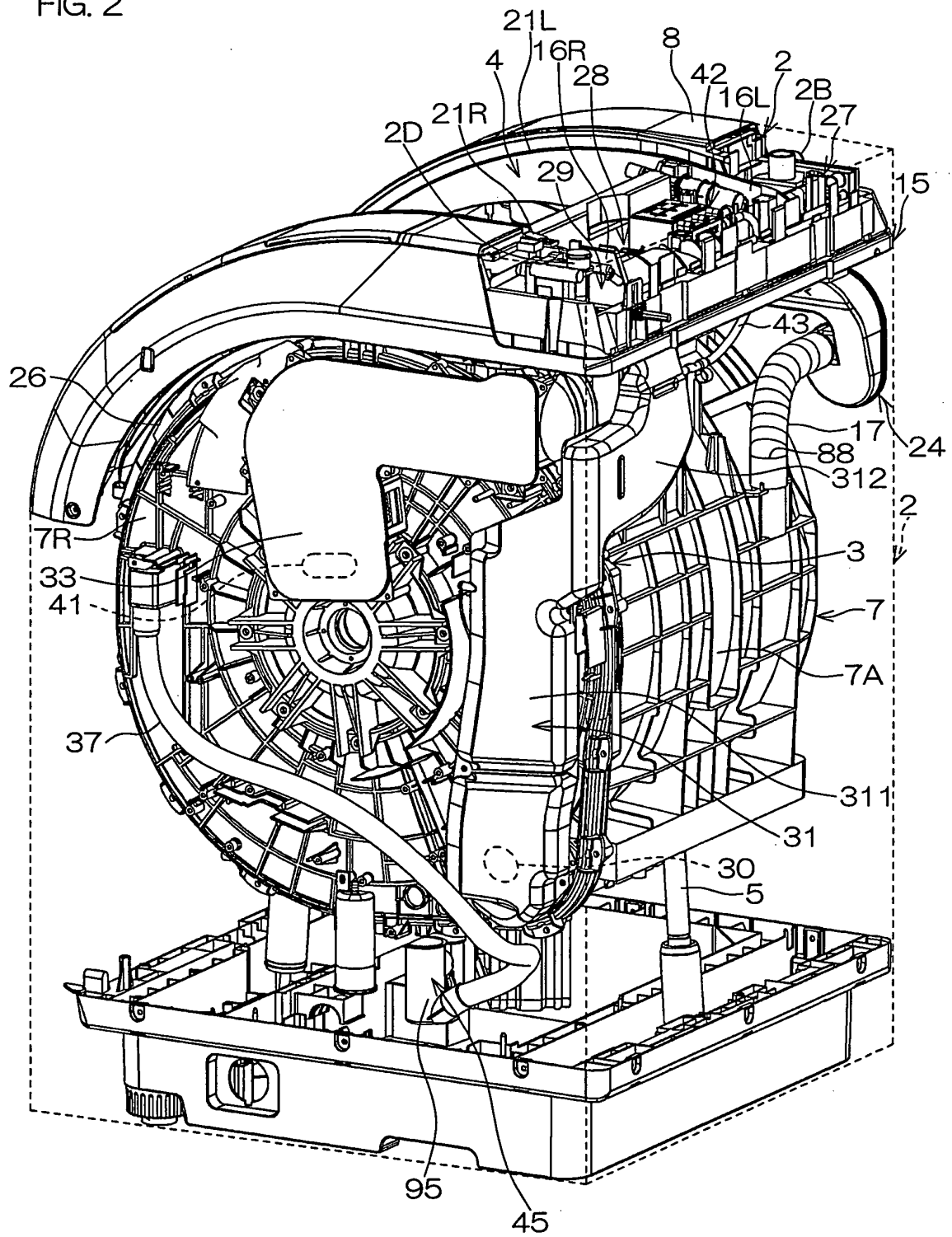


FIG. 2



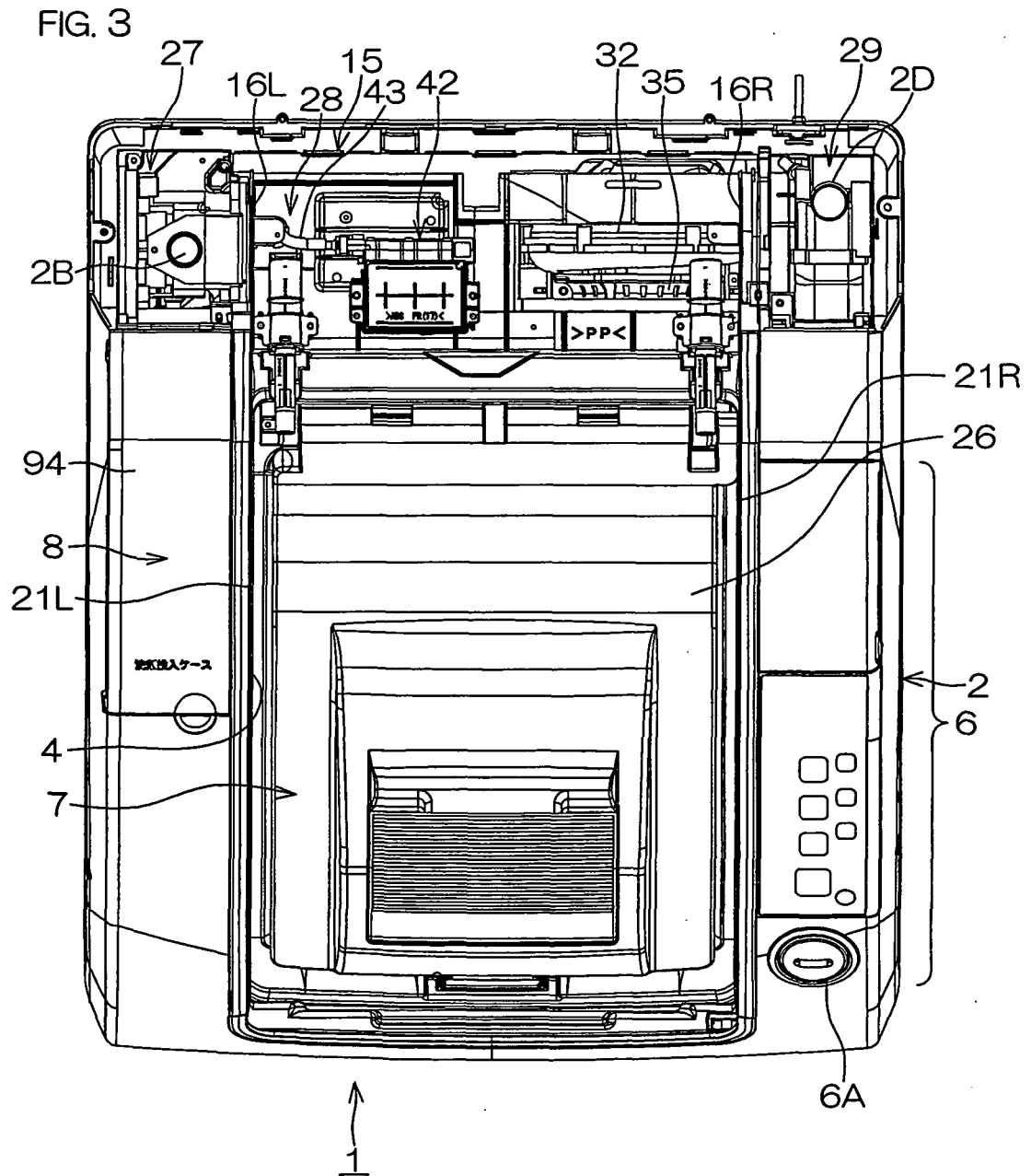


FIG. 4

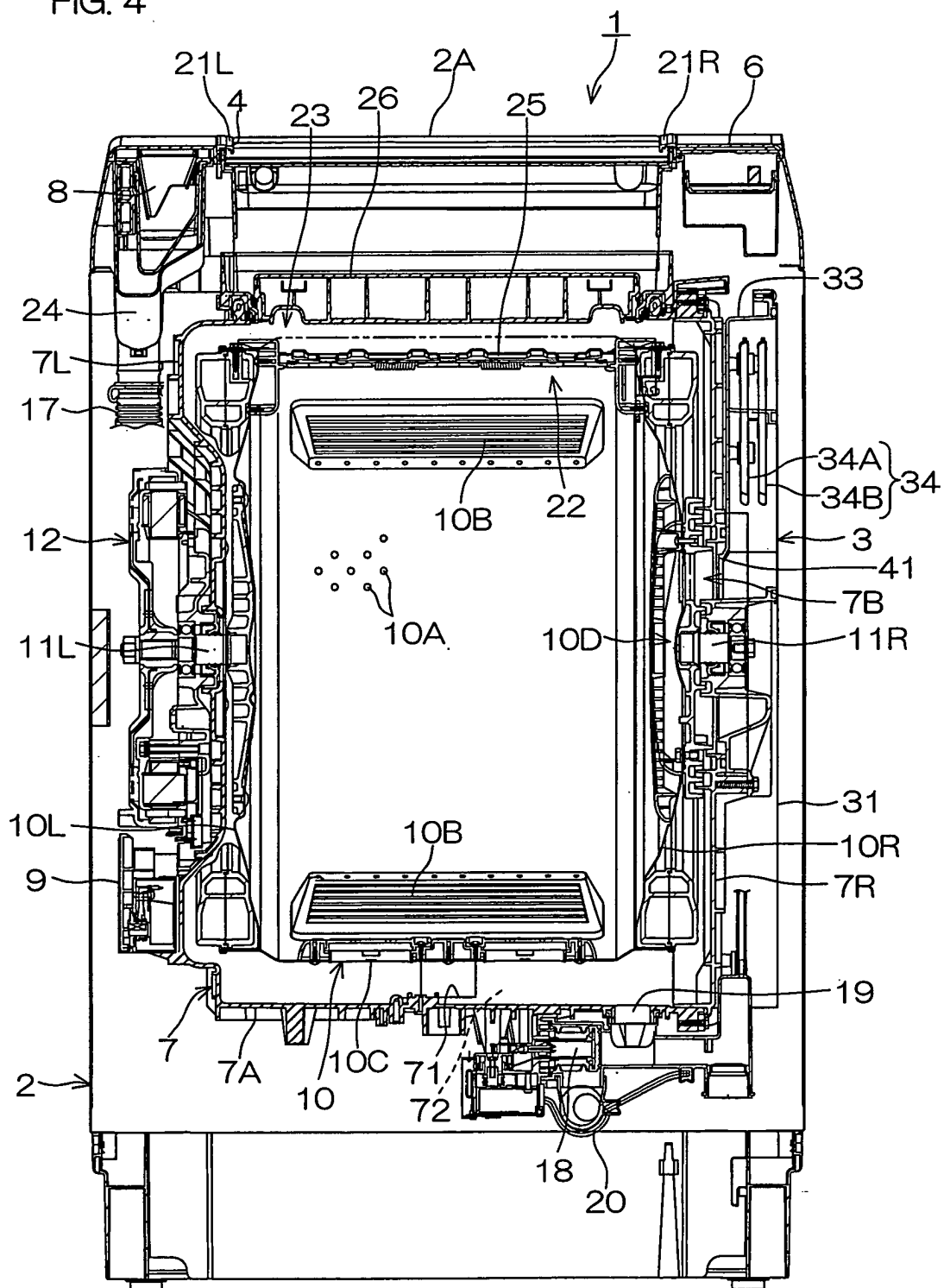


FIG. 5A

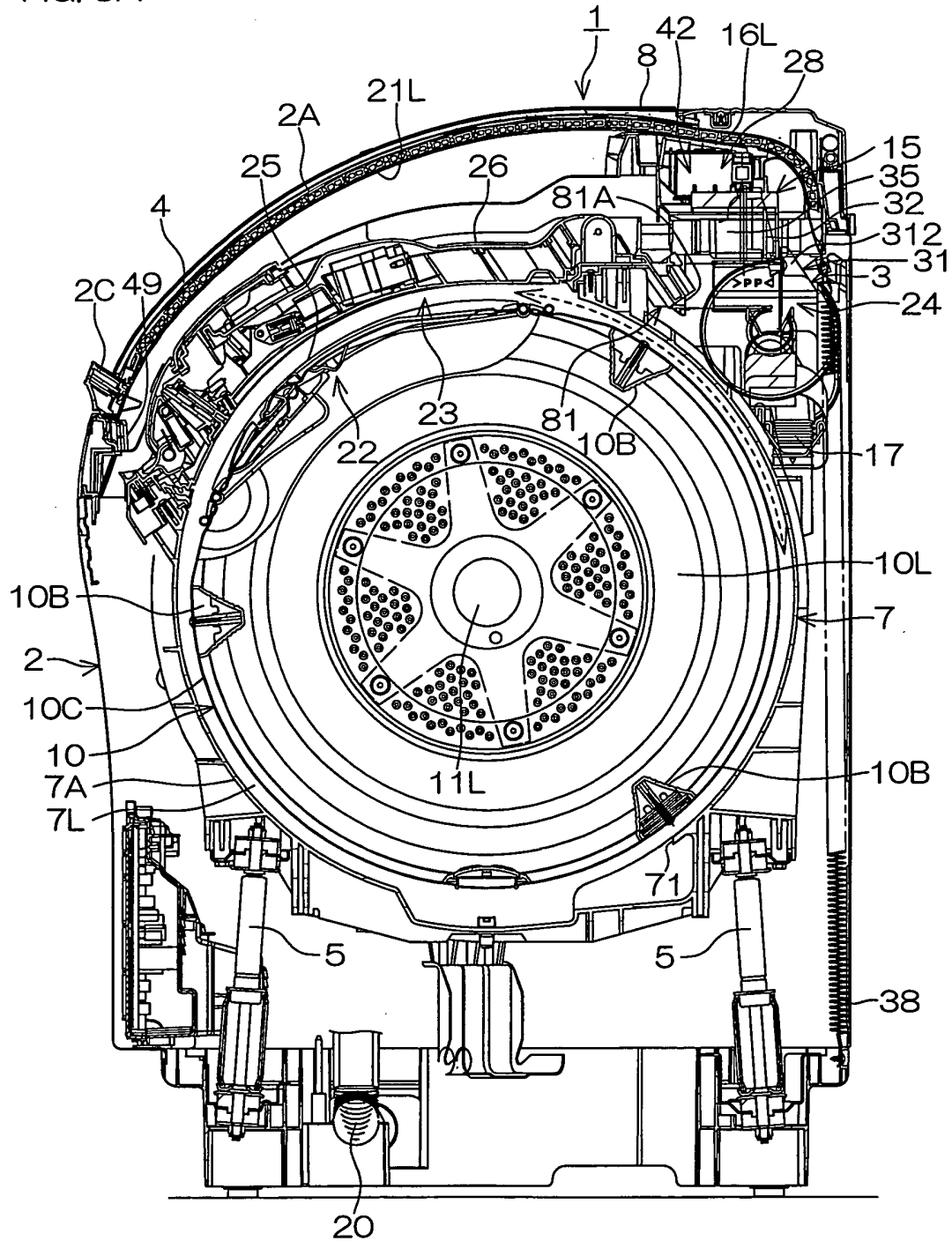
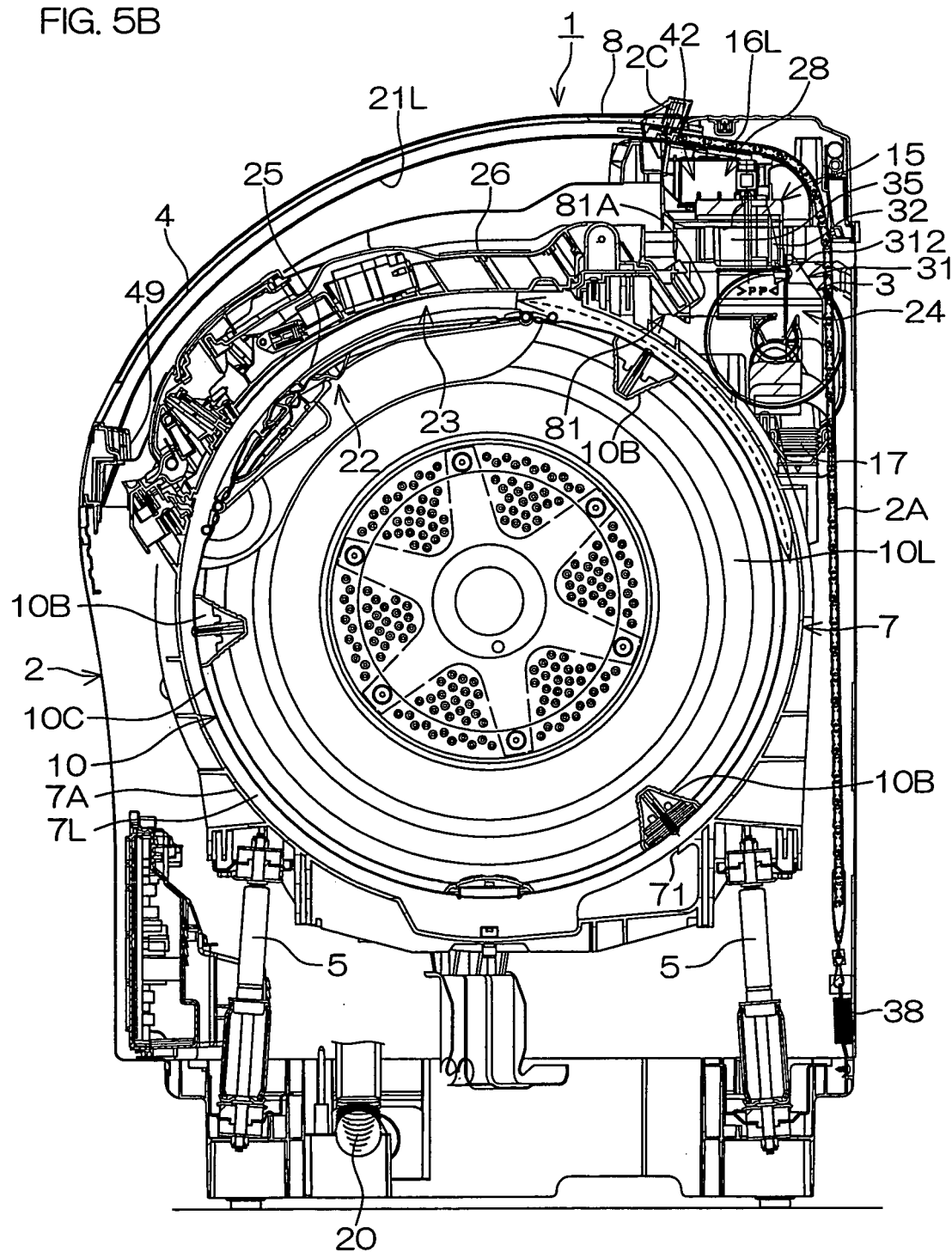
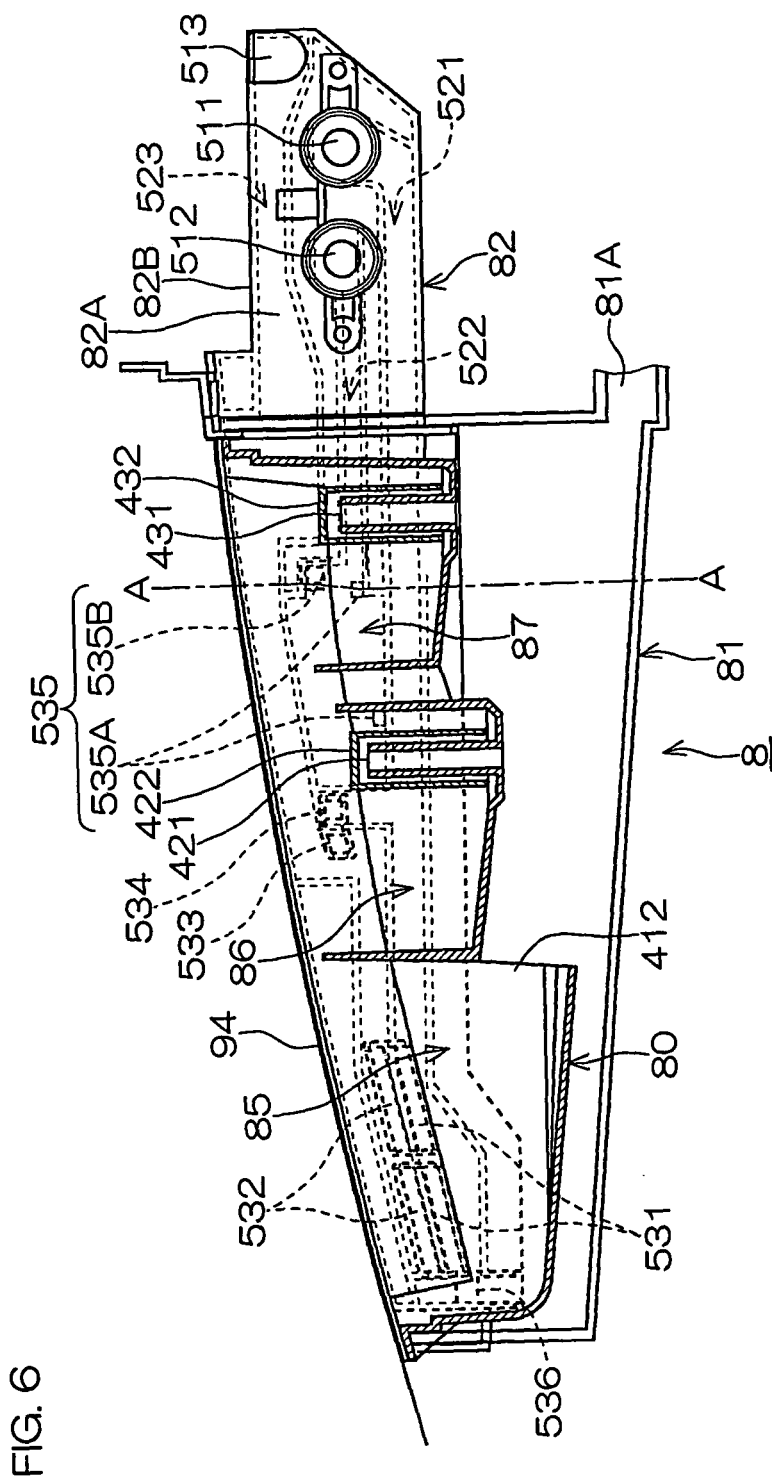


FIG. 5B





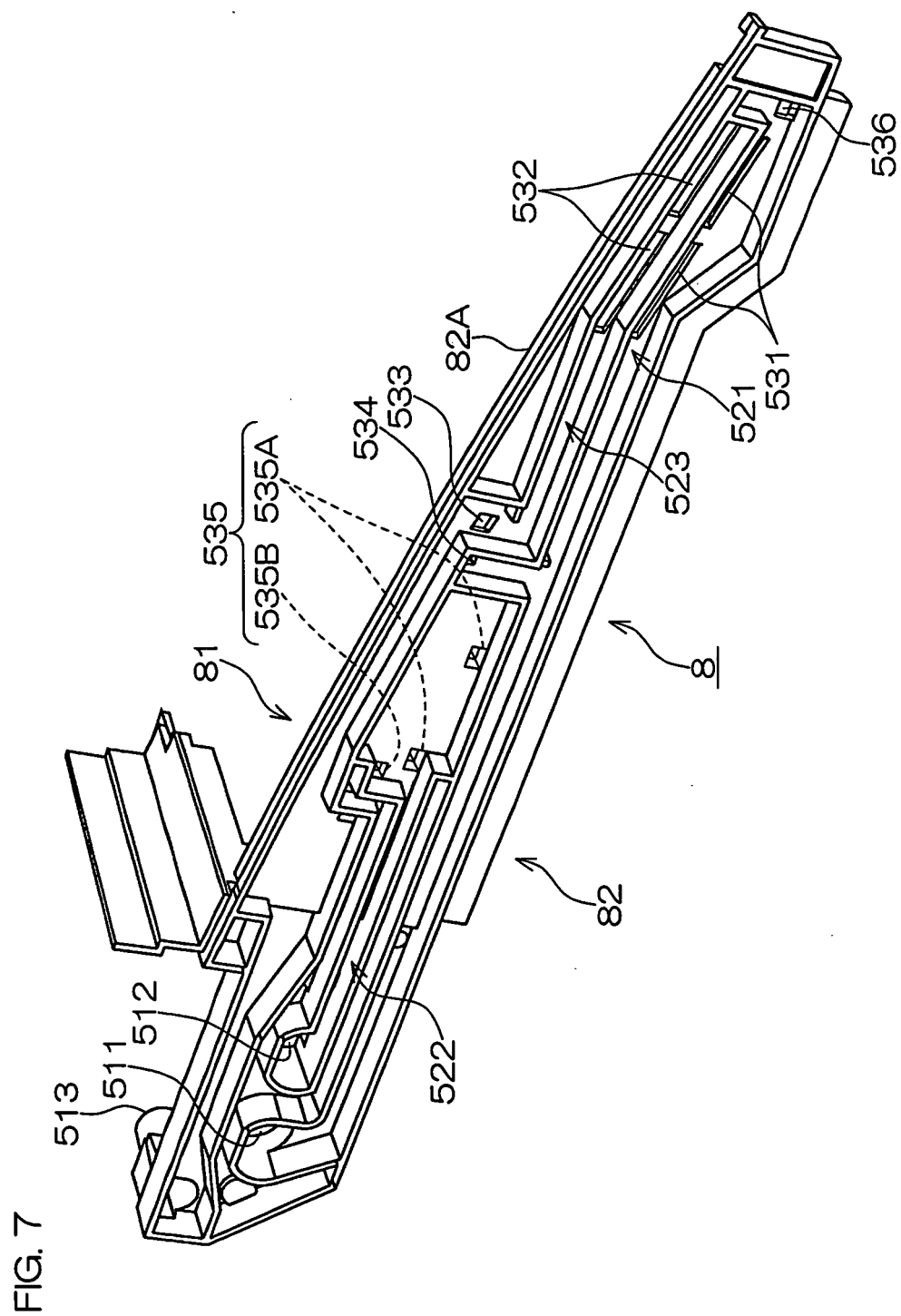


FIG. 8

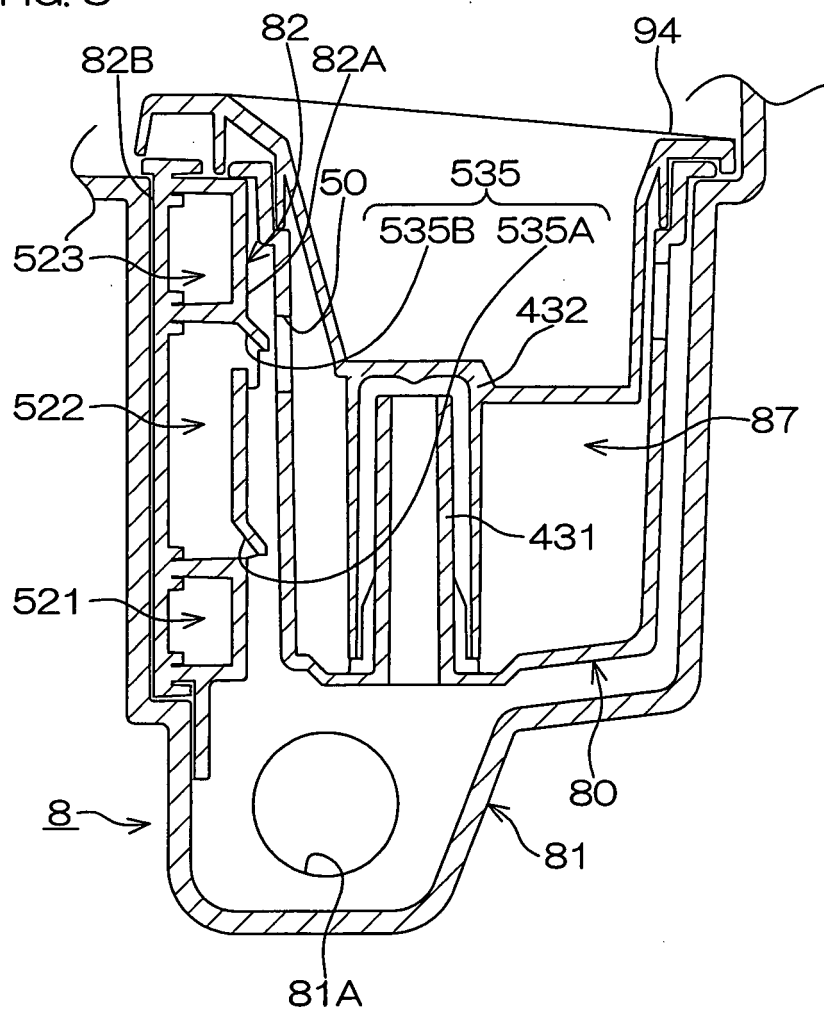


FIG. 9

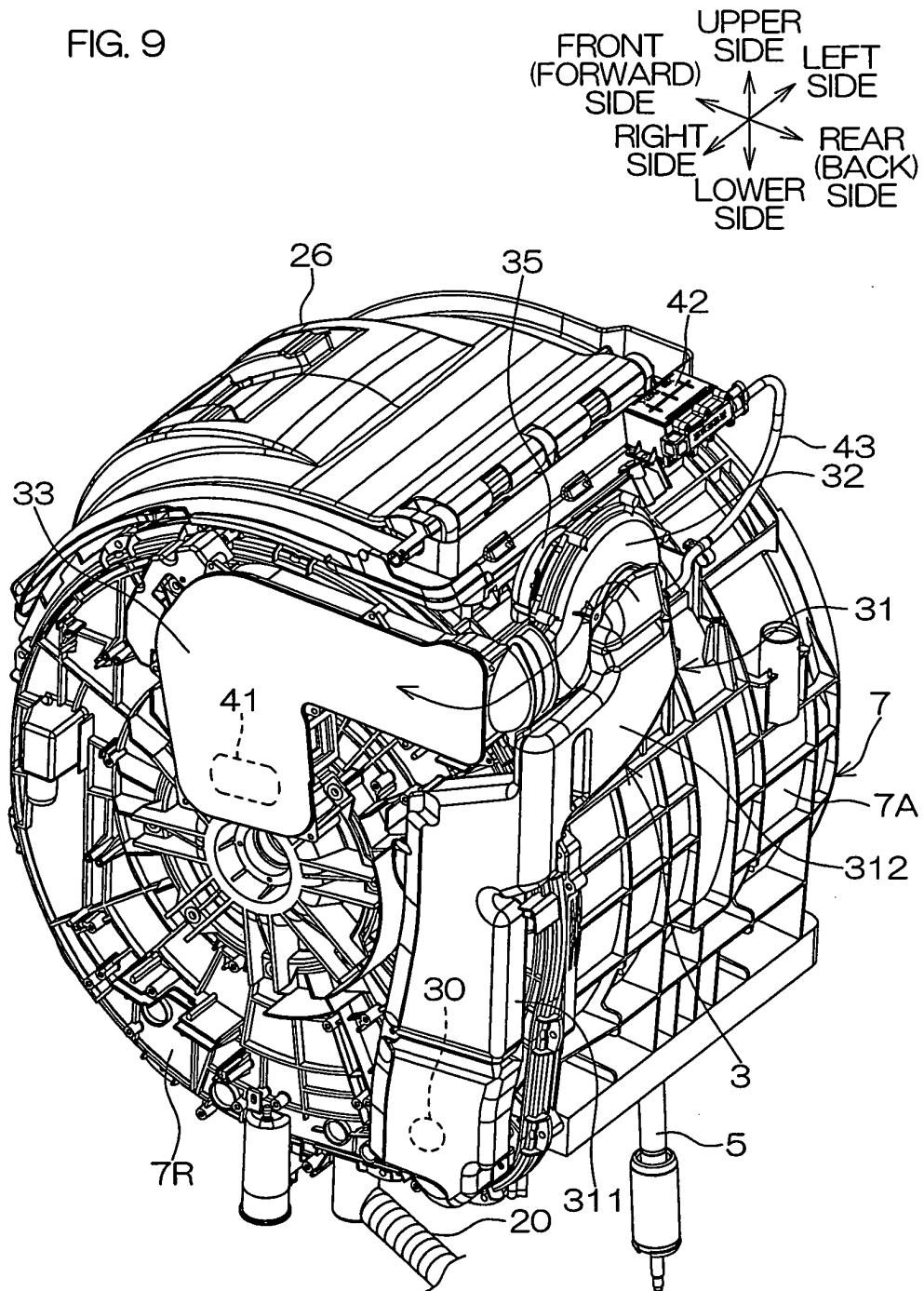


FIG. 10

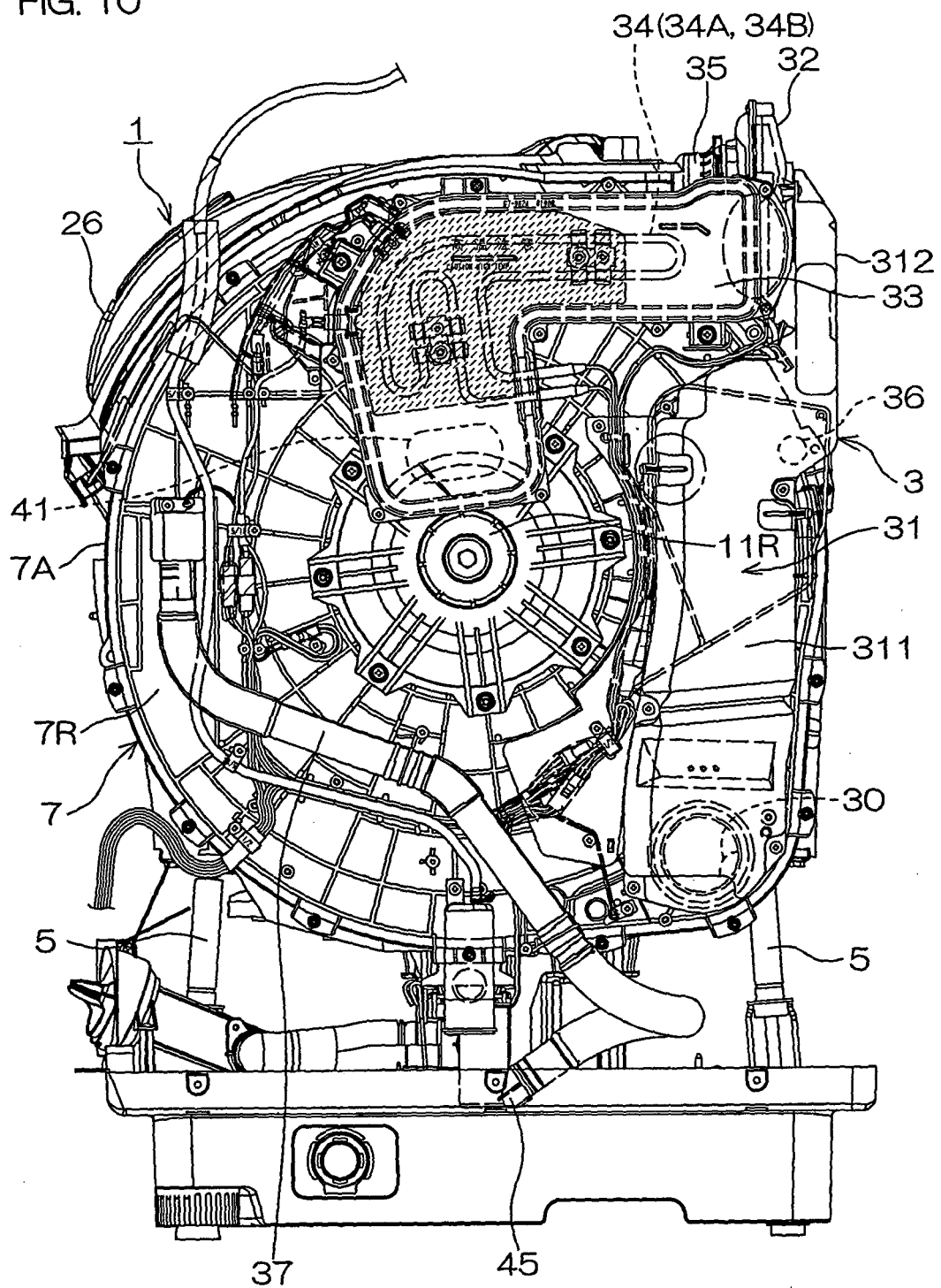


FIG. 11

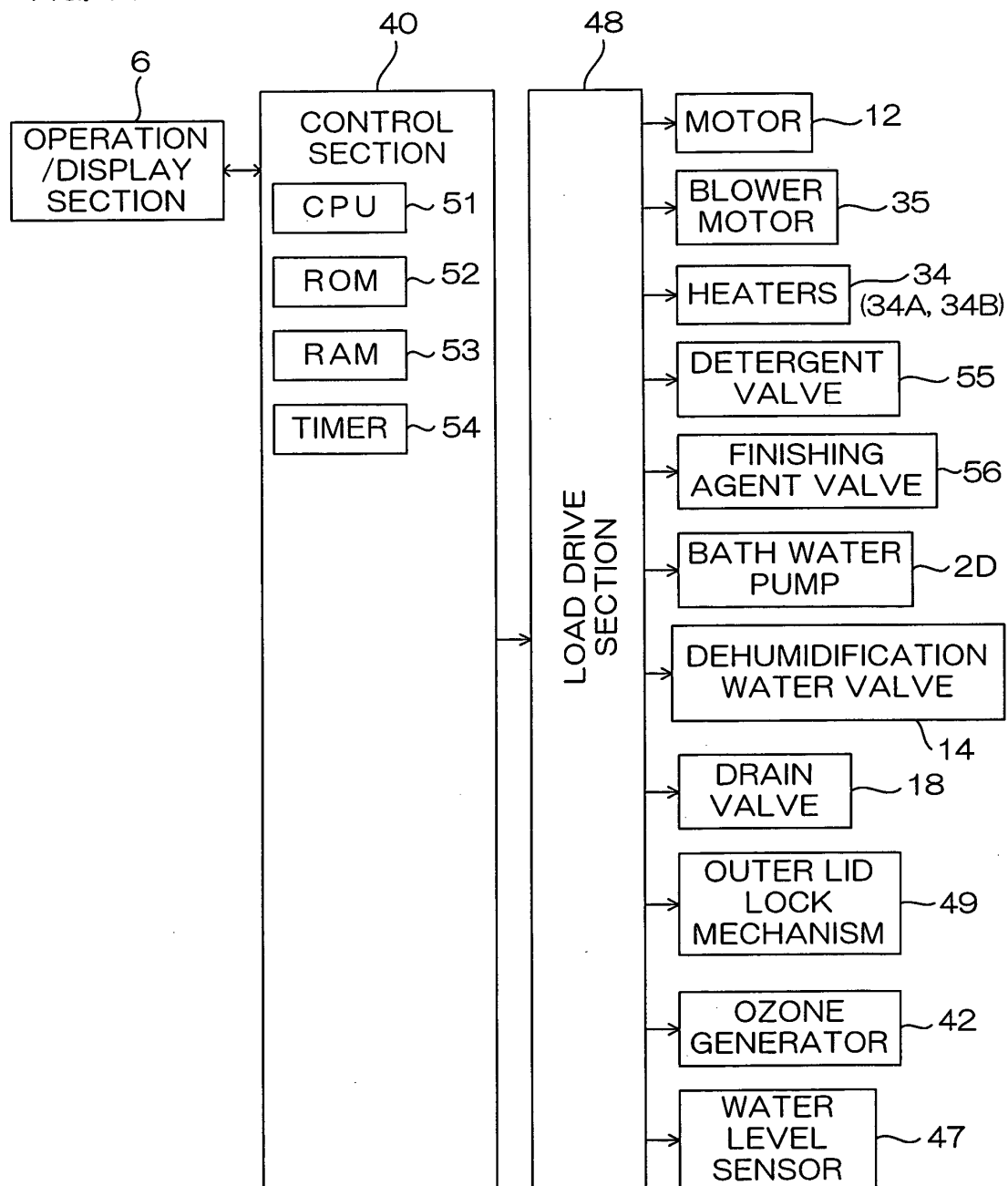


FIG. 12

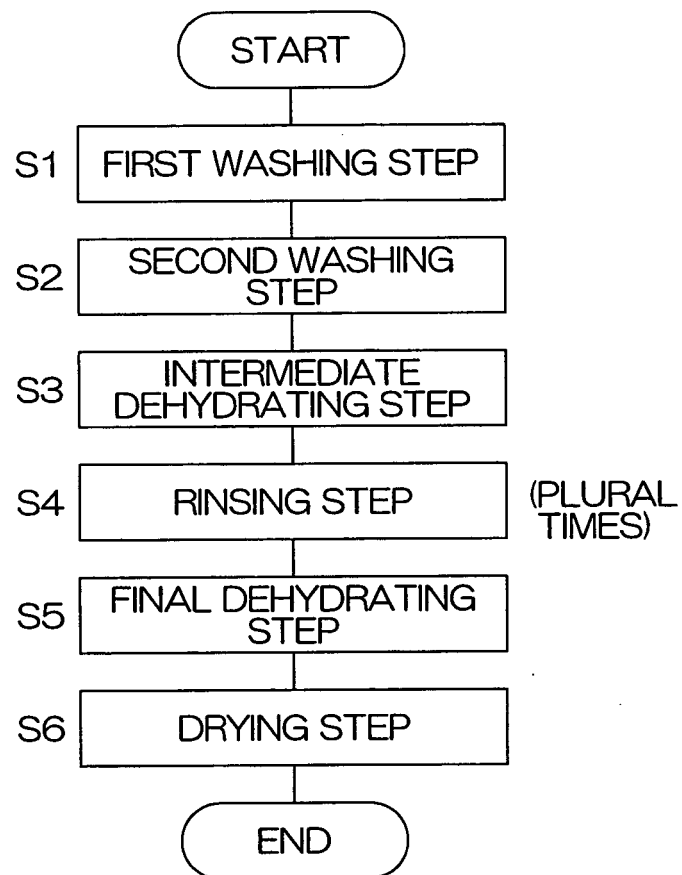


FIG. 13A

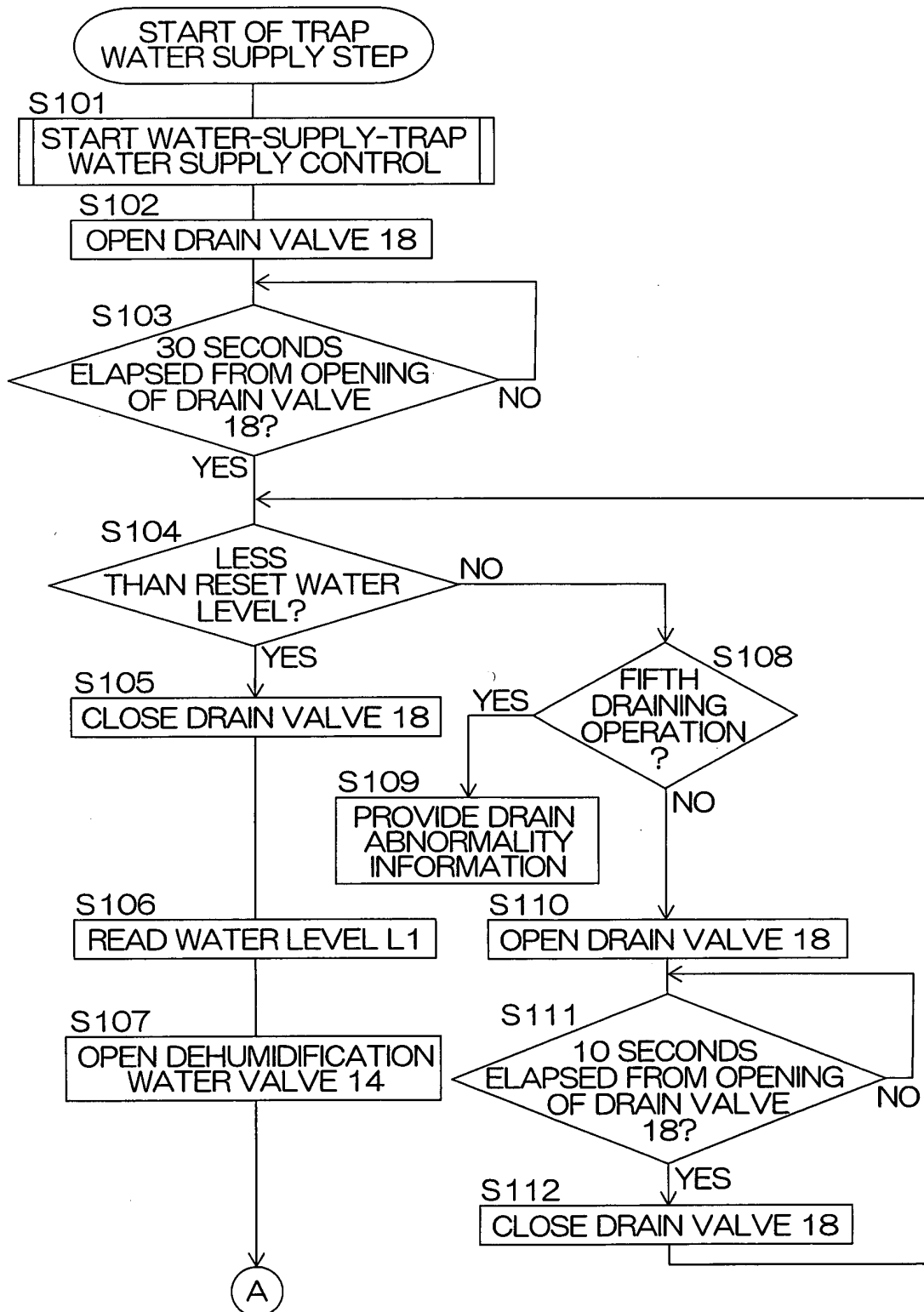


FIG. 13B

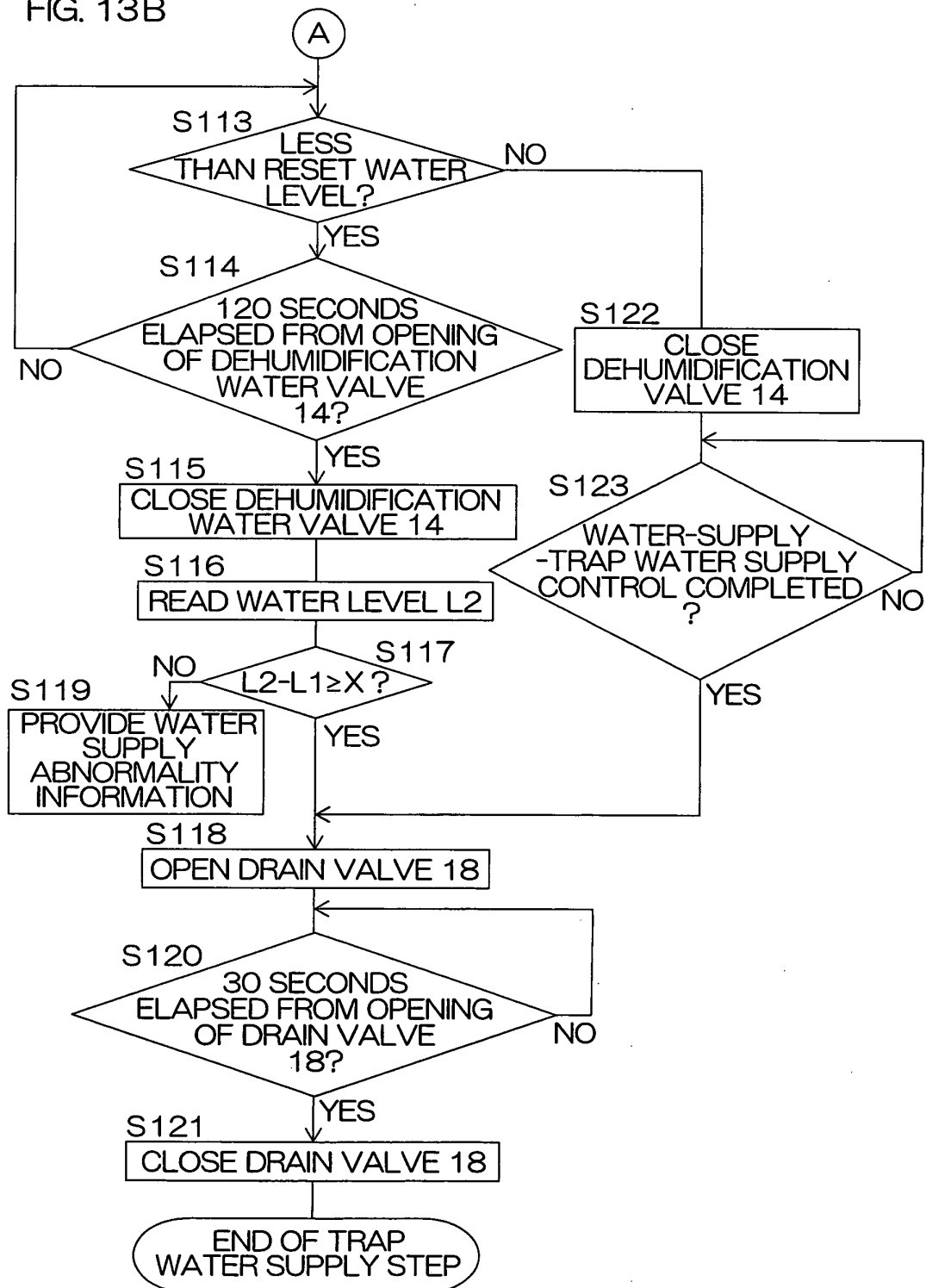
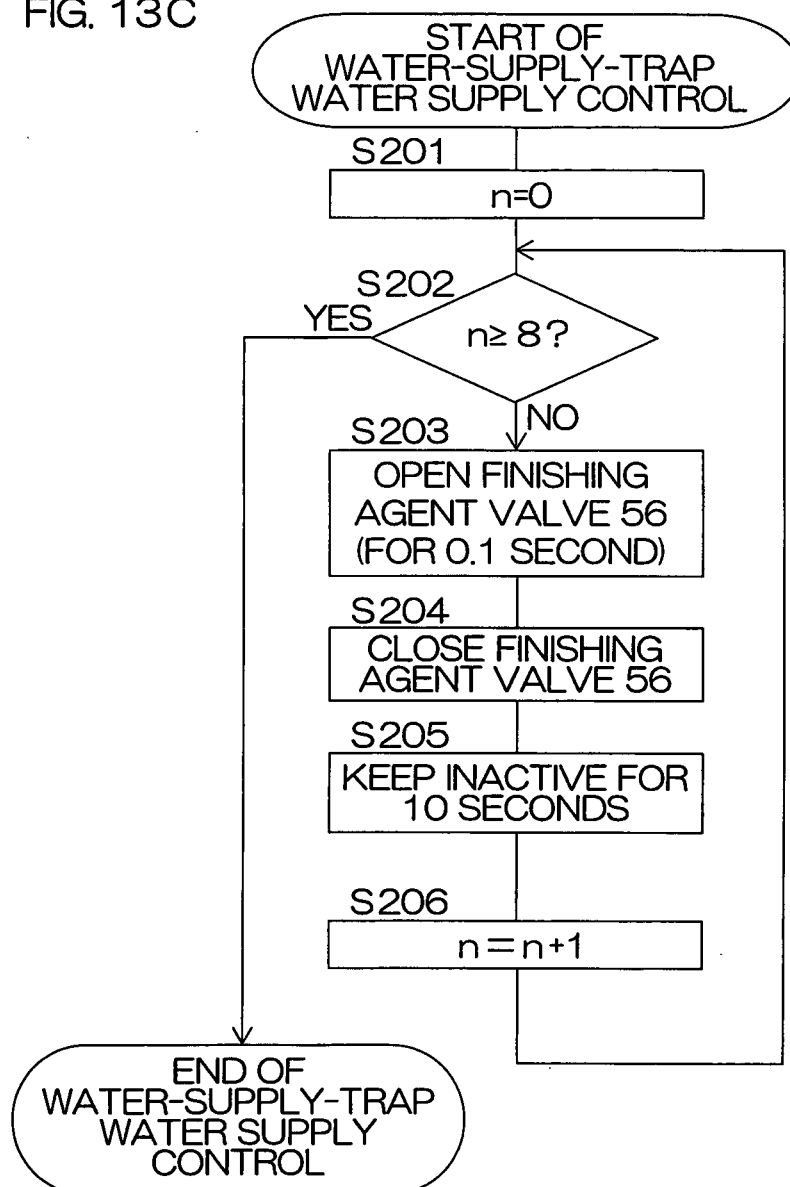


FIG. 13C



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/050601

A. CLASSIFICATION OF SUBJECT MATTER

D06F17/12(2006.01)i, D06F25/00(2006.01)i, D06F33/02(2006.01)i, D06F35/00(2006.01)i, D06F39/00(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)

D06F17/12, D06F25/00, D06F33/02, D06F35/00, D06F39/00

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 2006-109886 A (Sanyo Electric Co., Ltd.), 27 April, 2006 (27.04.06), Page 3, right column, lines 8 to 17; page 6, right column, lines 16 to 25; page 13, left column, lines 33 to 41; Fig. 1 (Family: none)	1-4, 6
Y	JP 2003-220292 A (Taga Denki Kabushiki Kaisha), 05 August, 2003 (05.08.03), Page 3, right column, lines 39 to 46 (Family: none)	1-4, 6

☒ 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

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"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

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"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

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Authorized officer

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-104397 A (Hitachi, Ltd.), 20 April, 1999 (20.04.99), Page 3, right column, line 30 to page 4, left column, line 2 (Family: none)	1-4, 6

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REFERENCES CITED IN THE DESCRIPTION

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