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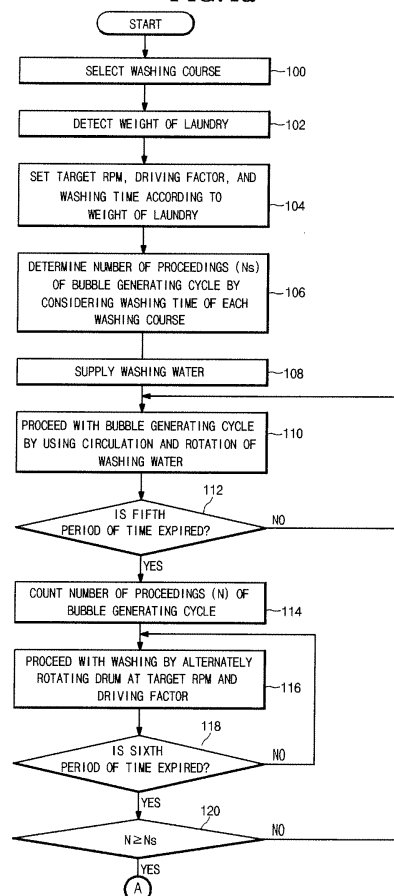
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(54) **Washing machine and control method thereof**

(57) A washing machine (1) provided with a structure thereof capable of draining and circulating by using a single pump (51) and capable of enhancing washing performance by using a circulation of water and a rotation of a drum (12), and a control method thereof, in which the structure of the washing machine (1) is simplified through the change of the flow path that enables the draining and the circulation of water by using a general pump (51) while decreasing the number of the components of the washing machine (1), the manufacturing cost of the washing machine (1) is reduced, because the washing machine (1) accelerates the dissolution of detergent by generating large amount of bubbles by using the circulation of water and the rotation of the drum (12), without additional components, thereby washing performance of the washing machine (1) is enhanced, and by maintaining the bubbles that are generated, the non-tangible quality that a user feels in the course of washing is enhanced.

FIG.4a



Description

[0001] The present invention relates to a washing machine capable of enhancing washing performance by using a circulation of water and a rotation of a drum, and a control method thereof.

[0002] In general, a washing machine, that is, a drum washing machine in general, while provided with a tub configured to store water, that is, washing water or rinsing water, a drum rotatably installed inside the tub and configured to accommodate a laundry, and a motor to generate rotation force to rotate the drum, is an apparatus configured to have a washing of the laundry inside thereof take place through ascending and descending motions along an inner wall of the drum.

[0003] The washing machine as such is configured to proceed with washing through a series of motions including a washing cycle configured to separate contamination of the laundry by use of the water, in particular, the washing water, provided with detergent dissolved therein, a rinsing cycle configured to rinse the bubbles or the remaining detergent of the laundry by use of the water, in particular, the rinsing water, provided with no detergent therein, and a spin-drying cycle configured to spin-dry the laundry at high speed.

[0004] The washing cycle from the cycles mentioned above is configured to input detergent along with the water, in particular, the washing water, into an inside the tub, alternate the drum forward/backward according to the driving of the motor to generate a water current to deliver the washing water, that is, the water having the detergent, to the laundry, and remove the contamination of the laundry.

[0005] However, a conventional washing machine is needed to be provided with water filled up to the space between the tub and the drum to perform a washing, and thus the consumption of water is large and the detergent is needed to be used in proportion to the amount of the water, and in a case of performing a washing using heat, as to increase the temperature of the water being input into the conventional washing machine, the amount of energy is as large in proportion to the amount of the water.

[0006] In addition, as to enhance washing performance of the conventional washing machine, washing water is needed to be effectively delivered to the laundry that is positioned at a center of an inner portion of the conventional washing machine, but due to the structural characteristics of the conventional washing machine, without additional use of water, the height ascension of the washing water is difficult while some of the detergent that is being input into the conventional washing machine along with the washing water may be wasted without being dissolved, and thus the concentration of the washing water may be reduced, and accordingly, a limitation in implementing a high-concentration washing may be present.

[0007] As to overcome the difficulty as such, a method, which is configured to enhance washing performance by

accelerating the dissolution of detergent while minimizing the usage of water by using an apparatus to circulate water inside the tub or to generate bubbles, is traditionally being suggested.

[0008] However, as to circulate the water or to generate bubbles inside the tub, additional components such as a pump, a hose, and other injection-molded product, are needed to be added thereto, and accordingly, an additional process is added in manufacturing the conventional washing machine and the material cost of the conventional washing machine is increased.

[0009] In an aspect of one or more embodiments, there is provided a washing machine provided with a structure thereof capable of draining and circulating by using a single pump and capable of enhancing washing performance by using a circulation of water and a rotation of a drum, and a control method thereof.

[0010] In an aspect of one or more embodiments, there is provided a method of controlling a washing machine provided with a tub, a drum rotatably installed inside the tub, and a pump configured to circulate water in the tub, includes (a) rotating the drum toward one direction for a first period of time after supplying washing water to the tub, (b) stopping the drum for a second period of time after rotating the drum toward the one direction, (c) rotating the drum toward an opposite direction opposite to the one direction for a third period of time after the second period of time is expired; and (d) stopping the drum for a fourth period of time after rotating the drum toward the opposite direction. During a forward/backward alternate operation of the drum comprising (a) to (d), a bubble generating cycle to generate bubbles through rotation of the drum and friction of the circulated water may be performed by driving the pump. The bubble generating cycle may be performed after a water supplying cycle in which water and detergent are supplied to the tub to perform a washing.

[0011] The method may further include a washing motor configured to rotate the drum. During the rotating of the drum toward the one direction, the washing motor may be driven toward a normal direction for the first period of time while maintaining at a predetermined revolutions per minute (RPM).

[0012] During the rotating of the drum toward the opposite direction, the washing motor may be driven toward a reverse direction for the third period of time while maintaining at a predetermined RPM.

[0013] The first period of time may be same as the third period of time. The second period of time may be same as the fourth period of time. The second period of time may be set to be shorter than the first period of time. The first period of time may be about 14 seconds. The second period of time may be about 6 seconds. The first period of time may be different from the third period of time. The second period of time may be different from the fourth period of time.

[0014] During the forward/backward alternate operation of the drum, the predetermined RPM may be at least

80 RPM. The method may further include, during the forward/backward alternate operation of the drum, changing the RPM of the motor. The method may further include, during the forward/backward alternate operation of the drum, changing a driving time of the motor or a stopping time of the motor.

The forward/backward alternate operation of the drum including from (a) to (d) may be performed for a predetermined period of time.

[0015] The method may further include counting the number of proceedings of the bubble generating cycle, wherein if the counted number of proceedings of the bubble generating cycle reaches to a predetermined reference number of proceedings, the bubble generating cycle may be finished.

[0016] The predetermined reference number of proceedings may be determined by considering a washing time at each washing cycle.

[0017] In an aspect of one or more embodiments, there is provided a washing machine which includes a tub, a drum, a washing motor, a flow path, and a control unit. The tub may be configured to accommodate water. The drum may be rotatably installed inside the tub. The washing motor may be configured to rotate the drum. The flow path switching apparatus may be configured to switch a flow path of water such that water in the tub is drained or circulated. The control unit, after water and detergent are supplied to the tub, may be configured to perform a bubble generating cycle in which water in the tub is circulated by controlling the flow path switching apparatus and the drum is alternately rotated forward and backward by controlling the washing motor.

[0018] The control unit, during the forward and backward alternate rotation of the drum, may be configured to drive the washing motor at a predetermined RPM and a predetermined driving factor.

[0019] The control unit may be configured to alternately rotate the drum while having the RPM of the motor at 80 RPM or above.

[0020] The control unit, during the forward/backward alternate rotation of the drum, may be configured to change the RPM of the motor.

[0021] The control unit, during the forward/backward alternate rotation of the drum, may be configured to change the driving factor of the motor.

[0022] The control unit may be configured to count a time that the forward/backward alternate rotation of the drum is performed, and to stop the forward/backward alternate rotation of the drum if the counted time reaches to a predetermined period of time.

[0023] The flow path switching apparatus may include a pump configured to pump the water in the tub, and a flow path switching valve configured to switch a flow path such that water being discharged from the tub is drained to an outside or the water is circulated to the tub.

[0024] In an aspect of one or more embodiments, there is provided a method of controlling a washing machine provided with a tub, a drum rotatably installed inside the

tub, a washing motor to rotate the drum, and a pump configured to circulate water in the tub includes supplying water and detergent to the tub, performing a bubble generating cycle, in which water being discharged from the tub is circulated to the tub by driving the pump at the same time of alternately rotating the drum forward and backward by driving the washing motor at a predetermined RPM and a predetermined driving factor, and performing a washing cycle, in which the drum alternately rotates forward and backward, by driving the washing motor at a target RPM and a target driving factor. A proceeding time, or operating time, of the bubble generating cycle and a proceeding time of the washing cycle may be counted, and if the counted proceeding time of the bubble generating cycle and the counted proceeding time of the washing cycle pass over a predetermined period of time, the bubble generating cycle and the washing cycle may be alternately performed with each other.

[0025] The bubble generating cycle includes an operation of rotating the drum toward one direction for a first period of time, an operation of stopping the drum for a second period of time after rotating the drum toward the one direction, an operation of rotating the drum toward an opposite direction for the first period of time after the second period of time is expired, and an operation of stopping the drum for the second period of time after rotating the drum toward the opposite direction.

[0026] The bubble generating cycle may include generating bubbles through rotation of the drum and friction of the circulated water by driving the pump during the forward and backward alternate rotation of the drum.

[0027] The bubble generating cycle may include driving the washing motor toward a normal direction or toward a reverse direction for the first period of time while maintaining the washing motor at a predetermined RPM during the forward and backward alternate rotation of the drum.

[0028] An RPM of the washing motor of the bubble generating cycle may be set to be higher than an RPM of the washing motor of the washing cycle.

[0029] A proceeding time of the bubble generating cycle may be set to be shorter than a proceeding time of the washing cycle.

[0030] The method may further include counting the number of proceedings of the bubble generating cycle, also referred to as the number of operation cycles, and finishing the bubble generating cycle when the counted number of the proceedings reaches to a predetermined reference number of proceedings.

[0031] The method may further include only performing the washing cycle during a remaining washing time after the finishing of the bubble generating cycle.

[0032] The predetermined reference number of proceedings may be at least twice.

[0033] In an aspect of one or more embodiments, there is provided a method of controlling a washing machine provided with a tub, a drum rotatably installed inside the tub, a pump to pump water in the tub, and a flow path

switching valve configured to switch a flow path to drain or circulate the water in the tub includes determining whether a current cycle is a washing cycle, switching the flow path so that water being discharged from the tub is introduced to the tub by driving the flow path switching valve if determined as the washing cycle, introducing the water being discharged from the tub by driving the pump to the tub, and performing a bubble generating cycle to generate bubbles through friction of the water introduced to the tub and the drum by rotating the drum.

[0034] In an aspect of one or more embodiments of a washing machine and control method thereof, by using a conventional drain pump, through the switch of the flow path that enables the draining and the circulation of water, the structure of the washing machine may be simplified while the number of the components of the washing machine may be decreased, and thereby the manufacturing cost of the washing machine may be reduced.

[0035] In an aspect of one or more embodiments of a washing machine and control method thereof, by generating large amount of bubbles by using the circulation of water as well as the rotation of the drum, without additional components, the dissolution of detergent may be accelerated, and thereby washing performance of the washing machine may be enhanced, and by maintaining the bubbles that are generated, the non-tangible quality that a user feels in the course of washing may be enhanced.

[0036] These and/or other aspects will become apparent and more readily appreciated from the following description of embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view showing an exterior appearance of a washing machine in accordance with an embodiment;

FIG. 2 is a cross-sectional view showing a structure of the washing machine in accordance with an embodiment;

FIG. 3 is a control block diagram of the washing machine in accordance with an embodiment;

FIGS. 4A and 4B are flow charts showing a control method of a washing machine in accordance with an embodiment;

FIG. 5 is a graph showing a driving profile of a washing motor during a bubble generating cycle of the washing machine in accordance with an embodiment; and

FIG. 6 is a flow chart of the bubble generating cycle in accordance with an embodiment.

[0037] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0038] FIG. 1 is a perspective view showing an exterior appearance of a washing machine in accordance with an embodiment, and FIG. 2 is a cross-sectional view

showing a structure of the washing machine in accordance with an embodiment.

[0039] In FIG. 1 and FIG. 2, a washing machine 1 in accordance with an embodiment includes a body 10 having an approximate shape of a box and forming an exterior appearance of the washing machine 1, a tub 11 having a shape of a drum installed inside the body 10 and provided to store water, that is, washing water or rinsing water, and a drum 12 having a shape of a cylinder rotatably installed inside the tub 11 and provided with a plurality of holes 13 formed thereto.

[0040] At an outer side of a rear surface unit of the tub 11, a washing motor 15 is installed as a driving apparatus configured to rotate a rotation axis 15a connected to the drum 12 so that a washing cycle, a rinsing cycle, and a spin-drying cycle may be performed.

[0041] In general, as the washing motor 15, a universal motor composed of field coils and an armature, or a BLDC motor (Brushless Direct Motor) composed of a permanent magnet and an electromagnet is being used, and any motor capable of being applied to the drum 12 provided with a mid-to-small size thereof may be used.

[0042] At a lower side of an inside the tub 11, a water level sensor 16, which is changed according to the level of the water as to detect the amount of the water, that is, the level of the water, in the tub 11, a washing heater 17 configured to apply heat at the water in the tub 11, and a temperature sensor 18 configured to detect the temperature of the water, that is, washing water or rinsing water, in the tub 11 are installed.

[0043] In addition, at a front surface unit of the body 10, a door 19 is installed as to insert a laundry into the drum 12 or to withdraw a laundry inside the drum 12.

[0044] At an upper portion of the body 10, a detergent supply apparatus 20 configured to supply detergent, as well as a water supply apparatus 30 configured to supply water, that is, washing water or rinsing water, is installed.

[0045] The detergent supply apparatus 20 is provided with an inside thereof divided into a plurality of spaces, and is installed at a front surface portion of the body 10 so that a user may be easily able to insert detergent and rinsing substance at each of the plurality of space.

[0046] In addition, the water supply apparatus 30 includes a cold water 31 and a hot water supply pipe 32 connecting the in-between of an outside water supply pipe and the detergent supply apparatus 20 as to supply water, that is, washing water or rinsing water, to an inside the tub 11, a cold water valve 33 and a hot water valve 34 configured to control the supply of water while being installed in between the cold water supply pipe 31 and the hot water supply pipe 32, and a water supply pipe 35 connecting the detergent supply apparatus 20 to the tub 11. The structure allows the water being supplied to an inside the tub 11 to pass through the detergent supply apparatus 20, so that the detergent inside the detergent supply apparatus 20 may be supplied to the tub 11 along with water.

[0047] In addition, at an upper portion of the front sur-

face of the body 10, a control panel 40, at which various buttons and displays configured to control the washing machine 1 are disposed, is provided, and at one side of the control panel 40, a detergent input unit 21 connected to the detergent supply apparatus 20 to input washing machine-purpose detergent into the washing machine 1 is provided.

[0048] In addition, in accordance with an embodiment, the washing machine 1 is provided with a flow path switching apparatus 50 installed thereto as to drain or circulate the water inside the tub 11, and the flow path switching apparatus 50 includes a pump 51 installed at a lower portion of the tub 11 and configured to pump the water inside the tub 11 and a flow path switching valve 52 configured to change the flow path of the water, which is being discharged from the tub 11 by the pump 51, toward a draining direction or toward a circulating direction.

[0049] The pump 51 is connected to a pump case 53 to drain the water being discharged from the tub 11 to the outside or to circulate to the tub 11, and a first connection pipe 54 is installed between the tub 11 and the pump case 53 to guide the water contained in the tub 11 to the pump case 53.

[0050] The flow path switching valve 52 is installed at an exit side of the pump 51, while an entry of the flow path switching valve 52 is connected to the pump 51 and an exit of the flow path switching valve 52 is connected to a drain flow path 55a or a circulation flow path 56a. A drain pipe 55 is connected the drain flow path 55a provided the exit side of the flow path switching valve 52 so that the water that is guided to the pump case 53 is drained to an outside, and a circulation pipe 56 is connected to the circulation flow path 56a provided at the other exit side of the flow path switching valve 52 so that the water that is guided to the pump case 53 is introduced to an inside the tub 11.

[0051] That is, at the time when a draining is being taken place, the direction of the flow path of the flow path switching valve 52 is changed to the drain flow path 55a, so that the water discharged from the tub 11 is drained to an outside through the drain pipe 55 without being introduced to the tub 11, and at the time when a washing is being taken place, the direction of the flow path of the flow path switching valve 52 is changed to the circulation flow path 56a, so that the water discharged from the tub 11 is introduced again to the tub 11 through the circulation pipe 56 without being drained to an outside.

[0052] As the above, according to the change of the flow path of the flow path switching valve 52, at the time when a draining is being taken place, the water being discharged from the tub 11 is drained to an outside through the drain pipe 55, and at the time when a washing is being taken place, the water being discharged from the tub 11 is introduced again to the tub 11 through the circulation pipe 56.

[0053] The direction of the flow path of the flow path switching valve 52 is normally connected to the drain flow

path 55a.

[0054] The circulation pipe 56 is provided a structure that one side of the circulation pipe 56 is connected to the flow path switching valve 52 while the other side thereof is connected to the tub 11, so that in a case when the pump 51 is in motion, the water in the tub 11 is guided to the pump case 53 through a first connection pipe 54, the water guided to the pump case 53 is guided to the flow path switching valve 52 through a second connection pipe 57, and the water guided to the flow path switching valve 52 is circulated while being supplied again to the tub 11 through the circulation pipe 56. At this time, in order for the water being circulated to be smoothly supplied to a lower portion of the tub 11, the position of the circulation pipe 52 connected to the tub 11 is installed as low as possible.

[0055] In addition, in between the pump 51 and the flow path switching valve 52, the second connection pipe 57 configured to guide the water stagnantly remaining at the pump case 53 to the flow path switching valve 52 is installed.

[0056] In addition, in accordance with an embodiment, the washing machine 1 is provided with a suspension spring 60 elastically supporting the tub 11 at an upper portion of the tub 11 so as to prevent the vibration from being generated, as well as a damper 62 configured to reduce the vibration at a lower portion of the tub 11, in the process of the washing machine 1 being in motion.

[0057] The suspension spring 60 and the damper 62 as such are configured to movably support the tub 11 at an upper portion of the tub 11 and at a lower portion of the tub 11, respectively. That is, a vibration is generated in all directions toward a front, a rear, an upper, and a lower side as the tub 11 is vibrated as a result of the vibratory exciting force that is generated while the drum 12 is being rotated, and the vibration of the tub 11 as such is reduced by the suspension spring 60 and the damper 62.

[0058] FIG. 3 is a control block diagram of the washing machine in accordance with an embodiment.

[0059] In FIG. 3, in accordance with an embodiment, the washing machine 1 includes an input unit 70, a control unit 72, a memory 73, a driving unit 74, and a display unit 76.

[0060] The input unit 70 is configured to receive an input of a command to implement a washing cycle, a rinsing cycle, and a spin-drying cycle of the washing machine 1 by a manipulation of a user, and may be composed of keys, buttons, switches, and a touch pad, and includes all apparatuses that generate predetermined input data by manipulations such as pressing, contacting, pressurizing, and rotating.

[0061] In addition, the input unit 70 is provided at the control panel 40, and includes a plurality of buttons, such as a power button, a reservation button, a temperature button, a soaking button, a washing button, a rinsing button, a spin-dry button, and a detergent selection button, through which a command of a user related to a motion

of the washing machine 1 is input. The plurality of buttons includes a course selection button configured to select a washing course, including a standard course, a wool course, and a delicate course, depending on the type of a laundry being inserted into the washing machine 1, for example, the standard course that a user selects according to the type of a laundry.

[0062] The control unit 72 is referred to as a micro computer configured to control the overall motion of the washing machine 1 including a washing, a rinsing, and a spin-drying according to the driving information that is input from the input unit 70, and is configured to establish a target washing level, a target rinsing level, a target RPM, a target driving factor, that is, the ON/OFF time of the motor, a washing time, and a rinsing time according to the weight, that is, the load, of the laundry during the selected washing course.

[0063] In addition, the control unit 72 is configured to proceed with a bubble generating cycle configured to supply the water that is set according to the weight (the load) of the laundry during a washing, generate bubbles in large quantity by using the rotation of the drum 12 and the circulation of the water, and proceed with a washing by maintaining the generated bubbles generated.

[0064] With respect to the bubble generating cycle, by driving the pump 51 after the supply of washing water is taken place, the water, that is, the detergent water, inside the tub 11 is circulated, and at the same time, while the washing motor 15 is maintained at a predetermined RPM, that is, the RPM at the rate of about 80 RPM to 89 RPM in which bubbles may be generated as friction occurs between the drum and the tub, the washing motor 15 is driven at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF, so that the drum 12 is alternately rotated toward left and right directions of the drum 12. According to the above, when the water in between the drum 12 and the tub 11 is introduced again to an inside the tub 11 after being circulated, the drum is rotated at the predetermined RPM, that is, the RPM at the rate of about 80 RPM to 89 RPM, bubbles are generated by the friction between the water being introduced again and the drum 12. If a bubble generating cycle, in which the washing motor 15 is driven at a predetermined RPM (about 80 to 89 RPM) and a predetermined driving factor (about 14 seconds of the motor-On/about 6 seconds of the motor-Off) while driving the pump 51 so as to alternately rotate the drum 12 toward left and right directions of the drum 12, is performed for a predetermined period of time, that is, the period of time estimated to be about 1 minute to 2 minutes suitable for bubbles to be generated in large quantity by the friction between the drum and the water in the tub, large quantity of bubbles are generated inside the drum 12. The large quantity of bubbles generated through the bubble generating cycle expedites the dissolving of the detergent that is introduced along with the water, that is, the washing water, to the tub 11, and thus the washing performance is enhanced, and as the large quantity of the bub-

bles overflows toward a diaphragm of the door 19 positioned at a front surface of the drum 12, the non-tangible quality that a user feels with respect to the washing performance in the course of washing may be enhanced.

[0065] However, the large quantity of bubbles generated according to the proceeding of the bubble generating cycle is dissipated after about 5 to 6 minutes, and thus, by proceeding again with the bubble generating cycle within the predetermined period of time, that is, the period of time estimated at about 5 minutes maximum to proceed the bubble generating cycle before the large amount of the bubbles is dissipated, the large quantity of the bubbles are maintained inside the drum 12, so that the visibility of the bubbles that a user feels is also increased.

[0066] In addition, the control unit 72 determines the number of the proceedings 'Ns' of the bubble generating cycle by considering the washing time of the selected washing course.

[0067] The memory 73 stores the setting information, including the control data configured to control the motion of the washing machine 1, the reference data being used during the controlling of the motion of the washing machine 1, the operation data being generated while the washing machine 1 performs a predetermined operation, the setting data being input by the input unit 70 for the washing machine 1 to perform a predetermined operation, the usage information including the frequency by which the washing machine 1 performs a particular operation and the model information of the washing machine 1, and the malfunction information including the cause or the position of a malfunction in a case when the malfunction is occurred.

[0068] The driving unit 74, according to the driving control signal of the control unit 72, is configured to drive the washing motor 15, the washing heater 17, the cold water and hot water valve 33 and 34, the pump 51, and the flow path switching valve 52 that are related to the operation of the washing machine 1.

[0069] The display unit 76 is provided at the control panel 40, and according to the display control signal of the control unit 72, displays the operation status of the washing machine 1 and the manipulation status of a user.

[0070] Hereinafter, the operation process and the effect of the control method of the washing machine in accordance with an embodiment will be described.

[0071] FIGS. 4A and 4B are flow charts showing operations of the control method of the washing machine in accordance with an embodiment, and are referred to as the algorithms capable of enhancing the washing performance and the non-tangible quality by adding generating of bubbles in addition to a basic washing cycle.

[0072] On FIGS. 4A to 4B, a user inputs a laundry into an inside the drum 12, and also inputs detergent into the detergent supply apparatus 20. Then, by manipulating the buttons of the input unit 70 disposed at the control panel 40, a washing course is selected (100) from a standard course, a wool course, and a delicate course,

and for example, the standard course that a user selects according to the type of the laundry. At this time, the driving information of the washing course selected by the user is being input into the control unit 72 through the input unit 70.

[0073] Thus, the control unit 72 detects the weight, that is, the load, of the laundry being inserted into the drum 12 to proceed with the washing cycle (102). At this time, as for a method of measuring the weight of the laundry, a method of detecting a weight of the laundry by measuring the length of time of the washing motor 15 reaching at predetermined speed or a predetermined number of rotations by use of the instantaneous acceleration of the washing motor 15, or as disclosed in the Japanese Publication No. 2002-336593, in the Japanese Publication No. 2004-267334, and in the Japanese Publication No. 07-90077, a method of measuring a weight of the laundry by directly or indirectly measuring the amount of inertia of the drum 12 by applying torque to the washing motor 15 for a predetermined period of time, and then by using the second law of motion (torque = inertia X acceleration).

[0074] Other than the above, the weight, that is, the load, of the laundry may be able to be detected by using a load cell.

[0075] When the weight, that is, the amount of the load, of the laundry is detected, the control unit 72, according to the detected weight, that is, the amount of the load, of the laundry, sets a target washing water level, a target rinsing water level, a target RPM, a target driving factor, that is, the target ON/OFF time of the motor, a washing time, and a rinsing time (104).

[0076] The setting of the target washing water level, the target rinsing water level, the target RPM, the target driving factor, that is, the ON/OFF time of the motor, the washing time, and the rinsing time represents the case when a separate command with reference to the operation of the washing machine 1 is not additionally input by a user. In a case when a separate command with reference to the operation of the washing machine 1 is additionally input by a user, the target washing water level, the target rinsing water level, the target RPM, the target driving factor, that is, the ON/OFF time of the motor, the washing time, and the rinsing time, all of which are set according to the weight, that is, the amount of the load, of the laundry, are being changed according to the command of the user.

[0077] Then, the control unit 72 determines the number of the standard proceedings 'Ns' of the bubble generating cycle by considering the washing time of the selected washing course (106).

[0078] The number of the standard proceedings 'Ns' of the bubble generating cycle is set to be at least twice, and according to the washing time of each washing course, the number of the standard proceedings 'Ns' of the bubble generating cycle is changed. For example, as the washing time is extended, by increasing the number of the standard proceedings 'Ns' of the bubble generating

cycle, the washing performance is enhanced, and at the same time, the visibility of the bubbles that a user feels is also increased.

[0079] Then, the control unit 72 drives the cold water valve 33 or the hot water valve 34 to supply the water, that is, the washing water, needed for the washing cycle according to the weight, that is, the amount of the load, of the laundry, or the command of a user.

[0080] When the cold water valve 33 or the hot water valve 34 is being driven, the cold water valve 33 or the hot water valve 34 is open, and the water, that is, the washing water, that is supplied through an outside water supply pipe is supplied to the tub 11 after passing through the cold water supply pipe 31 or the hot water supply pipe 32 and also through the detergent supply apparatus 20. At this time, the detergent inside the detergent supply apparatus 20 is dissolved by the water, that is, the washing water, and is introduced into the tub 11 after passing through the connection pipe 35 along with the water, that is, the washing water, and thus the detergent water, that is, the water mixed with the detergent is supplied to a lower portion, that is, the in between the tub and the drum to be specific, of the tub 11 (108).

[0081] Thus, the control unit 72 determines whether the level of the water being supplied to the tub 11 is at the target washing level, that is, the level that is determined according to the predetermined amount of the laundry, by detecting the level of the water being supplied to the tub 11 by use of the water level sensor 16, and continues the water supply motion until the level of the water being supplied to the tub 11 is reached at the target washing level.

[0082] When the level of the water being supplied to the tub 11 through the water supply operation is reached at the target washing level, the control unit 72 stops the water supply operation by stopping the cold water valve 33 or the hot water valve 34.

[0083] When the supply of the washing water, that is, the detergent water is finished up to the target washing level, the control unit 72 proceeds with the bubble generating cycle configured to generate bubbles in large quantity by using the circulation of the washing water, that is, the detergent water, and the rotation of the drum 12 (110).

[0084] The basic washing cycle is referred to as the alternate rotating of the drum forward and backward 12 by driving the washing motor 15 at the target RPM and the driving factor, that is, the ON/OFF time of the motor, both of which are set according to the weight, that is, the amount of the load, of the laundry after the detergent water, that is, the detergent mixed with the washing water, is supplied, and the proceeding of a washing during a predetermined washing time by using the movement of the laundry and the water current that are generated by alternately rotating the drum 12 backward and forward.

[0085] In the contrary, the bubble generating cycle represents circulating the water, that is, the detergent water,

inside the tub 11 by driving the pump 51 after the detergent water, that is, the washing water mixed with detergent, is supplied, and at the same time of alternately rotating the drum 12 forward and backward by driving the washing motor 15 at the predetermined RPM, that is, the RPM at the rate of about 80 RPM to 89 RPM and at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF. As a result of the above, when the water in between the drum 12 and the tub 11 is circulated to be introduced again to an inside the tub 11, a large quantity of bubbles is generated by the friction according to the rotation of the drum 12, and the detergent solution is accelerated as a result, and as the bubbles generated overflow toward the diaphragm of the door 19 positioned at a front surface of the drum 12, the non-tangible quality that a user feels with respect to the washing performance in the course of washing is enhanced. The direction of the flow path of the flow path switching valve 52 at the time of a washing is changed toward the circulation flow path 56a, and the water being pumped from the tub 11 according to the driving of the pump 51 is not drained to an outside, but is introduced again into the tub 11 through the circulation pipe 56.

[0086] With respect to the proceeding of the algorithm of the bubble generating cycle, the detailed description will be provided by referring to FIG. 5 and FIG. 6.

[0087] At this time, the control unit 72 determines whether a predetermined period of time, that is, the period of time of approximately 1 minute to 2 minutes, and hereafter referred to as the fifth period of time, is expired by counting the proceeding time of the bubble generating cycle (112).

[0088] If the fifth period of time, that is, the period of time of approximately 1 minute to 2 minutes, is not expired as a result of the determination of the operation 112, the control unit 72 returns to the operation 110 and proceeds with the bubble generating cycle until the fifth period of time is expired.

[0089] If the fifth period of time is expired as a result of the determination of the operation 112, the control unit 72 stops the bubble generating cycle, and counts the number of the proceedings 'N' (that is, the number of the drum being rotated and of the water being circulated by driving the pump and the washing motor) of the bubble generating cycle (114).

[0090] As the above, after the bubbles are generated in large quantity through the bubble generating cycle, the control unit 72, by alternately rotating the drum 12 forward and backward by driving the washing motor 15 at the target RPM, that is, the RPM at the rate of about 40 RPM to 50 RPM and at the driving factor, that is, the ON/OFF time of the motor, both of which are predetermined for the washing cycle, generates the water current that delivers the detergent water, that is, the washing water mixed with detergent, to a laundry, thereby proceeding with the basic washing cycle (116).

[0091] Since the basic washing cycle proceeds in a state that the large quantity of the bubbles that are gen-

erated through the bubble generating cycle is applied on the laundry inside the drum 12, the washing performance is enhanced, and at the same time, the visibility of the bubbles that a user feels is also increased.

5 [0092] At this time, the control unit 72 determines whether a predetermined period of time, that is, the predetermined period of time of approximately 5 minutes required to proceed with the bubble generating cycle before the bubbles are dissipated, is expired by counting the time when the bubble generating cycle is stopped (118). The large quantity of the bubbles that is generated according to the proceeding of the bubble generating cycle, after approximately 5 to 6 minutes are expired, is dissipated, and thus the bubble generating cycle is needed to be proceeded again within a predetermined period of time, that is, the predetermined period of time of approximately 5 minutes, and hereafter referred to as the sixth period of time, so that the bubbles that are applied inside the drum 12 are maintained.

20 [0093] If the sixth period of time, that is, the period of time of approximately 5 minutes, is not expired as a result of the determination of the operation 118, the control unit 72 returns to the operation 116 and proceeds with the bubble generating cycle until the sixth period of time is expired.

25 [0094] If the sixth period of time is expired as a result of the determination of the operation 118, the control unit 72 stops the basic washing cycle, and determines whether the counted number of the proceedings 'N' of the bubble generating cycle is reached at the predetermined number of the standard proceedings 'Ns', that is, the optimal number of the standard proceedings of approximately 2 to 4 times at which the detergent dissolution is accelerated according to the washing time of each washing course and at which the visibility of the bubbles that a user feels may be increased (120).

30 [0095] If the number of the proceedings 'N' of the bubble generating cycle is not reached at the predetermined number of the standard proceedings 'Ns' as a result of the determination of the operation 120, the control unit 72 returns to the operation 110 to proceed with the bubble generating cycle in which the water is circulated by driving the pump 51 until the number of the proceedings 'N' of the bubble generating cycle is reached at the predetermined number of the standard proceedings 'Ns' that is decided according to the washing time of the each washing course, and at the same time, the drum 12 is alternately rotated forward and backward by driving the washing motor 15 toward normal and reverse directions thereof.

35 [0096] As the above, if the number of the proceedings 'N' of the bubble generating cycle is reached at the predetermined number of the standard proceedings 'Ns', the control unit 72 finishes the bubble generating cycle, and drives the washing motor 15 at the target RPM, that is, the RPM at the rate of about 40 RPM to 50 RPM and at the driving factor, that is, the ON/OFF time of the motor, both of which are predetermined to continuously proceed

with the washing for the remaining period of the washing time. By alternately rotating the drum 12 forward and backward according to the driving of the washing motor 15, the water current that delivers the detergent water, that is, the washing water mixed with detergent to the laundry is generated to proceed with the basic washing cycle (122).

[0097] Then, the control unit 72 determines whether the washing time, which is predetermined according to the weight of the laundry, is expired (124).

[0098] If the washing time is not expired as a result of the determination of the operation 124, the control unit 72 returns to the operation 122 and proceeds with the basic washing cycle until the remaining washing time is expired.

[0099] If the washing time is expired as a result of the determination of the operation 124, the control unit 72 stops the washing motor 15, drains the detergent water, that is, the washing water mixed with detergent (126), and proceeds with an interim spin-drying (128). At the time of a draining, the direction of the flow path of the flow path switching valve 52 is changed toward the drain flow path 55a, so that the water being discharged from the tub 11 according to the driving of the pump 51 is not introduced to the tub 11, and is drained to an outside through the drain pipe 55. If the direction of the flow path of the flow path switching valve 52 is in a state of being changed toward the drain flow path 55a at normal times, that is, at the time except for the period of the washing time, the direction of the flow path of the flow path switching valve 52 is not needed to be changed, and in the case as such, the flow path switching valve 52 is not needed to be operated through the driving unit 74.

[0100] Then, the control unit 72 drives the cold water valve 33 or the hot water valve 34 to supply the water, that is, the rinsing water, needed for the rinsing cycle.

[0101] When the cold water valve 33 or the hot water valve 34 is being driven, the cold water valve 33 or the hot water valve 34 is open, and the water, that is, the rinsing water, is supplied to the tub 11 after passing through the cold water supply pipe 31 or the hot water supply pipe 32 (130). At this time, the control unit 72 controls the water supply operation into an alternation water supply operation configured to supply rinsing water while alternately rotating the drum 12 forward and backward so as to enhance rinsing performance, so that the laundry being stuck at the drum 12 is loose to be well mixed with water, and accordingly, the effect of the enhanced rinsing performance is attained. Thus, the control unit 72 determines whether the level of the water being supplied to the tub 11 is at the target rinsing level, that is, the level that is determined according to the predetermined amount of the laundry, by detecting the level of the water being supplied to the tub 11 by use of the water level sensor 16, and continues the water supply operation until the level of the water being supplied to the tub 11 is reached at the target rinsing level.

[0102] When the supply of the rinsing water up to the

target rinsing level is finished, the control unit 72, the control unit 72 drives the washing motor 15 at the target RPM and the driving factor, that is, the ON/OFF time of the motor, both of which are predetermined for the rinsing cycle to alternately rotate the drum 12 forward and backward and to generate the water current bringing the rinsing water into contact with the laundry, thereby proceeding with the rising cycle (132).

[0103] When the rinsing is finished during the predetermined rinsing time, the control unit 72 stops the washing motor 15, and drains the water, that is, the rinsing water (134). The proceeding of the rinsing cycle as such is repeated during the predetermined number of proceedings.

[0104] When the last rinsing cycle is finished as the rinsing cycle is proceeded during the predetermined number of proceedings, the control unit 72 determines whether the current cycle is the spin-drying cycle (136).

[0105] If the current cycle is not the rinsing cycle as a result of the determination of the operation 136, the control unit 72 returns to the operation 128 to proceed with the interim spin-drying, and then proceeds with the operations that follow thereafter.

[0106] If the current cycle is the rinsing cycle as a result of the determination of the operation 136, the control unit 72 proceeds with the spin-drying cycle at the predetermined final spin-drying RPM approximately above the range of 700 RPM and 1,000 RPM (138).

[0107] During the bubble generating cycle, the driving profile of the washing motor 15 configured to alternately rotate the drum 12 forward and backward is illustrated on FIG. 5.

[0108] FIG. 5 is a graph showing the driving profile of the washing motor during the bubble generating cycle of the washing machine in accordance with an embodiment.

[0109] On FIG. 5, with respect to the bubble generating cycle, after the water, that is, the washing water, is supplied to an inside the drum 12, friction is generated at the water, that is, the detergent water to be specific, in between the drum 12 and the tub 11, by alternately rotating the drum 12, while the washing motor 15 is maintained at the predetermined RPM, that is, the RPM at the rate of about 80 RPM to 89 RPM at which friction is generated between the drum and the tub and bubbles may be generated by the friction, and is driven at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF. The large quantity of bubbles is generated by the friction of the water, that is, the detergent water, in between the drum 12 and the tub 11, accelerates the dissolving of the detergent, and as the large quantity of the bubbles overflows toward a diaphragm of the door 19 positioned at a front surface of the drum 12, the non-tangible quality that a user feels with respect to the washing performance in the course of washing is enhanced.

[0110] The bubble generating cycle as such is started after the supply of the washing water is finished. As to generate bubbles, when the diameter of the drum 12 is

approximately 500 ± 50 mm, the washing motor 15 is driven for more than 1 minutes, approximately for about 1 minute to 2 minutes, at the RPM at the rate of about 80 RPM to 89 RPM, and at this time, the driving of the washing motor 15 is not performed in a continuous manner, but the ON-time and the OFF-time of the washing motor 15 is repeated, as illustrated on FIG. 5. The OFF-time is configured to induce the additional generation of the turbulent current through the stopping and driving of the drum 12, other than the turbulent current caused by the alternately rotating of the drum 12 forward and backward, and also configured to provide the time for the generated bubbles to move toward the diaphragm of the door 19 positioned at a front surface of the washing machine 1.

[0111] The predetermined RPM, that is, the RPM in the approximate range of 80 RPM to 89 RPM, to generate bubbles is set to be higher than the washing RPM, that is, the RPM in the approximate range of 40 RPM to 50 RPM, and is set to be lower than the spin-drying RPM that is, the RPM greater than 700 RPM.

[0112] In addition, the bubbles generated through the bubble generating cycle is dissipated after about 5 to 6 minutes, and thus, by proceeding with the additional rotation of the drum 12 in an alternating manner forward and backward within about 5 minutes maximum to generate the large amount of the bubbles, so that the visibility of the bubbles may be maintained.

[0113] Next, the proceeding of the algorithm of the bubble generating cycle will be described by referring to FIG. 6.

[0114] FIG. 6 is a flow chart showing the operations of the bubble generating cycle in accordance with an embodiment.

[0115] On FIG. 6, when the supply of the water, that is, the detergent water, in between the drum 12 and the tub 11 is finished, the control unit 72 changes the direction of the flow path toward the circulation flow path 56a by driving the flow path switching valve 51 through the driving unit 74 (200). When the direction of the flow path of the flow path switching valve 52 is changed toward the circulation flow path 56a, a circulation structure is provided as the water being discharged from the tub 11 is not drained to an outside, but is introduced again into the tub 11 through the circulation pipe 56.

[0116] In the state when the direction of the flow path of the flow path switching valve 52 is changed toward the circulation flow path 56a, the control unit 72 drives the pump 51 through the driving unit 74, and drives the washing motor 15 toward a normal direction at the predetermined RPM at the rate of approximately 80 RPM and 89 RPM, hereinafter referred to as the bubble generating RPM (201).

[0117] Then, the control unit 72 counts the period of time that the pump 41 is driven and the washing motor 15 is driven at the normal direction at the bubble generating RPM, thereby determining whether a predetermined first period of time, which is approximately 14 seconds, is expired (202).

[0118] If the first period of time is not expired as a result of the determination from the operation 202, the control unit 72 returns to the operation 201 and drives the pump 51, and drives the washing motor 15 toward the normal direction at the bubble generating RPM until the first period of time is expired.

As the above, when the pump 51 is driven, the water, that is, the detergent water, in between the drum 12 and the tub 11 is being circulated through the circulation pipe 56, and is introduced toward an lower side of an inside the tub 11, and when the washing motor 15 is driven toward a normal direction during the first period of time, which is approximately 14 seconds, at the bubble generating RPM, the drum 12 is strongly rotated toward one direction. According to the strong rotation of the drum 12, a friction is generated at the water that is being introduced through the circulation pipe 56 to an inside the tub 11, and as a result, turbulence is generated. By the generation of the turbulence by the circulation of the water and the rotation of the drum 12, bubbles are generated to expedite the detergent dissolution.

[0119] If the first period of time is expired as a result of the determination from the operation 202, the control unit 72 stops the pump 51 and the washing motor 15 through the driving unit 74 (204), and then by counting the period of time during which the pump 51 and the washing motor 15 stop, determines whether a predetermined second period of time, which is approximately 6 seconds, is expired (206).

[0120] If the second period of time is not expired as a result of the determination from the operation 206, the control unit 72 returns to the operation 204 and stops the pump 51 and the washing motor 15 until the second period of time is expired.

[0121] As the above, after the driving of the washing motor 15 toward a normal direction, when the washing motor 15 is stopped for the second period of time, which is approximately 6 seconds, other than the turbulence by the rotation of the drum 12, an additional generation of the turbulence is induced as the drum 12 repeats the process of stopping and driving, and as the bubbles generated are moved toward the diaphragm of the door 19 positioned at a front surface of the washing machine 1, the non-tangible quality that a user feels with respect to the washing performance in the course of washing is enhanced.

[0122] If the second period of time is expired as a result of the determination from the operation 206, the control unit 72 drives the pump 51 through the driving unit 74, and drives the washing motor 15 toward a reverse direction at the bubble generating RPM (208).

[0123] Then, the control unit 72 counts the period of time during which the pump 51 is driven and the washing motor 15 is driven toward the reverse direction at the bubble generating RPM, thereby determining whether the first period of time is expired (210).

[0124] If the first period of time is not expired as a result of the determination from the operation 210, the

control unit 72 returns to the operation 208 to drive the pump 51 while driving the washing motor 15 toward the reverse direction at the bubble generating RPM until the first period of time is expired.

[0125] As the above, when the pump 51 is driven, the water, that is, the detergent water, in between the drum 12 and the tub 11 is being circulated through the circulation pipe 56, and is introduced toward an lower side of an inside the tub 11, and when the washing motor 15 is driven toward a reverse direction during the first period of time, which is approximately 14 seconds, at the bubble generating RPM, the drum 12 is strongly rotated toward an opposite direction. At this time, in the state of generating the additional turbulence, according to the reaction of the strong rotation of the drum 12 that rotates toward the opposite direction, a strong friction is generated at the water that is being introduced through the circulation pipe 56 to an inside the tub 11, and as a result, turbulence is generated further stronger. By the strong generation of the turbulence by the rotation of the drum 12 toward the opposite direction, a large quantity of bubbles is generated to expedite the detergent dissolution.

[0126] If the first period of time is expired as a result of the determination from the operation 210, the control unit 72 stops the pump 51 and the washing motor 15 through the driving unit 74 (212), and then by counting the period of time during which the pump 51 and the washing motor 15 stop, thereby determining whether the second period of time is expired (214).

[0127] If the second period of time is not expired as a result of the determination from the operation 214, the control unit 72 returns to the operation 212 and stops the pump 51 and the washing motor 15 until the second period of time is expired.

[0128] As the above, after the driving of the washing motor 15 toward the reverse direction, when the washing motor 15 is stopped for the second period of time, which is approximately 6 seconds, other than the strong turbulence by the rotation of the drum 12 toward an opposite direction, an additional generation of the turbulence is induced as the drum 12 repeats the process of stopping and driving, and as the bubbles generated overflow toward the diaphragm of the door 19 positioned at a front surface of the washing machine 1, the visibility of the bubbles that a user feels is enhanced.

[0129] If the second period of time is expired as a result of the determination from the operation 214, the control unit 72 counts the period of the proceeding time of the bubble generating cycle according to the driving of the pump 51, as well as the driving of the washing motor 15 toward a normal direction and a reverse direction (216).

[0130] Then, the control unit 72 proceeds to the operation 112, and determines whether the counted period of the proceeding time of the bubble generating cycle is exceeded with respect to the fifth period of time, which is approximately 1 minute to 2 minutes. As a result of the determination, if the fifth period of time, which is approximately 1 minute to 2 minutes is not expired, the con-

trol unit 72 continues with the proceeding of the bubble generating cycle until the fifth period of time is expired.

[0131] When the fifth period of time is expired, the control unit 72 determines that a large quantity of bubbles is generated inside the drum 12, and finishes the bubble generating cycle.

[0132] In an aspect of an embodiment, the maintaining of the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM is described as an example, but embodiments are not limited hereto, and by maintaining the RPM of the motor of the bubble generating cycle at any RPM between the washing RPM, which is at the rate of about 40 RPM to 50 RPM, and the spin-drying RPM, which is approximately above 700 RPM, the objective and the effect that are same as one or more embodiments may be able to be attained.

[0133] In addition, in an aspect of an embodiment, the maintaining of the RPM of the motor and the driving factor each at the same rate regardless of the number of the times by which the drum 12 is alternately rotated forward and backward, when the drum 12 is alternately rotated forward and backward for the fifth period of time by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM, is described as an example, but one or more embodiments are not limited hereto, and even when the ON-time or the OFF-time of the driving factor of the motor is changed according to the number of the times by which the drum 12 is alternately rotated forward and backward, the objective and the effect that are same as one or more embodiments may be able to be attained.

[0134] For example, by using a method to strongly perform the alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first alternate rotation of the drum 12 forward and backward, and to strongly perform the alternate rotation on the drum 12 by driving at the driving factor of about 12 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second alternate rotation of the drum 12 forward and backward, a large quantity of bubbles is generated by changing the ON-time of the driving factor of the motor as the alternate rotation of the drum 12 is proceeded forward and backward.

[0135] In addition, by using a method to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first alternate rotation of the drum 12 forward and backward, and to strongly perform an alternate rotation on the drum

12 by driving at the driving factor of about 14 seconds of the motor-ON/about 4 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second alternate rotation of the drum 12, a large quantity of bubbles is generated by changing the OFF-time of the driving factor of the motor as the alternate rotation of the drum 12 is proceeded forward and backward.

[0136] Other than the above, by using a method to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first alternate rotation of the drum 12 forward and backward, and to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 12 seconds of the motor-ON/about 4 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second alternate rotation of the drum 12 forward and backward, a large quantity of bubbles is generated by changing the ON-time and the OFF-time of the driving factor of the motor as the alternate rotation of the drum 12 is proceeded forward and backward.

[0137] In an aspect of an embodiment, the maintaining of the RPM of the motor and the driving factor each at the same rate regardless of the number of the proceedings of the bubble generating cycle, when the bubble generating cycle is proceeded at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM, is described as an example, but one or more embodiments are not limited hereto, and even when the ON-time or the OFF-time of the driving factor of the motor is changed according to the number of the proceedings of the bubble generating cycle, the objective and the effect that are same as one or more embodiments may be able to be attained.

[0138] For example, by using a method to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first bubble generating cycle, and to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 12 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second bubble generating cycle, a large quantity of bubbles is generated by changing the ON-time of the driving factor of the motor according to the number of the proceedings of the bubble generating cycle.

[0139] In addition, by using a method to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first bubble generating cycle, and to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 4 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second bubble generating cycle, a large quantity of bubbles is generated by changing the OFF-time of the driving factor of the motor according to the number of the proceedings of the bubble generating cycle.

[0140] Other than the above, by using a method to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a first bubble generating cycle, and to strongly perform an alternate rotation on the drum 12 by driving at the driving factor of about 12 seconds of the motor-ON/about 4 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM at the time of a second bubble generating cycle, a large quantity of bubbles is generated by changing the ON-time and the OFF-time of the driving factor of the motor according to the number of the proceedings of the bubble generating cycle.

[0141] In an aspect of an embodiment, the maintaining of the RPM of the motor and the driving factor each at the same rate regardless of the number of the proceedings of the bubble generating cycle, when the bubble generating cycle is proceeded at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM, is described as an example, but the one or more embodiments are not limited hereto, and even when the RPM of the motor is changed according to the number of the proceedings of the bubble generating cycle, the objective and the effect that are same as one or more embodiments may be able to be attained.

[0142] In an aspect of an embodiment, the maintaining of the RPM of the motor and the driving factor each at the same rate regardless of the number of the alternate rotations of the drum 12 forward and backward, when the drum 12 is alternately rotated forward and backward for the fifth period of time by driving at the driving factor of about 14 seconds of the motor-ON/about 6 seconds of the motor-OFF while maintaining the RPM of the motor of the bubble generating cycle at the rate of about 80 RPM to 89 RPM, is described as an example, but one or more embodiments are not limited hereto, and even when the RPM of the motor is changed according to the

number of the alternate rotation of the drum 12 forward and backward, the objective and the effect that are same as one or more embodiments may be able to be attained.

[0143] Although a few embodiments have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

Claims

1. A method of controlling a washing machine provided with a tub, a drum rotatably installed inside the tub, and a pump configured to circulate water in the tub, the method comprising:

(a) rotating the drum in one direction for a first period of time after supplying washing water to the tub;

(b) stopping the drum for a second period of time after rotating the drum in the one direction;

(c) rotating the drum in an opposite direction opposite to the one direction for a third period of time after the second period of time is expired; and

(d) stopping the drum for a fourth period of time after rotating the drum in the opposite direction,

wherein during a forward/backward alternate operation of the drum comprising (a) to (d), a bubble generating cycle to generate bubbles through rotation of the drum and friction of the circulated water is performed by driving the pump.

2. The method of claim 1, wherein:

the bubble generating cycle is performed after a water supplying cycle in which water and detergent are supplied to the tub to perform washing.

3. The method of claim 1 or 2, wherein the washing machine further comprises a washing motor configured to rotate the drum, wherein during the rotating of the drum in the one direction, the washing motor is driven in a normal direction for the first period of time while maintaining a predetermined (revolutions per minute) RPM.

4. The method of claim 3, wherein:

during the rotating of the drum in the opposite direction, the washing motor is driven in a reverse direction for the third period of time while maintaining a predetermined RPM.

5. The method of claim 4, wherein:

during the forward/backward alternate operation of the drum, the predetermined RPM is 80 RPM or above.

6. The method of claim 4, further comprising:

during the forward/backward alternate operation of the drum, changing the RPM of the motor.

7. The method of any one of the preceding claims, further comprising:

during the forward/backward alternate operation of the drum, changing a driving time of the motor or a stopping time of the motor.

8. The method of any one of the preceding claims, wherein:

the forward/backward alternate operation of the drum comprising from (a) to (d) is performed for a predetermined period of time.

9. The method of any one of the preceding claims, further comprising:

counting the number of proceedings of the bubble generating cycle, wherein if the counted number of proceedings of the bubble generating cycle reaches a predetermined reference number of proceedings, the bubble generating cycle is finished.

10. A washing machine, comprising:

a tub to accommodate water;
a drum rotatably installed inside the tub;
a washing motor configured to rotate the drum;
a flow path switching apparatus configured to switch a flow path of water such that water in the tub is drained or circulated; and
a control unit, after water and detergent are supplied to the tub, configured to perform a bubble generating cycle in which water in the tub is circulated by controlling the flow path switching apparatus and the drum is alternately rotated forward and backward by controlling the washing motor.

11. The washing machine of claim 10, wherein:

the control unit, during the forward and backward alternate rotation of the drum, is configured to drive the washing motor at a predetermined RPM and a predetermined driving factor.

12. The washing machine of claim 10, wherein:

the flow path switching apparatus comprises a pump configured to pump the water in the tub, and a flow path switching valve configured to switch a flow path such that water being discharged from the tub is drained to an outside or the water is circulated to the tub. 5

13. A method of controlling a washing machine provided with a tub, a drum rotatably installed inside the tub, a washing motor to rotate the drum, and a pump configured to circulate water in the tub, the method comprising: 10

supplying water and detergent to the tub; performing a bubble generating cycle, in which water being discharged from the tub is circulated to the tub by driving the pump at the same time as alternately rotating the drum forward and backward by driving the washing motor at a predetermined RPM and a predetermined driving factor; and 15 20

performing a washing cycle, in which the drum alternately rotates forward and backward, by driving the washing motor at a target RPM and a target driving factor, 25

wherein a proceeding time of the bubble generating cycle and a proceeding time of the washing cycle are counted, and if the counted proceeding time of the bubble generating cycle and the counted proceeding time of the washing cycle 30

pass over a predetermined period of time, the bubble generating cycle and the washing cycle are alternately performed with each other.

14. The method of claim 13, wherein the bubble generating cycle comprises: 35

rotating the drum toward one direction for a first period of time; an operation of stopping the drum for a second period of time after rotating the drum toward the one direction; 40

rotating the drum toward an opposite direction for the first period of time after the second period of time is expired; and

stopping the drum for the second period of time after rotating the drum toward the opposite direction. 45

15. The method of claim 14, wherein: 50

the bubble generating cycle comprises generating bubbles through rotation of the drum and friction of the circulated water by driving the pump during the forward and backward alternate rotation of the drum. 55

FIG. 1

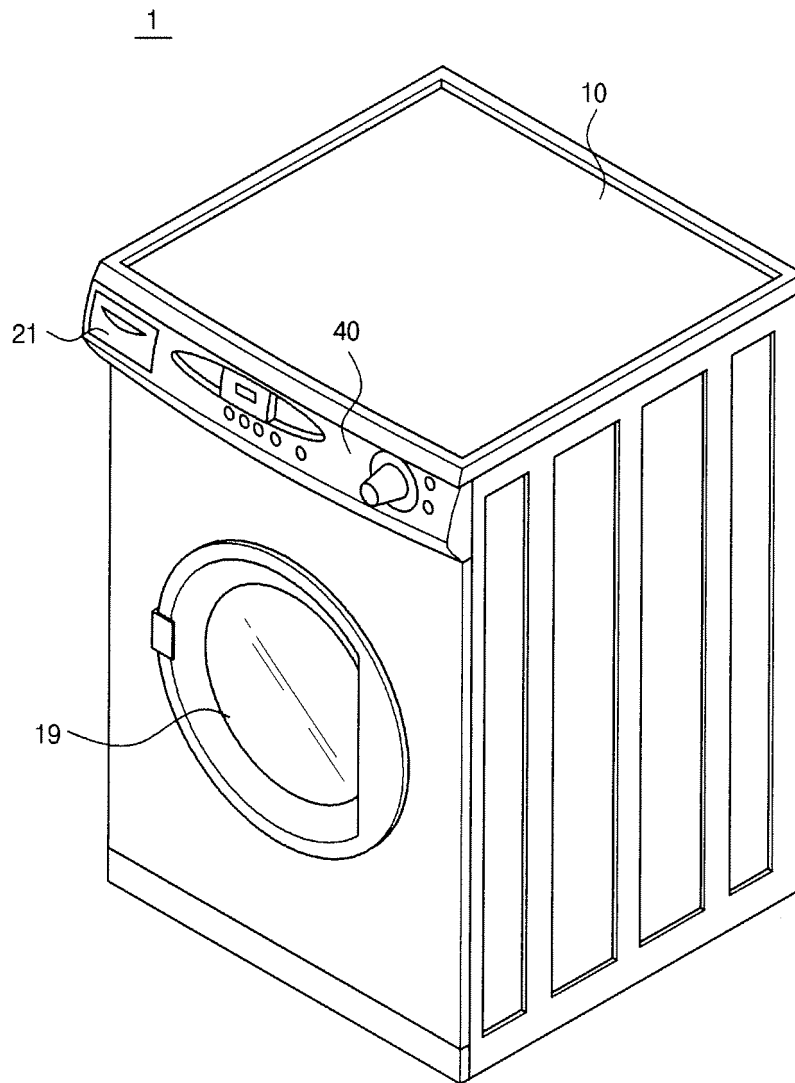


FIG.2

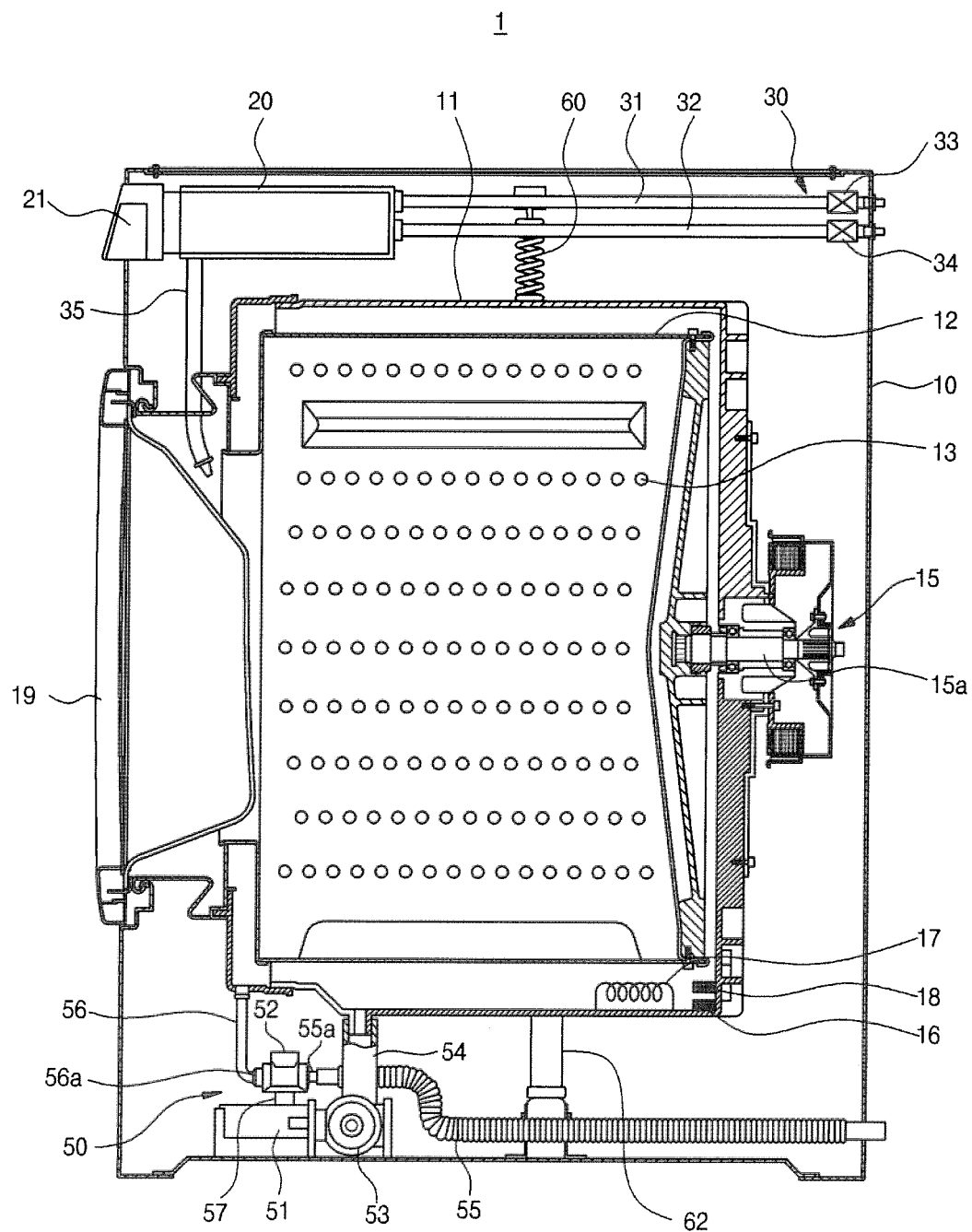


FIG.3

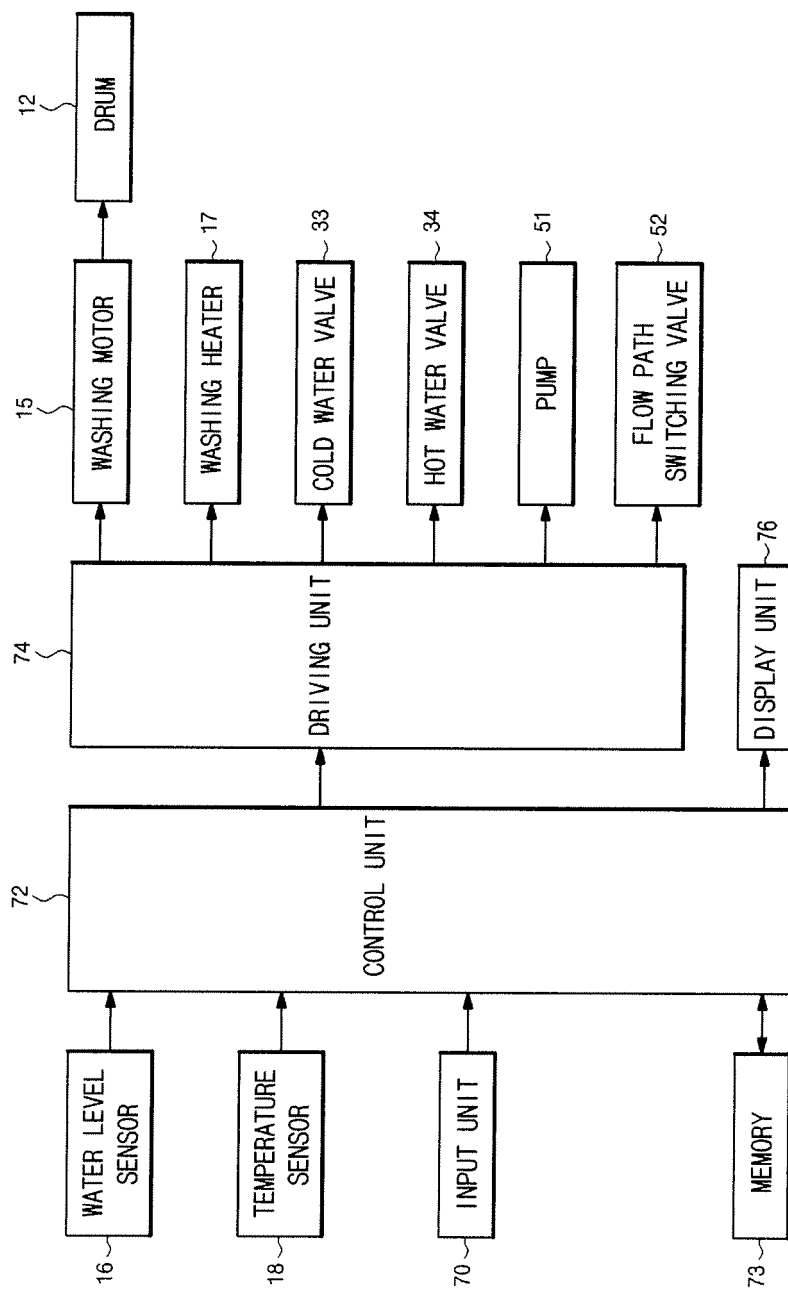


FIG.4a

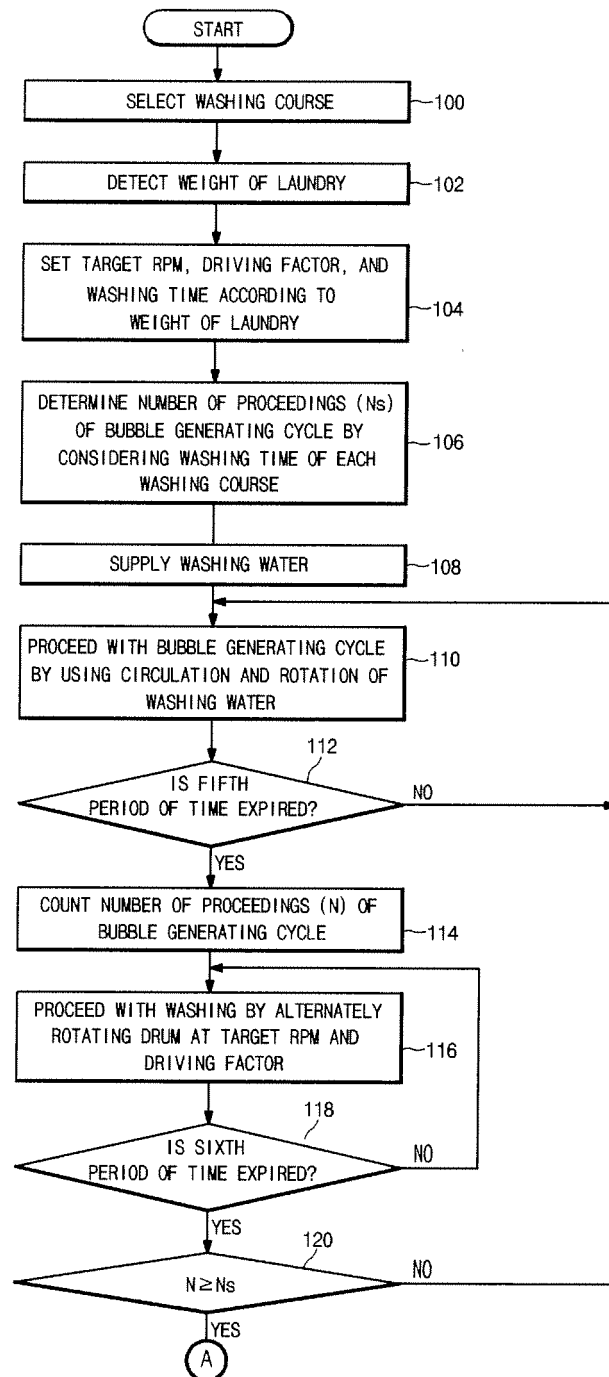


FIG.4b

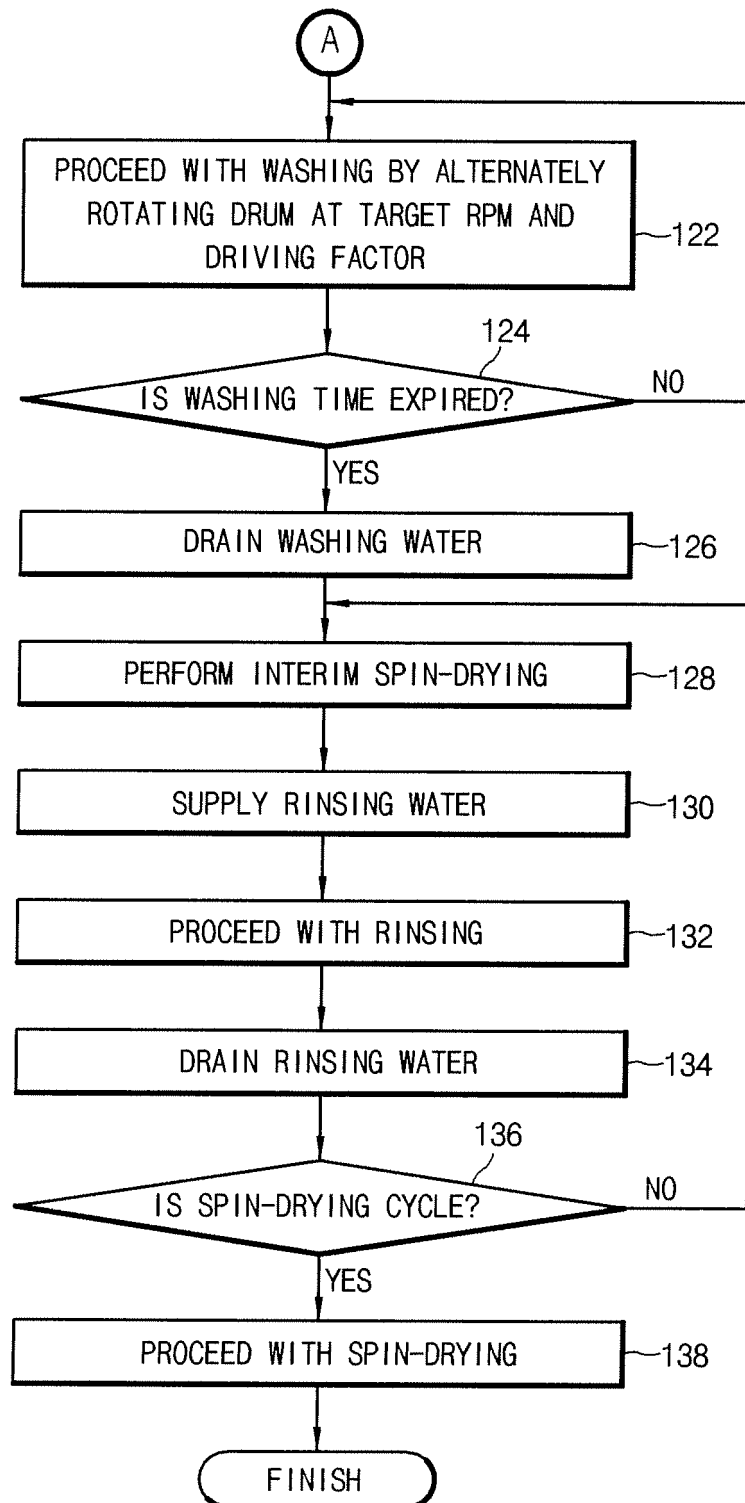


FIG.5

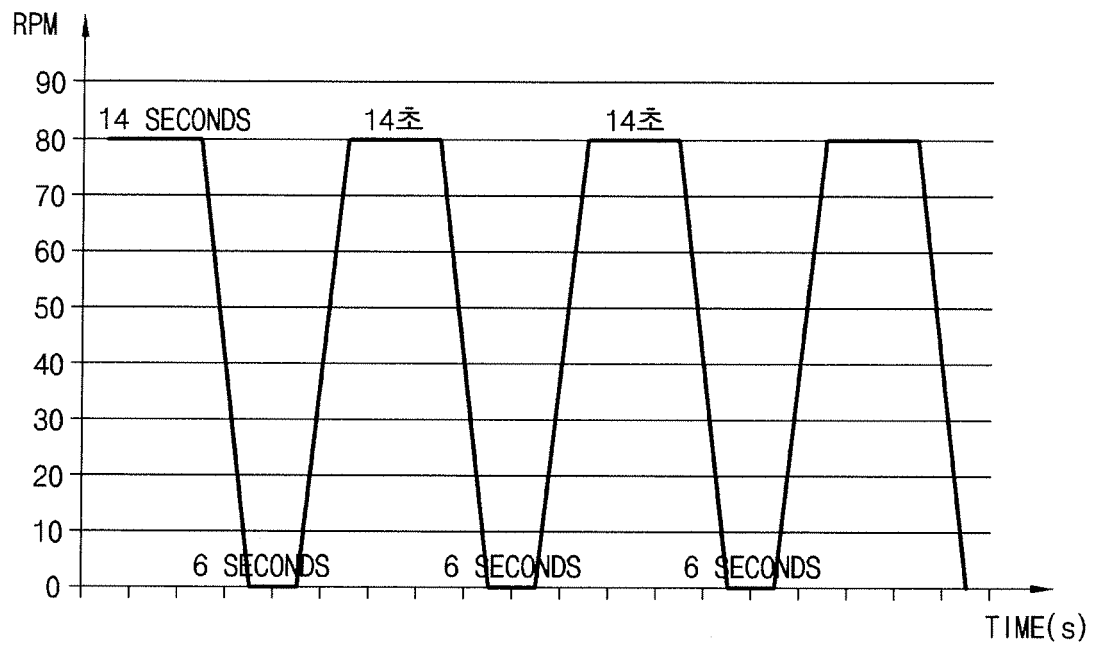
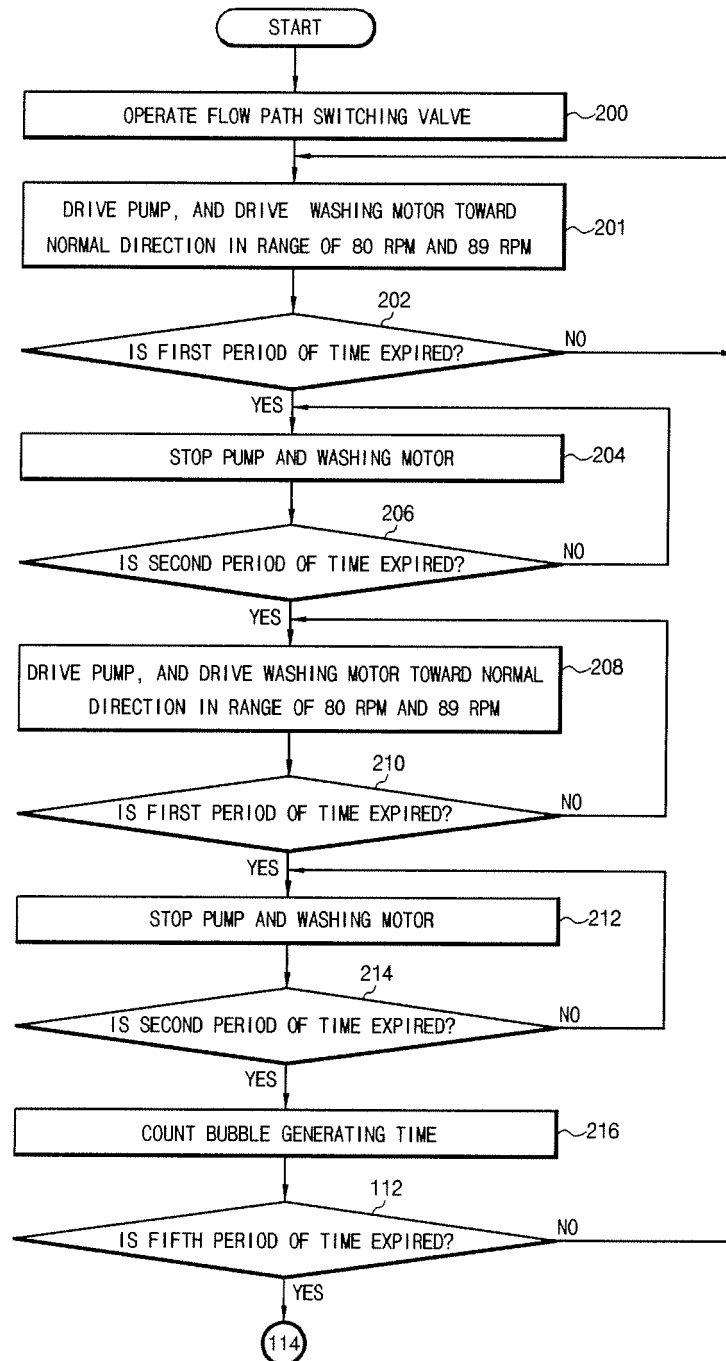


FIG.6





EUROPEAN SEARCH REPORT

Application Number
EP 13 16 6422

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 August 2013	Examiner Clivio, Eugenio
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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