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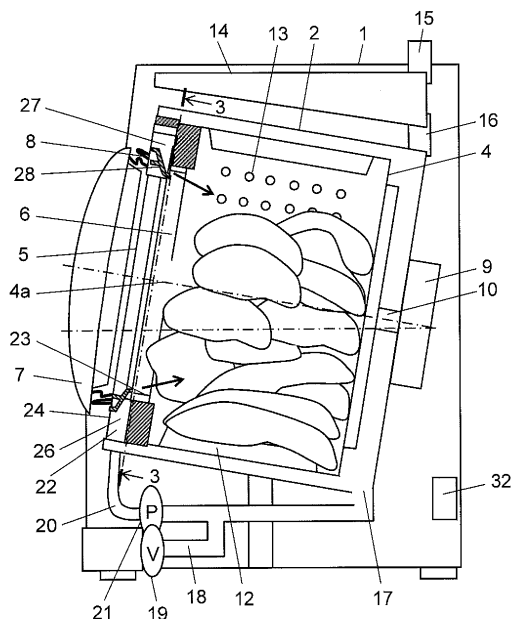
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(54) **DRUM-TYPE WASHING MACHINE**

(57) A washing machine includes: a water tub for storing washing water; a rotary tub located so as to be rotatable in the water tub and having a front end provided with an opening; a motor for driving the rotary tub; a circulating water channel for circulating the washing water in the water tub to the rotary tub; a pump for transferring the washing water in the water tub to the circulating water channel; a nozzle channel having a substantially circular shape, being in communication with the circulating water channel, and provided outside a peripheral edge of the opening of the rotary tub; a plurality of nozzles provided on the nozzle channel, for jetting the washing water transferred by the pump toward an inside of the rotary tub; and a controller for driving the motor and the pump to execute a washing process. The washing process includes a first rotation step of rotating at a speed that does not allow a washing target in the rotary tub to be stuck to an inner peripheral wall of the rotary tub, and a second rotation step of rotating at a speed that allows the washing target in the rotary tub to be stuck to the inner peripheral wall of the rotary tub. The controller drives the pump in the second rotation step, to supply the washing water to the washing target stuck to the inner peripheral wall of the rotary tub.

FIG. 1



Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a front-loading-type washing machine for washing clothes and the like.

BACKGROUND ART

10 **[0002]** A conventional front-loading-type washing machine uses a smaller amount of water than a top-loading-type washing machine, and part of a washing target in a water tub is not soaked in washing water. The washing water in the water tub is thus circulated into a rotary tub with use of a pump so as to be jetted toward the washing target (see PTL 1, for example).

[0003] In the front-loading-type washing machine according to PTL 1, the washing water is jetted from a plurality of jetting ports that are provided from the front end of the rotary tub to the center of the rotary tub at slightly different angles.

15 **[0004]** In the conventional configuration described above, the jetting ports are located at the upside of the front end of the rotary tub and the washing water is jetted downward. Although the washing water is jetted from the plurality of jetting ports that are aligned toward the rear end of the rotary tub at the slightly different angles, the washing target located at various positions in the rotary tub cannot be evenly supplied with the washing water. Even if the washing water can be applied evenly in the rotary tub, when the rotary tub accommodates a large amount of washing target, the
20 washing water is supplied only to surfaces of the washing target near the jetting ports and is unlikely to spread to an inner portion of the piled washing target. The conventional front-loading-type washing machine thus fails to achieve sufficient washing and rinsing effects.

Citation List

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Patent Literature

[0005] PTL 1: Unexamined Japanese Patent Publication No. H10-127978

30 SUMMARY OF THE INVENTION

[0006] A front-loading-type washing machine according to the present invention includes: a water tub for storing washing water; a rotary tub located so as to be rotatable in the water tub and having a front end provided with an opening; a motor for driving the rotary tub; a circulating water channel for circulating the washing water in the water tub to the
35 rotary tub; a pump for transferring the washing water in the water tub to the circulating water channel; a nozzle channel having a substantially circular shape, being in communication with the circulating water channel, and provided outside a peripheral edge of the opening of the rotary tub; a plurality of nozzles provided on the nozzle channel, for jetting the washing water transferred by the pump toward an inside of the rotary tub; and a controller for driving the motor and the pump to execute a washing process. The washing process includes a first rotation step of rotating at a speed that does
40 not allow a washing target in the rotary tub to be stuck to an inner peripheral wall of the rotary tub, and a second rotation step of rotating at a speed that allows the washing target in the rotary tub to be stuck to the inner peripheral wall of the rotary tub. The controller drives the pump in the second rotation step, to supply the washing water to the washing target stuck to the inner peripheral wall of the rotary tub.

[0007] In this configuration, the washing water transferred into the water tub by the pump can be supplied continuously and evenly, not only to part of the washing target near the jetting ports but also to the entire washing target stuck to the inner peripheral wall of the rotary tub. This leads to improvement in washing efficiency regardless of the amount of the washing target in the rotary tub.

BRIEF DESCRIPTION OF DRAWINGS

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[0008]

FIG. 1 is a sectional view depicting a schematic structure of a front-loading-type washing machine according to a first exemplary embodiment of the present invention.

55 FIG. 2 is a sectional view depicting a main portion of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 3 is a sectional view along arrows 3-3 indicated in FIG. 1, of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 4 is a sectional view depicting a nozzle of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 5 is a sectional view of a conventional nozzle.

FIG. 6A is a pattern view depicting a situation of a washing target in a rotary tub of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 6B is a pattern view depicting other situations of the washing target in the rotary tub of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 6C is a pattern view depicting still other situations of the washing target in the rotary tub of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 7 is a pattern view depicting a situation of washing targets in a case where a single nozzle jets circulating water.

FIG. 8 is a pattern view depicting a situation of the washing targets in a case where a plurality of nozzles jet circulating water in the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 9A is a timing chart indicating behavior in the washing process of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 9B is another timing chart indicating behavior in the washing process of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 9C is still another timing chart indicating behavior in the washing process of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENT

[0009] Described below with reference to the drawings is a washing machine according to an exemplary embodiment of the present invention. It is noted that the following exemplary embodiment is merely an example embodying the present invention and is not to limit the technical scope of the present invention.

FIRST EXEMPLARY EMBODIMENT

[0010] The first exemplary embodiment of the present invention is described below with reference to the drawings. FIG. 1 is a sectional view depicting a schematic structure of a front-loading-type washing machine according to the first exemplary embodiment of the present invention. FIG. 2 is a sectional view depicting a main portion of the front-loading-type washing machine according to the first exemplary embodiment of the present invention. FIG. 3 is a sectional view along arrows 3-3 indicated in FIG. 1, of the front-loading-type washing machine according to the first exemplary embodiment of the present invention. FIG. 4 is a sectional view depicting a nozzle of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

[0011] In FIGs. 1 to 4, water tub 2 having a bottomed cylindrical shape is elastically supported in housing 1. Water tub 2 accommodates rotary tub 4 that has a bottomed cylindrical shape and is located so as to be rotatable. Rotary tub 4 has rotation axis 10 that substantially is matched with the center line of the cylindrical shape of rotary tub 4 and is also matched with the center line of the cylindrical shape of water tub 2. Water tub 2 and rotary tub 4 are provided at the front ends with openings 5 and 6, respectively. Assuming that opening 5 of water tub 2 is located at the front side of housing 1, a shaft on rotation axis 10 of rotary tub 4 is supported so as to be inclined (e.g. 10 degrees to 20 degrees) upward toward the front with respect to the horizontal direction. Rotation axis 10 inclined upward toward the front achieves deeply stored water with a small amount and thus improves the water saving property. Rotation axis 10 can be located horizontally if the water saving property is not taken into consideration.

[0012] Housing 1 is provided, on the front surface, with openable door 7 that faces opening 5 of water tub 2 and opening 6 of rotary tub 4. A user opens door 7 in order to load and unload a washing target into and out of rotary tub 4. Opening 5 of water tub 2 is surrounded with bellows 8 that is made of a soft elastic material such as rubber. When door 7 is closed, its inner surface comes into pressure contact with an end of bellows 8 and opening 5 and door 7 are sealed with each other.

[0013] Water tub 2 is provided, at an end surface not having opening 5, with motor 9 for driving to rotate rotary tub 4. Motor 9 has a rotor coupled to the shaft on rotation axis 10 of rotary tub 4, so that rotation of motor 9 is transmitted to rotary tub 4 by way of the shaft on rotation axis 10. Rotary tub 4 has a peripheral wall that is provided with a plurality of projections 12 projecting toward rotation axis 10. When rotary tub 4 rotates, the washing target is agitated by being caught by projections 12 to be lifted upward and being dropped from certain height.

[0014] The peripheral wall of rotary tub 4 is entirely provided with a plurality of small holes 13, so that washing water in water tub 2 having reached predetermined water level enters rotary tub 4 through small holes 13. The washing water is defined as water containing a detergent component in the washing process.

[0015] Water tub 2 is provided thereabove with detergent case 14 accommodating detergent. Detergent case 14 is connected to water supply valve 15 that is connected with a water tap. Water supply valve 15 is opened or closed so

as to supply tap water or stop supply of tap water into detergent case 14. Detergent case 14 is provided therebelow with water supply channel 16 that guides, into water tub 2, water having been guided into detergent case 14 along with detergent.

[0016] Water tub 2 is provided, at the lower portion, with exhaust port 17 and exhaust channel 18. Exhaust port 17 allows washing water in water tub 2 to be exhausted, and exhaust channel 18 guides the washing water exhausted through exhaust port 17 to the outside of housing 1. Exhaust channel 18 is provided halfway with exhaust valve 19 for opening and closing exhaust channel 18.

[0017] Exhaust port 17 is connected with circulating water channel 20 that guides the washing water exhausted from water tub 2 again into water tub 2 by way of rotary tub 4. Circulating water channel 20 is provided such that exhaust channel 18 is branched halfway. Circulating water channel 20 is located below water tub 2 so as to extend forward and substantially horizontally from the lower rear end of water tub 2. Circulating water channel 20 is provided halfway with pump 21. Pump 21 is capable of sucking the washing water in water tub 2 into circulating water channel 20 through exhaust port 17, pressurizing the washing water flown into circulating water channel 20 and transferring to rotary tub 4, so as to circulate the washing water to water tub 2 by way of circulating water channel 20.

[0018] Water tub 2 is provided, at the front inner end, with nozzle channel 22 that is located on the outer periphery of circular opening 5 of water tub 2 when viewed from opening 6 of rotary tub 4. Nozzle channel 22 is in communication with circulating water channel 20, has a substantially circular shape, and is located outside peripheral edge 23 of circular opening 6 of rotary tub 4. Opening 5 of water tub 2, opening 6 of rotary tub 4, and nozzle channel 22 are located substantially concentrically. Nozzle channel 22 has inner peripheral edge 24 that is positioned radially outside peripheral edge 23 of opening 6.

[0019] The washing water in water tub 2 transferred by pump 21 passes through circulating water channel 20, is guided into nozzle channel 22 through inlet port 25 provided in nozzle channel 22, and is guided to at least three (seven in the example shown in FIG. 3) nozzles 26 (26a to 26g) provided on nozzle channel 22. Nozzles 26 are provided so as to jet washing water from nozzle channel 22 toward rotation axis 10 of rotary tub 4.

[0020] Nozzles 26 and peripheral edge 23 of opening 6 form space 27 therebetween. Space 27 is provided with reflector 28 for reflecting the washing water jetted from nozzles 26 into space 27 toward opening 6. Reflector 28 guides the washing water jetted into space 27 through opening 6 into rotary tub 4. The plurality of nozzles 26 (26a to 26g) are positioned away from peripheral edge 23 of opening 6 of rotary tub 4. In this configuration, nozzles 26 are capable of applying diffused washing water to the washing target in rotary tub 4 even though nozzles 26 are not exposed into opening 6 of rotary tub 4. The washing target is not damaged by being caught at opening 6 when loaded into or unloaded out of rotary tub 4. Furthermore, the washing target can be loaded or unloaded easily and usability is thus improved.

[0021] There is provided no guide wall surface or the like for guiding jet flows from nozzles 26 to reflector 28. The jet flows from nozzles 26 are released into space 27 and then hit collision surface 28a of reflector 28. Collision surface 28a is configured such that the jet flows from nozzles 26 are diffused and guided into rotary tub 4 through opening 6 of rotary tub 4. The jet flows from nozzles 26 are guided into rotary tub 4 without receiving unnecessary resistance by any wall surface even though nozzles 26 are positioned away from peripheral edge 23 of opening 6 of rotary tub 4. This configuration minimizes deterioration in speed of the flows of the washing water, and the washing water can be powerfully supplied to the washing target in rotary tub 4.

[0022] Nozzles 26 each have a circular hole shape, because nozzles 26 need not to be flattened in order to follow any guide wall surface. The circular hole shape minimizes pressure loss among shapes having a same sectional area. This shape minimizes deterioration in flow rate of the washing water jetted from nozzles 26, so that the washing target in rotary tub 4 can be supplied with the washing water of a sufficient amount. Reflector 28 diffuses the jet flows each having a bar shape, so that the washing water can be applied to a wide range of the washing target in rotary tub 4. This enhances washing performance and rinsing performance.

[0023] Reflector 28 has an annular shape so as to surround opening 5 and face the front surface of rotary tub 4. Collision surface 28a hit by the washing water jetted from nozzles 26 is inclined with respect to the directions of the jet flows from nozzles 26. In this configuration, each of the jet flows from nozzles 26 is not scattered into multiple directions by collision surface 28a, but stably reaches collision surface 28a and is diffused while flowing along the inclined surface. The washing target in rotary tub 4 can be thus supplied with the washing water that is diffused stably.

[0024] The jet flows can reach collision surface 28a more stably and be diffused as collision surface 28a has a smaller inclination angle with respect to the direction of the jet flow from each of nozzles 26. However, if reflector 28 is configured only by collision surface 28a that has a small inclination angle with respect to the direction of the jet flow from each of nozzles 26, the jet flow cannot be guided toward the rear end in rotary tub 4. In this case, the washing water is supplied only to clothes located near the front end in rotary tub 4.

[0025] Reflector 28 is thus provided, at the inner peripheral edge, with guide 28b that guides the jet flows from nozzles 26 having hit collision surface 28a toward the rear end in rotary tub 4. Collision surface 28a is inclined at a smaller angle than guide 28b with respect to the direction of the jet flow from each of nozzles 26. In this configuration, collision surface 28a does not need to guide the jet flows from nozzles 26 directly into rotary tub 4. Collision surface 28a can be thus

provided to have a small inclination angle with respect to the direction of the jet flow from each of nozzles 26. The jet flows from nozzles 26 can thus reach collision surface 28a more stably and be diffused. Guide 28b thereafter guides the jet flows so as to be directed into rotary tub 4, so that the washing target in rotary tub 4 can be supplied with the washing water that is diffused stably.

[0026] Reflector 28 is also configured such that guide 28b guides washing water for a distance shorter than a distance of the washing water guided by collision surface 28a. In order to cause the jet flow from each of nozzles 26 to stably reach collision surface 28a and be diffused, the jet flow needs to be in contact with collision surface 28a for a distance not less than the range of collision of the jet flow. Meanwhile, guide 28b has only to change the directions of the jet flows. The distance of contact between guide 28b and each of the jet flows can be thus shorter than the distance of contact between collision surface 28a and each of the jet flows. This configuration minimizes deterioration in speed of the jet flows at guide 28b, so that the washing water can be more powerfully supplied to the washing target in rotary tub 4. This enhances washing performance and rinsing performance.

[0027] The washing water transferred by pump 21 forms the bar-shaped jet flows that are jetted toward rotation axis 10 from the plurality of nozzles 26a to 26g provided on nozzle channel 22. The washing water jetted into space 27 hits collision surface 28a of reflector 28, and is reflected toward opening 6 of rotary tub 4 and diffused in the rotation direction of rotary tub 4. Guide 28b causes the washing water to be jetted from the vicinity of peripheral edge 23 of opening 6 into rotary tub 4.

[0028] The plurality of nozzles 26 are provided on nozzle channel 22 that has a substantially circular shape and is located outside peripheral edge 23 of opening 6. The direction of the washing water jetted from each of nozzles 26a to 26g is displaced in a same direction from the direction toward rotation axis 10 of rotary tub 4 at a predetermined displacement angle (deviation angle) θ_1 when viewed from the opening of rotary tub 4.

[0029] This configuration expands the travel range of the washing water jetted into rotary tub 4, and the washing target in rotary tub 4 can be supplied with the washing water efficiently and evenly. If the displacement angle (deviation angle) for the directions of the jetted washing water is too large, there is generated an area near rotation axis 10 through which the washing water does not pass. In order not to generate such an area near rotation axis 10, through which the washing water does not pass, the displacement angle (deviation angle) θ_1 for displacing direction B of the jetted washing water with respect to rotation axis 10 is preferably set to about a half (e.g. 5 degrees to 15 degrees) of expansion angle θ_2 (e.g. 10 degrees to 30 degrees) of the washing water diffused in the rotation direction of rotary tub 4.

[0030] Nozzle channel 22 is provided with swelling portions 29 each of which is formed by partially swelling nozzle channel 22 toward rotation axis 10 of rotary tub 4. Nozzles 26 are each configured such that swelling portion 29 has flat portion 30 provided with circular nozzle hole 31. Nozzle hole 31 has length L not more than diameter d of nozzle hole 31. Flat portion 30 is perpendicular to the direction of the washing water jetted from nozzle hole 31, and is inclined at the angle same as displacement angle (deviation angle) θ_1 for the direction of the jetted washing water with respect to the direction toward rotation axis 10.

[0031] The inside of swelling portion 29 is separated from a main flow (an arrow indicated by a dotted line) of the washing water flowing in nozzle channel 22 to end 22a. Nozzles 26 (26a to 26g) are thus unlikely to be influenced by the main flow. This configuration can inhibit turbulence of the jet flows from nozzles 26 (26a to 26g) and stabilize the directions of the jetted washing water. The jet flows from nozzles 26 (26a to 26g) can be also contracted, so that the jet flows each have an increased speed and the washing water can be jetted more powerfully.

[0032] This configuration is described in detail below. FIG. 5 is a sectional view of a conventional nozzle. As shown in FIG. 5, nozzle 100 is typically formed such that inner wall surface 103 of nozzle channel 102 is decreased gradually and smoothly toward nozzle hole 101, in order to minimize pressure loss. A water flow in nozzle channel 102 is thus inhibited from separating from inner wall surface 103 until immediately before the flow is jetted from nozzle hole 101. This leads to prevention of a turbulent flow and achieves efficient nozzle 100. The speed of the jet flow from nozzle hole 101 of nozzle 100 is determined by a sectional area of nozzle hole 101 if the jet flow has a constant flow rate. In order to increase the speed of the jet flow, it is necessary to increase the flow rate or decrease the sectional area of nozzle hole 101.

[0033] However, when increasing a circulating flow rate in circulating water channel 20 for supplying nozzle channel 22 with washing water, water tub 2 has decreased water level and air is likely to enter pump 21. Pump 21 then causes the so-called air entrainment and the circulating flow rate in circulating water channel 20 is rather decreased. When washing is executed with a small amount of water in water tub 2, there is thus limitation to increase in circulating flow rate in circulating water channel 20. Decrease in sectional area of nozzle hole 31 causes reliability problems, e.g. lint or the like falling off from the washing target blocks nozzle hole 31. There is also limitation to decrease in sectional area of nozzle hole 31.

[0034] As shown in FIG. 4, according to the present invention, nozzle channel 22 is provided with swelling portion 29 that is swelled toward rotation axis 10 of rotary tub 4, and nozzle hole 31 is provided therearound with flat portion 30 that is substantially perpendicular to the penetration direction of nozzle hole 31. Swelling portion 29 provides inner wall surface 22b in nozzle channel 22, and the washing water is likely to flow along inner wall surface 22b due to viscosity

of the flowing washing water. When the washing water is jetted from nozzle hole 31 as a jet flow, the flow of the washing water is separated from the peripheral wall of nozzle hole 31 because inner wall surface 22b is largely curved at about 90 degrees.

[0035] As indicated in FIG. 4, sectional area C of the jet flow is smaller than sectional area D of nozzle hole 31, in other words, the jet flow is contracted. In comparison to the conventional nozzle, nozzle 26 according to the present exemplary embodiment is capable of increasing the speed of the jet flow and the washing water can be jetted from nozzle 26 more powerfully even if the flow rate is the same and nozzle hole 31 has the same sectional area.

[0036] Nozzle hole 31 has a circular shape in cross section along arrows E-E in FIG. 4. The jet flow is thus contracted uniformly, and the jet flow from nozzle hole 31 is inhibited from causing turbulence. The washing water can be jetted in a set direction so as to be applied to the washing target. Furthermore, nozzle hole 31 having no corner is unlikely to catch lint or the like falling off from the washing target and can be prevented from being blocked by such lint.

[0037] Moreover, nozzle hole 31 has length L not more than diameter d of nozzle hole 31. If nozzle hole 31 is too long in the jetting direction, the flow once separated from the peripheral wall of nozzle hole 31 and contracted is jetted while gradually expanding. This cancels the effect of increase in speed of the jet flow. Length L of nozzle hole 31 is thus preferably about not more than diameter d of nozzle hole 31. In this configuration, the jet flow from nozzle hole 31 can be certainly increased in speed, and the washing water can be certainly jetted more powerfully.

[0038] Nozzle channel 22 is branched into two directions at inlet port 25 and extends to each end 22a. The channel of the water flowing in nozzle channel 22 is accordingly divided into two channels. This configuration shortens each of the divided flow channels even though nozzle channel 22 has a long annular shape surrounding opening 5. The channels accordingly have reduced pressure loss. Sufficient pressure can be thus applied to each of nozzles 26a to 26g so as to keep the speed of the jet flow from each of nozzle 26. The washing water can be then applied evenly to the washing target in rotary tub 4. Nozzle channel 22 can achieve the same effect even when having an annular shape without any end 22a, because such nozzle channel 22 is still branched into two directions at inlet port 25.

[0039] The washing water flows through inlet port 25 into nozzle channel 22 toward rotation axis 10 (arrow F) of rotary tub 4. The flow of the washing water can be smoothly branched into two directions and sufficient pressure can be applied to each of nozzles 26a to 26g. It is thus possible to keep the speeds of the jet flows from nozzles 26.

[0040] Housing 1 is provided, inside at the lower rear end, with controller 32 for controlling motor 9, water supply valve 15, exhaust valve 19, pump 21, and the like, so as to control behavior in each of the washing, rinsing, and spin-drying processes in accordance with a set program.

[0041] Described below are the behavior and functions of the front-loading-type washing machine thus configured. FIGs. 6A to 6C are pattern views each depicting a situation of the washing target in the rotary tub of the front-loading-type washing machine according to the first exemplary embodiment of the present invention. FIGs. 9A to 9C are timing charts each indicating the behavior in the washing process of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

[0042] When a user opens door 7, loads the washing target into rotary tub 4, and starts the machine, controller 32 detects the amount of the loaded washing target. Water supply valve 15 is then opened, and washing water dissolves washing detergent stored in detergent case 14 and is supplied from water supply channel 16 into water tub 2.

[0043] The washing water stored in water tub 2 is detected by a water level detector (not shown). When the stored washing water reaches an amount set in accordance with the amount of the washing target, controller 32 stops supply of water and starts washing. Rotary tub 4 is driven to rotate positively and negatively by motor 9. The washing target accommodated in rotary tub 4 is lifted upward in the rotation direction by projections 12 provided on cylindrical wall 11 of rotary tub 4 and is then dropped. The washing target is washed by the function of beating and washing.

[0044] The level of the washing water is set by a distance for which the washing target is dropped to reach the washing water so that the effect of beating and washing can be exerted. The washing water is stored at a lower portion in rotary tub 4. However, if the water level is low in water tub 2, the washing water is unlikely to entirely spread into the washing target. When pump 21 is operated to apply the washing water onto the washing target in rotary tub 4, the washing water in water tub 2 is sucked into circulating water channel 20 through exhaust port 17 located at the bottom of water tub 2.

[0045] The washing water transferred from circulating water channel 20 through inlet port 25 into nozzle channel 22 is branched into two directions toward ends 22a of nozzle channel 22 having the long annular shape, and is jetted from the plurality of nozzles 26 (26a to 26g) located at equal intervals into rotary tub 4 while being diffused. Upon washing and rinsing, controller 32 causes pump 21 to be operated so as to circulate the washing water in water tub 2 and evenly apply the washing water onto the washing target.

[0046] The plurality of nozzles 26 (26a to 26g) each have jetting direction B of washing water that is displaced in the same direction from the direction toward rotation axis 10 of rotary tub 4 at predetermined displacement angle (deviation angle) $\theta 1$ when viewed from the opening of rotary tub 4. The washing water transferred into water tub 2 by pump 21 can be jetted into rotary tub 4 in an equally expanded range. The washing water can be more often applied onto the washing target agitated and shifted in rotary tub 4. The entire washing target in rotary tub 4 can be continuously and evenly supplied with the washing water.

[0047] At least one nozzle 26g among the plurality of nozzles 26 is configured to jet washing water into rotary tub 4 from the vicinity of the upper end of peripheral edge 23 of opening 6 of rotary tub 4. The washing water can be then applied onto the washing target from around the uppermost end of the washing target. The washing water supplied to the upper portion of the washing target flows downward due to gravity. In this process, the washing water is supplied also to the lower portion of the washing target. The entire washing target can be continuously supplied with the washing water evenly and efficiently.

[0048] The washing process in the front-loading-type washing machine mainly has the function of beating and washing described above. Beating and washing are executed in the first rotation step at a speed that does not allow the washing target in rotary tub 4 to be stuck to the inner peripheral wall of rotary tub 4, such as 45 r/min. The function of washing with centrifugal force may be effective depending on the amount of the washing target, the type of dirt, and the like. Washing with centrifugal force is executed in the second rotation step at a speed that allows the washing target in rotary tub 4 to be stuck to the inner peripheral wall of rotary tub 4, such as 100 r/min. In the second rotation step, the washing water, along with dirt and detergent, is shifted outward from the center in rotary tub 4 due to centrifugal force.

[0049] More specifically, when a large amount of washing target is accommodated in rotary tub 4 as shown in FIG. 6A, the function of beating and washing may not be exerted sufficiently. Especially the center portion of the washing target in rotary tub 4 constantly rotates around the center and the washing water is unlikely to spread into the center portion. It is difficult to achieve the efficient washing effect. If the washing target has dirt that is not solid but has water solubility, the washing water has only to pass through fibers of the washing target in order to remove the dirt. However, if the washing water does not spread as described above, the washing effect is not expected.

[0050] In order to solve this problem, the present exemplary embodiment includes the second rotation step at a speed that allows the washing target in rotary tub 4 to be stuck to the inner peripheral wall of rotary tub 4, the so-called washing with centrifugal force. As shown in FIG. 6B, by executing the second rotation step, the washing water, along with dirt and detergent, is shifted outward from the center in rotary tub 4 so as to pass through fibers due to centrifugal force. It is thus possible to effectively remove water-soluble dirt and the like on the washing target at the center of rotary tub 4.

[0051] By alternately repeating the first rotation step and the second rotation step described above, the entire washing target in rotary tub 4 can be washed efficiently regardless of the amount of the washing target in rotary tub 4 or the type of dirt on the washing target.

[0052] It is, however, essential to execute the second rotation step for a plurality of times in order to achieve a desired effect of washing with centrifugal force. More specifically, as shown in FIG. 6B, once the washing water, along with dirt and detergent, has passed through fibers and shifted outward from the center in rotary tub 4 due to centrifugal force, the washing water is not shifted any more in this state even if the machine operates continuously. In other words, the washing water needs to be supplied again to the clothes close to the center of rotary tub 4. It is thus necessary to execute the first rotation step at a low speed and then execute again the second rotation step at a high speed.

[0053] However, as indicated in FIG. 9A, there may be caused a harmful effect by frequently, e.g. for four or five times, executing the second rotation step in the washing process. For example, if rotary tub 4 soaked in water tub 2 is rotated at a high speed, the washing water in water tub 2 may be excessively foamed due to the agitating function of rotary tub 4.

[0054] Furthermore, as indicated in FIG. 9B, when rotary tub 4 is rotated at a high speed, it is necessary to execute the balance controlling process of balancing rotary tub 4. Frequent execution of the balance controlling process, which does not contribute to the washing effect, leads to unnecessary extension of washing time.

[0055] In view of this, instead of frequently executing the second rotation step in the washing process, as shown in FIG. 6C, in the second rotation step, pump 21 is driven to constantly supply the washing water in water tub 2 to the washing target stuck to the inner peripheral wall of rotary tub 4 through circulating water channel 20, nozzle channel 22, the plurality of nozzles 26, and the like. Accordingly, as indicated in FIG. 9C, even in a case of less frequently, e.g. one or two times, executing the second rotation step, it is possible to achieve the effect of washing with centrifugal force equivalent to that achieved in the case of not driving pump 21 but frequently executing the second rotation step at a high speed. At the same time, in the second rotation step described above, it is possible to avoid excessive foaming due to the agitating function of rotary tub 4 and unnecessary extension of washing time due to increase in time for the balance controlling process.

[0056] In the case where the second rotation step is executed once or twice and pump 21 is driven, it is impossible to achieve the effect of washing with centrifugal force by executing less frequently the rotation step at a high speed if the entire washing target in rotary tub 4 is not evenly supplied with the washing water from the plurality of nozzles 26. If part of the washing target stuck to the inner peripheral wall of rotary tub 4 is not supplied with the washing water, it is necessary to execute the first rotation step in order to supply again the washing water to the part of the washing target. The plurality of nozzles 26 thus provided enable the washing water transferred into water tub 2 by pump 21 to be not only supplied onto part of the washing target near nozzles 26 but also supplied continuously and evenly onto the entire washing target stuck to the inner peripheral wall of rotary tub 4. Details thereof are described below.

[0057] FIG. 7 is a pattern view depicting a situation of washing targets in a case where a single nozzle jets circulating water. FIG. 8 is a pattern view depicting a situation of the washing targets in the case where the plurality of nozzles jet

circulating water in the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

[0058] As shown in FIG. 7, when washing water is supplied from single nozzle a onto washing targets A to G in rotary tub 4, washing targets A to G are each supplied with the washing water only once while rotary tub 4 rotates once. In this case, washing is not sufficiently achieved. In order to achieve a desired washing effect, it is necessary to execute the second rotation step for a long period of time, which inevitably leads to increase in time for executing the step and excessive consumption of power.

[0059] In view of these, in the second rotation step, pump 21 is driven to constantly supply the washing water in water tub 2 evenly to the entire washing targets stuck to the inner peripheral wall of rotary tub 4 through circulating water channel 20, nozzle channel 22, the plurality of nozzles 26, and the like. This configuration solves the above problems. More specifically, as shown in FIG. 8, when the washing water is supplied to washing targets A to G in rotary tub 4 from the plurality of nozzles, e.g. seven nozzles a to g, washing targets A to G are each provided with the washing water repeatedly for seven times while rotary tub 4 rotates once. In other words, seven times of the washing water is supplied in the same period of time in comparison to the case where single nozzle 26 is provided. This enhances the washing effect by seven times. The similar effect can be exerted even if the time for executing the step is reduced to be one-seventh. It is thus possible to decrease time for executing the step and reduce power consumption.

[0060] When a user sets the water level in water tub 2 to be higher than the predetermined water level with use of a water level setting unit (not shown) for setting water level in water tub 2, controller 32 controls so as not to execute the second rotation step. Even in a case where rotary tub 4 accommodates a large amount of washing targets, as long as the washing water spreads into the washing target at the center of rotary tub 4, in other words, as long as the washing target at the center is soaked in the washing water, the washing effect can be expected by executing only the first rotation step. Furthermore, high water level in water tub 2 may be more likely to cause excessive foaming due to agitation of the washing water in water tub 2 by rotary tub 4. Controller 32 thus preferably controls so as not to execute the second rotation step if the water level in water tub 2 is higher than the predetermined water level.

[0061] After elapse of predetermined washing time, controller 32 causes exhaust valve 19 to be opened so as to exhaust the washing water in water tub 2 through exhaust channel 18. After completion of exhausting water, rinsing water is newly supplied to execute the rinsing process. Behavior of rotary tub 4 in the rinsing process is similar to that in the washing process. Similarly to the washing process, by executing the first rotation step and the second rotation step also in the rinsing process, rinsing can be achieved effectively regardless of the amount of the washing target in rotary tub 4.

[0062] After execution of the rinsing process for a predetermined number of times, controller 32 causes exhaust valve 19 to be opened so as to exhaust the rinsing water in water tub 2. Thereafter, the spin-drying process of removing the rinsing water absorbed in the washing target by rotating rotary tub 4 at a high speed is executed for a predetermined period of time, and the machine is stopped. Alternatively, the machine can be provided with a dryer so that the drying process is executed subsequently to the spin-drying process.

[0063] As described above, the front-loading-type washing machine according to the present exemplary embodiment is capable of jetting the washing water from the plurality of locations at the peripheral edge of opening 6 of rotary tub 4 so as to supply the washing water evenly to the washing target in rotary tub 4. The washing efficiency can be improved by jetting the washing water in the rotation step at a speed that allows the washing target in rotary tub 4 to be stuck to the inner peripheral wall of rotary tub 4.

[0064] As described above, a front-loading-type washing machine according to the present invention includes: a water tub for storing washing water; a rotary tub located so as to be rotatable in the water tub and having a front end provided with an opening; a motor for driving the rotary tub; a circulating water channel for circulating the washing water in the water tub to the rotary tub; a pump for transferring the washing water in the water tub to the circulating water channel; a nozzle channel having a substantially circular shape, being in communication with the circulating water channel, and provided outside a peripheral edge of the opening of the rotary tub; a plurality of nozzles provided on the nozzle channel, for jetting the washing water transferred by the pump toward an inside of the rotary tub; and a controller for driving the motor and the pump to execute a washing process. The washing process includes a first rotation step of rotating at a speed that does not allow a washing target in the rotary tub to be stuck to an inner peripheral wall of the rotary tub, and a second rotation step of rotating at a speed that allows the washing target in the rotary tub to be stuck to the inner peripheral wall of the rotary tub. The controller drives the pump in the second rotation step, to supply the washing water to the washing target stuck to the inner peripheral wall of the rotary tub.

[0065] In this configuration, the washing water transferred into the water tub by the pump can be supplied continuously and evenly, not only to part of the washing target near the jetting ports but also to the entire washing target stuck to the inner peripheral wall of the rotary tub. In the second rotation step, it is possible to achieve the so-called effect of washing with centrifugal force, by which the washing water, along with dirt and detergent, is shifted from the center portion to the peripheral portion of the washing target in the rotary tub due to centrifugal force. When the washing water is constantly supplied with use of the pump, spin-drying of the washing water due to centrifugal force and absorption of water by

applying the circulating water (washing water) are repeated so as to further enhance the effect of washing with centrifugal force. This leads to improvement in washing performance.

[0066] The front-loading-type washing machine according to the present invention further includes a water level setting unit for setting water level in the water tub. The controller does not cause the second rotation step to be executed when the water level setting unit sets the water level in the water tub to be higher than predetermined water level.

[0067] This configuration cuts out the unnecessary step when the water level in the water tub is high and the washing target is sufficiently soaked in the washing water by executing only the first rotation step. If the second rotation step is executed with high water level in the water tub, excessive foaming can be caused by agitation of the washing water in the water tub due to rotation. It is also possible to reduce a risk of such defect.

[0068] The front-loading-type washing machine according to the present invention is provided, in a space between the nozzles and the peripheral edge of the opening, with a reflector for reflecting the washing water jetted from the nozzles into the space toward the opening. The reflector has a collision surface inclined from a direction of the jetted washing water and a guide provided at an inner peripheral edge, for guiding a jet flow having hit the collision surface into the rotary tub.

[0069] In this configuration, the collision surface does not need to guide the jet flows from the nozzles directly into the rotary tub. The collision surface can be located to have a small inclination angle with respect to the direction of the jet flow from each of the nozzles. The jet flows from the nozzles can thus reach the collision surface more stably so as to be diffused. The guide thereafter guides the jet flows so as to be directed into the rotary tub, so that the washing target in the rotary tub can be supplied with the washing water that is diffused stably.

[0070] In the front-loading-type washing machine according to the present invention, the collision surface is inclined with respect to the direction of the jetted washing water at an inclination angle set to be smaller than an inclination angle of the guide with respect to the direction of the jetted washing water. Furthermore, the guide guides the washing water for a distance set to be shorter than a distance of the washing water guided by the collision surface.

[0071] This configuration minimizes deterioration in speed of the jet flow at the guide, so that the washing water can be more powerfully supplied to the washing target in the rotary tub. This enhances washing performance and rinsing performance.

[0072] In the front-loading-type washing machine according to the present invention, the nozzle channel has a swelling portion that is partially swelled from the nozzle channel toward a rotation axis of the rotary tub. The swelling portion has a flat portion provided with a circular nozzle hole. The nozzle hole penetrates substantially perpendicularly to the flat portion and has a length not more than a diameter thereof.

[0073] This configuration can inhibit turbulence of the jet flows from the nozzles and stabilize the directions of the jetted washing water. The jet flows from the nozzles can be also contracted, so that the jet flows each have an increased speed and the washing water can be jetted more powerfully.

[0074] In the front-loading-type washing machine according to the present invention, the nozzle hole penetrates in a direction displaced at a predetermined displacement angle from a direction toward the rotation axis of the rotary tub.

[0075] This configuration expands the travel range of the washing water jetted into the rotary tub, and the washing target in the rotary tub can be continuously supplied with the washing water evenly and efficiently.

INDUSTRIAL APPLICABILITY

[0076] As described above, the front-loading-type washing machine according to the present invention is capable of supplying washing water evenly to the entire washing target regardless of the amount of the washing target in the rotary tub and improving washing efficiency and rinsing efficiency, thereby being useful as a front-loading-type washing machine.

REFERENCE MARKS IN THE DRAWINGS

[0077]

1	housing
2	water tub
4	rotary tub
5, 6	opening
7	door

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	8	bellows
	9	motor
5	10	rotation axis
	11	cylindrical wall
	12	projection
10	13	small hole
	14	detergent case
15	15	water supply valve
	16	water supply channel
	17	exhaust port
20	18	exhaust channel
	19	exhaust valve
25	20	circulating water channel
	21	pump
	22, 102	nozzle channel
30	22b, 103	inner wall surface
	23	peripheral edge
35	24	inner peripheral edge
	25	inlet port
	26, 26a, 26b, 26c, 26d, 26e, 26f, 26g, 100	nozzle
40	27	space
	28	reflector
45	28a	collision surface
	28b	guide
	29	swelling portion
50	30	flat portion
	31, 101	nozzle hole
55	32	controller

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

a water tub for storing washing water;
 a rotary tub located so as to be rotatable in the water tub and having a front end provided with an opening;
 a motor for driving the rotary tub;
 a circulating water channel for circulating the washing water in the water tub to the rotary tub;
 a pump for transferring the washing water in the water tub to the circulating water channel;
 a nozzle channel having a substantially circular shape, being in communication with the circulating water channel,
 and provided outside a peripheral edge of the opening of the rotary tub;
 a plurality of nozzles provided on the nozzle channel, for jetting the washing water transferred by the pump
 toward an inside of the rotary tub; and
 a controller for driving the motor and the pump to execute a washing process; wherein
 the washing process includes a first rotation step of rotating at a speed that does not allow a washing target in
 the rotary tub to be stuck to an inner peripheral wall of the rotary tub, and a second rotation step of rotating at
 a speed that allows the washing target in the rotary tub to be stuck to the inner peripheral wall of the rotary tub, and
 the controller drives the pump in the second rotation step, to supply the washing water to the washing target
 stuck to the inner peripheral wall of the rotary tub.

2. The front-loading-type washing machine according to claim 1, further comprising:

a water level setting unit for setting water level in the water tub; wherein
 the controller does not cause the second rotation step to be executed when the water level setting unit sets the
 water level in the water tub to be higher than predetermined water level.

3. The front-loading-type washing machine according to claim 1, further comprising:

in a space between the nozzles and the peripheral edge of the opening, a reflector for reflecting the washing
 water jetted from the nozzles into the space toward the opening; wherein
 the reflector has a collision surface inclined from a direction of the jetted washing water and a guide provided
 at an inner peripheral edge, for guiding a jet flow having hit the collision surface into the rotary tub.

4. The front-loading-type washing machine according to claim 3, wherein

the collision surface is inclined with respect to the direction of the jetted washing water at an inclination angle set
 to be smaller than an inclination angle of the guide with respect to the direction of the jetted washing water, and the
 guide guides the washing water for a distance set to be shorter than a distance of the washing water guided by the
 collision surface.

5. The front-loading-type washing machine according to claim 1, wherein

the nozzle channel has a swelling portion that is partially swelled from the nozzle channel toward a rotation axis of
 the rotary tub, the swelling portion has a flat portion provided with a circular nozzle hole, the nozzle hole penetrates
 substantially perpendicularly to the flat portion and has a length not more than a diameter thereof.

6. The front-loading-type washing machine according to claim 5, wherein

the nozzle hole penetrates in a direction displaced at a predetermined displacement angle from a direction toward
 the rotation axis of the rotary tub.

Amended claims under Art. 19.1 PCT**1.** (Amended) A front-loading-type washing machine comprising:

a water tub for storing washing water;
 a rotary tub located so as to be rotatable in the water tub and having a front end provided with an opening;
 a motor for driving the rotary tub;
 a circulating water channel for circulating the washing water in the water tub to the rotary tub;
 a pump for transferring the washing water in the water tub to the circulating water channel;

a nozzle channel having a substantially circular shape, being in communication with the circulating water channel, and provided outside a peripheral edge of the opening of the rotary tub;
 at least three nozzles provided on the nozzle channel, for jetting the washing water transferred by the pump toward an inside of the rotary tub; and
 a controller for driving the motor and the pump to execute a washing process; wherein
 the washing process includes a first rotation step of rotating at a speed that does not allow a washing target in the rotary tub to be stuck to an inner peripheral wall of the rotary tub, and a second rotation step of rotating at a speed that allows the washing target in the rotary tub to be stuck to the inner peripheral wall of the rotary tub, and the controller drives the pump in the second rotation step, to supply the washing water to the washing target stuck to the inner peripheral wall of the rotary tub.

2. The front-loading-type washing machine according to claim 1, further comprising:

a water level setting unit for setting water level in the water tub; wherein
 the controller does not cause the second rotation step to be executed when the water level setting unit sets the water level in the water tub to be higher than predetermined water level.

3. The front-loading-type washing machine according to claim 1, further comprising:

in a space between the nozzles and the peripheral edge of the opening, a reflector for reflecting the washing water jetted from the nozzles into the space toward the opening; wherein
 the reflector has a collision surface inclined from a direction of the jetted washing water and a guide provided at an inner peripheral edge, for guiding a jet flow having hit the collision surface into the rotary tub.

4. The front-loading-type washing machine according to claim 3, wherein
 the collision surface is inclined with respect to the direction of the jetted washing water at an inclination angle set to be smaller than an inclination angle of the guide with respect to the direction of the jetted washing water, and the guide guides the washing water for a distance set to be shorter than a distance of the washing water guided by the collision surface.

5. The front-loading-type washing machine according to claim 1, wherein
 the nozzle channel has a swelling portion that is partially swelled from the nozzle channel toward a rotation axis of the rotary tub, the swelling portion has a flat portion provided with a circular nozzle hole, the nozzle hole penetrates substantially perpendicularly to the flat portion and has a length not more than a diameter thereof.

6. The front-loading-type washing machine according to claim 5, wherein
 the nozzle hole penetrates in a direction displaced at a predetermined displacement angle from a direction toward the rotation axis of the rotary tub.

FIG. 1

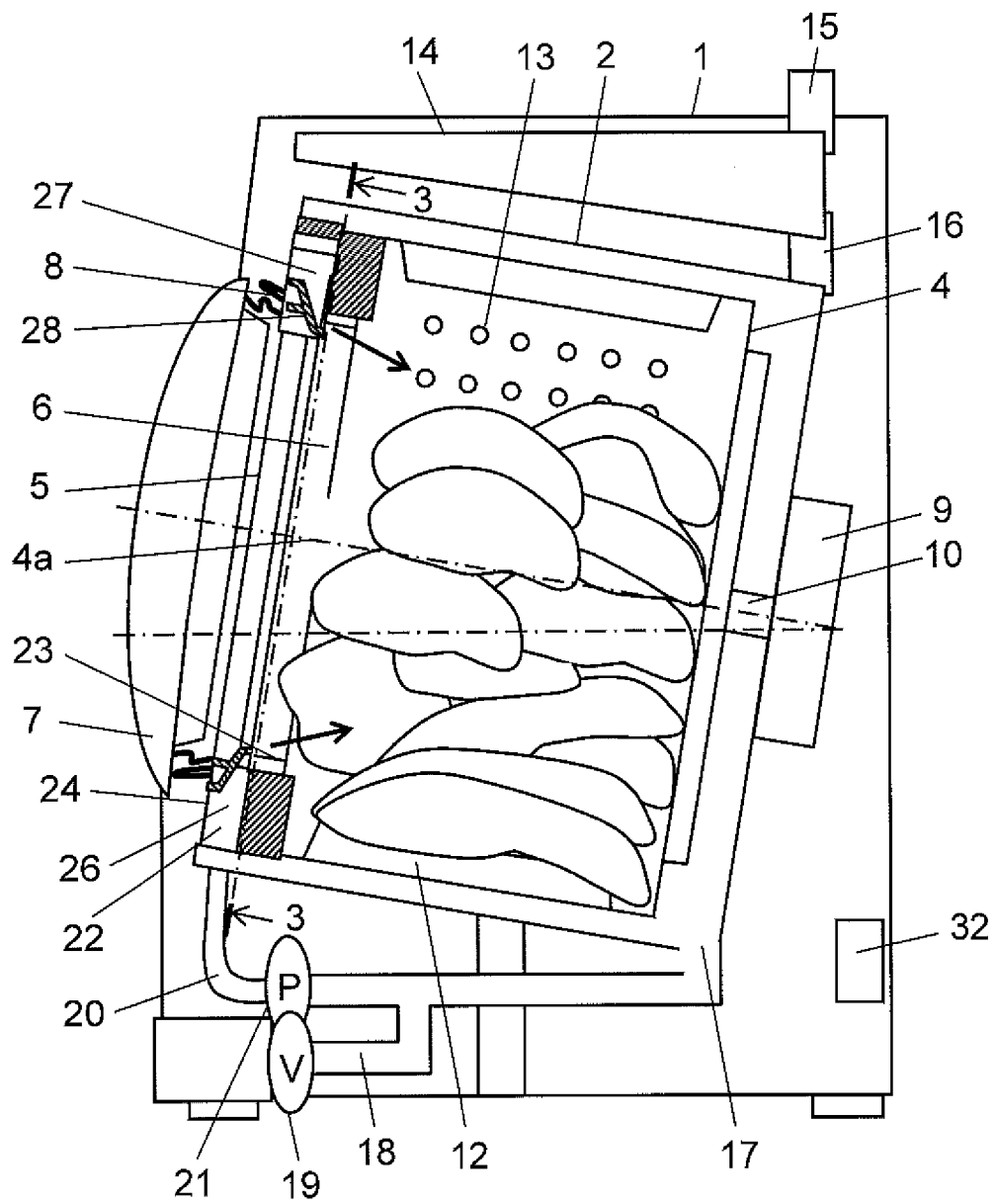


FIG. 2

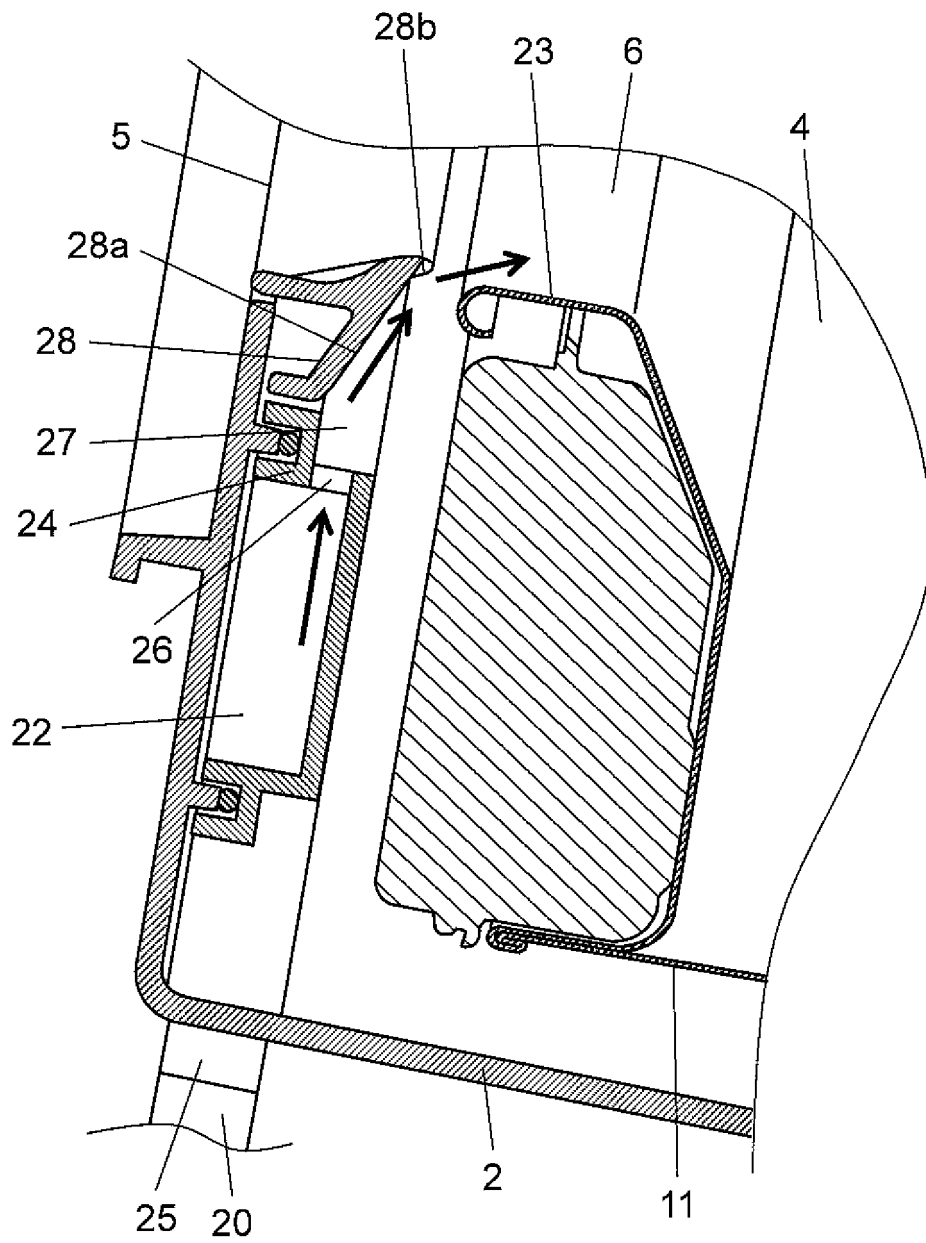


FIG. 3

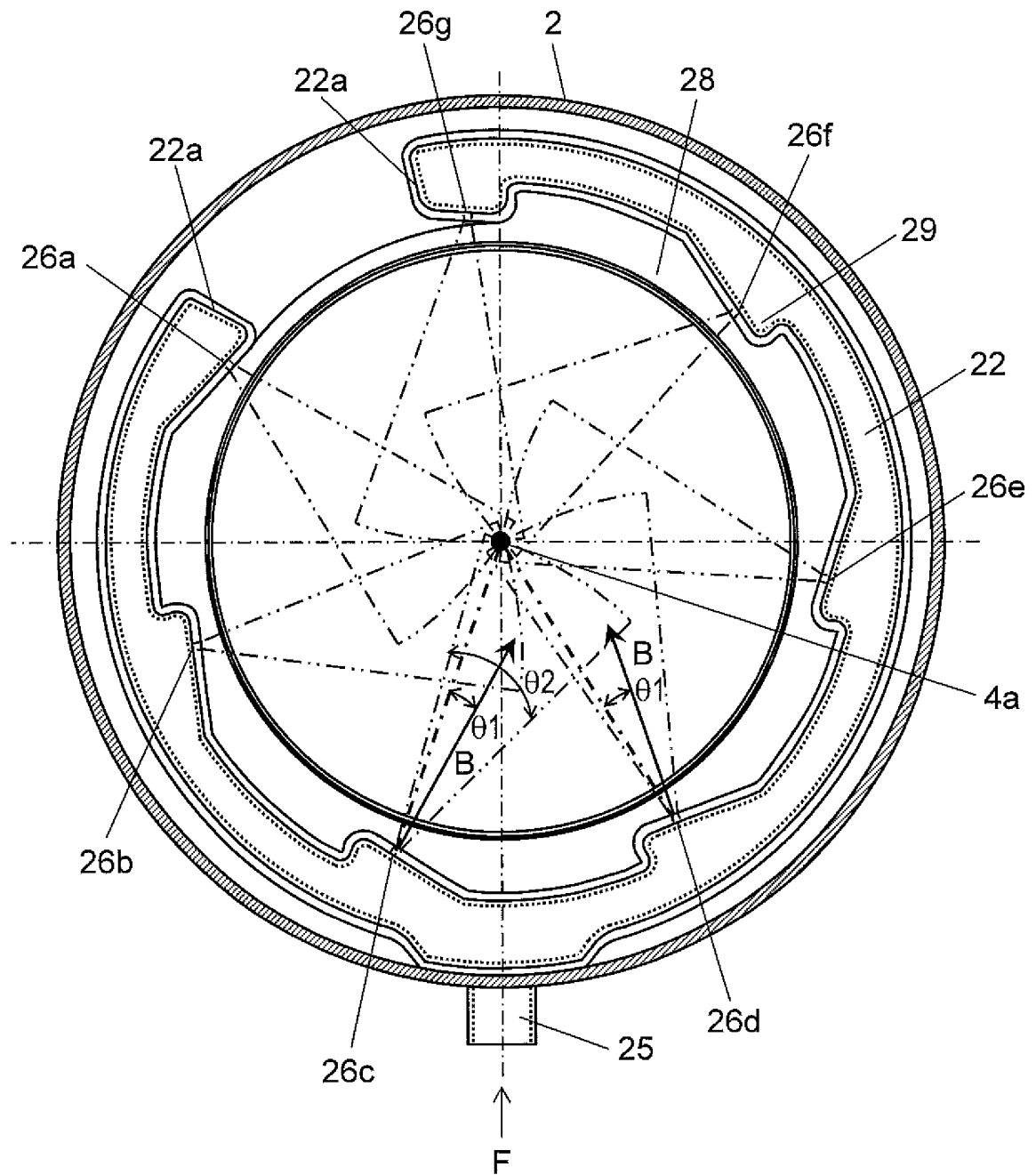


FIG. 4

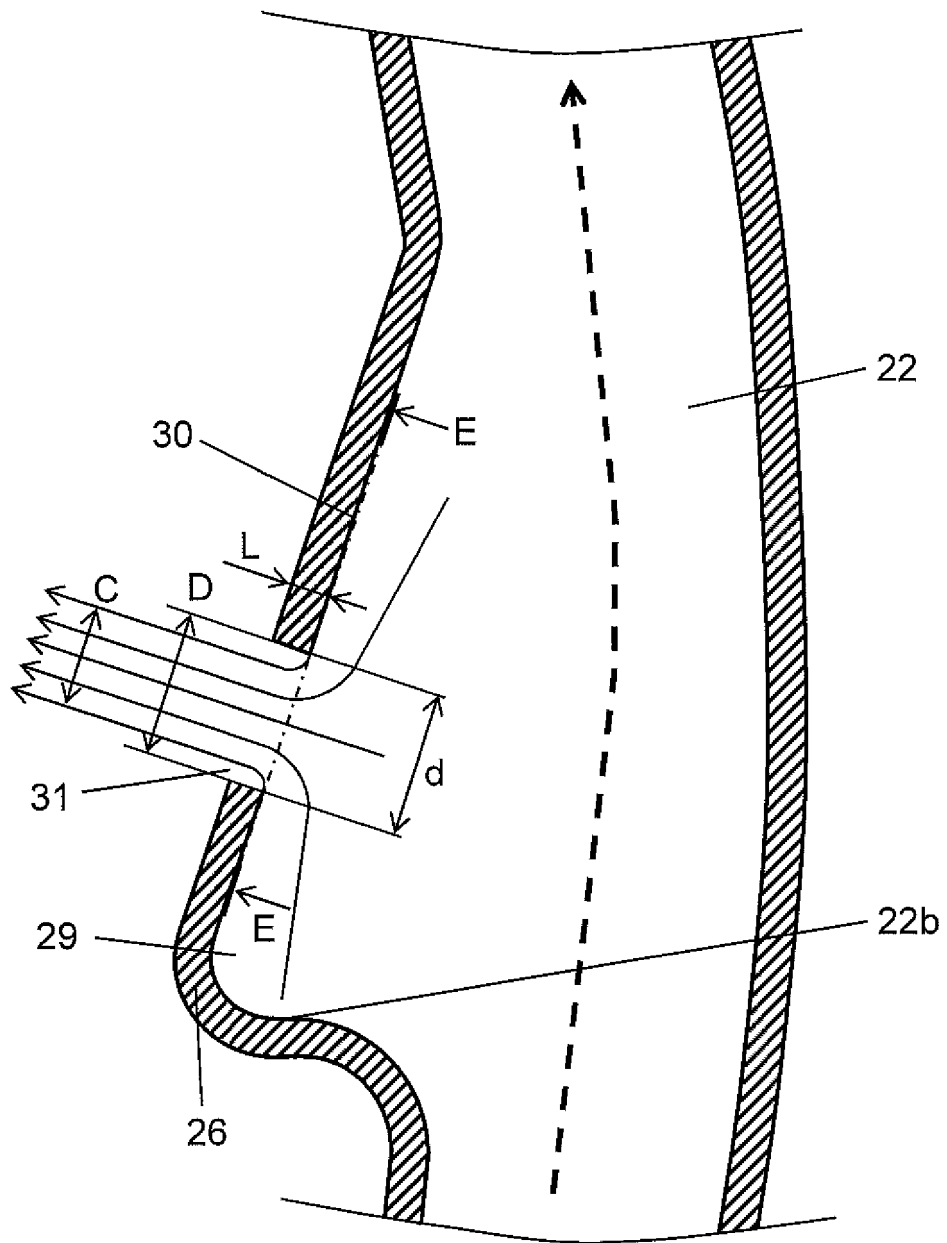


FIG. 5

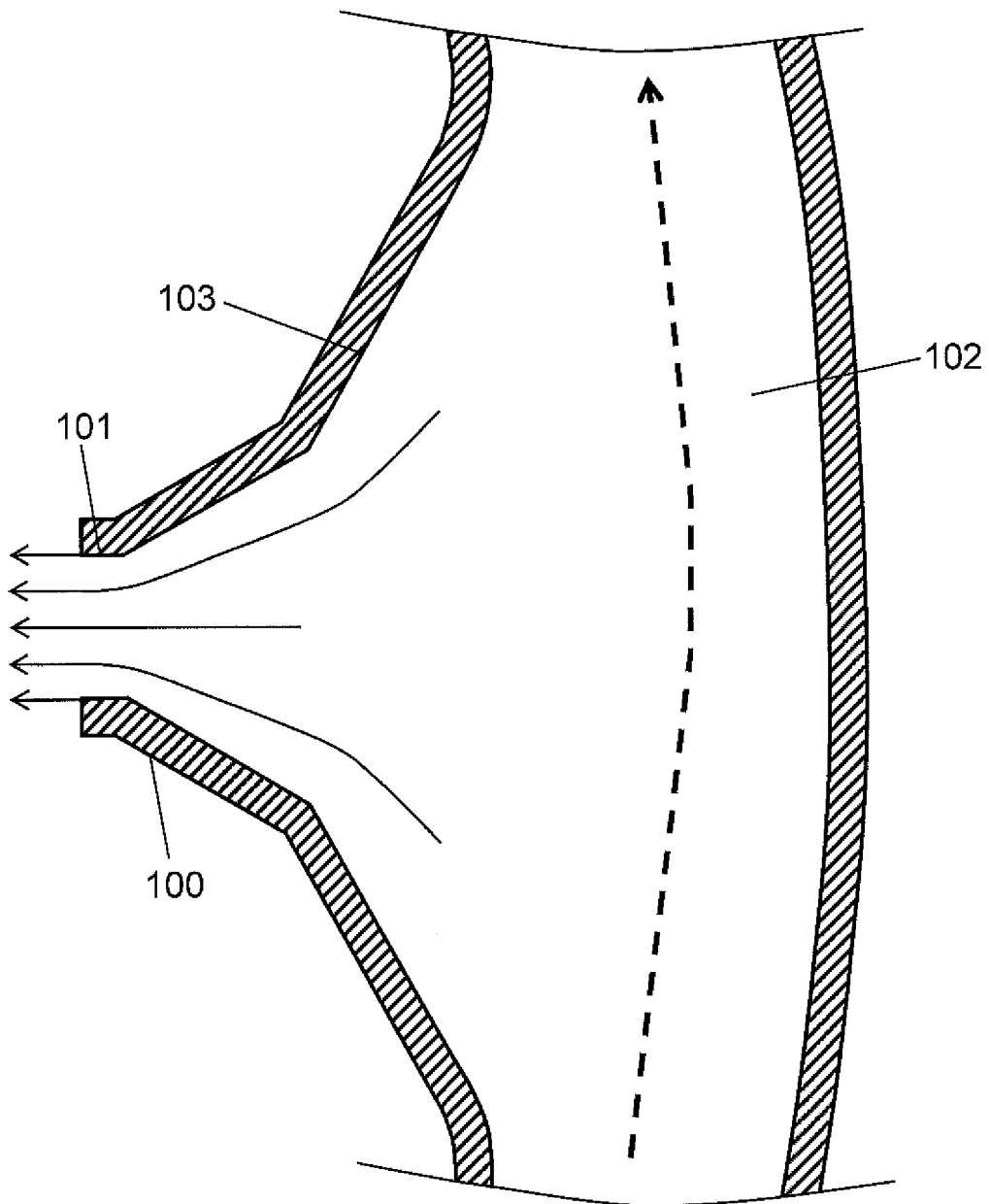


FIG. 6A

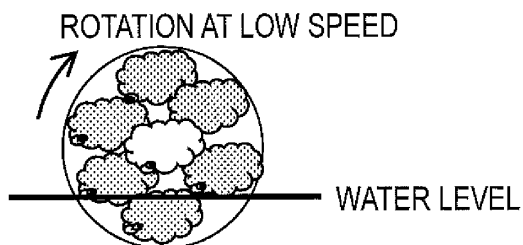


FIG. 6B

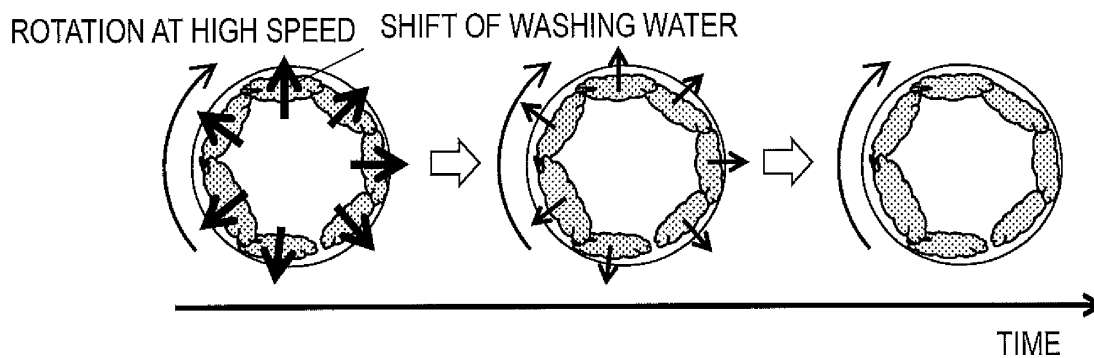


FIG. 6C

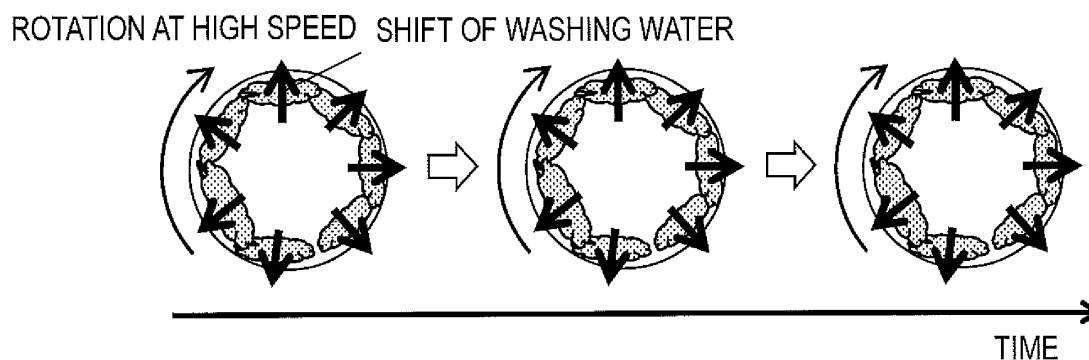


FIG. 7

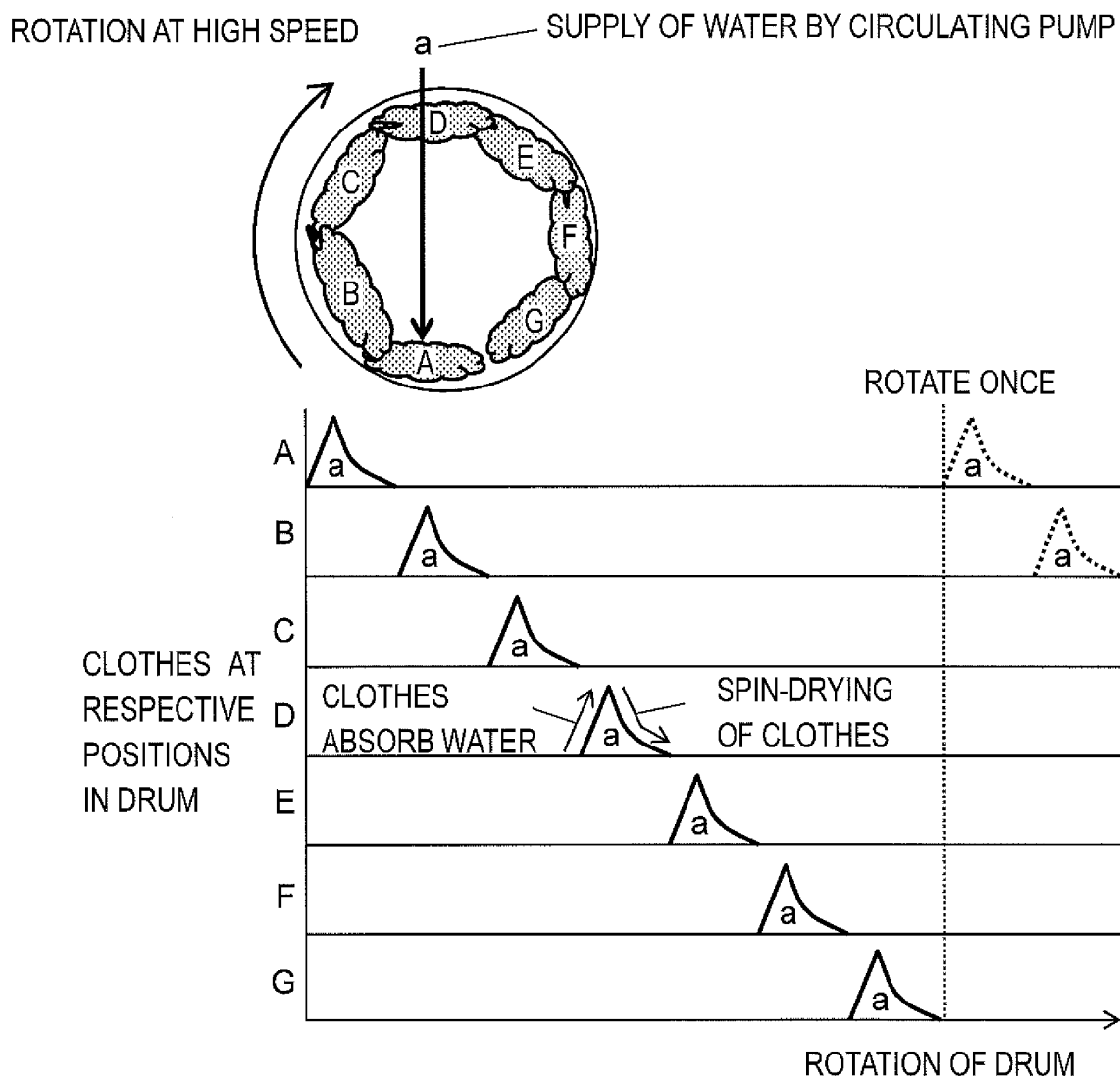


FIG. 8

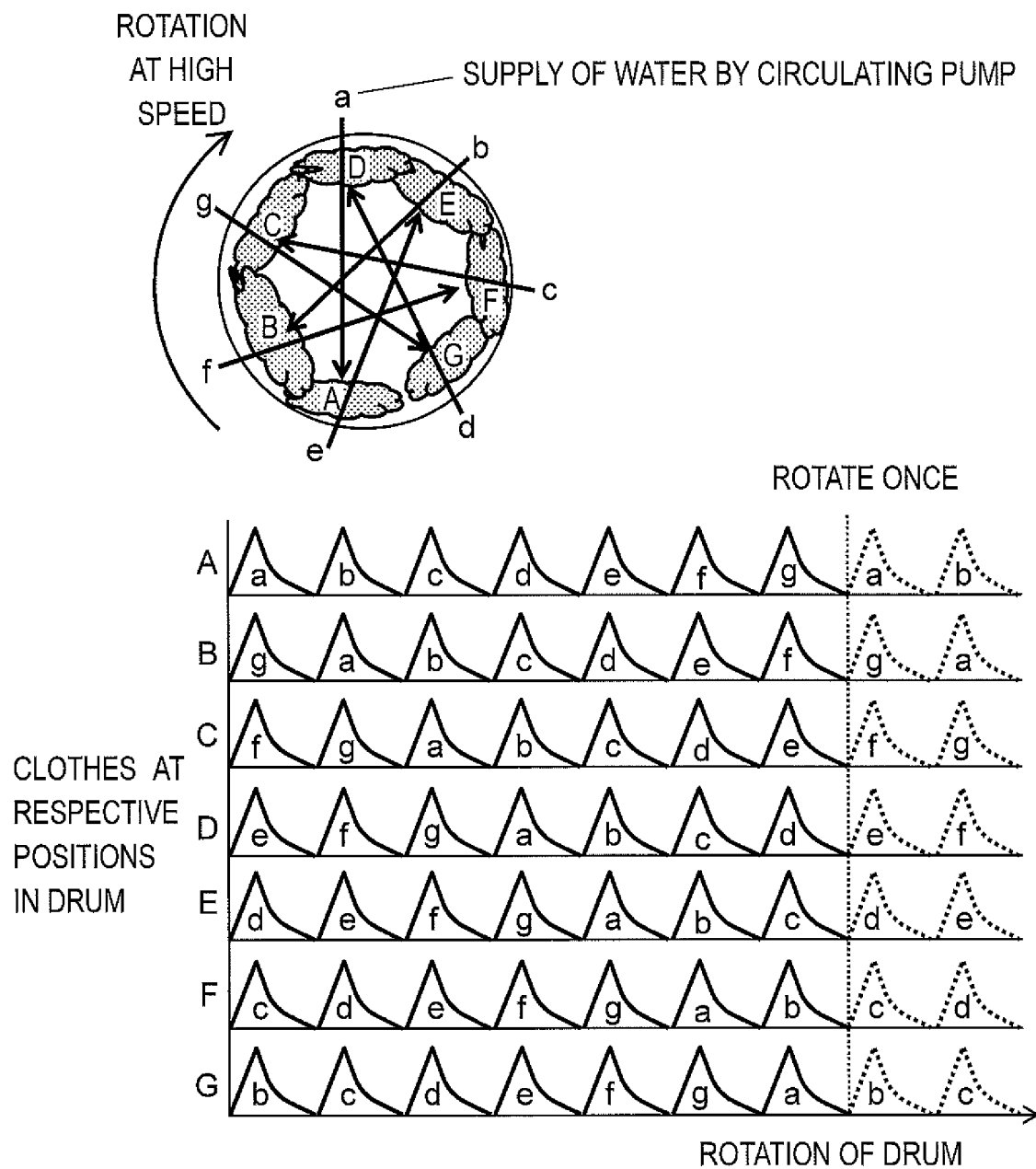


FIG. 9A

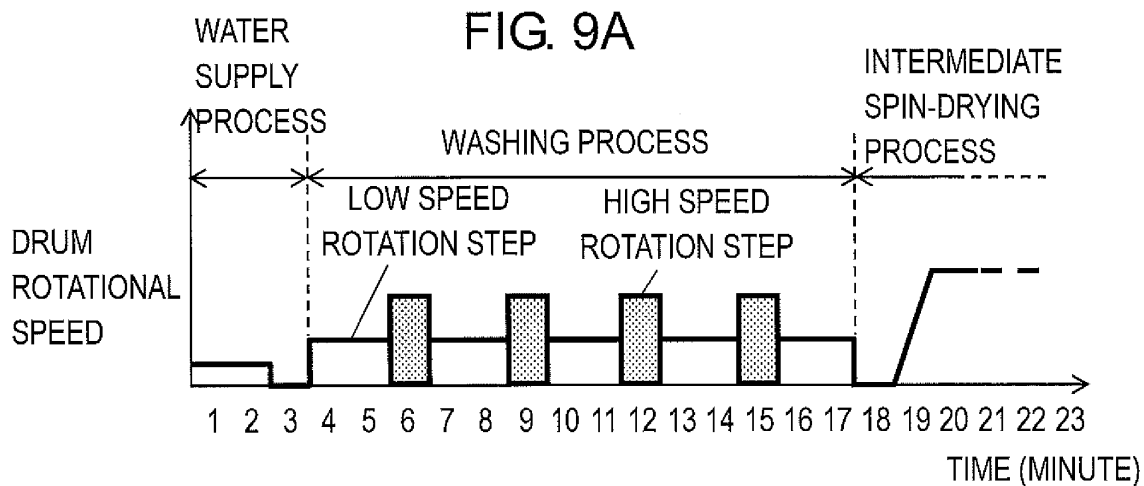


FIG. 9B

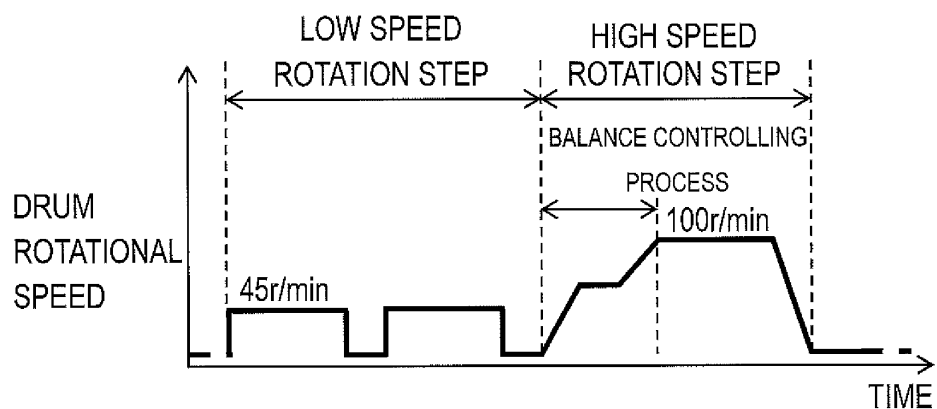
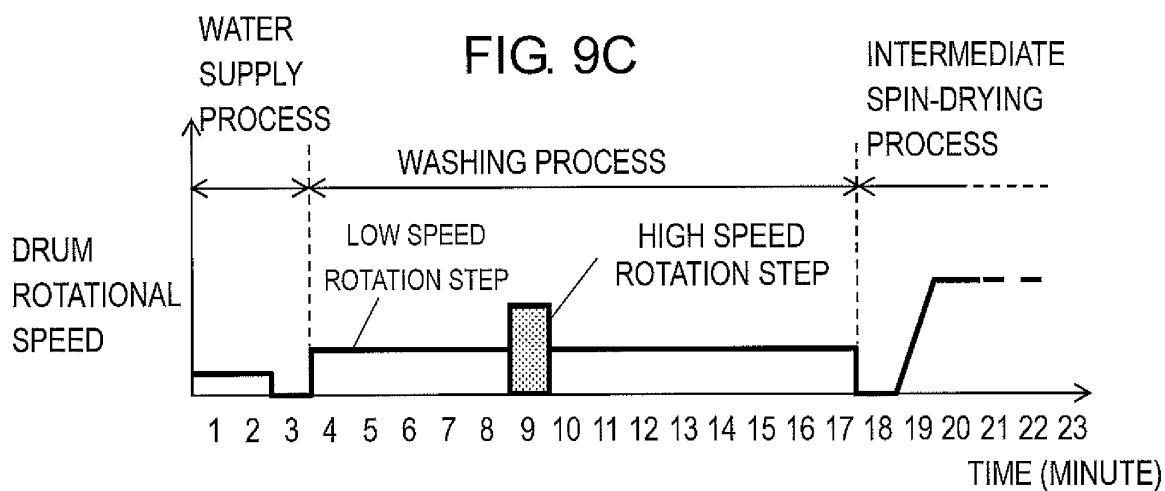


FIG. 9C



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/005477

A. CLASSIFICATION OF SUBJECT MATTER

D06F39/08 (2006.01) i, D06F25/00 (2006.01) i, D06F33/02 (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)

D06F39/08, D06F25/00, D06F33/02

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 Y	JP 2011-509139 A (LG Electronics Inc.), 24 March 2011 (24.03.2011), paragraphs [0024] to [0027]; fig. 1, 2 & US 2009/0249840 A1 & EP 2271800 A & WO 2009/125952 A2 & KR 10-2009-0107164 A & CN 101925699 A	1, 2 3-6
Y	JP 2007-111410 A (Matsushita Electric Industrial Co., Ltd.), 10 May 2007 (10.05.2007), paragraph [0059]; fig. 3, 4 (Family: none)	1-6

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
24 September, 2012 (24.09.12)Date of mailing of the international search report
02 October, 2012 (02.10.12)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/005477

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-235069 A (Matsushita Electric Industrial Co., Ltd.), 08 September 1998 (08.09.1998), paragraphs [0039] to [0043] (Family: none)	1-6
Y	JP 2011-45516 A (Panasonic Corp.), 10 March 2011 (10.03.2011), paragraphs [0045] to [0046]; fig. 8 & WO 2011/024409 A1 & TW 201111578 A & CN 102482834 A	3, 4
Y	JP 2011-55923 A (Panasonic Corp.), 24 March 2011 (24.03.2011), fig. 3 & CN 201785630 U & CN 102011289 A & TW 201113407 A	5, 6
Y	JP 2011-45517 A (Panasonic Corp.), 10 March 2011 (10.03.2011), paragraph [0038]; fig. 9 & WO 2011/024409 A1 & TW 201111578 A & CN 102482834 A	6
P, X	JP 2011-245268 A (Toshiba Corp., Toshiba Consumer Electronics Holdings Corp., Toshiba Home Appliances Corp.), 08 December 2011 (08.12.2011), claim 1 (Family: none)	1, 2

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/005477

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The invention in claim 1 is disclosed in paragraphs [0024]-[0027], fig.1 and 2 in the document 1.

Therefore, the invention of claim 1 cannot be considered to be novel in the light of the invention disclosed in the document 1, and does not have a special technical feature.

Consequently, the following three inventions (invention groups) are involved in claims.

Meanwhile, the invention of claim 1 having no special technical feature is classified into invention 1.

(Continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/005477

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10
15
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40
45
50
55

Continuation of Box No.III of continuation of first sheet(2)

(Invention 1) claims 1 and 2
(Invention 2) claims 3 and 4
(Invention 3) claims 5 and 6

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H10127978 B [0005]