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(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**
Yeongtong-gu
Suwon-si, Gyeonggi-do 16677 (KR)

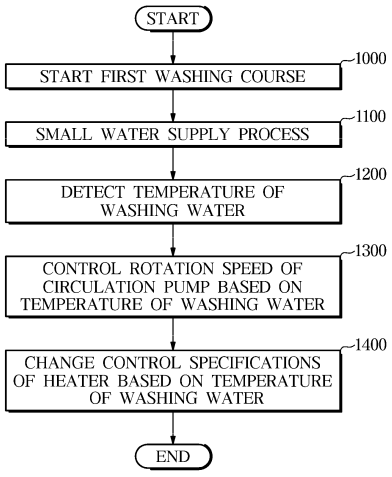
(72) Inventors:
- **KANG, Minji**
  Suwon-si Gyeonggi-do 16677 (KR)
- **KIM, Hyeoncheol**
  Suwon-si Gyeonggi-do 16677 (KR)
- **WOO, Jihyun**
  Suwon-si Gyeonggi-do 16677 (KR)
- **KIM, Hooijoong**
  Suwon-si Gyeonggi-do 16677 (KR)
- **BANG, Eunsuk**
  Suwon-si Gyeonggi-do 16677 (KR)

(74) Representative: **Walaski, Jan Filip et al**
Venner Shipley LLP
200 Aldersgate
London EC1A 4HD (GB)

(54) WASHING MACHINE AND METHOD FOR CONTROLLING WASHING MACHINE

(57) A washing machine that may save energy while maintaining washing performance according to a water temperature includes: a main body; a tub provided inside the main body; a first water supply device configured to supply washing water without detergent to the tub; a second water supply device configured to supply washing water containing detergent to the tub; a temperature sensor configured to detect a temperature of the washing water stored in the tub; a circulation bubble device configured to circulate the washing water stored in the tub or generate bubbles in the washing water stored in the tub; a circulation pump configured to supply the washing water stored in the tub to the circulation bubble device; and a controller configured to control the first water supply device to supply the washing water without detergent to the tub, and control a rotation speed of the circulation pump based on a temperature of the washing water without detergent.

FIG. 7



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Description

[Technical Field]

[0001] The disclosure relates to a washing machine and a method for controlling the same. More particularly, the disclosure relates to a washing machine and a method for controlling the same that may save energy while maintaining washing performance according to a water temperature.

[Background Art]

[0002] In general, a washing machine may include a tub accommodating laundry and a drum rotatably installed in the tub. In addition, the washing machine may wash laundry by rotating the drum containing the laundry.

[0003] Laundry may be put into the drum through an inlet formed in a main body, and the inlet formed in the main body may be opened or closed by a door.

[0004] The washing machine may perform a washing cycle including a washing process of separating contaminants from the laundry using water mixed with detergent, a rinsing process of rinsing away any foam or residual detergent from the laundry with detergent-free water, a spin-drying process of spin-drying the laundry at high speed, and the like.

[0005] The washing machine may use water supplied from an external water supply source to perform the washing cycle.

[0006] However, in a case where a temperature of the water supplied from the external water supply source is low, detergent does not dissolve well in the water, resulting in low washing performance, and in a case where a heater is operated excessively to increase the water temperature, energy efficiency decreases.

[DISCLOSURE]

[Technical Problem]

[0007] An aspect of the disclosure is to provide a washing machine and a method for controlling the same that adjusts a rotation speed of a circulation pump according to a temperature of water supplied from an external water supply source to save energy while maintaining washing performance.

[Technical Solution]

[0008] In accordance with an aspect of the disclosure, a washing machine include: a main body; a tub provided inside the main body; a first water supply device configured to supply washing water without detergent to the tub; a second water supply device configured to supply washing water containing detergent to the tub; a temperature sensor configured to detect a temperature of the washing water stored in the tub; a circulation bubble device configured to circulate the washing water stored in the tub or generate bubbles in the washing water stored in the tub; a circulation pump configured to supply the washing water stored in the tub to the circulation bubble device; and a controller configured to control the first water supply device to supply the washing water without detergent to the tub, and control a rotation speed of the circulation pump based on a temperature of the washing water without detergent.

[0009] In addition, the controller may be configured to control the circulation pump to rotate at a first speed based on the temperature of the washing water without detergent being less than a preset temperature, and control the circulation pump to rotate at a second speed lower than the first speed based on the temperature of the washing water without detergent being higher than the preset temperature.

[0010] In addition, the washing machine may further include: a heater configured to heat the washing water stored in the tub, wherein the controller may be configured to: operate the heater for a first preset time based on the temperature of the washing water without detergent being less than a preset temperature, and operate the heater for a second preset time, or operate the heater until the temperature of the washing water stored in the tub reaches a target temperature, based on the temperature of the washing water without detergent being higher than the preset temperature.

[0011] In addition, in response to the temperature of the washing water without detergent being less than the preset temperature, the controller may be configured to turn off the heater even in a case where the temperature of the washing water stored in the tub does not reach the target temperature.

[0012] In addition, the controller may be configured to: perform a weight detection process for detecting a weight of laundry and a material detection process for detecting a material of the laundry after controlling the first water supply device to supply the washing water without detergent to the tub, and control the second water supply device to supply the washing water containing the detergent to the tub after performing the weight detection process and the material detection process.

[0013] In addition, the controller may be configured to control the rotation speed of the circulation pump based on the temperature of the washing water without detergent and the weight of the laundry.

[0014] In addition, the controller may be configured to determine an operation mode of the circulation bubble device based on the material of the laundry.

[0015] In addition, the controller may be configured to control the circulation bubble device to circulate the washing water stored in the tub based on determining that the material of the laundry is a first material, and control the circulation bubble device to generate bubbles in the washing water stored in the tub based on determining that the material of the laundry is a second material.

[0016] In addition, the controller may be configured to control the rotation speed of the circulation pump based on the temperature of the washing water without detergent, only in a case where a user input to start a first washing course is received.

[0017] In addition, the washing machine may further include: an output interface including at least one of a display or a speaker; and a communication circuitry configured to receive weather information from a server, wherein the controller may be configured to control the output interface to provide feedback recommending selection of the first washing course, based on the weather information satisfying a preset condition.

[0018] According to an aspect of the disclosure, a method for controlling a washing machine including a circulation bubble device configured to circulate washing water stored in a tub or generate bubbles in the washing water stored in the tub and a circulation pump configured to supply the washing water stored in the tub to the circulation bubble device may include: supplying washing water without detergent to the tub; and controlling a rotation speed of the circulation pump based on a temperature of the washing water without detergent.

[0019] In addition, the controlling of the rotation speed of the circulation pump may include: controlling the circulation pump to rotate at a first speed based on the temperature of the washing water without detergent being less than a preset temperature; and controlling the circulation pump to rotate at a second speed lower than the first speed based on the temperature of the washing water without detergent being higher than the preset temperature.

[0020] In addition, the method for controlling the washing machine may further include: operating a heater configured to heat the washing water stored in the tub for a first preset time based on the temperature of the washing water without detergent being less than a preset temperature; and operating the heater for a second preset time, or operating the heater until a temperature of the washing water stored in the tub reaches a target temperature, based on the temperature of the washing water without detergent being higher than the preset temperature.

[0021] In addition, the operating of the heater for the first preset time may include turning off the heater even in a case where the temperature of the washing water stored in the tub does not reach the target temperature.

[0022] In addition, the method for controlling the washing machine may further include: performing a weight detection process for detecting a weight of laundry and a material detection process for detecting a material of the laundry after supplying the washing water without detergent to the tub; and supplying the washing water containing detergent to the tub after performing the weight detection process and the material detection process.

[0023] In addition, the controlling of the rotation speed of the circulation pump may include: controlling the rotation speed of the circulation pump based on the temperature of the washing water without detergent and the weight of the laundry.

[0024] In addition, the method for controlling the washing machine may further include: determining an operation mode of the circulation bubble device based on the material of the laundry.

[0025] In addition, the determining of the operation mode of the circulation bubble device may include: controlling the circulation bubble device to circulate the washing water stored in the tub based on determining that the material of the laundry is a first material; and controlling the circulation bubble device to generate bubbles in the washing water stored in the tub based on determining that the material of the laundry is a second material.

[0026] In addition, the controlling of the rotation speed of the circulation pump may be performed only in a case where a user input to start a first washing course is received.

[0027] In addition, the method for controlling the washing machine may further include: providing feedback recommending selection of the first washing course, based on weather information received from a server satisfying a preset condition.

[Advantageous Effects]

[0028] According to an aspect of the disclosure, even in a case where a temperature of water supplied from an external water supply source is low, energy used to perform a washing cycle is saved while maintaining washing performance.

[0029] According to an aspect of the disclosure, energy consumption of a washing machine is reduced in winter when temperatures are low.

[0030] According to an aspect of the disclosure, user satisfaction is improved by allowing a user to decide whether to select an energy saving course.

[0031] According to an aspect of the disclosure, a user's choice may be induced by recommending an energy saving course before starting a washing cycle in winter when temperatures are low.

[DESCRIPTION OF DRAWINGS]

[0032]

FIG. 1 illustrates an exterior of a washing machine according to an embodiment of the disclosure;

FIG. 2 is a side cross-sectional view of a washing machine according to an embodiment of the disclosure;

FIG. 3 is an exploded perspective view of a circulation bubble device according to an embodiment of the disclosure;

FIGS. 4 and 5 are views illustrating operations of a circulation bubble device according to various embodiments of the disclosure;

FIG. 6 is a block diagram illustrating a configuration of a washing machine according to an embodiment of the disclosure;

FIG. 7 is a flowchart illustrating a method for controlling a washing machine according to an embodiment of the disclosure;

FIG. 8 illustrates a control panel of a washing machine according to an embodiment of the disclosure;

FIG. 9 illustrates a washing cycle of a washing machine according to an embodiment of the disclosure;

FIG. 10 is a view illustrating a state in which a washing machine performs a small water supply process according to an embodiment of the disclosure;

FIG. 11 is a lookup table in which a temperature of washing water provided in a small water supply process and a rotation speed of a circulation pump are matched according to an embodiment of the disclosure;

FIG. 12 is a view illustrating a state in which a circulation bubble device operates in a circulation mode according to an embodiment of the disclosure;

FIG. 13 is a view illustrating a state in which a circulation bubble device operates in a bubble mode according to an embodiment of the disclosure;

FIG. 14 is a flowchart illustrating a method for controlling a washing machine according to an embodiment of the disclosure; and

FIG. 15 illustrates a control panel of a washing machine in a case where weather information satisfies a preset condition according to an embodiment of the disclosure.

[MODES OF THE INVENTION]

[0033] The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of various embodiments of the disclosure as defined by the claims and their equivalents.

[0034] The terms and words in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the disclosure.

[0035] It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise.

[0036] In addition, it will be understood that the terms "include" and "have," are intended to indicate the presence of the features, numbers, steps, operations, components, parts, or combinations thereof disclosed in the disclosure, but do not preclude the presence or addition of one or more other elements.

[0037] In addition, it will be understood that, although the terms including ordinal numbers, such as "first", "second", or the like, may be used herein to describe various components, these components should not be limited by these terms.

[0038] In addition, the terms "portion", "device", "block", "member", and "module" used herein refer to a unit for processing at least one function or operation. For example, the terms may mean at least one process that may be processed by at least one hardware, such as field-programmable gate array (FPGA) or application specific integrated circuit (ASIC), or at least one software or processor stored in memory.

[0039] Hereinafter, various embodiments of the disclosure are described with reference to the accompanying drawings. Like reference numerals throughout the disclosure denote like elements.

[0040] An operation principle and embodiments are described below with reference to the accompanying drawings.

[0041] FIG. 1 illustrates an exterior of a washing machine according to an embodiment of the disclosure. FIG. 2 is a side cross-sectional view of a washing machine according to an embodiment of the disclosure.

[0042] Referring to FIGS. 1 and 2, a configuration of a washing machine 1 is described with reference to FIGS. 1 and 2.

[0043] The washing machine 1 according to an embodiment may include a top-loading washing machine in which an inlet 11 for inserting or taking out laundry is disposed on an upper side of a main body 10, or a front-loading washing machine in which the inlet 11 for inserting or taking out laundry is disposed on a front side of the main body 10. In other words, the washing machine 1 according to an embodiment is not limited to the top-loading washing machine or the front-loading washing machine, and may be any one of the top-loading washing machine or the front-loading washing machine. In addition, the washing machine 1 may include a washing machine of a loading type other than the top-loading washing machine and the front-loading washing machine.

[0044] However, for convenience of description, the washing machine 1 according to an embodiment may be assumed to be the front-loading washing machine in which the inlet 11 for inserting or taking out laundry is disposed on a front side of the main body 10, as shown in FIG. 1.

[0045] Referring to FIGS. 1 and 2, the washing machine 1 may include the main body 10, and a door 12 positioned in front of the main body 10. The inlet 11 for inserting or taking out laundry may be positioned at a front center of the main body 10. The door 12 may open or close the inlet 11. One side of the door 12 may be rotatable by a hinge. The inlet 11 closed by the door 12 may be detected by a door sensor. The door 12 is closed, thereby closing the inlet 11, and during operation of the washing machine 1, the door 12 may be locked by a door locking device.

[0046] On a front upper side of the main body 10, a control panel 110 including an input interface 111 for obtaining user input and a display 112 for displaying operation information of the washing machine 1 may be disposed. The control panel 110 may provide a user interface for interaction between s user and the washing machine 1.

[0047] The tub 20 may be positioned inside the main body 10 and may accommodate washing water for washing and/or rinsing. The tub 20 may include tub front parts with an opening in the front, and tub rear parts with a closed rear part in a cylindrical shape. The tub front parts may be provided with the opening for inserting or taking out the laundry from a drum 30.

[0048] The opening in the tub 20 may correspond to the inlet 11 in the main body 10.

[0049] The inlet 11 of the main body 10 and the opening of the tub 20 may be connected by a diaphragm.

[0050] The diaphragm may have a substantially ring shape, and may form a passage between the inlet 11 of the main body 10 and the opening of the tub 20, thereby guiding the laundry put into the inlet 11 to the inside of the drum.

[0051] The diaphragm may seal the inlet 11 of the main body 10 and the opening of the tub 20, thereby preventing washing water and/or laundry in the tub 20 from leaking out of the washing machine 1.

[0052] In addition, the diaphragm may reduce transmission of vibrations generated during rotation of the drum 30 to the main body 10. To this end, the diaphragm may be made of an elastic rubber material and may include a buffer portion bent between the main body 10 and the tub 20.

[0053] A drum motor 160 for rotating the drum 30 may be provided on a rear wall of the tub rear parts.

[0054] The drum 30 may be rotatable inside the tub 20 and may accommodate the laundry. The drum 30 may include a cylindrical drum body, drum front parts in front of the drum body, and drum rear parts in the rear of the drum body. The tub 20 and the drum 30 may be arranged to be inclined with respect to the ground. However, the tub 20 and the drum 30 may also be arranged horizontally with respect to the ground.

[0055] On an inner surface of the drum body, through holes 31a connecting the inside of the drum 30 and the inside of the tub 20, and a lifter 31b for lifting the laundry to an upper part of the drum 30 while the drum 30 rotates may be provided. The drum front parts may be provided with an opening for inserting or taking out the laundry from the drum 30. The drum rear parts may be connected to a shaft 163 of the drum motor 160 rotating the drum 30.

[0056] The drum motor 160 may rotate the drum 30. The drum motor 160 may be positioned outside the tub rear parts and may be connected to the drum rear parts through the shaft 163. The shaft 163 may penetrate the tub rear parts and may be rotatably supported by a bearing disposed in the tub rear parts.

[0057] The drum motor 160 may include a stator 161 fixed to the outside of the tub rear parts, and a rotor 162 that is rotatable and connected to the shaft 163. The rotor 162 may rotate by magnetic interaction with the stator 161, and the rotation of the rotor 162 may be transmitted to the drum 30 through the shaft 163. The drum motor 160 may be, for example, a permanent synchronous motor (PMSM) or a brushless direct current (BLDC) motor whose rotation speed is easy to control.

[0058] According to various embodiments of the disclosure, the washing machine 1 may further include a pulsator (not shown) that rotates independently of the drum 30.

[0059] The pulsator may rotate independently of the drum 30 to form a water current inside the drum 30.

[0060] In an embodiment of the disclosure, the pulsator may be driven by the drum motor 160, or may be driven by a pulsator motor provided separately from the drum motor 160.

[0061] In a case where the pulsator is driven by the drum motor 160, the drum motor 160 may be implemented as a dual rotor motor including one stator and two rotors (e.g., an inner rotor and an outer rotor), and one of the two rotors may be connected to the drum 30, and the other may be connected to the pulsator.

[0062] Inside a lower part of the tub 20, a heater 40 may be installed to heat the washing water stored in the tub 20, and a water level sensor (not shown) may be installed to detect a frequency that changes depending on a water level to detect the amount (water level) of water in the drum 30.

[0063] In addition, a temperature sensor 120 may be provided in the lower part of the tub 20 to detect a temperature of the washing water stored in the tub 20. The temperature sensor 120 positioned in the lower part of the tub 20 may detect the temperature of the washing water supplied to the tub 20 and stored in the tub 20.

[0064] Water supply devices 151 and 152 may be positioned in an inner upper part of the main body 10 to supply washing water to the tub 20.

[0065] The water supply devices 151 and 152 may supply washing water to the tub 20 and the drum 30.

[0066] According to various embodiments of the disclosure, the water supply devices 151 and 152 may include the first water supply device 151 supplying washing water without detergent to the tub, and the second water supply device 152 supplying washing water containing detergent to the tub.

[0067] The first water supply device 151 may include a first water supply pipe 151b which is connected to an external water supply source to supply washing water to the tub 20 without passing through a detergent box 153, a first water supply valve 151a arranged on the first water supply pipe 151b, and at least one nozzle 151c and 151d connected to the first water supply pipe 151b to supply washing water without detergent into the tub 20. The first water supply pipe 151b may extend from the external water supply source to the at least one nozzle 151c and 151d without passing through the detergent box 153.

[0068] The at least one nozzle 151c and 151d may include the first nozzle 151c spraying washing water without detergent toward the door 12 and/or the second nozzle 151d spraying washing water without detergent toward the tub 20.

[0069] The first nozzle 151c may spray washing water directly toward the door 12, and the washing water falling

directly may be stored in the tub 20 after washing the door 12.

[0070] The second nozzle 151d may spray washing water into the drum 30 and may be inclined toward the inside of the drum 30 to have a spray angle that is not interfered with by the door 12.

[0071] Accordingly, the washing water without detergent sprayed through the second nozzle 151d may be immediately stored in the tub 20.

[0072] The second water supply device 152 may include a second water supply pipe 152b connected to the external water supply source to supply washing water to the detergent box 153, a second water supply valve 152a arranged on the second water supply pipe 152b, and a third water supply pipe 154 connecting the detergent box 153 and the tub 20. The second water supply pipe 152b may be provided above the tub 20 and may extend from the external water supply source to the detergent box 153. The third water supply pipe 154 may be provided above the tub 20 and may extend from the detergent box 153 to the tub 20.

[0073] In response to the opening of the second water supply valve 152a, the washing water supplied from the external water supply source through the second water supply pipe 152b may flow into the detergent box 153.

[0074] The washing water supplied to the detergent box 153 through the second water supply pipe 152b may be mixed with detergent or softener inside the detergent box 153, and the washing water containing detergent may be supplied to the tub 20 through the third water supply pipe 154.

[0075] The detergent box 153 may be divided into a detergent storage space and a softener storage space, and the second water supply pipe 152b may include one water supply pipe connected to the detergent storage space and another water supply pipe connected to the softener storage space. In addition, the second water supply valve 152a may include one water supply valve for opening and closing the one water supply pipe connected to the detergent storage space, and another water supply valve for opening and closing the other water supply pipe connected to the softener storage space.

[0076] The first water supply valve 151a and/or the second water supply valve 152a may open or close the first water supply pipe 151b and/or the second water supply pipe 152b in response to an electrical signal from a controller 190 to be described later. For example, the first water supply valve 151a and/or the second water supply valve 152a may allow or block the supply of washing water without detergent and/or washing water containing detergent to the tub 20. The first water supply valve 151a and/or the second water supply valve 152a may include, for example, a solenoid valve that opens and closes in response to an electrical signal.

[0077] The water supply devices 151 and 152 may further include a flow sensor that may detect the amount of washing water supplied into the tub 20.

[0078] For example, the flow sensor may include a first flow sensor positioned in the first water supply pipe 151b to measure the amount of washing water passing through the first water supply pipe 151b, and/or a second flow sensor positioned in the second water supply pipe 152b to measure the amount of washing water passing through the second water supply pipe 152b.

[0079] A pump 170 may be installed in an inner lower part of the main body 10 to draw in water stored in the tub 20.

[0080] A plurality of pipes may include a first drain pipe 171 connected to a drain 32 of the tub 20, a second drain pipe 172 for pumping the water drained from the tub 20 and discharging it to the outside of the main body 10, and a connection hose 173 connected to a circulation bubble device 180 to allow the water drained from the tub 20 to be re-supplied to the tub 20.

[0081] The circulation bubble device 180 may be connected to the connection hose 173 connected to the pump 170 to receive water from the pump 170, and may be connected to a connection pipe 50 connected to an upper part of the tub 20 to allow air to be transferred from the tub 20. In this instance, one end of the connection pipe 50 may be connected to the circulation bubble device 180, and the other end of the connection pipe 50 may be connected to a communication hose 186 communicating with the inside of the tub 20. The communication hose 186 may be connected to the tub 20 and may be disposed at a position higher than the level of water accommodated in the tub 20 to allow the air in the tub 20 to be drawn in. Accordingly, the water flowing from the pump 170 and the air transferred through the connection pipe 50 may be mixed in the circulation bubble device 180 to generate bubbles, and the generated bubbles may be supplied to the tub 20.

[0082] The circulation bubble device 180 may selectively form (or define) any one of a bubble supply flow path for generating bubbles by mixing air with the washing water flowing from the pump 170 and supplying the generated bubbles to the tub 20, or a circulation flow path for guiding the washing water flowing from the pump 170 to the communication hose 186 through the connection pipe 50 and re-supplying the washing water to the tub 20 to circulate the washing water stored in the tub 20, which will be described later.

[0083] The pump 170 may include a circulation pump supplying the washing water stored in the tub 20 to the circulation bubble device 180 and/or a drain pump pumping the washing water stored in the tub 20 to the second drain pipe 172. However, the circulation pump and the drain pump may be implemented as a single configuration or as different configurations.

[0084] Hereinafter, for convenience of description, it is assumed that the pump 170 is the circulation pump supplying the washing water stored in the tub 20 to the circulation bubble device 180.

[0085] FIG. 3 is an exploded perspective view of a circulation bubble device according to an embodiment of the disclosure. FIGS. 4 and 5 illustrate operations of a

circulation bubble device according to various embodiments of the disclosure.

[0086] Referring to FIGS. 3 to 5, the circulation bubble device 180 may include a housing 181 that forms an external shape, a switching member 182 disposed in the housing 181, and a driving device 183 to drive the switching member 182, wherein the switching member 182 allows the bubble supply flow path generating bubbles and the circulation flow path circulating the washing water stored in the tub 20 to be selectively formed.

[0087] The housing 181 may include a first connection port 181a, a second connection port 181d, a switching flow path 181c, and a third connection port 181e, wherein the first connection port 181a is connected to the connection hose 173 and is provided with an orifice portion 181b having a reduced diameter, the second connection port 181d is positioned in a direction of movement of the washing water passing through the orifice portion 181b with respect to the first connection port 181a and is connected to the tub 20, the switching flow path 181c is disposed between the first connection port 181a and the second connection port 181d to connect the first connection port 181a and the second connection port 181d, and the third connection port 181e is connected to the switching flow path 181c so as to be inclined with respect to the direction of movement of the washing water and is connected to the connection pipe 50 to allow air of the tub 20 to be introduced through the connection pipe 50 or allow the washing water to be discharged to the communication hose 186 through the connection pipe 50.

[0088] In this instance, an upper part of the switching flow path 181c of the housing 181 may be open for installation of the switching member 182, and a first cover 184 may be installed in the housing 181 to close the upper part of the switching flow path 181c. In addition, a driving portion 181f in which the above-described driving device 183 is installed may be provided at a lower part of the housing 181. The driving portion 181f may be opened downward for installation of the driving device 183, and a second cover 185 may be installed in the housing 181 to cover the open lower part of the driving portion 181f.

[0089] The switching member 182 may rotate to allow the washing water transferred through the first connection port 181a to be transferred to one of the second connection port 181d or the second connection port 181d. The switching member 182 may include an opening and closing portion 182a, a shaft portion 182b, a connection portion 182d, and a hinge protrusion 182c, wherein the opening and closing portion 182a opens and closes the switching flow path 181c, the shaft portion 182b is positioned on one side of the opening and closing portion 182a to allow the switching member 182 to be rotatably installed on the switching flow path 181c, the connection portion 182d is provided in a polygonal shape at a lower end of the shaft portion 182b and is connected to a pinion 1833 to allow the switching member 182 to rotate with the pinion 1833, and the hinge protrusion 182c is provided at an upper end of the shaft portion 182b and allows the switching member 182 to be rotatably installed at a hinge portion 184a positioned on the first cover 184.

[0090] The driving device 183 includes an actuator 1831, a rack 1832 moved by the actuator 1831, and a pinion 1833 that engages with the rack 1832 and rotates according to the movement of the rack 1832. The pinion 1833 includes a plurality of teeth 1833a engaged with the rack 1832, and a connection hole 1833b formed in a polygonal shape to correspond to the connection portion 182d of the switching member 182 described above. However, the driving device 183 is not limited to the above example, and may be provided as a motor according to embodiments. For example, the pinion 1833 may be rotated by a motor of the driving device 183.

[0091] The circulation bubble device 180 may receive water stored in the tub 20 from the circulation pump 170 through the connection hose 173.

[0092] Referring to FIG. 4, in a case where the circulation bubble device 180 operates in a circulation mode that circulates the water in the tub 20 and re-supplies the water to the tub 20, the circulation bubble device 180 may control the driving device 183 to close the switching flow path 181c, the rack 1832 is moved by the operation of the actuator 1831, and the pinion 1833 rotates according to the movement of the rack 1832. Because the switching member 182 is connected to the pinion 1833 through the connection portion 182d, the switching member 182 rotates together with the pinion 1833, and the opening and closing portion 182a of the switching member 182 closes the middle of the switching flow path 181c.

[0093] In a state in which the switching flow path 181c is closed, the washing water transferred through the first connection port 181a connected to the connection hose 173 is guided to the connection pipe 50 through the third connection port 181e, and is discharged from the upper part of the tub 20 through the communication hose 186.

[0094] As described above, as the circulation flow path is formed by the circulation bubble device 180, the washing water stored in the tub 20 is drawn into the circulation pump 170 and then transferred to the circulation bubble device 180 through the connection hose 173, and transferred from the circulation bubble device 180 to the inside of the tub 20 through the connection pipe 50, and thus the washing water circulates.

[0095] In this instance, the washing water discharged from the upper part of the tub 20 into the tub 20 through the communication hose 186 may be used to increase washing performance through friction with the laundry. However, in a case where the circulation bubble device 180 operates in the circulation mode, the washing water is discharged from a high position, and thus the laundry fabric may be damaged.

[0096] Referring to FIG. 5, in a case where the circulation bubble device 180 operates in a bubble mode to generate bubbles in the washing water stored in the tub 20, the circulation bubble device 180 may control the driving device 183 to open the switching flow path 181c. In this state, the washing water that has passed through

the orifice portion 181b passes through the switching flow path 181c at high speed, and thus a pressure in the switching flow path 181c may be lowered by Bernoulli's law. When the pressure in the switching flow path 181c becomes lower than atmospheric pressure, air is drawn into the switching flow path 181c from the tub 20 through the connection pipe 50 connected to the third connection port 181e. In the switching flow path 181c, the washing water and air are mixed to generate bubbles, and the generated bubbles are supplied to the tub 20 through the third connection port 181e.

[0097] As described above, as the bubble supply flow path is formed by the circulation bubble device 180, the washing water of the tub 20 is drawn into the circulation pump 170 and then transferred to the circulation bubble device 180 through the connection hose 173, and the air in the tub 20 is drawn into the circulation bubble device 180 through the connection pipe 50 and mixed with the washing water transferred from the circulation pump 170, thereby generating bubbles in the circulation bubble device 180. In this instance, bubbles generated in the circulation bubble device 180 are supplied to the tub 20.

[0098] In this instance, the bubbles supplied to the tub 20 may assist the detergent and/or softener contained in the washing water to be absorbed into the laundry. Accordingly, in a case where the circulation bubble device 180 operates in the bubble mode, a degree of detergent adsorption may be increased.

[0099] FIG. 6 is a block diagram illustrating a configuration of a washing machine according to an embodiment of the disclosure.

[0100] Referring to FIG. 6, the washing machine 1 may include the control panel 110, a speaker 113, the temperature sensor 120, the drum motor, the first water supply device 151, the second water supply device 152, the heater 40, the circulation pump 170, the circulation bubble device 180, the controller 190, and a communication circuitry 195.

[0101] The control panel 110 may include the input interface 111 receiving user input, and the display 112 displaying wash settings or washing operation information in response to the user input.

[0102] For example, the input interface 111 may include a power button, an operation button, a course selection dial (or a course selection button), and a washing/rinsing/spin-drying setting button. The input interface 111 may include, for example, a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, or a touch switch.

[0103] The input interface 111 may provide an electrical output signal corresponding to the user input to the controller 190.

[0104] The display 112 may include a screen displaying a washing course and an operation time of the washing machine 1 selected by rotating the course selection dial (or pressing the course selection button), and an indicator displaying washing/rinsing/spin-drying settings selected by the setting button. The display 112 may include, for example, a liquid crystal display (LCD) panel, a light emitting diode (LED) panel, or the like.

[0105] The display 112 may provide various types of visual feedback to a user based on a control signal from the controller 190.

[0106] Washing courses of the washing machine 1 may include predetermined process conditions (e.g., washing temperature, number of rinses, spin speed) according to the type of laundry (e.g., shirts, pants, underwear, bedclothes), the material of laundry (e.g., cotton, polyester, wool, delicate clothing, regular clothing), and the amount of laundry. For example, a standard washing course may include generalized conditions for laundry. A bedclothes washing course may include optimized conditions for washing bedclothes. The washing courses may include a variety of courses, such as a standard washing, intense washing, wool washing, bedclothes washing, regular washing, baby clothes washing, towel washing, small load washing, boil washing, energy saving washing, outdoor clothes washing, rinsing + spin-drying, and spin-drying.

[0107] According to various embodiments of the disclosure, the washing course of the washing machine 1 may further include a first washing course for washing the laundry in the most efficient manner based on the weight and material of the laundry and surrounding environment information. In the first washing course, the washing machine 1 may identify the weight of the laundry through a weight detection process, identify the material of the laundry through a material detection process, and obtain information about the surrounding environment through various sensors, in order to wash the laundry in the most optimized process for a current condition. Accordingly, the first washing course may be referred to as an artificial intelligence course (AI course).

[0108] The speaker 113 may provide various types of auditory feedback to the user based on a control signal from the controller 190.

[0109] The temperature sensor 120 may be positioned on a lower side of the tub 20 and may detect a temperature of the washing water stored in the tub 20. The temperature sensor 120 may transmit temperature information of the washing water stored in the tub 20 to the controller 190, and the controller 190 may control each component (e.g., the circulation pump 170, the heater 40) of the washing machine 1 based on the temperature information obtained from the temperature sensor 120.

[0110] The drum motor 160 may rotate based on a control signal from the controller 190, thereby rotating the drum 30.

[0111] The washing machine 1 may further include driving circuitry for controlling a rotation speed of the drum motor 160. The controller 190 may apply a drive signal to the driving circuitry, thereby supplying a driving current for driving the drum motor 160 to the drum motor 160.

[0112] The first water supply device 151 may supply washing water that does not pass through the detergent

box 153, i.e., washing water without detergent, to the tub 20 based on a control signal from the controller 190.

[0113] For example, the controller 190 may control the first water supply device 151 to supply the washing water without detergent to the tub 20.

[0114] The second water supply device 152 may supply washing water that has passed through the detergent box 153, i.e., washing water containing detergent, to the tub 20 based on a control signal from the controller 190.

[0115] For example, the controller 190 may control the second water supply device 152 to supply the washing water containing detergent to the tub 20.

[0116] The heater 40 may operate based on a control signal from the controller 190, thereby heating the washing water stored in the tub 20.

[0117] As will be described later, the controller 190 may perform temperature control for operating the heater 40 until the washing water stored in the tub 20 reaches a predetermined temperature after supplying water for washing or rinsing. In addition, the controller 190 may perform time control for operating the heater 40 for a preset time regardless of the temperature of the washing water stored in the tub 20 after supplying water for washing.

[0118] The circulation pump 170 may supply the washing water stored in the tub 20 to the circulation bubble device 180.

[0119] According to various embodiments of the disclosure, the controller 190 may control a rotation speed of the circulation pump 170. To this end, the circulation pump 170 may include, for example, a permanent synchronous motor (PMSM) or a brushless direct current (BLDC) motor whose rotation speed is easy to control.

[0120] The controller 190 may supply the washing water stored in the tub 20 to the circulation bubble device 180 by operating the circulation pump 170 after supplying water for washing or rinsing.

[0121] According to various embodiments of the disclosure, the controller 190 may increase the rotation speed of the circulation pump 170 to increase the amount of washing water supplied to the circulation bubble device 180 per hour, and may decrease the rotation speed of the circulation pump 170 to decrease the amount of washing water supplied to the circulation bubble device 180 per hour.

[0122] The circulation bubble device 180 may operate in the above-described circulation mode or bubble mode based on a control signal from the controller 190.

[0123] The controller 190 may control the driving device 183 of the circulation bubble device 180 to allow the circulation bubble device 180 to operate in either the circulation mode or the bubble mode.

[0124] The controller 190 may include a processor 191 generating a control signal related to an operation of the washing machine 1, and memory 192 storing programs, applications, instructions, and/or data for the operation of the washing machine 1. The processor 191 and the memory 192 may be implemented as separate semiconductor devices or as a single semiconductor device. In addition, the controller 190 may include a plurality of processors or a plurality of memories. The controller 190 may be provided at various locations in the washing machine 1. For example, the controller 190 may be included in a printed circuit board provided in the control panel 110.

[0125] The processor 191 may include operation circuitry, memory circuitry, and control circuitry. The processor 191 may include a single chip or a plurality of chips.

[0126] In addition, the processor 191 may include a single core or a plurality of cores.

[0127] The memory 192 may store a program for performing a washing cycle according to a washing course, a program for changing process conditions according to the type of laundry, and data including process conditions according to a washing course. In addition, the memory 192 may store a currently selected washing course and wash settings based on user input.

[0128] In an embodiment of the disclosure, the memory 192 may store programs including an algorithm for performing a washing cycle according to a washing course and wash settings, an algorithm for identifying the type of laundry, an algorithm for changing a washing cycle process condition according to the type of laundry, and the like.

[0129] The memory 192 may include volatile memory, such as static random access memory (S-RAM) and dynamic random access memory (D-RAM)) and nonvolatile memory, such as read only memory (ROM) and erasable programmable read only memory (EPROM). The memory 192 may include single memory device or a plurality of memory devices.

[0130] The processor 191 may process data and/or signals using the programs provided from the memory 192, and may transmit control signals to each component of the washing machine 1 based on the processing results. For example, the processor 191 may process a user input received through the control panel 110. In response to the user input, the processor 191 may output a control signal for controlling each component of the washing machine 1 (e.g., display 112, heater 40, drum motor 160, water supply devices 151 and 152, circulation pump 170, circulation bubble device 180, or the like).

[0131] As another example, the processor 191 may identify the weight and material of laundry using the programs provided from the memory 192.

[0132] The processor 191 may control each component of the washing machine 1 to perform a washing cycle including a washing process, a rinsing process, and a spin-drying process according to a predetermined process condition. In addition, the processor 191 may control the control panel 110 to display wash settings and washing operation information.

[0133] In addition, the processor 191 may control the communication circuitry 195 to transmit predetermined information to an external device.

[0134] The communication circuitry 195 may transmit data to an external device or receive data from the ex-

ternal device based on a control signal from the controller 190. For example, the communication circuitry 195 may communicate with a server and/or a user terminal device and/or a home appliance to transmit and receive various data.

[0135] For the communication, the communication circuitry 195 may establish a direct (e.g., wired) communication channel or a wireless communication channel between external electronic devices (e.g., server, user terminal device, and/or home appliance), and support the performance of the communication through the established communication channel. According to an embodiment of the disclosure, the communication circuitry 195 may include a wireless communication module (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module (e.g., a local area network (LAN) communication module, or a power line communication module). Among these communication modules, the corresponding communication module may communicate with an external device through a first network (e.g., a short-range wireless communication network, such as Bluetooth, wireless fidelity (wi-fi) direct, or infrared data association (IrDA)) or a second network (e.g., a long-range wireless communication network, such as a legacy cellular network, a fifth-generation (5G) network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN))). These various types of communication modules may be integrated as one component (e.g., a single chip) or implemented as a plurality of separate components (e.g., multiple chips).

[0136] According to various embodiments of the disclosure, the communication circuitry 195 may establish communication with a user terminal device through a server.

[0137] In various embodiments of the disclosure, the communication circuitry 195 may include a wi-fi module and communicate with an external server and/or a user terminal device based on establishment of communication with an access point (AP) within a home.

[0138] In an embodiment of the disclosure, the communication circuitry 195 may request weather information from a server and receive the weather information from the server.

[0139] Although the configuration of the washing machine 1 has been described above, the washing machine 1 may further include various configurations within a scope of general technology.

[0140] FIG. 7 is a flowchart illustrating a method for controlling a washing machine according to an embodiment of the disclosure.

[0141] Referring to FIG. 7, the washing machine 1 may start a first washing course based on a user input at operation 1000.

[0142] Specifically, the controller 190 may control each component of the washing machine 1 using an algorithm corresponding to the first washing course based on receiving the user input for starting the first washing course.

[0143] FIG. 8 illustrates a control panel of a washing machine according to an embodiment of the disclosure.

[0144] Referring to FIG. 8, the input interface 111 of the control panel 110 may include an input device 110a in a form of a jog shuttle or dial and/or input devices 110b-1 to 110b-6 in a form of a touch pad or button.

[0145] According to various embodiments of the disclosure, the input interface 111 may include a power button 110b-1 for receiving an input for power, an operation/pause button 110b-2 for receiving an input for starting or pausing an operation, a washing temperature button 110b-3 for receiving an input for adjusting a washing temperature, a rinse count button 110b-4 for receiving an input for adjusting the number of rinses, a spin speed button 110b-5 for receiving an input for adjusting a spin speed, and/or an additional function button 110b-6 for receiving an input for performing additional functions.

[0146] The input interface 111 may receive a selection of a desired washing course from a user. For example, the user may select a desired washing course by rotating the input device 110a. In this instance, the display 112 may display a washing course selected each time the input device 110a is rotated, and when the desired course is selected, the user may press the operation/pause button 110b-2 to control the washing machine 1 to perform a desired washing course.

[0147] For example, in a case where the desired course corresponds to the first washing course (AI course), the user may rotate the input device 110a until the first washing course is selected, and when the first washing course is selected, the user may press the operation/pause button 110b-2 to control the washing machine 1 to start the first washing course.

[0148] In addition, the user may set detailed options through the washing temperature button 110b-3, the rinse count button 110b-4, the spin speed button 110b-5, and/or the additional function button 110b-6 before starting the desired course.

[0149] The display 112 may display a corresponding course 117a according to the rotation of the input device 110a, and may display a washing temperature 117b which is selected through the washing temperature button 110b-3 or corresponds to a default setting value.

[0150] In addition, the display 112 may display the number of rinses 117c which is selected through the rinse count button 1 10b-4 or corresponds to a default setting value, display a spin speed 117d which is selected through the spin speed button 110b-5 or corresponds to a default setting value, and display an additional function 117e which is selected through the additional function button 110b-6.

[0151] As described above, the first washing course is a course that washes laundry under process conditions most optimized for a current state, and the washing machine 1 performing the first washing course may determine various process conditions (e.g., washing temper-

ature, the number of rinses, spin speed, or the like) during the washing cycle by itself.

[0152] According to various embodiments of the disclosure, based on the selection of the first washing course, the controller 190 may control the display 112 to not display information about detailed options (e.g., washing temperature 117b, the number of rinses 117c, and/or the spin speed 117d).

[0153] When the user selects the first washing course and then presses the operation button 110b-2, the washing machine 1 may start the first washing course.

[0154] The washing machine 1 may perform a small water supply process based on the start of the first washing course at operation 1100.

[0155] FIG. 9 illustrates a washing cycle of a washing machine according to an embodiment of the disclosure.

[0156] Referring to FIG. 9, a washing cycle corresponding to the first washing course may include a small water supply process at operation 1100, a weight detection process 1001, a material detection process 1002, a washing process 1010, a rinsing process 1020, and a spin-drying process 1030.

[0157] The small water supply process at operation 1100, the weight detection process 1001, the material detection process 1002, the washing process 1010, the rinsing process 1020, and the spin-drying process 1030 may be performed sequentially. However, one of the above processes may be omitted, and the order of any two processes may be reversed.

[0158] For example, the order of the weight detection process 1001 and the material detection process 1002 may be reversed.

[0159] FIG. 10 is a view illustrating a state in which a washing machine performs a small water supply process according to an embodiment of the disclosure.

[0160] Referring to FIG. 10, in an embodiment of the disclosure, the controller 190 may perform the small water supply process at operation 1100 by controlling the first water supply device 151 to supply washing water without detergent to the tub 20.

[0161] According to various embodiments of the disclosure, a small amount of washing water without detergent may be supplied to the tub 20 in the small water supply process at operation 1100.

[0162] For example, the controller 190 may open the first water supply valve 151a until a flow rate measured from the first flow sensor positioned in the first water supply pipe 151b reaches a preset value, and may close the first water supply valve 151a based on the flow rate measured from the first flow sensor reaching the preset value.

[0163] As another example, the controller 190 may open the first water supply valve 151a for a preset time and close the first water supply valve 151a based on the elapse of the preset time.

[0164] According to various embodiments of the disclosure, the controller 190 may control at least one nozzle 151c and 151d to allow the washing water flowing through the first water supply pipe 151b to be supplied to the tub 20 through the first nozzle 151c and/or the second nozzle 151d.

[0165] In an example, the controller 190 may close the first nozzle 151c and open the second nozzle 151d to allow the washing water flowing through the first water supply pipe 151b to be supplied to the tub 20 through the second nozzle 151d.

[0166] Through the small water supply process at operation 1100, pure washing water that has not passed through the detergent box 153 may be supplied to the tub 20. For example, a preset amount of washing water without detergent may be stored in the tub 20 by the small water supply process at operation 1100.

[0167] For example, a water level of washing water supplied to the tub 20 in the small water supply process at operation 1100 may not exceed the drum 30.

[0168] The controller 190 may control the second water supply device 152 to prevent washing water containing detergent from being supplied to the tub 20 in the small water supply process at operation 1100. For example, the controller 190 may control the second water supply valve 152a to remain closed during the small water supply process at operation 1100.

[0169] The temperature sensor 120 may detect a temperature of the washing water without detergent supplied to the tub 20 at operation 1200, and may transmit information about the temperature of the washing water to the controller 190.

[0170] Referring again to FIG. 9, after performing the small water supply process at operation 1100, the controller 190 may perform the weight detection process 1001 to detect the weight of the laundry accommodated in the drum 30 and/or the material detection process 1002 to detect the material of the laundry.

[0171] In an embodiment of the disclosure, the controller 190 may repeatedly turn on/off the drum motor 160 to perform the weight detection process 1001, and based on a back electromotive force value generated when the drum motor 160 is turned off, the controller 190 may measure a load (weight of laundry) inside the drum 30. The memory 192 may store data about the weight of laundry measured in the weight detection process 1001.

[0172] The material detection process 1002 may include a first rotation process that measures a value of driving current applied to the drum motor 160 by rotating the drum 30 containing dry laundry, a water supply process that supplies washing water to the tub 20 to a preset water level while rotating the drum 30, and a second rotation process that rotates the drum 30 after completion of the water supply process and measures a value of driving current applied to the drum motor 160.

[0173] The controller 190 may determine the material of the laundry based on an average of the driving current values in the first rotation process (dry current average), an average of the driving current values in the second rotation process (wet current average), and a standard deviation of the driving current values in the second rotation process (standard deviation of wet current).

[0174] According to various embodiments of the disclosure, the controller 190 may use a classifier pretrained by machine learning to determine the material of the laundry.

[0175] The classifier for determining the material of laundry may be trained based on a machine learning model or a deep learning model which is a type of machine learning. For example, the classifier may be trained based on at least one of an artificial neural network (ANN), a deep neural network (DNN), a convolution neural network (CNN), a recurrent neural network (RNN), and the like.

[0176] Meanwhile, because a small amount of washing water is supplied to the tub 20 in the small water supply process at operation 1100, the washing water supplied to the tub 20 during the small water supply process at operation 1100 does not affect the weight detection process 1001 or the material detection process 1002.

[0177] Accordingly, the controller 190 may perform the weight detection process 1001 and/or the material detection process 1002 after performing the small water supply process at operation 1100.

[0178] According to various embodiments of the disclosure, the small water supply process at operation 1100 may be replaced with the water supply process included in the material detection process 1002. Specifically, after performing the first rotation process of the material detection process 1002 after the weight detection process 1001, the controller 190 may control the first water supply device 151 to supply the washing water without detergent to the tub 20, and then perform the second rotation process.

[0179] According to the disclosure, a time required for the small water supply process at operation 1100 may be shortened.

[0180] In an embodiment of the disclosure, the controller 190 may change process conditions of the washing process 1010, the rinsing process 1020, and the spin-drying process 1030 based on the temperature of the washing water without detergent, the weight of the laundry, and/or the material of the laundry.

[0181] In the washing process 1010, the laundry may be washed. Specifically, foreign substances adhered to the laundry may be separated by chemical action of detergent and/or mechanical action, such as falling.

[0182] The washing process 1010 may include a supply of water 1011 for supplying water to the tub 20, a wash 1012 for washing the laundry by rotating the drum 30 at low speed, a drain 1013 for discharging water accommodated in the tub 20, and an intermediate spin-dry 1014 for separating water from the laundry by rotating the drum 30 at high speed.

[0183] In this instance, for supply of water 1011, the controller 190 may control the second water supply device 152 to supply the washing water containing detergent to the tub 20. For example, the controller 190 may control the first water supply device 151 to supply the washing water without detergent to the tub 20 in the small water supply process at operation 1100, and then control the second water supply device 152 to supply the washing water containing detergent to the tub 20 for the supply of water 1011 of the washing process 1010.

[0184] For the wash 1012, the controller 190 may rotate the drum motor 160 in the forward or reverse direction. By the rotation of the drum 30, the laundry falls from an upper side of the drum 30 to a lower side, and the laundry may be washed by falling.

[0185] According to various embodiments of the disclosure, the controller 190 may improve washing performance by operating the circulation pump 170 at a predetermined speed during the wash 1012. As will be described later, a rotation speed of the circulation pump 170 may be determined in advance in the small water supply process at operation 1100.

[0186] According to various embodiments of the disclosure, the controller 190 may operate the heater 40 to increase a temperature of the washing water stored in the tub 20 during the supply of water 1011 or the wash 1012. As will be described later, operation specifications of the heater 40 may be determined in advance in the small water supply process at operation 1100.

[0187] For the intermediate spin-dry 1014, the controller 190 may rotate the drum motor 160 at high speed. By the high-speed rotation of the drum 30, water may be separated from the laundry accommodated in the drum 30, and thus discharged to the outside of the washing machine 1.

[0188] During the intermediate spin-dry 1014, the rotation speed of the drum 30 may be increased gradually.

[0189] By the rinsing process 1020, the laundry may be rinsed. Specifically, detergent or foreign substances left in the laundry may be washed away with water.

[0190] The rinsing process 1020 may include a supply of water 1021 for supplying water to the tub 20, a rinse 1022 for rinsing the laundry by driving the drum 30, a drain 1023 for discharging water stored in the tub 20, and an intermediate spin-dry 1024 for separating water from the laundry by driving the drum 30.

[0191] According to various embodiments of the disclosure, during the rinse 1022, the controller 190 may improve rinsing efficiency by operating the circulation pump 170 at a predetermined speed. As will be described later, a rotation speed of the circulation pump 170 may be determined in advance in the small water supply process at operation 1100.

[0192] According to various embodiments of the disclosure, the controller 190 may operate the heater 40 to increase the temperature of the washing water stored in the tub 20 during the supply of water 1021 or the rinse 1022. In this instance, operating specifications of the heater 40 may be determined in advance in the small water supply process at operation 1100.

[0193] The supply of water 1021, the drain 1023, and the intermediate spin-dry 1024 of the rinsing process 1020 may be the same as the supply of water 1011, the drain 1013, and the intermediate spin-dry 1014 of the

washing process 1010, respectively. During the rinsing process 1020, the supply of water 1021, the rinse 1022, the drain 1023, and the intermediate spin-dry 1024 may be performed once or multiple times.

[0194] By the spin-drying process 1030, the laundry may be dehydrated. Specifically, water may be separated from the laundry by the high-speed rotation of the drum 30, and the separated water may be discharged to the outside of the washing machine 1.

[0195] The spin-drying process 1030 may include a final spin-dry 1031 in which water is separated from the laundry by rotating the drum 30 at high speed. Because of the final spin-drying 1031, the final intermediate spin-dry 1024 of the rinsing process 1020 may be omitted.

[0196] For the final spin-dry 1031, the controller 190 may rotate the drum motor 160 at high speed. By the high-speed rotation of the drum 30, water may be separated from the laundry accommodated in the drum 30 and discharged to the outside of the washing machine 1. In addition, the rotation speed of the drum motor 160 may be increased gradually.

[0197] Because the operation of the washing machine 1 ends with the final spin-dry 1031, an operation time of the final spin-dry 1031 may be longer than that of the intermediate spin-dry 1014 and 1024.

[0198] According to various embodiments of the disclosure, the controller 190 may control the rotation speed of the circulation pump 170 based on a temperature of the washing water without detergent at operation 1300.

[0199] More specifically, the controller 190 may set an operation revolutions per minute (RPM) of the circulation pump 170 in an operation period (e.g., a predetermined period after water supply for washing or rinsing) of the circulation pump 170 based on the temperature of the washing water without detergent.

[0200] According to various embodiments of the disclosure, the controller 190 may change control specifications of the heater 40 based on the temperature of the washing water without detergent at operation 1400.

[0201] More specifically, the controller 190 may set a control method of the heater 40 in an operation period (e.g., a predetermined period after water supply for washing or rinsing) of the heater 40 based on the temperature of the washing water without detergent.

[0202] FIG. 11 is a lookup table in which a temperature of washing water provided in a small water supply process and a rotation speed of a circulation pump are matched according to an embodiment of the disclosure.

[0203] Referring to FIG. 11, the memory 192 may store a lookup table in which a temperature of washing water and a rotation speed of the circulation pump 170 are matched.

[0204] According to various embodiments of the disclosure, in the lookup table, a temperature of washing water, a weight of laundry, and a rotation speed of the circulation pump 170 are matched, without being limited thereto.

[0205] For example, the controller 190 may control the rotation speed of the circulation pump 170 based on the temperature of washing water without detergent, and may also control the rotation speed of the circulation pump 170 based on the temperature of the washing water without detergent and the weight of the laundry.

[0206] The controller 190 may determine an RPM of the circulation pump 170 according to the temperature of the washing water without detergent measured by the temperature sensor 120 after the small water supply process at operation 1100 based on the lookup table.

[0207] In addition, the controller 190 may determine a control method of the heater 40 according to the temperature of the washing water without detergent measured by the temperature sensor 120 after the small water supply process at operation 1100 based on the lookup table.

[0208] For example, in a case where a weight k of laundry is lighter than a first preset weight k1, the controller 190 may determine a speed of the circulation pump 170 as a first sub-1 speed (R11) based on a temperature T of the washing water without detergent being less than a first preset temperature (t1, e.g., approximately 5°C or lower).

[0209] In addition, the controller 190 may determine the speed of the circulation pump 170 as a first sub-2 speed (R12) based on the temperature T of the washing water without detergent being less than a second preset temperature (t2, e.g., approximately 10°C).

[0210] In addition, the controller 190 may determine the speed of the circulation pump 170 as a first sub-3 speed (R13) based on the temperature T of the washing water without detergent being greater than the second preset temperature t2.

[0211] In this instance, the first sub-1 speed (R11) may be faster than the first sub-2 speed (R12), and the first sub-2 speed (R12) may be faster than the first sub-3 speed (R13).

[0212] Likewise, in a case where the weight k of the laundry is heavier than the first preset weight k1 and lighter than a second preset weight k2, the controller 190 may determine the speed of the circulation pump 170 as a second sub-1 speed (R21) based on the temperature T of the washing water without detergent being less than the first preset temperature t1.

[0213] In addition, the controller 190 may determine the speed of the circulation pump 170 as a second sub-2 speed (R22) based on the temperature T of the washing water without detergent being less than the second preset temperature t2.

[0214] In addition, the controller 190 may determine the speed of the circulation pump 170 as a second sub-3 speed (R23) based on the temperature T of the washing water without detergent being higher than the second preset temperature t2.

[0215] In this instance, the second sub-1 speed (R11) may be faster than the second sub-2 speed (R22), and the second sub-2 speed (R22) may be faster than the second sub-3 speed (R23).

[0216] Likewise, in a case where the weight k of the

laundry is heavier than the second preset weight k2 and lighter than a third preset weight k3, the controller 190 may determine the speed of the circulation pump 170 as a third sub-1 speed (R31) based on the temperature T of the washing water without detergent being less than the first preset temperature t1.

[0217] In addition, the controller 190 may determine the speed of the circulation pump 170 as a third sub-2 speed (R32) based on the temperature T of the washing water without detergent being less than the second preset temperature t2.

[0218] In addition, the controller 190 may determine the speed of the circulation pump 170 as a third sub-3 speed (R33) based on the temperature T of the washing water without detergent being higher than the second preset temperature t2.

[0219] In this instance, the third sub-1 speed (R31) may be faster than the third sub-2 speed (R32), and the third sub-2 speed (R32) may be faster than the third sub-3 speed (R33).

[0220] The controller 190 may control the circulation pump 170 to rotate at the first speed (R11, R21, R31) based on the temperature T of the washing water without detergent being less than the preset temperature t1, and may control the circulation pump 170 to rotate at the second speed (R12, R22, R32) that is smaller than the first speed (R11, R21, R31) based on the temperature T of the washing water without detergent being higher than the preset temperature t1.

[0221] In addition, the controller 190 may control the circulation pump 170 to rotate at the second speed (R12, R22, R32) based on the temperature T of the washing water without detergent being less than the preset temperature t2, and may control the circulation pump 170 to rotate at the third speed (R13, R23, R33) that is smaller than the second speed (R12, R22, R32) based on the temperature T of the washing water without detergent being higher than the preset temperature t2.

[0222] In summary, the controller 190 may set the RPM of the circulation pump 170 to be higher as the temperature of the washing water supplied to the tub 20 in the small water supply process at operation 1100 is lower, and may set the RPM of the circulation pump 170 to be lower as the temperature of the washing water supplied to the tub 20 in the small water supply process at operation 1100 is higher. The controller 190 may operate the circulation pump 170 at a preset rotation speed in an operation period (e.g., a predetermined period after water supply for washing or rinsing) of the circulation pump 170.

[0223] The parameters t1, t2, k1, k2, k3, or the like, included in the lookup table may be changed to optimal values by various experiments, and the form of the lookup table is only an example of the disclosure.

[0224] According to various embodiments of the disclosure, the controller 190 may control the heater 40 using a time control method based on the temperature T of the washing water without detergent being less than the preset temperature t2, and may control the heater 40 using the time control method and/or a temperature control method based on the temperature T of the washing water without detergent being higher than the preset temperature t2.

[0225] The time control method refers to a method in which the heater 40 is operated in an operation period of the heater 40 (a predetermined period after water supply for washing or rinsing) and then the heater 40 is turned off based on the elapse of a preset time.

[0226] The temperature control method refers to a method in which the heater 40 is operated in an operation period of the heater 40 and then the heater 40 is turned off based on a temperature of the washing water stored in the tub 20 reaching a preset temperature.

[0227] For example, the controller 190 may operate the heater 40 for a first preset time based on the temperature T of the washing water without detergent being less than the preset temperature t2 (time control).

[0228] In addition, based on the temperature T of the washing water without detergent being higher than the preset temperature t2, the controller 190 may operate the heater 40 for a second preset time or until the temperature of the washed washing water stored in the tub 20 reaching a target temperature (time control and/or temperature control). In this case, the controller 190 may turn off the heater 40, in a case where any one of a condition of the temperature of the washing water stored in the tub 20 reaching the target temperature or a condition of the elapse of the second preset time is satisfied.

[0229] The controller 190 may turn off the heater 40, even in a case where the temperature of the washing water stored in the tub 20 does not reach the target temperature, based on the temperature T of the washing water without detergent being less than the preset temperature t2 (time control).

[0230] In this instance, the first preset time (e.g., approximately 10 minutes) may be the same as the second preset time (e.g., approximately 10 minutes), but is not limited thereto.

[0231] According to the disclosure, the first preset time and the second preset time are almost the same, and thus energy consumed by the heater 40 to heat the washing water may be saved even in a case where the temperature of the washing water is low.

[0232] In addition, the controller 190 may set the target temperature based on the weight of the laundry and/or the material of the laundry. For example, the target temperature may be set in advance by the controller 190 before the heater 40 operates.

[0233] In a case where the temperature of the washing water supplied to the tub 20 is low, for example, in winter when the temperature is low, the heater 40 is operated for a long time to raise the temperature of the washing water to the target temperature. However, even though the heater 40 is operated for a long time, the temperature of washing water does not rise efficiently due to the low temperature, resulting in a significantly low energy efficiency compared to washing performance in winter.

[0234] Meanwhile, in a case where the heater 40 is not operated for a long time based on energy efficiency, washing may not be performed smoothly because detergent does not dissolve well in water.

[0235] According to the disclosure, the temperature of washing water supplied to the tub 20 may be determined more accurately by measuring a temperature of washing water that has not passed through the detergent box.

[0236] According to the disclosure, as the temperature of the washing water supplied to the tub 20 in the small water supply process at operation 1100 is higher, the rotation speed of the circulation pump 170 decreases, and as the temperature of the washing water supplied to the tub 20 in the small water supply process at operation 1100 is lower, the rotation speed of the circulation pump 170 increases.

[0237] Accordingly, the washing machine 1 according to the disclosure may increase the amount of washing water supplied to the circulation bubble device 180 in an environment where detergent does not easily dissolve in the washing water, thereby improving washing performance.

[0238] Meanwhile, in summer when the water temperature is high, supplying a large amount of washing water to the circulation bubble device 180 may result in longer washing time or damage to the laundry, instead of improvement of washing performance.

[0239] Accordingly, the washing machine 1 according to the disclosure may reduce the amount of washing water supplied to the circulation bubble device 180 in an environment where the temperature of the washing water is high, thereby preventing longer washing time or damage to the laundry.

[0240] Meanwhile, in winter when the water temperature is low, in a case where the heater 40 is operated to heat the temperature of the washing water stored in the tub 20 to the target temperature, excessive energy is consumed in the operation of the heater 40, and a longer washing process time is caused.

[0241] According to the disclosure, when the water temperature is low, the time control method may be used to control the heater 40, thereby preventing excessive energy consumption in the operation of the heater 40, and at the same time, washing performance may be secured by increasing the rotation speed of the circulation pump 170.

[0242] In addition, according to the disclosure, when the water temperature is high, the time control method or the temperature control method may be used to properly operate the heater 40 and reduce the rotation speed of the circulation pump 170.

[0243] As a result, in a case where washing is performed using the washing machine 1 according to the disclosure in winter when the water temperature is low as well as in summer when the water temperature is high, there may be little difference in energy consumption with a similar washing performance.

[0244] Meanwhile, in a case where the rotation speed of the circulation pump 170 is increased, the amount of washing water supplied to the circulation bubble device 180 increases.

[0245] FIG. 12 is a view illustrating a state in which a circulation bubble device operates in a circulation mode according to an embodiment of the disclosure. FIG. 13 is a view illustrating a state in which a circulation bubble device operates in a bubble mode according to an embodiment of the disclosure.

[0246] Referring to FIG. 12, in a case where the circulation bubble device 180 operates in a circulation mode, an increase in rotation speed of the circulation pump 170 increases the amount of water falling into the tub 20 through the connection pipe 50.

[0247] In the case where the circulation bubble device 180 operates in the circulation mode, washing performance may be significantly improved by friction between laundry and water falling into the tub 20.

[0248] However, in a case where the laundry fabric is delicate, an increase in the amount of water falling into the tub 20 may cause damage to the laundry fabric due to the falling washing water.

[0249] Referring to FIG. 13, in a case where the circulation bubble device 180 operates in a bubble mode, an increase in rotation speed of the circulation pump 170 increases the amount of bubbles supplied to the tub 20.

[0250] In the case where the circulation bubble device 180 operates in the bubble mode, detergent and/or softener may be more efficiently applied to laundry by bubbles in the washing process 1010, and the detergent and/or softener applied to the laundry may be more efficiently desorbed by bubbles in the rinsing process 1020.

[0251] In the case where the circulation bubble device 180 operates in the bubble mode, washing performance may be increased to some extent, although not as much as in the case where the circulation bubble device 180 operates in the circulation mode.

[0252] In addition, in the case where the circulation bubble device 180 operates in the bubble mode, there is no risk of damage to the laundry fabric even though the fabric is delicate.

[0253] According to various embodiments of the disclosure, the controller 190 may determine an operation mode of the circulation bubble device 180 based on a material of the laundry identified in the material detection process.

[0254] For example, based on determining that the material of the laundry is a first material (e.g., delicate clothing), the controller 190 may control the circulation bubble device 180 to circulate the washing water stored in the tub 20 (circulation mode), and based on determining that the material of the laundry is a second material (e.g., general clothing), the controller 190 may control the circulation bubble device 180 to generate bubbles in the washing water stored in the tub 20 (bubble mode).

[0255] For example, in a case where the material of the laundry is identified as the first material that may be an easily damaged laundry fabric, the controller 190 may

improve washing performance by a bubble generating operation of the circulation bubble device 180, and in a case where the material of the laundry is identified as the second material which is a laundry fabric that is not easily damaged, the controller 190 may improve washing performance by the circulation operation of the circulation bubble device 180.

[0256] According to various embodiments of the disclosure, the controller 190 may control the circulation bubble device 180 to alternately operate in the circulation mode and the bubble mode in the case where the material of the laundry is identified as the second material.

[0257] However, the controller 190 may only operate the circulation bubble device 180 in the bubble mode, in the case where the material of the laundry is identified as the first material.

[0258] According to the disclosure, damage to the laundry fabric may be prevented by changing the operation mode of the circulation bubble device 180 according to the material of the laundry.

[0259] FIG. 14 is a flowchart illustrating a method for controlling a washing machine according to an embodiment of the disclosure. FIG. 15 illustrates a control panel of a washing machine in a case where weather information satisfies a preset condition according to an embodiment of the disclosure.

[0260] Referring to FIGS. 14 and 15, the washing machine 1 may be turned on at operation 2000 based on a user input.

[0261] For example, a user may turn on the washing machine 1 by pressing or touching the power button 110b-1 of the control panel 110.

[0262] The controller 190 may control the communication circuitry 195 to request weather information from a server based on the washing machine 1 being turned on.

[0263] According to various embodiments of the disclosure, the embodiment described with reference to FIG. 7 may be performed only when the first washing course is selected by the user.

[0264] For example, according to various embodiments of the disclosure, the controller 190 may control a rotation speed of the circulation pump 170 based on a temperature of washing water without detergent only upon receiving a user input to start the first washing course.

[0265] For example, in a case where the user selects a different course (e.g., second washing course), the small water supply process at operation 1100 may be omitted from the washing cycle described with reference to FIG. 9, and further, the weight detection process 1001 and/or the material detection process 1002 may also be omitted.

[0266] In a case where the user selects the second washing course (e.g., general washing course) rather than the first washing course while a temperature of washing water supplied to the tub 20 is low, such as in winter, the rotation speed of the circulation pump 170 and the control method of the heater 40 are not changed, causing excessive energy consumption and time required to perform the second washing course.

[0267] According to various embodiments of the disclosure, the controller 190 may control the display 112 and/or the speaker 113 to provide feedback recommending selection of the first washing course based on weather information satisfying a preset condition (Yes at operation 2100).

[0268] In this instance, the preset condition may include a temperature included in the weather information received from the server being less than a preset temperature (e.g., approximately 5°C).

[0269] For example, the preset condition may include at least one weather condition in which the temperature of the washing water supplied to the tub 20 is estimated to be low.

[0270] For example, the controller 190 may control the display 112 to output a visual indicator (e.g., text, figure, image, or the like) recommending the selection of the first washing course at operation 2200 based on the weather information satisfying the preset condition (Yes at operation 2100).

[0271] The visual indicator recommending the selection of the first washing course may notify the user that energy consumption may be reduced by selecting the first washing course.

[0272] As another example, the controller 190 may control the speaker 113 to output a sound recommending the selection of the first washing course based on the weather information satisfying the preset condition (Yes at operation 2100).

[0273] The sound recommending the selection of the first washing course may notify the user that energy consumption may be reduced by selecting the first washing course.

[0274] According to the disclosure, in the case of winter, the first washing course, which is superior in terms of energy efficiency, may be recommended to the user, and thus user satisfaction may be increased.

[0275] Meanwhile, the disclosed embodiments may be implemented in the form of a recording medium that stores instructions executable by a computer. The instructions may be stored in the form of program codes, and when executed by a processor, the instructions may create a program module to perform operations of the disclosed embodiments. The recording medium may be implemented as a computer-readable recording medium.

[0276] The computer-readable recording medium may include all kinds of recording media storing instructions that may be interpreted by a computer. For example, the computer-readable recording medium may be read only memory (ROM), random access memory (RAM), a magnetic tape, a magnetic disk, flash memory, an optical data storage device, or the like.

[0277] The computer-readable recording medium may be provided in the form of a non-transitory storage medium. Here, when a storage medium is referred to as "non-transitory," it may be understood that the storage medium is tangible and does not include a signal (e.g.,

an electromagnetic wave), but rather that data is semi-permanently or temporarily stored in the storage medium. For example, a "non-transitory storage medium" may include a buffer in which data is temporarily stored.

[0278] According to an embodiment of the disclosure, the methods according to the various embodiments disclosed herein may be provided in a computer program product. The computer program product may be traded between a seller and a buyer as a product. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or may be distributed through an application store (e.g., Play Store™) online. In the case of online distribution, at least a portion of the computer program product may be stored at least semi-permanently or may be temporarily generated in a storage medium, such as memory of a server of a manufacturer, a server of an application store, or a relay server.

[0279] While the disclosure has been shown and described with reference to various embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims and their equivalents.

Claims

1. A washing machine, comprising:

a main body;
a tub provided inside the main body;
a first water supply device configured to supply washing water without detergent to the tub;
a second water supply device configured to supply washing water containing detergent to the tub;
a temperature sensor configured to detect a temperature of the washing water stored in the tub;
a circulation bubble device configured to circulate the washing water stored in the tub or generate bubbles in the washing water stored in the tub;
a circulation pump configured to supply the washing water stored in the tub to the circulation bubble device; and
a controller configured to control the first water supply device to supply the washing water without detergent to the tub, and control a rotation speed of the circulation pump based on a temperature of the washing water without detergent.

2. The washing machine of claim 1, wherein the controller is configured to control the circulation pump to rotate at a first speed based on the temperature of the washing water without detergent being less than a preset temperature, and control the circulation pump to rotate at a second speed lower than the first speed based on the temperature of the washing water without detergent being higher than the preset temperature.

3. The washing machine of claim 1, further comprising:

a heater configured to heat the washing water stored in the tub,
wherein the controller is configured to:

operate the heater for a first preset time based on the temperature of the washing water without detergent being less than a preset temperature, and
operate the heater for a second preset time, or operate the heater until the temperature of the washing water stored in the tub reaches a target temperature, based on the temperature of the washing water without detergent being higher than the preset temperature.

4. The washing machine of claim 3, wherein, in response to the temperature of the washing water without detergent being less than the preset temperature, the controller is configured to turn off the heater even in a case where the temperature of the washing water stored in the tub does not reach the target temperature.

5. The washing machine of claim 1, wherein the controller is configured to:

perform a weight detection process for detecting a weight of laundry and a material detection process for detecting a material of the laundry after controlling the first water supply device to supply the washing water without detergent to the tub, and
control the second water supply device to supply the washing water containing the detergent to the tub after performing the weight detection process and the material detection process.

6. The washing machine of claim 5, wherein the controller is configured to control the rotation speed of the circulation pump based on the temperature of the washing water without detergent and the weight of the laundry.

7. The washing machine of claim 5, wherein the controller is configured to determine an operation mode of the circulation bubble device based on the material of the laundry.

8. The washing machine of claim 7, wherein the controller is configured to control the circulation bubble

device to circulate the washing water stored in the tub based on determining that the material of the laundry is a first material, and
control the circulation bubble device to generate bubbles in the washing water stored in the tub based on determining that the material of the laundry is a second material.

9. The washing machine of claim 1, wherein the controller is configured to control the rotation speed of the circulation pump based on the temperature of the washing water without detergent, only in a case where a user input to start a first washing course is received.

10. The washing machine of claim 9, further comprising:

an output interface comprising at least one of a display or a speaker; and
a communication circuitry configured to receive weather information from a server,
wherein the controller is configured to control the output interface to provide feedback recommending selection of the first washing course, based on the weather information satisfying a preset condition.

11. A method for controlling a washing machine comprising a circulation bubble device configured to circulate washing water stored in a tub or generate bubbles in the washing water stored in the tub and a circulation pump configured to supply the washing water stored in the tub to the circulation bubble device, the method comprising:

supplying washing water without detergent to the tub; and
controlling a rotation speed of the circulation pump based on a temperature of the washing water without detergent.

12. The method of claim 11, wherein the controlling of the rotation speed of the circulation pump comprises:

controlling the circulation pump to rotate at a first speed based on the temperature of the washing water without detergent being less than a preset temperature; and
controlling the circulation pump to rotate at a second speed lower than the first speed based on the temperature of the washing water without detergent being higher than the preset temperature.

13. The method of claim 11, further comprising

operating a heater configured to heat the washing water stored in the tub for a first preset time based on the temperature of the washing water without detergent being less than a preset temperature; and
operating the heater for a second preset time, or operating the heater until a temperature of the washing water stored in the tub reaches a target temperature, based on the temperature of the washing water without detergent being higher than the preset temperature.

14. The method of claim 13, wherein the operating of the heater for the first preset time comprises turning off the heater even in a case where the temperature of the washing water stored in the tub does not reach the target temperature.

15. The method of claim 11, further comprising

performing a weight detection process for detecting a weight of laundry and a material detection process for detecting a material of the laundry after supplying the washing water without detergent to the tub; and
supplying the washing water containing detergent to the tub after performing the weight detection process and the material detection process.

FIG. 1

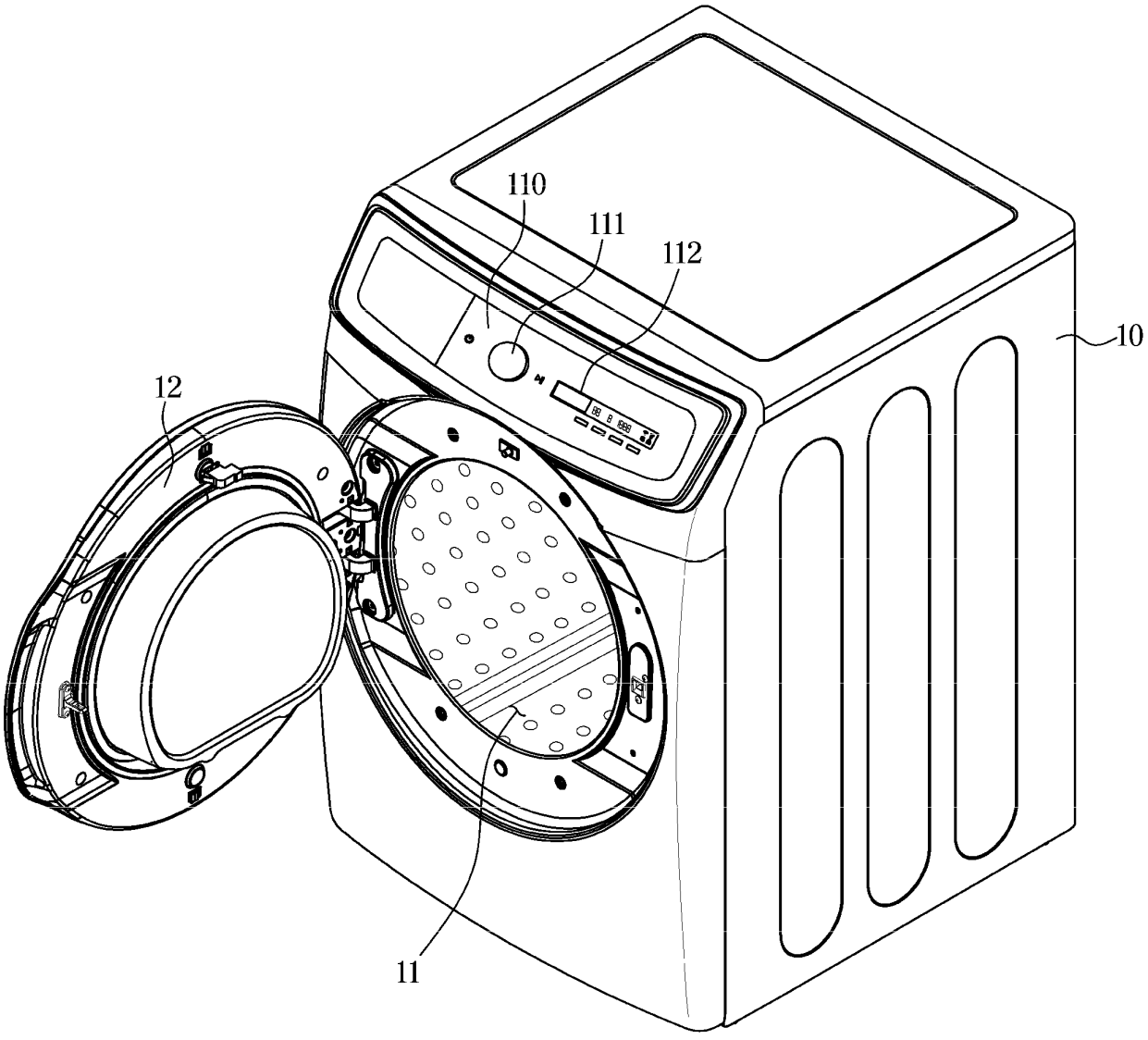
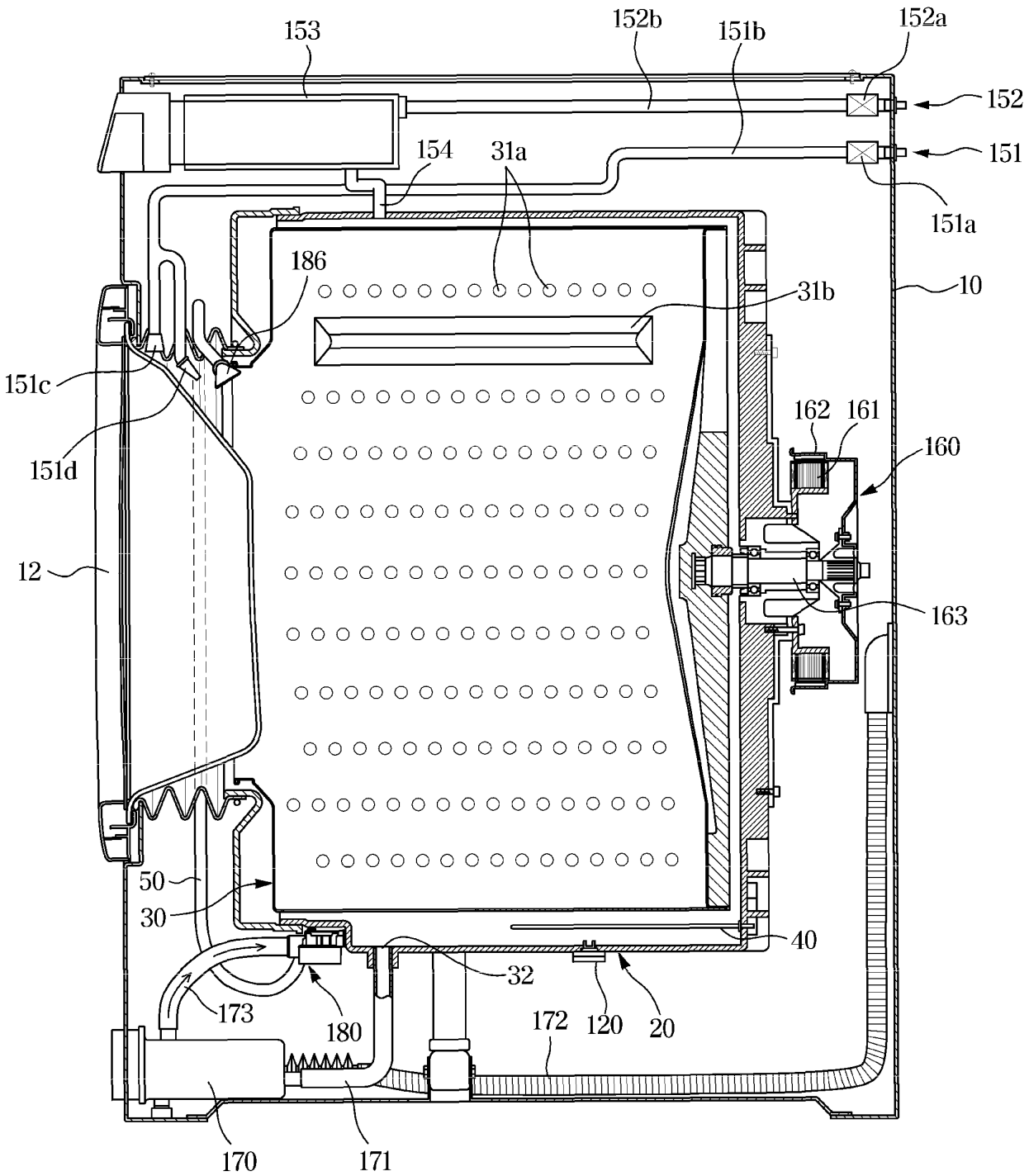


FIG. 2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151a
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31b
10
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151d
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173
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120
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170
171

FIG. 3

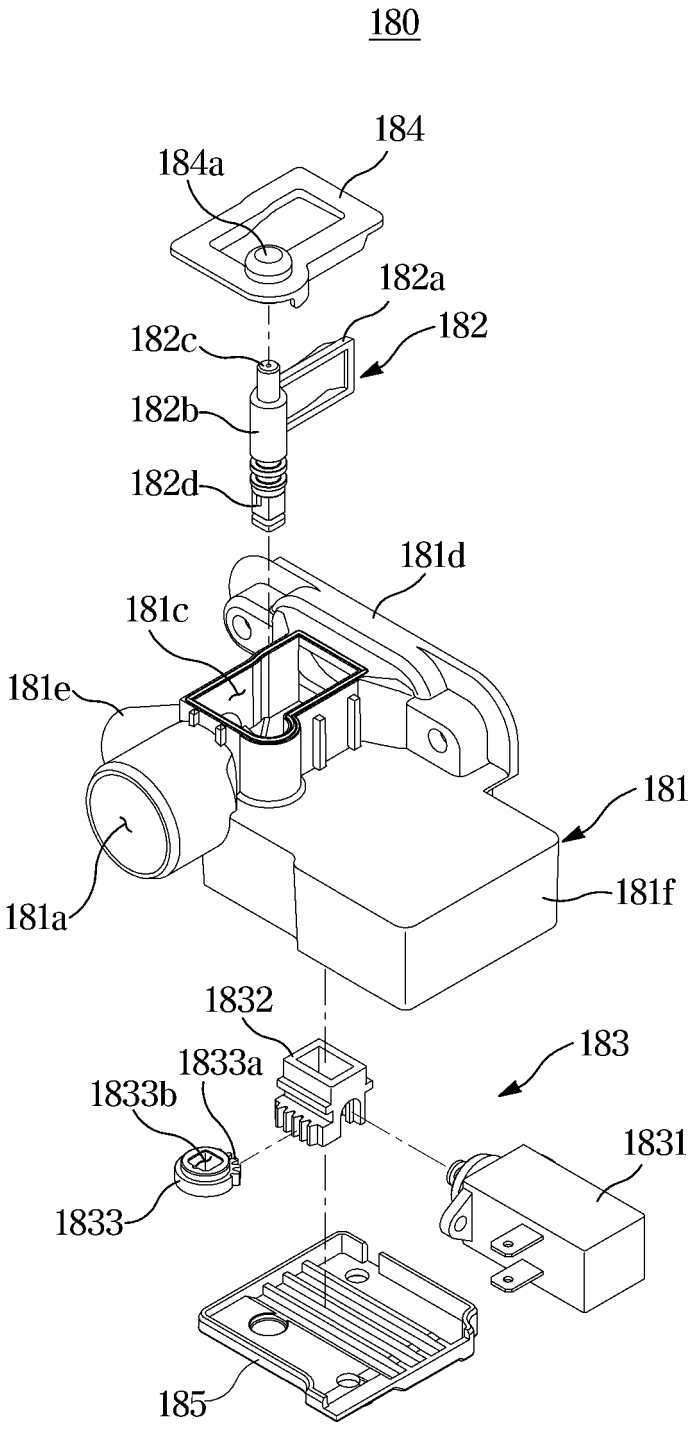
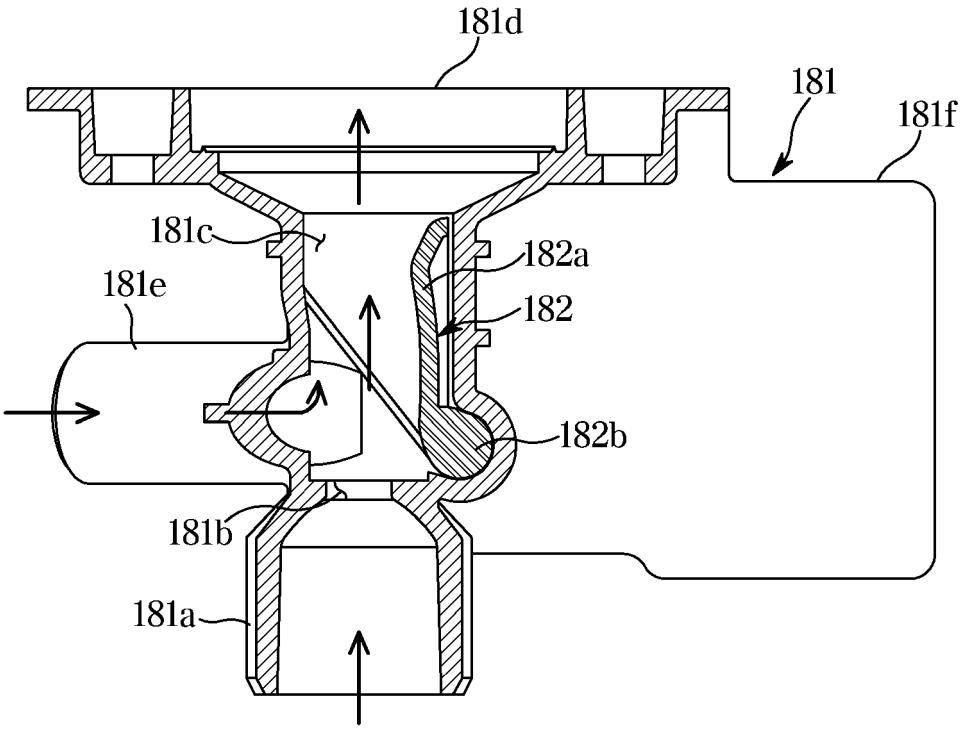

180
184
184a
182a
182
182c
182b
182d
181d
181c
181e
181
181a
181f
1832
183
1833a
1833b
1831
1833
185

FIG. 4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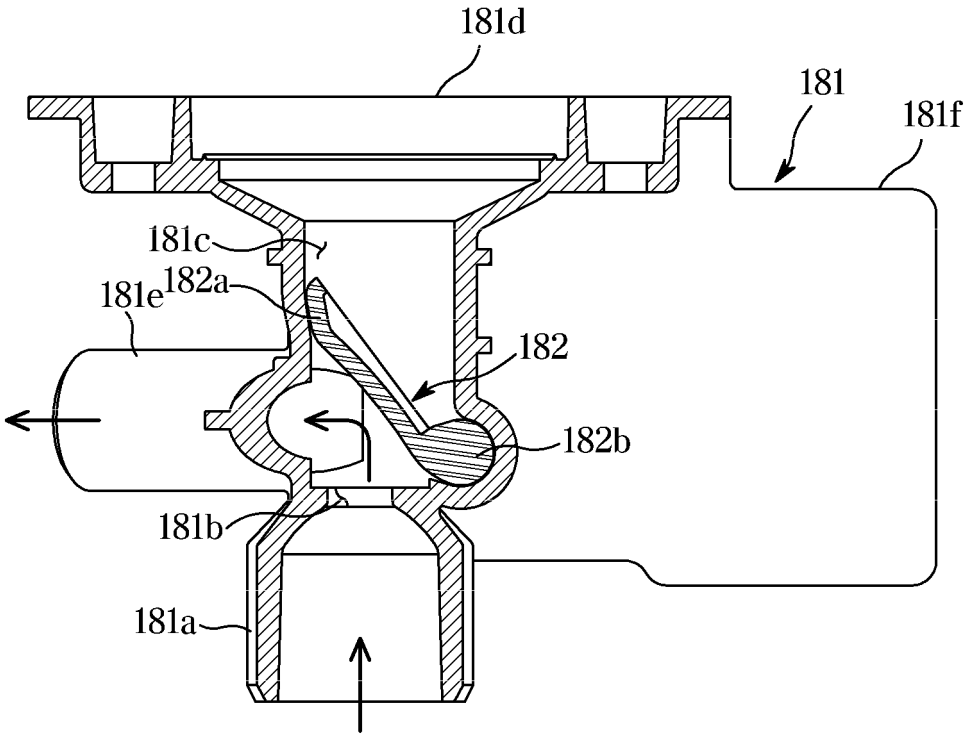
182
182b
181b
181a

FIG. 5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181c
181e
182a
182
182b
181b
181a

FIG. 6

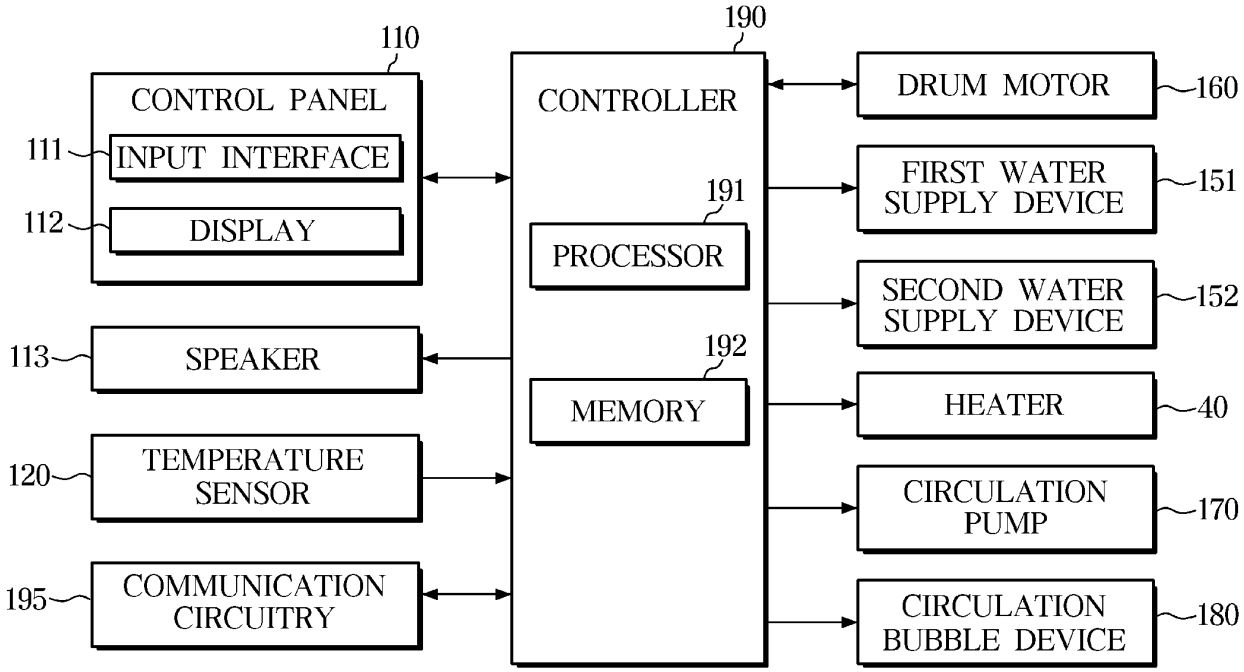

110
CONTROL PANEL
111
INPUT INTERFACE
112
DISPLAY
113
SPEAKER
120
TEMPERATURE SENSOR
195
COMMUNICATION CIRCUITRY
190
CONTROLLER
191
PROCESSOR
192
MEMORY
DRUM MOTOR
160
FIRST WATER SUPPLY DEVICE
151
SECOND WATER SUPPLY DEVICE
152
HEATER
40
CIRCULATION PUMP
170
CIRCULATION BUBBLE DEVICE
180

FIG. 7

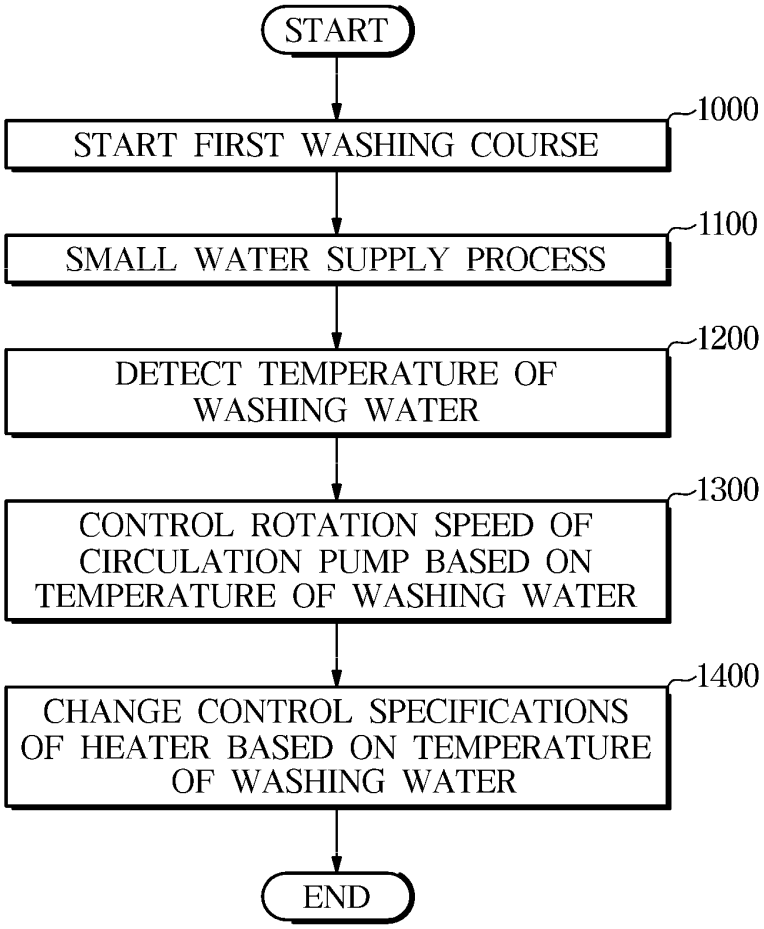

START
START FIRST WASHING COURSE
1000
SMALL WATER SUPPLY PROCESS
1100
DETECT TEMPERATURE OF WASHING WATER
1200
CONTROL ROTATION SPEED OF CIRCULATION PUMP BASED ON TEMPERATURE OF WASHING WATER
1300
CHANGE CONTROL SPECIFICATIONS OF HEATER BASED ON TEMPERATURE OF WASHING WATER
1400
END

FIG. 8

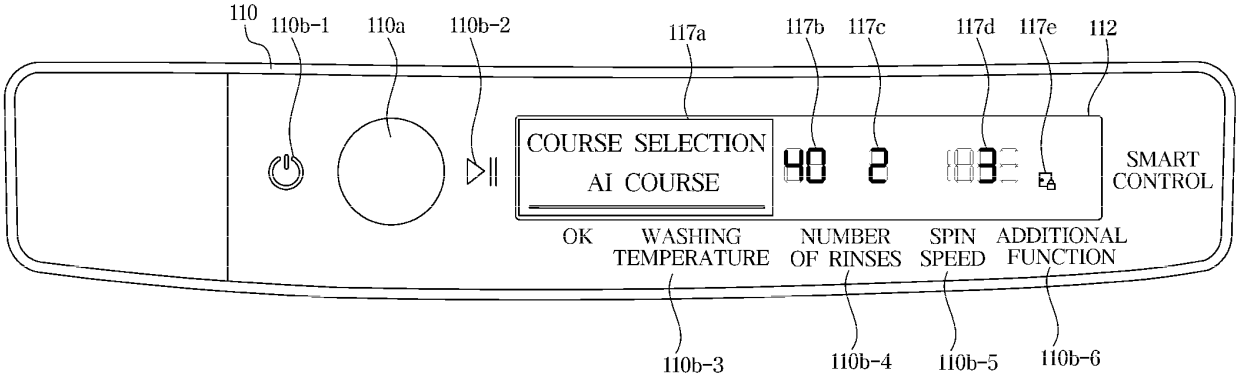

110
110b-1
110a
110b-2
117a
117b
117c
117d
117e
112
COURSE SELECTION
AI COURSE
40
2
SMART CONTROL
OK
WASHING TEMPERATURE
NUMBER OF RINSES
SPIN SPEED
ADDITIONAL FUNCTION
110b-3
110b-4
110b-5
110b-6

FIG. 9

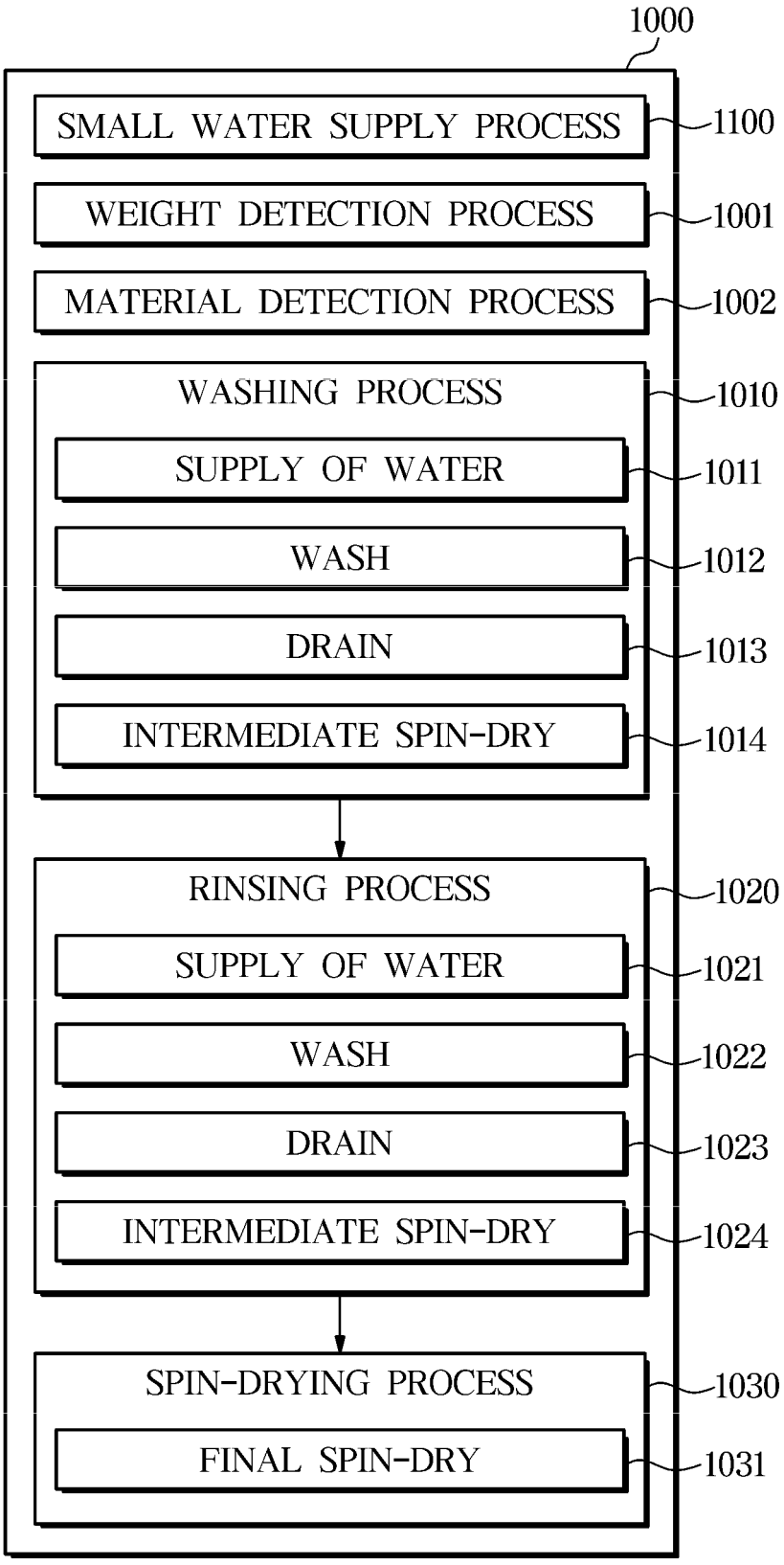
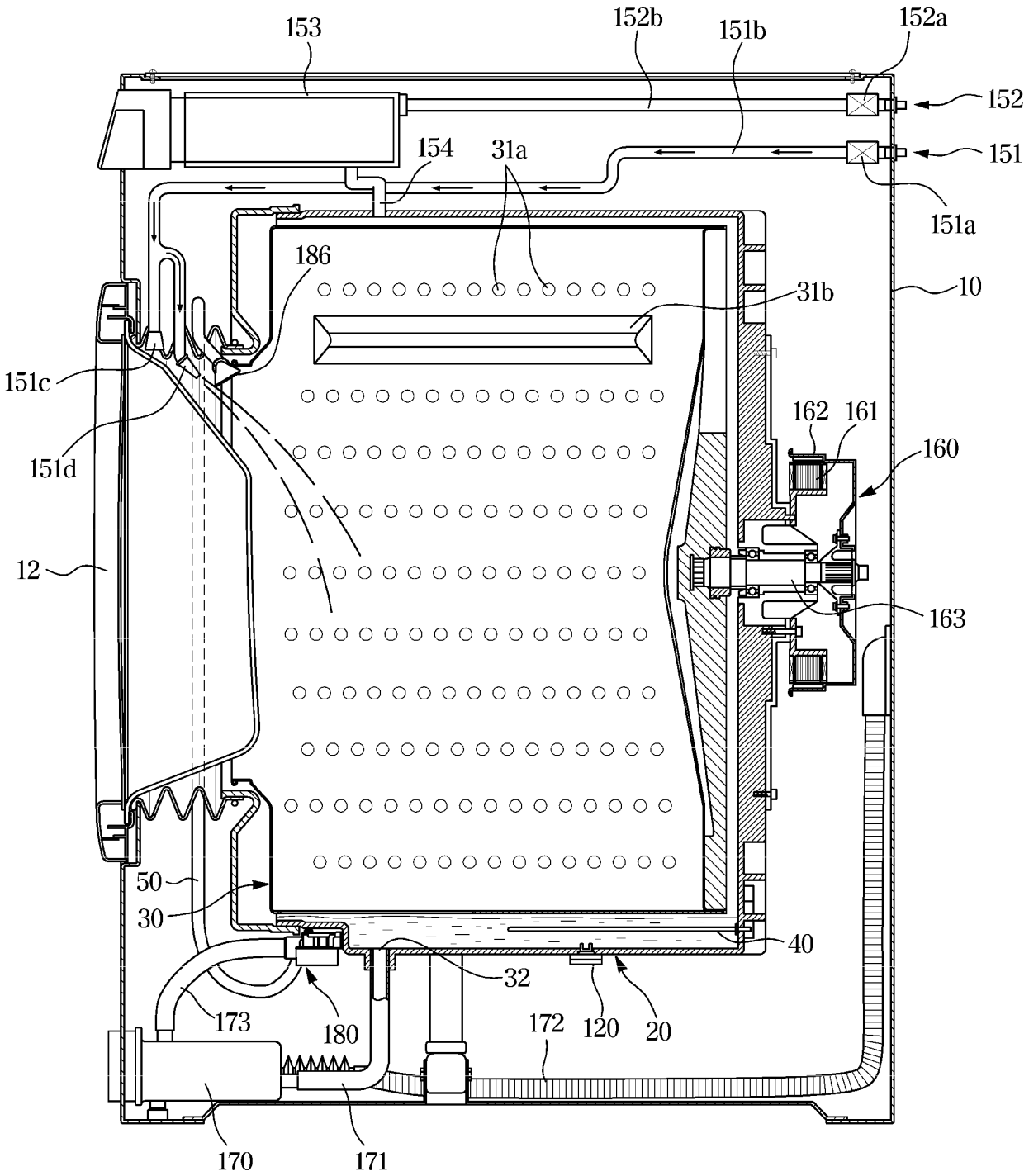

1000
SMALL WATER SUPPLY PROCESS
1100
WEIGHT DETECTION PROCESS
1001
MATERIAL DETECTION PROCESS
1002
WASHING PROCESS
1010
SUPPLY OF WATER
1011
WASH
1012
DRAIN
1013
INTERMEDIATE SPIN-DRY
1014
RINSING PROCESS
1020
SUPPLY OF WATER
1021
WASH
1022
DRAIN
1023
INTERMEDIATE SPIN-DRY
1024
SPIN-DRYING PROCESS
1030
FINAL SPIN-DRY
1031

FIG. 10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151b
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151
154
31a
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31b
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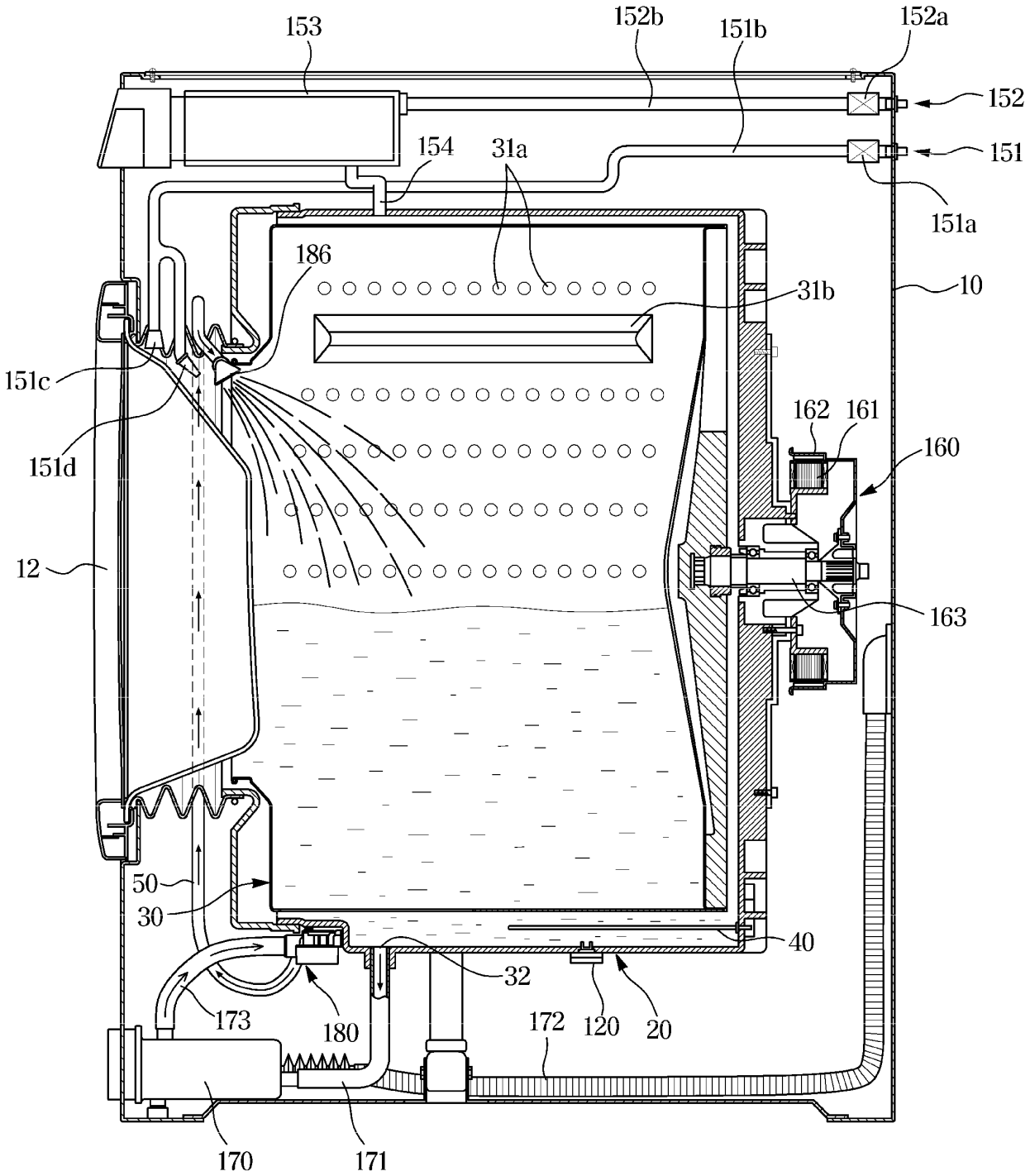
151c
151d
162
161
160
12
163
50
30
40
32
173
180
172
120
20
170
171

FIG. 11

WEIGHT (k, kg)	WATER TEMPERATURE (T, ℃)	ROTATION SPEED OF CIRCULATION PUMP(rpm)	HEATER OPERATION
k<k1	T<t1	R11	TIME CONTROL
	t1≤T<t2	R12	
	t2≤T	R13	TIME CONTROL or TEMPERATURE CONTROL
k1≤k<k2	T<t1	R21	TIME CONTROL
	t1<T<t2	R22	
	t2≤T	R23	TIME CONTROL or TEMPERATURE CONTROL
k2≤k<k3	T<t1	R31	TIME CONTROL
	t1<T<t2	R32	
	t2≤T	R33	TIME CONTROL or TEMPERATURE CONTROL
⋮	⋮	⋮	⋮

FIG. 12


153
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154
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151a
186
31b
10
151c
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160
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163
50
30
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173
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172
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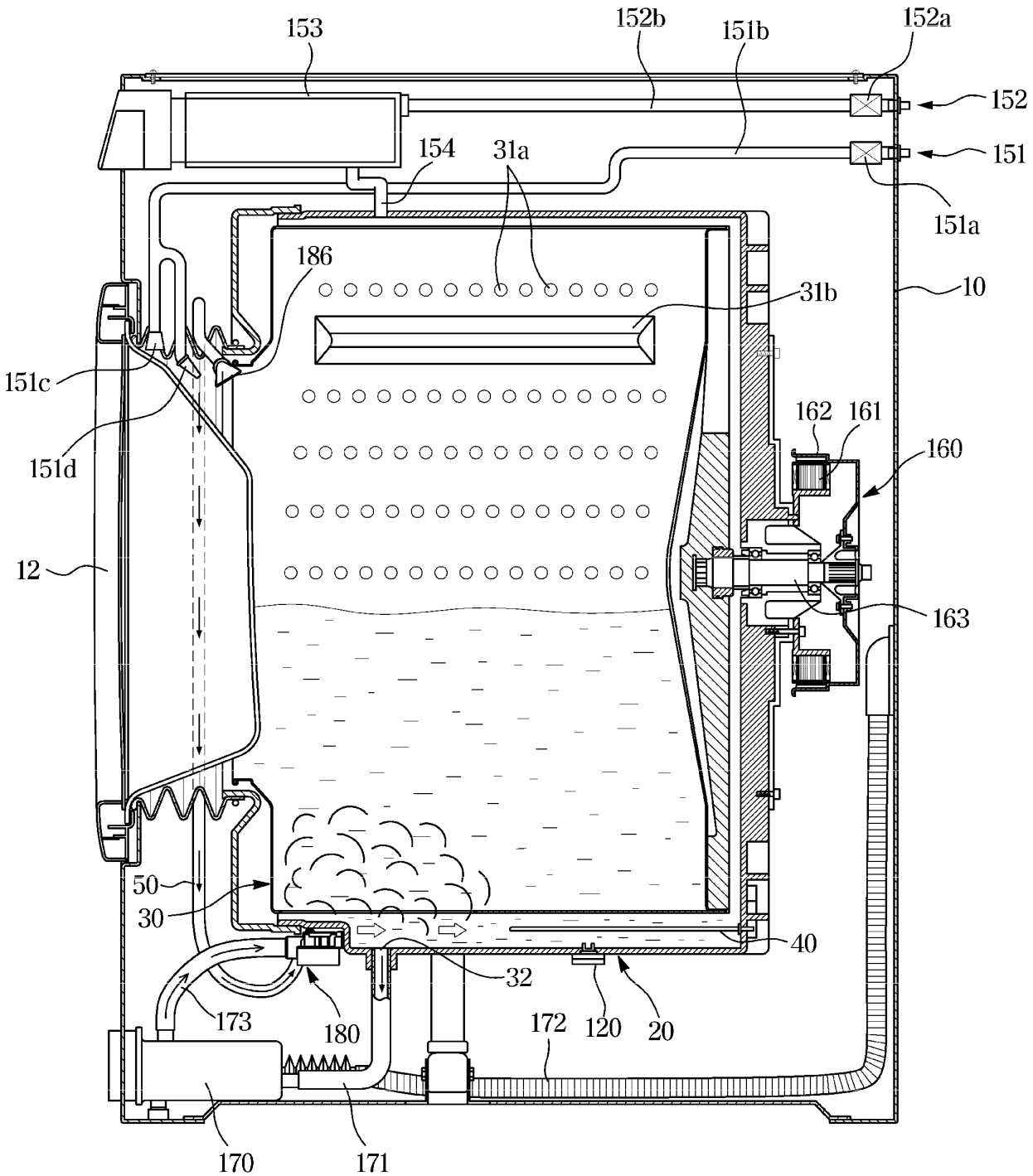
170
171

FIG. 13


153
152b
151b
152a
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151
154
31a
151a
186
31b
10
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151d
162
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160
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163
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30
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173
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172
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170
171

FIG. 14

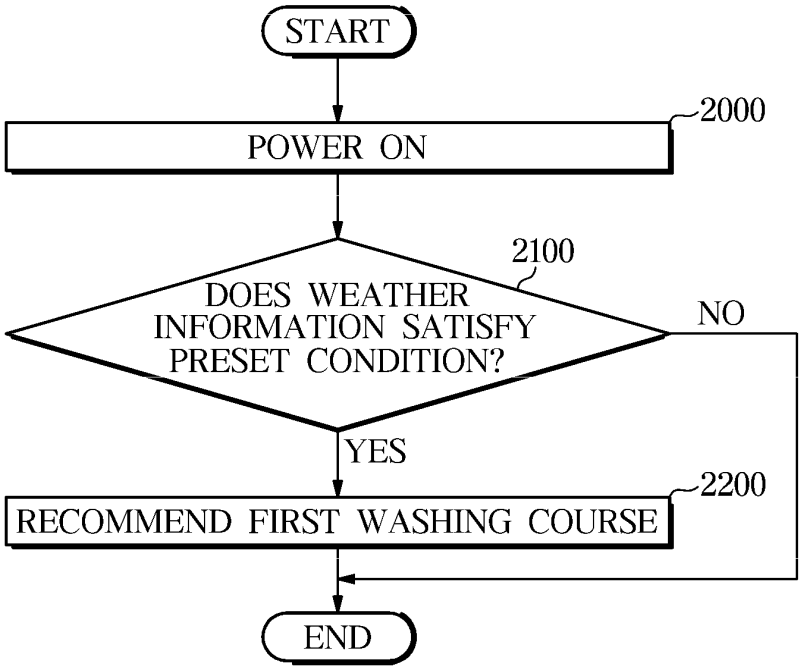
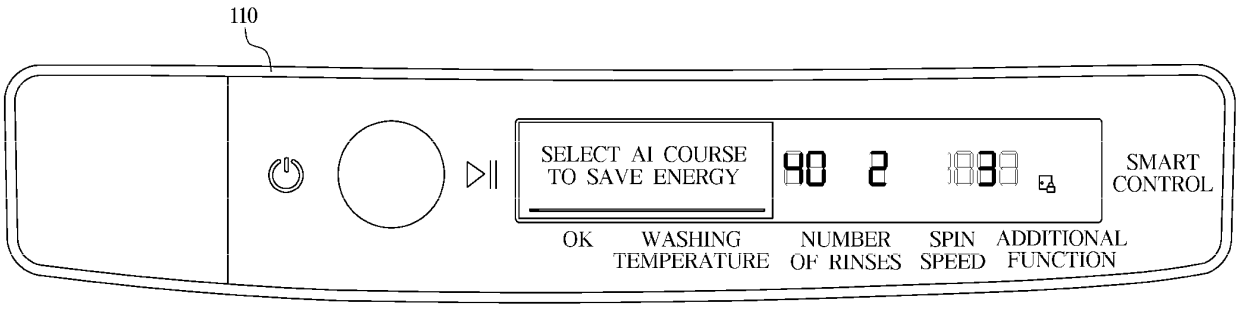

START
POWER ON
2000
DOES WEATHER INFORMATION SATISFY PRESET CONDITION?
2100
NO
YES
RECOMMEND FIRST WASHING COURSE
2200
END

FIG. 15


110
SELECT AI COURSE TO SAVE ENERGY
SMART CONTROL
OK
WASHING TEMPERATURE
NUMBER OF RINSES
SPIN SPEED
ADDITIONAL FUNCTION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/003064

A. CLASSIFICATION OF SUBJECT MATTER

D06F 34/24(2020.01)i; **D06F 33/46**(2020.01)i; **D06F 39/08**(2006.01)i; **D06F 35/00**(2006.01)i; **D06F 39/04**(2006.01)i; **D06F 34/18**(2020.01)i; **D06F 34/34**(2020.01)i; **D06F 34/05**(2020.01)i; **D06F 103/16**(2020.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F 34/24(2020.01); D06F 33/02(2006.01); D06F 33/30(2020.01); D06F 35/00(2006.01); D06F 39/02(2006.01); D06F 39/04(2006.01); D06F 39/08(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 세탁(washing), 세제(detergent), 수온(water temperature), 펌프(pump)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2008-0039646 A (SAMSUNG ELECTRONICS CO., LTD.) 07 May 2008 (2008-05-07) See paragraphs [0044]-[0054] and [0064]-[0069]; claim 14; and figures 1-2.	1-15
A	KR 10-2013-0010801 A (LG ELECTRONICS INC.) 29 January 2013 (2013-01-29) See paragraphs [0038]-[0083]; claims 1-16; and figures 1-11.	1-15
A	KR 10-2018-0108026 A (DAEWOO ELECTRONICS CO., LTD.) 04 October 2018 (2018-10-04) See paragraphs [0029]-[0169]; claims 1-10; and figures 1-11.	1-15
A	WO 2015-022002 A1 (ELECTROLUX APPLIANCES AKTIEBOLAG) 19 February 2015 (2015-02-19) See page 8, line 21 – page 34, line 16; claims 1-29; and figures 1-14.	1-15
A	US 2016-0060800 A1 (WHIRLPOOL CORPORATION) 03 March 2016 (2016-03-03) See paragraphs [0009]-[0060]; claims 1-36; and figures 1-5.	1-15

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 June 2023	**27 June 2023**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2023/003064

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WO 2015-022002 A1	19 February 2015	EP 3033450 A1	22 June 2016
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US 2016-0060800 A1	03 March 2016	None	

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