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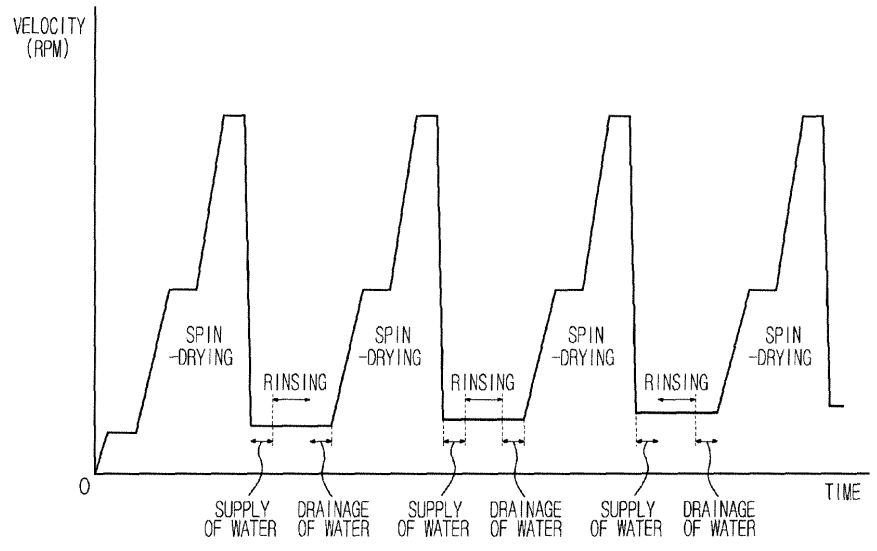
(54) Washing machine and rinsing control method thereof

(57) Disclosed herein are a washing machine that performs a rinsing operation while rotating a drum (12) at a predetermined RPM without stopping the drum after spin-drying and a rinsing control method thereof. The washing machine includes a drum to receive laundry and a motor (15) to rotate the drum. The rinsing control method includes rotating the drum to perform spin-drying and decelerating the drum to a predetermined velocity to perform rinsing. Consequently, it is possible to improve rinsing efficiency even using a small amount of water. Also, it is possible to uniformly distribute the laundry in the drum without eccentricity, although a laundry untangling process for spin-drying is performed only once during the rinsing, which is performed several times, thereby reducing the total rinsing time.

FIG. 6



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application Nos. 2008-0006797 and No. 2008-0006798, filed on January 22, 2008 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a washing machine and a rinsing control method thereof, and, more particularly, to a washing machine that performs a rinsing operation while rotating a drum at a predetermined RPM and a rinsing control method thereof.

2. Description of the Related Art

[0003] Generally, a washing machine (normally, a drum type washing machine) is a machine, including a water tub to receive water (wash water or rinse water), a cylindrical drum rotatably mounted in the water tub to receive laundry, and a motor to generate a drive force necessary to rotate the drum, which lifts the laundry along the inner wall of the drum and drops the laundry, during the rotation of the drum, to wash the laundry.

[0004] The washing machine performs washing through a series of operations, e.g., a washing operation to separate contaminants from the laundry with water containing detergent (specifically, wash water), a rinsing operation to rinse out bubbles or residual detergent from the laundry with water containing no detergent (specifically, rinse water), and a spin-drying operation to spin-dry the laundry. In the rinsing operation, the drum is stopped, and water draining and intermediate spin-drying processes are performed, after the completion of the washing operation, and then the laundry is brought into contact with water and, at the same time, is lifted and dropped, while alternatively rotating the drum at a velocity (approximately 30 to 50 RPM) to rinse the laundry using a fall of water during the supply of water, thereby rinsing the laundry. In other words, the rinsing operation is performed through a series of processes, e.g., the stoppage of the drum, the drainage, the spin drying, and the rinsing (the alternating rotation of the drum at a velocity of 30 to 50 RPM).

[0005] The rinsing operation is achieved by repeating the above-mentioned series of processes several times. To spin-dry the laundry after the drainage, a process to uniformly distribute the laundry W in the drum 12 as shown in FIG. 1 is needed. This is because the drum 12 is rotated at a predetermined RPM (approximately 1000 RPM or more) to spin-dry the laundry at high velocity such that the spin-drying process, performed during the rinsing operation, drains water contained in the laundry W outside by a centrifugal force. If the drum 12 is rotated at the predetermined RPM (approximately 1000 RPM or more) in an unbalanced state in which the laundry W is nonuniformly distributed along the inner wall of the drum 12 as shown in FIG. 2, an eccentric force is applied to a rotary shaft of the drum 12 with the result that great vibration is generated. Also, when the spin-drying process is performed in the unbalanced state, spin-drying time may increase and spin-drying errors may occur due to the unbalance. Furthermore, when the laundry W is picked out after the completion of washing, a large amount of force is necessary to untangle the tangled laundry, which causes dissatisfaction of housewives, main users of the washing machine.

[0006] In order to solve the problem, according to the related art, a laundry untangling process is performed to untangle the tangled laundry W through the alternating rotation of the drum 12 before the drum 12 is rotated at the predetermined RPM (approximately 1000 RPM or more) at the time of every spin-drying process in the rinsing operation, which is repeated several times, and the unbalance value is measured. When the measured unbalance value is within an allowable value, the drum 12 is rotated at the predetermined RPM (approximately 1000 RPM or more) to perform the spin-drying process to drain water contained in the laundry W outside by a centrifugal force. On the other hand, when the measured unbalance value exceeds the allowable value, the laundry untangling process is reperformed to untangle the tangled laundry W through the alternating rotation of the drum 12.

[0007] In the washing machine above, however, the laundry untangling process is performed before the drum 12 is rotated at the predetermined RPM (approximately 1000 RPM or more) at the time of every spin-drying process in the rinsing operation, which is repeated several times, and the unbalance value is measured. As a result, the total rinsing time increases. Also, a velocity (alternating rotation of 30 to 50 RPM) of water passing through the laundry W is low in the rinsing process using the fall of water, with the result that the detergent contained in the laundry W does not well dissolve, or the dissolved detergent does not flow out of the laundry W. Consequently, the residual detergent is left in the laundry, whereby the rinsing efficiency is lowered. To raise the rinsing efficiency, it is required to supply a large amount of water sufficient to fully wet the laundry, which increases the water consumption.

SUMMARY OF THE INVENTION

[0008] Therefore, it is an aspect of the invention to provide a washing machine and a rinsing control method thereof that are capable of performing a rinsing operation, while rotating a drum in a predetermined RPM, thereby improving rinsing efficiency.

[0009] It is another aspect of the invention to provide

a washing machine and a rinsing control method thereof that are capable of performing a rinsing operation at a predetermined RPM to maintain a balanced state without stopping a drum after spin-drying, thereby omitting a laundry untangling process performed at the time of every spin-drying, and therefore, reducing the total rinsing time.

[0010] It is a further aspect of the invention to provide a washing machine and a rinsing control method thereof that are capable of performing further rinsing within reduced rinsing time, thereby achieving much more rinsing within the total rinsing time, and therefore, improving rinsing efficiency.

[0011] In accordance with one aspect, the present invention provides a rinsing control method of a washing machine including a drum to receive laundry and a motor to rotate the drum, the rinsing control method including rotating the drum to perform spin-drying and decelerating the drum to a predetermined velocity to perform rinsing.

[0012] Preferably, the rinsing control method further includes performing a laundry untangling process to uniformly distribute the laundry in the drum to perform the spin-drying, and the laundry untangling process is performed only once during the rinsing, which is performed several times.

[0013] Preferably, the predetermined velocity is a balance maintenance velocity to uniformly distribute the laundry in the drum though the deceleration of the drum after the spin-drying.

[0014] Preferably, the balance maintenance velocity is a velocity to cling the laundry to the inner wall of the drum while maintaining balance without eccentricity.

[0015] Preferably, the balance maintenance velocity is approximately 100 RPM or more.

[0016] Preferably, the performing rinsing includes performing the supply of water, rinsing, and drainage of water for rinsing while rotating the drum at the balance maintenance velocity.

[0017] Preferably, the performing rinsing includes rotating the drum to perform spin-drying after the drainage and continuously performing the supply of water, rinsing, and drainage of water for the next rinsing while rotating the drum at the balance maintenance velocity.

[0018] Preferably, the balance maintenance velocity is a velocity in which the water passes through the laundry by a centrifugal force to dissolve detergent contained in the laundry.

[0019] Preferably, the balance maintenance velocity is a velocity in which the water passes through the laundry by a centrifugal force to immediately discharge detergent remaining in the laundry.

[0020] In accordance with another aspect, the present invention provides a rinsing control method of a washing machine including a drum to receive laundry and a motor to rotate the drum, the rinsing control method including rotating the drum to perform spin-drying and decelerating the drum to a predetermined velocity to supply water.

[0021] In accordance with a further aspect, the present invention provides a washing machine including a drum to receive laundry, a motor to rotate the drum, and a control unit to control the velocity of the drum such that the drum is rotated to perform spin-drying and is decelerated to a predetermined velocity to perform rinsing.

[0022] Preferably, the control unit controls a laundry untangling process to be performed to uniformly distribute the laundry in the drum to perform the spin-drying, the laundry untangling process being performed only once during the rinsing, which is performed several times.

[0023] Preferably, the washing machine further includes a water supply unit, and the control unit controls the motor to rotate the drum at the balance maintenance velocity and the water supply unit to supply water, during the rotation of the drum, to perform the rinsing.

[0024] Preferably, the washing machine further includes a drainage unit, and the control unit controls the drainage unit to drain the water during the rotation of the drum.

[0025] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings, of which:

FIG. 1 is a view illustrating the balanced state of laundry in a drum of a washing machine;

FIG. 2 is a view illustrating the unbalanced state of laundry in a drum of a washing machine;

FIG. 3 is a sectional view illustrating the structure of a washing machine according to an embodiment of the present invention;

FIG. 4 is a rinsing control block diagram of the washing machine according to the embodiment of the present invention;

FIGS. 5A and 5B are flow charts illustrating a rinsing control method of the washing machine according to the embodiment of the present invention; and

FIG. 6 is a graph illustrating a rinsing operation of the washing machine according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Reference will now be made in detail to the embodiment of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiment is described below to explain the present invention by referring to the figures.

[0028] FIG. 3 is a sectional view illustrating the structure of a washing machine according to an embodiment of the present invention.

[0029] Referring to FIG. 3, the washing machine includes a water tub 11 mounted in a machine body 10 to receive water (wash water or rinse water) and a cylindrical drum 12 rotatably mounted in the water tub 11. The drum 12 has a plurality of spin-drying holes.

[0030] Outside a rear 11 c of the water tub 11 is mounted a motor 15 to rotate a rotary shaft 13 connected to the drum 12 to perform washing, rinsing, and spin-drying operations. The motor 15 includes a stator 15a fixed to the rear 11 c of the water tub 11, a rotor 15b rotatably mounted around the stator 15a, and a rotary plate 15c connected between the rotor 15b and the rotary shaft 13.

[0031] At the inside bottom of the water tub 11 is mounted a wash heater 16 to heat water (specifically, wash water) supplied into the water tub 11. To this end, a heater receiving part 17 is formed at the bottom of the water tub 11 such that the heater receiving part 17 protrudes downward to receive the wash heater 16 and, at the same time, collect a predetermined amount of water. This is because the wash heater 16 can be immersed in the water collected in the heater receiving part 17, and the drum can be rotated without the interference with the wash heater 16 since the wash heater 16 is received in the heater receiving part 17.

[0032] Also, the machine body 10 is provided at the front thereof with an inlet 10b which corresponds to an inlet 12b of the drum 12 and an inlet 11b of the water tub 11 such that laundry W is put in or taken out from the drum 12 through the inlet 10b. At the machine body 10 is also mounted a door 18 to open and close the inlet 10b. Between the inlet 10b of the machine body 10 and the inlet 11 b of the water tub 11 is mounted a cylindrical diaphragm 11 d to prevent the leakage of wash water.

[0033] Above the water tub 11 are mounted a detergent supply unit 19 to supply detergent and a water supply unit 20 to supply water (wash water or rinse water).

[0034] The detergent supply unit 19 has several partitioned spaces. The detergent supply unit 19 is mounted at the front side of the machine body 10 such that a user easily puts detergent and rinse in the respective partitioned spaces.

[0035] The water supply unit 20 includes a first water supply pipe 22 connected between an external water supply pipe 21, through which water (wash water or rinse water) is supplied into the water tub 11, and the detergent supply unit 19, a second water supply pipe 23 connected between the detergent supply unit 19 and the water tub 11, and a water supply valve 24 mounted on the first water supply pipe 22 to control the supply of water. Consequently, water is supplied into the water tub 11 via the detergent supply unit 19 such that detergent is supplied into the water tub 11 together with the water.

[0036] The washing machine further includes a drainage unit 30 to drain the water in the water tub 11 and a circulation unit 40 to supply the water in the water tub 11 into the drum 12. The drainage unit 30 includes a first drainage pipe 31 connected to a drainage port 17a formed at the heater receiving part 17 in the bottom of the water tub 11 to guide the water in the water tub 11 outside, a drainage pump 32 mounted on the first drainage pipe 31, and a second drainage pipe 33 connected to the outlet of the drainage pump 32. The circulation unit 40 includes a flow channel switching valve 41 mounted on the second drainage pipe 33, a circulation pipe 42 extending from the flow channel switching valve 41 to the inlet 12b of the drum 12, and a spray nozzle 43 mounted at the outlet of the circulation pipe 42. The flow channel switching valve 41 serves to switch flow channels such that the water from the outlet of the drainage pump 32 is drained outside or flows to the circulation pipe 42. The flow channel switching valve 41 may be an electric three-way valve. The spray nozzle 43 is mounted adjacent to the inlet 12b of the drum 12 such that the spray nozzle 43 sprays water into the drum 12 through the inlet 12b of the drum 12.

[0037] Consequently, when the drainage pump 32 is operated while the flow channel switching valve 41 is operated such that water flows to the circulation pipe 42, water in the bottom of the water tub 11 is supplied into the rotary drum 12 through the first drainage pipe 31 and the circulation pipe 42. Also, when the drainage pump 32 is operated while the flow channel switching valve 41 is operated such that water flows to the second drainage pipe 33, the water in the water tub 11 is drained outside.

[0038] FIG. 4 is a rinsing control block diagram of the washing machine according to the embodiment of the present invention. The washing machine further includes an input unit 50, a water level detection unit 52, a temperature detection unit 54, a control unit 56, a drive unit 58, a velocity detection unit 60, and a current detection unit 62.

[0039] The input unit 50 inputs operation information, such as a washing course, a washing temperature, spin-drying RPM, and the addition of rinsing, which are selected by a user, to the control unit 56. The water level detection unit 52 detects the water level of water supplied into the water tub 11, and the temperature detection unit 54 detects the temperature of water supplied into the water tub 11.

[0040] The control unit 56 is a microprocessor to control the overall operation of the washing machine, such as washing, rinsing, and spin-drying, based on the operation information inputted from the input unit 50. The control unit 56 stores the amount of rinse water, motor RPM and operation rate (motor on-off time), and rinsing time set according to the amount of load (the weight of laundry) in the selected washing course. The control unit 56 controls the rinsing operation, including the supply of water, rinsing, and drainage of water, to be performed, while continuously rotating the drum 12 at a velocity (100 to 150 RPM) to maintain a balanced state without stopping the motor 12 after spin-drying, such that the water passes through the laundry W at high velocity and is drained.

[0041] Also, the control unit 56 controls intermediate spin-drying (initial spin-drying) to be performed after the drainage of wash water (detergent and water) to perform rinsing after the washing. At this time, as shown in FIG. 1, a laundry untangling process is performed to uniformly distribute the laundry W in the drum 12 such that the laundry W is maintained in a balanced state, and then the unbalance value is measured, which is necessary to smoothly spin-dry the laundry W. When the measured unbalance value is within an allowable value, the control unit 45 controls the drum 12 to be rotated at a predetermined RPM (approximately 800 to 1000 RPM) such that spin-drying is performed. After the completion of the spin-drying, the control unit 56 lowers the velocity of the drum 12 to a velocity to maintain the balanced state, e.g., approximately 100 to 150 RPM, without stopping the drum 12, and control the rinsing operation, including the supply of water, rinsing, and drainage of water, to be performed while continuously rotating the drum 12. At this time, the balanced state is continuously maintained, and therefore, the control unit 56 controls spin-drying to be immediately performed without the execution of a laundry untangling process.

[0042] In the rinsing operation, which is repeatedly performed, the laundry W is maintained in the balanced state in which the laundry W is uniformly distributed along the inner wall of the drum 12. Consequently, control unit 56 omits a laundry untangling process and an unbalanced state measuring process at the time of every spin-drying. As a result, the total rinsing time is reduced. Also, when the control unit 56 controls further rinsing to be performed within the reduced rinsing time, it is possible to perform much more rinsing within rinsing time necessary for the related art washing machine, thereby improving rinsing efficiency.

[0043] Also, the control unit 56 controls the operations of the motor 15, the water supply unit 20 and the drainage unit 30 such that a rinsing operation, including the supply of water, rinsing, and drainage of water, is performed, while the drum 12 is rotated at a velocity (approximately 100 to 150 RPM) to maintain the balanced state in one direction, with the result that water (specifically, rinse water) passes through the laundry W at high velocity by a centrifugal force to dissolve the detergent contained in the laundry W, and the water having passed through the laundry W is immediately drained to fully remove the residual detergent from the laundry W.

[0044] The drive unit 58 drives the motor 15, the wash heater 16, the water supply valve 24, the drainage pump 32, and the flow channel switching valve 41 according to a drive control signal of the control unit 56. The velocity detection unit 60 inputs a motor velocity signal corresponding to the rotation velocity of the drum 12 to the control unit 56 to detect whether the velocity of the drum 12 has lowered due to the velocity reduction of the motor 15. The current detection unit 62 inputs a motor current signal corresponding to the rotation velocity of the drum 12 to the control unit 56 to measure an unbalanced state.

[0045] Hereinafter, the operation of the washing machine with the above-stated construction and a rinsing control method thereof will be described.

[0046] FIGS. 5A and 5B are flow charts illustrating a rinsing control method of the washing machine according to the embodiment of the present invention.

[0047] A washing operation to perform washing with water and detergent is identical to the operation of a general washing machine, and therefore, a detailed description thereof will not be given.

[0048] When a user puts laundry W in the drum 12 and selects operation information, such as a washing course, spin-drying RPM, and the addition of rinsing, based on the kinds of the laundry W, the operation information selected by the user is inputted to the control unit 56 through the input unit 54.

[0049] Subsequently, the control unit 56 determines whether the power is on so as to perform a rinsing operation based on the operation information inputted from the input unit 54 (100).

[0050] When the power is on, the control unit 56 detects the amount of load (the weight of laundry) put in the drum 12, and sets the minimum amount of water, motor operation rate (motor on-off time), and washing and rinsing time for washing and rinsing based on the detected amount of load.

[0051] Subsequently, the control unit 56 controls a washing operation to be performed such that water (specifically, wash water) necessary to wash the laundry W is supplied into the water tub 11 together with detergent to supply water having an amount set based on the amount of load, the washing is performed by a frictional force with the drum 12 and a falling force of the laundry W while the wash water (water and detergent) is well absorbed into the laundry, by the rotation of the drum 12 and the operation of the circulation unit 40 (102).

[0052] During the washing process, the control unit 56 determines whether washing time set based on the amount of load has elapsed (104). When the washing time has not elapsed, the procedure returns to Operation 102 to continue the washing operation to perform washing with wash water.

[0053] When it is determined at Operation 104 that the washing time has elapsed, the control unit 56 drains the wash water through the drainage unit 30 (106), and controls a laundry untangling process to be performed in which the motor 15 is controlled through the drive unit 58 to smoothly perform spin-drying, such that the drum 15 is alternately rotated, thereby untangling the tangled laundry W (108).

[0054] The laundry untangling process is a process in which an operation to stop the drum for a predetermined time (approximately 5 seconds) after the motor 26 is rotated in the forward direction at a predetermined RPM (e.g. approximately 40 to 45 RPM) for a predetermined time (e.g. approximately 5 seconds) and an operation to stop the drum for a predetermined time (e.g. approximately 5 seconds) after the motor 26 is rotated in the

reverse direction at a predetermined RPM (e.g. approximately 40 to 45 RPM) for a predetermined time (e.g. approximately 5 seconds) are repeatedly performed in an alternating fashion. In the laundry untangling process, therefore, the drum 12 is alternately rotated to untangle the laundry W, with the result that the laundry W is uniformly distributed in the drum 12 to maintain the balance state, as shown in FIG. 1.

[0055] After the completion of the laundry untangling process, the control unit 56 measures an unbalance value through the current detection unit 62 from a predetermined unbalance measurement velocity before the rotation of the drum 12 at a predetermined RPM (e.g. approximately 800 to 1000 RPM) (110), and determines whether the measured unbalance value is equal to or less than a predetermined allowable value (112).

[0056] A method of measuring the unbalance value by the control unit 56 is to estimate the size of unbalance in the drum 12 utilizing weight information of the laundry W and a control variable, such as a velocity ripple or a current ripple. This method is disclosed in Korean Patent Application No. 2005-105681, which has been filed in the name of the applicant of the present application. Also, a generally known technology may be applied, and therefore, a detailed description thereof will not be given.

[0057] When it is determined at Operation 112 that the unbalance value exceeds the allowable value, the control unit 56 determines that the state of the laundry is the unbalanced state and controls the operation of the motor 15 through the drive unit 58 such that the drum 12 is stopped (113). After that, the procedure returns to Operation 108 to reperform the laundry untangling process to maintain the balanced state.

[0058] When it is determined at Operation 112 that the unbalance value is equal to or less than the allowable value, the control unit 56 determines that the state of the laundry is the balanced state and performs a spin-drying process in which the operation of the motor 15 is controlled through the drive unit 58, such that the drum 12 is rotated at the predetermined RPM (approximately 800 to 1000 RPM), to drain the water contained in the laundry W outside by a centrifugal force (114).

[0059] Subsequently, the control unit 56 determines whether the spin-drying has been completed (116). When the spin-drying has not been completed, the procedure returns to Operation 114 to continue the spin-drying. On the other hand, when the spin-drying has been completed, the control unit 56 reduces the velocity of the motor 15 through the drive unit 58 to reduce the rotation velocity of the drum 12 to a velocity (approximately 100 to 150 RPM) to maintain the balanced state without stopping the drum 12 (118).

[0060] At this time, the velocity detection unit 60 detects a motor velocity signal corresponding to the rotation velocity of the drum 12 and inputs the detected motor velocity signal to the control unit 56.

[0061] Subsequently, the control unit 56 determines whether the rotation velocity of the drum 12, detected by the velocity detection unit 60, is a predetermined balance maintenance velocity (a velocity in which the laundry is maintained in the balanced state while remains clung to the inner wall of the drum; approximately 100 to 150 RPM) (120). When the rotation velocity of the drum 12 is not the balance maintenance velocity, the control unit reduces the velocity of the motor 15 and thus the rotation velocity of the drum 12.

[0062] When it is determined at Operation 120 that the rotation velocity of the drum 12 is the balance maintenance velocity, the control unit 56 performs rinsing operation,.

[0063] At this time, the control unit 56 controls the drum 12 to be rotated in one direction while maintaining the rotation velocity of the drum 12 at the balance maintenance velocity (approximately 100 to 150 RPM), such that the laundry W remains clung to the inner wall of the drum 12, to reduce rinsing time and improve rinsing efficiency. During the rotation of the drum 12, the control unit 56 controls the water supply unit 20 to supply rinse water. As a result, the water supply valve 24 is opened, and therefore, water (rinse water) is supplied into the water tub 11 through the supply water pipes 21, 22, and 23 (122).

[0064] During the supply of rinse water for rinsing, the water level detection unit 52 detects the water level of the rinse water supplied into the water tub 11, and the control unit 56 determines whether the detected water level is a predetermined water level (124). The predetermined water level may be set at various different levels.

[0065] When the water level of the rinse water is not the predetermined water level, the control unit 56 controls water to be continuously supplied into the water tub 11 until the water level of the rinse water reaches the predetermined water level. When the water level of the rinse water is the predetermined water level, the control unit 56 controls the control valve 24 to be closed such that the supply of water is interrupted (126).

[0066] After the supply of water is interrupted, the control unit 56 controls the rinsing operation to be performed in which the drum is rotated in one direction while the rotation velocity of the drum 12 is continuously maintained at the balance maintenance velocity (e.g. approximately 100 to 150 RPM) such that the laundry W remains clung to the inner wall of the drum 12, and the rinse water is supplied into the drum 12 through the circulation unit 40, to rinse the laundry W with the rinse water supplied into the water tub 11.

[0067] Water is supplied during the rotation of the drum in one direction at the velocity (approximately 100 to 150 RPM) at which the balanced state is maintained while the laundry W remains clung to the inner wall of the drum 12. After the supply of water is completed, the drum 12 is continuously rotated in one direction to continue the rinsing, with the result that the rinse water passes through the laundry at high velocity.

[0068] The passage of the rinse water through the laundry will be described in more detail.

[0069] When laundry having mass m performs a circular movement along the circumference of the drum 12 having a radius r at uniform velocity, a centrifugal force F is represented by the following equation:

$$F = mr\omega^2 = mv^2/r$$

Where, w is angular velocity and v is circular movement velocity of the drum 12 (v= rw).

[0070] Consequently, when the drum 12 is rotated in one direction at a velocity (e.g. approximately 100 to 150 RPM) higher than the rotation velocity (approximately 30 to 50 RPM) of the drum 12 of the related art washing machine, rinse water passes through the laundry at high velocity by a centrifugal force, with the result that detergent contained in the laundry is rapidly dissolved, and therefore, rinsing efficiency is improved.

[0071] During the rinsing operation, the control unit 56 determines whether predetermined rinsing time has elapsed (130). When the rinsing time has not lapsed, the procedure returns to Operation 128 to continue the rinsing operation while maintaining the rotation velocity of the drum 12.

[0072] When it is determined at Operation 130 that the rinsing time has lapsed, the control unit 56 controls the drainage pump 32 and the flow channel switching valve 41 to drain the rinse water.

[0073] Even during the drainage of the rinse water, to improve rinsing efficiency, the control unit 56 controls the drum 12 to be rotated in one direction while the rotation velocity of the drum 12 is maintained at the balance maintenance velocity (e.g. approximately 100 to 150 RPM) such that the laundry W remains clung to the inner wall of the drum 12 (132).

[0074] When the drum 12 is rotated in one direction at the velocity (approximately 100 to 150 RPM) to maintain the balanced state while the laundry W remains clung to the inner wall of the drum 12 to drain the rinse water, the water having passed through the laundry W is immediately drained. Consequently, the amount of detergent left in the laundry W is reduced to further improve rinsing efficiency, as compared to the related art in which water is drained while the drum is stopped.

[0075] After the drainage of the rinse water, the control unit 56 raises the rotation velocity of the drum 12 according to the operation of the motor 15 such that the drum is rotated at a predetermined number of rotations (approximately 1000 RPM) to perform intermediate spin-drying (134).

[0076] That is, the present invention omits a laundry untangling process, which was performed at the time of every spin-drying to smoothly perform spin-drying after the drainage of the rinse water, and accelerates the rotation velocity of the drum 12 to the predetermined number of rotations (approximately 1000 RPM) such that the spin-drying is immediately performed.

[0077] More specifically, the laundry untangling process is performed at the time of every spin-drying to smoothly achieve spin-drying after the drainage in the related art. According to the present embodiment, however, the rinsing operation, including the supply of water, rinsing, and drainage of water, is performed while the drum is continuously rotated at a velocity (100 to 150 RPM) to maintain the balanced state without stopping the drum 12, as shown in FIG. 6, after the initial spin-drying (intermediate spin-drying after washing). Consequently, the laundry untangling process to smoothly achieve spin-drying may only be performed once (even though the present invention does not limit the laundry untangling process to be performed only once) after the initial spin-drying (intermediate spin-drying after washing). Although the laundry untangling process may be omitted at subsequent spin-drying processes, the laundry W is continuously maintained in the balanced state in which the laundry W is uniformly distributed along the inner wall of the drum 12. Consequently, the laundry untangling process and the process to measure the unbalanced state after the laundry untangling process may be omitted, and therefore, the total rinsing time is reduced.

[0078] Subsequently, the control unit 56 determines whether the rinsing operation is the final rinsing (136). When the rinsing operation is not the final rinsing, the procedure returns to Operation 114 to continuously perform the supply of water, rinsing, and drainage of water for the next rinsing while rotating the drum 12 at a velocity (100 to 150 RPM) to maintain the balanced state without stopping the drum 12. When the rinsing operation is the final rinsing, the spin-drying is performed at a predetermined final spin-drying RPM (approximately 1100 RPM or more) (138), and then the drum 12 is stopped to end the operation.

[0079] As apparent from the above description, the washing machine and the rinsing control method thereof according to the present invention have the effect of performing a rinsing operation, including the supply of water, rinsing, and drainage of water, while rotating the drum at a predetermined RPM, such that water can pass through laundry at high velocity and be drained by a centrifugal force, thereby improving rinsing efficiency.

[0080] Also, the washing machine and the rinsing control method thereof according to the present invention have the effect of performing a rinsing operation at a predetermined RPM to maintain a balanced state without stopping the drum after spin-drying, thereby omitting a laundry untangling process performed at the time of every spin-drying, and therefore, reducing the total rinsing time. Furthermore, the washing machine and the rinsing control method thereof according to the present invention have the effect of performing further rinsing within reduced rinsing time, thereby improving rinsing efficiency.

[0081] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the prin-

ciples and spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A rinsing control method of a washing machine including a drum to receive laundry and a motor to rotate the drum, the rinsing control method comprising:

   rotating the drum to perform spin-drying; and
   decelerating the drum to a predetermined velocity to perform rinsing operation.

2. The rinsing control method according to claim 1, further comprising:

   performing a laundry untangling process to uniformly distribute the laundry in the drum to perform the spin-drying, wherein
   the laundry untangling process is performed only once during the rinsing operation, which is performed several times.

3. The rinsing control method according to claim 1, wherein the predetermined velocity is a balance maintenance velocity to uniformly distribute the laundry in the drum though the deceleration of the drum after the spin-drying.

4. The rinsing control method according to claim 3, wherein the balance maintenance velocity is a velocity to cling the laundry to the inner wall of the drum while maintaining balance without eccentricity.

5. The rinsing control method according to claim 3, wherein the balance maintenance velocity is approximately 100 RPM or more.

6. The rinsing control method according to claim 3, wherein the performing rinsing operation includes performing the supply of water, rinsing, and drainage of water for rinsing operation while rotating the drum at the balance maintenance velocity.

7. The rinsing control method according to claim 6, wherein the performing rinsing operation includes
   rotating the drum to perform spin-drying after the drainage, and
   continuously performing the supply of water, rinsing, and drainage of water for the next rinsing operation while rotating the drum at the balance maintenance velocity.

8. The rinsing control method according to claim 6, wherein the balance maintenance velocity is a velocity in which the water passes through the laundry by a centrifugal force to dissolve detergent contained in the laundry.

9. The rinsing control method according to claim 6, wherein the balance maintenance velocity is a velocity in which the water passes through the laundry by a centrifugal force to immediately discharge detergent remaining in the laundry.

10. A rinsing control method of a washing machine including a drum to receive laundry and a motor to rotate the drum, the rinsing control method comprising:

    rotating the drum to perform spin-drying; and
    decelerating the drum to a predetermined velocity to supply water.

11. A washing machine comprising:

    a drum to receive laundry;
    a motor to rotate the drum; and
    a control unit to control the velocity of the drum such that the drum is rotated to perform spin-drying and is decelerated to a predetermined velocity to perform rinsing operation.

12. The washing machine according to claim 11, wherein the control unit controls a laundry untangling process to be performed to uniformly distribute the laundry in the drum to perform the spin-drying, the laundry untangling process being performed only once during the rinsing operation, which is performed several times.

13. The washing machine according to claim 11, wherein the predetermined velocity is a balance maintenance velocity to uniformly distribute the laundry in the drum though the deceleration of the drum after the spin-drying.

14. The washing machine according to claim 13, further comprising:

    a water supply unit, wherein
    the control unit controls the motor to rotate the drum at the balance maintenance velocity and the water supply unit to supply water, during the rotation of the drum, to perform the rinsing.

15. The washing machine according to claim 14, further comprising:

    a drainage unit, wherein
    the control unit controls the drainage unit to drain the water during the rotation of the drum.

FIG. 1

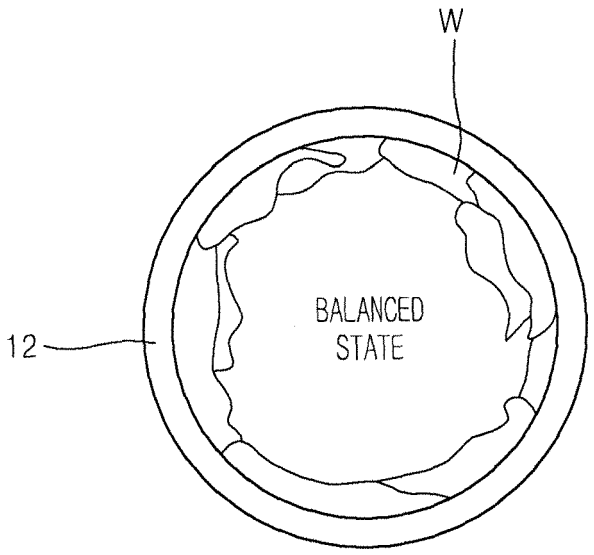


FIG. 2

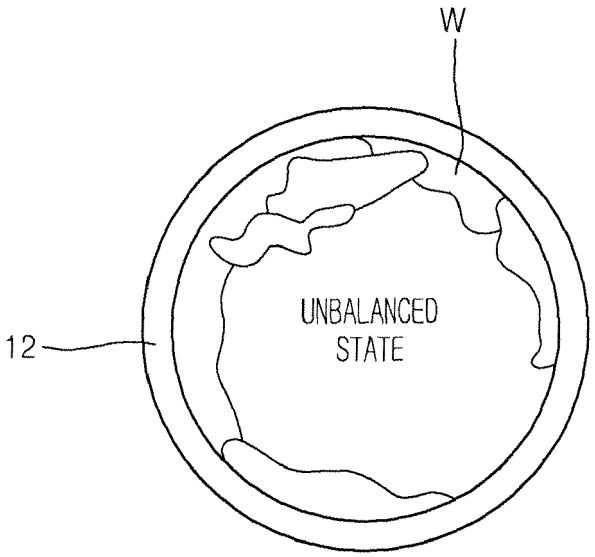


FIG. 3

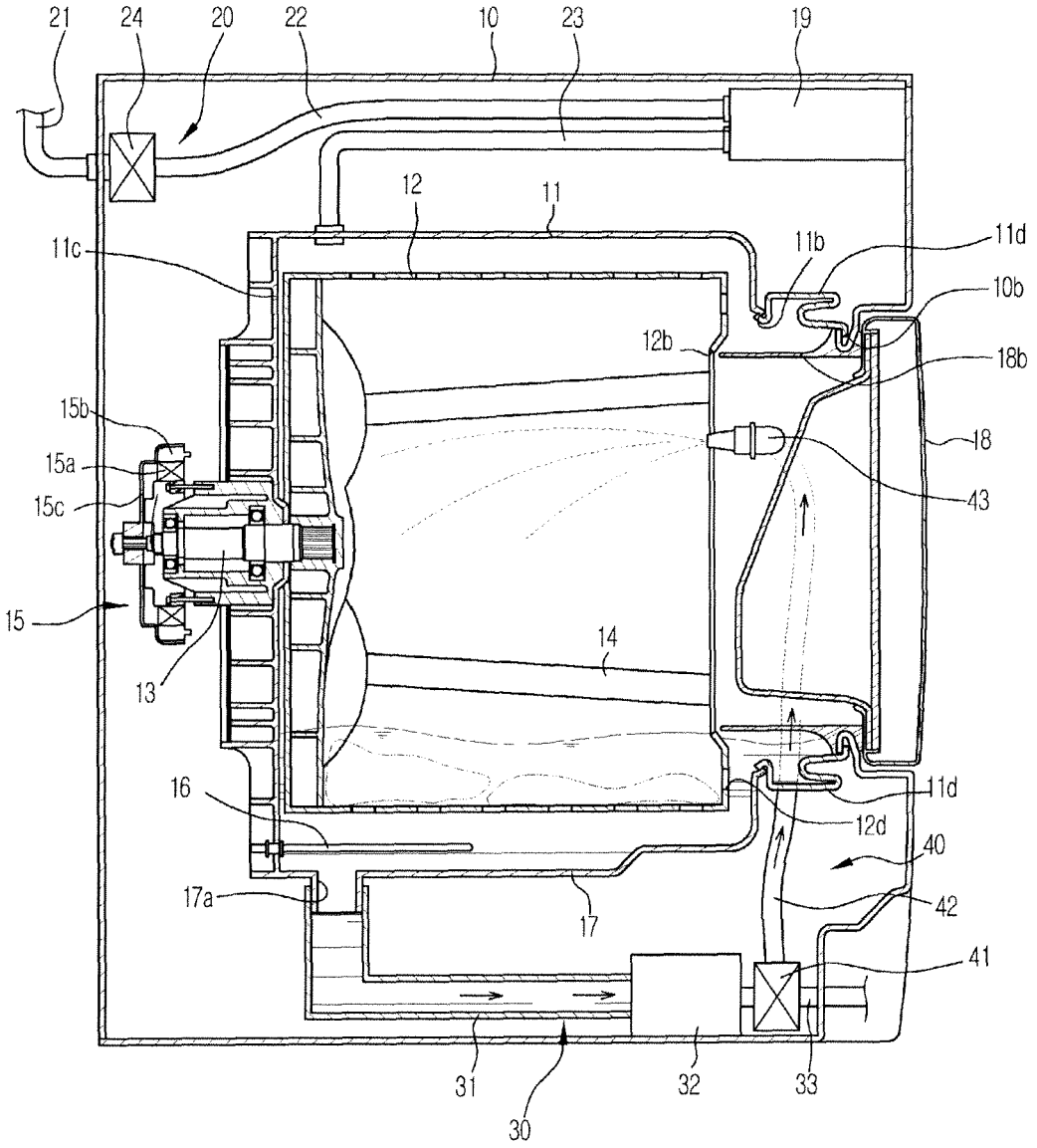

21
24
20
22
10
23
19
12
11
11c
11b
11d
10b
12b
18b
15b
15a
15c
18
43
15
14
13
16
11d
12d
40
17a
17
42
41
31
30
32
33

FIG. 4

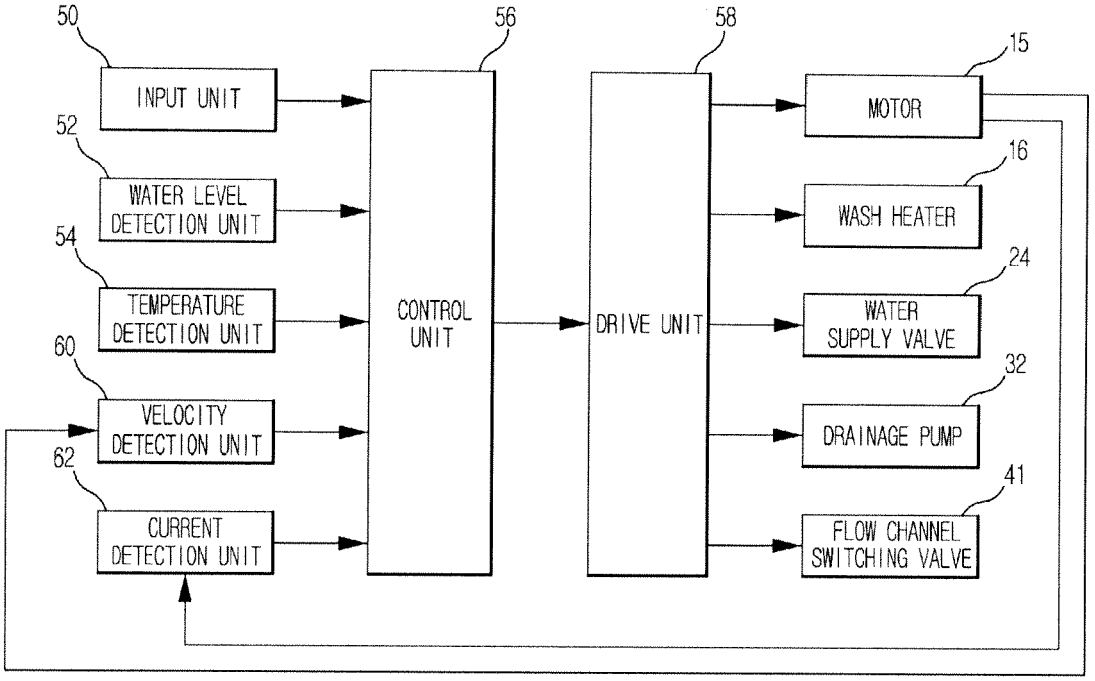

50
INPUT UNIT
52
WATER LEVEL DETECTION UNIT
54
TEMPERATURE DETECTION UNIT
60
VELOCITY DETECTION UNIT
62
CURRENT DETECTION UNIT
56
CONTROL UNIT
58
DRIVE UNIT
15
MOTOR
16
WASH HEATER
24
WATER SUPPLY VALVE
32
DRAINAGE PUMP
41
FLOW CHANNEL SWITCHING VALVE

FIG. 5A

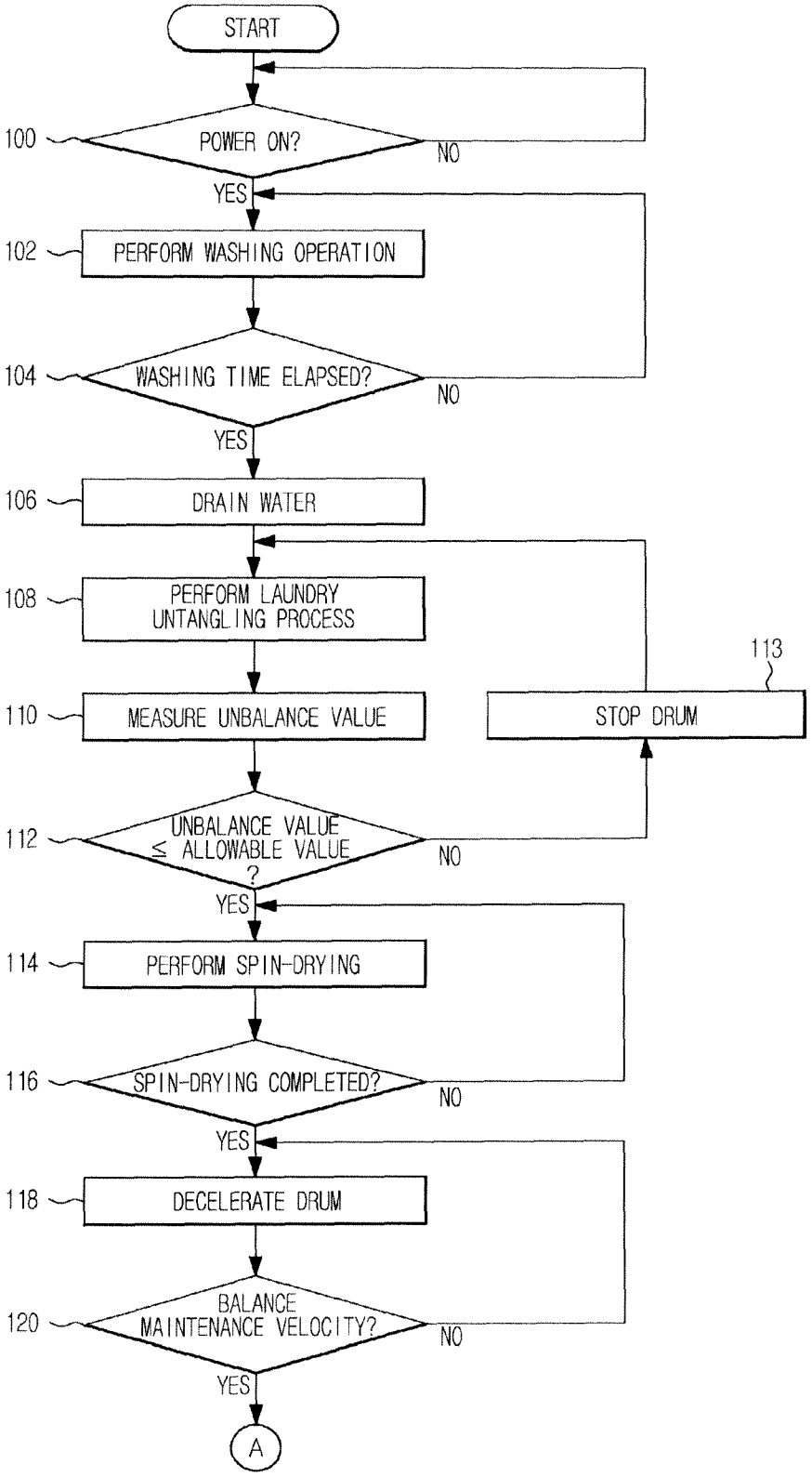

START
100
POWER ON?
NO
YES
102
PERFORM WASHING OPERATION
104
WASHING TIME ELAPSED?
NO
YES
106
DRAIN WATER
108
PERFORM LAUNDRY UNTANGLING PROCESS
110
MEASURE UNBALANCE VALUE
112
UNBALANCE VALUE ≤ ALLOWABLE VALUE ?
NO
YES
113
STOP DRUM
114
PERFORM SPIN-DRYING
116
SPIN-DRYING COMPLETED?
NO
YES
118
DECELERATE DRUM
120
BALANCE MAINTENANCE VELOCITY?
NO
YES
A

FIG. 5B

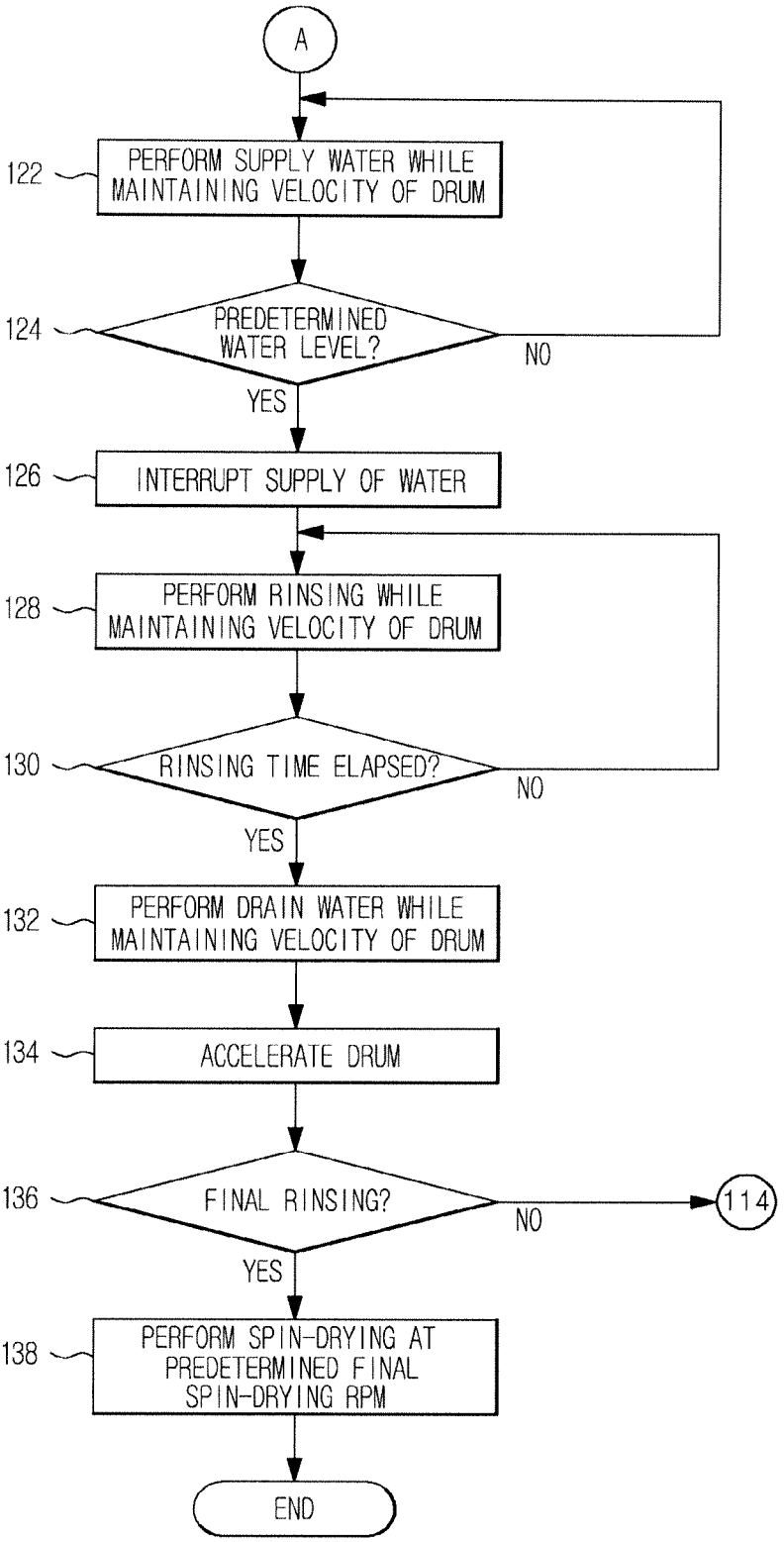
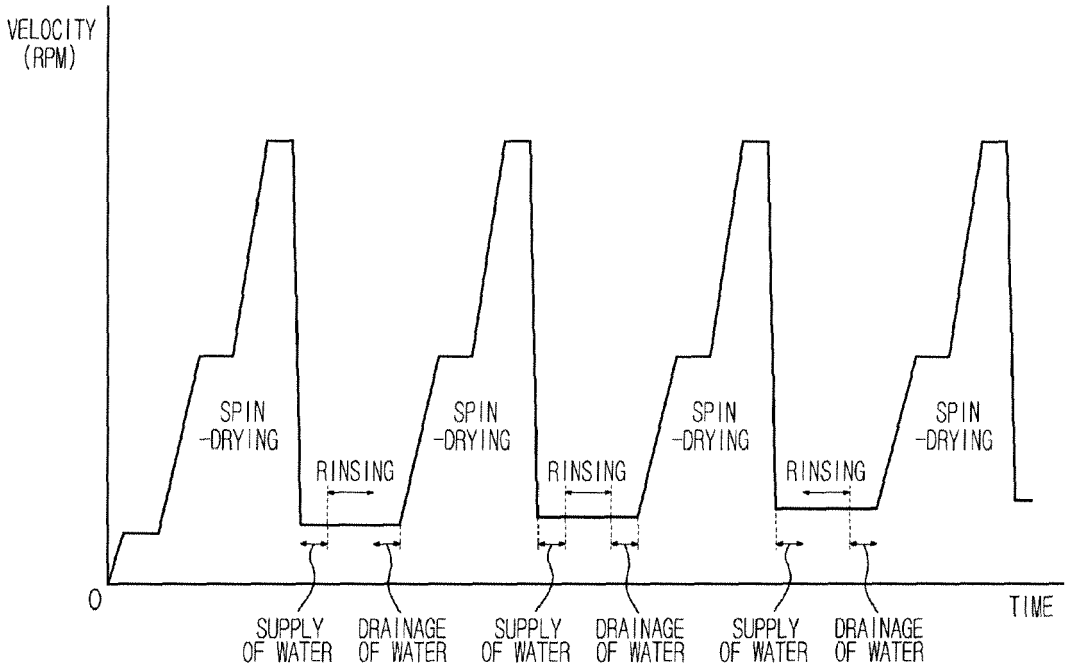

A
122
PERFORM SUPPLY WATER WHILE MAINTAINING VELOCITY OF DRUM
124
PREDETERMINED WATER LEVEL?
NO
YES
126
INTERRUPT SUPPLY OF WATER
128
PERFORM RINSING WHILE MAINTAINING VELOCITY OF DRUM
130
RINSING TIME ELAPSED?
NO
YES
132
PERFORM DRAIN WATER WHILE MAINTAINING VELOCITY OF DRUM
134
ACCELERATE DRUM
136
FINAL RINSING?
NO
114
YES
138
PERFORM SPIN-DRYING AT PREDETERMINED FINAL SPIN-DRYING RPM
END

FIG. 6


VELOCITY
(RPM)
SPIN
-DRYING
RINSING
SPIN
-DRYING
RINSING
SPIN
-DRYING
RINSING
SPIN
-DRYING
0
TIME
SUPPLY
OF WATER
DRAINAGE
OF WATER
SUPPLY
OF WATER
DRAINAGE
OF WATER
SUPPLY
OF WATER
DRAINAGE
OF WATER

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EUROPEAN SEARCH REPORT

Application Number
EP 08 17 2272

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 April 2009	Spitzer, Bettina

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