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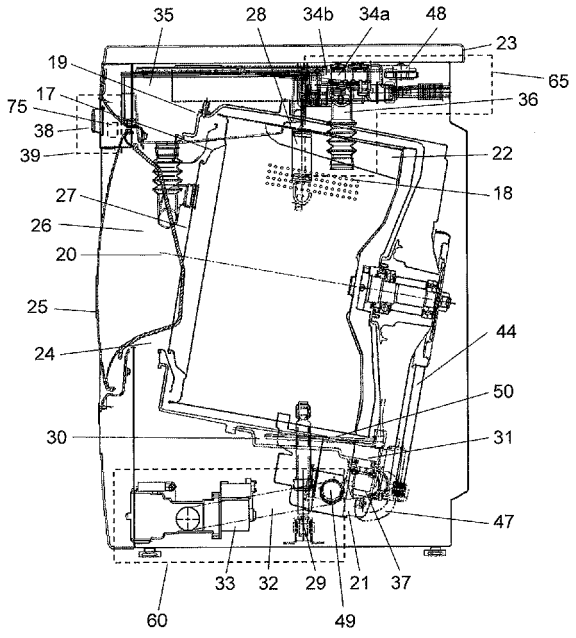
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(54) Drum-type washer

(57) A drum-type washer includes a rotating drum (17), a drain outlet (31), a motor (21), a feed-water unit (65), a drainage unit (60), and a controller (38). The drum (17) is rotatable in a washing tub (19) and has a rotation axis either horizontal or inclined from a horizontal. The drain outlet (31) is in the bottom of the washing tub (19). The motor (21) rotates the drum (17). The feed-water unit (65) feeds water into the washing tub (19). The drainage unit (60) drains water from the washing tub (19). The controller (38) controls at least the motor (21), the feed-water unit (65), and the drainage unit (60) so as to perform at least the wash, rinse, and spin cycles. The washer also includes a water circulation channel (47), which extends from an opening (45) in the rear side of the washing tub (19) and communicates with a drain space (37) downstream of the drain outlet (31).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a drum-type washer for washing laundry in a rotating drum.

2. Background Art

[0002] Conventional drum-type washers have a structure shown in Fig. 8, which will be described as follows.

[0003] As shown in Fig. 8, a drum-type washer includes drum 1 rotatably mounted in washing tub 3. Drum 1 has a large number of water-through-holes 2 in the entire outer peripheral surface. The washer also includes rotating shaft 4 fixed at one end to the rotation center of drum 1 and at the other end to drum pulley 5. The washer also includes motor 6, which is connected to drum pulley 5 via belt 7 so as to rotate drum 1. Drum 1 has an opening with lid 8. Washing tub 3 is suspended inside washer body 9 by spring 10 and vibro-isolatedly supported by vibration free damper 11. Vibration of washing tub 3 during spin cycle is prevented from being transmitted to washer body 9 by vibration free damper 11 and is reduced by weight 12. Washing tub 3 has drain outlet 17a at its bottom. The washer also includes feed valve 13 for feeding water into washing tub 3, drainage pump 14 for draining water from washing tub 3, and heater 15 for heating water in washing tub 3. The washer also includes control device 16, which controls the operations of motor 6, feed valve 13, drainage pump 14, heater 15, and the like so as to perform a series of cycles including wash, rinse, and spin cycles. An example of a conventional technique related to the present invention is shown in Japanese Patent Unexamined Publication No. H10-201988.

[0004] The following is a description of the operation of the above-described drum-type washer.

[0005] First, the user opens lid 8, loads laundry into drum 1, and turns the washer on to start a wash cycle. As a result, feed valve 13 is opened to feed water into washing tub 3. When the water reaches a predetermined level, feed valve 13 is closed to stop feeding water. Then, drum 1 is rotated by motor 6 at low speed, raising the laundry in drum 1 and then dropping it into the water during the wash cycle. When the wash cycle is performed for a predetermined time, the water in washing tub 3 is drawn into drainage pump 14 via drain outlet 17a. Then, drainage pump 14 is operated to drain the water as intermediate spinning so as to start a rinse cycle. The rinse cycle includes the same operation as the wash cycle. In a subsequent spin cycle, drum 1 is rotated at high speed to centrifugally dehydrate the laundry.

[0006] In the wash cycle, the detergent poured into a detergent container (not shown) is supposed to be introduced into washing tub 3 together with the water flowing through feed valve 13 immediately after washing is started. This operation is done manually or by other means. When the cleaning water comes into contact with laundry stains, the detergent cleans and removes stains, providing a high cleaning effect. In the above-described conventional structure, however, the detergent introduced at the start of washing often drops directly through drain outlet 17a as detergent aggregates before it is completely dissolved in the water in washing tub 3. This causes the detergent to get into the drain space and then to be discharged without fulfilling its function.

SUMMARY OF THE INVENTION

[0007] In view of the above-described problem, the present invention provides a drum-type washer which allows detergent to provide excellent cleaning effect in the following manner. Even if the detergent drops through drain outlet 17a and accumulates in the drain space, it can be returned into washing tub 3 and dissolved in the water with the help of the rotation of drum 1.

[0008] The drum-type washer according to the present invention includes a rotating drum rotatable in a washing tub, the rotating drum having a rotation axis horizontal or inclined from a horizontal; a drain outlet in a bottom of the washing tub; a motor for rotating the rotating drum; a feed-water unit for feeding water into the washing tub; a drainage unit for draining water from the washing tub; and a controller for controlling at least the motor, the feed-water unit, and the drainage unit so as to perform at least wash, rinse, and spin cycles. The washer further includes a water circulation channel, which is extended from a rear-side opening in the rear side of the washing tub and communicated with a drain space in the downstream of the drain outlet.

[0009] In the wash cycle, the cleaning water in the rotating drum goes out through the opening in the rear side of the drum into the water circulation channel, and flows into the drain space. The cleaning water then stirs up the detergent that has accumulated in the drain space after dropping through the drain outlet, thereby returning the detergent into the washing tub. The returned detergent is dissolved in the cleaning water in the washing tub or the drum by the rotation of the drum, thus coming into contact with laundry and fulfilling its function. As a result, the drum-type washer provides excellent washing performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a sectional view of a side of a drum-type washer according to a first embodiment of the present invention.

Fig. 2 is a sectional view of a side of a washing tub of the drum-type washer according to the first embodiment.

Fig. 3 is a rear view of the washing tub of the drum-

type washer according to the first embodiment.

Fig. 4 is a longitudinal sectional view of the washing tub of the drum-type washer according to the first embodiment.

Fig. 5 is a sectional view of a side of a washing tub of a drum-type washer according to a second embodiment of the present invention.

Fig. 6 is a longitudinal sectional view of a washing tub of a drum-type washer according to a third embodiment of the present invention.

Fig. 7 is a sequence diagram of control signals of a motor and a heater of the drum-type washer according to the third embodiment.

Fig. 8 is a sectional view of a side of a conventional drum-type washer.

DETAILED DESCRIPTION OF THE INVENTION

[0011] First to fourth embodiments of the present invention will be described as follows with reference to drawings. In the drawings, the dimensions of some components are exaggerated for clarity. In the second to fourth embodiments, like components are labeled with like reference numerals with respect to the first embodiment, and the description thereof will be sometimes omitted. Note that the present invention is not limited to these embodiments.

FIRST EMBODIMENT

[0012] Fig. 1 is a sectional view of a side of a drum-type washer according to a first embodiment of the present invention. Fig. 2 is a sectional view of a side of a washing tub of the washer. Figs. 3 and 4 are a rear view and a longitudinal sectional view, respectively, of the washing tub.

[0013] As shown in Fig. 1, the drum-type washer includes rotating drum 17 rotatably mounted in washing tub 19. Rotating drum 17 is formed in a bottomed cylindrical shape and has a large number of water-through-holes 18 in the entire outer periphery. Rotating drum 17 has rotating shaft 20 as its rotation axis, which is either horizontal or slightly inclined from the horizontal. More specifically, the rotation axis is inclined downward from the front side to the rear side of rotating drum 17. Rotating shaft 20 is connected via belt 44 to motor 21, which is fixed on the bottom of washing tub 19 so that rotating drum 17 can be rotated by motor 21 in the forward and reverse directions. Rotating drum 17 is provided on its inner circumference wall with several projection boards 22.

[0014] The washer also includes body 23 having opening 24, which is formed on the front side of washing tub 19 and in the direction perpendicular to an upwardly inclined surface of body 23. Opening 24 is covered with openable lid 25. When washing laundry, the user opens lid 25 and loads the laundry into rotating drum 17 through opening 24, laundry loading-unloading opening 26 of washing tub 19, and laundry loading-unloading opening 27 of drum 17. When washing is over, the user unloads the laundry from rotating drum 17 through these openings. Providing lid 25 in the direction perpendicular to the upwardly inclined surface of body 23 allows the user to load and unload laundry without bending over too much.

[0015] Washing tub 19 is swingably suspended from body 23 by spring 28 and damper 29. Washing tub 19 is provided on its inside bottom with long U-shaped drainage ditch 30 along the direction of rotating shaft 20. Drainage ditch 30 is equipped with heater 50, and has drain outlet 31 at a position to its bottom rear side. Drain outlet 31 is connected to drain space 37, which is connected at its outlet with drainage channel 32 via drain valve 49 as a component of drainage unit 60. Drainage channel 32 is connected at the other end thereof with drainage pump 33 as another component of drainage unit 60, so that drainage pump 33 drains water from washing tub 19. The washer also includes feed-water unit 65, which has feed valve 34a for feeding water into washing tub 19 via detergent container 35 and feed-water channel 36. The washer also includes water level detector 48 for detecting the water level in washing tub 19.

[0016] The washer also includes control device 39, which has controller 38 composed of a microcomputer. Controller 38 controls the operations of motor 21, drainage pump 33, feed valves 34a and 34b, drain valve 49, and other components via a power switching unit (not shown) so as to control wash, rinse, spin, and dry cycles.

[0017] Control device 39 receives information from an input setting unit (not shown) for setting an operation course and other conditions, and displays the information on a display unit (not shown) provided therein. The display unit is on the front side of body 23, so that the user can see it easily. Control device 39 also has storage unit 75, which stores data required for controller 38 to control. Storage unit 75 and the display unit can be provided in control device 39 together with controller 38.

[0018] As shown in Figs. 1 and 2, washing tub 19 is provided on its bottom with rear-side opening 45. Rear-side opening 45 and opening 46 at the bottom of drain space 37 are connected via water circulation channel 47 so that the water used for washing can circulate there. Water circulation channel 47 is formed by blow molding ethylene-propylene rubber (hereinafter "EPDM"), which is chemical and heat resistant, meaning to be resistant to warm water and detergent. The use of EPDM can form water circulation channel 47 into a desired shape to fit within the limited space on the rear side of washing tub 19.

[0019] The following is a specific description of the operation of the drum-type washer having the above-described structure.

[0020] First, the user opens lid 25, which is a door to the washer, loads laundry into rotating drum 17, pours an appropriate amount of detergent into detergent container 35, and turns the washer on to start a wash cycle. As a result, feed valve 34a is turned on to feed water, which is made to pass through detergent container 35

having the detergent therein and feed-water channel 36, and then is fed into washing tub 19 together with the detergent. At the same time, rotating drum 17 starts to be rotated at a first predetermined rotational speed which is, for example, 120 r/min. At this moment, rotating drum 17 rotates counterclockwise as viewed from the front.

[0021] During the counterclockwise rotation, the detergent-containing water is stirred, allowing the detergent to be dissolved in the water. At the same time, the water hits the sidewalls (not shown) of drainage ditch 30. The sidewalls form the sides of U-shaped drainage ditch 30. When the water hits the sidewalls of drainage ditch 30, this produces foam containing highly concentrated detergent in the water and on the water surface. The foam grows and fills the space between rotating drum 17 and washing tub 19. The foam then expands to the front side of drum 17 and tub 19, gets into drum 17 through laundry loading-unloading opening 27, and finally permeates the laundry.

[0022] At this moment, most of the detergent that has reached drainage ditch 30 is dissolved by stirring. However, when the amount of detergent is large, some of the detergent that remains without being dissolved in the water sometimes drops through drain outlet 31 and accumulates in drain space 37.

[0023] Then, the produced foam envelops and removes stains from the laundry by the centrifugal force generated by the rotation of rotating drum 17. Then, the foam again passes through water-through-holes 18 in the outer periphery of rotating drum 17 and is discharged between drum 17 and washing tub 19, thereby washing the laundry. This operation is performed until the water in the washing tub 19 reaches a predetermined level, and then the rotational speed of rotating drum 17 is changed to a second predetermined rotational speed (for example, 45 r/min). Then, a washing operation is performed for a fixed time by repeating forward and reverse rotations alternately with pauses therebetween for a predetermined period of time (for example, a 20 sec ON time and a 7 sec OFF time).

[0024] The rotation of rotating drum 17 at the second predetermined rotational speed causes the laundry in drum 17 to be raised in the direction of rotation by projection boards 22 formed on the inner circumference wall of drum 17. Thus, the laundry is repeatedly raised and dropped from an appropriate height, thereby being beat-washed. Beat-wash includes a combination of the mechanical action by drop impact and the detergent effect by the water circulating to and from water circulation channel 47.

[0025] When rotating drum 17 is in the paused state, water circulation channel 47 and washing tub 19 have the same water level. When drum 17 starts to be rotated, on the other hand, the water level of washing tub 19 is temporarily lowered because the water is pushed up by the centrifugal force generated by the rotation of drum 17. As a result, the water level of water circulation channel 47 is also lowered. As shown in Figs. 2 and 4, rear-side opening 45 formed in a recess of washing tub 19 can effectively collect water. The collected water flows through rear-side opening 45 of washing tub 19 down to opening 46 at the bottom of drain space 37, thereby applying a water force to opening 46. The water force pushes up the detergent accumulated in drain space 37 to drain outlet 31 so as to accelerate the dissolution of the accumulated detergent.

[0026] When washing is performed at a certain water temperature by heating heater 50, warm water is fed from rear-side opening 45 of washing tub 19 to drain space 37 through water circulation channel 47. The warm water heats up the water originally drawn in drain space 37 so as to effectively dissolve the detergent, allowing the detergent to fulfill its function. As a result, the drum-type washer provides excellent washing performance.

[0027] As described above, the drum-type washer of the present invention includes rotating drum 17, drain outlet 31, motor 21, feed-water unit 65, drainage unit 60, and controller 38 controlling at least motor 21, feed-water unit 65, and drainage unit 60 so as to perform at least wash, rinse, and spin cycles. Rotating drum 17 is rotatably mounted in washing tub 19, and has rotating shaft 20 as its rotation axis, which is either horizontal or inclined from a horizontal. Drain outlet 31 is in the bottom of washing tub 19. Motor 21 rotates rotating drum 17. Feed-water unit 65 feeds water into washing tub 19. Drainage unit 60 drains water from washing tub 19. The drum-type washer of the present invention also includes water circulation channel 47 extended from rear-side opening 45, that is, the opening in the rear side of washing tub 19 in such a manner as to be communicated with drain space 37 in the downstream of drain outlet 31.

[0028] With this structure, in the wash cycle, even if detergent drops through drain outlet 31 and accumulates in drain space 37, it can be returned into washing tub 19 and dissolved in the cleaning water, providing its full cleaning effect.

[0029] The opening in the rear side of washing tub 19, such as rear-side opening 45, can be formed at a position not lower than the rated water level in the wash cycle.

[0030] In this case, when the water level in washing tub 19 increases during the rotation of rotating drum 17, and reaches rear-side opening 45 at the position not lower than the rated water level, the water circulates inside and outside washing tub 19 through water circulation channel 47 from rear-side opening 45 to drain space 37 and opening 46. The water circulation allows the powerful water to rush as cleaning water into drain space 37 from opening 46 at the bottom of drain space 37 through rear-side opening 45 and water circulation channel 47. Then, the cleaning water hits the detergent accumulated in drain space 37, and breaks detergent aggregates. At the same time, the inrush of the cleaning water into drain space 37 produces a turbulent flow, which increases the dissolution speed of the detergent.

[0031] The rear side of washing tub 19 can be corrugated with alternating projections and recesses, and the

opening on the rear side, such as rear-side opening 45, is formed in one of the recesses and connected to the downstream of drain outlet 31.

[0032] In this case, the water in washing tub 19 can be effectively collected to rear-side opening 45 of tub 19 during the rotation of rotating drum 17. As a result, powerful cleaning water hits the detergent accumulated in drain space 37 and breaks detergent aggregates. At the same time, the turbulent flow generated in drain space 37 increases the dissolution speed of the detergent.

[0033] Drain space 37 has an opening such as opening 46 at the bottom thereof, the opening being communicated with the drain space 37 side of water circulation channel 47.

[0034] In this case, opening 46 of drain space 37 can have a simple structure, allowing a reduction in the cost of the mold. As a result, the drum-type washer is inexpensive and provides excellent washing performance.

[0035] As shown in Fig. 2, water circulation channel 47 has elbow-shaped ends.

[0036] In this case, water circulation channel 47 extending from the rear side of washing tub 19 to drain space 37 can be compact. As a result, water circulation channel 47 can be accommodated within the limited space on the rear side of drum-type washer, thereby making washer body 23 compact.

[0037] Water circulation channel 47 is made of chemical and heat resistant resin.

[0038] In this case, the inner wall surface of water circulation channel 47 can be prevented from being altered or deteriorated in quality by the hot water or the detergent during washing, allowing the washer to be long lasting.

[0039] Water circulation channel 47 may be formed by blow molding.

[0040] In this case, water circulation channel 47 can be formed into a desired shape at low cost, allowing the washer inexpensive.

[0041] Water circulation channel 47 may be made of EPDM.

[0042] In this case, the washer can be long lasting and chemical and heat resistant.

SECOND EMBODIMENT

[0043] Fig. 5 is a sectional view of a side of a washing tub of a drum-type washer according to a second embodiment of the present invention. The washer and the control device of the second embodiment are structured basically the same as those in the first embodiment. More specifically, the difference is that opening 46, which is at the bottom of drain space 37 in the first embodiment, is on a side of drain space 37 in the second embodiment as shown in Fig. 5. When opening 46 is on a side of drain space 37, the rotation of rotating drum 17 allows the water flown through water circulation channel 47 to hit the detergent accumulated in drain space 37 from the side.

[0044] When rotating drum 17 starts to be rotated, the water flown through drain outlet 31 and the water flown through opening 46 produce a turbulent flow in drain space 37. The turbulent flow hits and moves the detergent, thereby effectively dissolving it. In particular, the water flown through opening 46 pushes the detergent accumulated in drain space 37 from the side. The detergent thus pushed is mixed with the water present on the opposite side, thereby producing a turbulent flow in the water. The turbulent flow effectively stirs up the detergent from drain space 37 into washing tub 19, so that the detergent is brought again into contact with the laundry, thereby removing stain therefrom more effectively. As a result, the washer has excellent washing performance.

[0045] As described above, in Fig. 5, drain space 37 has opening 46 at a side thereof, opening 46 being communicated with the drain space 37 side of water circulation channel 47.

[0046] In this case, the cleaning water, which is the powerful water flowing from different directions, hit the detergent accumulated in drain space 37, thereby breaking the detergent aggregates. Furthermore, the turbulent flow generated in drain space 37 increases the dissolution speed of the detergent.

[0047] As shown in Fig. 5, water circulation channel 47 has elbow-shaped ends.

[0048] In this case, water circulation channel 47 extending from the rear side of washing tub 19 to drain space 37 can be compact. As a result, water circulation channel 47 can be accommodated within the limited space on the rear side of the drum-type washer, thereby making washer body 23 compact.

[0049] Water circulation channel 47 is made of chemical and heat resistant resin.

[0050] In this case, the inner wall surface of water circulation channel 47 can be prevented from being altered or deteriorated in quality by the hot water or the detergent during washing, allowing the washer to be long lasting.

[0051] Water circulation channel 47 may be formed by blow molding.

[0052] In this case, water circulation channel 47 can be formed into a desired shape at low cost, allowing the washer inexpensive.

[0053] Water circulation channel 47 may be made of EPDM.

[0054] In this case, the washer can be long lasting and chemical and heat resistant.

THIRD EMBODIMENT

[0055] Fig. 6 is a longitudinal sectional view of a washing tub of a drum-type washer according to a third embodiment of the present invention. A sectional view of a side of the washer and a rear view of the washing tub of the washer according to the third embodiment are identical to those in the first embodiment as shown in Figs. 1 and 3, respectively.

[0056] The drum-type washer of the present third embodiment is substantially the same as in the first embodiment, and hence, the description thereof will be omitted.

[0057] The following is a specific description of the operation of the washer of the present embodiment.

[0058] As shown in Fig. 1, the user opens lid 25, which is a door to the washer, loads laundry into rotating drum 17, closes lid 25, and turns on the power switch. Then, the user selects a course and cycles shown on the operation panel, and presses the start button to start the operation. As a result, lid 25 is locked.

[0059] First, a feed-water cycle is started. Feed valve 34a is turned on to feed water into washing tub 19 through feed-water channel 36. Then, it is determined whether the water has reached a predetermined water level S1 (for example, 0 mm or the reset water level) by a water level sensor (not shown) or the like. When it is affirmatively determined, feed valve 34a is turned off to stop feeding water; otherwise, the water feeding is continued. When the water level S1 is determined to have been reached, motor 21 is driven to rotate rotating drum 17. Next, it is determined whether rotating drum 17 has reached a first predetermined rotational speed (for example, 85 r/min). When it is affirmatively determined, the process goes to the next cycle; otherwise, the rotation is continued to increase the rotational speed.

[0060] When the first predetermined rotational speed is determined to have been reached, feed valve 34b is turned on to start feeding water. The water is made to pass through feed-water channel 36 and detergent container 35 and is fed into washing tub 19 together with detergent. Thus, the detergent is introduced into washing tub 19.

[0061] Then, it is determined whether the water has reached a predetermined water level S2 (for example, 60 mm) by the water level sensor or the like. When it is affirmatively determined, the process proceeds to the next cycle where feed valve 34b is turned off to stop feeding water; otherwise, the water feeding is continued. When the water level S2 is determined to have been reached, it is also determined whether a predetermined rotation time T1 has been passed. When it is affirmatively determined, the rotation of rotating drum 17 is stopped so that the process proceeds to the next cycle; otherwise, the rotation is continued.

[0062] As a result, the detergent-containing water is stirred, allowing the detergent to be dissolved in the water. At the same time, the water hits the sidewalls of drainage ditch 30. When the water hits the sidewalls, this produces foam containing highly concentrated detergent, which grows and fills the space between rotating drum 17 and washing tub 19. The foam then expands to the front side of rotating drum 17 and washing tub 19, gets into rotating drum 17 through laundry loading-unloading opening 27, and finally permeates the laundry. At this moment, most of the detergent that has reached drainage ditch 30 is dissolved by stirring. However, when the amount of detergent is large, some of the detergent that remains without being dissolved in the water sometimes drops through drain outlet 31 and accumulates in drain space 37.

[0063] At the same time, rotating drum 17 starts to be rotated at a second predetermined rotational speed (for example, 120 r/min). At this moment, rotating drum 17 rotates counterclockwise as viewed from the front. The produced foam envelops and removes stains from the laundry by the centrifugal force generated by the rotation of rotating drum 17. Then, the foam again passes through water-through-holes 18 in the outer periphery of rotating drum 17 and is discharged between drum 17 and washing tub 19, thereby washing the laundry. This operation is performed for a predetermined time until the water in the washing tub 19 reaches a predetermined level. The process performed at the first and second predetermined rotational speeds is what is called a "foaming cycle", which is a previous step of a full-scale washing. The foaming cycle has a main purpose of dissolving and dispersing detergent in the water so as to generate highly concentrated foam, and permeating the washing solution into the laundry.

[0064] Next, the process goes to a wash cycle in which the full-scale washing is performed. The rotational speed of rotating drum 17 is changed to a third predetermined rotational speed (for example, 45 r/min). Then, a washing operation is performed for a fixed time by repeating forward and reverse rotations alternately as a first ON time with pauses as a first OFF time therebetween (for example, a 20 sec ON time and a 7 sec OFF time). The rotation of motor 21 is shown in Fig. 7.

[0065] Fig. 7 is a sequence diagram of control signals of motor 21 and heater 50 of the washer of the present third embodiment. The control signals of motor 21 are shown as signals to control the rotation of drum 17.

[0066] The rotation of rotating drum 17 at the third predetermined rotational speed causes the laundry in drum 17 to be raised in the direction of rotation by projection boards 22 formed on the inner circumference wall of drum 17. Thus, the laundry is repeatedly raised and dropped from an appropriate height, thereby being beat-washed.

[0067] As shown in Fig. 6, when rotating drum 17 is in the paused state, water circulation channel 47 and washing tub 19 have the same water level. When drum 17 starts to be rotated, on the other hand, the water level of washing tub 19 is temporarily lowered in parts because the water is pushed up by the centrifugal force generated by the rotation of rotating drum 17. As a result, the water level of water circulation channel 47 is also lowered. As shown in Fig. 2, rear-side opening 45 can collect water effectively because it is formed in a recess on the inside bottom of washing tub 19 having substantially radial projections and recesses. When motor 21 is turned on and rotating drum 17 is rotated vigorously, the water in washing tub 19 is collected and pushed out to flow through rear-side opening 45 of washing tub 19 down to opening 46 of drain space 37.

[0068] The water is then pushed out through opening 46 at the bottom of drain space 37, and the water force pushes up the detergent accumulated in drain space 37 to drain outlet 31. As a result, the water in drain space

37 is discharged into washing tub 19, and at the same time, a turbulent flow is generated in the vicinity of drain outlet 31. The turbulent flow efficiently mixes the detergent and the water, thereby accelerating the dissolution of the accumulated detergent.

[0069] The washing is performed by repeating the first ON time and the first OFF time. When a predetermined time has passed, the stirring time of rotating drum 17 is changed to a second ON time and a second OFF time. The second ON time is longer than the first ON time by a fixed time. The stirring time is, for example, a 35 sec ON time and a 4 sec OFF time.

[0070] When the stirring time of rotating drum 17 is changed from the first ON and OFF times to the second ON and OFF times, the scheduled time has passed after the start of the wash cycle, and therefore, the detergent has been well dissolved and hardly accumulates in drain space 37. Even so, in order to minimize the accumulation of the detergent that remains without being dissolved, the second ON time is set longer than the ON time set at the start of the wash cycle. This allows the detergent that has dropped into water circulation channel 47, for example, at reverse rotation of rotating drum 17 to flow from opening 46 of drain space 37 to rear-side opening 45 of washing tub 19, and then to return to washing tub 19. As a result, less amount of detergent accumulates in drain space 37. Thus, the rotation of rotating drum 17 allows water circulation channel 47 to have opposite water flows: the water flowing into washing tub 19 from water circulation channel 47, and the water flowing out of washing tub 19 into water circulation channel 47. This prevents the detergent that remains without being dissolved from staying under rotating drum 17, thereby increasing the speed of dissolution of the detergent. The improved dissolution of the detergent can generate highly concentrated washing solution in a shorter time than before. This shortens the wash time without decreasing the washing effect.

[0071] As described above, the drum-type washer of the present invention includes rotating drum 17, drain outlet 31, motor 21, feed-water unit 65, drainage unit 60, and controller 38 controlling at least motor 21, feed-water unit 65, and drainage unit 60 so as to perform at least wash, rinse, and spin cycles. Rotating drum 17 is rotatably mounted in washing tub 19, and has rotating shaft 20 as its rotation axis, which is either horizontal or inclined from a horizontal. Drain outlet 31 is in the bottom of washing tub 19. Motor 21 rotates rotating drum 17. Feed-water unit 65 feeds water into washing tub 19. Drainage unit 60 drains water from washing tub 19. The washer of the present invention also includes water circulation channel 47 extended from rear-side opening 45, that is, the opening in the rear side of washing tub 19 in such a manner as to be communicated with drain space 37 in the downstream of drain outlet 31.

[0072] The washer of the present invention also includes heater 50, which is a component of a heating unit for heating water. Controller 38 turns on and off motor 21 in the wash cycle so as to circulate water to and from water circulation channel 47.

[0073] With this structure, in the wash cycle, even if detergent drops through drain outlet 31 and accumulates in drain space 37, it can be returned into washing tub 19 and dissolved in the cleaning water, providing its full cleaning effect.

[0074] When a predetermined time has passed after the wash cycle is started, controller 38 controls the ON time of motor 21 to be longer than the ON time set at the start of the wash cycle.

[0075] In this case, immediately after the start of the wash cycle, rotating drum 17 is rotated at low speed so as to reduce the convection of water in washing tub 19, thereby maximizing the effect of heating the water. When the predetermined time has passed after the start of a wash cycle, rotating drum 17 is rotated at high speed so as to increase the circulating volume of the heated water, and hence, the solubility of the detergent, thereby providing high detergency performance.

[0076] When the predetermined time has passed after the start of a wash cycle, controller 38 controls the OFF time of motor 21 to be shorter than the OFF time set at the start of the wash cycle.

[0077] As a result, in the predetermined time after the start of the wash cycle, the water moves slowly around heater 50 so as to have sufficient contact time with heater 50, thereby efficiently increasing the temperature of the water. When the predetermined time has passed, rotating drum 17 is rotated at high speed so as to increase the circulating volume of heated water from washing tub 19 to drain space 37. This allows the detergent to be dissolved more easily, and hence, to provide its full cleaning effect.

[0078] Controller 38 controls heater 50 to be ON for the predetermined time after the start of a wash cycle, and to be OFF when the predetermined time has passed, also controls the ON time of motor 21 to be longer than the ON time set at the start of the wash cycle.

[0079] With this structure, immediately after the start of a wash cycle, the water in washing tub 19 is heated to the maximum extent possible, and when the water has been heated, heater 50 is turned off and the heated water is circulated. Thus, the heat time of heater 50 and the switching from the first to the second ON time of rotating drum 17 are in unison with each other. As a result, even when the heat time of heater 50 is changed according to the water temperature, the amount of laundry, and the amount of water at the start of washing, the detergent can be dissolved effectively and efficiently. This achieves energy conservation and high detergency performance.

FOURTH EMBODIMENT

[0080] A sectional view of a side of a drum-type washer according to a fourth embodiment of the present invention is shown in Fig. 1, which is the same as in the first embodiment. A rear view and a longitudinal sectional

view of washing tub 19 of the washer according to the fourth embodiment are identical to those in the first embodiment as shown in Figs. 3 and 6, respectively.

[0081] The drum-type washer of the present fourth embodiment has a foaming cycle and a wash cycle as in the first embodiment.

[0082] Fig. 7 is a sequence diagram of control signals of motor 21 and heater 50 of the washer according to the fourth embodiment. The control signals of motor 21 are shown as signals to control the rotation of rotating drum 17. The sequence diagram is identical to that of the third embodiment.

[0083] The above structure will be described as follows based on the sequence diagram of motor 21 and heater 50 shown in Fig. 7. Note that the description of the same operation as in the first embodiment will be omitted.

[0084] After performing the same foaming cycle as in the first embodiment, a wash cycle is started.

[0085] In the wash cycle, as shown in Fig. 7, until a predetermined time passes after the start of the wash cycle, motor 21 is driven with the first ON time and the first OFF time, and heater 50 performs heating. When the predetermined time has passed, the first ON time and the first OFF time are changed to a longer ON time and a shorter OFF time, respectively.

[0086] Until the predetermined time passes after the start of the wash cycle, rotating drum 17 is rotated in a shorter time and stopped for a longer time than after the predetermined time has passed. This allows the water in rotating drum 17 to flow slowly, and the detergent that remains without being dissolved to be easily dropped and collected in drainage ditch 30 in the bottom of washing tub 19. The water around heater 50 in the recess of drainage ditch 30 is heated up when heater 50 is turned on. Since rotating drum 17 is rotated slowly, the water around heater 50 moves little and is heated up. The detergent that remains without being dissolved is collected in drainage ditch 30 having heater 50 therein is mixed with the heated water, thereby being dissolved in an accelerated manner.

[0087] When the predetermined time has passed, the water in washing tub 19 is warm, and is fed from rear-side opening 45 to drain space 37 through water circulation channel 47. As a result, the water originally drawn in drain space 37 is heated up so as to effectively dissolve the detergent. When the predetermined time has passed in the wash cycle, as shown in Fig. 7, the stirring time of rotating drum 17 is changed to make the ON time longer and the OFF time shorter by a predetermined time. In this situation, the water in water circulation channel 47 continues to flow all the time, thereby dissolving more of the detergent, and allowing the detergent to have its full cleaning effect. As a result, the drum-type washer provides excellent washing performance.

[0088] Controller 38 controls heater 50 to be ON for the predetermined time after the start of a wash cycle, and to be OFF when the predetermined time has passed, and also controls the OFF time of motor 21 to be shorter than the OFF time set at the start of the wash cycle.

[0089] With this structure, the heat time of heater 50 and the switching from the first to the second ON time of rotating drum 17 are in unison with each other. Immediately after the start of a wash cycle, the water in washing tub 19 is heated to the maximum extent possible, and the water heated to a preset temperature is circulated. Later, the ON time is made longer so that more water can be circulated from washing tub 19 to drain space 37 through water circulation channel 47. As a result, even when the heat time of heater 50 is changed according to the water temperature, the amount of laundry, and the amount of water at the start of washing, the detergent can be dissolved effectively, providing its full cleaning effect.

[0090] As described hereinbefore, the drum-type washer of the present invention, which allows detergent accumulated in the drain space during washing to be effectively dissolved by making use of the water movement in the water circulation channel, provides excellent washing performance.

Claims

1. A drum-type washer comprising:

   a rotating drum rotatable in a washing tub, the rotating drum having a rotation axis horizontal or inclined from a horizontal;
   a drain outlet in a bottom of the washing tub;
   a motor for rotating the rotating drum;
   a feed-water unit for feeding water into the washing tub;
   a drainage unit for draining water from the washing tub;
   a controller for controlling at least the motor, the feed-water unit, and the drainage unit so as to perform at least wash, rinse, and spin cycles; and
   a water circulation channel extended from a rear-side opening in a rear side of the washing tub, the water circulation channel being communicated with a drain space in a downstream of the drain outlet.

2. The drum-type washer of claim 1, wherein the rear-side opening in the rear side of the washing tub is at a position not lower than a rated water level in a wash cycle.

3. The drum-type washer of claim 1 or 2, wherein the rear side of the washing tub is corrugated with alternating projections and recesses, and the rear-side opening in the rear side of the washing tub is formed in one of the recesses and connected to the downstream of the drain outlet.

4. The drum-type washer of any one of claims 1 to 3, wherein
the drain space has an opening at a bottom thereof, the opening being communicated with the drain space side of the water circulation channel.

5. The drum-type washer of any one of claims 1 to 3, wherein
the drain space has an opening at a side thereof, the opening being communicated with the drain space side of the water circulation channel.

6. The drum-type washer of any one of claims 1 to 5, wherein
the water circulation channel has elbow-shaped ends.

7. The drum-type washer of claim 6, wherein
the water circulation channel is made of chemical and heat resistant resin.

8. The drum-type washer of claim 6, wherein
the water circulation channel is formed by blow molding.

9. The drum-type washer of claim 6, wherein
the water circulation channel is made of ethylene-propylene rubber.

10. The drum-type washer of claim 1, wherein
the controller turns on and off the motor in a wash cycle so as to circulate the water to and from the water circulation channel.

11. The drum-type washer of claim 10, wherein
when a predetermined time has passed after a start of the wash cycle, the controller controls an ON time of the motor to be longer than an ON time set at the start of the wash cycle.

12. The drum-type washer of claim 10 or 11, wherein
when a predetermined time has passed after a start of the wash cycle, the controller controls an OFF time of the motor to be shorter than an OFF time set at the start of the wash cycle.

13. The drum-type washer of claim 10, further comprising:

a heating unit for heating water, wherein
the controller controls the heating unit to be ON for a predetermined time after a start of the wash cycle, and to be OFF when the predetermined time has passed, and also controls an ON time of the motor to be longer than an ON time set at the start of the wash cycle.

14. The drum-type washer of claim 10 or 13, further comprising:

a heating unit for heating water, wherein
the controller controls the heating unit to be ON for a predetermined time after a start of the wash cycle, and to be OFF when the predetermined time has passed, and also controls an OFF time of the motor to be shorter than an OFF time set at the start of the wash cycle.

FIG. 1

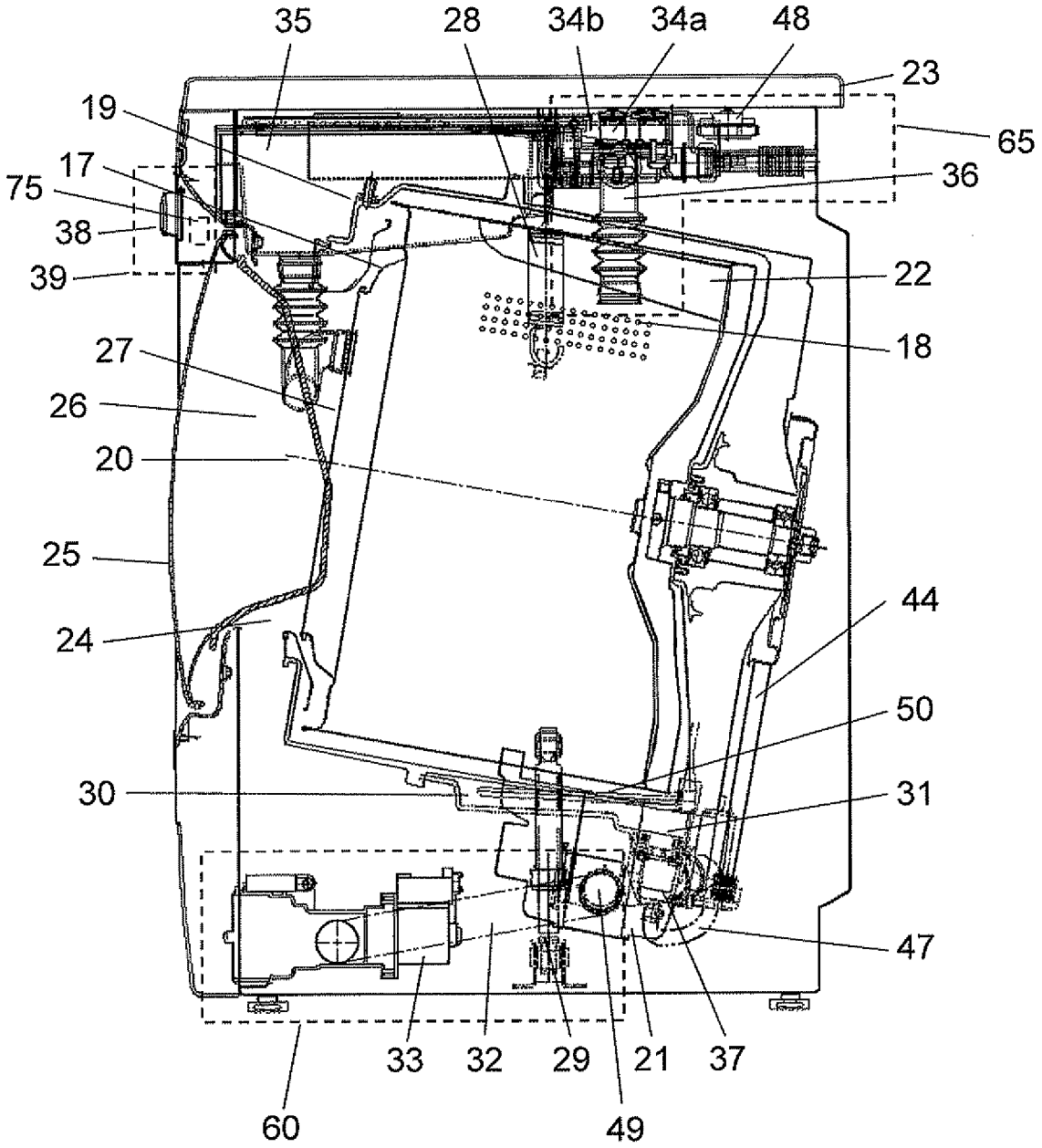

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FIG. 2

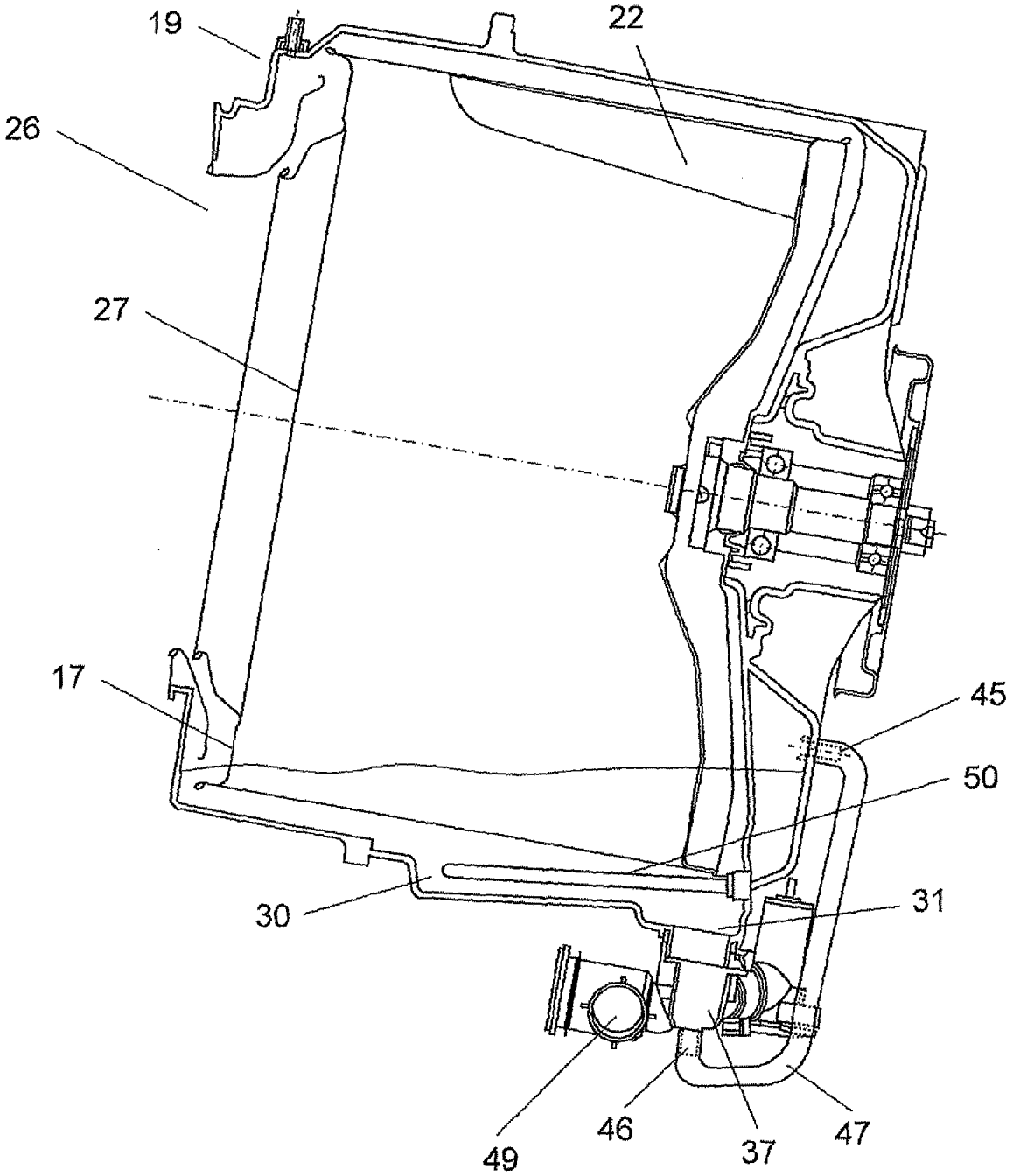


FIG. 3

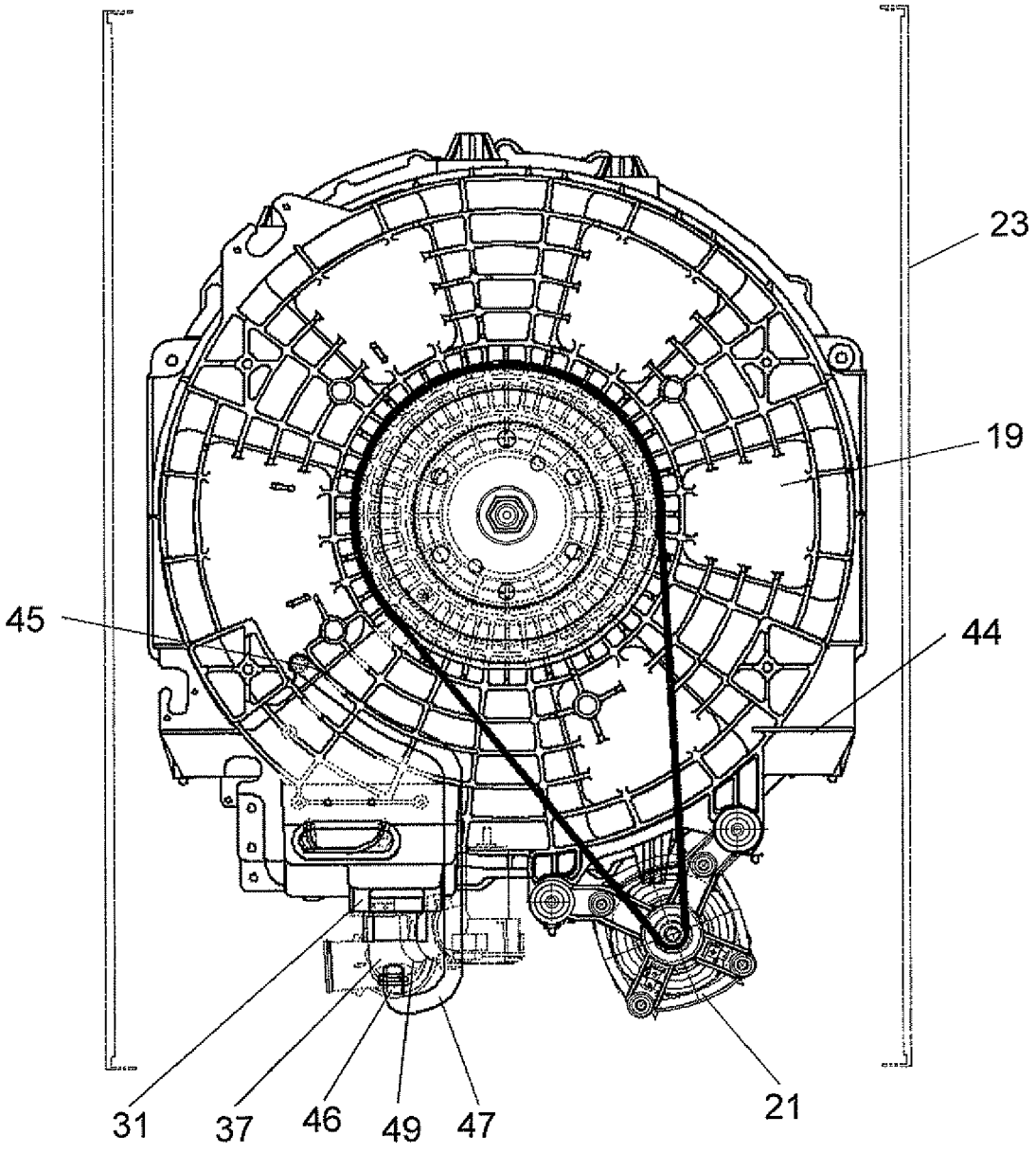


FIG. 4

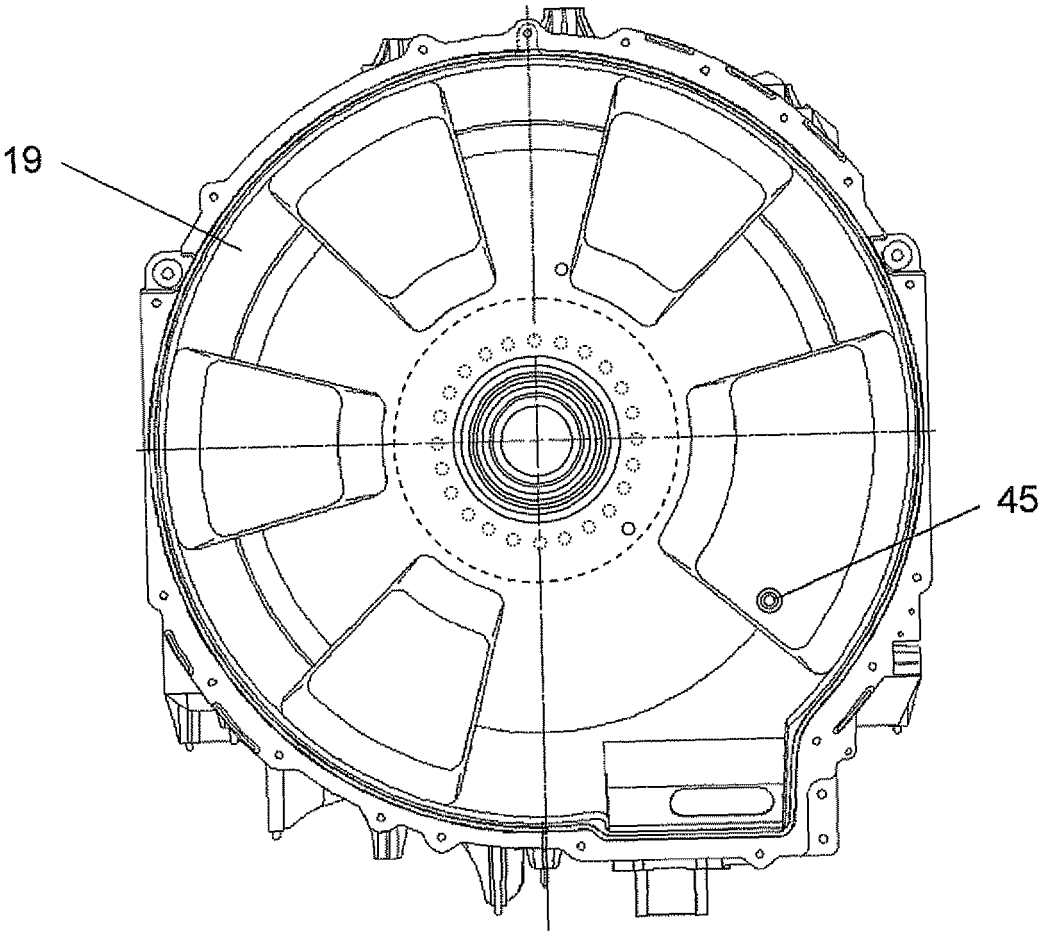


FIG. 5

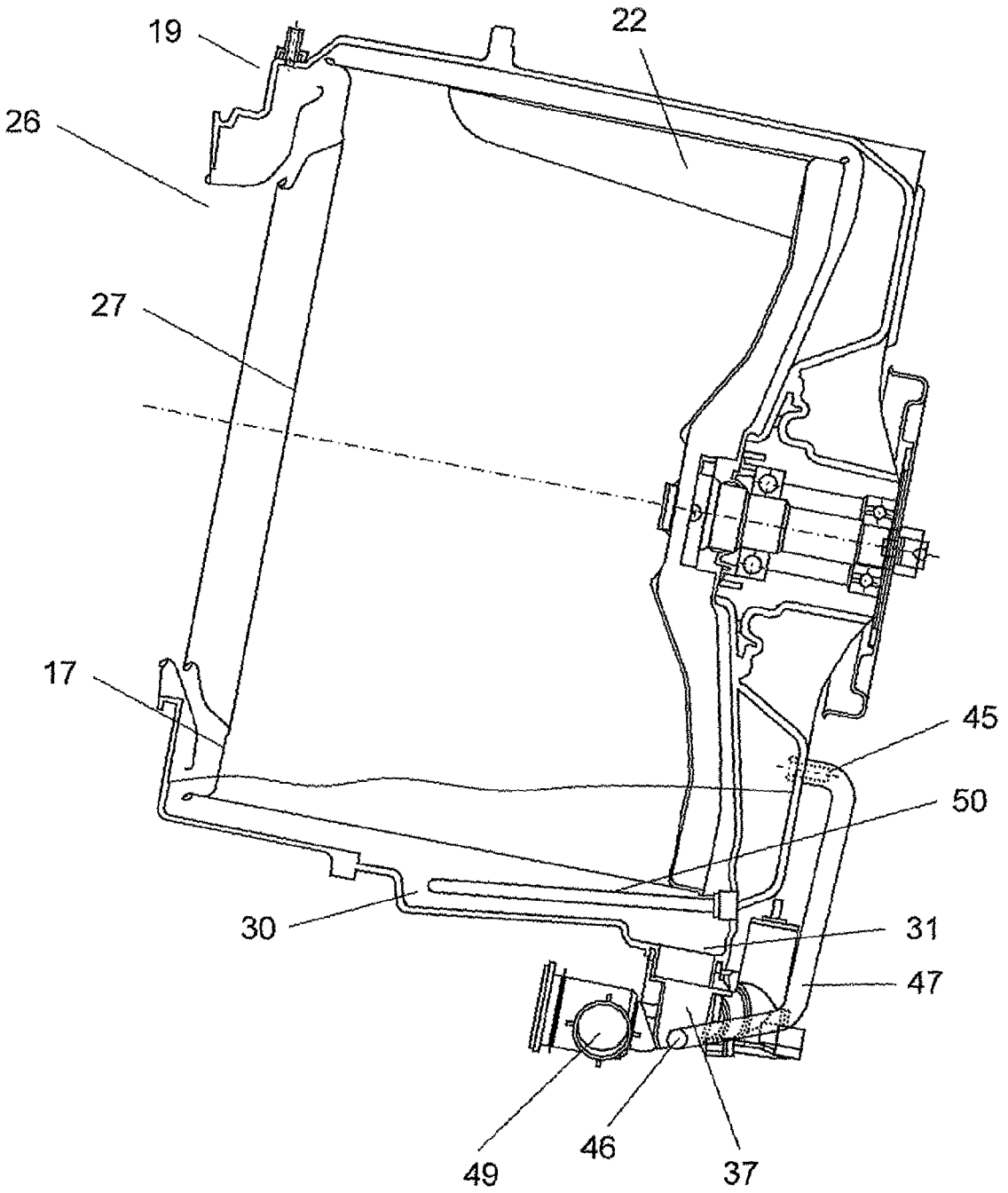


FIG. 6

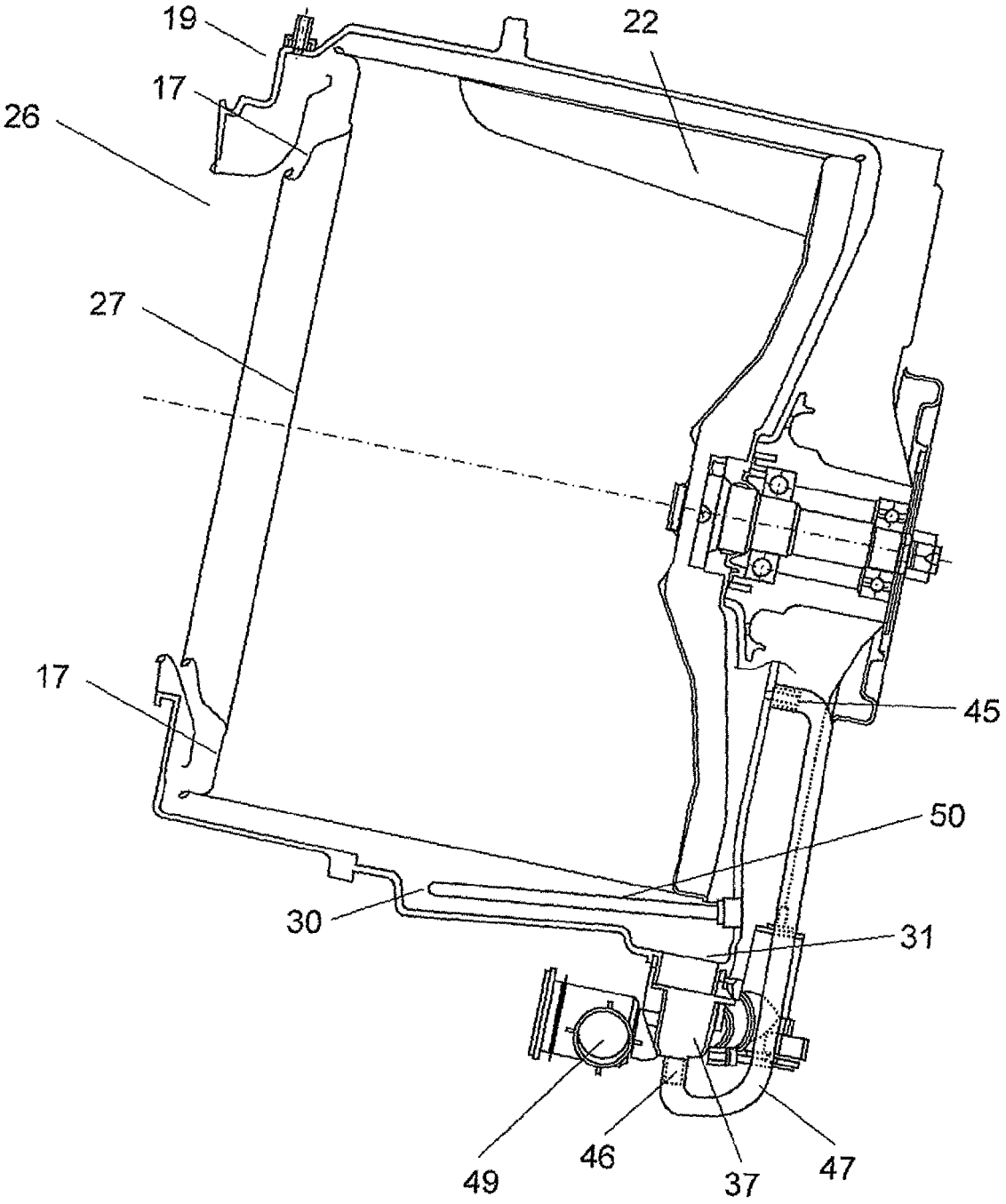


FIG. 7

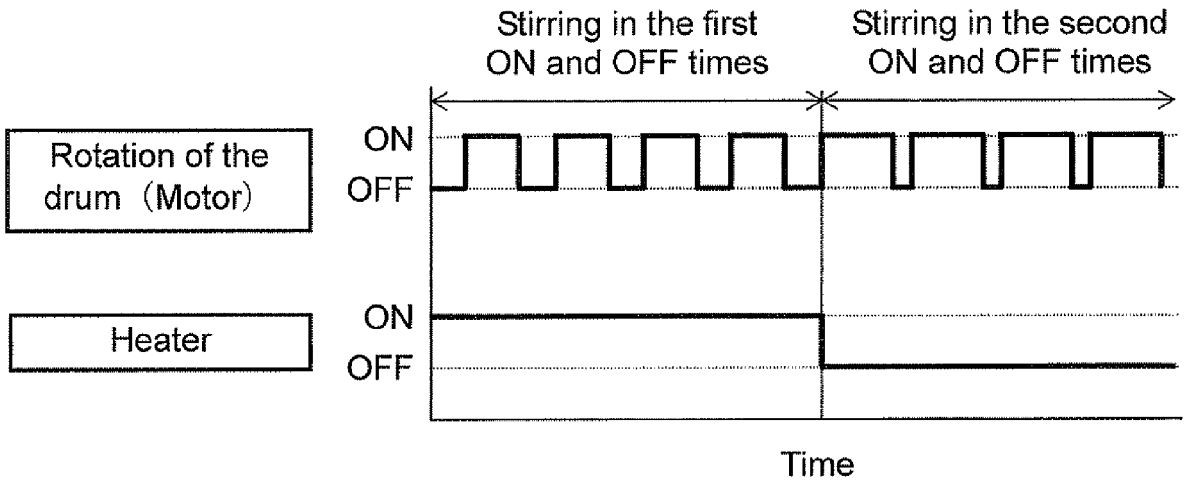
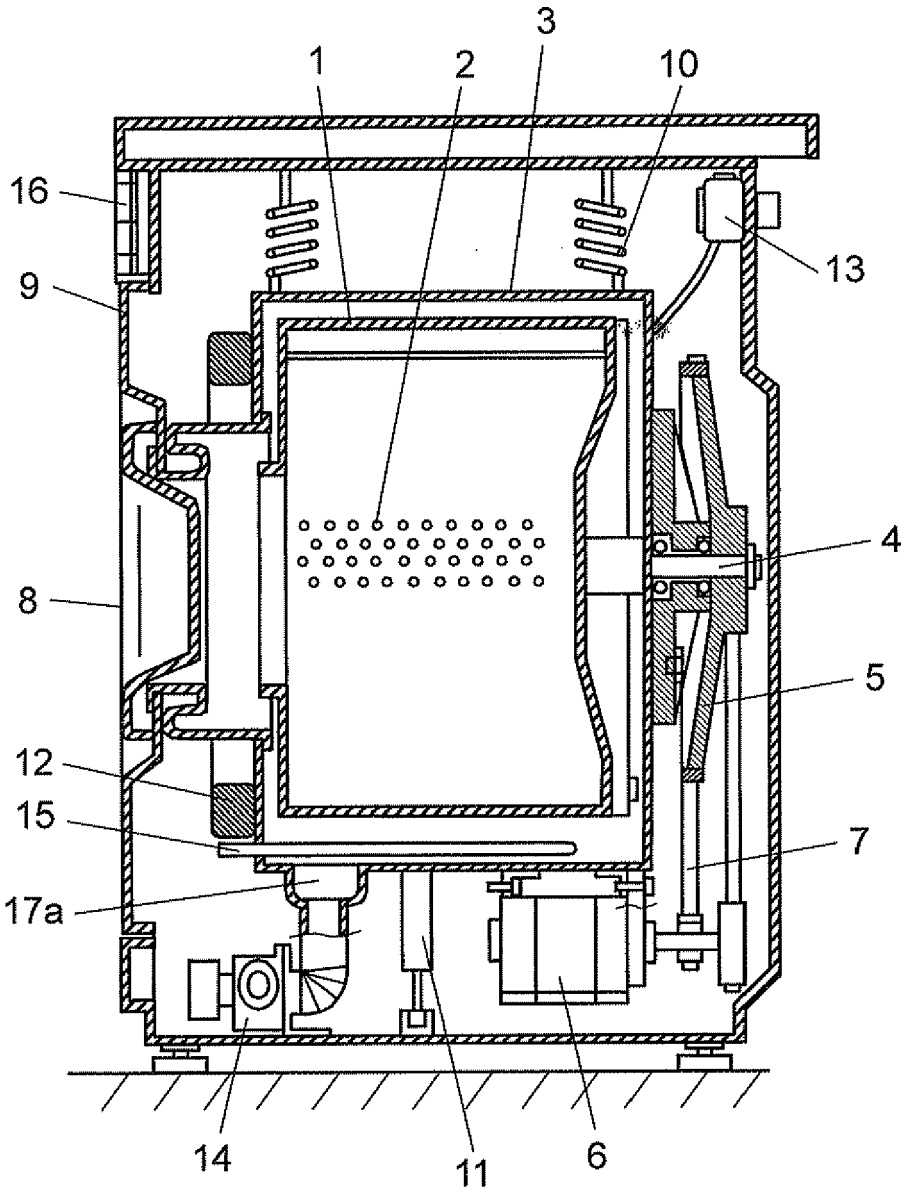

Stirring in the first
ON and OFF times
Stirring in the second
ON and OFF times
Rotation of the drum (Motor)
ON
OFF
Heater
ON
OFF
Time

FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 4187

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 June 2010	Clivio, Eugenio

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