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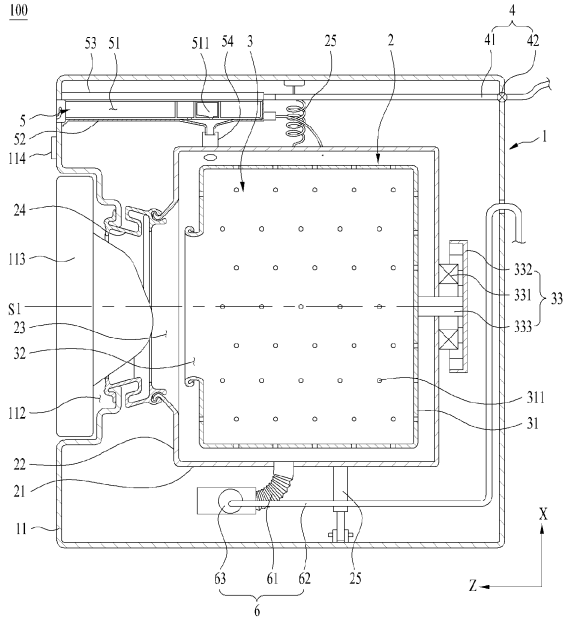
(54) **CLOTHING PROCESSING APPARATUS AND METHOD FOR CONTROLLING CLOTHING PROCESSING APPARATUS**

(57) The present application relates to a clothing processing apparatus comprising: a tub including a tub body which provides a space in which water is stored, and a tub inlet which is provided to pass through one surface of the tub body; a drum including a drum body which is rotatably provided within the tub and in which clothes are stored, and a drum inlet which is provided to pass through one surface of the drum body and communicates with the tub inlet; a water supply unit which supplies water into the tub; a detergent supply unit which supplies a detergent into the tub; and a sensor which is provided to sense a capacitance change in the tub body and can sense at least one of the height of foam generated in the tub body and the height of water stored in the tub body.

[FIG. 1]



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Description

TECHNICAL FIELD

[0001] The present application relates to a laundry treatment apparatus and method of controlling the same.

BACKGROUND ART

[0002] In general, a laundry treatment device conceptually includes a washing machine for washing a washing object such as laundry and the like and a dryer for drying a drying object.

[0003] The related art laundry treatment devices for washing are provided to include a tub providing a space for water storage, a drum rotatably provided within the tube to store a washing object, a water supply unit supplying water to the tub, a detergent supply unit supplying detergent to the tub, and a drain unit discharging water stored in the tub to the outside of the tub.

[0004] The laundry treatment device with the aforementioned structure performs washing in a manner of repeating a foreign substance separating process of removing foreign substances remaining in a washing object by rotating the drum after supplying water and detergent to the tub through the water supply unit and the detergent supply unit, a draining process of discharging the water stored in the tub, and a dewatering process of removing water remaining in the washing object by rotating the drum.

[0005] Foam is generated inside the tub during the foreign substance separating process, and the related art laundry treatment devices have a structure that is difficult to measure or predict an amount of the foam generated inside the tub.

[0006] The foam generated in the foreign substance separating process causes a problem of discharging the foam to the outside of the tub, a problem of causing a large load on the driving unit rotating the drum, and a problem of having difficulty in rotating the drum at a high rotational speed required for the dewatering process.

[0007] Regarding the related art laundry treatment devices, there is a method of detecting foam through a change in the number of revolutions of the drum or a torque variation of the driving unit above (e.g., a torque variation of the motor) (Publication No. 10-2000-0025493, Publication No. 10-2006-0115264). Since the above-described related art methods estimate the generation of foam and the amount of foam (e.g., the height of foam, etc.) based on the data (indirect data) of a target affected by the foam, the timing of determining the generation of foam is delayed disadvantageously (it is only possible to recognize the generation of foam after a certain period of time has passed since the foam has been generated) and it is difficult to accurately determine the amount of foam.

DISCLOSURE

TECHNICAL TASKS

[0008] One technical task of the present application is to provide an apparatus for treating laundry and method of controlling the same that may determine a water level inside a tub and an amount of foam generated inside the tub (such as a height of the foam, etc.).

[0009] In addition, another technical task of the present application is to provide an apparatus for treating laundry and method of controlling the same that include an electrostatic sensor capable of determining at least one of a water level inside a tub and an amount of foam generated inside the tub.

[0010] In addition, another technical aspect of the present application is to provide an apparatus for treating laundry and method of controlling the same that include an electrostatic sensor capable of measuring a water level inside a tub and an amount of foam generated inside the tub in real time.

TECHNICAL SOLUTIONS

[0011] In one technical aspect of the present application, provided is an apparatus for treating laundry, the apparatus including a tub having a tub body providing a space for storing water and a tub entrance perforating one surface of the tub body, a drum having a drum body rotatably provided within the tub to store the laundry and a drum entrance perforating one surface of the drum body to communicate with the tub entrance, a water supply unit supplying water to the tub, a detergent supply unit supplying detergent to the tub, and a sensor detecting a change in capacitance inside the tub body to sense at least one of a height of foam generated within the tub body or a height of the water stored in the tub body.

[0012] The tub body may be provided as a cylinder in a hollow shape having a central axis parallel to a ground, the tub entrance may be provided in any one of a front surface or a rear surface of the cylinder, and the sensor may be fixed to at least one of the front surface or the rear surface.

[0013] The tub body may be provided as a cylinder in a hollow shape having a central axis orthogonal to a ground, the tub entrance may be provided in an upper surface of the cylinder, and the sensor may be fixed to at least one of the upper surface and an area in a circumferential surface of the tub body located above a horizontal line passing through a center of the tub body.

[0014] The tub body may be provided as a cylinder in a hollow shape having a central axis inclined at an angle of less than 90 degrees with respect to a ground, the tub entrance may be provided in a front surface of the cylinder, and the sensor may be fixed to the front surface.

[0015] The sensor may be fixed at a position capable of determining whether the foam within the tub body has reached a preset reference height.

[0016] The apparatus may further include a driving unit providing a motive power necessary for rotation of the drum, and the reference height may be set to a height of the foam at which a rotational speed of the drum becomes lower than a set speed by 10% or more when a power of a preset reference power amount is supplied to the driving unit.

[0017] The reference height may be set to a multitude of heights corresponding to a multitude of reference water levels set to increase in proportion to an amount of the laundry put into the drum and the number of the sensors may be equal to the number of the reference heights.

[0018] The reference water level may include a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged, a highest water level located at a point higher than the lowest water level and lower than a horizontal line passing through a center of the tub entrance, and an intermediate water level located between the lowest water level and the highest water level, the reference height may include a first reference height positioned between the lowest water level and the intermediate water level, a second reference height positioned between the intermediate water level and the highest water level, and a third reference height positioned at a point higher than the highest water level, and the sensor may include a first sensor fixed to the front surface and positioned at the first reference height, a second sensor positioned at the second reference height, and a third sensor positioned at the third reference height.

[0019] The reference water level may include a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged and an intermediate water level set to a water level higher than the lowest water level, the reference height may include a first reference height positioned between the lowest water level and the intermediate water level and a second reference height positioned at a point higher than the intermediate water level, and the sensor may include a first sensor fixed to the front surface and positioned at the first reference height and a second sensor positioned at the second reference height.

[0020] The sensor may be fixed at a position capable of determining whether a water level inside the tub body reaches a reference water level.

[0021] The reference water level may include a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged, a highest water level located at a point higher than the lowest water level and lower than a horizontal line passing through a center of the tub entrance, and an intermediate water level located between the lowest water level and the highest water level, and the sensor may include a first sensor positioned at the same height as the lowest water level, a second sensor positioned at the same height as the intermediate water level, and a third sensor positioned at the same height as the highest water level.

[0022] The reference water level may include a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged and an intermediate water level set to a water level higher than the lowest water level, and the sensor may include a first sensor positioned at the same height as the lowest water level and a second sensor positioned at the same height as the intermediate water level.

[0023] In another technical aspect of the present application, provided is a method of controlling a laundry treating apparatus comprising a tub providing a space for storing water, a drum rotatably provided in the tub to store laundry, a water supply unit supplying water to the tub, a detergent supply unit supplying detergent to the tub, and a sensor detecting a change in capacitance inside a tub body to sense at least one of a height of foam generated inside the tub body or a height of water stored in the tub body, the method including a laundry amount detecting step of determine an amount of the laundry stored in the drum by rotating the drum, a water supply step of supplying the water to the tub through a water supply unit according to a laundry amount, a detergent supply step of supplying the detergent to the tub by the detergent supply unit, a washing step of removing foreign substances from the laundry by rotating the drum, and a measuring step of measuring by the sensor whether capacitance inside the tub body has increased and a time for which the capacitance has continued to increase during the washing step.

[0024] When the capacitance inside the tub body is equal to or greater than a reference capacitance (e.g., when the foam inside the tub body reaches a reference height) and a state in which the capacitance is greater than or equal to the reference capacitance continues for a first reference time or more, the washing step may decrease a rotational speed of the drum.

[0025] The washing step may be configured to alternately execute clockwise rotation and counterclockwise rotation of the drum. When the capacitance inside the tub body is equal to or greater than a reference capacitance and a state in which the capacitance is equal to or greater than the reference capacitance continues for a first reference time or more, the washing step may set a rotation direction change period of the drum to be long.

[0026] The method may further include an intermediate drain step of draining the water stored in the tub when the capacitance inside the tub body is equal to or greater than a reference capacitance and a state in which the capacitance is greater than or equal to the reference capacitance continues for more than a second reference time longer than the first reference time and a water resupply step of supplying water to the tub after completion of the intermediate drain step.

[0027] The method may further include an observation motion executing step of rotating the drum at a rotational speed of inducing a centrifugal force less than 1G in either a clockwise direction or a counterclockwise direc-

tion, the observation motion executing step executed in progress of the washing step, a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is less than a reference capacitance or a holding time of a state in which the capacitance is equal to or greater than the reference capacitance is less than a preset third reference time, a dewatering step of removing water from the laundry by rotating the drum at a rotational speed of inducing a centrifugal force equal to or greater than 1G, and a rinsing step of separating the detergent and foreign substances from the laundry by rotating the drum at a rotational speed of inducing the centrifugal force less than 1G after supplying water to the tub after completion of the dewatering step.

[0028] The method may further include a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is equal to or greater than the reference capacitance and a holding time of a state in which the capacitance is greater than or equal to the reference capacitance is greater than or equal to the third reference time and a rinsing step of separating the detergent and foreign substances from the laundry by rotating the drum after supplying water to the tub.

[0029] The method may further include a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is equal to or greater than the reference capacitance and a holding time of a state in which the capacitance is greater than or equal to the reference capacitance is greater than or equal to the third reference time, a foam removing step of simultaneously executing a process of supplying the water to the tub by the water supply unit and a process of draining the water supplied to the tub by a drain unit, and a dewatering step of removing water from the laundry by rotating the drum at a rotational speed of inducing the centrifugal force equal to or greater 1G based on completing the foam removing step.

ADVANTAGEOUS EFFECTS

[0030] The present application provides an apparatus for treating laundry and method of controlling the same that may determine a water level inside a tub and an amount of foam generated inside the tub (such as a height of the foam).

[0031] In addition, the present application provides an apparatus for treating laundry and method of controlling the same that include an electrostatic sensor capable of determining at least one of a water level inside a tub and an amount of foam generated inside the tub.

[0032] In addition, the present application provides an apparatus for treating laundry and method of controlling the same that include an electrostatic sensor capable of measuring a water level inside a tub and an amount of foam generated inside the tub in real time.

DESCRIPTION OF DRAWINGS

[0033]

FIG. 1 is a diagram illustrating an example of a laundry treating apparatus.

FIG. 2 is a diagram illustrating an example of a capacitive sensor provided in a laundry treating apparatus.

FIG. 3 and FIG. 4 are diagrams illustrating an example of a method of controlling a laundry treating apparatus.

BEST MODE

[0034] Hereinafter, a preferred embodiment of an apparatus for treating laundry and method of controlling the same will be described in detail with reference to the accompanying drawings.

[0035] As shown in FIG. 1, a laundry treating apparatus 100 includes a cabinet 1, a tub 2 provided inside the cabinet to provide a space for storing water, and a drum 3 rotatably provided inside the tub to store laundry.

[0036] The cabinet 1 is provided to include a front panel 11 forming a front surface of the laundry treating apparatus, and the front panel 11 is provided with an entrance 12 allowing the inside of the cabinet to communicate with the outside. The entrance 12 may be provided to be opened and closed by a door 13 rotatably provided on the front panel 11.

[0037] The front panel 11 may be provided with a control panel 14. And, the control panel 14 may include a display unit displaying information of a user-selectable course and the like, a power switch supplying power to the laundry treating apparatus, and an input unit enabling selection and execution of a control command displayed on the display unit.

[0038] The tub 2 may be provided as a cylindrical tub body 21 of which inside is hollow. A tub entrance 23 is provided at any one of a front surface 22 (i.e., a tub front surface) and a rear surface 26 (i.e., a tub rear surface) of the tub body 21. The diagram illustrates a case in which a tub entrance 23 is provided at the tub front surface 22.

[0039] The tub entrance 23 is connected to the entrance 12 through an insulating part 24. The insulating part 24 may be made of an elastic body (e.g., rubber, etc.) and may be provided as a pipe-shaped insulating body connecting the entrance 12 and the tub entrance 23. The insulating part 24 is a means for preventing the water stored in the tub body 21 from being discharged to the cabinet 1 through the tub entrance 23, and for attenuating the transmission of the vibration of the tub body 21 to the cabinet 1.

[0040] The tub body 21 may be fixed to the inside of the cabinet 1 through a tub support part 25. The tub support part 25 may include a spring for fixing a region of a circumferential surface of the tub body 21 that is located above a horizontal line that passes through a rotation

center of the drum to the cabinet 1 and a damper for fixing a region of the circumferential surface of the tub body 21 that is located below the horizontal line that passes through the rotation center of the drum to a bottom surface of the cabinet.

[0041] The drum 3 is provided to include a drum body 31 rotatable inside the tub body 21. The drum body 31 is provided in a cylindrical shape with an empty inside, and a drum through-hole 311 allowing the inside of the drum body to communicate with the inside of the tub body is provided on a circumferential surface, a front surface, a rear surface, and the like of the drum body 31. In addition, a drum entrance 32 is provided to a surface (i.e., a front surface of the drum) facing the entrance 11 in a space provided by the drum body 31.

[0042] The drum body 31 is rotated by the driving unit 33, which includes a stator 331 fixed to a rear surface of the tub body 21 to generate a rotating field, a rotor 332 located outside the tub body 21 to be rotated by the rotating field, and a rotating shaft 333 passing through the rear surface of the tub body 31 to connect the rear surface of the drum body 31 and the rotor 332.

[0043] The laundry treating apparatus 100 supplies water to the tub body 21 through the water supply unit 4, and the water stored in the tub body 21 is discharged to the outside of the cabinet 1 through the drain unit 6.

[0044] The water supply unit 4 may include a water supply pipe 41 connecting the tub body 21 with a water supply source (not shown) and a water supply valve 43 controlling the opening and closing of the water supply pipe 41.

[0045] The drain unit 6 may include a drain pump 63, a first drain pipe 61 for guiding the water of the tub body 21 to the drain pump 63, and a second drain pipe 63 for guiding the water discharged from the drain pump 63 to the outside of the cabinet 1.

[0046] The laundry treating apparatus 100 is provided to include a detergent supply unit 5 for supplying detergent to the tub body 21.

[0047] The detergent supply unit 5 may be provided to supply detergent to the tub body 21 when water is supplied to the tub through the water supply pipe 41, or may be provided to supply detergent independently of whether the water supply pipe 41 is opened. FIG. 1 illustrates an example of the former case.

[0048] The detergent supply unit 5 of FIG. 1 may include a storage body 51 that provides a space where detergent is stored and a housing 52 that is provided inside the cabinet 1 to provide a space where the storage body 51 is accommodated.

[0049] A discharge passage 511 is provided inside the storage body 51, a nozzle 53 for supplying water supplied from the water supply pipe 41 to the storage body 51 is provided to an upper surface of the storage body 51, and the housing 52 is connected to the tub body 21 through a supply pipe 54. Therefore, when water is supplied to the storage body 51 through the nozzle 53, water and detergent inside the storage body 51 are discharged to the housing 52 through the discharge passage 511, and the water and detergent inside the housing 52 may move to the tub body 21 through the supply pipe 54.

[0050] As shown in FIG. 2, the laundry treating apparatus 100 is provided to include a sensor 7 (e.g., a capacitive sensor or an electrostatic sensor) capable of detecting at least one of an amount of foam (such as the height of foam) generated inside the tub body 21 and the height of water stored in the tub body 21 by detecting the change in capacitance inside the tub body 21. The sensor 7 is fixed to the circumferential surface, the front surface 22, and the rear surface 26 of the tub body 21 and is located in an outer space (e.g., a space where water is not stored) of the tub body 21.

[0051] The sensor 7 may be provided as a capacitive sensor that includes two electrodes spaced apart from each other to output different signals according to changes in capacitance of a material located between the two electrodes (e.g., depending on a change in a dielectric constant of the material located between the two electrodes).

[0052] The sensor 7 may be fixed to any one of the circumferential surface, the front surface 22, and the rear surface 26 of the tub body 21, but considering that the water inside the tub body 21 may move along the circumferential surface of the tub body during high-speed rotation of the drum 3, it is preferable to be fixed to at least one of the front surface 22 and the rear surface 26 of the tub. The aforementioned sensor 7 may detect an amount of foam or a water level through a change in capacitance detected when foam or water rises to a point where the sensor is located, which is because it will be difficult to implement the aforementioned function in a situation where water moves along the circumferential surface of the tub body 21.

[0053] As shown in FIG. 1, when a central axis S1 of the tub body 21 is provided as a cylinder parallel to the ground, the sensor 7 may be fixed to at least one of the front surface 22 of the tub and the rear surface 26 of the tub. FIG. 2 illustrates a case where the sensor 7 is fixed to the front surface 22 of the tub as an example.

[0054] Unlike the drawing, when the central axis S1 of the tub body 21 is provided as a cylinder inclined at an angle of less than 90 degrees with respect to the ground (in this case, the tub entrance is provided on a front side of the cylinder), it is preferable that the sensor 7 is fixed to the front side of the tub that is less affected by water stored inside the tub body.

[0055] Furthermore, if the central axis S1 of the tub body 21 is provided as a cylinder orthogonal to the ground (in this case, the tub entrance is provided on an upper surface of the tub body), the sensor 7 may be fixed to the upper surface of the tub body 21 or may be fixed to an area of the circumferential surface of the tub body 21 located above the horizontal line passing through the center of the tub body.

[0056] When the sensor 7 is provided to sense a height of foam, the sensor 7 may be fixed at a position capable of

determining whether the foam inside the tub body 21 has reached a preset reference height H. The reference height H may be set to a height of the foam in which a rotational speed of the drum 3 is lower by 10% or more than a preset speed when power of a preset reference power amount is supplied to the driving unit 33.

[0057] The reference height is set to a single value, and the sensor 7 may be provided as a single capacitive sensor located at the reference height.

[0058] Alternatively, the reference height H is set to a multitude of heights H1, H2, and H3 corresponding to a multitude of reference levels L set to increase in proportion to an amount of laundry put into the drum 3, and the number of the sensor(s) 7 provided may be the same as the number of the reference height(s) H.

[0059] That is, the reference water level L may include a lowest water level L1 at which a lowest point in the circumferential surface of the drum body 21 is submerged, a highest water level L3 set higher than the lowest water level, and an intermediate water level L2 positioned between the lowest water level and the highest water level. The highest water level L3 may be set to a lower water level than a horizontal line S2 passing through the center of the tub entrance 23.

[0060] In this case, the reference height H may include a first reference height H1 between the lowest water level L1 and the intermediate water level L2, a second reference height H2 between the intermediate water level L2 and the highest water level L3, and a third reference height H3 above the highest water level L3. The sensor 7 may include a first sensor 71 fixed to the front surface 22 of the tub and located at the first reference height H1, a second sensor 72 located at the second reference height H2, and a third sensor 73 located at the third reference height H3.

[0061] Unlike the drawing, the reference level L may be set to the lowest water level L1 and the intermediate water level L2, the reference height H may be set to the first reference height H1 and the second reference height H2, and the sensor 7 may be provided to include only the first sensor 71 located at the first reference height and the second sensor 72 located at the second reference height.

[0062] In addition, the reference water level L may be set to the lowest water level L1 and the highest water level L3, the reference height H may be set to the first reference height H1 and the third reference height H3, and the sensor 7 may be provided to include only the first sensor 71 located at the first reference height and the third sensor 73 located at the third reference height.

[0063] Unlike the drawing, the sensor 7 may be provided to determine whether the water level inside the tub body 21 has reached the reference water level L.

[0064] As described above, the reference water level L may be set to include a lowest water level L1 set to a water level at which a lowest point of the circumferential surface of the drum body 31 is submerged, a highest water level L3 located at a point higher than the lowest water level and lower than the horizontal line S2 passing through the center of the tub entrance 23, and an intermediate water level L2 positioned between the lowest water level and the highest water level.

[0065] In this case, it is preferable that the first sensor 71 is fixed to the front surface 22 of the tub to be located at the same height as the lowest water level L1, the second sensor 72 is fixed to be located at the same height as the intermediate water level L2, and the third sensor 73 is fixed to be located at the same height as the highest water level L3.

[0066] Unlike the above description, the reference water level L is set to the lowest water level L1 and the intermediate water level L2, and the sensor 7 may include only the first sensor 71 for detecting the lowest water level L1 and the second sensor 72 for detecting the intermediate water level L2.

[0067] In addition, the reference water level L is set to the lowest water level L1 and the highest water level L3, and the sensor 7 may include only the first sensor 71 for detecting the lowest water level L1 and the third sensor 73 for detecting the highest water level L3.

[0068] Accordingly, the laundry treating apparatus 100 may accurately measure the water level inside the tub body 21, whether foam has been generated, or a height of the foam inside the tub body 21 in real time through the sensor 7.

[0069] FIG. 3 illustrates an example of the above-described method of controlling the laundry treating apparatus. For convenience, the description will be made based on a case where there is only one sensor 7.

[0070] The control method includes a laundry amount detecting step S10 of determining an amount of laundry stored in the tub 3 by rotating the drum 3 (S10), a water supply step S21 of supplying water the tub 2 through the water supply unit 4, a detergent supply step S22 of supplying detergent to the tub 2 by the detergent supply unit 5, a washing step S30 of removing foreign substances from the laundry by rotating the drum 3, and a measuring step (a first measuring step) S40 of measuring by the sensor 7 whether capacitance inside the tub body 21 has increased and a time for which the capacitance has continued to increase during the washing step S30.

[0071] The water supply step S21 and the detergent supply step S22 may be performed independently of each other, or the detergent supply step S22 may be configured to be executed by the water supply step S21.

[0072] The washing step S30 may be provided to alternately perform clockwise rotation and counterclockwise rotation of the drum. The measuring step S40 may be continuously performed while the washing step S30 is performed, or may be provided to be periodically executed while the washing step S30 is performed.

[0073] When a capacitance inside the tub body 21 is greater than or equal to a reference capacitance h (e.g., a height of foam inside the tub body reaches a reference height H) and a state in which the capacitance is greater than or equal to the reference capacitance continues

over a first reference time T1, the control method may execute a changing step S42 of changing at least one of a rotational speed and a rotation direction of the drum set in the washing step S30.

[0074] The state in which the capacitance inside the tub body 21 is greater than or equal to the reference capacitance means that the height h of the foam inside the tub body 21 reaches the reference height H. Accordingly, the changing step S42 is started when the state in which the height h of the foam inside the tub body 21 is greater than or equal to the reference height H continues over the first reference time T1.

[0075] Since the changing step S42 is a means to suppress the further generation of foam as much as possible, the changing step S42 is preferably provided to lower a rotational speed of the drum or to change a rotational direction change period of the drum to be long.

[0076] On the other hand, if the capacitance inside the tub body 21 is greater than or equal to the reference capacitance and the state in which the capacitance is greater than or equal to the reference capacitance is continued for more than or equal to a second reference time T2 longer than the first reference time T1, the control method may be provided to execute an intermediate drain step S43 of draining the water stored in the tub 2 and a water resupply step S44 of supplying water to the tub 2 after completion of the intermediate drain step.

[0077] The intermediate drain step S43 is performed through the drain unit 6, and the water resupply step S44 is performed through the water supply unit 4. The intermediate drain step S43 and the water resupply step S44 may be performed after temporarily stopping the washing step S30.

[0078] If it is determined that the foam inside the tub body 21 is less than a predetermined amount, the control method executes the washing step S30 and the measuring step S40 until a preset time elapses.

[0079] That is, if the capacitance measured in the measuring step S40 is less than the reference capacitance (or the foam inside the tub body does not reach the reference height), or if a duration time T of such a state is less than the first reference time T1 despite that the capacitance is equal to or greater than the reference capacitance, the control method determines whether the time for performing the washing step S30 has reached the set time (S45).

[0080] If it is determined that the washing step S30 has been executed for the set time (S45), the control method proceeds to an observation motion executing step S50. The observation motion executing step S50 is a step of executing an observation motion (e.g., a tumbling motion) in which the drum 3 is rotated at a rotational speed at which a centrifugal force of less than 1 G is induced only in one of a clockwise direction and a counterclockwise direction.

[0081] During the observation motion executing step S50, the control method executes a measuring step (i.e., a second measuring step) S60, in which the sensor 7 measures whether the capacitance inside the tub body 21 increases and the time the capacitance continued to increase.

[0082] If the capacitance measured during the observation motion executing step S50 is less than the reference capacitance or if the duration T of such a state is less than a preset third reference time T3 despite that the capacitance is equal to or greater than the reference capacitance (S61), the control method may sequentially execute a draining step S70, a dewatering step S80, and a rinsing step S90.

[0083] The draining step S70 may be provided to discharge the water stored in the tub 2 to the outside of the cabinet, and the dewatering step S80 may be provided to remove water from laundry by rotating the drum 3 at a rotational speed at which a centrifugal force of 1G or more is induced.

[0084] The rinsing step S90 may be provided to separate detergent and foreign substances from laundry through a process of supplying water to the tub 2 and rotating the drum 3 at a rotational speed that induces a centrifugal force of less than 1G after completion of the dewatering step S80.

[0085] Meanwhile, when the capacitance measured during the progress of the observation motion executing step S50 is greater than or equal to the reference capacitance and the time T for which the capacitance continues to be greater than or equal to the reference capacitance is greater than or equal to the third reference time T3, the control method may be provided to execute only the draining step S62 and the rinsing step S90.

[0086] When a large amount of foam is detected in the observation motion executing step S50, it may be difficult to increase the rotational speed of the drum to a preset dewatering speed during the proceeding of the dewatering step S80. This is because the foam inside the tub 2 acts as a load of the driving unit 33. When a large amount of foam is detected in the observation motion executing step S50, an error is highly likely to occur when the dewatering step S80 is executed, and thus the control method may execute only the draining step S62 and the rinsing step S90 while omitting the dewatering step S80.

[0087] FIG. 4 illustrates another embodiment of a method of controlling a laundry treating apparatus. In the control method of the present embodiment, the steps S70, S80, and S90, which are executed when the capacitance measured in the process of the observation motion executing step S50 and the second measuring step S60 or during the progress of the observation motion executing step S50 is less than the reference capacitance or when the duration time T of the state in which the capacitance is equal to or greater than the reference capacitance is less than the third reference time, are the same as those of the embodiment of FIG. 3.

[0088] If the capacitance measured by the sensor 7 during the progress of the observation motion executing step S50 is greater than or equal to the reference capacitance and the duration time T of the state in which the

capacitance is greater than or equal to the reference capacitance is greater than or equal to the third reference time T3, the control method is characterized in that the draining step S62, the foam removing step S63, the dewatering step S80, and the rinsing step S90 are sequentially executed.

[0089] The draining step S62, the dewatering step S80, and the rinsing step S90 may be provided in the same manner as the draining step, the dewatering step, and the rinsing step provided in the control method of FIG. 3.

[0090] The foam removing step S63 may be provided as a step of simultaneously executing a process in which the water supply unit 4 supplies water to the tub 2 and a process in which the drain unit 6 drains the water supplied to the tub 2.

[0091] When water supply and drainage are simultaneously performed through the foam removing step S63, the foam inside the tub may be discharged to the outside of the tub, so the control method according to the present embodiment may reduce the possibility of an error occurring due to the foam when executing the dewatering step S80.

[0092] Since the above-described structure and control method of the laundry treating apparatus relate to an example of the present application, the scope of the rights of the present application may not be limited to the above-described structure and control method.

Claims

1. An apparatus for treating laundry, the apparatus comprising:

a tub having a tub body providing a space for storing water and a tub entrance perforating one surface of the tub body;
a drum having a drum body rotatably provided within the tub to store the laundry and a drum entrance perforating one surface of the drum body to communicate with the tub entrance;
a water supply unit supplying water to the tub;
a detergent supply unit supplying detergent to the tub; and
a sensor detecting a change in capacitance inside the tub body to sense at least one of a height of foam generated within the tub body or a height of the water stored in the tub body.

2. The apparatus of claim 1, wherein the tub body is provided as a cylinder in a hollow shape having a central axis parallel to a ground, wherein the tub entrance is provided in any one of a front surface or a rear surface of the cylinder, and wherein the sensor is fixed to at least one of the front surface or the rear surface.

3. The apparatus of claim 1, wherein the tub body is provided as a cylinder in a hollow shape having a central axis orthogonal to a ground, wherein the tub entrance is provided in an upper surface of the cylinder, and wherein the sensor is fixed to at least one of the upper surface and an area in a circumferential surface of the tub body located above a horizontal line passing through a center of the tub body.

4. The apparatus of claim 1, wherein the tub body is provided as a cylinder in a hollow shape having a central axis inclined at an angle of less than 90 degrees with respect to a ground, wherein the tub entrance is provided in a front surface of the cylinder, and wherein the sensor is fixed to the front surface.

5. The apparatus of claim 2, wherein the sensor is fixed at a position capable of determining whether the foam within the tub body has reached a preset reference height.

6. The apparatus of claim 5, further comprising a driving unit providing a motive power necessary for rotation of the drum, wherein the reference height is set to a height of the foam at which a rotational speed of the drum becomes lower than a set speed by 10% or more when a power of a preset reference power amount is supplied to the driving unit.

7. The apparatus of claim 5, wherein the reference height is set to a multitude of heights corresponding to a multitude of reference water levels set to increase in proportion to an amount of the laundry put into the drum and wherein the number of the sensors is equal to the number of the reference heights.

8. The apparatus of claim 7, wherein the reference water level comprises a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged, a highest water level located at a point higher than the lowest water level and lower than a horizontal line passing through a center of the tub entrance, and an intermediate water level located between the lowest water level and the highest water level,

wherein the reference height comprises a first reference height positioned between the lowest water level and the intermediate water level, a second reference height positioned between the intermediate water level and the highest water level, and a third reference height positioned at a point higher than the highest water level, and
wherein the sensor comprises a first sensor fixed to the front surface and positioned at the first reference height, a second sensor positioned at the second reference height, and a third sensor positioned at the third reference

height.

9. The apparatus of claim 2, wherein the sensor is fixed at a position capable of determining whether a water level inside the tub body reaches a reference water level.

10. The apparatus of claim 9, wherein the reference water level comprises a lowest water level set to a water level at which a lowest point of a circumferential surface of the drum body is submerged, a highest water level located at a point higher than the lowest water level and lower than a horizontal line passing through a center of the tub entrance, and an intermediate water level located between the lowest water level and the highest water level and
wherein the sensor comprises a first sensor positioned at the same height as the lowest water level, a second sensor positioned at the same height as the intermediate water level, and a third sensor positioned at the same height as the highest water level.

11. A method of controlling a laundry treating apparatus comprising a tub providing a space for storing water, a drum rotatably provided in the tub to store laundry, a water supply unit supplying water to the tub, a detergent supply unit supplying detergent to the tub, and a sensor detecting a change in capacitance inside a tub body to sense at least one of a height of foam generated inside the tub body or a height of water stored in the tub body, the method comprising:

a laundry amount detecting step of determine an amount of the laundry stored in the drum by rotating the drum;
a water supply step of supplying the water to the tub through a water supply unit according to a laundry amount;
a detergent supply step of supplying the detergent to the tub by the detergent supply unit;
a washing step of removing foreign substances from the laundry by rotating the drum; and
a measuring step of measuring by the sensor whether capacitance inside the tub body has increased and a time for which the capacitance has continued to increase during the washing step.

12. The method of claim 11, wherein when the capacitance inside the tub body is equal to or greater than a reference capacitance (e.g., when the foam inside the tub body reaches a reference height) and a state in which the capacitance is greater than or equal to the reference capacitance continues for a first reference time or more, the washing step decreases a rotational speed of the drum.

13. The method of claim 11, wherein the washing step is configured to alternately execute clockwise rotation and counterclockwise rotation of the drum and
wherein when the capacitance inside the tub body is equal to or greater than a reference capacitance and a state in which the capacitance is equal to or greater than the reference capacitance continues for a first reference time or more, the washing step sets a rotation direction change period of the drum to be long.

14. The method of claim 11, further comprising:

an intermediate drain step of draining the water stored in the tub when the capacitance inside the tub body is equal to or greater than a reference capacitance and a state in which the capacitance is greater than or equal to the reference capacitance continues for more than a second reference time longer than the first reference time; and
a water resupply step of supplying water to the tub after completion of the intermediate drain step.

15. The method of claim 11, further comprising:

an observation motion executing step of rotating the drum at a rotational speed of inducing a centrifugal force less than 1G in either a clockwise direction or a counterclockwise direction, the observation motion executing step executed in progress of the washing step ;
a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is less than a reference capacitance or a holding time of a state in which the capacitance is equal to or greater than the reference capacitance is less than a preset third reference time;
a dewatering step of removing water from the laundry by rotating the drum at a rotational speed of inducing a centrifugal force equal to or greater than 1G; and
a rinsing step of separating the detergent and foreign substances from the laundry by rotating the drum at a rotational speed of inducing the centrifugal force less than 1G after supplying water to the tub after completion of the dewatering step.

16. The method of claim 15, further comprising:

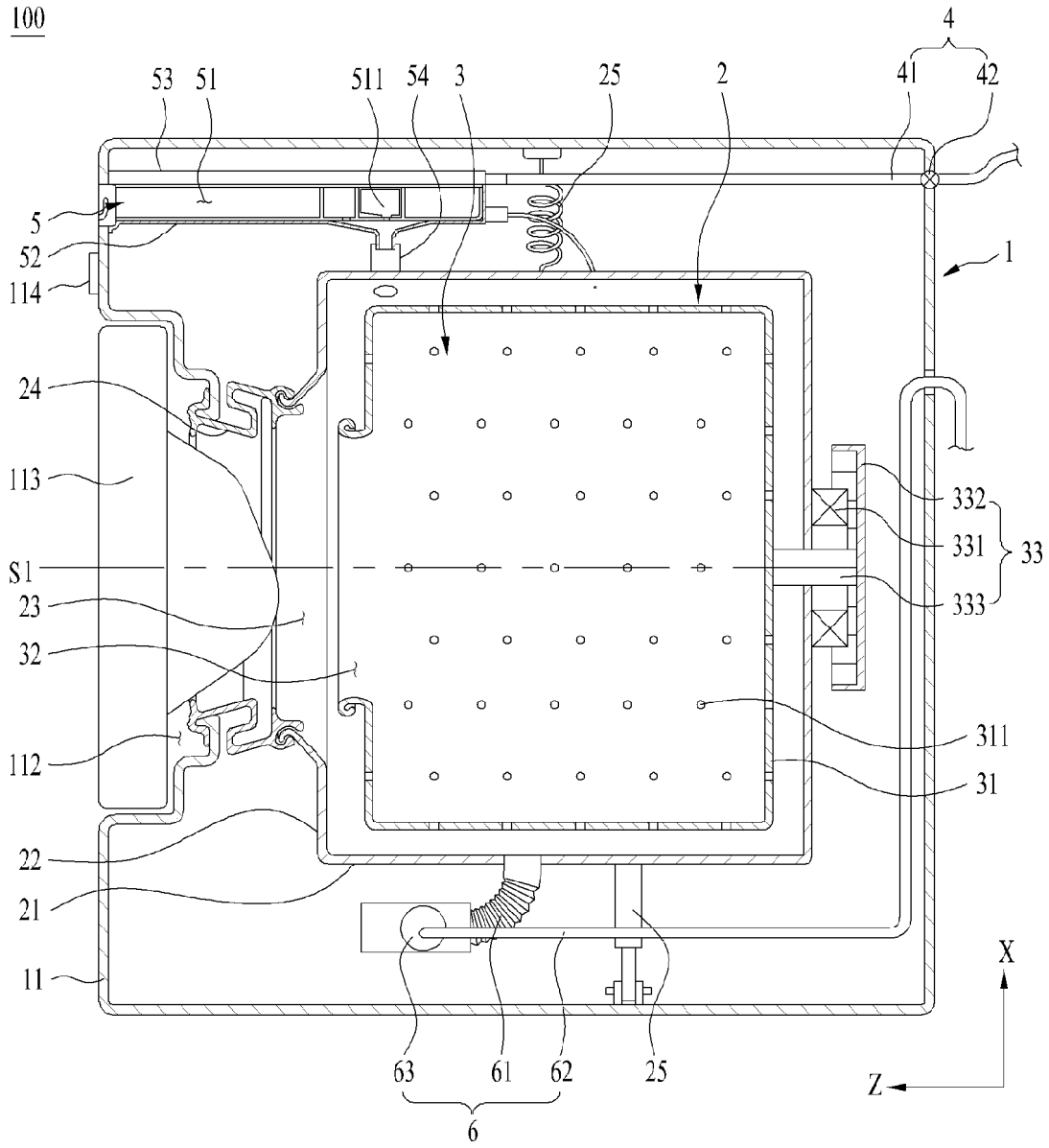
a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is equal to or greater than the reference capacitance and a holding time of a

state in which the capacitance is greater than or equal to the reference capacitance is greater than or equal to the third reference time; and
a rinsing step of separating the detergent and foreign substances from the laundry by rotating the drum after supplying water to the tub.

17. The method of claim 15, further comprising:

a draining step of draining the water stored in the tub when the capacitance measured by the sensor in progress of the observation motion executing step is equal to or greater than the reference capacitance and a holding time of a state in which the capacitance is greater than or equal to the reference capacitance is greater than or equal to the third reference time;
a foam removing step of simultaneously executing a process of supplying the water to the tub by the water supply unit and a process of draining the water supplied to the tub by a drain unit; and
a dewatering step of removing water from the laundry by rotating the drum at a rotational speed of inducing the centrifugal force equal to or greater 1G based on completing the foam removing step.

[FIG. 1]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331
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311
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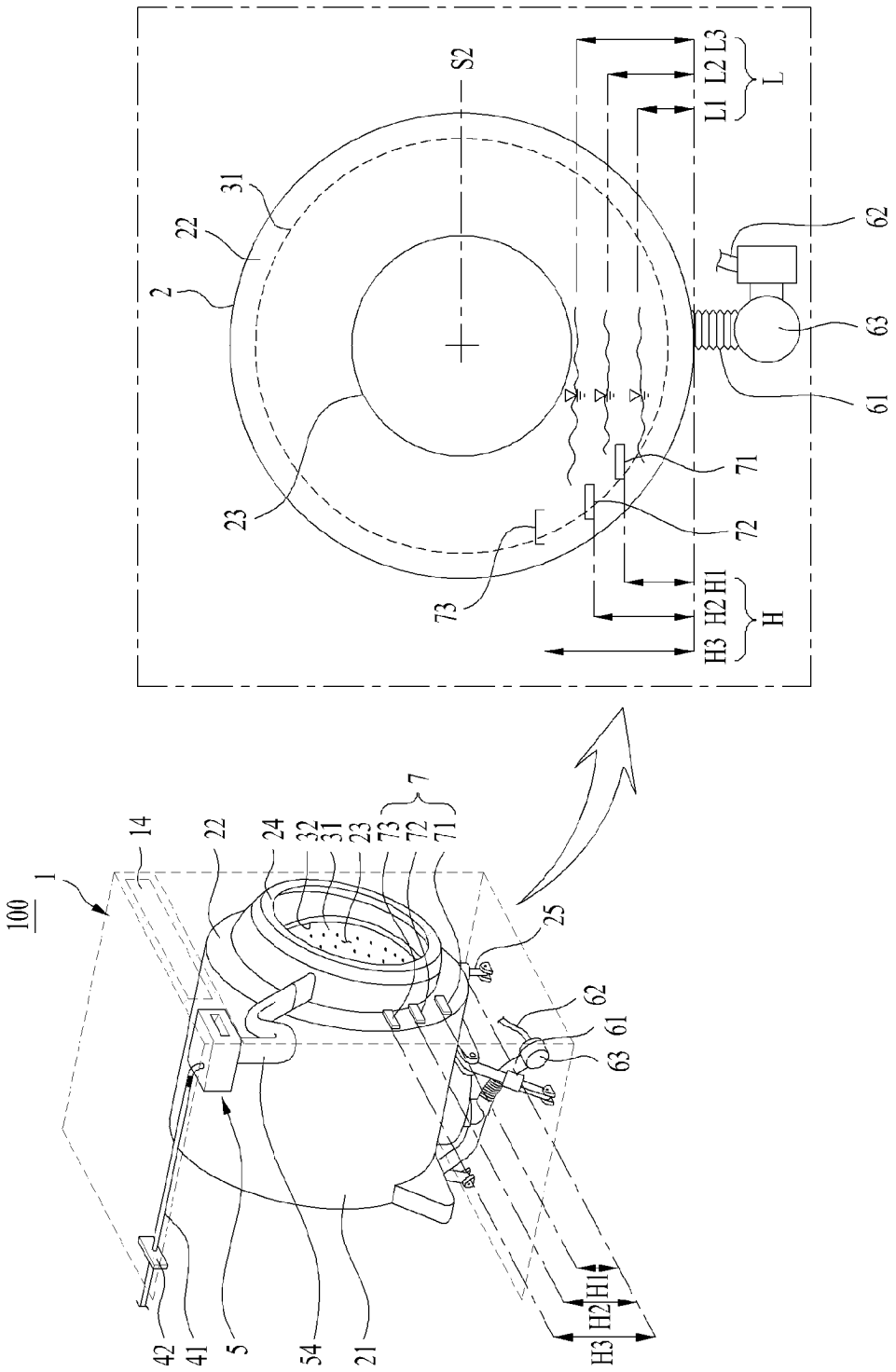
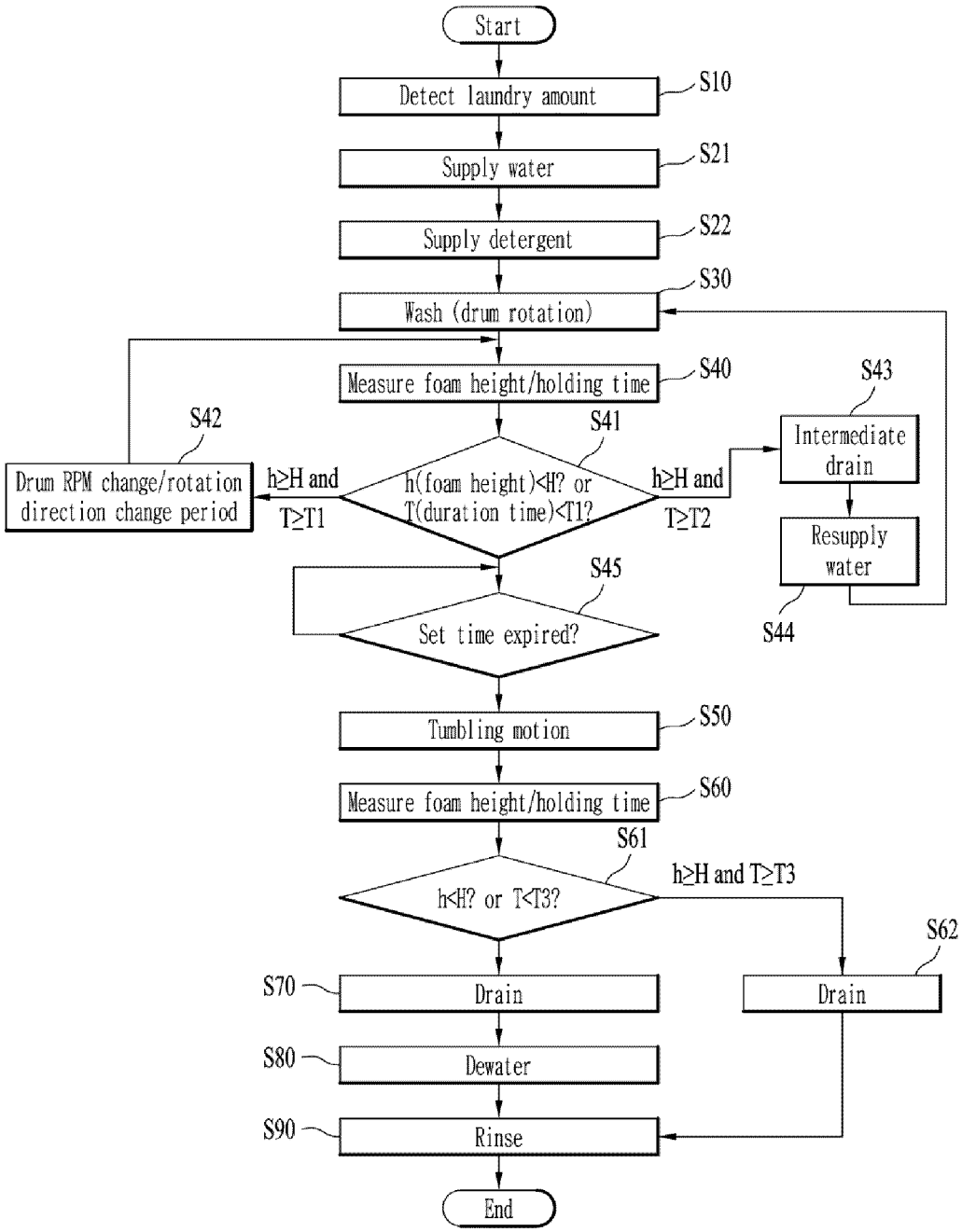
6

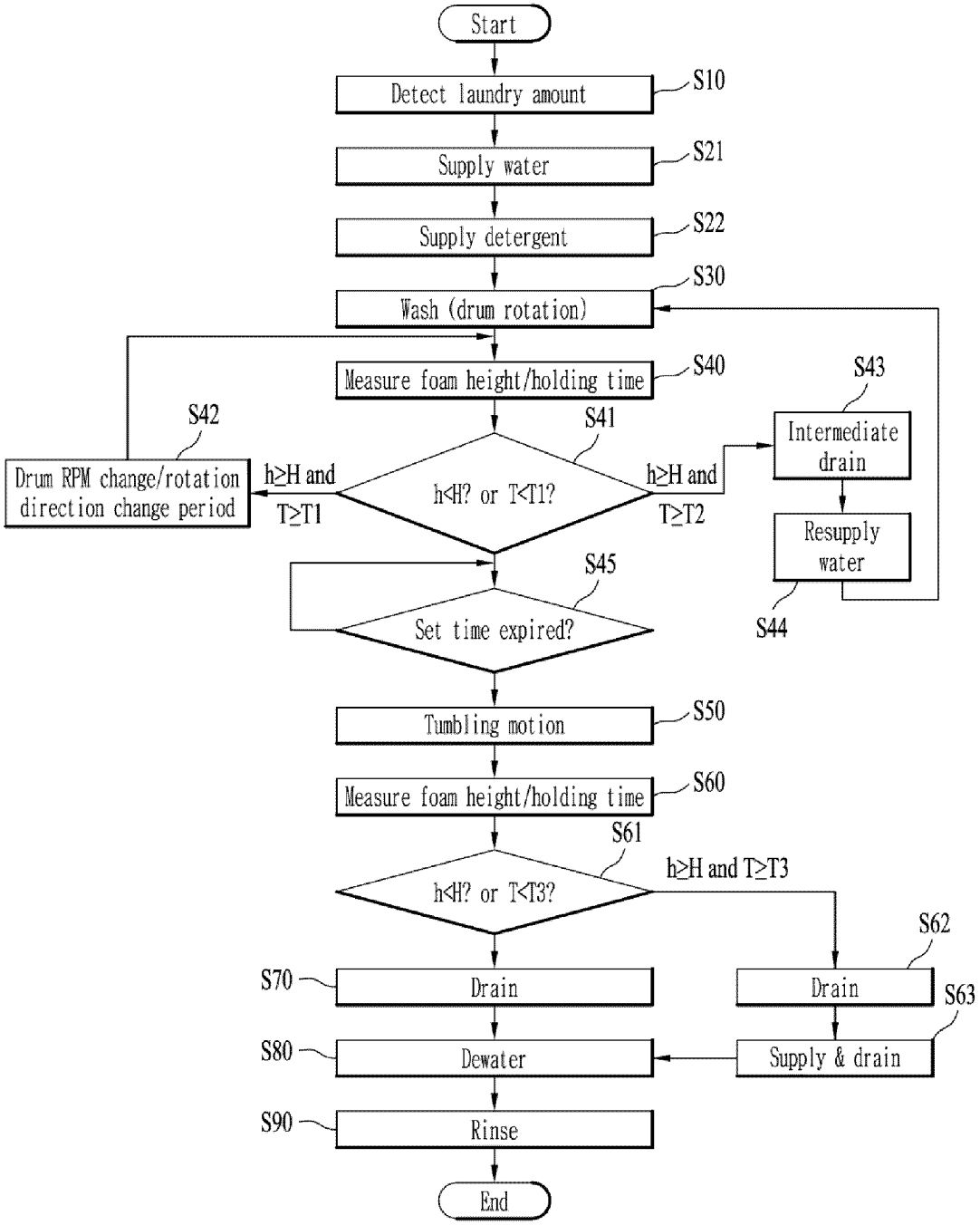
[FIG. 2]


S2
L1 L2 L3
L
31
22
2
62
63
61
71
72
23
73
H3 H2 H1
H
100
1
14
22
24
32
31
23
73
72
71
7
25
62
61
63
42
41
5
54
21
H3
H2
H1

[FIG. 3]


Start
Detect laundry amount
S10
Supply water
S21
Supply detergent
S22
Wash (drum rotation)
S30
Measure foam height/holding time
S40
S41
h(foam height)<H? or T(duration time)<T1?
h≥H and T≥T1
S42
Drum RPM change/rotation direction change period
h≥H and T≥T2
S43
Intermediate drain
Resupply water
S44
S45
Set time expired?
Tumbling motion
S50
Measure foam height/holding time
S60
S61
h<H? or T<T3?
h≥H and T≥T3
S62
Drain
S70
Drain
S80
Dewater
S90
Rinse
End

[FIG. 4]


Start
Detect laundry amount
S10
Supply water
S21
Supply detergent
S22
Wash (drum rotation)
S30
Measure foam height/holding time
S40
S41
h<H? or T<T1?
h≥H and T≥T1
S42
Drum RPM change/rotation direction change period
h≥H and T≥T2
S43
Intermediate drain
Resupply water
S44
S45
Set time expired?
Tumbling motion
S50
Measure foam height/holding time
S60
S61
h<H? or T<T3?
h≥H and T≥T3
S62
Drain
S63
Supply & drain
S70
Drain
S80
Dewater
S90
Rinse
End

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/018290

A. CLASSIFICATION OF SUBJECT MATTER

D06F 34/14(2020.01)i; **D06F 39/08**(2006.01)i; **D06F 39/06**(2006.01)i; **D06F 39/02**(2006.01)i; **D06F 37/04**(2006.01)i; **D06F 37/30**(2006.01)i; **D06F 35/00**(2006.01)i; **D06F 103/18**(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 34/14(2020.01); D06F 33/02(2006.01); D06F 33/30(2020.01); D06F 37/20(2006.01); D06F 37/28(2006.01); D06F 39/00(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: 터브 (tub), 드럼 (drum), 센서 (sensor), 물 (water), 정전용량 (capacitance)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2017-0138882 A (LG ELECTRONICS INC.) 18 December 2017 (2017-12-18) See paragraphs [0027]-[0191].	1,3
Y		2,4-7,9,11-14
A		8,10,15-17
Y	KR 10-2020-0095920 A (LG ELECTRONICS INC.) 11 August 2020 (2020-08-11) See paragraphs [0035]-[0057].	2,4-7,9
Y	KR 10-2021-0050779 A (LG ELECTRONICS INC.) 10 May 2021 (2021-05-10) See paragraphs [0062]-[0069].	11-14
A	JP 2012-110462 A (PANASONIC CORP.) 14 June 2012 (2012-06-14) See paragraphs [0031]-[0056].	1-17

☑ 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
28 February 2023	**02 March 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

International application No.
PCT/KR2022/018290

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2019-0024290 A1 (QINGDAO HAIER DRUM WASHING MACHINE CO., LTD.) 24 January 2019 (2019-01-24) See claims 1-9.	1-17

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2022/018290

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		AU 2020-200011 B2	24 June 2021
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		EP 3336234 B1	02 September 2020
		EP 3339493 A1	27 June 2018
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		KR 10-2018-0053194 A	21 May 2018
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		KR 10-2018-0053198 A	21 May 2018
		KR 10-2018-0053199 A	21 May 2018
		US 10036109 B2	31 July 2018
		US 10316447 B2	11 June 2019
		US 10544532 B2	28 January 2020
		US 10604877 B2	31 March 2020
		US 11066770 B2	20 July 2021
		US 11225741 B2	18 January 2022
		US 11299835 B2	12 April 2022
		US 2017-0356115 A1	14 December 2017
		US 2018-0171522 A1	21 June 2018
		US 2018-0171534 A1	21 June 2018
		US 2019-0276963 A1	12 September 2019
		US 2019-0382934 A1	19 December 2019
		US 2020-0149203 A1	14 May 2020
		US 2020-0208318 A1	02 July 2020
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		US 11459693 B2	04 October 2022

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2022/018290

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		CN 102535087 B	10 September 2014
		EP 2458061 A1	30 May 2012
		EP 2458061 B1	15 June 2016
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REFERENCES CITED IN THE DESCRIPTION

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- WO 1020060115264 A **[0007]**