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(72) Inventors:
• **KIM, Byungsun**
Seoul 08592 (KR)
• **SANG, Minkyu**
Seoul 08592 (KR)
• **LEE, Jihong**
Seoul 08592 (KR)
• **JUNG, Jongseok**
Seoul 08592 (KR)

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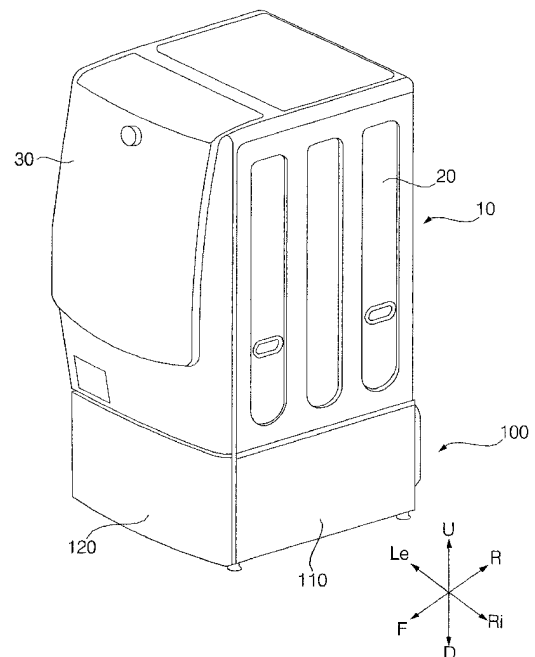
(71) Applicant: **LG Electronics Inc.**
Seoul 07336 (KR)

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

(54) **LAUNDRY TREATMENT APPARATUS AND CONTROL METHOD THEREOF**

(57) A laundry treatment apparatus and a control method thereof are disclosed. A water supply time is controlled, the supply of water is performed in a stepwise manner, and detergent or fabric softener is introduced into a tub without remaining in a detergent introduction unit using a siphon phenomenon. Consequently, it is possible to secure the time necessary for the water from the detergent introduction unit to be introduced into the tub through water supply control such that the detergent or the fabric softener in the detergent introduction unit is introduced into the tub together with the water in the detergent introduction unit, to control the supply of water irrespective of the amount of water remaining in the detergent introduction unit in order to remove remaining water from the detergent introduction unit, and to prevent the detergent introduction unit from being contaminated due to remaining water or from becoming clogged.

Fig. 1



Description

[0001] This application claims the priority benefit of Korean Patent Application No. 10-2017-0181372, filed on December 27, 2017 in the Korean Intellectual Property Office.

[0002] The present invention relates to a laundry treatment apparatus and a control method thereof.

[0003] In general, the term "laundry treatment apparatus" commonly designates various kinds of apparatuses for removing contaminants from clothing, bedding, etc. (hereinafter, referred to as 'laundry') using a chemical decomposition action of water and detergent and a physical action, such as friction, between water and laundry. The laundry treatment apparatus is basically configured to have a structure in which a drum for receiving laundry is rotatably installed. The laundry treatment apparatus may be classified as a front loading type laundry treatment apparatus, into which laundry is introduced through an introduction port provided in the front surface thereof, and a top loading type laundry treatment apparatus, into which laundry is introduced through an introduction port provided in the upper surface thereof.

[0004] The top loading type laundry treatment apparatus includes a cabinet, a tub disposed in the cabinet, the tub being provided in the upper surface thereof with an introduction port, a drum rotatably disposed in the tub, and a door for opening and closing the introduction port. In addition, a door may be disposed at the top of the tub so as to be connected to the tub in order to open and close the open top of the tub, and a top cover may be disposed at the remaining portion of the top of the tub, excluding the portion of the top of the tub at which the door is disposed, in order to cover the tub.

[0005] In addition, the laundry treatment apparatus further includes a detergent introduction unit for supplying detergent or fabric softener to the tub. When water is supplied into the tub through the detergent introduction unit from the outside, detergent or fabric softener from the detergent introduction unit is introduced into the tub together with the water.

[0006] In a conventional detergent introduction unit, however, some of the detergent or fabric softener remains in the detergent introduction unit even after water is supplied up to a predetermined level of the tub.

[0007] Korean Patent Application Publication No. 10-2106-0058737 (2016.05.25) discloses a laundry treatment apparatus including a detergent reception unit and a rotary device rotatably coupled to at least a portion of the detergent movement path such that detergent from the detergent reception unit is supplied in a dissolved state, whereby the detergent is prevented from remaining in the detergent reception unit.

[0008] In this publication, however, the detergent remaining in the detergent reception unit may not be removed depending on when the supply of water is stopped.

[0009] If detergent or fabric softener remains in the de-

tergent introduction unit, the detergent introduction unit may be contaminated. In addition, an introduction port, through which detergent or fabric softener is introduced into the tub, may become clogged.

SUMMARY OF THE INVENTION

[0010] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a laundry treatment apparatus that is capable of controlling the supply of water to a detergent introduction unit for receiving detergent or fabric softener in order to remove remaining water from the detergent introduction unit and a control method thereof.

[0011] The invention is defined by the independent claims. Dependent claims refer to preferred embodiments.

[0012] According to the invention, it is provided a laundry treatment apparatus comprising: a tub having therein a space for storing wash water; a drum rotatably provided in the tub; a door for opening and closing an open top of the tub; a top cover disposed along an outer circumference of the door so as to be spaced apart from the door by a predetermined distance; a detergent introduction unit formed in the top cover for receiving an additive; a water supply unit for allowing or interrupting supply of water to the tub or to the detergent introduction unit; and a controller for controlling rotation of the drum and performing control such that, while water is supplied to the tub, supply of at least some of the water to the detergent introduction unit is allowed or interrupted, wherein the controller is configured to control the water supply unit, to divide a water supply operation of supplying water to the detergent introduction unit into a plurality of steps, and to set a water supply time for each step in order to remove remaining water from the detergent introduction unit.

[0013] Preferably, the detergent introduction unit is configured to introduce the water and the additive therein into the tub using a siphon phenomenon.

[0014] Preferably, the controller is configured to interrupt a supply of water to the detergent introduction unit for a time during which the water supplied to the detergent introduction unit is introduced into the tub.

[0015] Preferably, the water supply unit comprises a water supply valve for allowing or interrupting supply of water to the tub.

[0016] Preferably, the water supply unit comprises a first valve mounted in a water supply channel, diverging from a water supply pipe for guiding at least some of water that is supplied to the tub to the detergent introduction unit, for allowing or interrupting supply of water to the detergent introduction unit.

[0017] Preferably, the controller is configured to transmit a control command for opening the water supply valve after opening the first valve and closing the first valve after closing the water supply valve to the water supply

unit in order to stepwise supply water to the detergent introduction unit.

[0018] Preferably, the detergent introduction unit comprises an introduction bowl formed in the top cover so as to be recessed downwards, the introduction bowl having therein a space of a predetermined size for receiving the additive.

[0019] Preferably, the detergent introduction unit comprises a detergent housing mounted in the top cover for receiving the introduction bowl.

[0020] Preferably, the detergent introduction unit is disposed at a front corner of the top cover.

[0021] Preferably, the detergent introduction unit comprises a water supply connection pipe connected to a water supply channel, diverging from a water supply pipe for guiding at least some of water that is supplied to the tub to the detergent introduction unit, for supplying water to the detergent introduction unit.

[0022] Preferably, the detergent introduction unit comprises a plurality of introduction holes formed in the introduction bowl such that the water and the additive flow between the detergent housing and the introduction bowl therethrough.

[0023] Preferably, the detergent introduction unit comprises an introduction pipe formed by the introduction bowl and the detergent housing for allowing a mixture of the water and the additive in the detergent introduction unit to flow to the tub therethrough according to the siphon phenomenon.

[0024] Preferably, the controller is configured to divide a time for which water is supplied to the tub into a plurality of periods.

[0025] Preferably, the controller is configured to control the water supply unit such that supply of water to the detergent introduction unit is allowed or interrupted in each period.

[0026] Preferably, after the water is supplied to the detergent introduction unit, the controller is configured to interrupt supply of water to the detergent introduction unit for a predetermined amount of time or more such that a mixture of the water and fabric softener in the detergent introduction unit is introduced into the tub according to the siphon phenomenon.

[0027] Preferably, the controller is configured to set a water supply time for which water is supplied to the detergent introduction unit such that the water supply time is longer than a siphon operation time until, after the water is supplied to a laundry introduction unit, the water in the laundry introduction unit starts to be introduced into the tub.

[0028] Preferably, the controller is configured to set a water supply time for which water is supplied to the detergent introduction unit a value obtained by subtracting the siphon operation time from the water supply time is equal to or less than an introduction time until a level of the water in the detergent introduction unit reaches a bottom level after the water from the laundry introduction unit is introduced into the tub.

[0029] Preferably, the controller is configured to set the water supply time for which water is supplied to the detergent introduction unit to 16 to 18 seconds.

[0030] Preferably, the controller is configured to set a time for which supply of water to the detergent introduction unit is stopped to 16 to 20 seconds.

[0031] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a first period in which water is supplied to the tub and to the detergent introduction unit until water in the tub reaches a predetermined water level and supply of water is stopped when the water in the tub reaches the predetermined water level.

[0032] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a second period in which supply of water to the detergent introduction unit is interrupted and water is supplied to the tub for a first time.

[0033] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a third period in which water is supplied to the detergent introduction unit and to the tub for a second time.

[0034] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a fourth period in which supply of water is interrupted for a third time.

[0035] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a fifth period in which water is supplied to the tub and to the detergent introduction unit for a fourth time.

[0036] Preferably, in order to control supply of water to the tub and to the detergent introduction unit, the controller is configured to divide a water supply period into a sixth period in which water is supplied up to a target level of the tub.

[0037] Preferably, when an operation is temporarily stopped in one of the first to sixth periods, an initial operation of each period is performed again.

[0038] Furthermore, according to the invention, it is provided a control method of a laundry treatment apparatus, the control method comprising: supplying water to a tub and to a detergent introduction unit until water in the tub reaches a predetermined water level and stopping supply of water when the water in the tub reaches the predetermined water level as a first step; interrupting supply of water to the detergent introduction unit and supplying water to the tub for a first time as a second step; supplying water to the detergent introduction unit and to the tub for a second time as a third step; interrupting supply of water for a third time as a fourth step; supplying water to the tub and to the detergent introduction unit for a fourth time as a fifth step; and supplying water up to a target level of the tub and completing supply of water as

a sixth step.

[0039] Preferably, when an operation is temporarily stopped and then a stopped state is released at one of the first to sixth steps, an initial operation of each period is performed again.

[0040] Preferably, each of the second step, the fourth step, and the sixth step comprises interrupting supply of water to the detergent introduction unit for a predetermined amount of time or more such that a mixture of the water and fabric softener in the detergent introduction unit is introduced into the tub according to a siphon phenomenon.

[0041] Preferably, each of the third step and the fifth step comprises supplying water for a water supply time set to be longer than a siphon operation time until, after water is supplied to the laundry introduction unit, the water in the laundry introduction unit starts to be introduced into the tub and such that a value obtained by subtracting the siphon operation time from the water supply time is equal to or less than an introduction time until a level of the water in the detergent introduction unit reaches a bottom level after the water from the laundry introduction unit is introduced into the tub.

[0042] In accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of a laundry treatment apparatus including a drawer disposed so as to be withdrawn through one side of a cabinet, which is open, the cabinet defining the external appearance thereof, the drawer being open at the top thereof, a tub disposed in the drawer for defining a space for storing wash water, a drum rotatably disposed in the tub, a door for opening and closing the top of the tub, which is open, a top cover for covering the open top of the drawer, the top cover being disposed along the outer circumference of the door so as to be spaced apart from the door by a predetermined distance, a detergent introduction unit formed in the top cover for receiving an additive, a water supply unit for allowing or interrupting the supply of water to the tub or to the detergent introduction unit, and a controller for controlling the rotation of the drum and performing control such that at least some of the water that is supplied to the tub is supplied to the detergent introduction unit, wherein the controller controls the water supply unit such that, while water is supplied to the tub, the supply of the water to the detergent introduction unit is allowed or interrupted, in order to remove remaining water from the detergent introduction unit.

[0043] In accordance with another aspect of the present invention, there is provided a control method of a laundry treatment apparatus, the control method including determining whether rinsing to be performed is final rinsing at a rinsing step that follows a washing step of separating foreign matter from laundry, supplying water to a tub upon determining that the rinsing to be performed is final rinsing, supplying at least some of the water that is supplied to the tub to a detergent introduction unit, interrupting the supply of water to the detergent in-

troducton unit, repeatedly allowing and interrupting the supply of water to the detergent introduction unit in order to remove remaining water from the detergent introduction unit, and interrupting the supply of water to the detergent introduction unit, supplying water up to a target level of the tub, and completing the supply of water.

[0044] In accordance with a further aspect of the present invention, there is provided a control method of a laundry treatment apparatus, the control method including supplying water to a tub and to a detergent introduction unit until water in the tub reaches a predetermined water level and stopping the supply of water when the water in the tub reaches the predetermined water level (a first step), interrupting the supply of water to the detergent introduction unit and supplying water to the tub for a first time (a second step), supplying water to the detergent introduction unit and to the tub for a second time (a third step), interrupting the supply of water for a third time (a fourth step), supplying water to the tub and to the detergent introduction unit for a fourth time (a fifth step), and supplying water up to a target level of the tub and completing the supply of water (a sixth step).

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of a laundry treatment apparatus according to an embodiment of the present invention;

FIG. 2 is a perspective view of a first laundry treatment apparatus according to an embodiment of the present invention;

FIG. 3 is a perspective view showing the state in which a drawer of the first laundry treatment apparatus according to the embodiment of the present invention is withdrawn;

FIG. 4 is a sectional view of the first laundry treatment apparatus according to the embodiment of the present invention;

FIG. 5 is an exploded perspective view showing a drawer according to an embodiment of the present invention and elements disposed in the drawer;

FIG. 6 is a plan view of the drawer according to the embodiment of the present invention;

FIG. 7 is a perspective view showing the state in which a door of the drawer according to the embodiment of the present invention is open;

FIG. 8 is a perspective view showing a detergent introduction unit of the drawer according to the embodiment of the present invention;

FIG. 9 is a sectional view of the detergent introduction unit shown in FIG. 8;

FIG. 10 is a reference view illustrating a water supply channel in the drawer according to the embodiment

of the present invention;

FIG. 11 is a block diagram schematically showing the control construction of the first laundry treatment apparatus according to the embodiment of the present invention;

FIG. 12 is a reference view illustrating the principle by which a detergent introduction unit according to an embodiment of the present invention is operated; FIGS. 13 and 14 are reference views illustrating the amount of water that remains in the detergent introduction unit through water supply control according to an embodiment of the present invention;

FIG. 15 is a reference view illustrating a water supply method of the first laundry treatment apparatus according to the embodiment of the present invention; and

FIG. 16 is a flowchart showing a control method of the first laundry treatment apparatus according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0046] Advantages, features and methods for achieving those of embodiments may become apparent upon referring to embodiments described later in detail together with the attached drawings. However, embodiments are not limited to the embodiments disclosed hereinafter, but may be embodied in different modes. The embodiments are provided for perfection of disclosure and informing a scope to persons skilled in this field of art. The same reference numbers may refer to the same elements throughout the specification.

[0047] Hereinafter, embodiments of a laundry treatment apparatus according to the present invention will be described with reference to the accompanying drawings.

<First laundry treatment apparatus and second laundry treatment apparatus>

[0048] FIG. 1 is a perspective view of a laundry treatment apparatus according to an embodiment of the present invention.

[0049] The laundry treatment apparatus according to the present invention, which is an apparatus that washes, rinses, spin-dries, or dries laundry, may be configured to include only a first laundry treatment apparatus 100 or to include both a first laundry treatment apparatus 100 and a second laundry treatment apparatus 10 disposed on the first laundry treatment apparatus 100.

[0050] Referring to FIG. 1, the laundry treatment apparatus according to this embodiment may be configured such that the second laundry treatment apparatus 10 is disposed on the first laundry treatment apparatus 100. However, this is merely an example. Alternatively, only the first laundry treatment apparatus 100 may be independently provided.

[0051] The second laundry treatment apparatus 10

may include a second cabinet 20, which defines the external appearance thereof, and a second door 30 for opening and closing the front of the second cabinet 20. In addition, the second laundry treatment apparatus 10 may further include a second tub (not shown) disposed in the second cabinet 20 for defining a space for storing wash water, a second drum (not shown) rotatably disposed in the second tub for defining a space for storing laundry, a second water supply unit (not shown) for supplying wash water to the second tub, and a second drainage unit (not shown) for discharging the wash water stored in the second tub out of the second cabinet 20.

<First laundry treatment apparatus>

[0052] FIG. 2 is a perspective view of a first laundry treatment apparatus according to an embodiment of the present invention. FIG. 3 is a perspective view showing the state in which a drawer of the first laundry treatment apparatus according to the embodiment of the present invention is withdrawn. FIG. 4 is a sectional view of the first laundry treatment apparatus according to the embodiment of the present invention. FIG. 5 is an exploded perspective view showing a drawer according to an embodiment of the present invention and elements disposed in the drawer. FIG. 6 is a plan view of the drawer according to the embodiment of the present invention. FIG. 7 is a perspective view showing the state in which a door of the drawer according to the embodiment of the present invention is open.

[0053] Hereinafter, the first laundry treatment apparatus according to the embodiment of the present invention (hereinafter, simply referred to as a "laundry treatment apparatus") will be described with reference to FIGS. 2 to 7.

[0054] The first laundry treatment apparatus according to this embodiment includes a cabinet 110, which defines the external appearance thereof, the cabinet 110 being open at one side thereof, a drawer 120 disposed so as to be withdrawn through the open side of the cabinet 110, the drawer 120 being open at the top thereof, a tub 170 disposed in the drawer 120 for defining a space for storing wash water, a drum 210 rotatably disposed in the tub 170, a door 190 for opening and closing the top of the tub 170, which is open, a top cover 140 for covering the open top of the drawer 120, the top cover 140 being disposed along the outer circumference of the door 190 so as to be spaced apart from the door 190 by a predetermined distance, and a shock absorption unit disposed at the tub 170 or disposed so as to be opposite the tub 170 for preventing the top cover 140 from contacting the door 190.

[0055] The laundry treatment apparatus 100 according to this embodiment may further include a plurality of suspension members (not shown) disposed between the tub 170 and the drawer 120. One end of each of the suspension members may be connected to the inner upper part of the drawer 120, and the other end of each of the sus-

pension members may be connected to the outer lower part of the tub 170.

[0056] The cabinet 110 defines the external appearance of the laundry treatment apparatus. The cabinet 110 has therein a space for receiving the drawer 120. The cabinet 110 may have a box shape that is open at the front thereof.

[0057] The cabinet 110 may be provided in the rear surface thereof with a through-hole, through which a portion of a water supply unit 240 or a drainage unit 250 extends. A separate base 126 may be mounted to the bottom of the cabinet 110.

[0058] The drawer 120 is disposed so as to be withdrawn through the front open side of the cabinet 110. The drawer 120 may be received in the cabinet 110, or may be disposed such that a portion of the drawer 120 is withdrawn ahead of the cabinet 110.

[0059] The drawer 120 has therein a space for receiving the tub 170. The top of the drawer 120 is open. The drawer 120 is disposed so as to be movable along the inner surface of the cabinet 110. The drawer 120 includes a drawer body 122, which defines a space for receiving the tub 170, the drawer body 122 being inserted into the cabinet 110, and a drawer panel 124 disposed at the front of the drawer body 122 for opening and closing the open front of the cabinet 110.

[0060] Inside the drawer body 122 are formed drawer brackets 130, to which the suspension members are connected. The drawer brackets 130 are formed at the inner upper part of the drawer body 122 so as to protrude. In this embodiment, four drawer brackets 130 are disposed at respective inner corners of the drawer body 122. The drawer brackets 130 protrude toward the center of the tub 170.

[0061] Each of the drawer brackets 130 is provided with a suspension hole (not shown), which is formed vertically through the drawer bracket 130 such that one end of a corresponding one of the suspension members is inserted into and supported by the drawer bracket 130. Each of the drawer brackets 130 is provided with a recess (not shown), which extends in one direction in order to guide the insertion of each of the suspension members into a corresponding one of the suspension holes.

[0062] The drawer panel 124 is disposed such that a portion of the drawer panel 124 is opposite the front edge 112 of the cabinet 110. The drawer panel 124 is disposed at the front of the drawer body 122. A portion of the drawer panel 124 may contact the front edge 112 of the cabinet 110 in order to limit the rearward movement of the drawer body 122.

[0063] The drawer panel 124 may be provided with a control panel 128 for allowing a control command related to the operation of the laundry treatment apparatus 100 to be input or outputting the operational state of the laundry treatment apparatus 100.

[0064] The top cover 140 is disposed at the top of the drawer body 122. The top cover 140 is provided with an entrance 142, through which laundry is introduced and

removed. The top cover 140 is disposed along the outer circumference of the door 190, a description of which will follow, so as to be spaced apart from the door 190 by a predetermined distance. When the tub 170 vibrates, the door 190, which is connected to the tub 170, may also vibrate. Since the top cover 140 is disposed along the outer circumference of the door 190 so as to be spaced apart from the door 190 by a predetermined distance, the top cover 140 may not be affected by the vibration of the tub 170. In addition, the top cover 140 may be provided with a water supply through-hole 144, through which one end of the water supply unit 240 extends.

[0065] The top cover 140 may be provided in the front thereof with at least one detergent introduction unit 154 for introducing detergent into the tub 170. In this embodiment, detergent introduction units 154 may be provided at opposite sides of the front of the drawer 120, which is adjacent to a user when the drawer 120 is withdrawn from the cabinet 110. The detergent introduction units 154 may be disposed at the front corners of the top cover 140. Each detergent introduction unit 154 includes an introduction bowl 156 formed in the top cover 140 so as to be recessed downwards. An introduction hole 158, through which detergent is introduced into the tub 170, is formed in one side of the introduction bowl 156. The top cover 140 may be formed at the top of the drawer body 122 so as to protrude in order to secure a storage space in the introduction bowl 156.

[0066] Each detergent introduction unit 154 is connected to the tub 170 via a detergent introduction pipe 160. Consequently, detergent stored in each detergent introduction unit 154 is supplied into the tub 170 via the detergent introduction pipe 160.

[0067] The top cover 140 is provided at the outer edge thereof with fastening ribs, which are fastened to the drawer 120. The top cover 140 is fastened to the drawer panel 124 at the front thereof, and is fastened to the drawer body 122 at the opposite sides and the rear thereof. The side ends and the rear end of the top cover 140 are bent toward the drawer body 122 and are provided with fastening ribs, which are fastened to the drawer body 122.

[0068] The top cover 140 covers the remaining portion of the top of the tub 170 excluding the portion of the tub 170 corresponding to the door 190. The top cover 140 includes a top part 146 formed at the top of the drawer 120 so as to be flat and a curved part 148 bent downwards from the top part 146 so as to be concave toward the door 190.

[0069] The top part 146 of the top cover 140 is spaced apart from a door panel 192 of the door 190, a description of which will follow, by a predetermined distance. The top part 146 is formed at almost the same height as the door panel 192, and is spaced apart from the door panel 192 by a predetermined distance. The top part 146 of the top cover 140 is formed at almost the same height as the door panel 192 in order to secure a space for temporarily storing detergent to be introduced into the introduction bowl 156 of each detergent introduction unit 154.

[0070] The curved part 148 is curved downwards toward the bottom of the door panel 192 and is disposed at the bottom of the door panel 192 so as to cover the top of the tub 170.

[0071] The tub 170 defines a space for storing wash water to be used to treat laundry. The tub 170 is disposed in the drawer 120. The tub 170 has a cylindrical shape that is hollow therein and is partially open at the top thereof.

[0072] The tub 170 includes a tub body 172, which defines a space for storing water, the tub body 172 being open at the top thereof, and a tub cover 176, which defines the top of the tub body 172.

[0073] The tub body 172 has a cylindrical shape that is open at the top thereof. The bottom of the tub body 172 is connected to the drainage unit 250, which drains wash water from the tub 170. At the outer circumference of the tub body 172 are formed tub brackets 174, to which the suspension members are connected.

[0074] The tub brackets 174 are disposed at the lower circumferential surface of the tub 170. The tub brackets 174 are disposed so as to correspond to the respective drawer brackets 130. The suspension members are connected to the tub brackets 174 via the drawer brackets 130 of the drawer 120 in order to connect the tub 170 to the drawer 120.

[0075] The tub cover 176 is provided with a laundry introduction port 178, through which the inside of the tub body 172 communicates with the outside of the tub body 172. The laundry introduction port 178 may be formed at the lower side of the entrance 142, which is formed in the top cover 140. The tub cover 176 is provided with a water supply port 180, through which water is supplied into the tub body 172. The water supply port 180 may be disposed at the lower side of the water supply through-hole 144, which is formed in the top cover 140.

[0076] The door 190, which opens and closes the laundry introduction port 178, is disposed at the upper side of the laundry introduction port 178 of the tub cover 176.

[0077] The door 190 is rotatably disposed at the upper side of the tub cover 176. The door 190 is hingedly fixed to the upper side of the tub cover 176. The door 190 may open the laundry introduction port 178 of the tub cover 176 such that the inside of the tub body 172 communicates with the outside of the tub body 172, or may close the laundry introduction port 178 of the tub cover 176 in order to prevent the water in the tub 170 from leaking to the outside.

[0078] The door 190 includes a door panel 192 for covering the open top of the tub 170, a sealing member 194 for sealing between the tub 170 and the door 190 when the door 190 closes the laundry introduction port 178 of the tub 170, and a connection member 196 for hingedly fixing the door panel 192 to the tub 170, the sealing member 194 being mounted to one side of the connection member 196. The door 190 may further include a hinge unit 198 disposed at one side of the door panel 192 for hingedly fixing the door panel 192 to one side of the tub

cover 176. The hinge unit 198 may be disposed at one side of the rear of the connection member 196.

[0079] The door 190 may further include a fixing member 200 for fixing the door 190 to one side of the tub 170 when the door 190 closes the laundry introduction port 178 of the tub 170. The fixing member 200 is disposed in front of the connection member 196. A one-touch click button, which is locked or unlocked by pushing, may be used as the fixing member 200.

[0080] The door panel 192 may open and close the laundry introduction port 178 of the tub cover 176. The door panel 192 is formed so as to be larger than the laundry introduction port 178 of the tub cover 176.

[0081] The sealing member 194 is disposed at the lower side of the door panel 192. The sealing member 194 forms a seal between the door panel 192 and the tub cover 176 when the door 190 closes the laundry introduction port 178 of the tub cover 176.

[0082] The drum 210 is rotatably disposed in the tub 170. The drum 210 has a cylindrical shape that is open at the top thereof. The open top of the drum 210 is disposed at the lower side of the laundry introduction port 178 of the tub 170. The drum 210 may include a balancer for preventing the drum 210 from vibrating excessively due to the eccentricity of laundry when the drum 210 is rotated by a driving unit 220.

[0083] The drum 210 is provided in the bottom surface and the circumferential surface thereof with a plurality of communication holes 212, through which the inside of the drum 210 communicates with the tub 170. The drum 210 is rotated in the tub 170 by the driving unit 220. The drum 210 is provided on the bottom surface thereof with at least one washing protrusion 214, which protrudes from the bottom surface of the drum 210 to generate a water current during the rotation of the drum 210.

[0084] The driving unit 220 includes a stator, a rotor configured to be rotated by a rotating field generated by the stator, and a rotary shaft for transmitting the rotational force of the rotor to the drum 210.

[0085] The laundry treatment apparatus according to this embodiment further includes a water supply unit 240 for supplying water to the tub 170 and a drainage unit 250 for discharging the wash water stored in the tub 170 to the outside.

[0086] The water supply unit 240 includes a water supply pipe 242, which is connected to the water supply through-hole 144 in the tub cover 176, and a water supply valve 244 for allowing or interrupting the supply of water to the water supply pipe 242. A portion of the water supply pipe 242 may be formed as a bellows pipe in order to prevent the water supply pipe 242 from being separated from the tub 170 due to the vibration of the tub 170 or such that the length of the water supply pipe 242 is adjustable when the drawer 120 is withdrawn. The top cover 140 may further include a water supply port cover 150 for preventing a portion of the water supply valve 244 from being exposed to the outside when the drawer 120 is withdrawn.

[0087] The drainage unit 250 may include a drainage pipe 252 disposed at the lower side of the tub 170 for defining a drainage channel and a drainage pump 254 for pumping the wash water flowing in the drainage channel out of the laundry treatment apparatus 100. The drainage unit 250 may be disposed between the tub 170 and the drawer 120. A portion of the drainage pipe 252 may be formed as a bellows pipe in order to prevent the drainage pipe 252 from being separated from the tub 170 due to the vibration of the tub 170 or such that the length of the drainage pipe 252 is adjustable when the drawer 120 is withdrawn.

[0088] Fig. 6 shows the detergent introduction unit 154 comprising a first introduction unit 155 for receiving fabric softener and a second introduction unit 152 for receiving detergent.

[0089] FIG. 8 is a perspective view showing the first introduction unit 155 of the drawer 120 according to the embodiment of the present invention, and FIG. 9 is a sectional view of the first introduction unit 155 shown in FIG. 8.

[0090] As shown in FIGS. 8 and 9, the first introduction unit 155 defines a space for receiving an additive, such as detergent or fabric softener.

[0091] The components of the detergent introduction unit 154 are disposed on the left side and the right side of the top cover 140 at the front of the drawer body 122. Depending on the circumstances, the detergent introduction unit 154 may be disposed on one side of the top cover 140 at the front of the drawer body 122.

[0092] Hereinafter, the structure of the detergent introduction unit 154 will be described based on the first introduction unit 155. The first introduction unit 155 and the second introduction unit 152 may be identical in structure to each other except that the first introduction unit 155 and the second introduction unit 152 are disposed in a symmetrical fashion.

[0093] The first introduction unit 155 includes an introduction bowl 156 for receiving fabric softener and a detergent housing 157 for receiving the introduction bowl 156. The first introduction unit 155 further includes a water supply connection pipe 153 connected to a water supply channel for supplying water and an introduction pipe 159 for supplying fabric softener to the tub 170 together with the water through the water supply connection pipe 153. The introduction pipe 159 is connected to the detergent introduction pipe 160.

[0094] The introduction bowl 156 is provided with an introduction hole 158. The fabric softener in the introduction bowl 156 is introduced into the detergent housing 157 through the introduction hole 158. As a result, the fabric softener is stored in both the introduction bowl 156 and the detergent housing 157.

[0095] In addition, the water that is supplied to the first introduction unit 155 through the water supply connection pipe 153 flows to the detergent housing 157 with the fabric softener through the introduction hole 158 and is introduced into the tub 170 through the introduction pipe

159. A plurality of introduction holes 158 is formed in the introduction bowl 156. A first introduction hole 158a may be formed so as to be adjacent to the introduction pipe 159, and a second introduction hole 158b may be formed so as to be adjacent to the water supply connection pipe 153.

[0096] The water supply connection pipe 153 is connected to the water supply channel in the water supply unit 240 in order to supply water to the first introduction unit 155 via the water supply channel. The water that is supplied through the water supply connection pipe 153 is primarily received by the detergent housing 157, and some of the supplied water is introduced into the introduction bowl 156 through the introduction hole 158. The water flows from the introduction bowl 156 to the detergent housing 157 through the introduction hole 158, and is introduced to the tub 170 through the introduction pipe 159.

[0097] The introduction pipe 159 is configured to have a structure using a siphon phenomenon, in which, when liquid supplied to the introduction pipe 159 exceeds a predetermined level, the liquid in the introduction pipe 159 is discharged to the outside. Once the liquid flows, all of the liquid received in the introduction pipe 159 is discharged due to the force of the liquid that flows.

[0098] The fabric softener received in the introduction bowl 156 and the detergent housing 157 is mixed with the water that is introduced through the water supply connection pipe 153. When the level of the mixture of the water and the fabric softener becomes higher than the free end of the introduction pipe 159, the mixture is discharged through the introduction pipe 159 due to water pressure, and a siphon phenomenon occurs in the first introduction unit 155. Due to the siphon phenomenon, the mixture in the first introduction unit 155 flows along the introduction pipe 159 and is introduced into the tub 170. As a result, the remaining water is removed from the first introduction unit 155.

[0099] In the case in which the supply of water through the water supply connection pipe 153 is stopped when a siphon phenomenon occurs in the first introduction unit 155, all of the mixture in the first introduction unit 155 may move to the tub 170 through the introduction pipe 159, whereby the remaining water may be removed from the first introduction unit 155.

[0100] In the case in which water is continuously supplied through the water supply connection pipe 153 when a siphon phenomenon occurs in the first introduction unit 155, the additionally supplied water may remain in the first introduction unit 155.

[0101] The first laundry treatment apparatus is configured such that water is not continuously supplied to the first introduction unit 155 but the supply of water is stopped for a predetermined amount of time after water is supplied for a specific amount of time. The first laundry treatment apparatus 100 is configured such that the supply of water is stopped for a predetermined amount of time in order to remove the remaining water from the first

introduction unit 155 using a siphon phenomenon.

[0102] FIG. 10 is a reference view illustrating a water supply channel in the drawer according to the embodiment of the present invention.

[0103] As shown in FIG. 10, when water from a water supply hose is supplied to the water supply unit 240 via the water supply valve 244 (F1), the water is introduced into the tub 170 through the water supply pipe 242 (F2). In addition, the water from the water supply hose is supplied to the detergent introduction unit 154 through a water supply channel (not shown) defined in the lower part of the top cover 140 (F3 and F4). The water supply channel diverges from the water supply pipe 242 and is formed in the left upper end and the right upper end of the drawer 120 and in the lower part of the top cover 140 in order to supply water to the first introduction unit 155 and to the second introduction unit 152.

[0104] The supply of water to the water supply pipe 242, through which water is directly introduced into the tub 170, and to the second introduction unit 152 is controlled by the water supply valve 244.

[0105] In the water supply channel connected to the first introduction unit 155 is mounted a first valve 371 for controlling the supply of water to the first introduction unit 155.

[0106] During washing and rinsing, some of the supplied water is supplied to the tub 170 through the water supply pipe 242 (F2), and some of the supplied water is supplied to the second introduction unit 152 through the water supply channel (F4), whereby the water is supplied into the tub 170 together with the detergent in the second introduction unit 152.

[0107] Fabric softener is not introduced during washing but is introduced during final rinsing. In the laundry treatment apparatus, therefore, the first valve 371 is controlled to supply water to the first introduction unit 155 (F3) such that the fabric softener is supplied to the tub 170 during final rinsing.

[0108] FIG. 11 is a block diagram schematically showing the control construction of the first laundry treatment apparatus 100 according to the embodiment of the present invention.

[0109] As shown in FIG. 11, the first laundry treatment apparatus 100 includes a manipulation unit 330, an output unit 340, a sensor unit 350, a driving controller 360, a water supply unit 240, a drainage unit 380, a communication unit 390, a memory 320, and a controller 310 for controlling the overall operation thereof.

[0110] The manipulation unit 330 includes input means, such as at least one button, a switch, and a touchpad, which are provided at the control panel 128 (see Fig. 6).

[0111] The manipulation unit 330 allows operation settings, including power on/off, operation mode, kind of laundry, washing course, water level, and temperature, to be input. When the kind of laundry is selected and the power is turned on through the manipulation unit 330, data regarding the operation settings are input to the con-

troller 310. In the case in which the first laundry treatment apparatus 100 and the second laundry treatment apparatus 10 are installed so as to be adjacent to each other within a predetermined distance or in the case in which the first laundry treatment apparatus 100 and the second laundry treatment 10 apparatus are disposed one on another, the manipulation unit 330 may include a twin washing key (not shown) for allowing the two laundry treatment apparatus to be operated together.

[0112] The output unit 340 outputs information about the operation settings and the operational state of the laundry treatment apparatus.

[0113] The output unit 340 includes a display for displaying a combination of one of more selected from among letters, numerical icons, images, and special characters on a screen, a lamp for indicating the operational state of the laundry treatment apparatus depending on lighting thereof, and a speaker or a buzzer for outputting a predetermined effect sound or warning sound.

[0114] The display may include a menu screen for operation settings and operation control of the laundry treatment apparatus, and may output an announcement message or a warning message including a combination of one or more selected from among letters, numbers, and images for operation settings and operation control of the laundry treatment apparatus.

[0115] The output unit 340 may output a warning sound or a warning message when the laundry treatment apparatus is in an abnormal state.

[0116] The memory 320 stores control data for operation control of the laundry treatment apparatus, data regarding the input operation settings, data regarding operation time calculated based on settings, data regarding a washing course, and data for determining whether errors have occurred.

[0117] In addition, the memory 320 stores data that is generated during the operation of the laundry treatment apparatus or sensed by the sensor unit 350 and data that is transmitted and received through the communication unit 390.

[0118] The memory 320 may be a hardware storage device, such as a ROM, a RAM, an EPROM, a flash drive, and a hard drive.

[0119] The communication unit 390 transmits and receives data in a wired or wireless fashion.

[0120] The communication unit 390 may be connected to a network provided in a building or within a predetermined distance, such as a home network, in order to transmit and receive data. In addition, the communication unit 390 may be connected to an external server, such as the Internet, in order to communicate with a terminal having a control function.

[0121] The communication unit 390 may transmit the operational state of the laundry treatment apparatus to a terminal or to another laundry treatment apparatus, and may receive a control command from the terminal or from an external server.

[0122] In the case in which the first laundry treatment

apparatus and the second laundry treatment apparatus are installed so as to be adjacent to each other within a predetermined distance, the communication unit 390 may transmit and receive data regarding the operation settings or the operational state of the second laundry treatment apparatus 10 to and from the second laundry treatment apparatus 10 such that the laundry treatment apparatuses can be operated together. For example, in the case in which the laundry treatment apparatuses are disposed one on another, the laundry treatment apparatuses may not simultaneously perform operations that generate vibrations based on received data.

[0123] The communication unit 390 transmits and receives data using short-distance wireless communication, such as ZigBee, Bluetooth, WiFi, or WiBro.

[0124] A power supply unit (not shown) converts commercial power supplied from the outside into operation power and supplies the converted operation power. The power supply unit interrupts the supply of overcurrent. The power supply unit rectifies and smooths power supplied from the outside in order to supply a predetermined operation power.

[0125] The sensor unit 350, which includes a plurality of sensors, measures the voltage or current of the laundry treatment apparatus and senses the rotational speed of a motor, a water level, temperature, and humidity. The measured and sensed values are input to the controller 310.

[0126] The sensor unit 350 may include a door sensor (not shown), a temperature sensor (not shown), a current sensor (not shown), and a water level sensor. In addition, the sensor unit 350 may further include a speed sensor for sensing the rotational speed of the motor, a humidity sensor, and a laundry sensor for sensing the state/material of laundry.

[0127] The temperature sensor senses the temperature in the laundry treatment apparatus and the water temperature. In the case in which a heater is provided, the temperature sensor senses the temperature of the heater. A plurality of temperature sensors may be provided at different positions in order to sense temperature. The water level sensor senses the level of water that is supplied to the tub 170. The current sensor senses current that is supplied to the motor. The door sensor senses whether the door 190 is open or closed. Before the laundry treatment apparatus is operated based on the settings, the door sensor senses whether the door 190 is open or closed, and transmits a sensing signal to the controller 310. In addition, the door sensor may sense whether laundry is caught in the door 190.

[0128] The driving controller 360 performs control such that current is supplied to the driving unit 220 and then the driving unit 220 is rotated. The driving controller 360 converts power supplied from the outside into power necessary to rotate the driving unit 220 in order to control the operation of the driving unit 220.

[0129] The driving controller 360 controls the rotational direction, the rotational angle, and the rotational speed

of the driving unit 220 according to a control command of the controller 310. The driving unit 220 is a motor. The driving controller 360 performs control such that the driving unit 220 is operated differently based on the set washing course and on whether washing, rinsing, or spin-drying is to be performed. The driving controller 360 controls the rotational direction, the rotational angle, and the rotational speed of the driving unit differently such that the wash water in the drum generates a water current having a specific form.

[0130] The water supply unit 240 controls the opening and closing of the water supply valve 244 and the first valve 371. Based on washing and rinsing cycles, the water supply unit 240 continuously supplies water or supplies water for a predetermined amount of time and then interrupts the supply of water, which is repeatedly performed such that water is intermittently supplied. At the time of final rinsing during the rinsing cycle, the water supply unit 240 controls the first valve 371 such that water is supplied to the first introduction unit 155.

[0131] The drainage unit 380 controls the opening and closing of a drainage valve 381 and the operation of a drainage pump 382 such that the water in the tub 170 is discharged to the outside through a drainage hose.

[0132] The controller 310 controls a series of washing procedures, including washing, rinsing, spin-drying, and drying. In the following description, the term "washing" refers to all operations of the laundry treatment apparatus, including a washing cycle, a rinsing cycle, a spin-drying cycle, and a drying cycle.

[0133] The controller 310 stores the operation settings in the memory 320 and signals a water level, temperature, and control pattern based on a washing course corresponding to the data stored in the memory in order to control the operation of the laundry treatment apparatus.

[0134] The controller 310 performs control such that the operation settings or the operational state of the laundry treatment apparatus is output through the output unit 340. In addition, the controller 310 performs control such that data is transmitted to the outside through the communication unit 390 and such that data received from the outside through the communication unit 390 is processed. The controller 310 may change the operation settings such that the laundry treatment apparatus is operated together with another laundry treatment apparatus based on data of the another laundry treatment apparatus received through the communication unit 390.

[0135] The controller 310 controls the water supply unit 240 and the drainage unit 380 such that water is supplied to the tub 170 and water is drained from the tub 170 depending on the operation settings, and transmits a control command to the driving controller 360 such that the drum 210 is rotated to perform washing according to the operation of the driving unit 220. In addition, the controller 310 transmits a control command to the heater (not shown) such that the heater heats wash water or such that a drying cycle is performed.

[0136] In addition, while water is supplied up to a pre-

determined level of the tub 170, the controller 310 controls the water supply unit 240 such that water is directly introduced into the tub 170 or is supplied into the tub 170 through the first introduction unit 155 or the second introduction unit 152 through the opening and closing of the valve.

[0137] The water supply unit 240 controls the opening and closing of the water supply valve 244 and the first valve 371 in response to a control command of the controller 310.

[0138] During a rinsing cycle, the controller 310 controls the water supply unit 240 such that some of the water is directly introduced into the tub 170 and such that some of the water is supplied to the tub 170 through the first introduction unit 155, whereby the fabric softener in the first introduction unit 155 is introduced into the tub together with the water.

[0139] The water supply unit 240 does not continuously supply water but supplies water for a predetermined amount of time and then stops the supply of water, which is repeatedly performed such that the fabric softener in the first introduction unit 155 is introduced into the tub 170 and such that no water remains in the first introduction unit 155.

[0140] The water supply unit 240 may supply water to the second introduction unit 152 in the same manner. Since detergent is received in the second introduction unit 152, the supply of water to the second introduction unit 152 may be controlled before washing such that no water remains in the second introduction unit 152.

[0141] FIG. 12 is a reference view illustrating the principle by which a detergent introduction unit 154 according to an embodiment of the present invention is operated.

[0142] As described above, the first introduction unit 155 includes the introduction bowl 156 and the detergent housing 157. The introduction pipe 159, which is defined by the introduction bowl 156 and the detergent housing 157, has a siphon structure, as shown in the figure.

[0143] In the case in which the level of the water in the first introduction unit 155 exceeds a reference water level h_1 , a mixture in the introduction bowl 156 and the detergent housing 157, i.e. a mixture of water and fabric softener, is discharged to the outside through the introduction pipe 159.

[0144] In the case in which water is supplied through the water supply connection pipe 153 while the water (the mixture) in the first introduction unit 155 is discharged to the tub 170 as the result of the level of the water in the first introduction unit 155 exceeding the reference water level, some water remains in the first introduction unit 155 when the supply of water is stopped. Meanwhile, in the case in which the supply of water is stopped when the water (the mixture) starts to be discharged from the first introduction unit 155, all of the water may be transmitted to the tub 170 due to a siphon phenomenon.

[0145] In the case in which the level of the water in the first introduction unit 155 is equal to or lower than a predetermined water level h_2 , all of the water in the first

introduction unit 155 may be discharged due to a siphon phenomenon. In the case in which the level of the water in the first introduction unit 155 is higher than the predetermined water level h_2 and is lower than the reference water level h_1 , some of the water remains in the first introduction unit 155 even when the water is discharged through the introduction pipe 159.

[0146] On the assumption that a siphon operation time until siphon operation is performed when water is supplied to the first introduction unit 155 is t_s and a time until the level of the water in the first introduction unit 155 reaches a bottom level after the siphon operation is performed, i.e. an introduction time, is t_e , an additional water supply time t_a must be longer than the siphon operation time t_s . The siphon operation time is a time until the mixture in the first introduction unit 155 starts to be introduced into the tub 170 after water is supplied to the first introduction unit 155.

[0147] The value obtained by subtracting the siphon operation time t_s from the additional water supply time t_a is a time during which water is additionally supplied after the siphon operation is performed, which is related to the amount of water remaining in the first introduction unit 155.

[0148] In the case in which the value obtained by subtracting the siphon operation time t_s from the additional water supply time t_a is greater than the introduction time t_e to the bottom level, some water remains in the first introduction unit 155. In the case in which the value obtained by subtracting the siphon operation time t_s from the additional water supply time t_a is equal to or less than the introduction time t_e to the bottom level, no water remains in the first introduction unit 155.

[0149] Consequently, the water level h_2 is set based on the level of water that is supplied to the first introduction unit 155 during the introduction time t_e to the bottom level. The water level h_2 may be variable depending on the capacity, water pressure, reference water level, water supply amount, and water introduction amount of the first introduction unit.

[0150] The controller 310 controls the water supply unit 240 such that the supply of water to the first introduction unit 155 is stepwise controlled during a rinsing cycle in order to prevent some water from remaining in the first introduction unit 155.

[0151] At the time of first supply of water during the rinsing cycle, water is supplied to the first introduction unit 155 based on the water level in the tub 170, which is set depending on a washing course. For this reason, it is difficult to determine whether some water remains in the first introduction unit 155. Consequently, the controller 310 performs control such that water is additionally supplied to the first introduction unit 155 stepwise in order to prevent some water from remaining in the first introduction unit 155.

[0152] Since it takes time until water is discharged due to a siphon phenomenon (the introduction time t_e to the bottom level), as described above, the controller 310 per-

forms control such that water is supplied for a specific amount of time and then the supply of water is stopped for a predetermined amount of time in order to introduce the water from the first introduction unit to the tub 170. In addition, since it is not possible to sense the level of the water remaining in the first introduction unit 155, the controller 310 performs control such that the additional supply of water is performed in two stages in order to prevent some water from remaining in the first introduction unit 155 irrespective of the level of the remaining water. At the time of additional supply of water, a water supply time and an interruption time may be set based on the predetermined water level described above in consideration of the capacity of the first introduction unit 155, the water supply flow rate, and the drainage flow rate.

[0153] After the first supply of water, additional supply of water may be performed twice in consideration both of the case in which the level of the remaining water is higher than a predetermined water level and of the case in which the level of the remaining water is equal to or lower than the predetermined water level.

[0154] FIGS. 13 and 14 are reference views illustrating the amount of water that remains in the detergent introduction unit 154 through water supply control according to an embodiment of the present invention.

[0155] As described with reference to FIG. 12, whether water remains in the first introduction unit 155 at the time of additional supply of water is determined depending on the level of the remaining water in the first introduction unit 155.

[0156] At the time of first supply of water to the first introduction unit 155, it is not possible to accurately check the amount of remaining water, since the amount of water that is supplied is variable depending on a washing course. After the first supply of water to the first introduction unit 155, therefore, the additional supply of water may be performed depending on the case in which the level of the remaining water is higher than the predetermined water level and the case in which the level of the remaining water is equal to or lower than the predetermined water level.

[0157] In the case in which the level of the remaining water in the first introduction unit 155 is a first water level h_3 , which exceeds the predetermined water level, after the first supply of water, as shown in FIG. 13(a), there is remaining water at the time of additional supply of water (second supply of water), as shown in FIG. 13(b). At this time, the level of the remaining water is a second water level h_5 , which is lower than the predetermined water level h_2 . When the additional supply of water (third supply of water) is performed, therefore, all of the water in the first introduction unit 155 is introduced into the tub 170, whereby there is no remaining water, as shown in FIG. 13(c).

[0158] Also, in the case in which the level of the remaining water in the first introduction unit 155 is a third water level h_4 after the first supply of water, as shown in FIG. 14(a), the third water level h_4 is lower than the pre-

determined water level h_2 . When the additional supply of water (second supply of water) is performed, therefore, there is no remaining water, as shown in FIG. 14(b).

[0159] When the additional supply of water (third supply of water) is performed in the state in which there is no remaining water (h_6), as shown in FIG. 14(b), there is no remaining water in the first introduction unit 155, as shown in FIG. 14(c).

[0160] At the time of additional supply of water, a water supply time and an interruption time may be set in consideration of a siphon operation time t_s until a siphon operation is performed and a time t_s until the level of the water in the first introduction unit 155 reaches the bottom level after the siphon operation is performed, as described with reference to FIG. 12. Even though the amount of remaining water at the time of first supply of water is not checked, the additional supply of water is performed twice while controlling a water supply time and an interruption time, as described above, whereby no water remains in the first introduction unit 155.

[0161] FIG. 15 is a reference view illustrating a water supply method of the first laundry treatment apparatus 100 according to the embodiment of the present invention.

[0162] As shown in FIG. 15, the water supply unit 240 controls the water supply valve 244 and the first valve 371 in response to a control command from the controller 310.

[0163] The water supply valve 244 is a main valve for supplying water from the water supply hose to the laundry treatment apparatus, and the first valve 371 is a valve for controlling the supply of water to the first introduction unit 15.

[0164] FIG. 15(a) shows the opening and closing operation of the water supply valve 244, and FIG. 15(b) shows the opening and closing operation of the first valve 371. A water supply procedure will be divided into a plurality of periods in order to describe the operation of the water supply valve 244 and the first valve 371. In the following description, the water supply procedure is a procedure of introducing fabric softener into the tub 170 at the time of final rinsing.

[0165] In the case in which water is supplied to the first introduction unit 155, the water supply unit 240 controls the first valve 371 before controlling the water supply valve 244, for example, at the final rinsing step. When the water supply valve 244 is opened, the operation of the first valve 371 may be limited due to water pressure. That is, the first valve 371 may malfunction due to water pressure. For this reason, the first valve 371 is controlled, and then the water supply valve 244 is controlled.

[0166] In a first period D_1 , before water is supplied, the water supply unit 240 opens the first valve (t_0) and then opens the water supply valve 244 (t_1) such that water is introduced into the tub 170 through the water supply pipe 241. In addition, the water is supplied to the first introduction unit 155 and the second introduction unit 152 through the water supply channel diverging from the wa-

ter supply pipe 241.

[0167] When the water in the tub 170 reaches a predetermined water level, the water supply unit 240 temporarily stops the supply of water. At this time, the water supply valve 244 is closed (t2) in consideration of the length of the water supply channel to the first valve 371 and the amount of water remaining in the water supply channel, and the first valve 371 is closed (t3) after a predetermined amount of time.

[0168] In the case in which the supply of water is temporarily stopped by input through the manipulation unit in the first period, the water supply unit 240 closes the water supply valve 244 and the first valve 371. When the temporarily stopped state is released, the first operation (t0) of the first period is performed again.

[0169] When first supply of water is completed in the first period D1, the water supply unit 240 stops the supply of water for a predetermined amount of time and then opens the water supply valve 244 such that water is supplied to the tub 170 in a second period D2. The first valve 371 remains closed. Water is directly introduced into the tub 170 through the water supply pipe 241, and some of the water is introduced into the tub 170 through the second introduction unit 152. No water is introduced into the first introduction unit 155.

[0170] While the supply of water to the first introduction unit 155 is stopped, some of the water in the first introduction unit 155 may be introduced into the tub 170, and some of the water may remain in the first introduction unit 155. It takes time until the water is discharged due to the siphon operation. Consequently, the supply of water to the first introduction unit 155 is stopped in order to discharge water from the first introduction unit 155.

[0171] In the case in which the supply of water is temporarily stopped by the manipulation in the second period, the water supply unit 240 stops the supply of water. When the temporarily stopped state is released, the first operation (t3) of the second period is performed again.

[0172] After the supply of water in the second period D2, the water supply unit 240 closes the water supply valve 244 in order to stop the supply of water.

[0173] In a third period D3, the water supply unit 240 opens the first valve (t6) after a predetermined amount of time in the state in which the water supply valve 244 and the first valve 371 are closed (t5), and opens the water supply valve 244 after a predetermined amount of time.

[0174] Water is introduced into the tub 170 through the water supply pipe 242. In addition, the water is supplied to the first and second introduction units 155, 152 through the water supply channel and is then introduced into the tub 170.

[0175] In the third period, the additional supply of water (second supply of water) to the first introduction unit 155 is performed.

[0176] The water supply unit 240 supplies water to the first introduction unit 155 for a predetermined amount of time.

[0177] After the predetermined amount of time, the water supply unit 240 closes the water supply valve 244, and then closes the first valve 371 in order to stop the supply of water (t8 and t9).

[0178] In the case in which the operation is temporarily stopped in the third period, the water supply unit 240 closes the water supply valve 244 and the first valve 371 in order to stop the supply of water. When the temporarily stopped state is released, the first operation (t5) of the third period is performed again.

[0179] In a fourth period D4, the water supply valve 244 and the first valve 371 remain closed for a predetermined amount of time, and the supply of water is stopped.

[0180] In the third period, the additional supply of water is performed in the state in which some of the water supplied at the time of the first supply of water (the first period) remains in the first introduction unit 155. In the fourth period, the supply of water is stopped, and the water introduced into the first introduction unit 155 is supplied to the tub 170 together with the fabric softener remaining in the first introduction unit 155 through the introduction pipe 159.

[0181] Whether water remains in the first introduction unit 155 at the time of the additional supply of water (second supply of water) is determined depending on the level of the remaining water at the time of the first supply of water.

[0182] In the case in which the level of the remaining water at the time of the first supply of water in the first period is equal to or higher to a predetermined water level, some water may remain in the first introduction unit 155 or all water may be discharged to the tub 170 through the introduction pipe 159 due to a siphon phenomenon in the fourth period as the result of additional supply of water in the third period.

[0183] In a fifth period D5, the water supply unit 240 opens the first valve 371 (t10) and opens the water supply valve 244 (t11) in order to supply water.

[0184] In the fifth period, the additional supply of water (third supply of water) to the first introduction unit 155 is performed.

[0185] In the case in which not all of the water introduced in the third period is introduced into the tub 170 but there is remaining water, the water may be completely introduced into the tub 170 through the additional supply of water in the fifth period.

[0186] In the case in which the operation is temporarily stopped by the manipulation in the fourth period and the fifth period, the water supply unit 240 performs the operation (t9) of the fourth period again when the temporarily stopped state is released.

[0187] The fourth period and the fifth period may constitute a single period.

[0188] After water is supplied for a predetermined amount of time, the water supply unit 240 closes the water supply valve 244 (S12) and then closes the first valve (S13) in order to stop the supply of water. After the first valve 371 is closed, all of the water supplied to the first

introduction unit 155 in a sixth period is introduced into the tub 170 due to a siphon phenomenon.

[0189] Since the level of the remaining water after the additional supply of water in the third period is equal to or lower than the predetermined water level, all of the water in the first introduction unit 155 may be introduced into the tub 170 through the additional supply of water in the fifth period. In a sixth period, all of the water in the first introduction unit 155 is introduced into the tub 170.

[0190] In the sixth period D6, the first valve 371 remains closed, and no additional supply of water is performed.

[0191] The water supply unit 240 opens the water supply valve (t14) to supply water up to a predetermined level of the tub 170.

[0192] In the case in which the operation is temporarily stopped by the manipulation when water is supplied in the first to fifth periods, the supply of water is stopped. When the temporarily stopped state is released, the water supply unit 240 controls the water supply valve 244 and the first valve 371 such that the initial operation of each period is performed again.

[0193] The reason that the temporarily stopped operation of each period is not performed but the initial operation of each period is performed again is that it is necessary to perform the operation of each period again in order to normally perform the supply of water, since it is not possible to determine whether there is remaining water as the result of stopping the supply of water to the first introduction unit 155, and thus the operation is controlled and determined based on the water supply time or the interruption time. Even when the operation is performed again after temporary stoppage, the water supply time in the sixth period is changed, since the final water level is set.

[0194] FIG. 16 is a flowchart showing a control method of the first laundry treatment apparatus according to the embodiment of the present invention.

[0195] As shown in FIG. 16, when operation settings are input through the manipulation unit 330, water is supplied to the tub 170 based on a washing course, temperature, etc., and washing is performed.

[0196] The laundry treatment apparatus removes contaminants from laundry through washing, rinsing, and spin-drying. In addition, the laundry treatment apparatus may dry the laundry after spin-drying the laundry.

[0197] At the time of washing, the water supply valve 244 is controlled to supply water up to a predetermined level of the tub 170. When the water supply valve 244 is opened, water is introduced into the tub 170 through the water supply pipe 159. Some of the water is introduced into the tub 170 together with detergent through the second introduction unit 152.

[0198] When washing is completed, water is drained, and water is supplied to the tub 170 again in order to perform rinsing. The rinsing is performed several times depending on settings.

[0199] After the water is drained from the tub 170 (S310), the controller 310 determines whether rinsing to

be performed is final rinsing before rinsing is performed (S320).

[0200] At the final rinsing, the controller 310 transmits a control command to the water supply unit 240 such that water is supplied to the first introduction unit 155 (S325).

[0201] At the final rinsing, when water is supplied to the tub 170, the water supply unit 240 opens the first valve 371 and then opens the water supply valve 244 such that some of the water is supplied to the first introduction unit 155 (first supply of water) (S330).

[0202] Some of the water is introduced into the tub 170 through the water supply pipe 159, and some of the water is introduced into the tub 170 through the first and second introduction units 155, 152 via the water supply channel.

The fabric softener in the first introduction unit 155 is introduced into the tub 170 together with the water supplied to the first introduction unit 155.

[0203] Time for the first supply of water is set based on the level of the water in the tub 170. When the level of the water in the tub 170 reaches a predetermined water level, the water supply unit 240 closes the water supply valve 244 and then closes the first valve 371 in order to stop the supply of water.

[0204] A predetermined time after the supply of water is stopped, the water supply unit 240 opens the water supply valve 244 in the state in which the first valve 371 remains closed in order to perform the supply of water (second supply of water) (S340). While water is supplied to the tub 170 through the water supply pipe 159 and the second introduction unit 152 in the state in which the supply of water to the first introduction unit 155 is stopped, the water supplied at the time of the first supply of water is discharged to the tub 170 through the introduction pipe 159. Water may remain in the first introduction unit 155 depending on the water supply interruption time.

[0205] After water is supplied for a predetermined amount of time, the water supply unit 240 closes the water supply valve 244 in order to stop the supply of water.

[0206] After a predetermined amount of time, the water supply unit 240 opens the first valve 371 and then opens the water supply valve 244 in order to perform third supply of water. Water is additionally supplied to the first introduction unit 155 (second supply of water for the first introduction unit 155) (S350). When water is additionally supplied after the first supply of water, the fabric softener remaining in the first introduction unit 155 is introduced into the tub 170 together with the water.

[0207] When the water supply valve 244 is closed and then the first valve 371 is closed in order to stop the supply of water, the water supply valve 244 and the first valve 371 remain closed for a predetermined amount of time, whereby the supply of water is stopped.

[0208] While the supply of water is stopped, the water in the first introduction unit 155 is discharged to the tub 170 through the introduction pipe 159. At this time, whether water remains in the first introduction unit 155 may be determined depending on the level of the water remaining in the first introduction unit 155 at the time of the first

supply of water. As described above, when the level of the water remaining in the first introduction unit 155 at the time of the first supply of water is equal to or lower than the predetermined water level h_2 , additionally supplied water is introduced into the tub 170 due to a siphon phenomenon, whereby all of the water may be discharged. When the level of the water remaining in the first introduction unit 155 at the time of the first supply of water is higher than the predetermined water level, some of the water may remain in the first introduction unit 155. At this time, the level of the remaining water is equal to or lower than the predetermined water level.

[0209] After the supply of water is stopped for a predetermined amount of time, the water supply unit 240 opens the water supply valve 244 in order to perform fourth supply of water (S360).

[0210] The water supply unit 240 closes the water supply valve 244 in order to stop the supply of water.

[0211] After the supply of water is stopped for a predetermined amount of time, the water supply unit 240 opens the first valve 371 and then opens the water supply valve 244 in order to perform fifth supply of water (S370).

[0212] As the first valve 371 is opened during the fifth supply of water, third supply of water for the first introduction unit 155 (additional supply of water) to the first introduction unit 155 through the water supply channel is performed for a predetermined amount of time.

[0213] As the result of the third supply of water to the first introduction unit 155 for the predetermined amount of time, all of the water in the first introduction unit 155 is discharged to the tub 170.

[0214] The water supply unit 240 closes the water supply valve 244 and then closes the first valve 371 in order to stop the supply of water.

[0215] After the third supply of water (the second supply of water to the first introduction unit 155), the level of the water remaining in the first introduction unit 155 is lower than a predetermined water level. As a result, while the supply of water to the first introduction unit 155 is stopped, all of the water in the first introduction unit 155, is supplied at the fifth supply of water, is discharged to the tub 170 due to a siphon phenomenon.

[0216] After a predetermined amount of time, the water supply unit 240 opens the water supply valve 244 in the state in which the first valve 371 remains closed in order to perform sixth supply of water (S380). Water is continuously supplied to the tub 170 until the level of the water in the tub 170 reaches a predetermined water level.

[0217] When the supply of water is completed, the drum 210 is rotated by the driving unit in order to perform rinsing (S390).

[0218] After rinsing, the water is drained and spin-drying is performed (S400).

[0219] In the present invention, therefore, fabric softener is discharged to the tub 170 together with water through the first introduction unit 155, which has a siphon structure. In addition, the additional supply of water is stepwise performed for a predetermined amount of time

in consideration of the capacity of the first introduction unit 155, the size of the siphon, the water supply flow rate, and the drainage flow rate, whereby it is possible to remove the remaining water from the first introduction unit 155.

[0220] As is apparent from the above description, it is possible for a laundry treatment apparatus according to the present invention and a control method thereof to control the supply of water to a detergent introduction unit, whereby it is possible to easily remove remaining water from the detergent introduction unit 154.

[0221] In addition, it is possible to easily set a water supply time based on the capacity of the detergent introduction unit 154, the water supply flow rate, and the drainage flow rate.

[0222] In addition, it is possible to secure the time necessary for the water from the detergent introduction unit 154 to be introduced into a tub 170 through water supply control such that detergent or fabric softener in the detergent introduction unit 154 is introduced into the tub 170 together with the water in the detergent introduction unit 154.

[0223] In addition, it is possible to control the supply of water irrespective of the level of water that is supplied to the tub 170 and the amount of water remaining in the detergent introduction unit 154 in order to remove remaining water from the detergent introduction unit 154, whereby it is possible to remove remaining water from the detergent introduction unit 154 even in the case in which the amount of water remaining in the detergent introduction unit 154 is not known.

[0224] In addition, it is possible to prevent wash water, detergent, or fabric softener from remaining in the detergent introduction unit 154, whereby it is possible to prevent the detergent introduction unit 154 from being contaminated by remaining water or from becoming clogged.

[0225] In addition, it is possible to keep the detergent introduction unit 154 clean.

[0226] Although an exemplary embodiment of the present invention has been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of the invention.

Claims

1. A laundry treatment apparatus comprising:

- a tub (170) having therein a space for storing wash water;
- a drum (210) rotatably provided in the tub (170);
- a door (190) for opening and closing an open top of the tub (170);
- a top cover (140) disposed along an outer circumference of the door (190) so as to be spaced

- apart from the door (190) by a predetermined distance;
- a detergent introduction unit (154) formed in the top cover (140) for receiving an additive;
- a water supply unit (240) for allowing or interrupting supply of water to the tub (170) or to the detergent introduction unit (154); and
- a controller (310, 360) for controlling rotation of the drum (210) and performing control such that, while water is supplied to the tub (170), supply of at least some of the water to the detergent introduction unit (154) is allowed or interrupted, wherein the controller (310, 360) is configured to control the water supply unit (240), to divide a water supply operation of supplying water to the detergent introduction unit (154) into a plurality of steps, and to set a water supply time for each step in order to remove remaining water from the detergent introduction unit (154).
2. The laundry treatment apparatus according to claim 1, wherein the detergent introduction unit (154) is configured to introduce the water and the additive therein into the tub (170) using a siphon phenomenon.
 3. The laundry treatment apparatus according to claim 1 or 2, wherein the controller (310, 360) is configured to interrupt a supply of water to the detergent introduction unit (154) for a time during which the water supplied to the detergent introduction unit (154) is introduced into the tub (170).
 4. The laundry treatment apparatus according to any one of claims 1 to 3, wherein the water supply unit (240) comprises:
 - a water supply valve (244) for allowing or interrupting supply of water to the tub (170); and
 - a first valve (371) mounted in a water supply channel, diverging from a water supply pipe (242) for guiding at least some of water that is supplied to the tub (170) to the detergent introduction unit (154), for allowing or interrupting supply of water to the detergent introduction unit (154), and wherein the controller (310, 360) is configured to transmit a control command for opening the water supply valve (244) after opening the first valve (371) and closing the first valve (371) after closing the water supply valve (244) to the water supply unit (240) in order to stepwise supply water to the detergent introduction unit (154).
 5. The laundry treatment apparatus according to any one of claims 1 to 4, wherein the detergent introduction unit (154) comprises:
 - an introduction bowl (156) formed in the top cover (140) so as to be recessed downwards, the introduction bowl (156) having therein a space of a predetermined size for receiving the additive; and
 - a detergent housing (157) mounted in the top cover (140) for receiving the introduction bowl (156), and wherein the detergent introduction unit (154) is disposed at a front corner of the top cover (140).
 6. The laundry treatment apparatus according to claim 5, wherein the detergent introduction unit (154) comprises:
 - a water supply connection pipe connected to a water supply channel, diverging from a water supply pipe (242) for guiding at least some of water that is supplied to the tub (170) to the detergent introduction unit (154), for supplying water to the detergent introduction unit (154);
 - a plurality of introduction holes (158) formed in the introduction bowl (156) such that the water and the additive flow between the detergent housing (157) and the introduction bowl (156) therethrough; and
 - an introduction pipe (159) formed by the introduction bowl (156) and the detergent housing (157) for allowing a mixture of the water and the additive in the detergent introduction unit (154) to flow to the tub (170) therethrough according to the siphon phenomenon.
 7. The laundry treatment apparatus according to any one of claims 1 to 6, wherein the controller (310, 360) is configured to divide a time for which water is supplied to the tub (170) into a plurality of periods, and the controller (310, 360) is configured to control the water supply unit (240) such that supply of water to the detergent introduction unit (154) is allowed or interrupted in each period.
 8. The laundry treatment apparatus according to any one of claims 1 to 7, wherein, after the water is supplied to the detergent introduction unit (154), the controller (310, 360) is configured to interrupt supply of water to the detergent introduction unit (154) for a predetermined amount of time or more such that a mixture of the water and fabric softener in the detergent introduction unit (154) is introduced into the tub (170) according to the siphon phenomenon.
 9. The laundry treatment apparatus according to any one of claims 1 to 8, wherein the controller (310, 360) is configured to set a water supply time for which water is supplied to the detergent introduction unit (154):

- such that the water supply time is longer than a siphon operation time until, after the water is supplied to a laundry introduction unit, the water in the laundry introduction unit starts to be introduced into the tub (170); and
- such that a value obtained by subtracting the siphon operation time from the water supply time is equal to or less than an introduction time until a level of the water in the detergent introduction unit (154) reaches a bottom level after the water from the laundry introduction unit is introduced into the tub (170).
- 10.** The laundry treatment apparatus according to any one of claims 1 to 9, wherein the controller (310, 360) is configured to set the water supply time for which water is supplied to the detergent introduction unit (154) to 16 to 18 seconds, and the controller (310, 360) is configured to set a time for which supply of water to the detergent introduction unit (154) is stopped to 16 to 20 seconds.
- 11.** The laundry treatment apparatus according to any one of claims 1 to 10, wherein, in order to control supply of water to the tub (170) and to the detergent introduction unit (154), the controller (310, 360) is configured to divide a water supply period into:
- a first period in which water is supplied to the tub (170) and to the detergent introduction unit (154) until water in the tub (170) reaches a predetermined water level and supply of water is stopped when the water in the tub (170) reaches the predetermined water level;
 - a second period in which supply of water to the detergent introduction unit (154) is interrupted and water is supplied to the tub (170) for a first time;
 - a third period in which water is supplied to the detergent introduction unit (154) and to the tub (170) for a second time;
 - a fourth period in which supply of water is interrupted for a third time;
 - a fifth period in which water is supplied to the tub (170) and to the detergent introduction unit (154) for a fourth time; and
 - a sixth period in which water is supplied up to a target level of the tub (170), and wherein when an operation is temporarily stopped in one of the first to sixth periods, an initial operation of each period is performed again.
- 12.** A control method of a laundry treatment apparatus, the control method comprising:
- supplying water to a tub (170) and to a detergent introduction unit (154) until water in the tub (170) reaches a predetermined water level and stop-
- ping supply of water when the water in the tub (170) reaches the predetermined water level as a first step;
- interrupting supply of water to the detergent introduction unit (154) and supplying water to the tub (170) for a first time as a second step;
- supplying water to the detergent introduction unit (154) and to the tub (170) for a second time as a third step;
- interrupting supply of water for a third time as a fourth step;
- supplying water to the tub (170) and to the detergent introduction unit (154) for a fourth time as a fifth step; and
- supplying water up to a target level of the tub (170) and completing supply of water as a sixth step.
- 13.** The control method according to claim 12, wherein, when an operation is temporarily stopped and then a stopped state is released at one of the first to sixth steps, an initial operation of each period is performed again.
- 14.** The control method according to claim 12 or 13, wherein, each of the second step, the fourth step, and the sixth step comprises interrupting supply of water to the detergent introduction unit (154) for a predetermined amount of time or more such that a mixture of the water and fabric softener in the detergent introduction unit (154) is introduced into the tub (170) according to a siphon phenomenon.
- 15.** The control method according to any one of claims 12 to 14, wherein each of the third step and the fifth step comprises supplying water for a water supply time set to be longer than a siphon operation time until, after water is supplied to the laundry introduction unit, the water in the laundry introduction unit starts to be introduced into the tub (170) and such that a value obtained by subtracting the siphon operation time from the water supply time is equal to or less than an introduction time until a level of the water in the detergent introduction unit (154) reaches a bottom level after the water from the laundry introduction unit is introduced into the tub (170).

Fig. 1

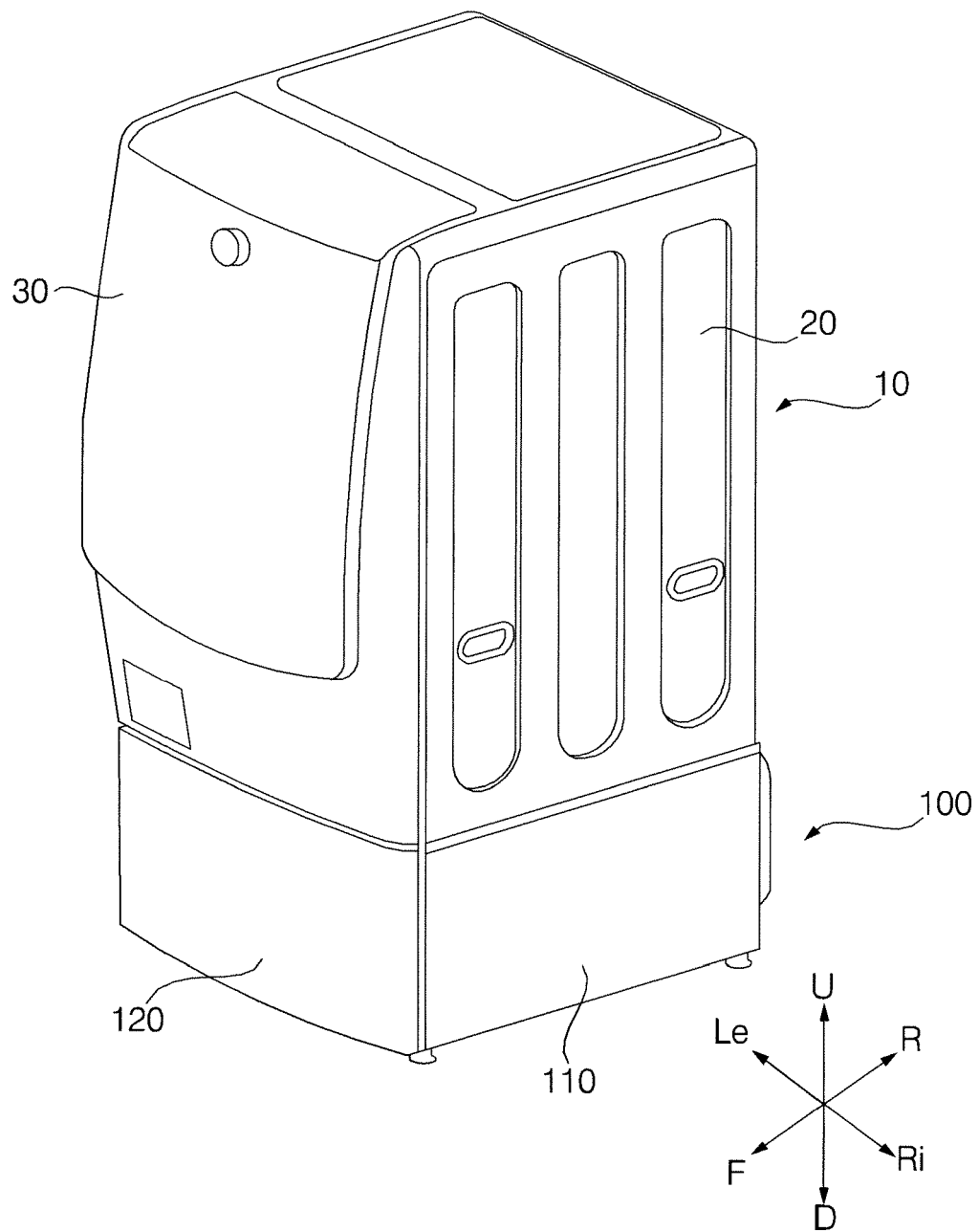


Fig. 2

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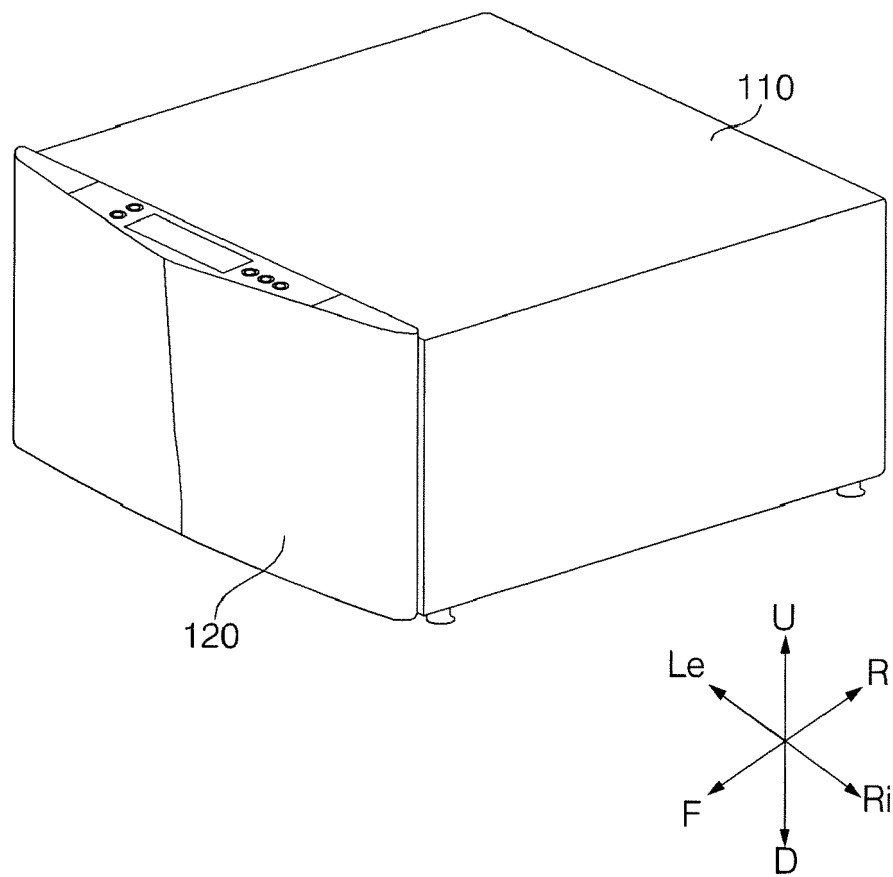


Fig. 3

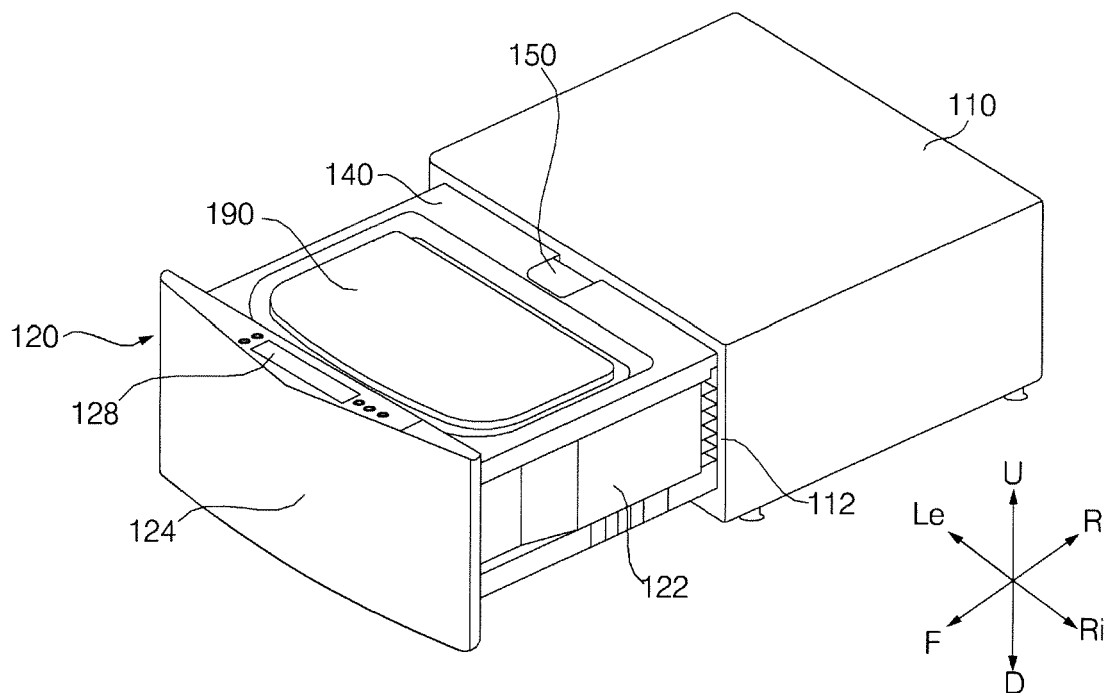


Fig. 4

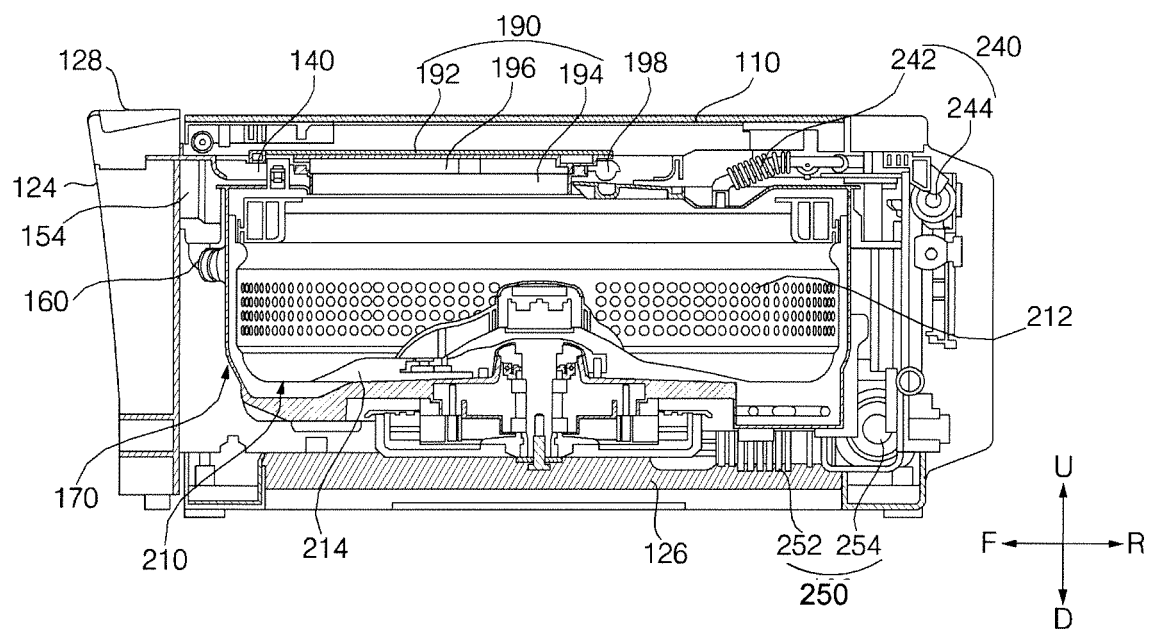


Fig. 5

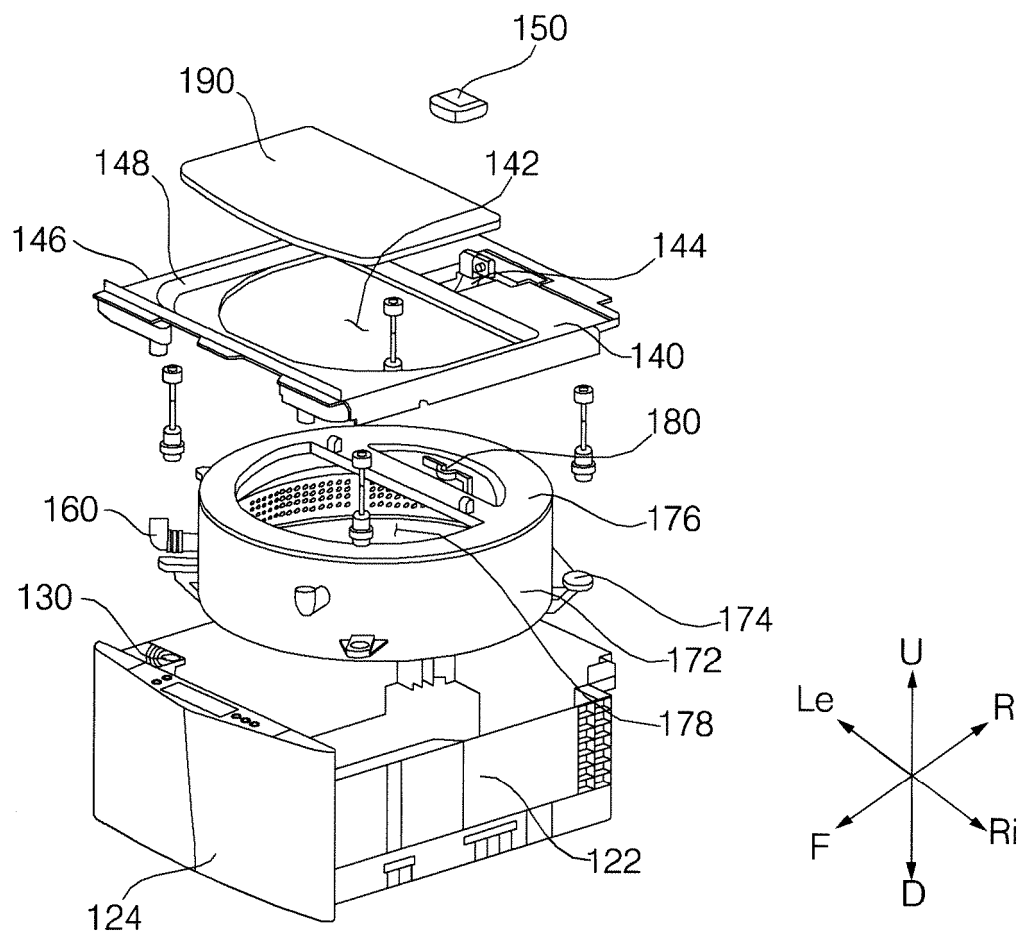


Fig. 6

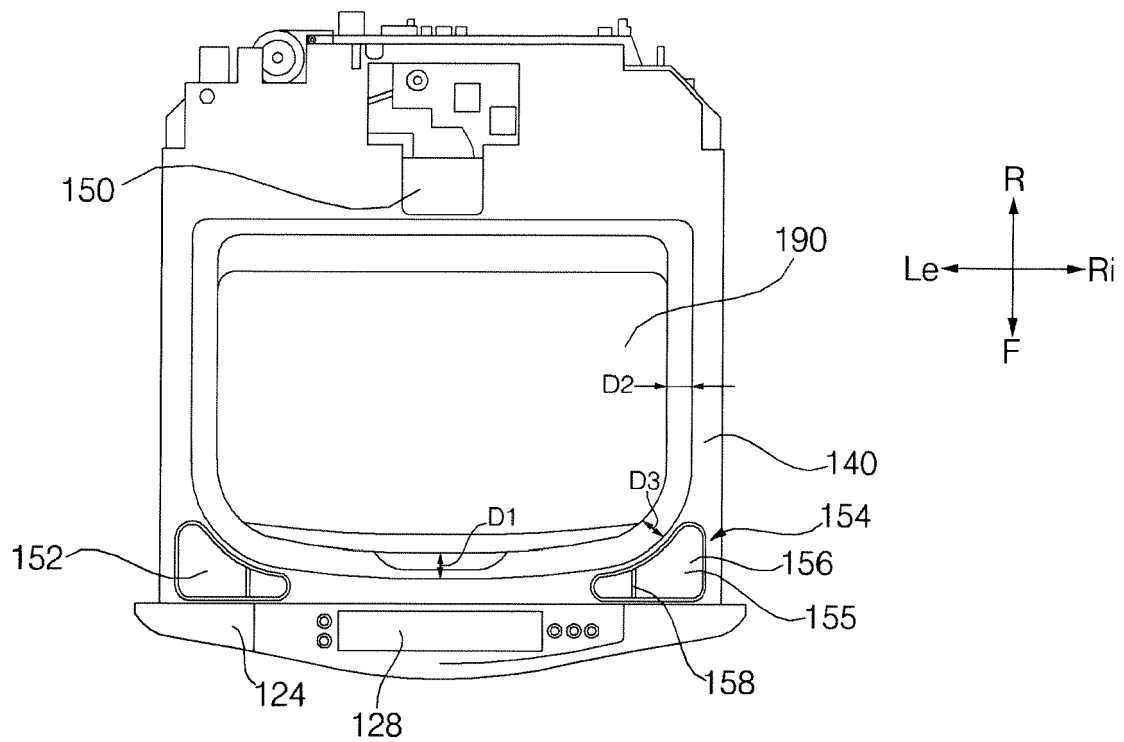


Fig. 7

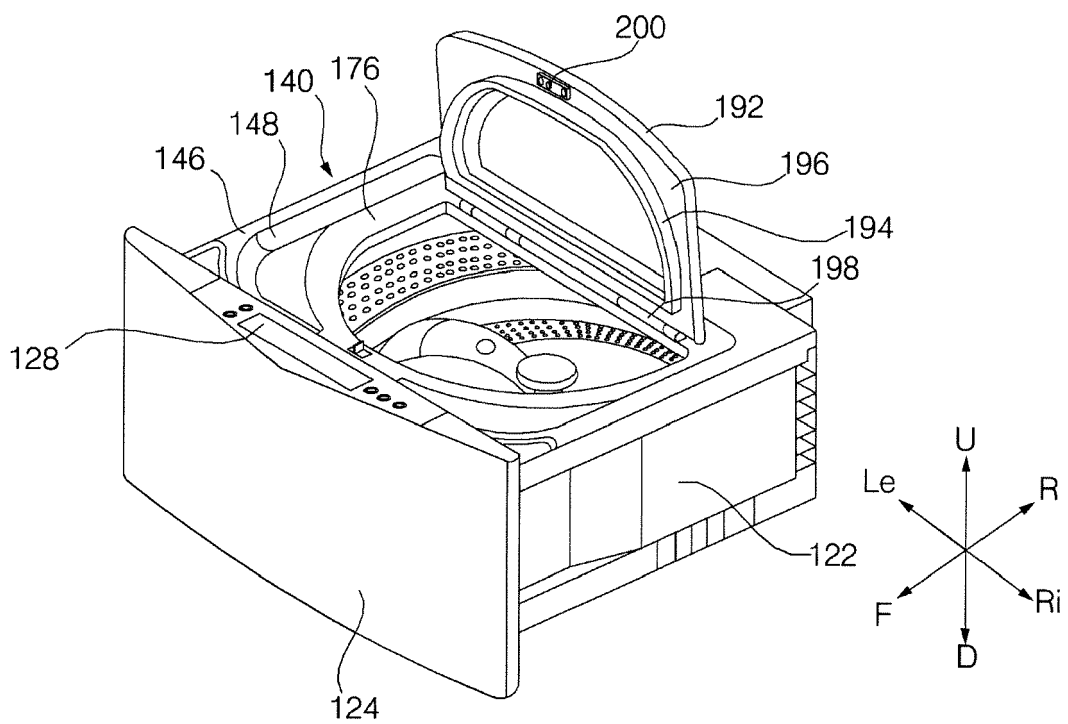


Fig. 8

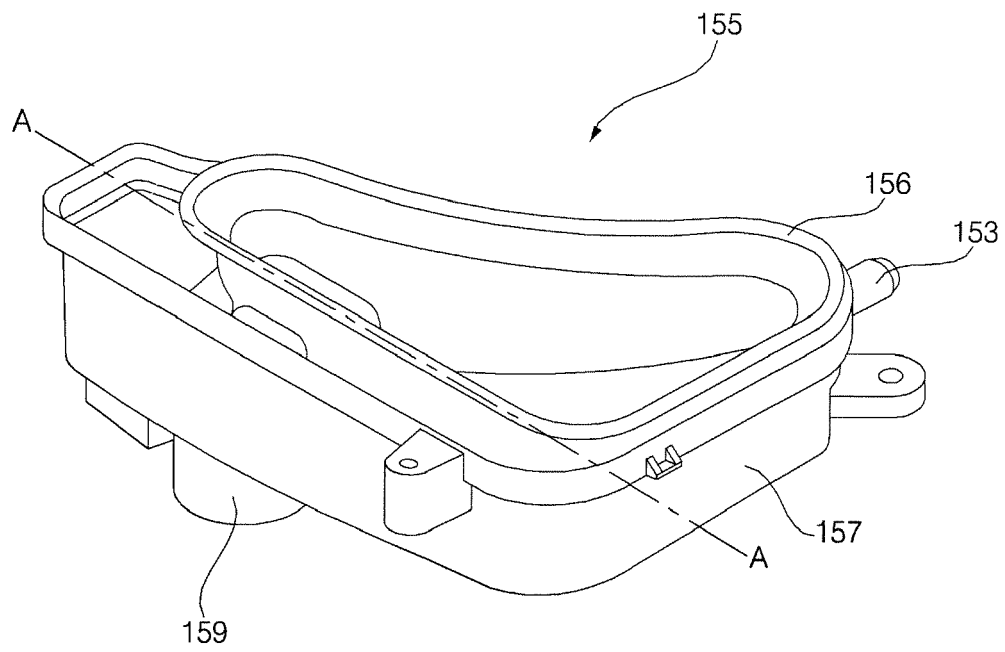


Fig. 9

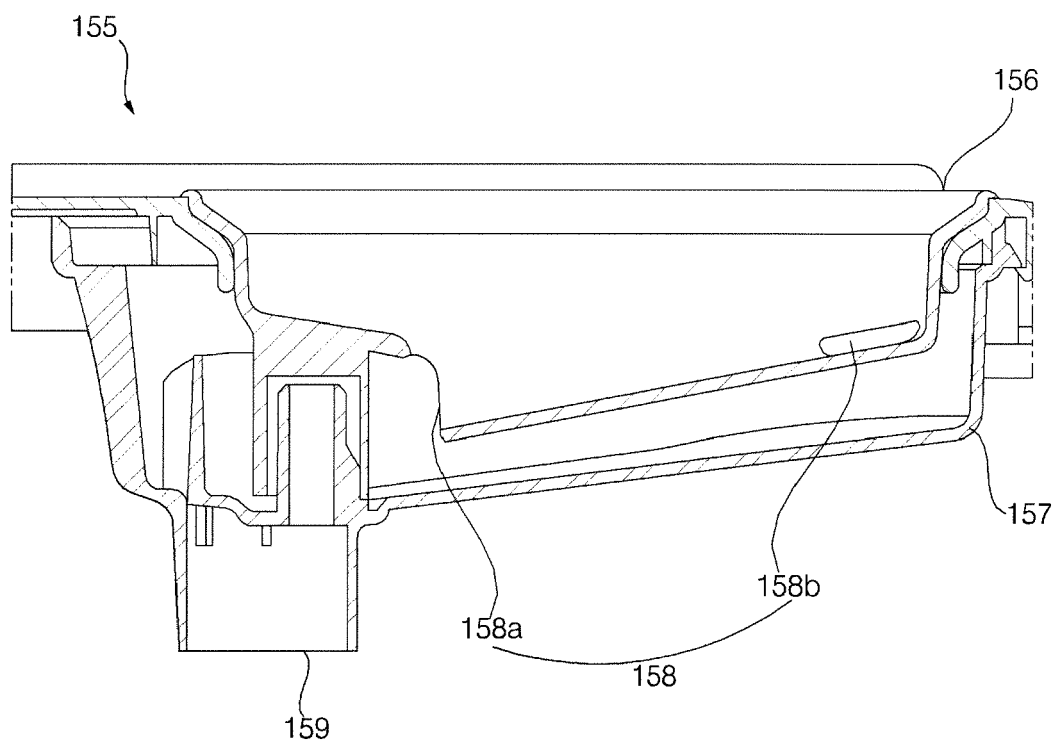


Fig. 10

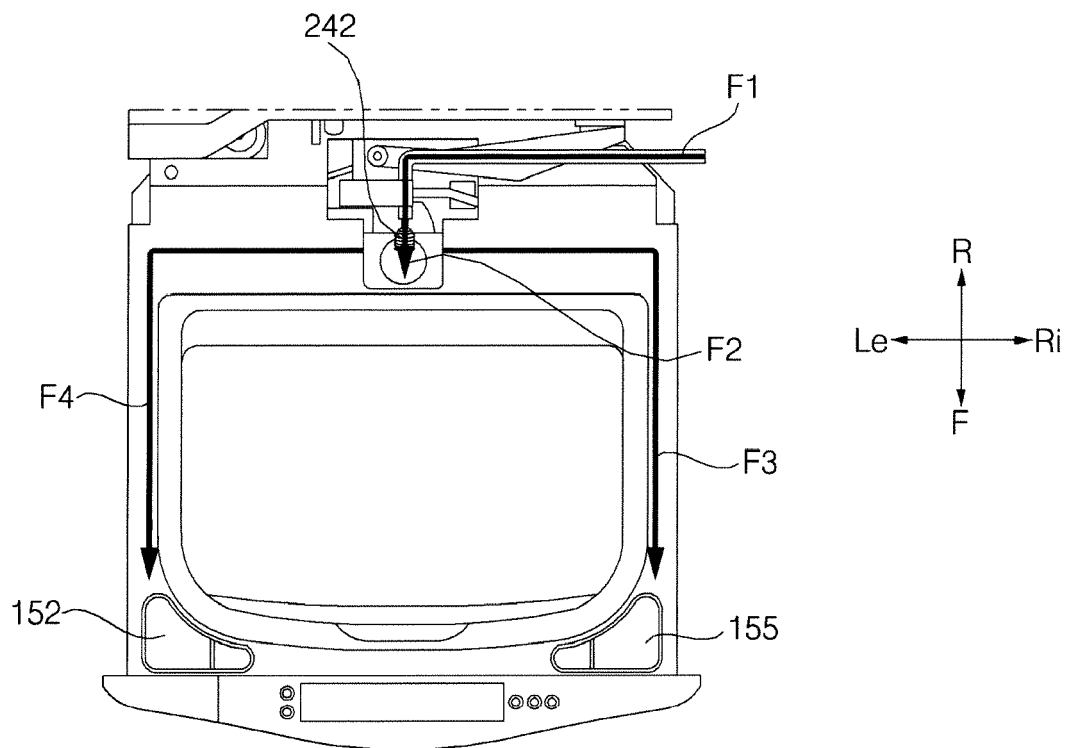


FIG. 11

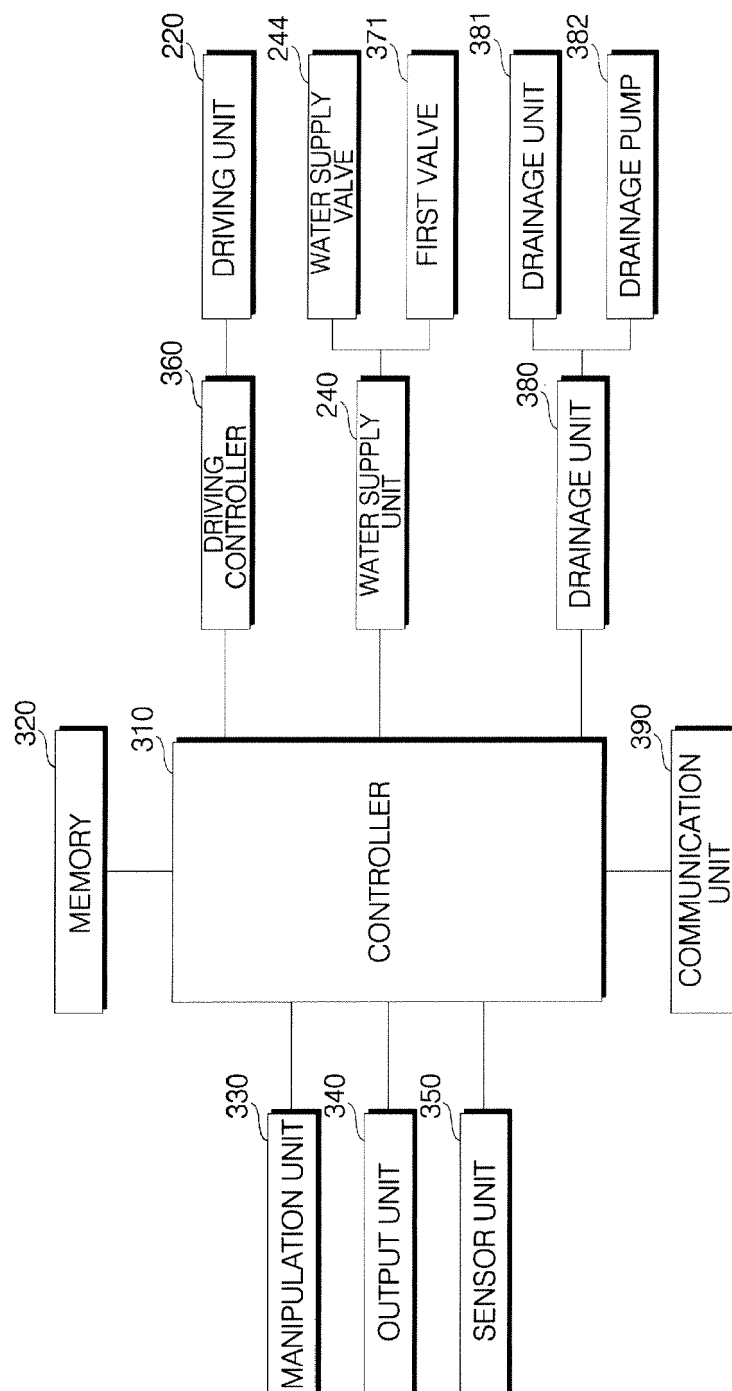


FIG. 12

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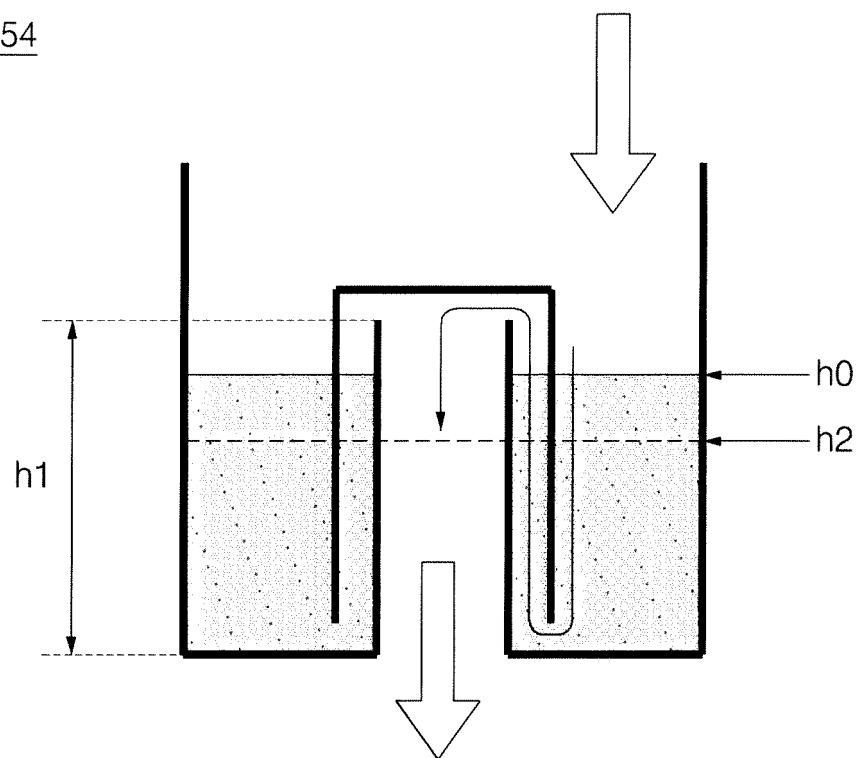


FIG. 13

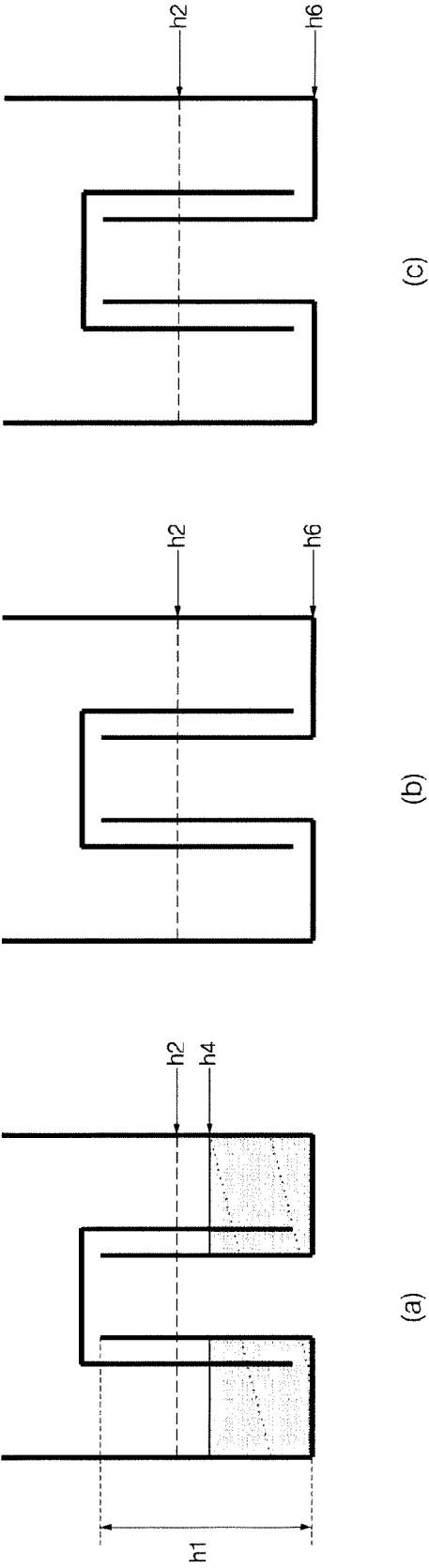


FIG. 14

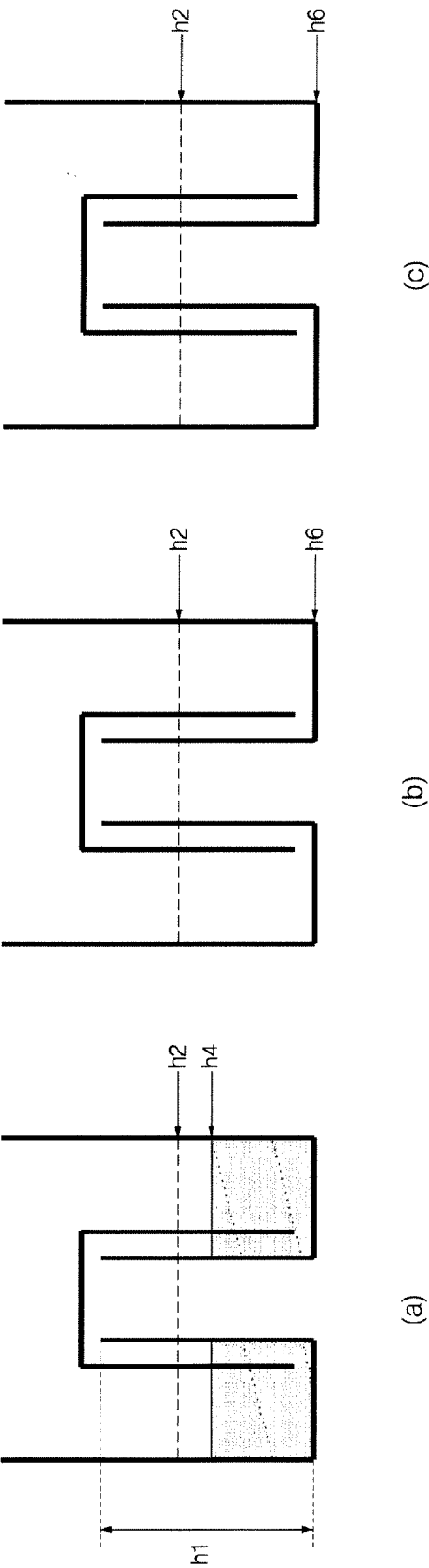


FIG. 15

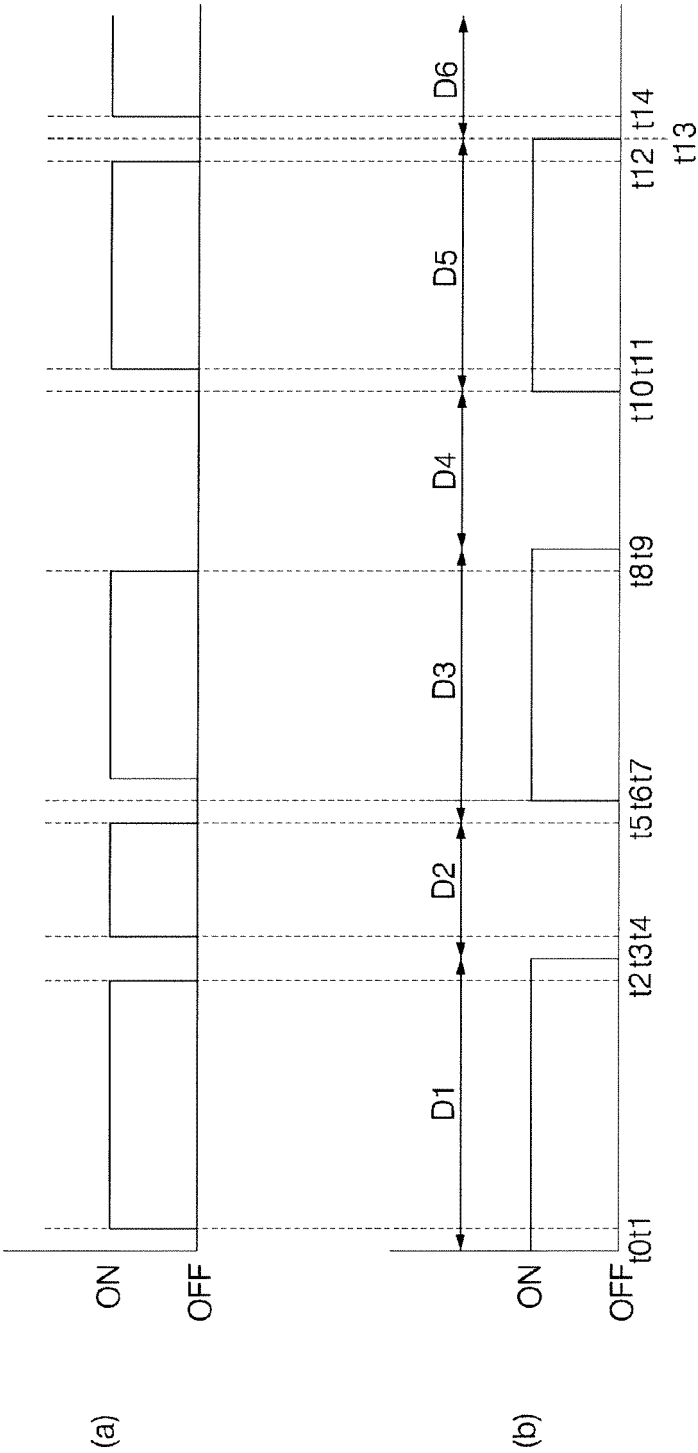
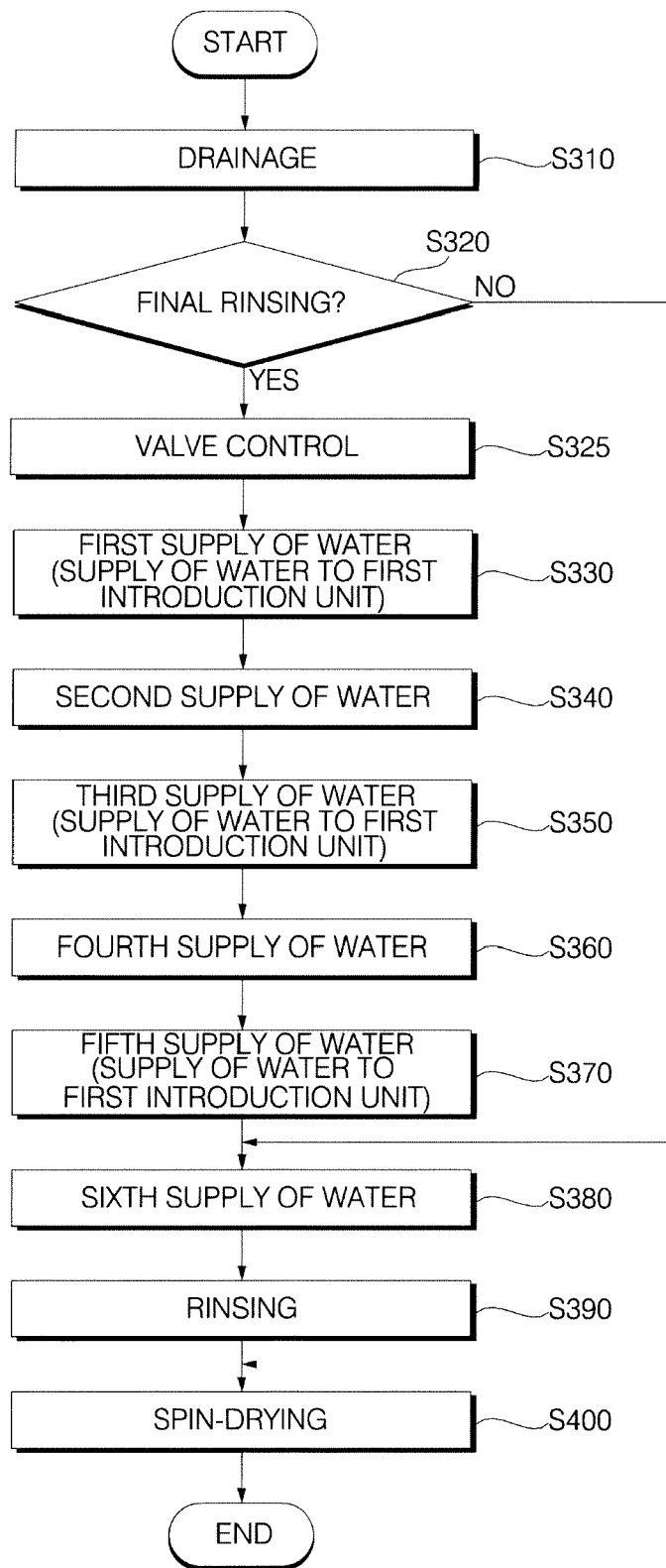


FIG. 16





EUROPEAN SEARCH REPORT

 Application Number
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A	* paragraph [0014] - paragraph [0024] * * paragraph [0034] - paragraph [0042]; figures 1, 2 * * paragraph [0051] - paragraph [0054] * * paragraph [0061] - paragraph [0080]; figures 3-5 *	2-6,9,15	ADD. D06F39/02 D06F39/08
X	US 2017/268152 A1 (LEIBMAN ALEXANDER B [US] ET AL) 21 September 2017 (2017-09-21)	1-8, 12-14	
A	* paragraph [0025] - paragraph [0032]; figures 1, 2 * * paragraph [0038] - paragraph [0040]; figure 4 * * paragraph [0044]; figure 4 * * paragraph [0050] - paragraph [0060]; figures 8, 9 *	9,10,15	
X	KR 2012 0004276 A (LG ELECTRONICS INC [KR]) 12 January 2012 (2012-01-12)	1,12	TECHNICAL FIELDS SEARCHED (IPC)
	* paragraph [0052] - paragraph [0060]; figures 1-4, 5a, 5b, 6 *		D06F
A	US 2015/059418 A1 (LEE DONGSOO [KR] ET AL) 5 March 2015 (2015-03-05) * the whole document *	1-15	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 April 2019	Examiner Sabatucci, Arianna
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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The members are as contained in the European Patent Office EDP file on
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