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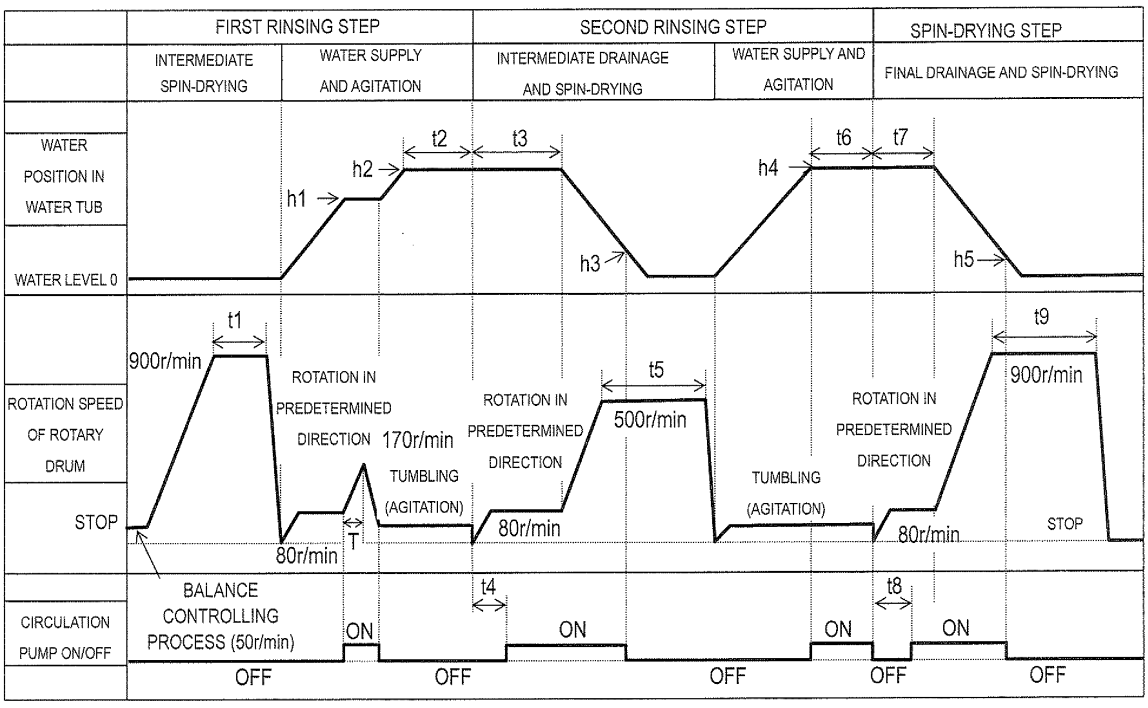
(54) DRUM WASHING MACHINE

(57) A front-loading-type washing machine includes a rotary drum; a water tub; a motor; a water supply valve which supplies water to the water tub; a drainage section which drains water from the water tub; and a control unit having a controller which controls at least washing, rinsing and spin-drying steps. The controller performs control in such a manner that during the rinsing step, after the rotary drum is rotated in a predetermined direction, water is drained by the drainage section, and at least during the drainage, a rotation speed of the rotary drum becomes a rotation speed at which the laundry adheres to an inner circumferential wall of the rotary drum.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to a front-loading-type washing machine which performs washing by sequentially controlling each step of washing, rinsing, spin-drying and the like.

BACKGROUND ART

[0002] In the related art, there is disclosed a front-loading-type washing machine which makes an early start of a spin-drying step by rotating a rotary drum during drainage so as to shorten a washing time (for example, see PTL 1).

[0003] The front-loading-type washing machine of the related art disclosed in PTL 1 performs an agitation operation in a washing step for a predetermined time and then, starts a drainage operation. In the drainage operation, first, a drain pump is driven and water in a water tub is drained. Next, it is detected whether a water level in the water tub or time elapsed from the drainage start reaches a driving condition of a rotary drum based on an input signal from a state detection circuit. At this time, the rotary drum is stopped at the latest when the driving condition is detected.

[0004] When it is detected that the input signal from the state detection circuit reaches the driving condition, the stopped rotary drum is rotated at a low speed and an early start of a spin-drying step is made.

[0005] However, in the front-loading-type washing machine in the related art, the rotary drum is stopped until the input signal reaches the driving condition from the drainage start. That is, the rotation of the rotary drum is started after the input signal reaches the driving condition. Accordingly, while a washing time can be shortened, there has been a problem that rinsing is started in a state where a water level in the water tub is lowered and therefore, rinsing performance is not sufficient.

Citation List

Patent Literature

[0006]

PTL 1: Japanese Patent Unexamined Publication No. 2004-16399

SUMMARY OF THE INVENTION

[0007] A front-loading-type washing machine according to the present invention includes: a rotary drum which accommodates laundry; a water tub which rotatably supports the rotary drum; a motor which drives the rotary drum in a rotary manner; a water supply valve which supplies water to the water tub; a drainage section which drains water from the water tub; and a control unit having a controller which controls at least washing, rinsing and spin-drying steps, in which the controller performs control in such a manner that during the rinsing step, after the rotary drum is rotated in a predetermined direction, water is drained by the drainage section, and at least during the drainage, a rotation speed of the rotary drum becomes a rotation speed at which the laundry adheres to an inner circumferential wall of the rotary drum.

[0008] Accordingly, because the rotary drum is rotated before drainage, at least during the drainage, laundry adheres to the rotary drum. As a result, it is possible to obtain water absorption into laundry and a spin-drying effect due to centrifugal force at the same time.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1 is a cross-sectional view of a front-loading-type washing machine according to a first embodiment of the present invention.

Fig. 2 is a block diagram describing a control circuit of the front-loading-type washing machine.

Fig. 3 is a time chart showing operations of a rinsing step and a spin-drying step of the front-loading-type washing machine.

Fig. 4 is a time chart showing operations of a rinsing step and a spin-drying step of a front-loading-type washing machine according to a second embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0010] Hereinafter, embodiments of the present invention will be described with reference to the drawings. The present invention is not limited to the embodiments.

(FIRST EXEMPLARY EMBODIMENT)

[0011] Hereinafter, a front-loading-type washing machine according to a first embodiment of the present invention will be described using Fig. 1.

[0012] Fig. 1 is a cross-sectional view of the front-loading-type washing machine according to the first embodiment of the present invention.

[0013] As shown in Fig. 1, the front-loading-type washing machine according to the embodiment includes at least rotary drum 4, water tub 3, motor 6, water supply valve 7b, drain valve 8b which is a drainage section, and control unit 11.

[0014] Water tub 3 is swingably provided in main body 1 and rotary drum 4 is rotatably provided in water tub 3. Rotary drum 4 is driven in a rotary manner around rotary axis 4a in normal or reverse rotation direction by motor 6 which is attached to the outside of the rear side of water tub 3.

[0015] On inner circumferential wall 4c of rotary drum

4, for example, plural agitating protrusions 4b which agitate laundry such as clothes and plural through holes 4e which communicate with the inside of water tub 3 are provided. On rear wall 4d that is the bottom of rotary drum 4, plural rear openings 4g are formed in a circumferential direction. Rear openings 4g are provided so as to face air inlet 18 formed on the upper side of the rear side of water tub 3.

[0016] In addition, rotary axis 4a of rotary drum 4 is provided to be inclined downward from the opening front side to the rear side at, for example, an angle $\theta = 20 \pm 15$ degrees from a horizontal direction X. Opening 13 of water tub 3 can be provided upward by inclining rotary axis 4a in this manner. Therefore, a user can put in or take out laundry such as clothes from rotary drum 4 through opening 13 of water tub 3 without bending over a great deal.

[0017] At this time, water tub 3 is provided in main body 1 with the same inclination as rotary drum 4. Therefore, in comparison with a case where rotary axis 4a is horizontal, the water supplied to water tub 3 is collected in the rear side, and a deep water storage state can be obtained even with a small amount of water. As a result, because favorable contact with laundry is made even with a small amount of water, it is possible to heighten a rinsing effect. Accordingly, during the drainage, even when a water level in rotary drum 4 is lowered, the water penetrates into the laundry for a long time to improve rinsing performance in comparison with the case where rotary axis 4a is horizontal. When there is no need to consider the amount of water supplied, rotary axis 4a may be horizontal or may have an inclination angle θ of less than 5 degrees. Therefore, the degree of freedom in design for the front-loading-type washing machine is improved.

[0018] In addition, on the front surface of main body 1, door 5, which faces opening 13 of water tub 3 and can be freely opened or closed, is provided and a user can put laundry such as clothes in rotary drum 4 through door 5. At the edge of opening 13 of water tub 3, circular sealing material 14 having elastic force is mounted. Even when water tub 3 vibrates right to left, up and down or back and forth, sealing material 14 is deformed to press the rear side of door 5, and therefore, sealability between water tub 3 and door 5 is maintained.

[0019] On the upper side of water tub 3, water supply unit 7 which supplies water to water tub 3 is provided. Water supply unit 7 includes water supply valve 7b, detergent container 7a to which water is supplied by opening or closing water supply valve 7b and water supply path 7c which supplies detergent in detergent container 7a and water to water tub 3.

[0020] On the lower side of water tub 3, drain unit 8 which drains water from water tub 3 is provided. Drain unit 8 includes drain pipe 8a of which one end is connected with the lowest part of water tub 3 and drain valve 8b. Drain valve 8b is opened to drain the water in water tub 3 through drain pipe 8a when needed, such as after a washing step is ended or when a rinsing step is ended, and closed to stop water drainage.

[0021] On the downstream side of drain pipe 8a, drain filter 8c which is detachable from the outside of main body 1 is provided. Drain filter 8c collects lint included in water drainage.

[0022] On the lower side of the rear side of water tub 3, drying unit 9 is provided. Drying unit 9 has blower 9c, circulating path 9d, inlet 9e, outlet 9f, dehumidifier 9g and heater 9h.

[0023] Blower 9c suctions air from outlet 9f which expels air from water tub 3 and rotary drum 4. Inlet 9e is provided on the rear side of water tub 3 and sends the suctioned air by blower 9c into rotary drum 4. The highly humid air from outlet 9f is dehumidified by dehumidifier 9g. The dehumidified air is heated by heater 9h provided on the lower side from dehumidifier 9g to become high-temperature air. Dehumidifier 9g and heater 9h are provided in circulating path 9d which connects blower 9c and inlet 9e. Dehumidifier 9g and heater 9h may be configured by a heat pump unit, or heater 9h may be configured by a heater and dehumidifier 9g may be configured by a water-cooling type or air-cooling type dehumidifier system.

[0024] On the lower side of the front side of water tub 3, circulating water path 31, which ejects the water in water tub 3 into rotary drum 4, and circulation pump 30, which suctions the water in water tub 3 and supplies the water to circulating water path 31, are provided. Circulation pump 30 is fixed to base plate 1a that is the bottom of main body 1, and suctions the water in water tub 3 to supply the water to circulating water path 31 through circulating water ejection pipe 32. The supplied water is ejected into rotary drum 4 from opening 15 of rotary drum 4 through circulating water path 31.

[0025] Specifically, circulating water ejection pipe 32 of circulating water path 31 is connected to ejection port 51 provided on front end wall 3f which is on the circumferential edge in the end of opening 13 of water tub 3 from the side of door 5. As indicated by the arrow A in Fig. 1, the water is ejected into rotary drum 4 through a flow path formed between the back surface of front end wall 3f of water tub 3 and the front surface of front end wall 4f of rotary drum 4 corresponding to the back surface of front end wall 3f.

[0026] Accordingly, as necessary, during each step of washing preparation, washing, rinsing and the like in which the amount of clothes is detected, the water in water tub 3 is circulated so as to prevent the detergent from being dissolved early and the laundry from being biased and improve washing and rinsing performance.

[0027] Ejection port 51 for the water from circulating water ejection pipe 32 is provided at a position in which the ejection port is not brought into contact with the laundry in rotary drum 4. Therefore, it is possible to prevent the laundry from being caught and disturbing the operation or being damaged during the washing, rinsing and drying steps.

[0028] When the water is simply ejected into rotary drum 4 from ejection port 51, as indicated by the arrow B in Fig. 1, the water can be ejected only to a part of the laundry in rotary drum 4, and therefore, a circulation effect cannot be utilized sufficiently. On the other hand, for example, when an ejection nozzle having plural ejection ports 51 is used for ejecting water in a wide area from ejection port 51, the force of water is reduced and as indicated by the arrow C in Fig. 1, the water can be ejected only to a part of the laundry in rotary drum 4. Then, while the pump pressure of circulation pump 30 may be increased to eject water vigorously, the pump pressure is increased, and a cost is increased. Therefore, in the first embodiment, for example, using a DC brushless motor capable of controlling the rotation speed in circulation pump 30 which circulates the water in water tub 3, the flow volume and the flow rate of water to be ejected are adjusted. Accordingly, the water can be supplied to a wide area and at the optimal position of the laundry in water tub 3 by circulation pump 30 without providing a special nozzle. As a result, washing performance and rinsing performance are improved. In addition, because the water is not wastefully supplied to a space where the laundry is not placed, wasteful electric power consumption can be suppressed and abnormal foam generation due to water containing detergent can be suppressed.

[0029] Further, a cloth amount detector (not shown) which detects the amount of the laundry put in rotary drum 4 is provided in main body 1.

[0030] Hereinafter, an example of a method of detecting the close amount detector will be described.

[0031] First, motor 6 is driven in a rotary manner. At this time, the rotation speed of rotary drum 4 is increased to the extent that the laundry adheres to inner circumferential wall 4c of rotary drum 4, for example, 100 rpm to 140 rpm. Rotary drum 4 is continuously rotated at the aforementioned rotation speed for a predetermined time and then, motor 6 is turned off. At this time, rotary drum 4 is continuously rotated due to the inertia of rotary drum 4. Accordingly, motor 6 of rotary drum 4 is rotated. Then, the rotation of rotary drum 4 is stopped by resistance such as friction. The time from the stop of electric power to the stop of rotary drum 4 is lengthened when the amount of laundry is large and shortened when the amount of laundry is small. Here, using the fact that the difference in time required for stopping rotary drum 4 is proportional to the amount of laundry, the amount of laundry is detected.

[0032] Furthermore, on the rear side of lower part 3b of water tub 3, water level detector 10 which detects the amount of water supplied to rotary drum 4 is provided. Water level detector 10 is configured in such a manner that air trap 10a provided at a predetermined position near lower part 3b of rotary drum 4 is brought into contact with a pressure detector (not shown) through hose 10b. The pressure detector includes, for example, a ferrite alloy integrated with a bellows part that moves due to pressure and a coil on the fixing side which surrounds the upper part of the outer circumference of the ferrite. Then, using a change in inductance between the ferrite and the coil, a moving stroke distance is converted to a pressure inside air trap 10a. Water level detector 10 is exposed to the atmosphere when there is no water in air trap 10a, and the output from the pressure detector is constant.

[0033] In this manner, water level detector 10 generally performs sensing by measuring the pressure inside air trap 10a using an air trap mechanism and can properly calculate the water level in water tub 3 without influence on the variation of a water level sensor by measuring the time until the pressure inside air trap 10a is changed to a stable atmosphere release pressure.

[0034] In addition, the output from water level detector 10 is changed due to the rotation, such as the existence of the rotation and the rotation speed of rotary drum 4 during the washing and rinsing steps, of rotary drum 4. Therefore, control unit 11, which will be described later, has plural frequencies corresponding to the rotation speed of rotary drum 4 and a water level table. That is, even when rotary drum 4 is stopped or being rotated, the water level can be detected.

[0035] On the upper side of water tub 3, rotation speed detector 21 which detects the rotation speed of rotary drum 4 and control unit 11 are provided.

[0036] The configuration of control unit 11 in the front-loading-type washing machine according to the embodiment will be described below using Fig. 2.

[0037] Fig. 2 is a block diagram describing a control circuit in front-loading-type washing machine according to the embodiment.

[0038] As shown in Fig. 2, control unit 11 includes at least, controller 11a, for example, having a microprocessor and the like, input setting section 11b, display 11c, storage section 11e and time measuring section 11f.

[0039] First, when a method of controlling the front-loading-type washing machine is input through input setting section 11b, controller 11a of control unit 11 displays the method on display 11c. Controller 11a of control unit 11 automatically controls motor 6, drain valve 8b, circulation pump 30 and water supply valve 7b through power switching section 11d according to an input mode setting and a control program stored in storage section 11e. Accordingly, control unit 11 controls a series of washing, rinsing, spin-drying steps.

[0040] Controller 11a supplies water, drains water or drives rotary drum 4 based on signals from time measuring section 11f which measures time, water level detector 10 and rotation speed detector 21. Thus, the time required for each operation and timing including the outputs from various sensors such as water level detector 10 and rotation speed detector 21 is figured out, and all the input and output controls can be managed by means of time. As a result, the time from the start of the washing step to the end of the spin-drying step is properly controlled to obtain a stable cleaning effect.

[0041] The operations and actions of the thus-configured front-loading-type washing machine will be de-

scribed below using Fig. 3 with reference to Fig. 1.

[0042] Since the existence of a drying function in the embodiment is irrelevant, the description of a drying step will be omitted.

[0043] In addition, in the following description, the operation that water is removed during the drainage will be described as drainage and spin-drying. In order to differentiate a drainage and spin-drying operation during a rinsing step and a drainage and spin-drying operation during a spin-drying step, drainage and spin-drying during a rinsing step is described as an intermediate drainage and spin-drying operation, and drainage and spin-drying during a spin-drying step is described as a final drainage and spin-drying operation.

[0044] First, door 5 is opened and laundry such as clothes is put in rotary drum 4 from opening 13 of water tub 3. Next, when a start switch (not shown) is manipulated to start operation, the amount of the laundry is detected by means of cloth amount detection with the rotation of rotary drum 4.

[0045] Water supply valve 7b is opened and water, of the amount of water set in advance according to the detected amount of the laundry, is supplied to water tub 3. At this time, the detergent accommodated in detergent container 7a is introduced into water tub 3 by using the water supply.

[0046] When the water level of water tub 3 is a predetermined level or more, controller 11a operates circulation pump 30 to accelerate the dissolution of the detergent. In addition, controller 11a controls motor 6 to drive rotary drum 4 in a rotary manner. Accordingly, an agitation operation, so-called tumbling, that the laundry in rotary drum 4 is lifted up in a rotation direction by agitating protrusions 4b and falls from the upper side of rotary drum 4 on the water surface of the water in which the detergent is dissolved due to the laundry's own weight, is repeatedly performed. As a result, contamination is removed by the detergent penetration into the laundry and the detergent discharge from the laundry Next, after a predetermined time has elapsed, controller 11a opens drain valve 8b through power switching section 11d, and discharges the contaminated water in water tub 3 from drain pipe 8a, and the washing step is ended.

[0047] Hereinafter, steps after the washing step will be described using Fig. 3.

[0048] Fig. 3 is a time chart showing operations of a rinsing step and a spin-drying step of the front-loading-type washing machine according to the first embodiment of the present invention.

[0049] In a first rinsing step, each operation of intermediate spin-drying, which mainly performs spin-drying, and water supply and agitation, which mainly performs rinsing, is sequentially performed.

[0050] First, as shown in Fig. 3, in the intermediate spin-drying operation, controller 11a starts a balance controlling process for reducing vibration that is generated by the laundry in rotary drum 4 when rotary drum 4 is rotated at a high speed. The balance controlling process is usually performed, for example, by rotating rotary drum 4 at a rotation speed of 50 rpm, and generally, for example, by detecting the vibration of rotary drum 4 using an vibration detection sensor (not shown) such as an acceleration sensor or the like.

[0051] After the balance controlling process is completed, controller 11a increases the rotation speed of rotary drum 4 to, for example, a predetermined rotation speed of about 900 rpm, and the water is removed from the laundry due to centrifugal force. After the rotation speed reaches the predetermined rotation speed, the rotation speed of rotary drum 4 is maintained during a predetermined time t1. Then, the driving of motor 6 is stopped. When the rotation of rotary drum 4 is stopped, the intermediate spin-drying operation is ended, and the operation is shifted to the next water supply and agitation. At this time, the laundry adheres to inner circumferential wall 4c of rotary drum 4.

[0052] In the water supply and agitation operation, first, controller 11a opens water supply valve 7b while rotating rotary drum 4 in a predetermined direction and collects water in water tub 3. At this time, for example, the rotation speed of rotary drum 4 is about 80 rpm, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4.

[0053] Then, when the water is collected in water tub 3 and water level detector 10 detects a water level h1, controller 11a controls water supply valve 7b to stop the water supply and turns on circulation pump 30. Accordingly, the water is ejected from ejection port 51 to the laundry in rotary drum 4. At this time, the rotation speed of rotary drum 4 is increased from 80 rpm, for example, to about 170 rpm to remove lint of the laundry by drain filter 8c.

[0054] When a predetermined time T has elapsed since an increase in the rotation speed of rotary drum 4 was started, controller 11a reduces the rotation speed of motor 6.

[0055] Controller 11a performs the tumbling operation in which the laundry in rotary drum 4 is agitated, water supply to water tub 3 is started and the operation of circulation pump 30 is stopped. In the tumbling operation, the rotation direction of rotary drum 4 may be forward-reversal rotation or may be rotation in a predetermined direction. Therefore, the laundry is detached from inner circumferential wall 4c of rotary drum 4, agitated in the water collected in water tub 3 and rinsed.

[0056] During the operation, when water is collected in water tub 3 and water level detector 10 detects a water level h2, controller 11a controls water supply valve 7b to stop water supply. When a predetermined time t2 has elapsed since the water supply was stopped, controller 11a stops the operation of rotary drum 4. The predetermined time t2 is set to be longer than the predetermined time t1 in which rotary drum 4 is rotated at a high rotation speed to have sufficient rinsing performance during the intermediate spin-drying in the first rinsing step. Therefore, the water supply and agitation is ended, and the

first rinsing step is ended. Then, the operation is shifted to a second rinsing step which is the next step.

[0057] In the second rinsing step, each operation of intermediate drainage and spin-drying, which mainly performs spin-drying, and water supply and agitation, which mainly performs rinsing, is sequentially performed.

[0058] As shown in Fig. 3, in the intermediate drainage and spin-drying operation, controller 11a rotates rotary drum 4 in a predetermined direction. At this time, the rotation direction may be the same as or reverse to the rotation direction of the water supply and agitation operation in the first rinsing step.

[0059] First, rotary drum 4 is rotated in a predetermined direction at a rotation speed of, for example, 80 rpm, which is a first rotation speed, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4 during the drainage. The rotation speed of rotary drum 4 may be, for example, 50 rpm to 120 rpm, which is a rotation speed at which the laundry adheres to inner circumferential wall 4c of rotary drum 4, and a rotation speed, for example, in a range of 80 rpm to 100 rpm is preferable. Moreover, the rotation speed of rotary drum 4 may not be constant and may be increased to a predetermined rotation speed in a stepwise or proportional manner.

[0060] After a time t3, which is a first predetermined time, has elapsed since the rotation of rotary drum 4 was started in a predetermined direction, controller 11a controls drain valve 8b to start drainage of the water in water tub 3. Accordingly, the water level of the water in water tub 3 is gradually lowered. At the same time, controller 11a increases the rotation speed of rotary drum 4 to a second rotation speed of, for example, about 500 rpm based on the signal from water level detector 10. At this time, the laundry in rotary drum 4 is rotated in a state where the laundry adheres to inner circumferential wall 4c of rotary drum 4. Here, the time t3 which is the first predetermined time is the time until rotary drum 4 has a predetermined rotation speed in a predetermined direction.

[0061] In addition, in the intermediate drainage and spin-drying during the second rinsing step, the first rotation speed of rotary drum 4 is lower than the second rotation speed in the intermediate spin-drying during the first rinsing step. That is, the rotation speed of rotary drum 4 is reduced so that water in the laundry is prevented from being completely removed. As a result, rinsing performance can be maintained without reducing centrifugal force due to the weight of the laundry containing water.

[0062] In addition, controller 11a starts driving of circulation pump 30 before drainage of the water in water tub 3 is started during the rotation of rotary drum 4.

[0063] In other words, after a time t4, which is a second predetermined time, has elapsed since the rotation of rotary drum 4 was started in a predetermined direction, controller 11a starts driving of circulation pump 30.

[0064] The water which has passed through circulating water path 31 from water tub 3 is ejected from ejection port 51 to the laundry in rotary drum 4 by circulation pump 30. At this time, the laundry absorbs the ejected water and also, water is removed due to centrifugal force by the rotation of rotary drum 4. The laundry is repeatedly subjected to water absorption and spin-drying.

[0065] The replacement of water with respect to the laundry is promoted and a detergent component in the laundry is dissolved in the water around the laundry. A detergent component remaining in the laundry, such as foam or the like, can be effectively removed. Therefore, the detergent component remaining in the laundry is decreased in a short period of time.

[0066] When the drainage proceeds and water level detector 10 detects a predetermined water level h3, controller 11a stops the driving of circulation pump 30. The predetermined water level h3 is a water level to the extent that circulation pump 30 does not cause air entrainment. Accordingly, the air entrainment of circulation pump 30 is prevented, and the water in water tub 3 can be effectively circulated through circulating water ejection pipe 32.

[0067] Next, after a predetermined time t5 has elapsed since the rotation of rotary drum 4 at a high speed was started in the intermediate drainage and spin-drying step, controller 11a stops the rotation of rotary drum 4. When the rotation of rotary drum 4 is stopped, the intermediate drainage and spin-drying operation is ended, and the operation proceeds to the water supply and agitation operation in the next second rinsing step.

[0068] In the water supply and agitation operation, controller 11a opens water supply valve 7b to collect water in water tub 3 and starts a tumbling operation which agitates rotary drum 4.

[0069] Next, when the water is collected in water tub 3 and water level detector 10 detects a water level h4, controller 11a controls water supply valve 7b to stop the water supply and starts driving of circulation pump 30 at the same time.

[0070] Then, after a predetermined time t6 has elapsed since the water supply was stopped, controller 11a stops the operations of rotary drum 4 and circulation pump 30 in order to end the water supply and agitation operation. Therefore, the second rinsing step is ended, and the operation is shifted to the final drainage and spin-drying in the next spin-drying step.

[0071] In the final drainage and spin-drying operation, first, controller 11a rotates rotary drum 4 in a predetermined direction. The rotation direction may be the same as or reverse to the rotation direction of the water supply and agitation operation in the first and second rinsing steps.

[0072] In addition, rotary drum 4 is rotated in a predetermined direction at a rotation speed of, for example, 80 rpm, which is a predetermined rotation speed, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4 during the drainage. The rotation speed of rotary drum 4 may be, for example, 50 rpm to 120 rpm, which is a rotation speed at which the laundry adheres

to inner circumferential wall 4c of rotary drum 4, and a rotation speed, for example, in a range of 80 rpm to 100 rpm is preferable. Moreover, the rotation speed of rotary drum 4 may not be constant and may be increased to a predetermined rotation speed in a stepwise or proportional manner.

[0073] Next, after a predetermined time t7 has elapsed since the rotation of rotary drum 4 was started in a predetermined direction, controller 11a controls drain valve 8b to start drainage of the water in water tub 3. Accordingly, the water level of the water in water tub 3 is gradually lowered. At the same time, controller 11a increases the rotation speed of rotary drum 4 to a high rotation speed of, for example, about 900 rpm based on the signal from water level detector 10. At this time, the laundry in rotary drum 4 is rotated in a state where the laundry adheres to inner circumferential wall 4c of rotary drum 4.

[0074] Controller 11a starts driving of circulation pump 30 before drainage of the water in water tub 3 is started during the rotation of rotary drum 4 in a predetermined direction.

[0075] In other words, after a predetermined time t8 has elapsed since the rotation of rotary drum 4 was started in a predetermined direction, controller 11a starts driving of circulation pump 30. The water which has passed through circulating water path 31 from water tub 3 is ejected from ejection port 51 to the laundry in rotary drum 4 by circulation pump 30. At this time, the laundry absorbs water by means of the ejected water. Furthermore, water is removed due to centrifugal force by the rotation of rotary drum 4. The laundry is repeatedly subjected to water absorption and spin-drying. The replacement of water with respect to the laundry is promoted and a detergent component in the laundry is dissolved in the water present around the laundry. A detergent component remaining in the laundry can be effectively removed. Therefore, the detergent component remaining in the laundry is decreased in a short period of time.

[0076] Then, when the drainage proceeds and water level detector 10 detects a predetermined water level h5, controller 11a stops the driving of circulation pump 30. Accordingly, while the water level falls to the predetermined water level h5 from the predetermined water level h4, the water from circulating water path 31 can be ejected to the laundry in rotary drum 4. Thus, an amount of water absorption of the laundry is increased without increasing the amount of water supplied and an amount of the detergent component remaining in the laundry can be reduced. The predetermined water level h5 is a water level to the extent that circulation pump 30 does not cause air entrainment. Accordingly, the air entrainment of circulation pump 30 is prevented and the water in water tub 3 can be effectively circulated through circulating water ejection pipe 32.

[0077] Next, after a predetermined time t9 has elapsed since the rotation of rotary drum 4 at a high speed was started in the final drainage and spin-drying operation, controller 11a stops the rotation of rotary drum 4. When the rotation of rotary drum 4 is stopped, the intermediate drainage and spin-drying operation is ended, and the spin-drying step is ended.

[0078] As described above, according to the embodiment, since a time point when the rotation of rotary drum 4 was started in a predetermined direction is set as a reference to set a time to start the drainage, the time until the drainage is started can be fixed. Therefore, the time of starting the drainage is properly controlled to shorten time and obtain a stable cleaning effect.

[0079] Further, according to the embodiment, a time point when the rotation of rotary drum 4 is started in a predetermined direction is set as a reference to set an ejection start time of water which is circulated in circulating water path 31 to be ejected. Therefore, the time of starting the circulation of water is properly controlled to obtain a high cleaning effect.

[0080] In the embodiment, the activation of circulation pump 30 has been described using an example defined by the time from time measuring section 11f, and is not limited thereto. Controller 11a may perform control in such a manner that circulation pump 30 is activated after the rotation speed of rotary drum 4 reaches a predetermined rotation speed. The details will be described in the following second embodiment.

(SECOND EXEMPLARY EMBODIMENT)

[0081] Fig. 4 is a time chart showing operations of a rinsing step and a spin-drying step of a front-loading-type washing machine according to a second embodiment of the present invention.

[0082] In the embodiment, intermediate drainage and spin-drying in a second rinsing step and final drainage and spin-drying in a spin-drying step are different from those in the first embodiment. Other configurations and operations are the same as in the first embodiment, the same reference numerals are attached to the same components, and as a detailed description, the detailed description of the first embodiment is used.

[0083] Here, the intermediate drainage and spin-drying in the second rinsing step and the final drainage and spin-drying in the spin-drying step will be described in detail.

[0084] As shown in Fig. 4, in the intermediate drainage and spin-drying, first, controller 11a rotates rotary drum 4 in a predetermined direction. At this time, the rotation direction may be the same as or reverse to the rotation direction of the water supply and agitation operation in the first rinsing step.

[0085] Rotary drum 4 is rotated in a predetermined direction at a predetermined rotation speed of, for example, 80 rpm, which is a first rotation speed, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4 during the drainage. The rotation speed of rotary drum 4 may be, for example, 50 rpm to 120 rpm, which is a rotation speed at which the laundry adheres to inner circumferential wall 4c of rotary drum 4, and a rotation

speed, for example, in a range of 80 rpm to 100 rpm is preferable. Moreover, the rotation speed of rotary drum 4 may not be constant and may be increased to a predetermined rotation speed in a stepwise or proportional manner.

[0086] When rotation speed detector 21 detects that the rotation speed of rotary drum 4 has reached a predetermined rotation speed since the rotation of rotary drum 4 was started in a predetermined direction, controller 11a starts driving of circulation pump 30. Accordingly, in a state where the rotation speed of rotary drum 4 is constant, water can be stably ejected to the laundry through circulating water path 31 in rotary drum 4. As a result, rinsing performance of the laundry is improved.

[0087] After a time t13, which is a first predetermined time, has elapsed since the rotation of rotary drum 4 reached the first predetermined rotation speed, controller 11a controls drain valve 8b to start drainage of the water in water tub 3. Accordingly, the water level of the water in water tub 3 is gradually lowered. At the same time, controller 11a increases the rotation speed of rotary drum 4 to a high rotation speed, which is a second rotation speed of, for example, about 500 rpm based on the signal from water level detector 10. At this time, the laundry in rotary drum 4 is rotated in a state where the laundry adheres to inner circumferential wall 4c of rotary drum 4.

[0088] In the intermediate drainage and spin-drying during the second rinsing step, the first rotation speed of rotary drum 4 is lower than the second rotation speed in the intermediate spin-drying during the first rinsing step which has been described in the first embodiment. That is, the rotation speed of rotary drum 4 is reduced so that water in the laundry is prevented from being completely removed. As a result, rinsing performance can be maintained without reducing centrifugal force due to the weight of the laundry containing water.

[0089] Next, after a time t14, which is a second predetermined time, has elapsed since the drainage was started, controller 11a stops driving of circulation pump 30. Then, after the rotation speed of rotary drum 4 reaches the first rotation speed, the operation can be shifted to the next operation. As a result, a reduction in rinsing performance of the laundry due to centrifugal force does not occur.

[0090] Next, after a predetermined time t15 has elapsed since the water level in water tub 3 became zero, controller 11a stops the operation of rotary drum 4. Then, the intermediate drainage and spin-drying step is ended by stopping the rotation of rotary drum 4, and the operation proceeds to the next operation of water supply and agitation.

[0091] In the water supply and agitation, first, controller 11a opens water supply valve 7b to collect water in water tub 3 and starts a tumbling operation which agitates rotary drum 4.

[0092] Next, when the water is collected in water tub 3 and water level detector 10 detects a water level h14, controller 11a controls water supply valve 7b to stop the water supply.

[0093] Then, after a predetermined time t16 has elapsed since the water supply was started, controller 11a starts driving of circulation pump 30. At this time, the water is collected in water tub 3 to the water level h14 and the tumbling operation is performed. Accordingly, a detergent component is dissolved out from the laundry in water tub 3 so that rinsing performance is improved.

[0094] After a predetermined time t17 has elapsed since the water supply was stopped, controller 11a stops the operation of rotary drum 4 and circulation pump 30 to end the water supply and agitation. Therefore, the second rinsing step is ended and the operation is shifted to final drainage and spin-drying in the next spin-drying step.

[0095] In the final drainage and spin-drying, first, during the drainage, controller 11a rotates rotary drum 4 in a predetermined direction at a predetermined rotation speed of, for example 80 rpm, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4. The rotary drum rotates in a predetermined direction. At this time, the rotation direction may be the same as or reverse to the rotation direction of the water supply and agitation in the first and second rinsing steps.

[0096] In addition, the rotation speed of rotary drum 4 may be a rotation speed of, for example, 50 rpm to 120 rpm, at which the laundry adheres to inner circumferential wall 4c of rotary drum 4, and a rotation speed, for example, in a range of 80 rpm, to 100 rpm is preferable. Then, the rotation speed of rotary drum 4 may not be constant and may be increased to a predetermined rotation speed in a stepwise or proportional manner.

[0097] Next, when rotation speed detector 21 detects that the rotation speed of rotary drum 4 reaches a predetermined rotation speed, controller 11a starts driving of circulation pump 30.

[0098] After a predetermined time t18 has elapsed since the rotation speed of rotary drum 4 reached a predetermined rotation speed, controller 11a controls drain valve 8b to start drainage of the water in water tub 3. Accordingly, the water level in water tub 3 is gradually lowered. At the same time, controller 11a increases the rotation speed of rotary drum 4 to for example, about 900 rpm based on the signal from water level detector 10. At this time, the laundry in rotary drum 4 is rotated in a state where the laundry adheres to inner circumferential wall 4c of rotary drum 4.

[0099] Next, after a predetermined time t19 has elapsed since the drainage was started, controller 11a stops circulation pump 30.

[0100] In addition, after a predetermined time t20 has elapsed since the water level in water tub 3 became zero, controller 11a stops the operation of rotary drum 4. The final drainage and spin-drying step is ended by stopping the rotation of rotary drum 4, and the spin-drying step is ended.

[0101] As described above, according to the embodiment, in the second rinsing step, rotary drum 4 is rotated

in a predetermined direction before the drainage is started. After the rotation speed of rotary drum 4 has reached a predetermined rotation speed, driving of circulation pump 30 is started. Therefore, in a state where the rotation of rotary drum 4 is stable, the water in water tub 3 can be circulated, and thus, rinsing performance is further improved.

[0102] In the embodiment, an example in which the drainage is started and the rotation speed of rotary drum 4 is increased from the first rotation speed to the second rotation speed has been described, but the embodiment is not limited thereto. For example, when the rotation speed of rotary drum 4 may be increased from the first rotation speed to the second rotation speed before the drainage or during the drainage and at least, the laundry adheres to the inner surface of rotary drum 4 during the drainage, the same effect can be obtained.

[0103] In the embodiment, through holes 4e are preferably provided over entire inner circumferential wall 4c of rotary drum 4, but the embodiment is not limited thereto. For example, the through holes may be formed partially on inner circumferential wall 4c of rotary drum 4, and the arrangement thereof is not particularly limited as long as the inside of water tub 3 communicates with the inside of rotary drum 4.

[0104] In the embodiment, an example in which water supply unit 7 is provided on the upper side of water tub 3 has been described, but the embodiment is not limited thereto. The water supply unit may be provided on the rear side, lateral side or bottom side of water tub 3 as long as the water can be supplied to water tub 3 and rotary drum 4.

[0105] In the embodiment, an example in which drain valve 8b is used as a drainage section has been described, but the embodiment is not limited thereto. The drainage section may include, for example, a drain pump and perform drainage of the water in water tubs 3 using the drain pump.

[0106] In the embodiment, a configuration in which circulation pump 30 is provided on base plate 1a which is the bottom of main body 1 has been described, but the embodiment is not limited thereto. For example, circulation pump 30 may be provided on lower part 3b of water tub 3 to circulate the water in water tub 3.

[0107] In the embodiment, an example in which one circulating water ejection pipe 32 is provided has been described, but the embodiment is not limited thereto. Plural circulating water ejection pipes 32 may be provided.

[0108] In addition, in the embodiment, an example in which ejection port 51 is provided only in the lower part has been described, but the embodiment is not limited thereto. That is, ejection port 51 may be provided not only in the lower part but also the upper part as long as the ejection port has a position with which the laundry in rotary drum 4 is not brought into contact, and plural ejection ports may be provided.

[0109] In addition, in the embodiment, an example in which the control of the rotation speed of circulation pump 30 is performed only with ON and OFF control has been described, but the embodiment is not limited thereto. For example, the rotation speed of circulation pump 30 may be controlled by changing the rotation speed in each step or according to an amount of laundry, as described below.

[0110] Specifically, in a normal washing step, circulation pump 30 operates at a rotation speed of, for example, about 3500 rpm and supplies about 20L water per minute to the laundry in water tub 3 so as to improve washing performance and rinsing performance. At this time, water is ejected from ejection port 51 in a direction of the arrow A in Fig. 1. On the other hand, when it is determined that the amount of laundry detected by the cloth amount detector is smaller than a predetermined value, the rotation speed of circulation pump 30 is reduced to, for example, about 2500 rpm, and the circulating water to be supplied is set to about 15L per minute. At this time, since the water was ejected from ejection port 51 in a direction of the arrow B in Fig, 1 by reducing the force of circulation pump 30, the ejection angle in a vertical direction is nearly horizontal and the degree of spreading in a horizontal direction is small. Accordingly, when the amount of laundry is small, the water can be effectively supplied to the laundry by avoiding a state where the ejected circulating water does not hit the laundry on the lower side of the inside of water tub 3.

[0111] In the embodiment, the rotation speed of rotary drum 4 is not particularly limited and a setting can be arbitrarily changed according to an amount of laundry or a degree of contamination. Moreover, in the embodiment, in relation to the ON and OFF control of circulation pump 30, circulation pump 30 is kept turned on during the rinsing step after circulation pump 30 is turned on, but the on period is not particularly limited, and ON and OFF control may be performed as necessary.

[0112] In addition, in the embodiment, the front-loading-type washing machine has been described as an example, but the embodiment is not limited thereto. For example, the same effect can be obtained from a pulsator agitation type or agitator type vertical washing machine (top-loading-type washing machine). In the case of the vertical washing machine, in order for water to penetrate uniformly, laundry may become wet uniformly from the outer circumferential side of the laundry using a shower provided outside the rotary drum. When the rotary drum is rotated during the drainage, the agitating blade and the rotary drum may integrally behave and thus, the laundry may absorb water or the water may be removed from the laundry by making the laundry adhere to the rotary drum.

[0113] As described above, according to the present invention, in the second rising step, rotary drum 4 is rotated in a predetermined direction before the drainage is started. Then, controller 11a drives drain valve 8b to drain water and at least during the drainage, performs control in such a manner that the rotation speed of rotary drum 4 becomes a rotation speed at which the laundry adheres to inner circumferential wall 4c of rotary drum 4. Accord-

ingly, the detergent component included in the laundry is removed from the laundry due to the centrifugal force by the increase of the rotation speed of rotary drum 4. By the spin-drying due to the centrifugal force and the driving of circulation pump 30, the ejected water is absorbed again into the laundry and the removed water is replenished. As a result, by repeatedly performing water absorption and water-removal, the detergent component in the laundry is effectively removed and thus, rinsing performance of the laundry is improved.

[0114] In addition, according to the present invention, because water is removed during water absorption, the water does not need to be repeatedly supplied to or drained from water tub 3. Accordingly, it is possible to increase a total amount of water absorption of the laundry without increasing an amount of water supplied, and water saving properties of the front-loading-type washing machine are improved. While the moisture in the laundry is maintained at a certain degree, the water is removed, and therefore, rotary drum 4 can be rotated with a stable centrifugal force.

INDUSTRIAL APPLICABILITY

[0115] In the front-loading-type washing machine according to the present invention, rinsing performance can be improved by repeatedly subjecting water absorption from rinsing water during the drainage and spin-drying by the rotation of the rotary drum to the laundry to make the detergent component dissolve out from the laundry. Therefore, the present invention can be also applied to a cleaning apparatus for fiber and the like and an industrial cleaning machine mainly used for washing with water, as well as a household washing machine.

REFERENCE MARKS IN THE DRAWINGS

[0116]

1 Main body
1a Base plate
3 Water tub
3f Front end wall
4 Rotary drum
4a Rotary axis
4b Agitating protrusion
4c Inner circumferential wall
4d Rear wall
4e Through hole
4f Front end wall
4g Rear opening
5 Door
6 Motor
7 Water supply unit
7a Detergent container
7b Water supply valve
7c Water supply path
8 Drain unit
8a Drain pipe
8b Drain valve (drainage section)
8c Drain filter
9 Drying unit
9c Blower
9d Circulating path
9e Inlet
9f Outlet
9g Dehumidifier
9h Heater
10 Water level detector 10a Air trap 10b Hose
11 Control unit
11a Controller
11b Input setting section
11c Display
11d Power switching section
11e Storage section
11f Time measuring section
13 Opening of water tub
14 Sealing material
15 Opening of rotary drum
18 Air inlet
21 Rotation speed detector
30 Circulation pump
31 Circulating water path
32 Circulating water ejection pipe
51 Ejection port

Claims

1. A front-loading-type washing machine comprising:

a rotary drum which accommodates laundry;
a water tub which rotatably supports the rotary drum;
a motor which drives the rotary drum in a rotary manner;
a water supply valve which supplies water to the water tub;
a drainage section which drains water from the water tub; and
a control unit having a controller which controls at least washing, rinsing and spin-drying steps,
wherein the controller performs control in such a manner that during the rinsing step, after the rotary drum is rotated in a predetermined direction, water is drained by the drainage section and at least during the drainage, a rotation speed of the rotary drum becomes a rotation speed at which the laundry adheres to an inner circumferential wall of the rotary drum.

2. The front-loading-type washing machine of Claim 1, wherein the rotation speed at which the laundry adheres to the inner circumferential wall of the rotary drum has a first rotation speed and a second rotation speed which is faster than the first rotation speed,

and
the controller performs control to rotate the rotary drum at the second rotation speed after a first predetermined time has elapsed since the rotary drum was rotated at the first rotation speed.

3. The front-loading-type washing machine of Claim 2, further comprising:

a circulating water path which ejects water in the water tub into the rotary drum; and
a circulation pump which suctions water in the water tub to supply the water to the circulating water path,
wherein the controller performs control to start driving of the circulation pump after a second predetermined time has elapsed since the rotary drum was rotated in a predetermined direction.

4. The front-loading-type washing machine of Claim 2, wherein the first predetermined time is the time until the rotary drum reaches the first rotation speed in a predetermined direction.

5. The front-loading-type washing machine of Claim 2, wherein the first predetermined time is a predetermined time elapsed after the rotary drum has reached a predetermined rotation speed in a predetermined direction.

6. The front-loading-type washing machine of Claim 3, wherein the controller starts driving of the circulation pump before drainage is started.

7. The front-loading-type washing machine of Claim 3, wherein the controller starts driving of the circulation pump after the rotary drum has reached a predetermined rotation speed.

8. The front-loading-type washing machine of Claim 3, wherein the control unit has a time measuring section which measures time and the controller performs control to drive at least one of the circulation pump and the drain valve based on a signal from the time measuring section.

9. The front-loading-type washing machine of Claim 3, further comprising:

a rotation speed detector which detects the rotation speed of the rotary drum,
wherein the controller performs control to drive at least one of the circulation pump and the drain valve based on a signal from the rotation speed detector.

10. The front-loading-type washing machine of Claim 9, wherein the rotation speed detector determines whether the rotation speed of the rotary drum reaches a predetermined rotation speed, and when the rotation speed of the rotary drum reaches a predetermined rotation speed, at least one of the circulation pump and the drain valve is driven.

Amended claims under Art. 19.1 PCT

1. Amended) A front-loading-type washing machine comprising:

a rotary drum which accommodates laundry;
a water tub which rotatably supports the rotary drum;
a motor which drives the rotary drum in a rotary manner;
a water supply valve which supplies water to the water tub;
a drainage section which drains water from the water tub;
a circulating water path which ejects water in the water tub into the rotary drum;
a circulation pump which suctions water in the water tub to supply the water to the circulating water path; and
a control unit having a controller which controls at least washing, rinsing and spin-drying steps,
wherein the controller performs control in such a manner that during the rinsing step, after the rotary drum is rotated in a predetermined direction, water is drained by the drainage section and at least during the drainage, a rotation speed of the rotary drum becomes a rotation speed at which the laundry adheres to an inner circumferential wall of the rotary drum, to have a period of driving the circulation pump during the drainage.

2. The front-loading-type washing machine of Claim 1,
wherein the rotation speed at which the laundry adheres to the inner circumferential wall of the rotary drum has a first rotation speed and a second rotation speed which is faster than the first rotation speed, and
the controller performs control to rotate the rotary drum at the second rotation speed after a first predetermined time has elapsed since the rotary drum was rotated at the first rotation speed.

3. Amended) The front-loading-type washing machine of Claim 2,
wherein the controller performs control to start driving of the circulation pump after a second predetermined time has elapsed since the rotary drum was rotated in the predetermined direction.

4.
The front-loading-type washing machine of Claim 2, wherein the first predetermined time is a time until the rotary drum reaches the first rotation speed in the predetermined direction.

5.
The front-loading-type washing machine of Claim 2, wherein the first predetermined time is a predetermined time elapsed after the rotary drum has reached a predetermined rotation speed in the predetermined direction.

6.
The front-loading-type washing machine of Claim 3, wherein the controller starts driving of the circulation pump before drainage is started.

7.
The front-loading-type washing machine of Claim 3, wherein the controller starts driving of the circulation pump after the rotary drum has reached a predetermined rotation speed.

8. Amended) The front-loading-type washing machine of Claim 1,
wherein the control unit has a time measuring section which measures time and the controller performs control to drive at least one of the circulation pump and the drain valve based on a signal from the time measuring section.

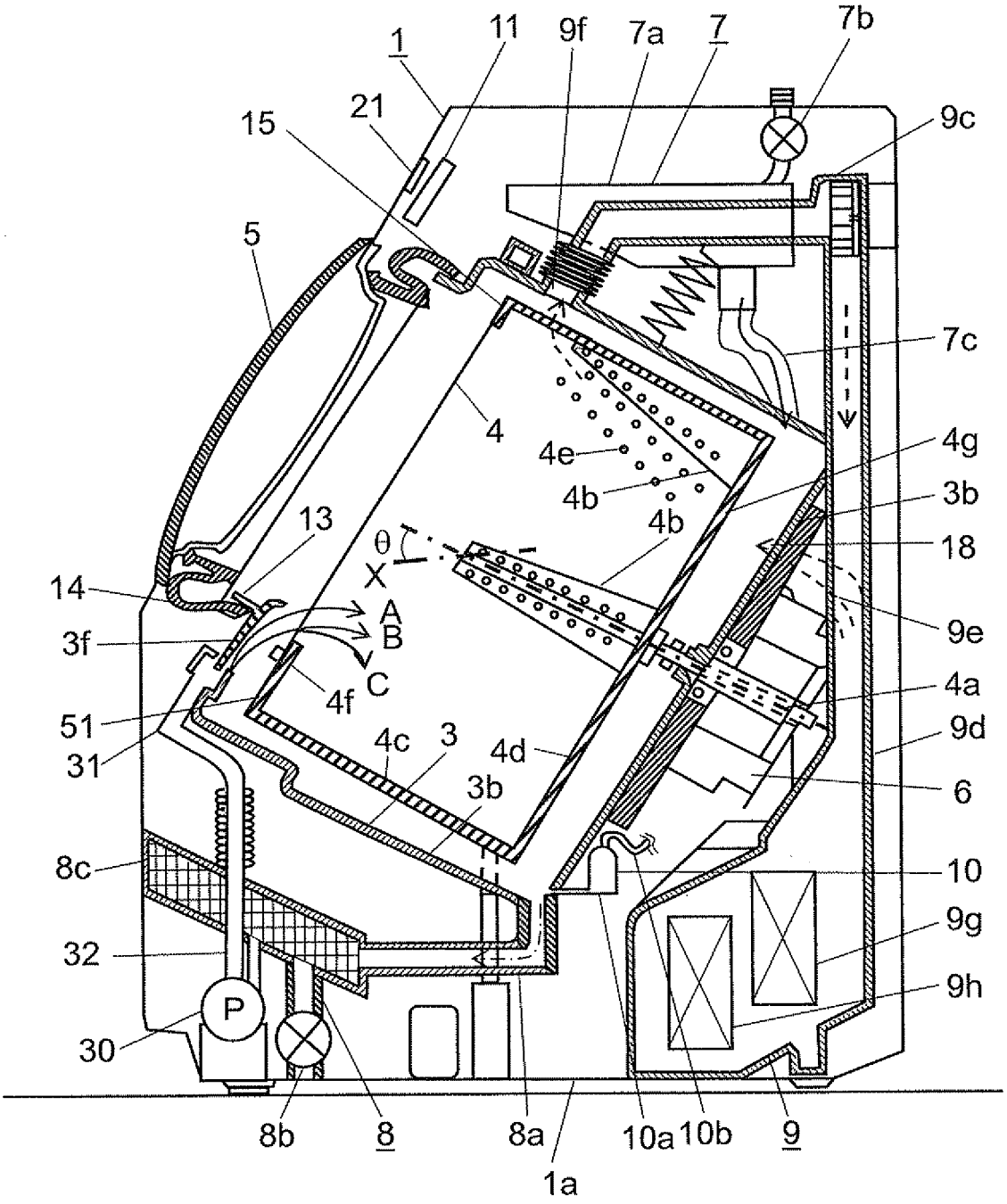
9. Amended) The front-loading-type washing machine of Claim 1, further comprising:

a rotation speed detector which detects the rotation speed of the rotary drum,
wherein the controller performs control to drive at least one of the circulation pump and the drain valve based on a signal from the rotation speed detector.

10. The front-loading-type washing machine of Claim 9,
wherein the rotation speed detector determines whether the rotation speed of the rotary drum reaches the predetermined rotation speed, and when the rotation speed of the rotary drum reaches a predetermined rotation speed, at least one of the circulation pump and the drain valve is driven.

11. Newly Added) The front-loading-type washing machine of Claim 1,
wherein the controller stops the circulation pump when a water level in the water tub is equal to or less than a predetermined water level.

FIG. 1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11
9f
7a
7
7b
21
15
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5
7c
4
4e
4g
4b
3b
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θ
18
14
X
A
B
C
9e
3f
4f
4a
51
4c
3
4d
9d
31
3b
6
8c
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9g
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9h
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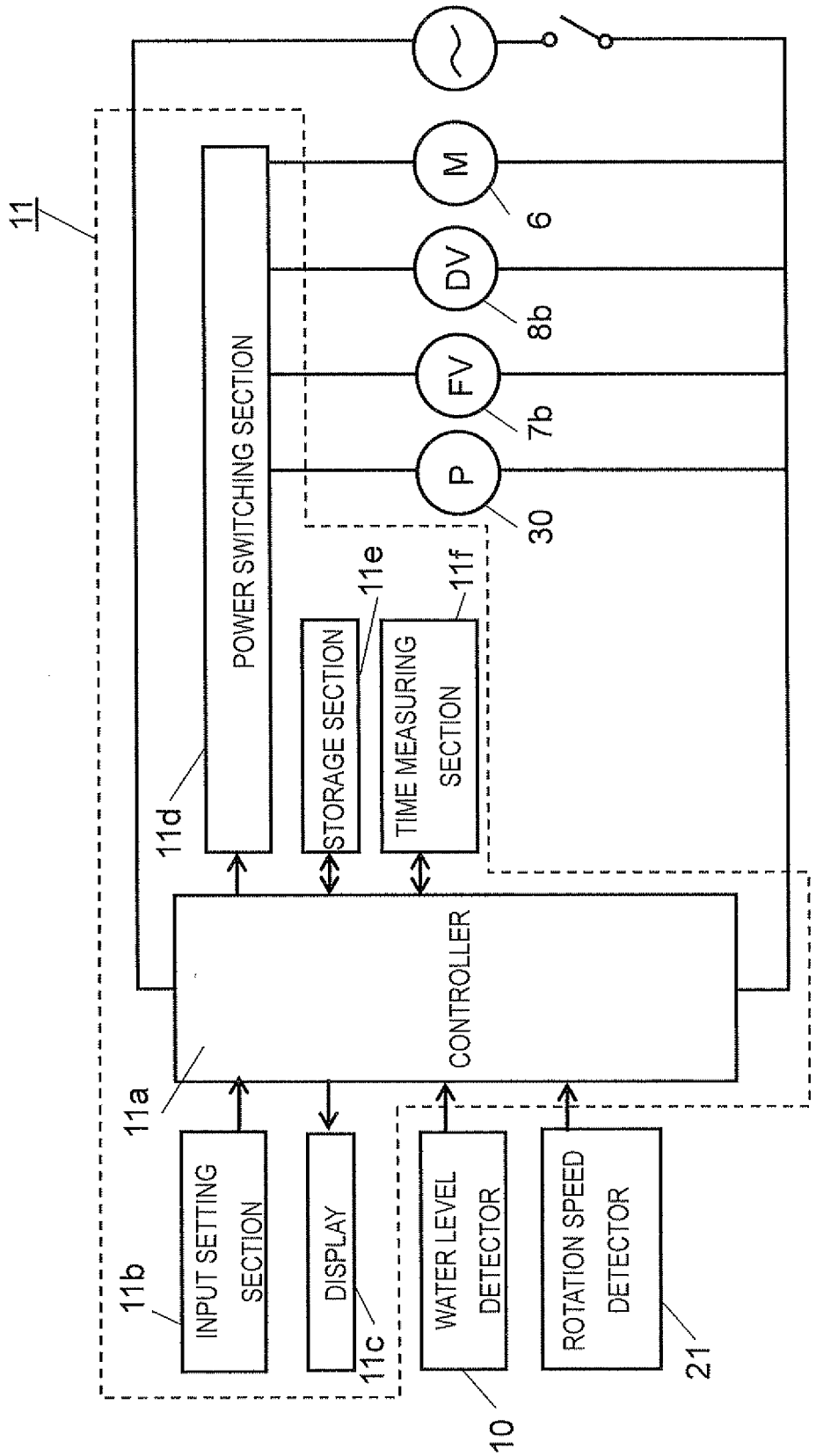
8b
8
8a
10a
10b
9
1a

FIG. 2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M
6
DV
8b
FV
7b
P
30
11d
STORAGE SECTION
11e
TIME MEASURING SECTION
11f
CONTROLLER
11a
INPUT SETTING SECTION
11b
DISPLAY
11c
WATER LEVEL DETECTOR
ROTATION SPEED DETECTOR
21
10

FIG. 3

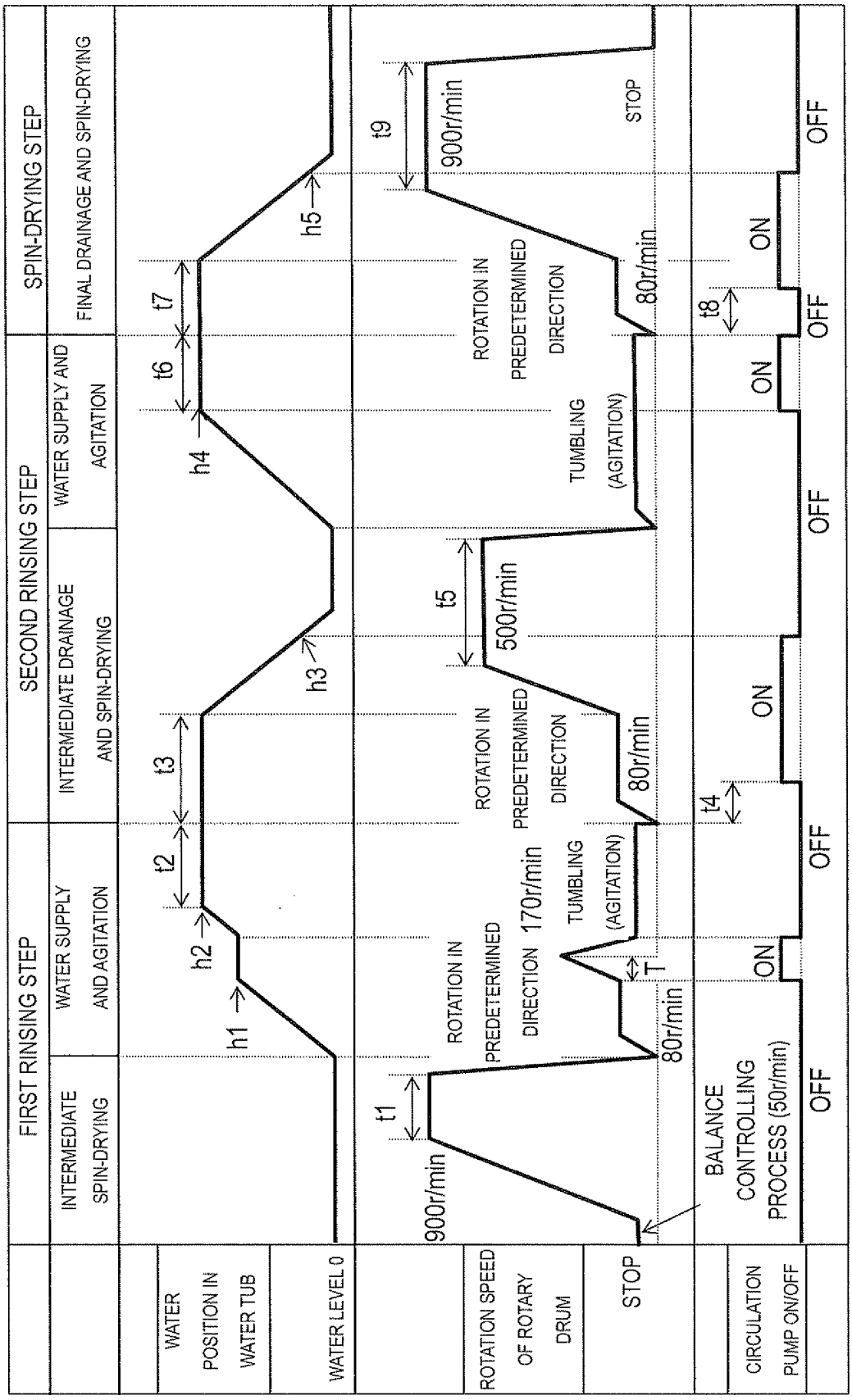
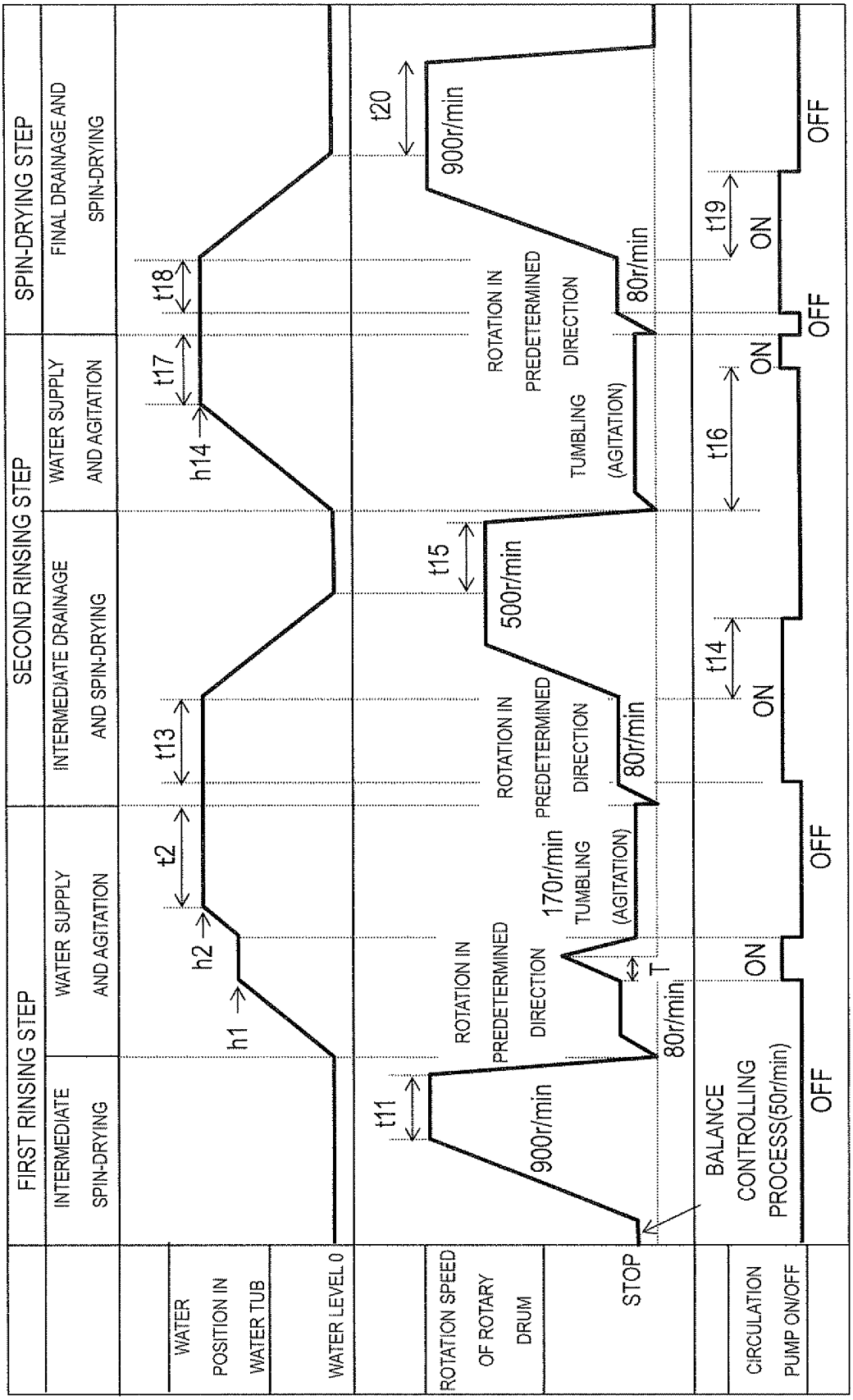

FIRST RINSING STEP
SECOND RINSING STEP
SPIN-DRYING STEP
INTERMEDIATE SPIN-DRYING
WATER SUPPLY AND AGITATION
INTERMEDIATE DRAINAGE AND SPIN-DRYING
WATER SUPPLY AND AGITATION
FINAL DRAINAGE AND SPIN-DRYING
WATER POSITION IN WATER TUB
WATER LEVEL 0
h1
h2
h3
h4
h5
t1
t2
t3
t4
t5
t6
t7
t8
t9
ROTATION SPEED OF ROTARY DRUM
900r/min
ROTATION IN PREDETERMINED DIRECTION
170r/min
80r/min
TUMBLING (AGITATION)
T
500r/min
ROTATION IN PREDETERMINED DIRECTION
80r/min
TUMBLING (AGITATION)
900r/min
STOP
BALANCE CONTROLLING PROCESS (50r/min)
CIRCULATION PUMP ON/OFF
ON
OFF

FIG. 4


FIRST RINSING STEP
SECOND RINSING STEP
SPIN-DRYING STEP
INTERMEDIATE SPIN-DRYING
WATER SUPPLY AND AGITATION
INTERMEDIATE DRAINAGE AND SPIN-DRYING
WATER SUPPLY AND AGITATION
FINAL DRAINAGE AND SPIN-DRYING
WATER POSITION IN WATER TUB
WATER LEVEL 0
h1
h2
h14
t2
t13
t17
t18
t20
ROTATION SPEED OF ROTARY DRUM
STOP
900r/min
t11
ROTATION IN PREDETERMINED DIRECTION
170r/min
TUMBLING (AGITATION)
80r/min
T
500r/min
t15
ROTATION IN PREDETERMINED DIRECTION
TUMBLING (AGITATION)
80r/min
900r/min
80r/min
t14
t16
t19
ON
ON
ON
CIRCULATION PUMP ON/OFF
BALANCE CONTROLLING PROCESS(50r/min)
OFF
OFF
OFF
OFF

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/001716

A. CLASSIFICATION OF SUBJECT MATTER
D06F33/02(2006.01)i, *D06F39/08*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F33/02, D06F39/08

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 2009-78068 A (Sanyo Electric Co., Ltd.), 16 April 2009 (16.04.2009), entire text; all drawings (Family: none)	1,2,4,5 3,6-10
A	JP 2004-16399 A (Sharp Corp.), 22 January 2004 (22.01.2004), entire text; all drawings (Family: none)	1-10
A	JP 2001-224886 A (Toshiba Corp.), 21 August 2001 (21.08.2001), entire text; all drawings (Family: none)	1-10

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

* Special categories of cited documents:
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 21 May, 2012 (21.05.12)	Date of mailing of the international search report 05 June, 2012 (05.06.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2004016399 A **[0006]**