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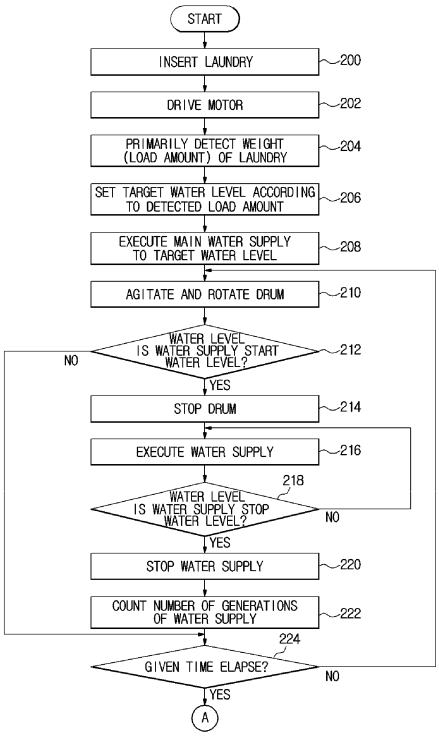
(54) Washing machine and control method thereof

(57) Washing machine (1) and control method thereof capable of accurately detecting the weight of laundry received in the washing machine (1) by primarily detecting the weight of the laundry according to driving of a motor (40) before the beginning of a washing process and correcting the primary detected weight of laundry according to the number of supplies of water which is additionally supplied within a given time after main water supply is completed during the washing process.

FIG. 4A



EP 2 871 274 A1

Description

[0001] The present invention relates to a washing machine and a control method thereof to detect weight of laundry received in the washing machine.

[0002] In general, a washing machine (typically, a drum washing machine) is an apparatus including a tub to store water (wash water or rinse water), a drum which is rotatably installed inside the tub to receive laundry, and a motor which generates drive force to rotate the drum, thereby allowing washing to be performed via tumbling of laundry in the drum along an inner wall of the drum during rotation of the drum.

[0003] In such a washing machine, washing is performed via a series of processes such as a washing process to eliminate stains on laundry using water in which detergent is dissolved (specifically, wash water), a rinsing process to rinse bubbles or remaining detergent on laundry using water in which detergent is contained (specifically, rinse water), and a dehydration process to dehydrate laundry at high speed.

[0004] When washing is performed via such a series of processes, the motor is driven by a given target RPM and a determined operation ratio in each of the washing process, the rinsing process, and the dehydration process. The RPM and the operation ratio of the motor in each process are determined according to weight (a load amount) of laundry.

[0005] Accordingly, the weight of laundry should be accurately detected in order to properly control operation of the motor according to the load amount and to set a use amount of water and a time consumed in the washing process and the rinsing process.

[0006] A conventional washing machine detects weight of laundry before washing begins. The weight of laundry is detected by a method of applying torque to a motor for a given time to directly or indirectly measure a moment of inertia of a drum and then using the second law of motion (torque = inertia x acceleration). Thus, a use amount of water and a time (a washing time, a dehydration time, or a rinsing time) are set according to the detected weight of laundry.

[0007] In a case of such a conventional washing machine, laundry is concentrated at a particular section in a space within the drum, and thus unbalance may be generated by the laundry. When the unbalance is generated, rotation speed of the drum periodically varies as the position of the unbalance is changed in a circumferential direction thereof. As a result, an error of the rotation speed of the drum increases when the moment of inertia of the drum is measured for a short time. Accordingly, in the related art, the moment of inertia is measured for a long time in order to suppress an effect of the unbalance.

[0008] However, in a case of measuring a moment of inertia for a long time by applying torque to the motor, the rotation speed of the motor (the rotation speed of the drum) is significantly changed due to various external environmental factors of the washing machine. For example, since the washing machine undergoes physical influences such as wind loss during rotation of a motor, friction resistance of bearing portions, contact friction of laundry, and mechanical vibration and electrical influences such as detection error of rotation speed and variation of power voltage, an error in detecting weight of laundry is generated, thereby enabling the weight of laundry to be not accurately detected.

[0009] Besides, in a case in which a user inserts wet laundry instead of dry laundry into the washing machine, this causes a result in which weight of laundry is erroneously detected as being a load amount greater than an actual amount of laundry. Consequently, an excessive use of water, time and energy may occur in the washing process and the rinsing process compared to what is actually required for laundry, and further, laundry may be damaged.

[0010] Therefore, it is an aspect of the present disclosure to provide a washing machine and a control method thereof capable of primarily detecting weight of laundry before the beginning of a washing process and correcting the primary detected weight of laundry, so as to more accurately detect weight of laundry.

[0011] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

[0012] In accordance with one aspect of the present disclosure, a control method of a washing machine including a tub to store water, a drum installed inside the tub to accommodate laundry, and a motor to rotate the drum, includes detecting weight of laundry by driving the motor before water is supplied to the tub, supplying water to a water level set according to the detected weight of laundry, detecting a water level changed according to rotation of the drum after water is supplied to the tub to determine whether or not it is a water resupply condition, resupplying water to a level of water resupply when it is determined to be the water resupply condition, and correcting the detected weight of laundry according to the number of resupplies of water.

[0013] The detecting weight of laundry may include primarily detecting weight of laundry by driving the motor before the beginning of a washing process and using an acceleration time taken when the drum reaches a certain speed.

[0014] The detecting a change in water level may include detecting a level of water in the tub changed according to agitation and rotation of the drum during a washing process. The change in water level may be proportional to the weight of laundry.

[0015] The determining whether or not it is a water resupply condition may include detecting a water level lowered as laundry absorbs water by agitating and rotating the drum during the washing process to determine whether or not the water level is a water level required for water resupply.

[0016] The control method may further include count-

ing a generation time of the water resupply, and counting the number of generations of water resupply until the counted time elapses over a given time.

[0017] The number of resupplies of water may be proportional to the weight of laundry. The control method may further include classifying the number of resupplies of water by the weight of laundry to store the same, and correcting the weight of laundry by a load higher than the detected weight of laundry when the counted number of resupplies of water is the reference number or more.

[0018] In accordance with another aspect of the present disclosure, a washing machine includes a tub to store water, a water supply unit to supply water to the tub, a drum installed inside the tub to accommodate laundry, a motor to rotate the drum, and a control unit which controls the motor before water is supplied to the tub to detect weight of laundry, controls the water supply unit according to the detected weight of laundry to supply water to a set water level, rotates the drum after water is supplied to the tub to detect a change in water level, counts the number of resupplies of water according to the change in water level, and corrects the detected weight of laundry according to the number of resupplies of water.

[0019] The control unit may control the motor before the beginning of a washing process to primarily detect weight of laundry using an acceleration time taken when the drum reaches a certain speed.

[0020] The control unit may detect a level of water in the tub changed according to agitation and rotation of the drum during a washing process.

[0021] The control unit may detect a water level lowered as laundry absorbs water by agitating and rotating the drum during the washing process to determine whether or not the water level is a water level required for water resupply.

[0022] The control unit may further include counting a generation time of the water resupply, and counting the number of generations of water resupply until the counted time elapses over a given time.

[0023] The control unit may further include classifying the number of resupplies of water by the weight of laundry to store the same, and correcting the weight of laundry by a load higher than the detected weight of laundry when the counted number of resupplies of water is the reference number or more.

[0024] These and/or other aspects of the disclosure 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 a configuration of a washing machine according to an embodiment of the present disclosure;

FIG. 2 is a perspective view illustrating a detergent supply unit according to the embodiment of the present disclosure;

FIG. 3 is a control block diagram of the washing machine according to the embodiment of the present disclosure;

FIGS. 4A and 4B are operation flowcharts illustrating a control method of the washing machine according to the embodiment of the present disclosure; and

FIG. 5 is a table illustrating a weight detection result of laundry in the washing machine according to the embodiment of the present disclosure.

[0025] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0026] FIG. 1 is a view illustrating a configuration of a washing machine according to an embodiment of the present disclosure.

[0027] As shown in FIG. 1, a washing machine 1 according to an embodiment of the present disclosure includes a main body 10 defining an external appearance thereof and having substantially a box shape, a tub 20 installed inside the main body 10, a drum 30 rotatably installed inside the tub 20, and a motor 40 to drive the drum 30.

[0028] The main body 10 is formed, at a front surface portion thereof, with an insertion port 11 through which laundry may be inserted into the drum 30. The insertion port 11 is opened and closed by a door 12 mounted to the front surface portion of the main body 10.

[0029] The drum 30 includes a cylindrical portion 31, a front surface plate 32 installed to the front of the cylindrical portion 31, and a rear surface plate 33 installed to the rear of the cylindrical portion 31. The front surface plate 32 is formed with an opening 32a for insertion of laundry, and the rear surface plate 33 is connected with a drive shaft 43 to which the motor 40 transmits power.

[0030] A plurality of through holes 34, through which wash water passes, are formed around the drum 30, and a plurality of lifters 35 are installed on an inner peripheral surface of the drum 30 so that, during rotation of the drum 30, laundry is tumbled therewithin.

[0031] The motor 40 includes a stator 41 which is fixed to a rear surface of the tub 20, a rotor 42 which rotates while interacting with the stator 41, and the drive shaft 43 one end of which is fixed to a center of the rotor 42 while the other end thereof passes through the tub 20 and is fixed to a center of the rear surface plate 33 of the drum 30.

[0032] The motor 40 is typically a universal motor configured by a field coil and an armature or a BLDC (Brushless Direct Motor) configured by a permanent magnet and an electromagnet. Furthermore, any motor may also be utilized as long as the motor 40 is applicable to the washing machine 1.

[0033] The drive shaft 43 is installed between the drum 30 and the motor 40. One end of the drive shaft 43 is connected to the rear surface plate 33 of the drum 30, and the other end of the drive shaft 43 extends outward of a rear wall of the tub 20. When the motor 40 drives the

drive shaft 43, the drum 30 connected to the drive shaft 43 rotates about the drive shaft 43.

[0034] The rear wall of the tub 20 is provided with a bearing housing 21 to rotatably support the drive shaft 43. The bearing housing 21 may be made of an aluminum alloy, and be inserted into the rear wall of the tub 20 during injection molding of the tub 20. Bearings 22 are installed between the bearing housing 21 and the drive shaft 43 so that the drive shaft 43 may smoothly rotate.

[0035] The tub 20 is supported by a damper 23. The damper 23 connect an inside bottom surface of the main body 10 to an outer surface of the tub 20 and reduces vibration generated at a lower portion of the tub 20.

[0036] The tub 20 is provided, at an upper portion thereof, with a water supply unit 50 to supply wash water to the tub 20 and a detergent supply unit 70 connected to the water supply unit 50 such that water transferred through the water supply unit 50 is supplied to the tub 20 together with detergent. The lower portion of the tub 20 is provided with a drainage unit 60 to discharge wash water in the tub 20 to the outside of the main body 10.

[0037] The water supply unit 50 includes water supply tubes 51 which connect an external water supply source (not shown) to the detergent supply unit 70 in order to supply water (wash water or rinse water) into the tub 20, a water supply valve 52 which is installed to the middle of each water supply tube 51 to control supply of water, and a connection tube 53 which connects the tub to the detergent supply unit 70.

[0038] The drainage unit 60 includes a drainage tube 61 through which water in the tub 20 is discharged to the outside of the main body 10 and a drainage pump 62 installed to the drainage tube 61 such that water is discharged through the drainage tube 61. The detergent supply unit 70 is connected to the tub 20 through the connection tube 53 connected to a lower portion thereof. Accordingly, water supplied through the water supply tube 51 passes through the detergent supply unit 70 and is supplied to the tub 20 through the connection tube 53. This configuration allows water supplied to the tub 20 to pass through the detergent supply unit 70, enabling detergent within the detergent supply unit 70 to be supplied to the tub 20 together with water.

[0039] In addition, the tub 20 is provided, at a lower inside thereof, with a water level sensor 80 which senses a water level frequency varying according to a water level in order to sense an amount of water (water level) in the tub 20.

[0040] FIG. 2 is a perspective view illustrating the detergent supply unit according to the embodiment of the present disclosure.

[0041] As shown in FIG. 2, the detergent supply unit 70 includes a detergent box 710 in which detergent is stored and a detergent box housing 700 accommodating the detergent box 710.

[0042] The detergent box housing 700 is fixed to the main body 10 of the washing machine 1 and the detergent box 710 slides inward of the detergent box housing 700 through an opening 701 formed in the front of the detergent box housing 700. Accordingly, a user may insert detergent into the washing machine 1 by separating only the detergent box 710 from the detergent box housing 700 to insert detergent into the detergent box 710 and then again mounting the detergent box 710 to the detergent box housing 700.

[0043] The detergent box housing 700 includes a fixing portion 702 to fix the detergent box housing 700 to the main body 10, a housing cover 703 covering an upper side of the detergent box housing 700, a plurality of water supply ports 704 provided at a rear end upper portion of the detergent box housing 700 such that the water supply tubes 51 are connected to the water supply ports 704, and a connection port 705 provided at a lower portion of the detergent box housing 700 such that the connection tube 53 is connected to the connection port 705.

[0044] The detergent box 710 is provided with a plurality of detergent storage portions 710a and 710b to store detergent. Liquid or powder detergent and softening agent may be inserted into the plural detergent storage portions 710a and 710b. As shown in the drawings, the plural detergent storage portions 710a and 710b are divided into a main detergent storage portion 710a to store liquid main detergent and a sub-detergent storage portion 710b to store liquid sub-detergent such as rinse or bleaching agent. Although not shown in the drawings, the detergent box 710 further includes a powder detergent storage portion to store powder detergent and a manual detergent supply portion to allow a user to directly supply rinse, bleaching agent, or the like.

[0045] A detergent box cover 711 is mounted to an upper portion of the detergent box 710 so as to prevent detergent stored in the detergent box 710 from overflowing. In addition, the detergent box cover 711 is provided with a plurality of detergent insertion ports 711a and 711b through which detergent may be inserted into the respective detergent storage portions 710a and 710b. The main detergent storage portion 710a and the sub-detergent storage portion 710b in which a great quantity of liquid detergent is stored are provided with storage portion covers 712a and 712b to prevent liquid detergent from overflowing.

[0046] In addition, the detergent supply unit 70 includes a detergent insertion module 720 configured such that liquid detergent mixes with water within the detergent box housing 700 to be supplied to the tub 20 together with water by inserting liquid detergent stored in the detergent box 710 into the detergent box housing 700.

[0047] The detergent insertion module 720 is configured to communicate with the detergent box 710 and is installed to an outer surface of the detergent box 710 such that electrical connection structures are not present within the detergent box 710. In the embodiment of the present disclosure, the detergent insertion module 720 is installed to a rear surface of the detergent box 710.

[0048] FIG. 3 is a control block diagram of the washing machine according to the embodiment of the present dis-

closure.

[0049] As shown in FIG. 3, the washing machine 1 according to the embodiment of the present disclosure includes an input unit 100, a control unit 102, a memory 104, a drive unit 106, and a display unit 108.

[0050] The input unit 100 allows commands for execution of the washing process, the rinsing process, and the dehydration process to be input by a user's operation. The input unit 100 may be configured by a key, a button, a switch, a touch pad, or the like, and include all types of devices which may generate predetermined input data by operation such as push, contact, pressure, and rotation.

[0051] In addition, the input unit 100 includes a plurality of buttons (power, reservation, wash water temperature, soaking, washing, rinsing, dehydration, types of detergent, etc.) though which user's commands related to operation of the washing machine 1 are input. Among of the plural buttons, a course selection button is provided to select a washing course (a plurality of washing courses being a standard course, a wool course, a delicate course, and the like, and the washing course being, for example, the standard course selected by a user according to types of laundry) according to types of laundry inserted into the washing machine 1.

[0052] The control unit 102 is a microcomputer to control the overall operations, such as washing, rinsing, and dehydration, of the washing machine 1 according to operation information input from the input unit 100. The control unit 102 sets an RPM and an operation ratio of the motor (an on/off time of the motor), a target water level (a target water level for washing and a target water level for rinsing), a washing time, a rinsing time, and the like.

[0053] In addition, the control unit 102 causes weight of laundry to be accurately detected by primarily detecting weight of laundry according to driving of the motor 40 before the beginning of the washing process after insertion of laundry and then correcting the primary detected weight of laundry according to the number of supplies (resupplies) of water which is additionally supplied within a given time (approximately 15 minutes) after main water supply is completed during the washing process.

[0054] A method of detecting weight of laundry will be described in more detail as follows. First, similarly to the conventional method, weight of laundry is primarily detected by, before the beginning of the washing process, driving the motor 40 to accelerate the drum 30 accommodating laundry to a certain speed and then applying any constant torque (or constant voltage) to use an acceleration time taken to reach the certain speed. In this case, since the taken acceleration time is proportional to weight of laundry, the weight of laundry is estimated using a weight reference table corresponding to the acceleration time.

[0055] Next, when the washing process begins, main water supply is executed to supply water (wash water) until a target water level for washing set according to the primary detected weight of laundry. When the main water supply is completed, the washing process is performed by driving the motor 40 to agitate and rotate the drum 30. When the washing process is performed, a water level is lowered as laundry absorbs water according to agitation and rotation of the drum 30. Therefore, water supply (water resupply) to additionally supply water (wash water) is executed according to a preset water supply condition (water level frequency for water supply start and stop). Since weight (an amount) of laundry is proportional to an amount of absorbing water from laundry, the weight of laundry may be determined according to the number of generations of water supply (water resupply). That is, since the number of generations of water supply (water resupply) varies according to weight of laundry, it may be determined whether an amount of laundry is small or large according to the number of generations of water supply.

[0056] The memory 104 may store set information such as control data to control operation of the washing machine 1, reference data used during operation control of the washing machine 1, operation data generated while the washing machine 1 performs a predetermined operation, and set data input by the input unit 100 such that the washing machine 1 performs a predetermined operation, use information including the number of particular operations performed by the washing machine 1 and model information of the washing machine 1, and failure information including a cause or position of erroneous operation during erroneous operation of the washing machine 1.

[0057] The drive unit 106 drives the motor 40, the water supply valve 52, the drainage pump 62, the detergent supply unit 70, and the like related to operation of the washing machine 1 according to a drive control signal of the control unit 102.

[0058] The display unit 108 displays an operation state of the washing machine 1 and an operation stats of a user according to a display control signal of the control unit 102.

[0059] Hereinafter, an operation process and an effect with respect to a control method of the washing machine according to the embodiment of the present disclosure will be described.

[0060] FIGS. 4A and 4B are operation flowcharts illustrating a control method of the washing machine according to the embodiment of the present disclosure, and relate to an algorithm capable of detecting accurately weight of laundry by primarily detecting weight of laundry before the beginning of the washing process and correcting the primary detected weight of laundry during the washing process. FIG. 5 is a table illustrating a weight detection result of laundry in the washing machine according to the embodiment of the present disclosure.

[0061] As shown in FIGS. 4A and 4B, when a user inserts laundry into the drum 30 (operation 200) and inputs a washing course (a plurality of washing courses being a standard course, a wool course, a delicate course, and the like, and the washing course being, for

example, the standard course selected by a user according to types of laundry) according to types of laundry and operation information related to operation of the washing machine 1, the operation information selected by a user is input to the control unit 102 through the input unit 100.

[0062] Accordingly, the control unit 102 drives the motor 40 in order to detect weight (a load amount) of laundry accommodated in the drum 30 (operation 202). A method of driving the motor 40 to detect weight of laundry may be applied in any way. For example, there is a method of detecting weight of laundry by applying a certain duty (90V) to the motor 40 and using values of time and angular speed taken to reach the certain duty while the motor 40 rotates at a weight detection RPM (approximately 70 to 150 RPM), a method of detecting weight of laundry using momentary acceleration of the motor 40 and a time taken to reach a constant speed (or a constant RPM), and a method of detecting weight of laundry by applying torque to the motor 40 for a given time to directly or indirectly measure a moment of inertia of a drum and then using the second law of motion (torque = inertia x acceleration), as disclosed in Japanese Unexamined Patent Application Publication No. 2002-336593, Japanese Unexamined Patent Application Publication No. 2004-267334, and Japanese Patent Application Publication No. H07-90077.

[0063] Additionally, it may also be possible to detect weight (a load amount) of laundry using a load cell, among the known methods.

[0064] As such, the control unit 102 primarily detects weight (a load amount) of laundry by driving the motor 40 before the beginning of the washing process (operation 204). The primary detected weight (load amount) of laundry is detected as a small load, a middle load, and a large load, as shown in FIG. 5.

[0065] When the weight (load amount) of laundry is primarily detected, the control unit 102 sets an RPM and an operation ratio of the motor (an on/off time of the motor), a target water level for washing, a target water level for rinsing, a washing time, a rinsing time, a detergent insertion amount (specifically, a detergent insertion time (ts)), and the like according to the detected weight (load amount) of laundry (operation 206).

[0066] Setting an RPM and an operation ratio of the motor (an on/off time of the motor), a target water level for washing, a target water level for rinsing, a washing time, a rinsing time, a detergent insertion time (ts), and the like according to weight (a load amount) of laundry corresponds to a case in which a separate command related to operation of the washing machine 1 is not additionally input by a user. In a case in which a separate command related to operation of the washing machine 1 is additionally input by a user, an RPM and an operation ratio of the motor (an on/off time of the motor), a target water level for washing, a target water level for rinsing, a washing time, a rinsing time, a detergent insertion time (ts), and the like set according to weight (a load amount) of laundry may be changed according to a user's command.

[0067] Subsequently, the control unit 102 operates the water supply valve 52 and the detergent supply unit 70 via the drive unit 106 in order to supply water (wash water) set according to weight (a load amount) of laundry or a user's command.

[0068] When the water supply valve 52 is operated, water (wash water) supplied through the external water supply tube passes through the water supply tube 51 and the detergent supply unit 70 to be supplied to the tub 20 together with detergent while the water supply valve 52 is opened.

[0069] Accordingly, the control unit 102 detects a level of water supplied to the tub 20 through the water level sensor 80 to determine whether or not the detected water level is a set target water level (a target water level frequency), and then executes main water supply operation until the level of water supplied to the tub 20 reaches a set target water level (operation 208).

[0070] When the level of water supplied to the tub 20 reaches a set target water level via the water supply operation, the control unit 102 closes the water supply valve 52 to stop the main water supply operation.

[0071] When the main water supply is completed by reaching the target water level, the control unit 102 generates a water stream which transfers water (wash water + detergent) to the laundry to perform the washing process by driving the motor 40 at an RPM and an operation ratio of the motor set according to weight (a load amount) of laundry to agitate and rotate the drum 30 (operation 210).

[0072] When the drum 30 agitates and rotates via left and right agitation of the motor 40, laundry absorbs water and thus the water level in the tub 20 is lowered. In this case, since weight (an amount) of laundry inserted into the drum 30 is proportional to an amount of absorbing water from laundry, the water level in the tub 20 varies according to weight (a load amount) of laundry.

[0073] In other words, the water level in the tub 20 is rapidly lowered when the weight (load amount) of laundry is a large load, and the water level in the tub 20 is slowly lowered when the weight (load amount) of laundry is a small load.

[0074] The control unit 102 detects a water level in the tub 20 lowered according to agitation and rotation of the drum 30 through the water level sensor 80 to determine whether or not the water level is a water supply start water level (a water supply start frequency in which water should be additionally supplied since the water level is lowered) (operation 212).

[0075] When the water level is determined to be a water supply start water level as a result of the determination of operation 212, the control unit 102 stops the motor 40 via the drive unit 106 to stop the agitation and rotation of the drum 30 (operation 214) and opens the water supply valve 52 so as to execute the water supply operation to additionally supply water (operation 216).

[0076] The control unit 102 detects a water level in the

tub 20 raised according to the water supply operation through the water level sensor 80 to determine whether or not the water level is a water supply stop water level (a water supply stop frequency in which additional water supply should be stopped since the water level is raised) (operation 218).

[0077] When the water level is determined to be not a water supply stop water level as a result of the determination of operation 218, the control unit 102 causes the operation to feed back to operation 216 and continuously executes the water supply operation. Meanwhile, when the water level is determined to be a water supply stop water level as a result of the determination of operation 218, the control unit 102 closes the water supply valve 52 via the drive unit 106 to stop the water supply operation (operation 220).

[0078] Next, the control unit 102 counts the number of generations of water supply according to execution and stop of the water supply operation (operation 222), and stores the counted number of generations of water supply in the memory 104.

[0079] In addition, the control unit 102 counts an execution time of the water supply operation to determine whether or not a pre-given time (a time to count the number of generations of supply of water additionally supplied after the main water supply is completed; approximately 15 minutes) elapses (operation 224).

[0080] When it is determined that the given time does not elapse as a result of the determination of operation 224, the control unit 102 causes the operation to feed back to operation 210 and executes subsequent operation.

[0081] Meanwhile, when it is determined that the given time elapses as a result of the determination of operation 224, the control unit 102 corrects the primary detected weight (load amount) of laundry according to the number of generations of water supply counted within the given time (operation 226), as shown in FIG. 5.

[0082] As shown in FIG. 5, a method of correcting the primary detected weight (load amount) of laundry is as follows.

[0083] First, in a case in which the primary detected weight (load amount) of laundry is a "small load", when the number of generations of water supply is once or less, it is finally determined that the primary detected weight (load amount) of laundry is a "small load" as it is, and when the number of generations of water supply is twice or more, it is finally determined that the primary detected weight (load amount) of laundry is a "middle load".

[0084] Next, in a case in which the primary detected weight (load amount) of laundry is a "middle load", when the number of generations of water supply is once or less, it is finally determined that the primary detected weight (load amount) of laundry is a "small load", when the number of generations of water supply is twice or three times, it is finally determined that the primary detected weight (load amount) of laundry is a "middle load" as it is, and when the number of generations of water supply is four times or more, it is finally determined that the primary detected weight (load amount) of laundry is a "large load".

[0085] Next, in a case in which the primary detected weight (load amount) of laundry is a "large load", when the number of generations of water supply is three times or less, it is finally determined that the primary detected weight (load amount) of laundry is a "middle load", and when the number of generations of water supply is four times or more, it is finally determined that the primary detected weight (load amount) of laundry is a "large load" as it is.

[0086] As such, the control unit 102 finally determines accurate weight of laundry by correcting the primary detected weight of laundry according to the number of generations of supply of water additionally supplied within a given time (approximately 15 minutes) during the washing process after the main water supply is completed. When the weight (load amount) of laundry is finally determined, the control unit 102 resets an RPM and an operation ratio of the motor (an on/off time of the motor), a target water level (a target water level for washing and a target water level for rinsing), a washing time, a rinsing time, and the like according to the finally determined weight (load amount) of laundry (operation 228).

[0087] Subsequently, the control unit 102 performs a subsequent process (specifically, a washing process, a rinsing process, and a dehydration process) of the washing machine 1 using the RPM and the operation ratio of the motor (the on/off time of the motor), the target water level for washing, the target water level for rinsing, the washing time, and the rinsing time which are reset (operation 230).

[0088] Meanwhile, although the embodiment of the present disclosure has been described with respect to a horizontal-axis drum washing machine as an example, the present disclosure is not limited thereto. For example, the same object and effect as those of the present disclosure may also be achieved in a vertical-axis fully automatic washing machine.

[0089] As is apparent from the above description, in accordance with a washing machine and a control method thereof, it may be possible to more accurately detect weight (a load amount) of laundry accommodated in the washing machine by primarily detecting weight of laundry according to driving of a motor before the beginning of a washing process and correcting the primary detected weight of laundry according to the number of supplies (resupplies) of water which is additionally supplied within a given time after main water supply is completed during the washing process. Consequently, it may be possible to accurately set a use amount of water, a time (a washing time, a dehydration time, or a rinsing time), and an operation ratio of a motor according to weight of laundry, resulting in a reduction in energy use and an improvement in washing performance.

[0090] Although a few embodiments of the present in-

vention 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 control method of a washing machine comprising a tub to store water, a drum installed inside the tub to accommodate laundry, and a motor to rotate the drum, comprising:

   detecting weight of laundry by driving the motor before water is supplied to the tub;
   supplying water to a water level set according to the detected weight of laundry; detecting a water level changed according to rotation of the drum after water is supplied to the tub to determine whether or not it is a water resupply condition;
   resupplying water to a level of water resupply when it is determined to be the water resupply condition; and
   correcting the detected weight of laundry according to the number of resupplies of water.

2. The control method according to claim 1, wherein the detecting weight of laundry comprises primarily detecting weight of laundry by driving the motor before the beginning of a washing process and using an acceleration time taken when the drum reaches a certain speed.

3. The control method according to claim 1 or 2, wherein the detecting a change in water level comprises detecting a level of water in the tub changed according to agitation and rotation of the drum during a washing process.

4. The control method according to claim 3, wherein the change in water level is proportional to the weight of laundry.

5. The control method according to claim 3 or 4, wherein the determining whether or not it is a water resupply condition comprises detecting a water level lowered as laundry absorbs water by agitating and rotating the drum during the washing process to determine whether or not the water level is a water level required for water resupply.

6. The control method according to any one of the preceding claims, further comprising:

   counting a generation time of the water resupply; and
   counting the number of generations of water resupply until the counted time elapses over a given time.

7. The control method according to claim 6, wherein the number of resupplies of water is proportional to the weight of laundry.

8. The control method according to claim 6 or 7, further comprising:

   classifying the number of resupplies of water by the weight of laundry to store the same; and
   correcting the weight of laundry by a load higher than the detected weight of laundry when the counted number of resupplies of water is the reference number or more.

9. A washing machine comprising:

   a tub to store water;
   a water supply unit to supply water to the tub;
   a drum installed inside the tub to accommodate laundry;
   a motor to rotate the drum; and
   a control unit which controls the motor before water is supplied to the tub to detect weight of laundry, controls the water supply unit according to the detected weight of laundry to supply water to a set water level, rotates the drum after water is supplied to the tub to detect a change in water level, counts the number of resupplies of water according to the change in water level, and corrects the detected weight of laundry according to the number of resupplies of water.

10. The washing machine according to claim 9, wherein the control unit controls the motor before the beginning of a washing process to primarily detect weight of laundry using an acceleration time taken when the drum reaches a certain speed.

11. The washing machine according to claim 9 or 10, wherein the control unit detects a level of water in the tub changed according to agitation and rotation of the drum during a washing process.

12. The washing machine according to claim 11, wherein the control unit detects a water level lowered as laundry absorbs water by agitating and rotating the drum during the washing process to determine whether or not the water level is a water level required for water resupply.

13. The washing machine according to any one of claims 9 to 12, wherein the control unit further comprises:

   counting a generation time of the water resupply;

and
counting the number of generations of water resupply until the counted time elapses over a given time.

14. The washing machine according to claim 13, wherein the control unit further comprises:

classifying the number of resupplies of water by the weight of laundry to store the same; and
correcting the weight of laundry by a load higher than the detected weight of laundry when the counted number of resupplies of water is the reference number or more.

FIG.1

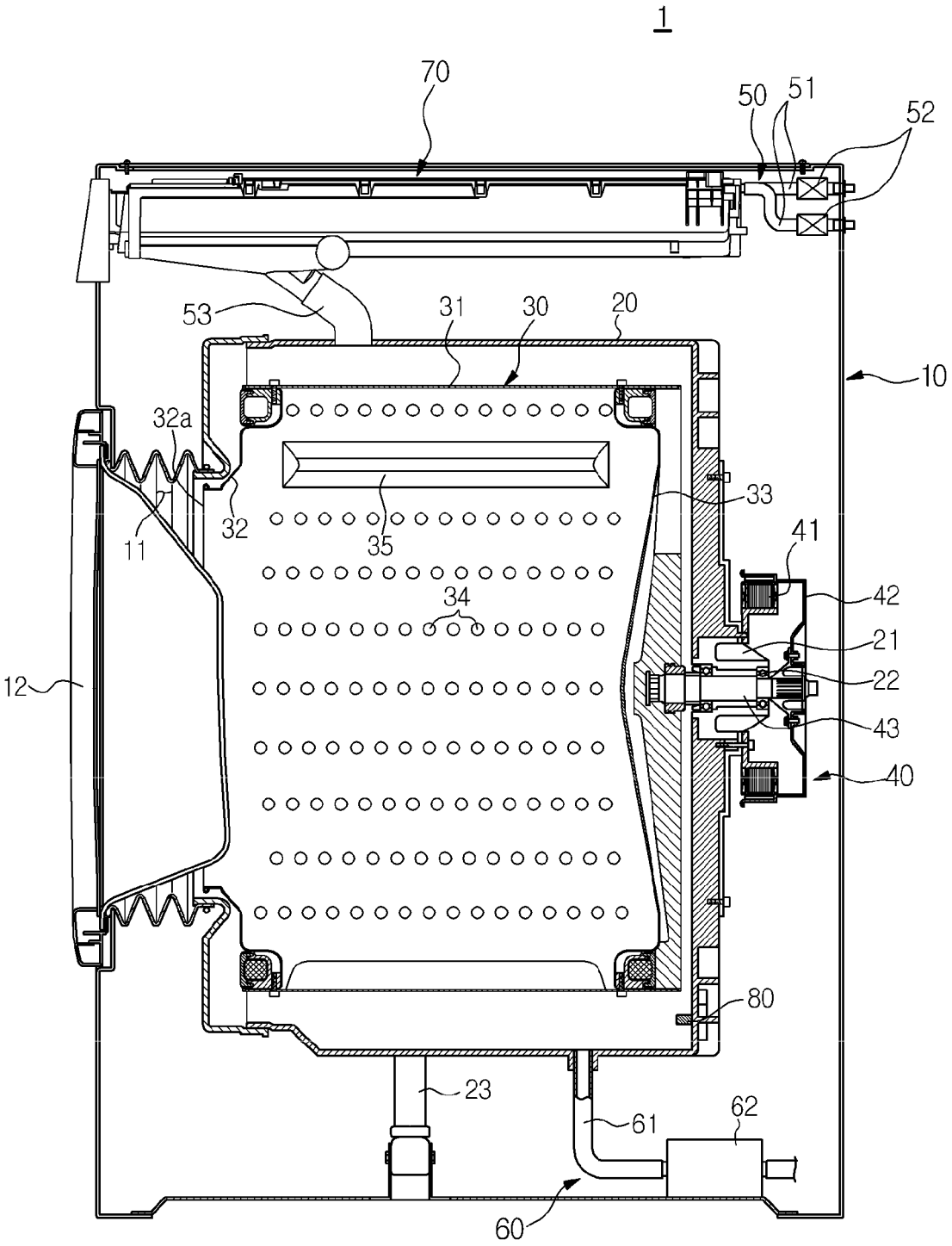
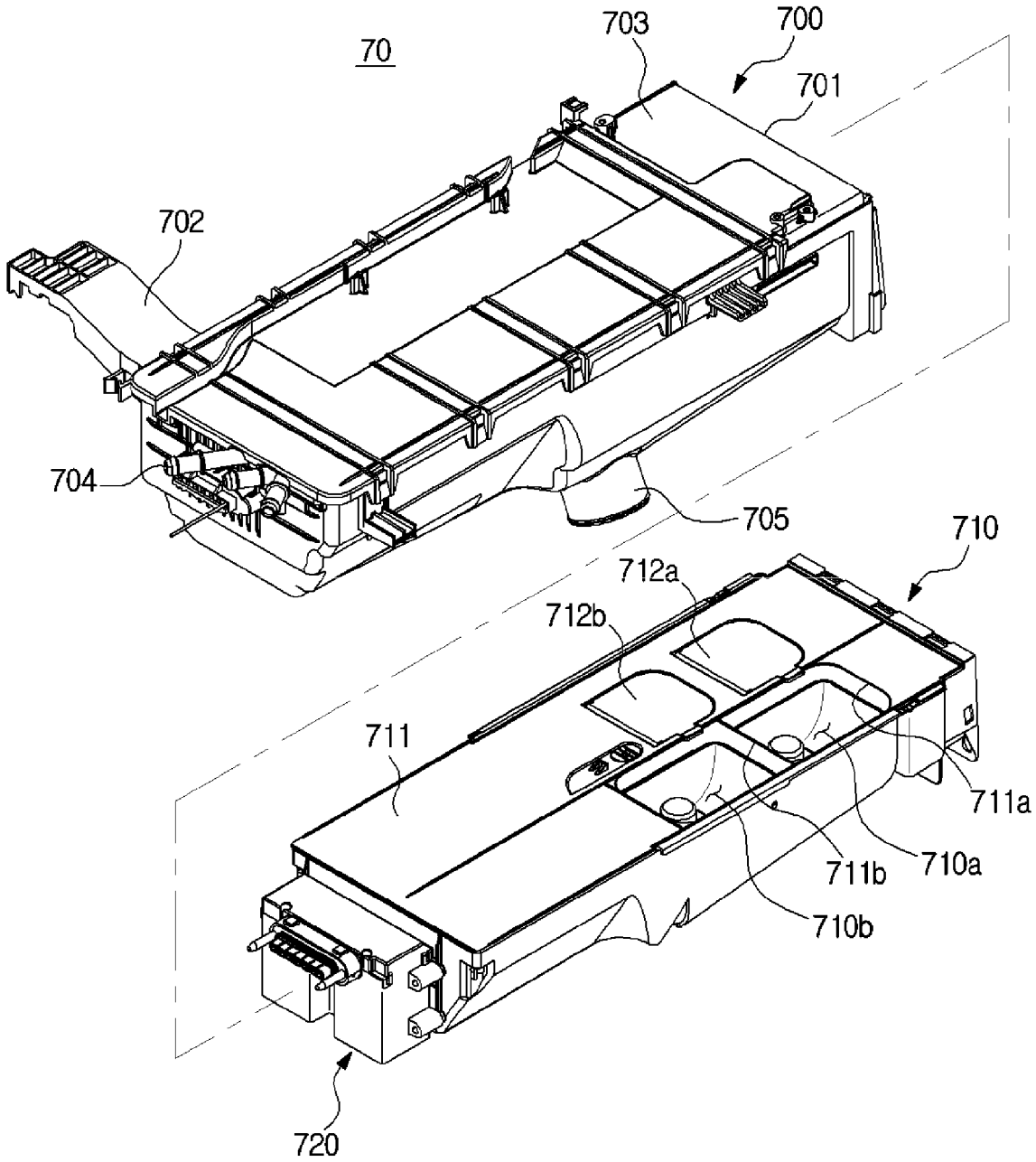

1
70
50
51
52
53
31
30
20
10
32a
11
32
35
33
41
42
34
21
22
12
43
40
80
23
61
62
60

FIG. 2


70
703
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701
702
704
705
710
712a
712b
711
711a
711b
710a
710b
720

FIG. 3

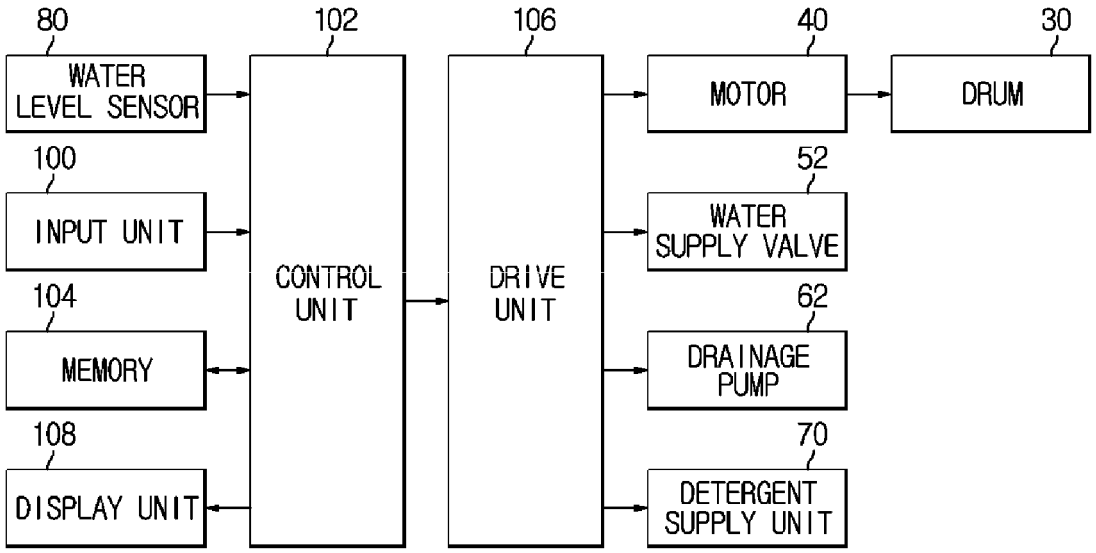
80
WATER LEVEL SENSOR
100
INPUT UNIT
104
MEMORY
108
DISPLAY UNIT
102
CONTROL UNIT
106
DRIVE UNIT
40
MOTOR
30
DRUM
52
WATER SUPPLY VALVE
62
DRAINAGE PUMP
70
DETERGENT SUPPLY UNIT

FIG. 4A

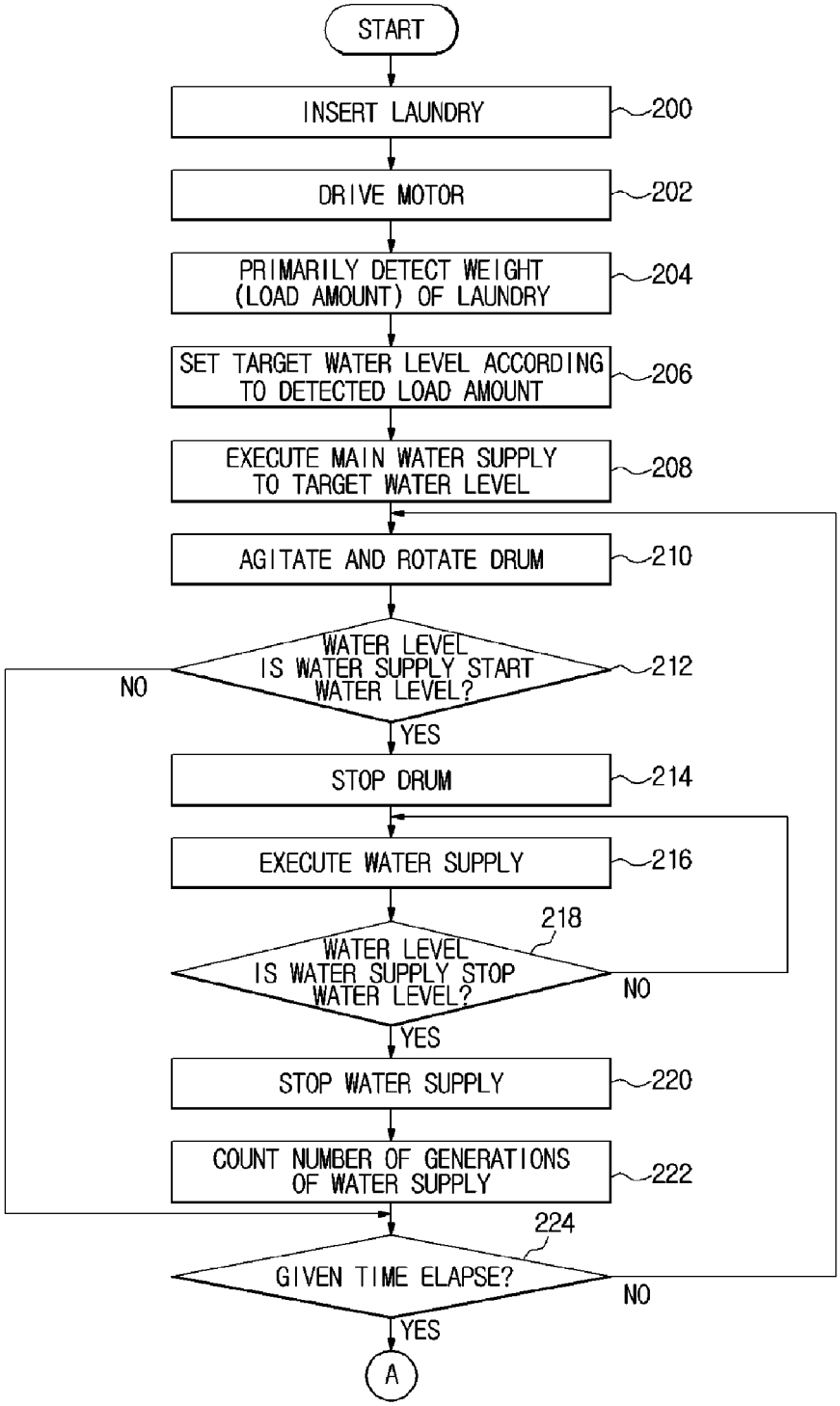
START
INSERT LAUNDRY
200
DRIVE MOTOR
202
PRIMARILY DETECT WEIGHT (LOAD AMOUNT) OF LAUNDRY
204
SET TARGET WATER LEVEL ACCORDING TO DETECTED LOAD AMOUNT
206
EXECUTE MAIN WATER SUPPLY TO TARGET WATER LEVEL
208
AGITATE AND ROTATE DRUM
210
WATER LEVEL IS WATER SUPPLY START WATER LEVEL?
212
NO
YES
STOP DRUM
214
EXECUTE WATER SUPPLY
216
218
WATER LEVEL IS WATER SUPPLY STOP WATER LEVEL?
NO
YES
STOP WATER SUPPLY
220
COUNT NUMBER OF GENERATIONS OF WATER SUPPLY
222
224
GIVEN TIME ELAPSE?
NO
YES
A

FIG. 4B

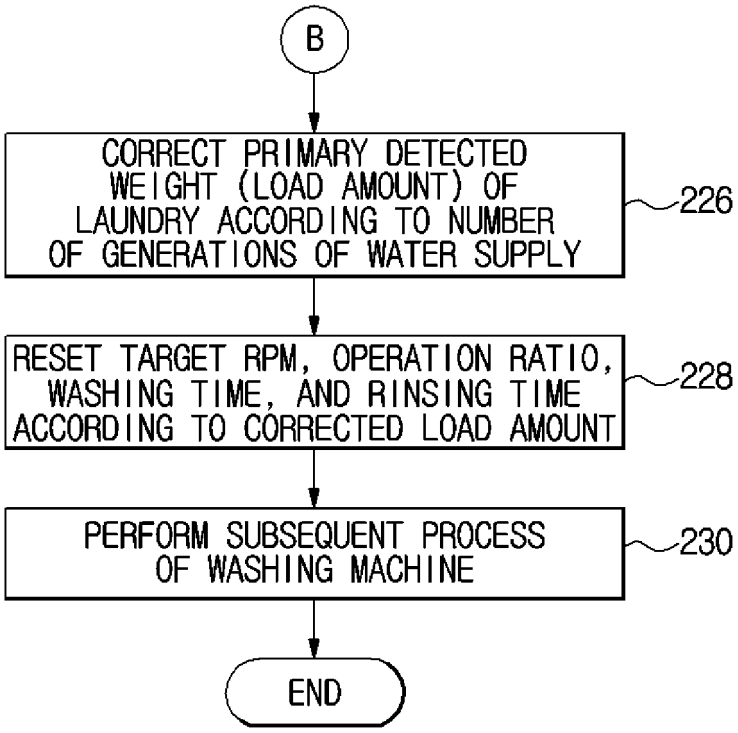
B
CORRECT PRIMARY DETECTED WEIGHT (LOAD AMOUNT) OF LAUNDRY ACCORDING TO NUMBER OF GENERATIONS OF WATER SUPPLY
226
RESET TARGET RPM, OPERATION RATIO, WASHING TIME, AND RINSING TIME ACCORDING TO CORRECTED LOAD AMOUNT
228
PERFORM SUBSEQUENT PROCESS OF WASHING MACHINE
230
END

FIG. 5

PRIMARY WEIGHT DETECTION	NUMBER OF WATER SUPPLIES	FINAL WEIGHT DETECTION
SMALL LOAD	ONCE OR LESS	SMALL LOAD
	TWICE OR MORE	MIDDLE LOAD
MIDDLE LOAD	ONCE OR LESS	SMALL LOAD
	TWICE OR THREE TIMES	MIDDLE LOAD
	FOUR TIMES OR MORE	LARGE LOAD
LARGE LOAD	THREE TIMES OR LESS	MIDDLE LOAD
	FOUR TIMES OR MORE	LARGE LOAD

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 4829

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Y A	US 2012/005840 A1 (JANG HOYONG [KR] ET AL) 12 January 2012 (2012-01-12) * paragraphs [0002] - [0006], [0012], [0055] - [0066]; figures 6,19,22 *	2,10 1,3-9, 11-14	
A	US 2004/154644 A1 (KIM YOUNG S [KR] KIM YOUNG SOO [KR]) 12 August 2004 (2004-08-12) * paragraphs [0003], [0018] - [0022]; claims; figures *	1-14	
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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	31 March 2015	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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31-03-2015

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