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(54) **WASHING MACHINE**

(57) A washing machine is provided. The washing machine can eliminate imbalance produced by washings while continuing to perform a normal dewatering operation without decelerating or stopping rotation of a rotating drum during dewatering operation of the washing machine. Therefore, the washings are efficiently dewatered without generating vibration and noise, and the power consumption will not increase. The washing machine includes: a washing drum (5); a plurality of hollow balancers (6) arranged on an inner circumferential surface of the washing drum in an axis direction of the washing drum; a water receiving ring unit (18, 69), the water receiving ring unit is formed by stacking multiple layers of annular water guiding grooves (19a, 19b, 19c), and fixed to an end in the axis direction of an outer surface of the washing drum (5), and the multiple layers of annular water guiding grooves correspond to the balancers respectively; a plurality of water passing components for connecting a part of the water guiding grooves (19a, 19b, 19c) with the balancers (6) corresponding to the water guiding grooves; and a nozzle unit (25a, 25b, 25c) for separately injecting adjustment water into the water guiding grooves (19a, 19b, 19c).

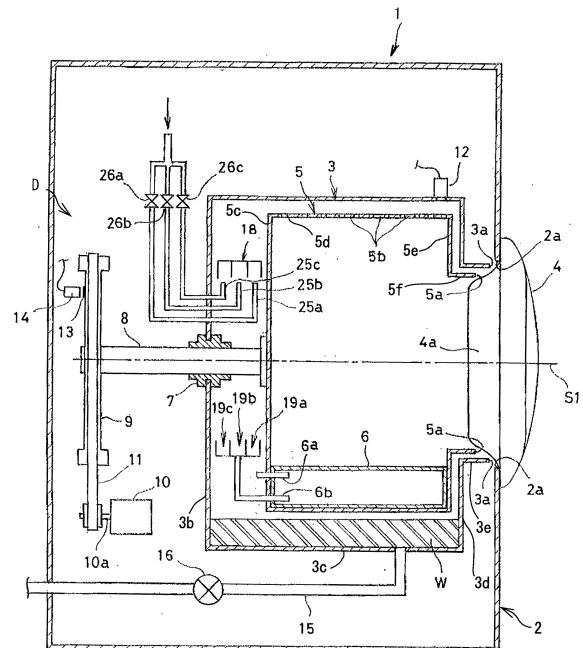


FIG. 2

Description**TECHNICAL FIELD**

[0001] The present disclosure relates to a washing machine having a dewatering function.

BACKGROUND

[0002] Some washing machines placed in ordinary families, coin-operated laundry rooms or the like have a washing-dewatering function or a washing-dewatering-drying function.

[0003] A washing machine having a dewatering function generates vibration and noise due to bias of washings in a rotating drum. In addition, since eccentricity of the rotating drum during rotation is large when the bias of the washings is large, and a large torque is required during the rotation, failing to start a dewatering operation. In order to overcome the problem, a user stops operation of the washing machine and eliminates the bias of the washings by a manual operation.

[0004] In order to eliminate such a cumbersome operation, a following washing machine is proposed. When it is determined by the washing machine that the bias of the washings, i.e., a magnitude of imbalance, is greater than a specified value, the rotating drum decelerates in response to an output time sequence of a position detection unit until a rotating speed at which a centrifugal force is smaller than a gravity, so as to eliminate the bias of the washings (with reference to patent literature 1).

[0005] In addition, another washing machine is also proposed. In the washing machine, acceleration sensors arranged on a front portion and a rear portion of the rotating drum are configured to calculate a difference between vibration quantities detected, so as to detect an imbalance state that the washings are biased to the front portion of the rotating drum, thereby preventing imbalance that the washings are biased to the front portion of the rotating drum during dewatering (with reference to patent literature 2).

Existing Technical Literatures**Patent Literatures****[0006]**

Patent Literature 1: Japanese Laid-Open Patent Publication No. 9-290089

Patent Literature 2: Japanese Laid-Open Patent Publication No. 2009-82558

SUMMARYProblems to be solved

[0007] In the above patent literature 1, a centrifugal force is reduced gradually by decelerating rotation of the rotating drum so that washings stacked together fall by gravity. However, the washings tangled with each other may fall by keeping a tangled state in the existing art, so the washings cannot be unfastened. When the rotating drum is rotated in such a state, since the imbalance is not eliminated, the imbalance will occur again and the rotating drum will decelerate repeatedly.

[0008] On the other hand, in the above patent literature 2, a difference between a vibration value detected by a vibration detection unit at a front portion and a vibration value detected by a detection unit at a rear portion is calculated when the drum rotates. Then, rotation of the rotating drum is decelerated or stopped when the difference between the vibration values is greater than a preset threshold value.

[0009] However, even through such existing art, the washings tangled with each other still cannot be unfastened and remain in the rotating drum, so the existing part does not a fundamental method to eliminate the imbalance.

[0010] Further, in the above patent literatures 1 and 2, the rotation of the rotating drum is decelerated or stopped, and electric power is required when a dewatering operation is repeated every time, causing a problem of increasing power consumption.

[0011] It should be noted that these problems not only occur in a drum type washing machine having the rotating drum (a washing drum), but also may occur in a vertical washing machine.

[0012] The present disclosure aims to solve such problems in the existing art. The present disclosure can provide a washing machine capable of reliably eliminating the imbalance of the washing drum during the dewatering operation, reducing generation of vibration and noise caused by eccentricity of the washing drum and efficiently dewatering the washings without decelerating or stopping the rotation of the washing drum even if the bias of the washings exists in the washing drum.

Solutions for solving problems

[0013] The washing machine of the present disclosure includes: a washing drum; a plurality of hollow balancers arranged on an inner circumferential surface of the washing drum along an axis direction of the washing drum; a water receiving ring unit, where the water receiving ring unit is formed by stacking multiple layers of annular water guiding grooves, and fixed to an end in the axis direction of an outer surface of the washing drum, the annular water guiding grooves correspond to the balancers respectively; water passing components for connecting a portion of the water guiding grooves with the balancers cor-

responding to the water guiding grooves; and a nozzle unit for separately injecting adjustment water into the water guiding grooves.

[0014] Particularly, according to the present disclosure, the balancers are lifting ribs for lifting washings. In addition, according to the present disclosure, the balancers are arranged on the inner circumferential surface of the washing drum, i.e., a rotating drum, at equal intervals. Each of the water guiding grooves is formed so that an inner circumferential surface of the water guiding groove is opened and an outer circumferential surface of the water guiding groove is bottomed. Bottom plates of each layer of the water guiding grooves of the water receiving ring unit are eccentric relative to an axis of the washing drum, and adjacent bottom plates are fixed in such a manner that angle differences of the adjacent bottom plates in an eccentric direction are the same. Eccentric top portions of the bottom plates are provided with the water passing components

[0015] In addition, according to the present disclosure, an inclined plate inclined downward from a front end to a rear end is arranged inside each of the lifting ribs.

[0016] In addition, according to the present disclosure, the bottom plates are funnel-shaped at mounting positions of the water passing components for being mounted on the bottom plates.

[0017] In addition, according to the present disclosure, each of the water guiding grooves includes: an annular water guiding groove body; and bulging portions protruding from the water guiding groove body to a radial outer side. A connecting opening communicated with the water guiding groove body is formed in each of the bulging portions at a lagging side of a rotation direction of the washing drum, and each of the bulging portions is connected with the water passing components at a leading side of the rotation direction.

[0018] In addition, according to the present disclosure, separation components for furling water storage regions inside the balancers in a circumferential direction of the washing drum are arranged.

[0019] In addition, according to the present disclosure, the washing machine has water storage portions which are mounted at an end in the axis direction of the outer surface of the washing drum and are communicated with any one of the plurality of balancers.

[0020] In addition, according to the present disclosure, the washing drum is the rotating drum with a substantially horizontal axis. Each of the water guiding grooves forming the water receiving unit is formed so that an inner circumferential surface of the water guiding groove is opened and an outer circumferential surface of the water guiding groove is bottomed. The nozzle unit is arranged at a position on a lower portion of the water receiving ring unit so that water is supplied to the water guiding grooves.

Effects of the disclosure

[0021] Through the present disclosure, since the

washing machine eliminates the imbalance generated by the bias of the washings by supplying the injected adjustment water of the selected water guiding grooves of the water receiving ring unit integrally rotating with the washing drum to the balancers through the water passing components, the generation of vibration and noise in a state of continuing to perform a normal dewatering operation can be prevented without decelerating or stopping the rotation of the washing drum halfway.

[0022] Since the washing machine of the present disclosure adopts the solution that the balancers are used as the lifting ribs, two functions of adjusting balance of the washing drum and lifting the washings can be acquired.

[0023] Since the washing machine of the present disclosure adopts the solution that the bottom plates of each layer of water guiding grooves of the water receiving ring unit are eccentric relative to the axis of the rotating drum, the water receiving ring unit can generate a centrifugal force toward a top direction of the eccentricity during rotation to efficiently supply the adjustment water injected into the water guiding grooves to the balancers.

[0024] Since the inclined plates inclined from the front ends to the rear ends are arranged inside the lifting ribs, the washing machine of the present disclosure can efficiently discharge the adjustment water.

[0025] Since the mounting portions of the water passing components of the bottom plates of the water guiding grooves of the water receiving ring unit are formed into a funnel shape, the washing machine of the present disclosure can improve retention of the adjustment water injected into the water guiding grooves and efficiently supply the adjustment water to the balancers.

[0026] Since the water guiding grooves of the washing machine of the present disclosure have the water guiding groove body and the bulging portions, the adjustment water in the water guiding groove body can smoothly flow into the bulging portions through the connection openings; and the adjustment water is efficiently supplied from the bulging portions to the balancers through the water passing components.

[0027] Since the washing machine of the present disclosure is provided with the separation components, the adjustment water can be concentrated in a narrow range in the rotation direction of the washing drum in the balancers; and the imbalance generated by the bias of the washings can be eliminated by less adjustment water within short time.

[0028] Since the washing machine of the present disclosure has the water storage portions, more adjustment water can be supplied to the vicinity of the washing drum; and a greater imbalance caused by the bias of the washings can be eliminated stably.

[0029] Since the nozzle unit is configured at the position capable of supplying water to the water guiding grooves on the lower portion of the water receiving ring unit, the drum type washing machine of the present disclosure can gently injecting the adjustment water into the

water guiding grooves from the nozzle unit and can inhibit water splashing.

BRIEF DESCRIPTION OF DRAWINGS

[0030]

FIG. 1 is a front view illustrating an appearance of a washing machine 1 according to a first embodiment of the present disclosure;

FIG. 2 is a schematic view illustrating an internal structure of the washing machine 1 of the present disclosure;

FIG. 3 is a perspective view, as viewed from the front, illustrating a rotating drum 5 adopted by a washing machine 1 of the present disclosure;

FIG. 4 is a perspective view, as viewed from the rear, illustrating the rotating drum 5 adopted by the washing machine 1 of the present disclosure;

FIG. 5 is a side view illustrating the rotating drum 5 adopted by the washing machine 1 of the present disclosure;

FIG. 6 is a perspective view illustrating a lifting rib 6 arranged in the rotating drum 5 of the washing machine 1 of the present disclosure;

FIG. 7 is a sectional view illustrating the lifting rib 6 arranged in the rotating drum 5 of the washing machine 1 of the present disclosure;

FIG. 8 is a sectional view illustrating a water receiving ring unit 18 arranged in the rotating drum 5 of the washing machine 1 of the present disclosure;

FIG. 9 is a perspective view illustrating an assembly of the water receiving ring unit 18 in FIG. 8;

FIG. 10 is a view illustrating a structure of the water receiving ring unit 18 in FIG. 8;

FIG. 11 is a view illustrating an assembled state of the water receiving ring unit 18 in FIG. 8;

FIG. 12 is a view illustrating a state of injecting adjustment water into a nozzle unit 25 of the water receiving ring unit 18;

FIG. 13 is a block view illustrating an electrical system of the washing machine 1 of the present disclosure;

FIG. 14 is a view illustrating an imbalance state of the rotating drum 5;

FIG. 15 is a view illustrating an imbalance state of the rotating drum 5;

FIG. 16 is a flow chart illustrating a control flow of dewatering operation of the washing machine 1 of the present disclosure;

FIG. 17 is a schematic view illustrating an internal structure of a modified embodiment according to the first embodiment of the present disclosure;

FIG. 18 is a sectional view illustrating a modified embodiment of the water receiving ring unit 18 according to the first embodiment of the present disclosure;

FIG. 19 is a perspective view illustrating an assembly of the water receiving ring unit 18 shown in FIG. 18;

FIG. 20 is a sectional view illustrating a modified embodiment of lifting ribs according to the first embodiment of the present disclosure;

FIG. 21 is a local perspective view illustrating another modified embodiment of a water receiving ring unit according to the first embodiment of the present disclosure;

FIG. 22 is a perspective view, as viewed from the rear, illustrating a rotating drum 5 provided in a washing machine 50 according to a second embodiment of the present disclosure;

FIG. 23 is an exploded perspective view illustrating a water receiving ring unit 69 shown in FIG. 22;

FIG. 24 is a sectional perspective view illustrating a water guiding groove 68 forming the water receiving ring unit 69 shown in FIG. 22, cut at sectional positions including a bulging portion 68b;

FIG. 25 is a longitudinal sectional perspective view illustrating the washing machine 50 cut near the nozzle unit 25;

FIG. 26 is a view illustrating a lifting rib 6 arranged in the rotating drum 5 of the washing machine 50;

FIG. 27 is a flow chart illustrating a control flow of dewatering operation of the washing machine 50 according to the second embodiment;

FIG. 28 is a flow chart illustrating a control flow of dewatering operation of the washing machine 50 according to the second embodiment;

FIG. 29 is a view illustrating a control flow of dewatering operation of the same washing machine 50; and

FIG. 30 is a view illustrating a modified embodiment of the washing machine 50 of the second embodiment.

DETAILED DESCRIPTION

The First Embodiment

[0031] Hereinafter, embodiments of the present disclosure are described in detail with reference to drawings. FIG. 1 is a front view illustrating an appearance of a washing machine 1 according to a first embodiment of the present disclosure. FIG. 2 is a schematic view illustrating an internal structure of the washing machine 1. FIG. 3 is a perspective view illustrating a rotating drum 5 as viewed from the front. FIG. 4 is a perspective view illustrating the rotating drum 5 as viewed from the rear. FIG. 5 is a side view illustrating the rotating drum 5.

[0032] The washing machine 1 shown in FIG. 1 and FIG. 2 is a horizontal drum type washing machine including a main body 2, an outer drum 3 wrapped in the main body 2, a door body 4 mounted on the main body 2, and a rotating drum 5 wrapped in the outer drum 3. An opening 2a is formed on a front surface of the main body 2 to take out/put in the washings. The door body 4 is arranged on the opening 2a and can be opened or closed freely, so as to maintain the opening in a closed state or an opened state.

[0033] The outer drum 3 shown in FIG. 2 is formed in a substantially bottomed cylinder shape. Specifically, the outer drum 3 includes: a disk-shaped bottom 3b; a cylindrical side wall 3c connected with an outer edge of the bottom 3b; an annular throttle portion 3d connected with the side wall 3c; and a cylindrical opening wall 3e connected with the throttle portion 3d and forming an opening 3a opposite to the opening 2a of the main body 2. The outer drum 3 has an axis S1 extending in a substantially horizontal direction. The outer drum 3 is arranged so that the opening 3a is opposite to the opening 2a of the main body 2.

[0034] The rotating drum 5 is arranged in an inner space of the outer drum 3. The rotating drum 5 is formed to have a substantially bottomed cylinder shape (with reference to FIG. 3 to FIG. 5). Specifically, the rotating drum 5 includes: a disk-shaped bottom 5c; a cylindrical side wall 5d connected with an outer edge of the bottom 5c; an annular throttle portion 5e connected with the side wall 5d; and a cylindrical opening wall 5f forming an opening 5a connected with the throttle portion 5e. An axis center of the rotating drum 5 is consistent with the axis S1 of the outer drum 3. A plurality of through holes 5b penetrating through the entire side wall 5d are formed in the side wall 5d of the rotating drum 5.

[0035] The door body 4 is arranged on the opening 2a on the front surface of the main body 2, and can be opened or closed freely. As shown in FIG. 2, the door body 4 closes the opening 2a of the main body 2 so that a convex portion 4a on a back surface of the door body

4 enters the opening 3a of the outer drum 3 and the opening 5a of the rotating drum 5 to prevent the washings in the rotating drum 5 from flying out.

[0036] The washing machine 1 further includes a driving portion D and a water receiving ring unit 18. The driving portion D includes a bearing 7, a main shaft 8, a belt pulley 9, a drum motor 10 and a transmission belt 11 which are fixed to the bottom 3b of the outer drum 3. The bearing 7 is arranged at the center of the bottom 5c of the rotating drum 5. One end of the main shaft 8 is fixed to the bottom 5c of the rotating drum 5, and the other end is fixed to the belt pulley 9. The main shaft 8 is pivotally supported by the bearing 7 and is a rotatable. An axis center of the main shaft 8 is consistent with the axis S1.

[0037] The drum motor 10 has an output shaft 10a. The transmission belt 11 is erected between the belt pulley 9 and the output shaft 10a. A torque of the drum motor 10 is transmitted to the belt pulley 9 and the main shaft 8 by the transmission belt 11, so as to rotate the rotating drum 5.

[0038] In addition, an acceleration sensor 12 is arranged on the outer drum 3 at positions corresponding to the top end of the rotating drum 5, and is configured to detect accelerations in a horizontal direction and a vertical direction. On the other hand, a proximity switch 14 is provided to detect a sensor tag 13 arranged on the belt pulley 9. In addition, the outer drum 3 is connected to a drain pipe 15 for discharging retained dewatering liquid W to the outside of the main body 2. The dewatering liquid W can be discharged to the outside of the main body 2 by opening and closing an electromagnetic valve 16.

[0039] FIG. 6 is a perspective view illustrating a lifting rib 6 arranged in the rotating drum 5 shown in FIG. 3. FIG. 7 is a sectional view illustrating the lifting rib 6 arranged in the rotating drum 5 shown in FIG. 3.

[0040] As shown in FIG. 6, the lifting rib 6 includes: a lifting rib body 6d; a tubular rod 6a connected with any one of water passing components 24a, 24b and 24c shown in FIG. 4 for supplying adjustment water described later; and a tubular rod 6b for discharging the adjustment water retained in the lifting rib 6. In addition, as shown in FIG. 3, a plurality of such lifting ribs 6 (three in the present embodiment) are arranged in the rotating drum 5 in a manner of extending parallel to a direction of the axis S1 (with reference to FIG. 2). Each lifting rib body 6d is formed as a hollow body triangularly protruding from the side wall 5d of the rotating drum 5 to the axis S1, and configured to lift the washings while being rotationally driven by the rotating drum 5. The plurality of lifting ribs 6 are arranged in a circumferential direction of the rotating drum 5 at equal intervals. In the present embodiment, the plurality of lifting ribs 6 are arranged in the circumferential direction of the rotating drum 5 at intervals of 120°.

[0041] Due to such a structure, the plurality of lifting ribs 6 can change a weight of the rotating drum 5 by the adjustment water at mounting positions of the lifting ribs

6, and can perform functions of a balancer when the bias of the washings occurs during dewatering described later. In addition, in machine types without the lifting ribs 6, a plurality of elongated hollow bodies can be arranged on the inner circumferential surface of the rotating drum 5 in the direction of the axis S1 as the above structure. It should be noted that the tubular rod 6b is arranged on the rear portion at the top side of the lifting rib 6. Thus, the adjustment water retained in the lifting rib 6 can be discharged to the outside of the rotating drum 5.

[0042] Next, a structure of the water receiving ring unit 18 for supplying the adjustment water to the lifting ribs 6 is described. FIG. 8 is a sectional view illustrating the water receiving ring unit 18 arranged in the rotating drum 5. FIG. 9 is a perspective view illustrating the assembly of the water receiving ring unit 18 in FIG. 8. FIG. 10 is a view illustrating a structure of the water receiving ring unit 18 in FIG. 8. FIG. 11 is a view illustrating an assembled state of the water receiving ring unit 18 in FIG. 8.

[0043] The water receiving ring unit 18 is fixed to the back surface of the rotating drum 5 as shown in FIG. 4 and FIG. 5. The water receiving ring unit 18 shown in FIG. 8 is configured to have an annular shape, and is formed by stacking three layers (corresponding to the number of the lifting ribs 6 arranged in the rotating drum 5) of water guiding grooves 19a, 19b and 19c with an opened inner circumferential surface and an outer circumferential surface closed by a bottom plate along the direction of the axis S1 (with reference to FIG. 2) of the rotating drum 5.

[0044] The water receiving ring unit 18 is formed by assembling plates shown in FIG. 9. The water receiving ring unit 18 is integrated in a state of clamping circular bottom plates 21 with the same shape between circular ring plates 20 with the same shape. Thus, three layers of water guiding grooves 19a, 19b and 19c which have the bottom plates 21 as bottom surfaces and have the ring plates 20 as side walls are formed. In this case, a position of each of the bottom plates 21 in FIG. 10 is represented by a dot dash line, a dotted line and a double-dot line. Centers of the bottom plates 21 are eccentric from centers RC of the ring plates 20 for distance (d), and form eccentric centers EC.

[0045] The ring plates 20 and the bottom plates 21 are assembled as shown by the dot dash lines, the dotted lines and the double-dot lines shown in FIG. 11 in such a manner that an angle difference in an eccentric direction of the adjacent bottom plates 21 is 120°, and then tubular rods 22a, 22b and 22c connected with the water passing components 24a, 24b and 24c (with reference to FIG. 4) are fixed on eccentric top portions of the bottom plates 21 located on an outer end of the ring plates 20. The water receiving ring unit 18 adopting such a structure is fixed so that the centers RC of the ring plates 20 are consistent with the axis S1 (with reference to FIG. 2) of the rotating drum 5. Thus, each of the bottom plates 21 of each of the water guiding grooves 19a, 19b and 19c is eccentrically configured about the axis S1 of the rotat-

ing drum 5 at the angle difference of 120°.

[0046] The tubular rods 22a, 22b and 22c of the water receiving ring unit 18 adopting the above structure are connected with one end of the water passing components 24a, 24b and 24c as shown in FIG. 4 respectively, and the other ends of the water passing components 24a, 24b and 24c are connected to the tubular rods 6a of the lifting ribs 6 respectively. It should be noted that the lifting ribs 6 are mounted to the water passing components 24a, 24b and 24c at bottom sides of the lifting ribs 6. Thus, the retention of the adjustment water supplied to the lifting ribs 6 in a centrifugal direction can be improved.

[0047] With such a structure, when the adjustment water is injected into the water guiding grooves 19a, 19b and 19c by the solution described later, if the rotation of the water receiving ring unit 18 exceeds a critical rotating speed at which the centrifugal force is generated, the adjustment water injected into the water guiding grooves 19a, 19b and 19c flows down to the tubular rods 22a, 22b and 22c while being subjected to a load in the centrifugal direction.

[0048] The water receiving ring unit 18 is provided with three water guiding grooves 19a, 19b and 19c and three lifting ribs 6 corresponding thereto to form the balancers. Moreover, angles between the eccentric top portions of the bottom plates 21 of the water guiding grooves 19a, 19b and 19c having the axis S1 of the rotating drum 5 as the center and angles between the lifting ribs 6 are 120°. It should be noted that the bottom plates 21 of the water guiding grooves 19a, 19b and 19c are designed in a circular shape as a preferred shape of the present embodiment, but can also be designed in an oblong shape including ellipse or a polygonal shape as long as the same function can be obtained.

[0049] The adjustment water injected into the water guiding grooves 19a, 19b and 19c of the water receiving ring unit 18 adopting the above structure flows to the eccentric top portions by the centrifugal force, and is supplied from the tubular rods 22a, 22b and 22c to the lifting ribs 6 through the water passing components 24a, 24b and 24c. The supplied adjustment water is retained on wall surfaces in a centrifugal direction in the lifting ribs 6. The adjustment water is supplied to the lifting ribs 6 in this way so as to increase the weight of the lifting ribs 6. Thus, the imbalance of the rotating drum 5 can be eliminated without decelerating or stopping the rotation of the washing drum 5 as long as the adjustment water is supplied to the lifting ribs 6 so as to disperse agglomerates of the washings described later, thereby preventing generation of vibration and noise in a state of continuing to perform a normal dewatering operation. In addition, thus, the rotating speed of the rotating drum 5 can be increased to start the dewatering operation.

[0050] As the dewatering operation is ended, the rotating speed of the rotating drum 5 is reduced; the centrifugal force in the lifting ribs 6 is also attenuated gradually; and the adjustment water becomes unaffected to the centrifugal force, moves in the lifting ribs 6 and is

discharged from the tubular rod 6b by the gravity.

[0051] Next, a nozzle unit 25 for injecting the adjustment water into the water guiding grooves 19a, 19b and 19c is described. FIG. 12 is a view illustrating the nozzle unit 25 for injecting the adjustment water into the water receiving ring unit 18. The nozzle unit 25 includes three nozzles 25a, 25b and 25c configured toward the bottom plates 21 of the water guiding grooves 19a, 19b and 19c as shown in FIG. 12. The nozzles 25a, 25b and 25c are configured to be inclined toward the rotating direction of the water receiving ring unit 18. Thus, when the adjustment water is injected from the nozzles 25a, 25b and 25c, the adjustment water is injected along curved surfaces of the bottom plates 21 of the water guiding grooves 19a, 19b and 19c, thus the adjustment water will not scatter in the water guiding grooves 19a, 19b and 19c and can be injected successfully.

[0052] The adjustment water is tap water supplied to the nozzles 25a, 25b and 25c through electromagnetic valves 26a, 26b and 26c shown in FIG. 2. It should be noted that the electromagnetic valves 26a, 26b and 26c can also be reversing electromagnetic valves.

[0053] Next, operation control of the washing machine 1 of the present disclosure is described. FIG. 13 is a block view illustrating an electrical system of the washing machine 1 of the present disclosure. FIG. 14 is a view illustrating an imbalance state of the rotating drum 5. FIG. 15 is a view illustrating the imbalance state of the rotating drum 5. A controller 30 includes a central processing unit (CPU) 31 for controlling the entire system. The central processing unit 31 is connected with a memory 32 which stores the following setting values required for rotation control of the rotating drum 5: a low-speed rotation setting value (N1) before the start of the dewatering operation; a high-speed rotation setting value (N2) after the start of the dewatering operation; an imbalance quantity setting value (m1) during low-speed dewatering operation and an imbalance quantity setting value (m2) during high-speed dewatering operation.

[0054] The central processing unit 31 is configured to output a control signal to a rotating speed controller 33, and further output the control signal to a motor controller (motor control circuit) 34 to perform the rotation control of a drum motor 10. It should be noted that the rotating speed controller 33 inputs a signal indicating the rotating speed of the drum motor 10 from the motor controller 34 in real time as a control element. An imbalance quantity detector 35 and an imbalance position detector 36 are connected with the acceleration sensor 12. The imbalance position detector 36 is connected with the proximity switch 14.

[0055] Thus, when the sensor tag 13 is detected by the proximity switch 14 (with reference to FIG. 2), the imbalance quantity (M) is calculated by the imbalance quantity detector 35 according to magnitudes of the acceleration in the horizontal direction and the vertical direction transmitted from the acceleration sensor 12, and the imbalance quantity is output to an imbalance quantity

determination portion 37. On the other hand, the imbalance position detector 36 is configured to calculate an angle of an imbalance direction according to the signal indicating a position of the sensor tag 13 input from the proximity switch 14, and output a signal of the imbalance position to a water injection controller 38.

[0056] When the signals indicating the imbalance quantity and the imbalance position transmitted from the imbalance quantity determination portion 37 and the imbalance position detector 36 are input, the water injection controller 38 determines whether to supply water to a certain lifting rib 6 in the rotating drum 5 according to a prestored control program and the amount of supplied water. Then, the selected electromagnetic valves 26a, 26b and 26c are opened to inject the adjustment water. When imbalance is generated in the rotating drum 5, injection of the adjustment water from the selected nozzles 25a, 25b and 25c to the water guiding grooves 19a, 19b and 19c of the water receiving ring unit 18 is started based on the calculation of the imbalance quantity. When the imbalance is eliminated by the lifting ribs 6, the injection of the adjustment water is stopped. Thus, the generation of vibration and noise can be prevented in a state of continuing to perform the dewatering operation without decelerating the rotation of the rotating drum 5.

[0057] It should be noted that the determination regarding the lifting ribs 6 made by the water injection controller 38 is shown in for example FIG. 14. When washing agglomerates LD as the imbalance elements are located between the lifting rib 6 at position B and the lifting rib 6 at position C of the rotating drum 5, the adjustment water is supplied to the lifting rib at position A. In addition, as shown in FIG. 15, when the washing agglomerates LD are located near the lifting rib 6 at position A, the adjustment water is supplied to the lifting ribs 6 at positions B and C.

[0058] Next, a control flow of the dewatering operation of the washing machine 1 of the present disclosure is described below with reference to a flow chart shown in FIG. 16. FIG. 16 is the flow chart illustrating the control flow of the dewatering operation of the washing machine 1 of the present disclosure.

<Step S1>

[0059] In step S1, the CPU 31 starts a dewatering process when receiving an input signal from a dewatering button (not shown) or receiving a signal for starting the dewatering process during washing mode operation. The process proceeds to a step S2.

<Step S2>

[0060] In step S2, the CPU 31 notifies the rotating speed controller 33 of a signal for starting a low-speed rotation (N1). The rotating speed controller 33 transmits the control signal to the motor controller 34 based on the notification. The motor controller 34 is energized based

on the control signal to drive the drum motor 10. Thus, the rotating drum 5 is rotationally driven at a preset rotating speed (100 rpm-400 rpm in the present embodiment). The process proceeds to step S3.

<Step S3>

[0061] In step S3, the CPU 31 reads from the imbalance position detector 36, and determines whether a signal indicating that the sensor tag 13 has been detected is received from the proximity switch 14 by the imbalance position detector 36. The process proceeds to step S4 when the sensor tag 13 has been detected. Step S3 is repeated when the sensor tag 13 is not detected.

<Step S4>

[0062] In step S4, the CPU 31 reads from the imbalance quantity detector 35 to acquire the acceleration in the horizontal direction and the vertical direction given by the acceleration sensor 12, and performs preset calculation to calculate the imbalance quantity M, and detects an imbalance position by the imbalance position detector 36. The process proceeds to step S5.

<Step 5>

[0063] In step S5, the CPU 31 compares the imbalance quantity M with an imbalance quantity setting value (m1) stored in the memory 32, to determine whether M is greater than m1. When M is greater than m1, the process proceeds to step S6. When M is not greater than m1, the process proceeds to step S7. The imbalance quantity setting value (m1) is a threshold value of a preset imbalance quantity at which the high-speed rotation of the rotating drum 5 may be started. In step S5, M being not greater than m1 means that the imbalance quantity M is a value at which the high-speed rotation of the rotating drum 5 may be started. In other words, M being not greater than m1 means that the imbalance of the rotating drum 5 is improved or does not exist from the beginning.

<Step S6>

[0064] In step S6, the CPU 31 transmits a water injection starting signal to the water injection controller 38, and starts to inject the adjustment water into the lifting ribs 6. In addition, when an action of step 6 is a second cycle, the electromagnetic valves 26a to 26c opened in the initial step S6 kept opened.

[0065] Specifically, when a detection result of the imbalance position is as shown in FIG. 14 and the washing agglomerates LD are present between the lifting ribs 6, the CPU 31 opens one of the electromagnetic valves 26a to 26c corresponding to the lifting rib 6 located at a position opposite to the washing agglomerates LD, and starts to inject water into the lifting rib 6 located at the position opposite to the washing agglomerates LD.

[0066] In addition, when the detection result of the imbalance position is as shown in FIG. 15 and the washing agglomerates LD are present in the vicinity of one lifting rib 6, the CPU 31 opens the electromagnetic valves 26a to 26c corresponding to the lifting ribs 6 except for the lifting rib 6, and starts to inject water into the lifting ribs 6 except for the lifting rib 6 located in the vicinity of the washing agglomerates LD. Then, the process returns to step S3.

<Step S7>

[0067] In step S7, the CPU notifies the water injection controller 38 of an instruction for closing the electromagnetic valves 26a to 26c, and stops supplying the adjustment water to the lifting ribs. Then, the process proceeds to step S8. It should be noted that the electromagnetic valves 26a to 26c are in a closed state when step S6 is not carried out, so the process directly proceeds to step S8 without any operation.

<Step S8>

[0068] In step S8, the CPU 31 controls the rotating drum 5 to start the high-speed rotation. Specifically, the CPU 31 notifies the rotating speed controller 33 of a signal for starting the high-speed rotation. The rotating speed controller 33 transmits a control signal to the motor controller 34 based on the notification. The motor controller 34 is energized based on the control signal to drive the drum motor 10. Thus, the rotating drum 5 is rotationally driven at a preset high speed (500 rpm-800 rpm in the present embodiment). The process proceeds to step S9.

<Step S9>

[0069] In step S9, the CPU 31 reads from the imbalance position detector 36, and determines whether the sensor tag 13 has been detected by the proximity switch 14. When it is determined that the sensor tag 13 has been detected by the proximity switch 14, the process proceeds to step S10. When it is determined that the sensor tag 13 has not been detected by the proximity switch 14, step S9 is repeated.

<Step S10>

[0070] In step S10, the CPU 31 reads from the imbalance quantity detector 35 to acquire the acceleration in the horizontal direction and the vertical direction given by the acceleration sensors 12, performs the preset calculation to calculate the imbalance quantity M, and detects the imbalance position by the imbalance position detector 36. The process proceeds to step S11.

<Step S11>

[0071] In step S11, the CPU 31 compares the imbalance quantity M with the imbalance quantity setting value (m2) stored in the memory 32, to determine whether M is greater than m2. When M is greater than m2, the process proceeds to step S12. When M is not greater than m2, the process proceeds to step S 13.

[0072] The imbalance quantity setting value (m2) is a threshold value of a preset imbalance quantity at which no problem occurs even if the rotating speed of the rotating drum 5 is increased to a preset high rotating speed. In step S11, M being not greater than m2 means that the imbalance quantity M is a value at which the rotating drum 5 can rotate at a high speed. In other words, M being not greater than m2 means that a degree of the imbalance of the rotating drum 5 is improved so that the rotating drum 5 can rotate at the high speed, or the imbalance capable of interfering with a degree of the high-speed rotation does not exist from the beginning.

<Step S12>

[0073] In step S12, the CPU 31 transmits a water injection start signal to the water injection controller 38, so as to inject the adjustment water into the lifting rib 6. Further, in the case where the operation of step 12 is the second cycle, the electromagnetic valves 26a to 26c opened in the initial step 12 kept opened.

[0074] Specifically, when the detection result of the imbalance position in step S10 is as shown in FIG. 14 and the washing agglomerate LD is present between the lifting ribs 6, the CPU 31 opens one of the electromagnetic valves 26a to 26c corresponding to the lifting rib 6 at the position opposite to the washing agglomerates LD, and water is injected into the lifting rib 6 located at the position opposite to the washing agglomerates LD.

[0075] In addition, when the detection result of the imbalance position in step S10 is as shown in FIG. 15 and the washing agglomerate LD is present near one of the lifting ribs 6, the CPU 31 opens the electromagnetic valves 26a to 26c corresponding to another lifting rib 6 except for this lifting rib 6, and water is injected into the another lifting rib 6 except for the lifting rib 6 located near the washing agglomerate LD. Then, the process returns to step S9.

<Step S13>

[0076] In step S13, the CPU 31 notifies the water injection controller 38 of the instruction for closing the electromagnetic valves 26a to 26c, and stops supplying the adjustment water to the lifting ribs 6. Then, the process proceeds to step S14. It should be noted that the electromagnetic valves 26a to 26c are in the closed state when step S12 is not carried out, so the process directly proceeds to step S8 without any operation.

<Step S 14>

[0077] In step S14, the CPU 31 reads from a timing portion (not shown) to determine whether the elapsed time from which the rotating drum 5 reaches the preset high rotating speed exceeds a set time preset for the dewatering operation. When the elapsed time exceeds the set time for the dewatering operation, the process proceeds to step S15. When the elapsed time does not exceed the set time for the dewatering operation, the process returns to step S9.

<Step 15>

[0078] In step 15, the rotating speed controller is notified of a signal for ending the dewatering operation. The rotational driving of the drum motor 10 is stopped so as to end the dewatering operation.

[0079] During the ending of the dewatering operation, the supplied adjustment water in the lifting ribs 6 can be completely discharged to the outside with slow rotation until the rotation of the rotating drum 5 is stopped, and is returned to the initial state. The process can be controlled repeatedly and correctly.

[0080] By the above flow of the dewatering operation, since a solution of detecting the imbalance state of the rotating drum 5 at two stages including the low-speed rotation and the high-speed rotation and trying to eliminate the imbalance state is adopted, the washing machine 1 capable of preventing the generation of vibration and noise in any process from the start of the dewatering operation to the end can be designed.

[0081] The first embodiment of the present disclosure is described above, but a structure of the first embodiment is not limited to the above structure, and various modifications can be made. For example, FIG. 17 is a view illustrating an internal structure of a modified embodiment of the first embodiment of the present disclosure. As shown in FIG. 17, the following solution can also be adopted: a branch pipe 116 is separated from the drain pipe 15; and dewatering liquid W retained at the bottom of the outer drum 3 is recycled by a pump 17 to be reused as the adjustment water, so as to improve economic benefits. Namely, the following structure can also be adopted: the dewatering liquid W pressed and fed by the pump 17 is used as the adjustment water, to be supplied to the nozzles 25a, 25b and 25c through the electromagnetic valves 26a, 26b and 26c.

[0082] It should be noted that a structure that the water receiving ring unit 18 is composed of three water guiding grooves 19a, 19b and 19c and three balancers 6 are arranged correspondingly is adopted in the above embodiment, but the present disclosure is not limited thereto, and a structure having more than two balancers 6 and a corresponding amount of water guiding grooves can also be adopted.

[0083] As described in detail above, the washing machine 1 of the present disclosure can provide the adjust-

ment water to the lifting ribs 6 by the centrifugal force generated by the water receiving ring unit 18 rotated together with the rotating drum 5, so as to eliminate the imbalance of the rotating drum 5. Since the generation of the centrifugal force of the water receiving ring unit 18 is independent of a configuration state of the rotating drum 5, the present disclosure not only is implemented in the horizontal drum type washing machine of the present embodiment, but also may be implemented in a vertical drum type washing machine and an inclined drum type washing machine.

[0084] FIG. 18 is a view illustrating a modified embodiment of the water receiving ring unit 18. FIG. 19 is a perspective view illustrating the assembly of the water receiving ring unit 18 in FIG. 18.

[0085] The water receiving ring unit 18 adopts a water guiding groove integrally formed a circular water guide ring 23 having a "┐"-shaped cross section, to realize a structure equivalent to the ring plates 20 and the bottom plates 21 in the first embodiment. The water guide rings 23 formed in this way are stacked to form the water guiding grooves 19a, 19b and 19c, thereby forming a water receiving ring unit 18A. The water guide rings 23 formed in this way have the same shape. Therefore, similar to the first embodiment, the water guiding grooves 19a, 19b and 19c are eccentrically configured at the angle difference of 120° about the axis S1 of the rotating drum 5; and the tubular rods 22a, 22b and 22c are fixed on the eccentric top portions of the bottom plates 21. The water receiving ring unit 18 is formed in this way, so that the amount of eccentricity can be set freely, and a range of the eccentricity is not limited by an amplitude of the ring plates 20 like the first embodiment.

[0086] In addition, FIG. 20 is a sectional view illustrating another example of the lifting rib 6 arranged in the rotating drum 5. An inclined plate 6c inclined downward from a front end to a rear end is arranged in the lifting rib 6. As the dewatering operation is ended, the rotating speed of the rotating drum 5 is reduced; then, the centrifugal force in the lifting rib 6 is also attenuated gradually; and the adjustment water becomes unaffected to the centrifugal force, moves in the lifting rib 6 and is discharged from the tubular rod 6b. At this time, the inclined plate 6c is arranged inside the lifting rib 6 in advance to promote discharge of the adjustment water particularly in a horizontal drum, and discharge water efficiently without remaining the adjustment water in the lifting rib 6.

[0087] FIG. 21 is a view illustrating a modified embodiment of the water receiving ring unit 18. The bottom plates 21 are formed into a funnel shape first as shown in FIG. 21 by mounting portions of the tubular rods 22a, 22b and 22c, so as to improve retention of the adjustment water.

The Second embodiment

[0088] FIGs. 22-26 are views illustrating a washing machine 50 of the second embodiment of the present dis-

closure. FIG. 22 is a perspective view illustrating the rotating drum 5 provided in the washing machine 50 of the present embodiment viewed from the back surface. FIG. 23 is an exploded perspective view illustrating a water guiding groove 68. Hereinafter, structures different from that of the first embodiment are described. Moreover, in FIGs. 22-26, the same reference numerals are given to the structures same as those of the first embodiment.

[0089] In the present embodiment, a plurality of water guiding grooves 68 constituting the water receiving ring unit 69 are not eccentric with each other, and are configured into a concentric circle shape. In addition, as shown in FIG. 22, each of the water guiding grooves 68 has water guide bodies 68a and bulging portions 68b. The water guide bodies 68a are components which have an annular shape, opened inner circumferential surfaces and substantially "┐"-shaped cross sections. At positions near the lifting ribs 6 corresponding to the water guiding grooves 68, a plurality of (total three in the present embodiment) bulging portions 68b are formed from bottoms of the water guide bodies 68a in a circumferential direction at equal intervals in a protruding manner. The bulging portions 68b are connected with the lifting ribs 6 through cylindrical water passing components 74. The water receiving ring unit 69 is configured to concentrically and circularly fix a plurality of (three in the present embodiment) water guiding grooves 68 and the rotating drum 5 at a bottom 5c of the rotating drum 5 in an stacking state.

[0090] Such a water receiving ring unit 69 is formed by assembling a plurality of plates as shown in FIG. 23. Examples of the plurality of plates may include a cylindrical ring plate 71, a plurality of (two in the present embodiment) circular plate-like first side plates 70 having outer circumferences substantially same as that of the ring plate 71 in length, a pair of substantially circular plate-like second side plates 72 having side plate bodies 72b and protruding portions 72a, and bulging components 73 formed by two ends of bent belt-like plates.

[0091] Openings 71b or notches 71a constituting connecting ports described later are formed at a plurality of (three in the present disclosure) positions in a circumferential direction of the ring plate 71 at equal intervals. The openings 71b are formed at central portions in an axis direction of the ring plates 71. The notches 71a are formed at two ends in the axis direction of the ring plates 71.

[0092] Each of the second side plates 72 includes: side plate bodies 72b having an outer circumference and an inner circumference substantially the same as those of the first side plates 70 in length; and protruding portions 72a protruding to radial outer side of the side plate bodies 72b. The protruding portions 72a are formed at a plurality of (three in the present embodiment) positions in the circumferential direction of the side plate bodies 72b in an approximately rectangular shape in which protruding ends 72a1 outline a gentle arc. In addition, an arc-shaped notch 72a2 constituting a water passing port 68b1 de-

scribed later is formed at one end side of the protruding end 72a1 of the protruding portion 72a of one of the pair of second side plates 72. The notch 72a2 is connected with a water passing component 74.

[0093] These plates are integrated in such a manner that the protruding portions 72a are overlapped with the openings 71b or the notches 71a, the pair of second side plates 72 clamp the ring plates 71 in which two first side plates 70 are embedded, and the bulging components 73 are further mounted between the pair of protruding portions 72a and 72a. Thus, the ring plates 71 are used as bottom surfaces; the first side plates 70 and the second side plates 72 or two first side plates 70 are used as bottom walls; and three water guiding grooves 68 in which the bulging portions 68b are formed by the protruding portions 72a and the bulging components 73 are stacked, thereby forming the water receiving ring unit 69.

[0094] FIG. 24 is a local sectional perspective view illustrating the water guiding grooves 68 cut in cross section positions including the bulging portions 68b. The bulging portions 68b of the water guiding grooves 68, as shown in FIG. 24, have the water passing ports 68b1 connected with the water passing components 74 shown in FIG. 22 on a leading side in a rotating direction X of the rotating drum 5, and have connecting openings 68a1 communicated with interiors of the water guide bodies 68a on a lagging side in the rotating direction X of the rotating drum 5. The connecting openings 68a1 are opened to a degree greater than the water passing ports 68b1, and are opened at about two thirds of the bulging portions 68b from one end of each of the bulging portions 68b to the rotating direction X.

[0095] The adjustment water is injected into the water guiding groove body 68a of such water guiding grooves 68 through the nozzle unit 25 as required during dewatering process, but the injected adjustment water may be rolled up more or less in the water guiding groove body 68a rotating at a high speed, and most adjustment water may be retained at lower portions of the water guiding groove body 68a. Moreover, when the bulging portions 68b are rotated to positions of the lower portions constituting the water receiving ring unit 69, the adjustment water flows down to the bulging portions 68b through the connecting openings 68a1. Then, the adjustment water is pushed to side walls 68b2 of the bulging portions 68b located on the lagging side in the rotating direction X, smoothly flows into the water passing ports 68b1 located on the leading side in the rotating direction X through the centrifugal force, and is supplied to the lifting ribs (bag body lifting ribs) 6 through the water through the water passing components 74 by water pressure.

[0096] In this way, the water guiding grooves 68 have the annular water guiding groove body 68a and the bulging portions 68b protruding from the water guiding groove body 68a to a radial outer side. The bulging portions 68 is provided with the openings 68a1 connected with the water guiding groove body 68a on the lagging side in the rotating direction X of the rotating drum 5. The water

passing components 74 are connected to the leading side in the rotating direction X. Therefore, the adjustment water can efficiently flow into the water through components 74 and the lifting ribs 6 from the bulging portions 68b by means of the gravity and the centrifugal force, so as to eliminate the imbalance (bias load) generated by the bias of the washings within a short time.

[0097] FIG. 25 is a longitudinal sectional perspective view illustrating a washing machine 50 cut near the nozzle unit 25. As shown in FIG. 25, in the present embodiment, the nozzle unit 25 having the nozzles 25a to 25c is arranged at the lower portion of the water receiving ring unit 69 (the lower portion of the rotating drum 5). The adjustment water is injected into the water guiding groove body 68a in the rotating direction X through the nozzles 25a to 25c from above. Such a nozzle unit 25 is arranged at a position on the lower portion of the water receiving ring unit 69 so that water is supplied to the water guiding grooves 68. A water supplying position is set at the lower portion of the rotating drum 5. Thus, the adjustment water can be gently injected into the water guiding groove body 68a of the water guiding grooves 68 rotating at the high speed by the nozzle unit 25, so that the water is hardly splashed during injection.

[0098] FIG. 26 is a view illustrating the lifting ribs 6 arranged in the rotating drum 5. Specifically, FIG. 26(a) is a longitudinal sectional perspective view partially illustrating the vicinity of the lifting ribs 6 of the washing machine 50; FIG. 26(b) is a perspective view illustrating the lifting ribs 6; and FIG. 26(c) is a sectional view illustrating the lifting ribs 6 cut in a direction orthogonal to a long-side direction.

[0099] As shown in FIG. 26, in the present embodiment, separation components (spacers) 56 for furling water storage regions T inside the lifting ribs 6 in the rotating direction (circumferential direction) of the rotating drum 5 are arranged. The separation components 56 are box-like components opened toward the axis S1 of the rotating drum 5, and have a length in the long-side direction approximately equal to the length in the long-side direction of the lifting ribs 6. In addition, a length W1 of the separation components 56 in the rotating direction of the rotating drum 5 is configured to be about half of a length W2 of the lifting ribs 6 in the rotating direction of the rotating drum 5. In addition, in the present embodiment, a water supply openings 6e inserted by the water passing components 74 are formed in end surfaces in the long-side direction of the lifting ribs 6 in the vicinity of opening edges 56a of the separation components 56 as shown in FIG. 26(a).

[0100] The adjustment water flowing into such lifting ribs 6 through the water passing components 74 is stored in the separation components 56 configured at central portions in the rotating direction of the lifting ribs 6 until an inflow volume exceeds a volume of the separation components 56. Thus, as shown by dotted lines in FIG. 26(c), since the adjustment water is concentrated in a narrow range in the rotating direction of the lifting ribs 6,

as shown by double-dot lines in FIG. 26, compared with a case of supplying the adjustment water to the lifting ribs 6 without the separation components 56, diffusion of the adjustment water in the rotating direction of the rotating drum 5 can be inhibited. Although the centrifugal force applied to the adjustment water during dewatering is a composite force of centrifugal forces respectively acting on the distributed water, the adjustment water is also concentrated to a narrow region in the rotating direction of the rotating drum 5, and the closer the directions of the centrifugal forces are, the larger the synthesized vector is. Therefore, the bias load of the washings can be eliminated efficiently by less adjustment water. When a volume of the supplied adjustment water exceeds the volume of the separation components 56, the adjustment water overflows from opening ends 56a of the separation components 56 and is gradually accumulated from the radial outer side of the rotating drum 5 to an inner side. Then, when the rotating speed of the rotating drum 5 is reduced and the centrifugal force is reduced, for example, to end the dewatering, the adjustment water in the lifting ribs 6 located on an upper portion of the rotating drum 5 flows to an axis S1 (with reference to FIG. 2) side by the gravity and is discharged out of the lifting ribs 6 through the water passing components 74.

[0101] Since the separation components 56 for furling the water storage regions T inside the lifting ribs 6 in the circumferential direction of the rotating drum 5 are configured in this way, the adjustment water can be concentrated in the narrow range in the rotating direction of the rotating drum 5 in the lifting ribs 6, and the imbalance generated by the bias of the washings can be eliminated by less adjustment water within the short time.

[0102] FIGs. 27 and 28 are flow charts illustrating control of the washing machine 50 of the second embodiment. FIG. 29 is a view illustrating a control flow of the dewatering operation of the washing machine 50.

[0103] In the present embodiment, when the CPU 31 receives the input signal from the dewatering button (not shown) or receives the signal for starting the dewatering process during washing mode operation, the process proceeds to step SP1, and the dewatering process is started. It should be noted that, in the present embodiment, the control of constituent elements in the controller 30 as recorded in the first embodiment is omitted.

<Step SP1>

[0104] In step SP1, the CPU 31 controls the rotating drum 5 to accelerate after the rotating drum 5 reverses slowly.

<Step SP2>

[0105] In step SP2, the CPU 31 controls the rotating drum 5 to rotate at a low speed based on the low-speed rotation setting value (N1).

<Step SP3>

[0106] In step SP3, the CPU 31 controls to detect the imbalance quantity (M) based on an acceleration value (an x component of the acceleration sensor) given by the acceleration sensor 12.

<Step SP4>

[0107] In step SP4, the CPU 31 compares the imbalance quantity (M) with an imbalance quantity setting value (ma) stored in the memory 32 to determine whether M is less than ma. When it is determined that M is less than ma, the process proceeds to step SP6. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP5. Herein, the imbalance quantity setting value (ma) is a threshold value indicating that a bias degree of the washings is too great to be eliminated even if the adjustment water is supplied to the lifting ribs 6. Namely, the case of proceeding to step SP5 means a case that the bias degree of the washings is too great to be eliminated even if the adjustment water is supplied to the lifting ribs 6.

<Step SP5>

[0108] In step SP5, the process returns to step SP1 after the rotation of the rotating drum 5 is stopped by the CPU 31, and repeats the steps SP1 to SP4.

<Step SP6>

[0109] In step SP6, the process proceeds to step SP7 when the CPU 31 determines that the elapsed time after starting the low-speed rotation is greater than a set time preset for performing low-speed rotating process.

<Step SP7>

[0110] In step SP7, the CPU 31 controls the rotating drum 5 to rotate at the high speed based on the high-speed rotation setting value (N2).

<Step SP8>

[0111] In step SP8, the CPU 31 controls to detect the imbalance quantity (M) and the imbalance position (N) based on the acceleration value given by the acceleration sensor 12.

<Step SP9>

[0112] In step SP9, the CPU 31 replaces an electromagnetic valve X, a region Y and an electromagnetic valve Z shown in FIG. 29 with values in a parameter table according to the imbalance position (N). In FIG. 29, a cross section of the rotating drum 5 is divided into six equal parts in the circumferential direction, and a posi-

tional relationship relative to the lifting ribs 6 is schematically shown. The lifting rib 6 marked as 25a indicates the lifting rib 6 which is supplied with the adjustment water through the nozzle 25a shown in FIG. 25. Similarly, the lifting rib 6 marked as 25b indicates the lifting rib 6 which is supplied with the adjustment water through the nozzle 25b shown in FIG. 25; and the lifting rib 6 marked as 25c indicates the lifting rib 6 which is supplied with the adjustment water through the nozzle 25c shown in FIG. 25.

<Step SP10>

[0113] In step SP10, the CPU 31 controls the electromagnetic valve X recorded in the parameter table of FIG. 29 to be opened. For example, when the imbalance position (N) is in a region I, the electromagnetic valve X is an electromagnetic valve 25c corresponding to the lifting rib 6 arranged opposite to the region I. Thus, the adjustment water is supplied to the lifting rib 6 corresponding to the electromagnetic valve X, a capacity and a position of the bias load are changed.

<Step SP11>

[0114] In step SP11 shown in FIG. 28, the CPU 31 calculates the imbalance quantity (M) and the imbalance position (N) again based on the acceleration value given by the acceleration sensor 12.

<Step SP12>

[0115] In step SP12, the CPU 31 compares the imbalance quantity (M) with the imbalance quantity setting value (ma) stored in the memory 32, to determine whether M is less than ma. When it is determined that M is less than ma, the process proceeds to step SP13. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP21 described later. Namely, when it is determined that the bias degree of the washings is too great to be eliminated even if the adjustment water is supplied to the lifting ribs 6, the process proceeds to step SP21.

<Step SP13>

[0116] In step SP13, the CPU 31 compares the imbalance quantity (M) with an imbalance quantity setting value (mb) stored in the memory 32, to determine whether M is less than mb. When it is determined that M is less than mb, the process proceeds to step SP23 described later. On the other hand, when it is determined that M is not less than mb, the process proceeds to step SP14 described later. Herein, the imbalance quantity setting value (mb) is less than the imbalance quantity setting value (ma), and is a threshold value indicating that the bias degree of the washings is too small to produce noise even if the adjustment water is not supplied to the lifting ribs 6. Namely, when it is determined that the bias load

is small or does not exist, and the noise is not produced even if the water is not supplied to the lifting ribs 6, the process proceeds to step SP23.

5 <Step SP14>

[0117] In step SP14, when the CPU 31 determines that the elapsed time from which the electromagnetic valve X is opened is greater than a set time, the process proceeds to step SP15. Herein, the set time is a time required for one lifting rib 6 being filled with the adjustment water.

10 <Step SP15>

15 **[0118]** In step SP15, the CPU 31 determines whether the imbalance position (N) is a region Y represented by the parameter table of FIG. 29. When it is determined that the imbalance position (N) is the region Y, the process proceeds to step SP16. When it is determined that the imbalance position (N) is not the region Y, the process returns to step SP11. For example, if the initial imbalance position (N) in step SP11 is the region I, the imbalance position (N) is always the region I as long as no calculation is performed again, and the process returns to step SP16. 20 Since a result of the recalculation in step SP16 is changed over time when the electromagnetic valve X supplies the water, the imbalance position (N) is changed from the region I to a region V when the weight of the lifting rib 6 corresponding to the electromagnetic valve 25c is increased, and the imbalance position (N) is changed to the region Y when step SP15 is repeated multiple times.

30 <Step SP16>

35 **[0119]** In step SP16, the CPU 31 controls the electromagnetic valve X recorded in the parameter table of FIG. 29 to be closed, and controls an electromagnetic valve Z to be opened. For example, when the initial imbalance position (N) is the region I, the electromagnetic valve X is the electromagnetic valve 25c corresponding to the lifting rib 6 arranged opposite to the region I, and the electromagnetic valve Z is the electromagnetic valve 25b corresponding to the lifting rib 6 located at a position closer to the region I than the lifting rib 6 corresponding to the electromagnetic valve 25c. Thus, the adjustment water is supplied to the lifting rib 6 corresponding to the electromagnetic valve Z, and the capacity and the position of the bias load are changed.

45 <Step SP17>

[0120] In step SP17, the CPU 31 calculates the imbalance quantity (M) and the imbalance position (N) again based on the acceleration value given by the acceleration sensor 12.

50

<Step SP18>

[0121] In step SP18, the CPU 31 compares the imbalance quantity (M) with the imbalance quantity setting value (ma) stored in the memory 32, to determine whether M is less than ma. When it is determined that M is less than ma, the process proceeds to step SP19. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP21 described later. Namely, when it is determined that the bias degree of the washings is too great to be eliminated even if more adjustment water is supplied to the lifting ribs 6, the process proceeds to step SP21.

<Step SP19>

[0122] In step SP19, the CPU 31 compares the imbalance quantity (M) with the imbalance quantity setting value (mb) stored in the memory 32, to determine whether M is less than mb. When it is determined that M is less than mb, the process proceeds to step SP23 described later. Namely, when it is determined that the degree of the bias load is eliminated by supplying the water to the lifting ribs 6 so that no noise is produced, the process proceeds to step SP23. On the other hand, when it is determined that M is not less than mb, the process proceeds to step SP20.

<Step SP20>

[0123] In step SP20, when the CPU 31 determines that the elapsed time from which the electromagnetic valve Z is opened is greater than the above set time, the process proceeds to step SP21. On the other hand, the process returns to step SP17 when it is determined that the elapsed time from which the electromagnetic valve Z is opened is not greater than the set time.

<Step SP21>

[0124] In step SP21 shown in FIG. 27, the CPU 31 enables all the electromagnetic valves X, Y and Z to be in the closed state.

<Step SP22>

[0125] In step SP22, the process returns to step SP1 after the CPU 31 controls the rotating drum 5 to stop rotating.

[0126] Thus, when it is determined that the degree of the bias load is too great to be eliminated by supplying the water to the lifting ribs 6, operations in the steps SP21 and 22 are performed, and the dewatering process is restarted from the first step.

<Step SP23>

[0127] In step SP23 shown in FIG. 28, the CPU 31

enables all the electromagnetic valves X, Y and Z to be in the closed state.

<Step SP24>

[0128] In step SP24 shown in FIG. 28, the CPU 31 controls the rotating drum 5 to rotate at a maximum speed for a specified time, to perform the dewatering process. Then, the dewatering process is ended.

[0129] Thus, in the present embodiment, the water is firstly supplied to the lifting rib 6 which is located at the position farthest from the initially detected imbalance position (N) and greatly affected by the adjustment of the imbalance quantity (M) and position (N). At the end of the water supply to the lifting rib 6, changes of the imbalance quantity (M) and position (N) generated due to the water supply are considered, and the water is supplied to a second lifting rib 6 as needed. Thus, a case that the adjustment water is not quantitatively supplied to each of the lifting ribs 6 due to resistances of wall surfaces of the water guiding grooves 68 like a case that the water is supplied to the plurality of lifting ribs 6 simultaneously is not considered; a difference between speeds at which the water is supplied to the lifting ribs 6 is not adjusted by opening and closing the electromagnetic valves 16, so the number of times of opening and closing of the electromagnetic valves 16 is small, and the reduction of durability lives of the electromagnetic valves 16 can be inhibited.

[0130] The second embodiment of the present disclosure is described above, but the structure of the second embodiment is not limited to the above structure, and various modifications can be made.

[0131] For example, as shown in FIG. 30, the following structure can be adopted: a plurality of water storage tanks (bags) 80 as the water storage portions are arranged on the bottom 5c of the rotating drum 5. FIG. 30 is a view illustrating a modified embodiment of the second embodiment. Specifically, FIG. 30(a) is a perspective view illustrating a modified embodiment viewed from the bottom 5c of the rotating drum 5; and FIG. 30(b) is a local sectional perspective view illustrating the modified embodiment cut near the water storage tanks 80 and the lifting ribs 6. The water storage tanks 80 are hollow components arranged on the radial outer side of the water receiving ring unit 69 and arranged at the positions corresponding to the lifting ribs 6 by means of a blind region of the water receiving ring unit 69. The water storage tanks 80 are communicated with the corresponding lifting ribs 6 through communication ports 80a. The adjustment water flows in from the lifting ribs 6 by the centrifugal force. The adjustment water flowing into the water storage tanks 80 is discharged to the lifting ribs 6 through the communication ports 80a when the rotating speed of the rotating drum 5 is reduced to reduce the centrifugal force.

[0132] In this way, the plurality of water storage tanks 80 as the water storage portions are mounted on the end

surface in the axis S1 direction of the outer surface of the rotating drum 5, specifically mounted on the bottom 5c of the rotating drum 5, and are respectively communicated with the plurality of lifting ribs 6, so more adjustment water can be accumulated by increasing the volume of the lifting ribs 6 by means of the water storage tanks 80; and the bias load can be eliminated safely even if the washing agglomerates are relatively large during dewatering.

[0133] In addition, the structure of the first embodiment and the structure of the second embodiment can also be combined with each other to constitute the present disclosure.

[0134] Further, the structure of the above embodiment can be applied to a vertical washing machine. In this case, for example, the structure is constituted in such a manner that the water receiving ring unit is configured below the washing drum extending on the axis in a vertical direction, upper surfaces or lower surfaces of the water guiding grooves are opened, and the adjustment water is supplied to the water guiding grooves from above or below.

List of reference numerals

[0135] 1, 50: washing machine; 2: main body; 3: outer drum; 4: door body; 5: rotating drum (washing drum); 6: lifting rib (balancer); 7: bearing; 8: main shaft; 9: belt pulley; 10: drum motor; 11: transmission belt; 12: acceleration sensor; 13: sensor tag; 14: proximity switch; 15: drain pipe; 16: electromagnetic valve; 17: pump; 18, 69: water receiving ring unit; 19a: water guiding groove; 19b: water guiding groove; 19c: water guiding groove; 20: ring plate; 21: bottom plate; 22a: tubular rod; 22c: tubular rod; 23: water guide ring; 24a: water passing component; 24b: water passing component; 24c: water passing component; 25: nozzle unit; 26a: electromagnetic valve; 26b: electromagnetic valve; 26c: electromagnetic valve; 30: controller; 56: separation component; 68: water guiding groove; 68a: water guiding groove body; 68a1: connecting opening; 68b: bulging portion; 74: water passing component; 80: water storage tank (water storage portion); and T: water storage region.

Claims

1. A washing machine, comprising:

a washing drum;
a plurality of hollow balancers arranged on an inner circumferential surface of the washing drum along an axis direction of the washing drum;
a water receiving ring unit, wherein the water receiving ring unit is formed by stacking multiple layers of annular water guiding grooves, and fixed to an end in the axis direction of an outer surface of the washing drum, wherein the mul-

tiple layers of annular water guiding grooves correspond to the balancers respectively;
a plurality of water passing components for connecting a part of the water guiding grooves with the balancers corresponding to the water guiding grooves; and
a nozzle unit for separately injecting adjustment water into the water guiding grooves.

2. The washing machine according to claim 1, wherein the balancers are lifting ribs for lifting washings.

3. The washing machine according to claim 1 or 2, wherein the balancers are arranged on the inner circumferential surface of the washing drum as a rotating drum at equal intervals, and each layer of the water guiding grooves is formed so that an inner circumferential surface of the water guiding groove is opened and outer circumferential surface of the water guiding groove is bottomed, wherein bottom plates of each layer of the water guiding grooves of the water receiving ring unit are eccentric relative to an axis of the washing drum, and adjacent bottom plates are fixed in such a manner that angle differences of the adjacent bottom plates in an eccentric direction are the same, and eccentric top portions of the bottom plates are provided with the water passing components.

4. The washing machine according to claim 2, wherein an inclined plate inclined downward from a front end to a rear end is arranged inside each of the lifting ribs.

5. The washing machine according to claim 3, wherein the bottom plates are funnel-shaped at mounting positions of the water passing components for being mounted on the bottom plates.

6. The washing machine according to claim 1 or 2, wherein each of the water guiding grooves comprises: an annular water guiding groove body; and bulging portions protruding from the water guiding groove body to a radial outer side, wherein a connecting opening communicated with the water guiding groove body is formed in each of the bulging portions at a lagging side of a rotation direction of the washing drum, and each of the bulging portions is connected with the water passing components at a leading side of the rotation direction.

7. The washing machine according to claim 1 or 2, wherein the washing machine comprises separation components for furling water storage regions inside the balancers in a circumferential direction of the washing drum.

8. The washing machine according to claim 1 or 2, wherein the washing machine comprises a plurality

of water storage portions, wherein the plurality of water storage portions are mounted at an end in the axis direction of an outer surface of the washing drum, and are communicated with the plurality of balancers respectively.

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9. The washing machine according to claim 1 or 2, wherein the washing drum is a rotating drum with a substantially horizontal axis, wherein each of the water guiding grooves forming the water receiving unit is formed so that an inner circumferential surface of the water guiding groove is opened and an outer circumferential surface of the water guiding groove is bottomed, and the nozzle unit is arranged at a position on a lower portion of the water receiving ring unit so that water is supplied to the water guiding grooves.

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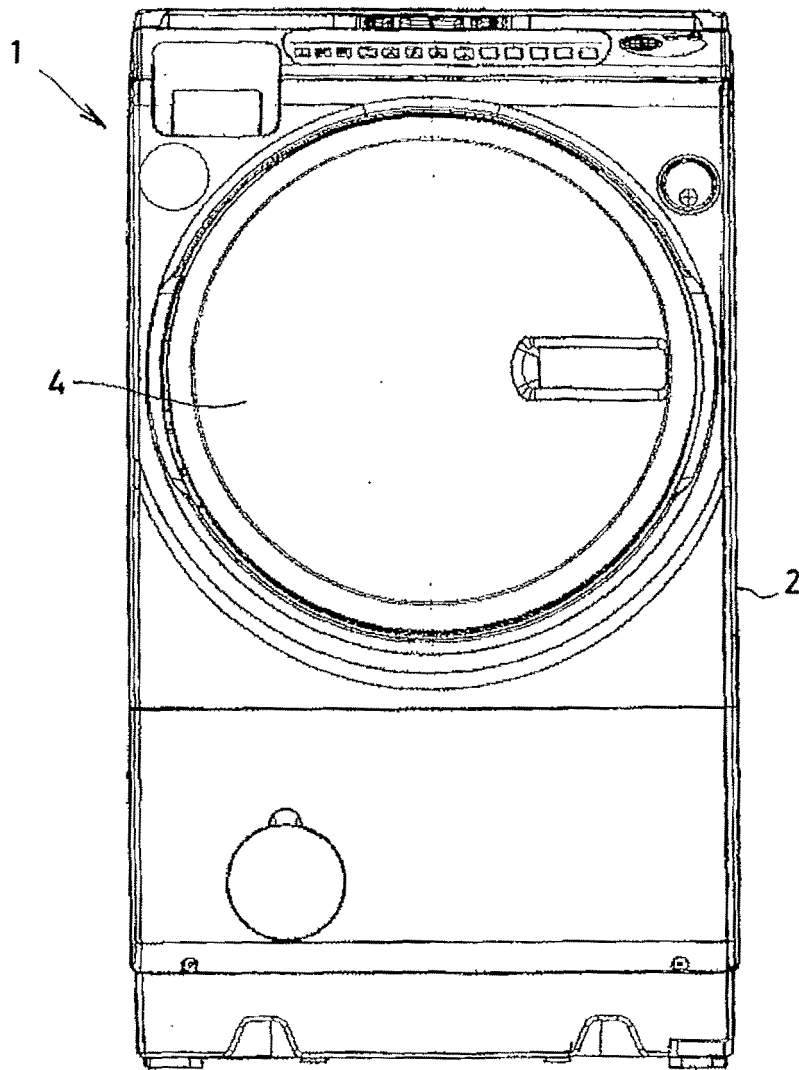


FIG. 1

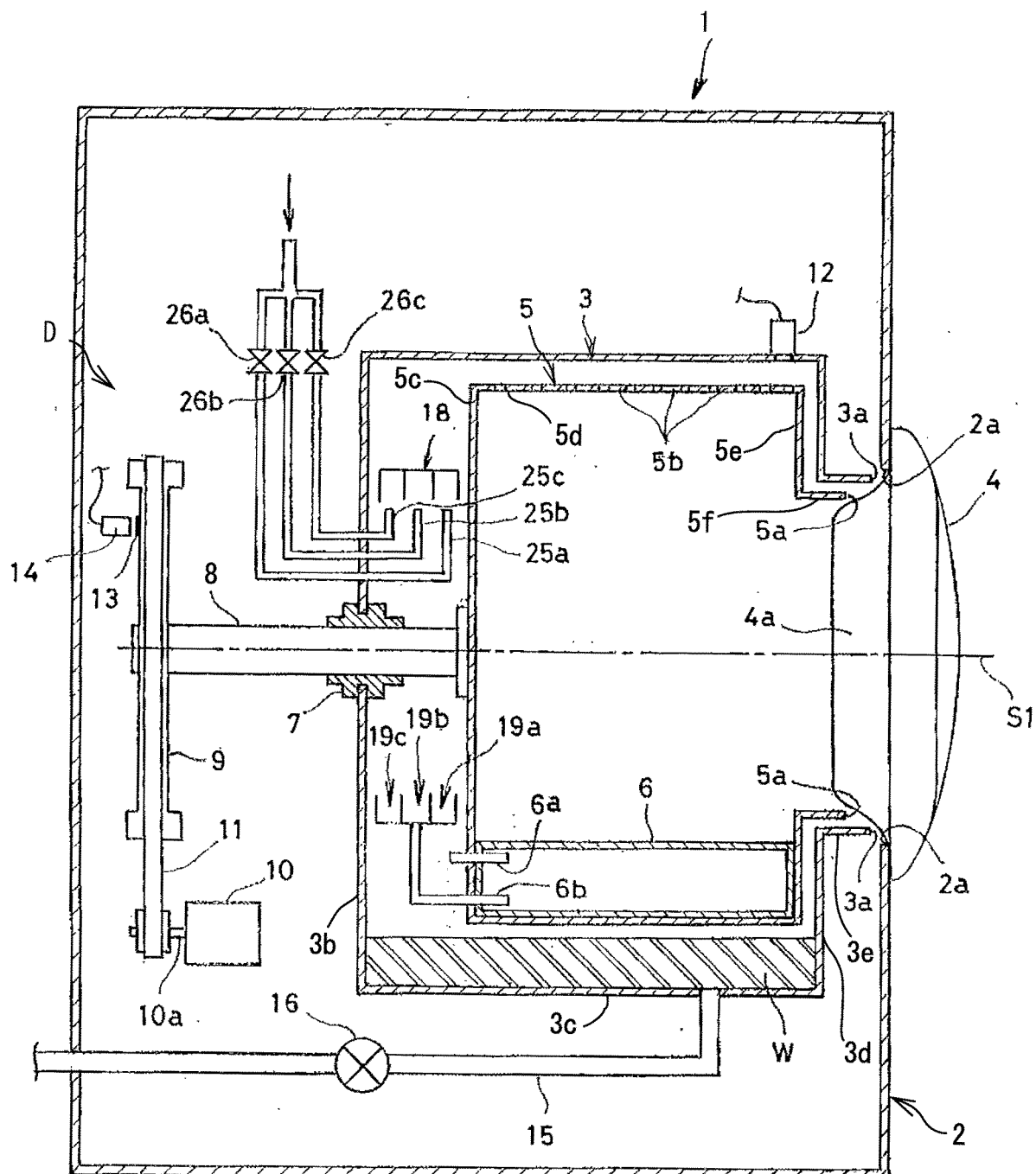


FIG. 2

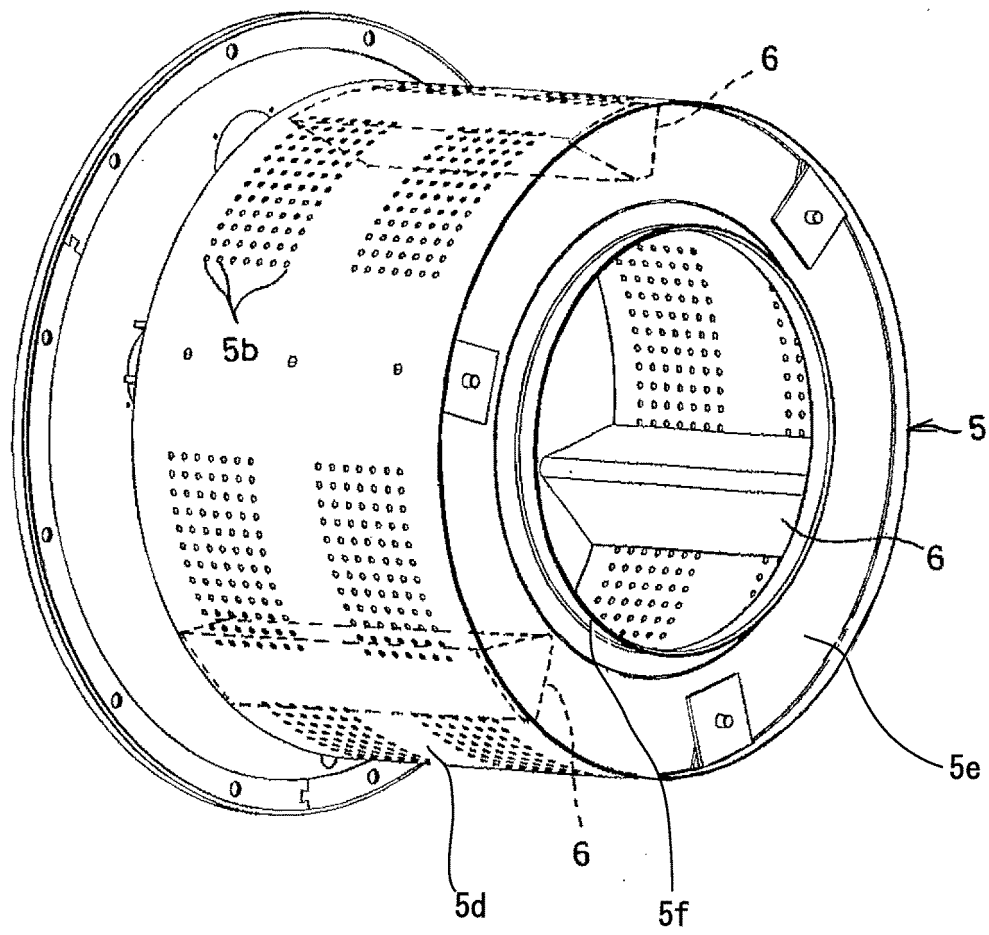


FIG. 3

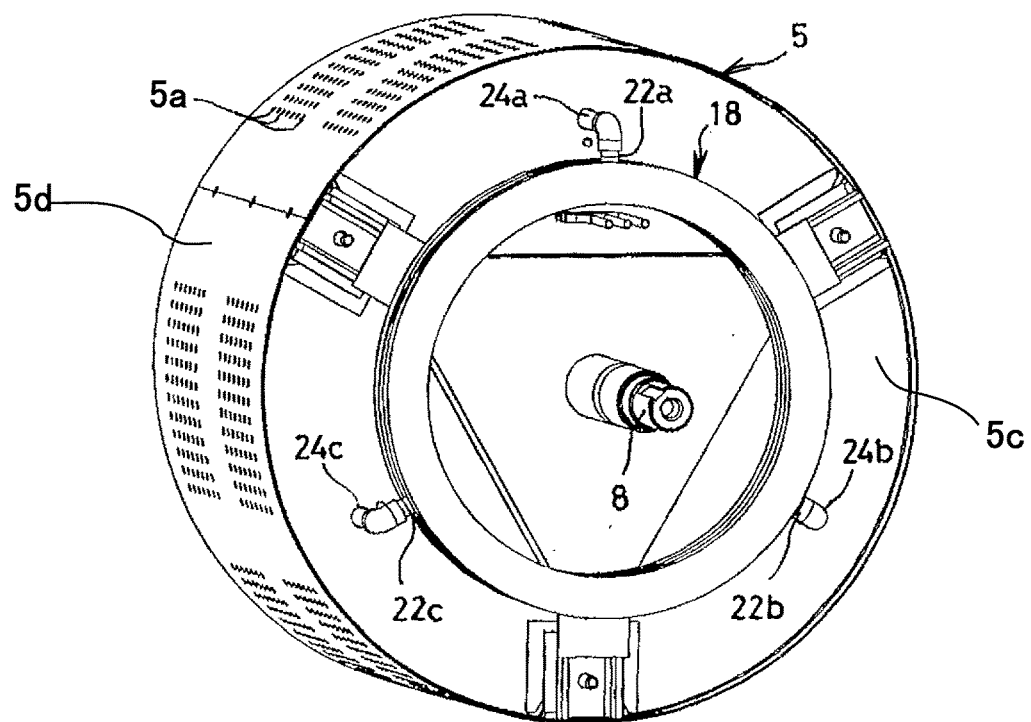


FIG. 4

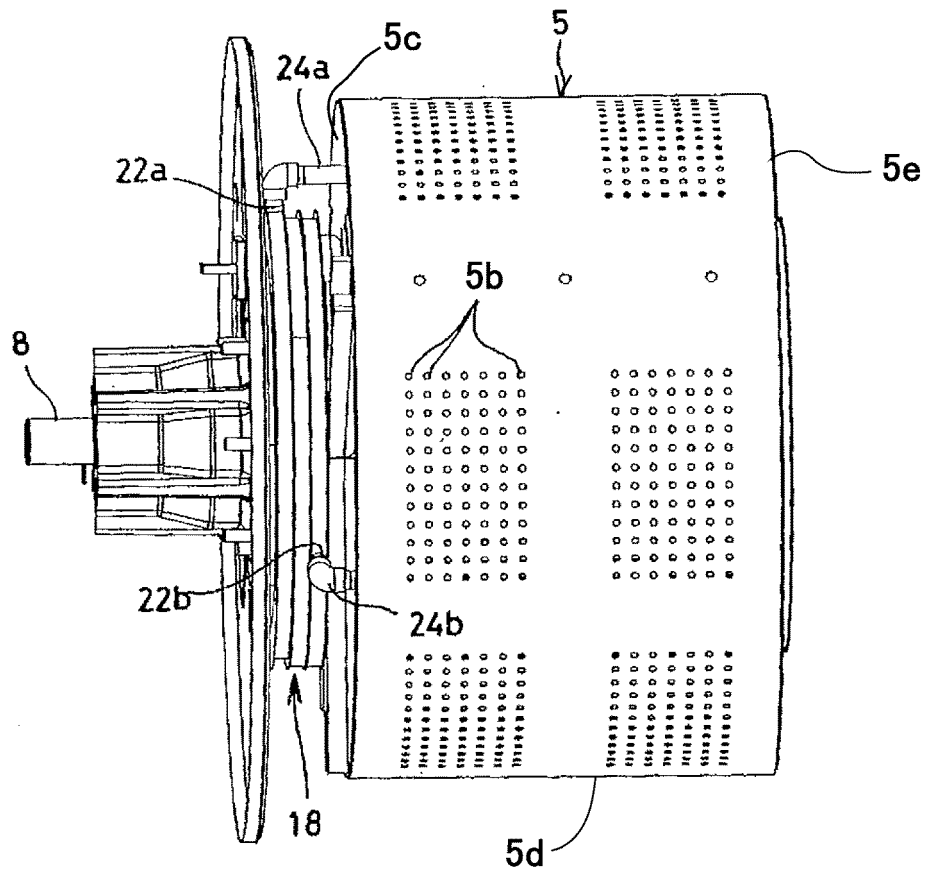


FIG. 5

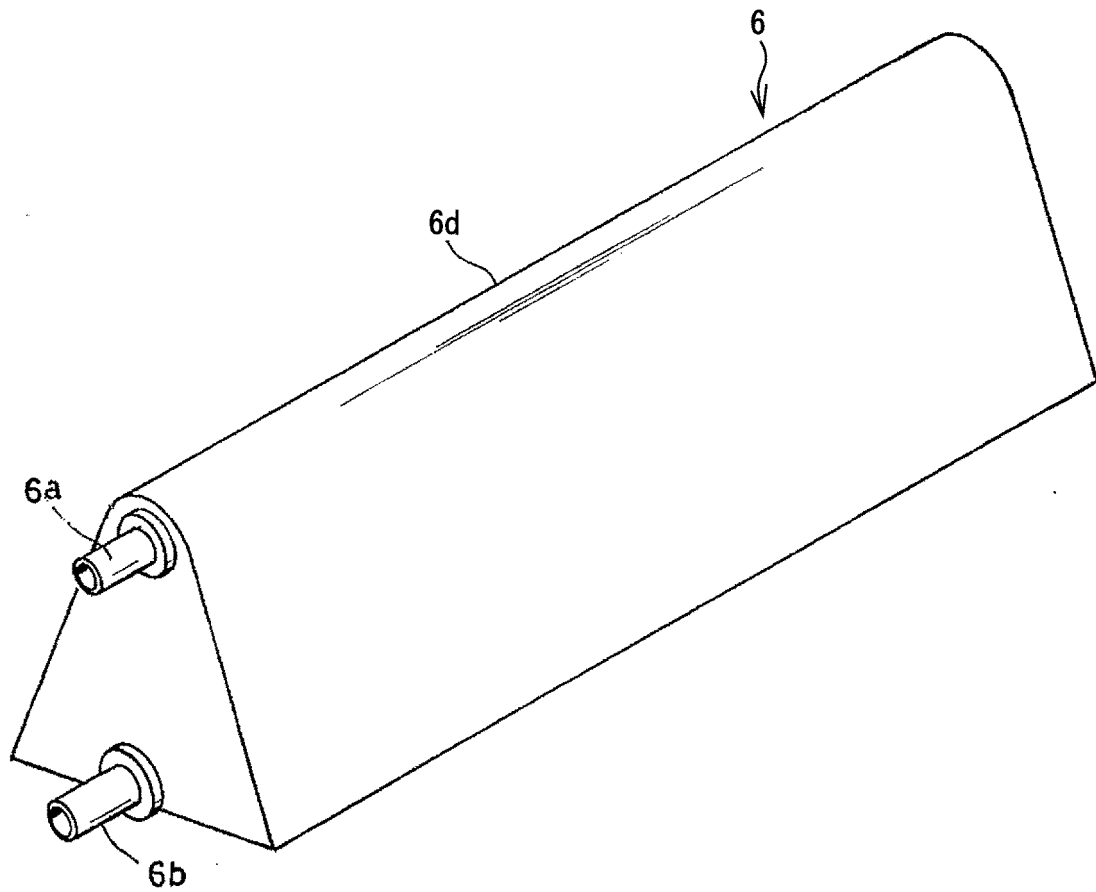


FIG. 6

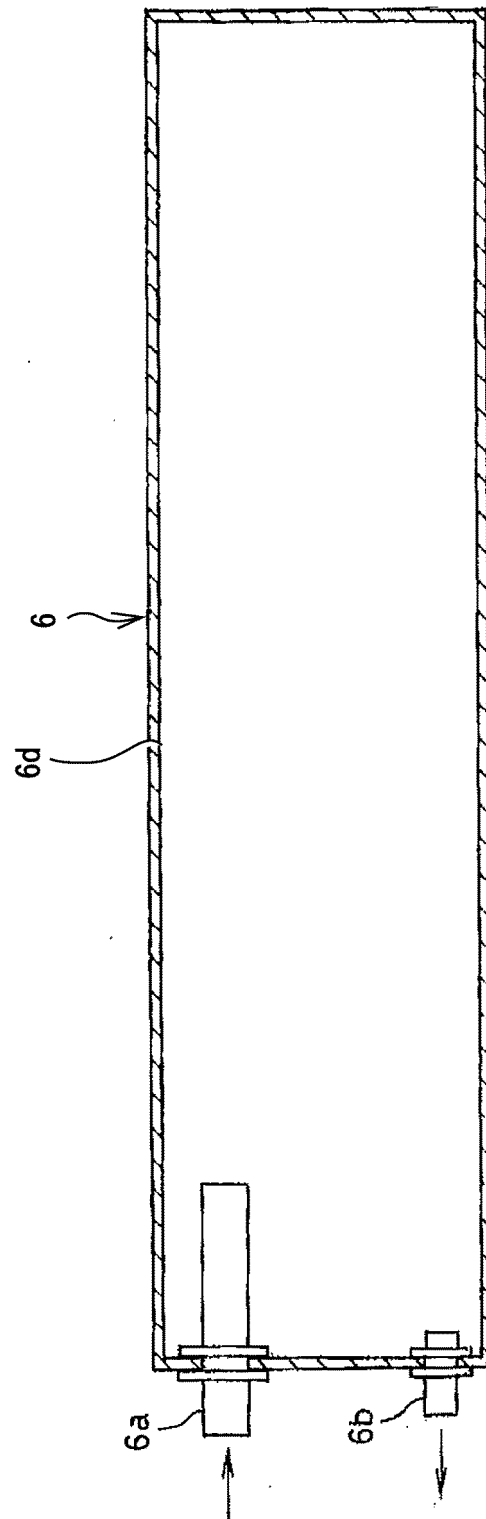


FIG. 7

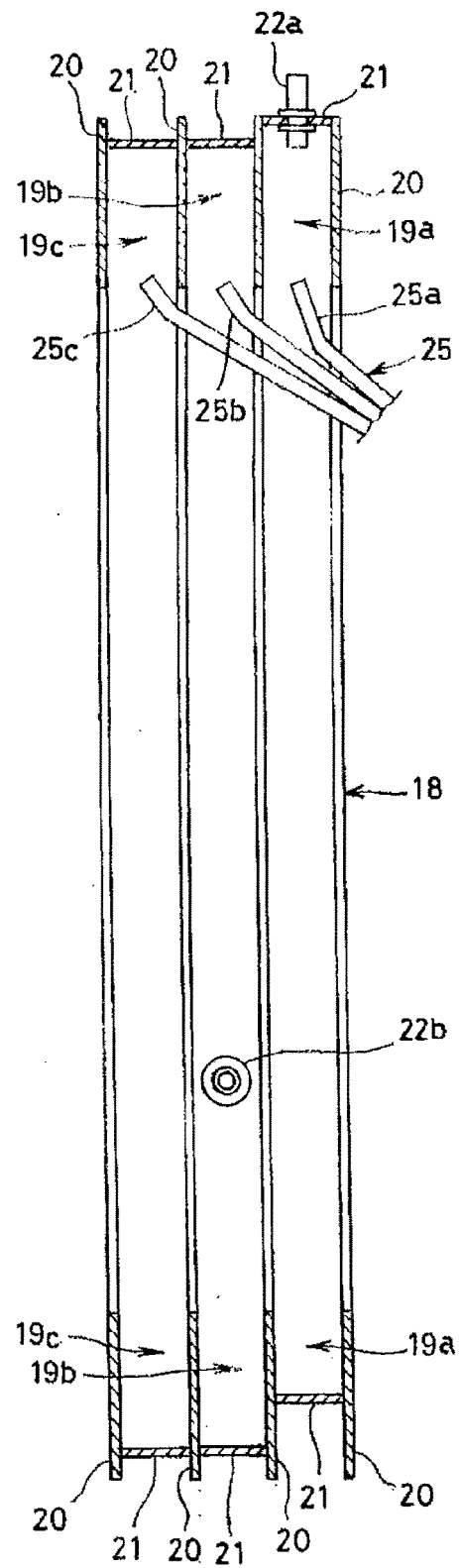


FIG. 8

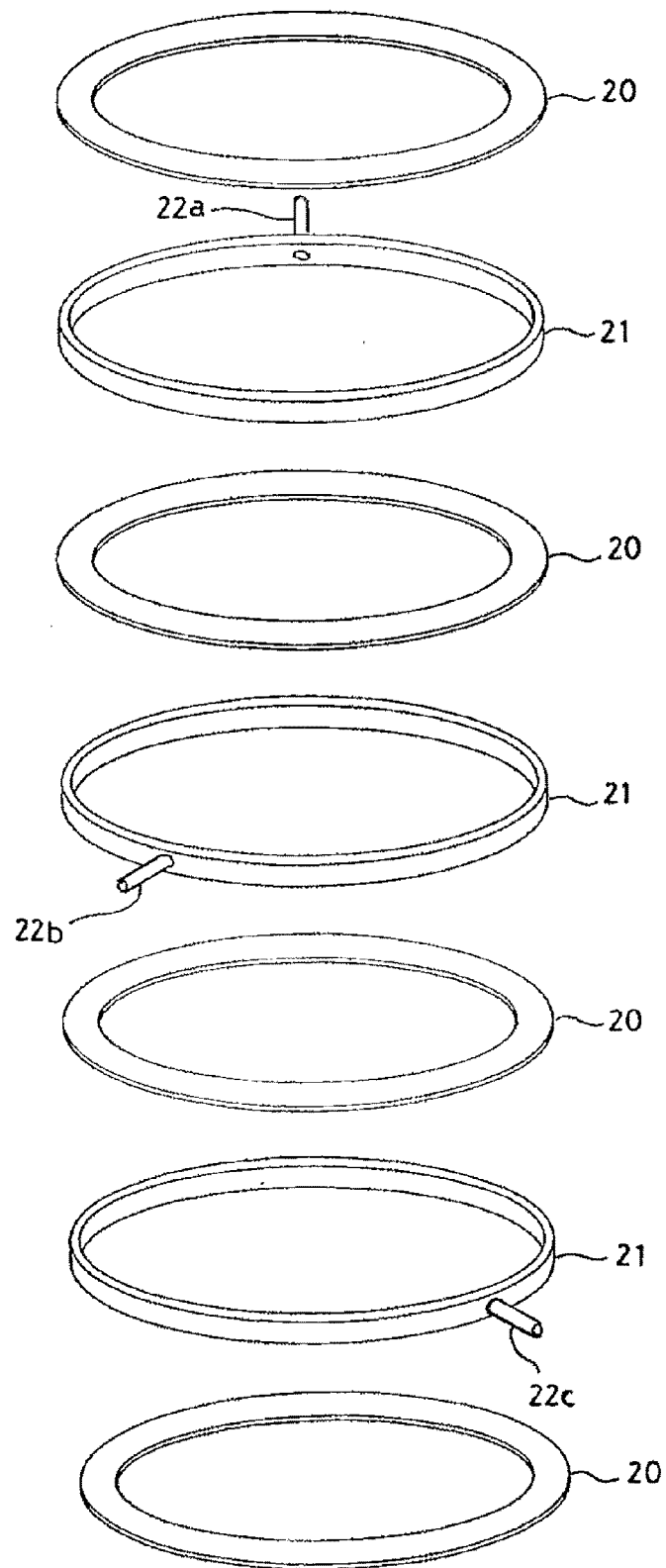


FIG. 9

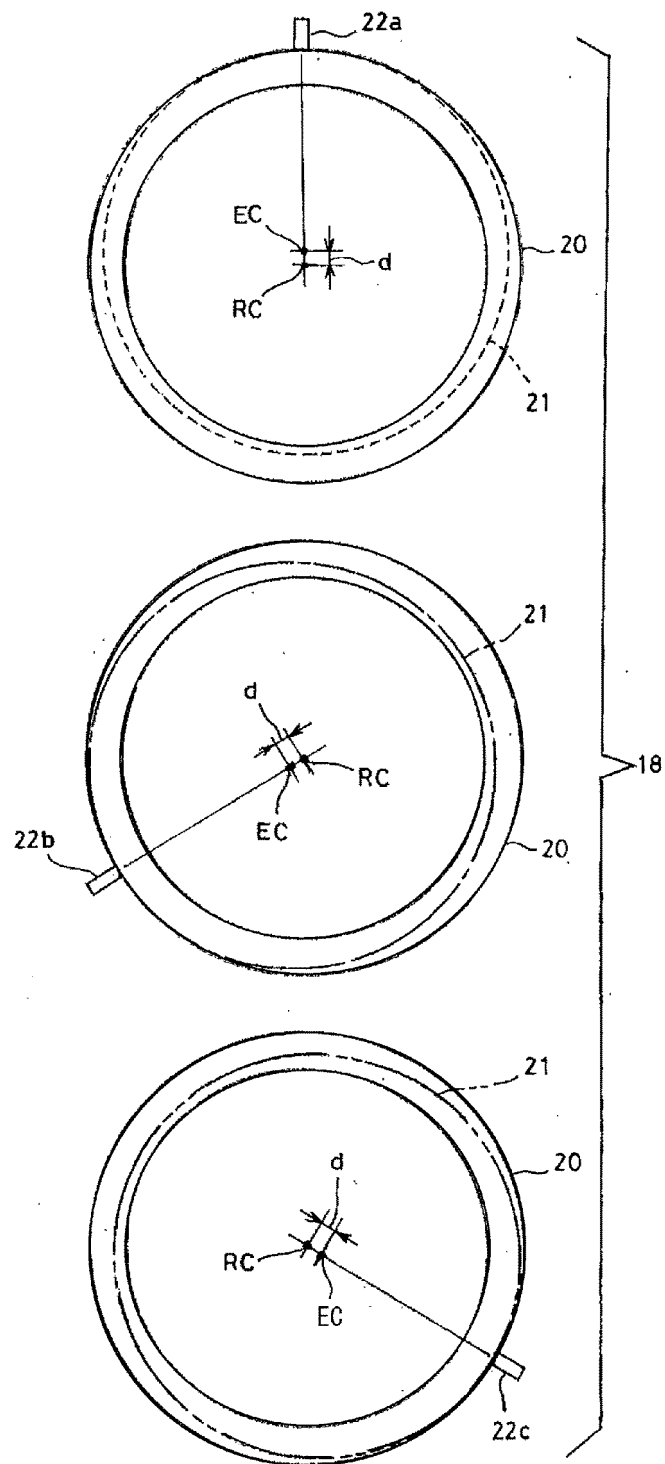


FIG. 10

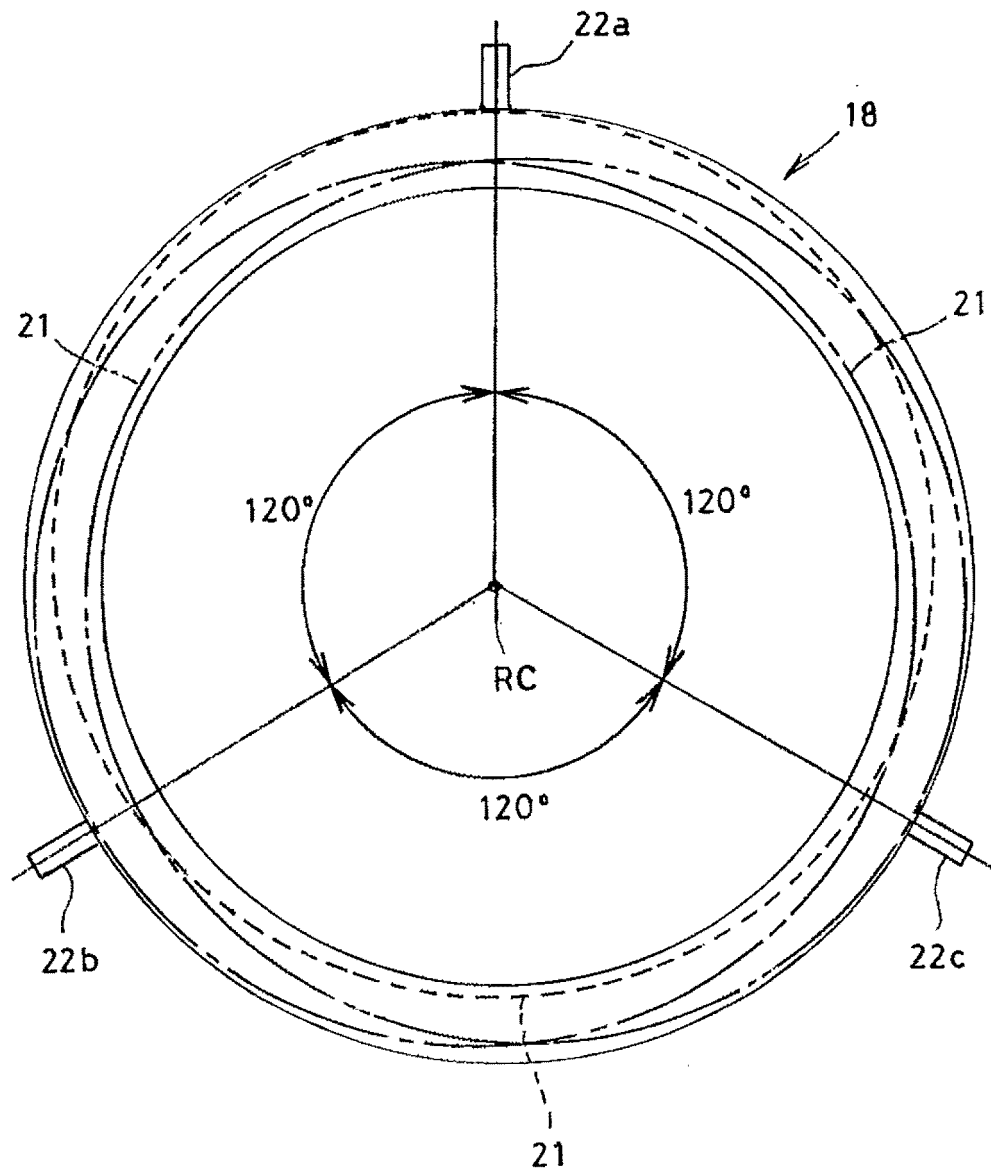


FIG. 11

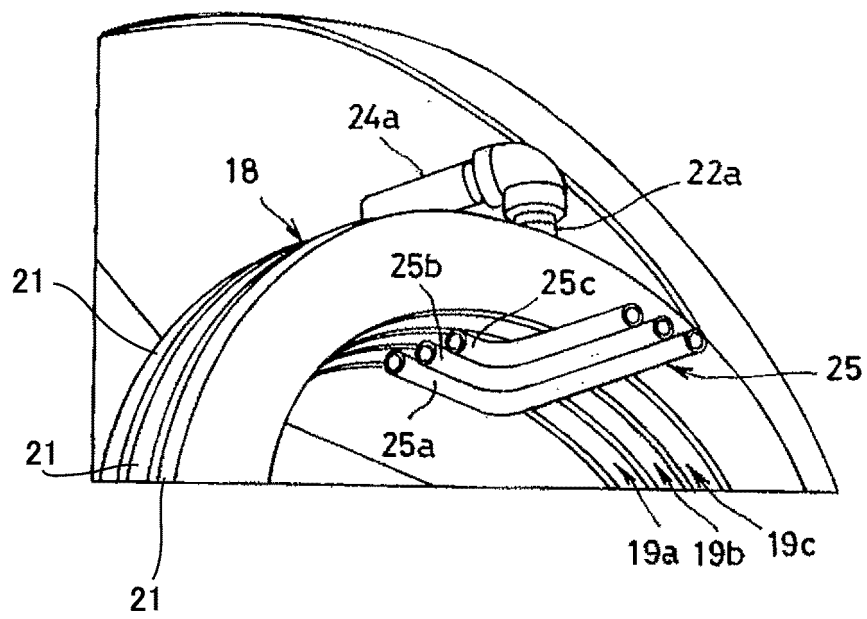


FIG. 12

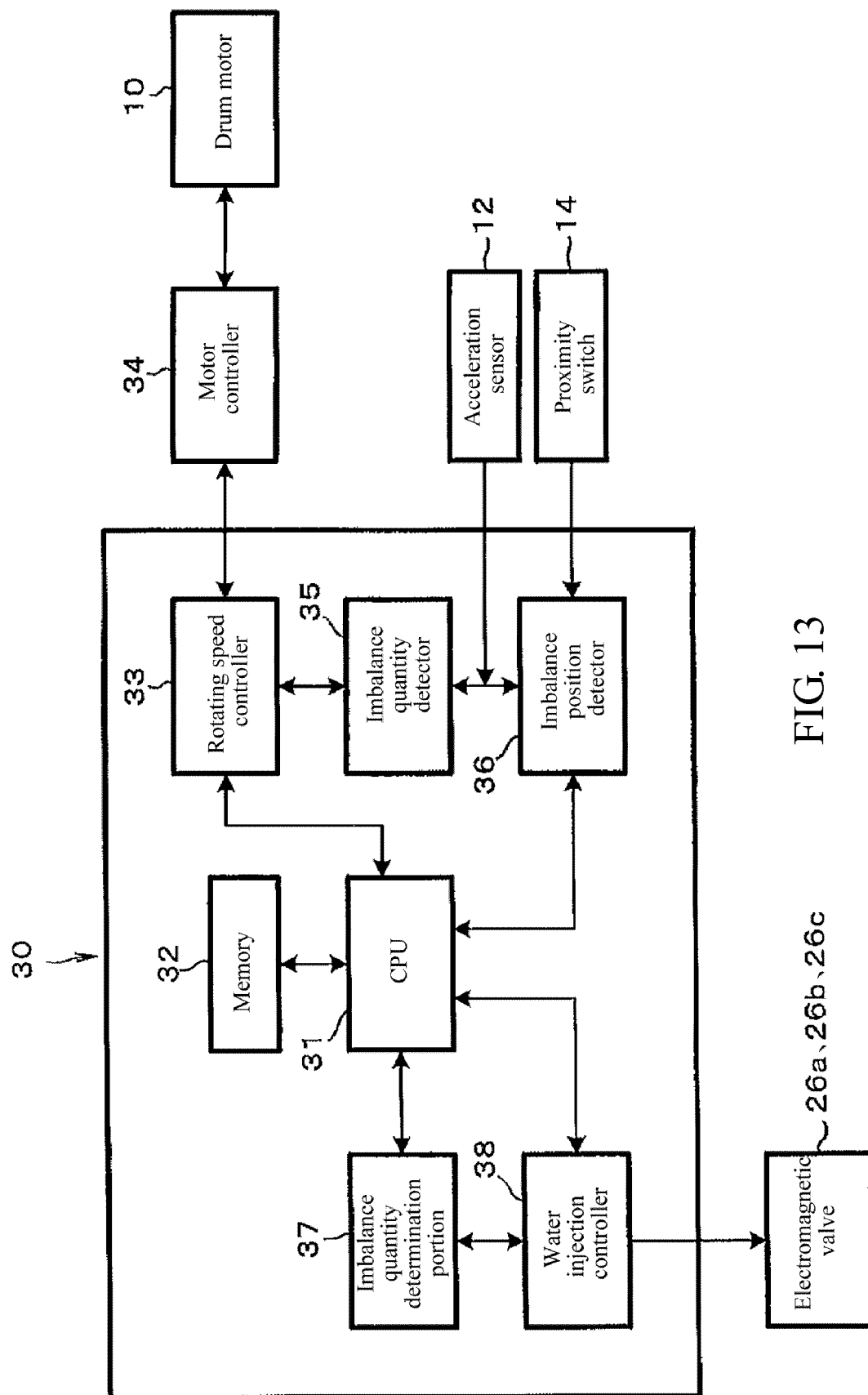


FIG. 13

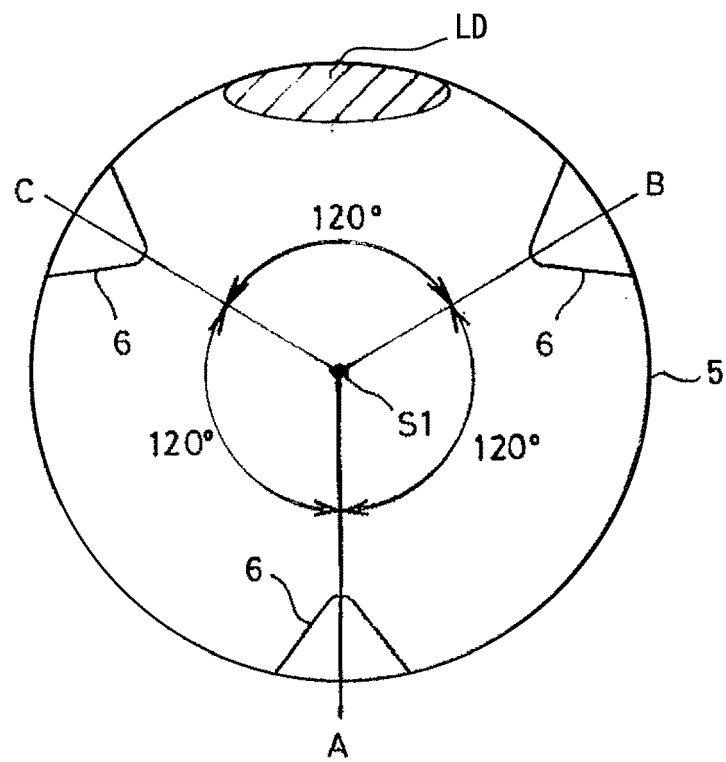


FIG. 14

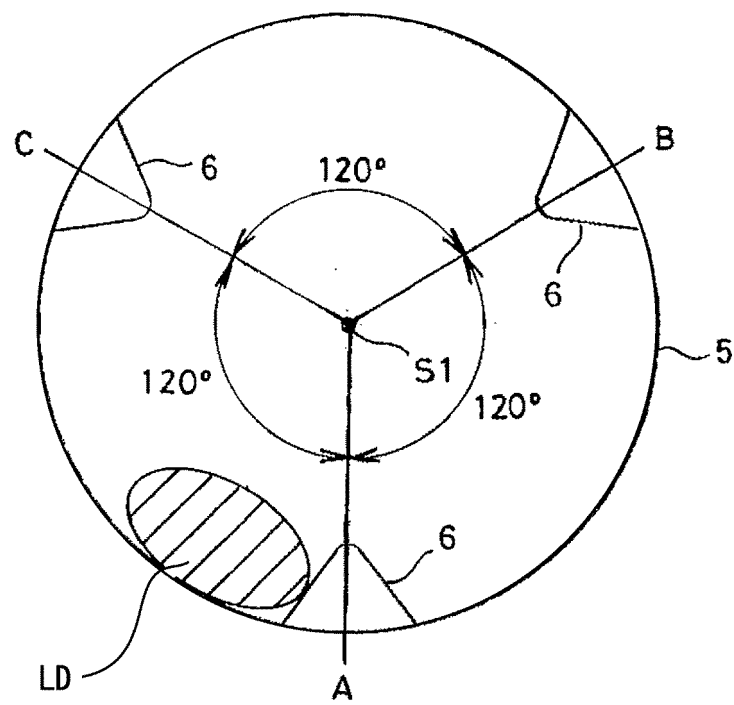


FIG. 15

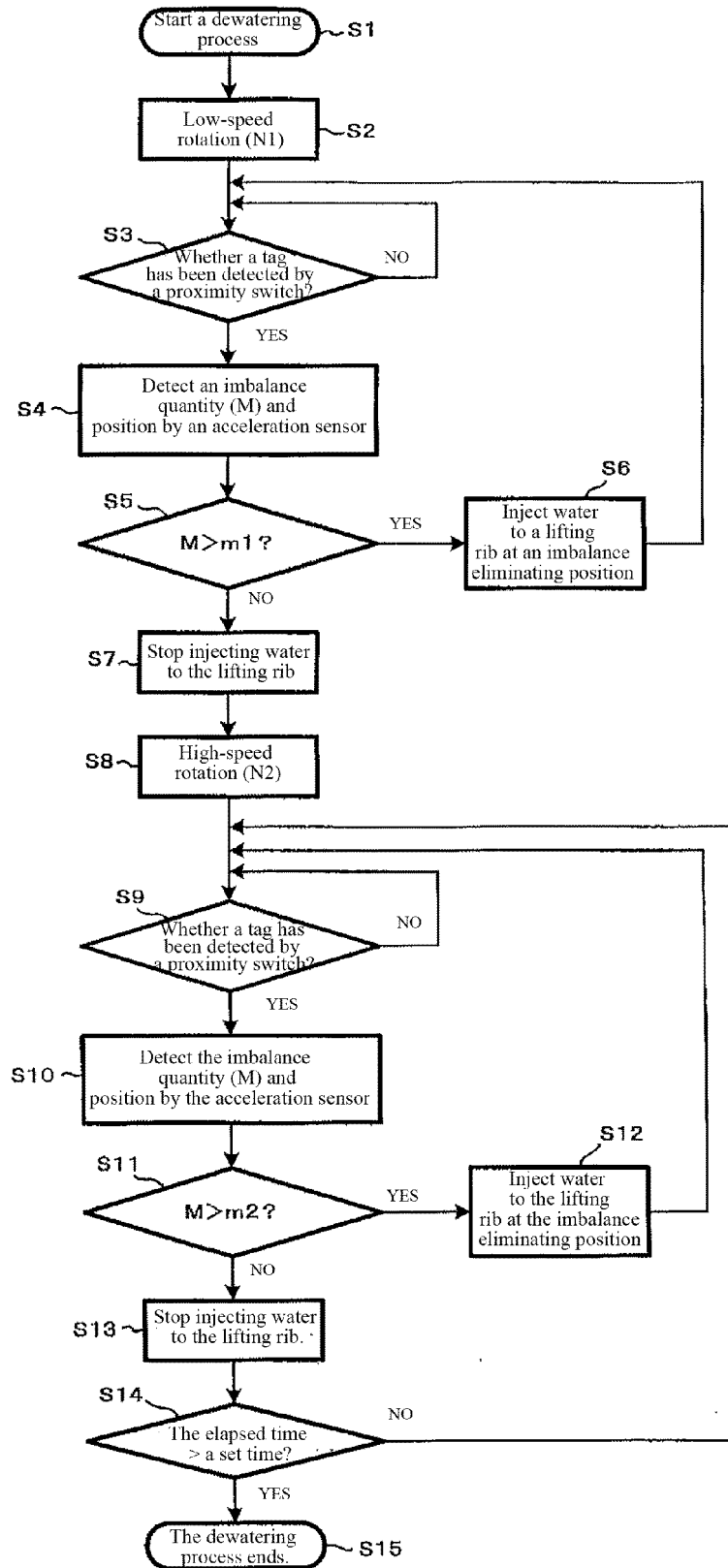


FIG. 16

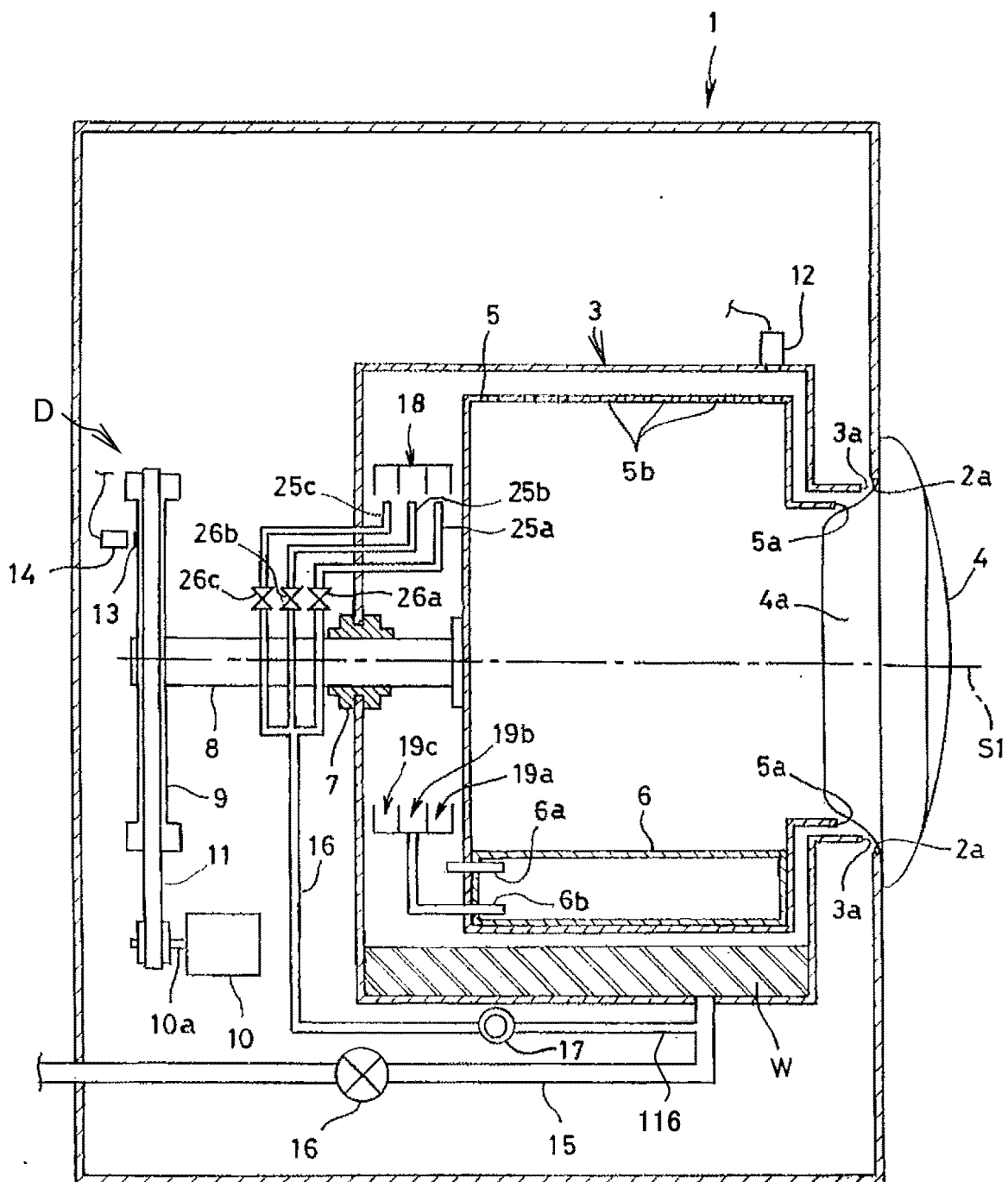


FIG. 17

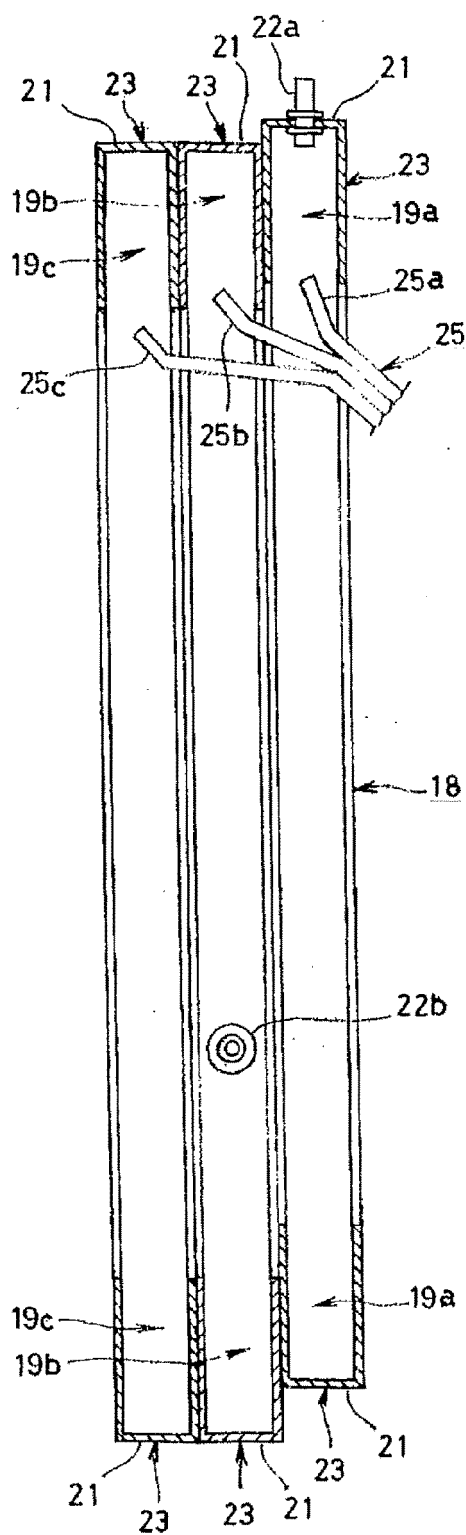


FIG. 18

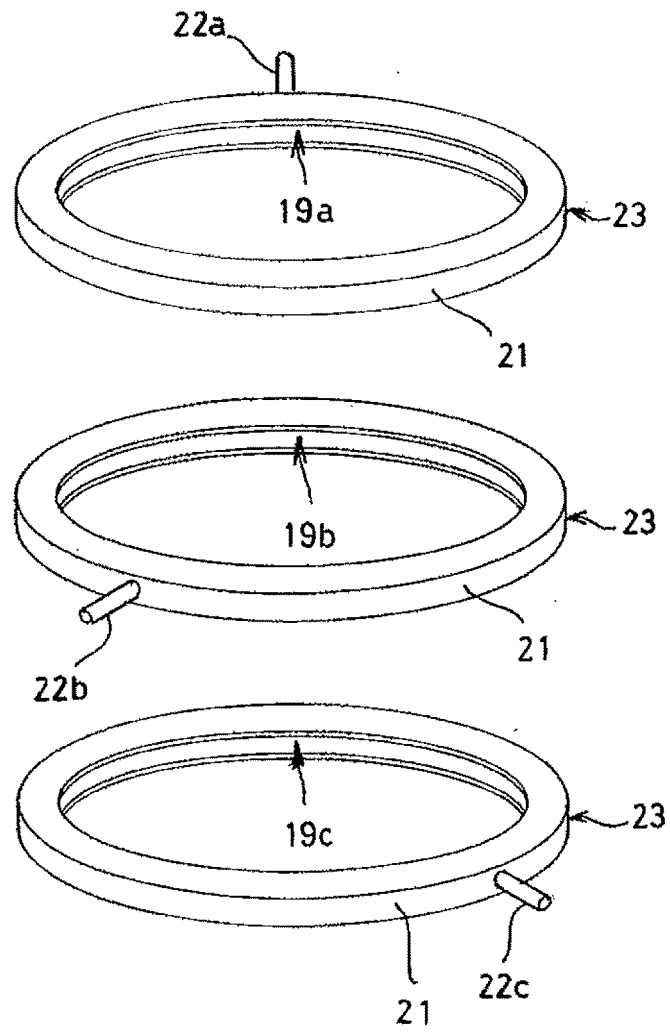
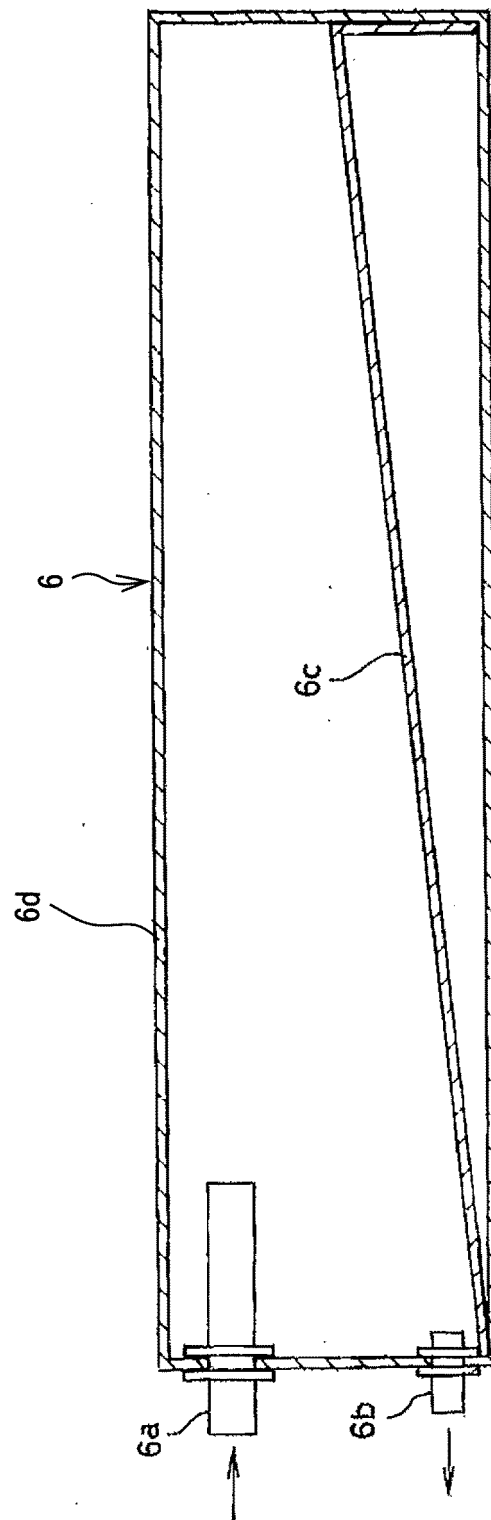


FIG. 19



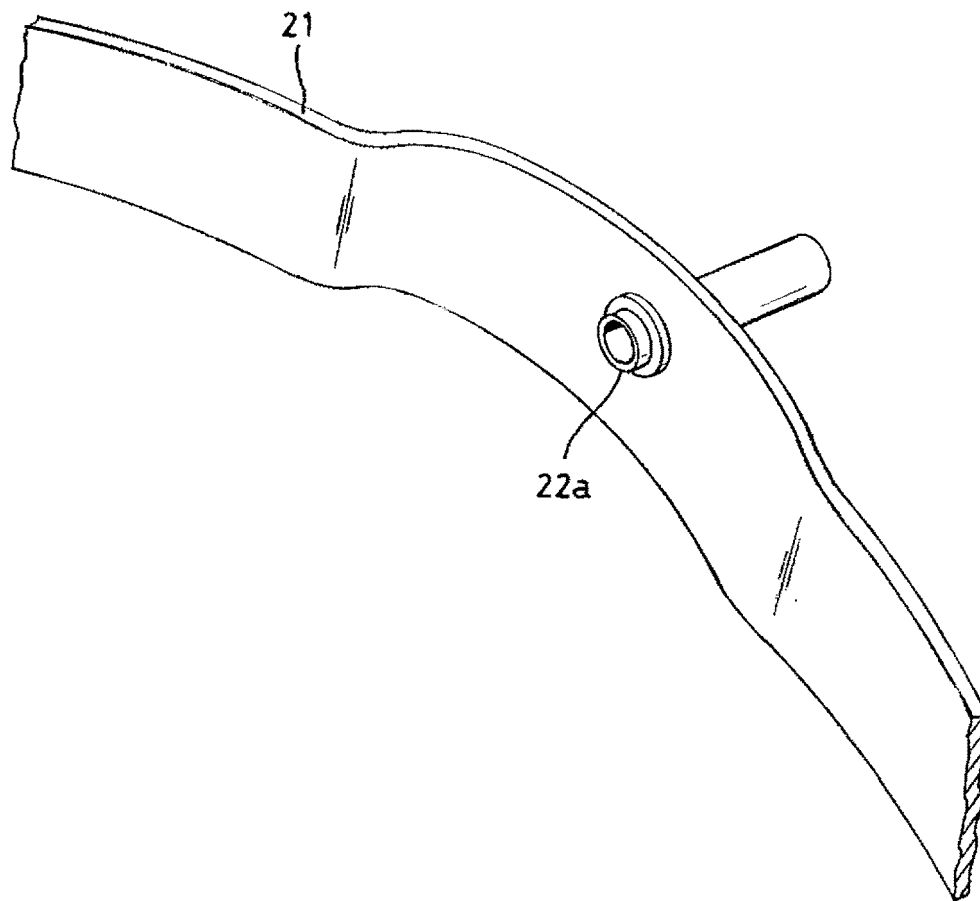


FIG. 21

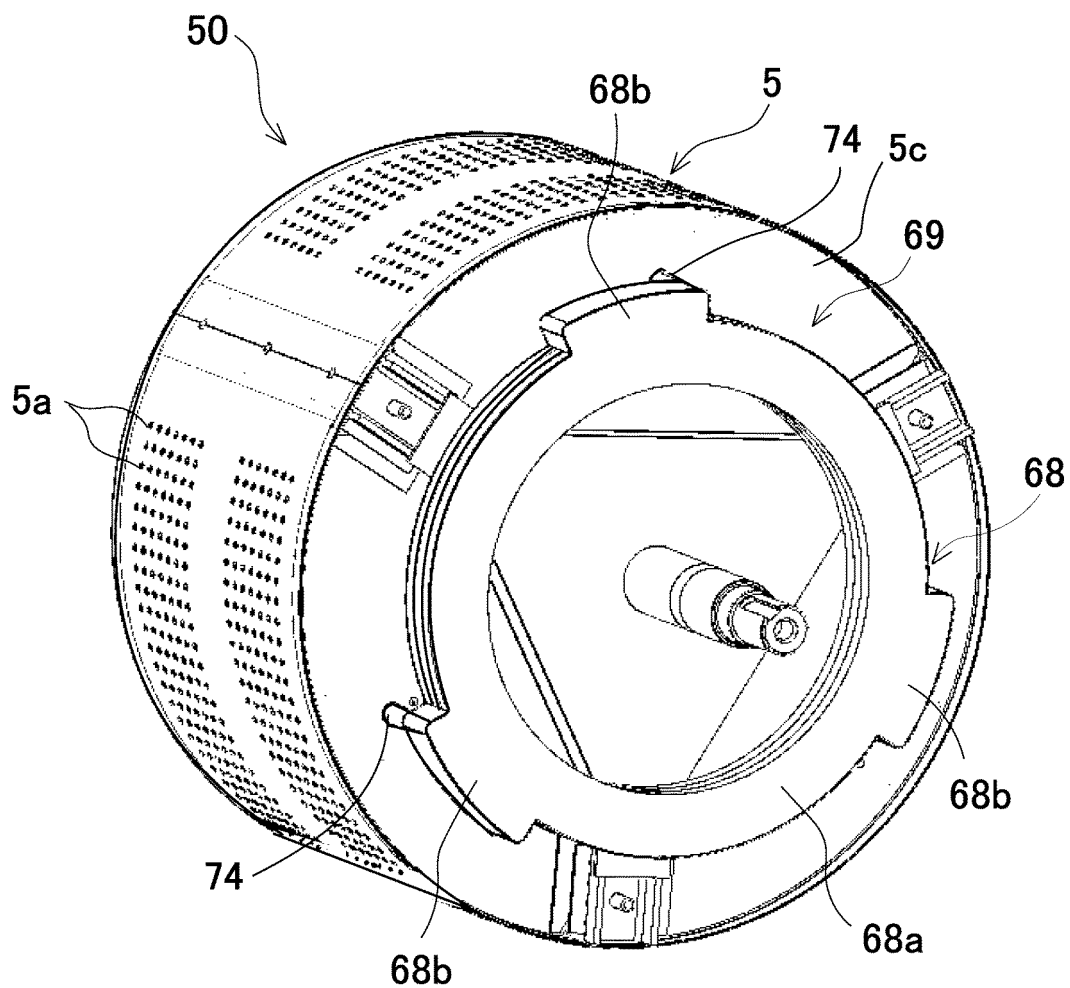


FIG. 22

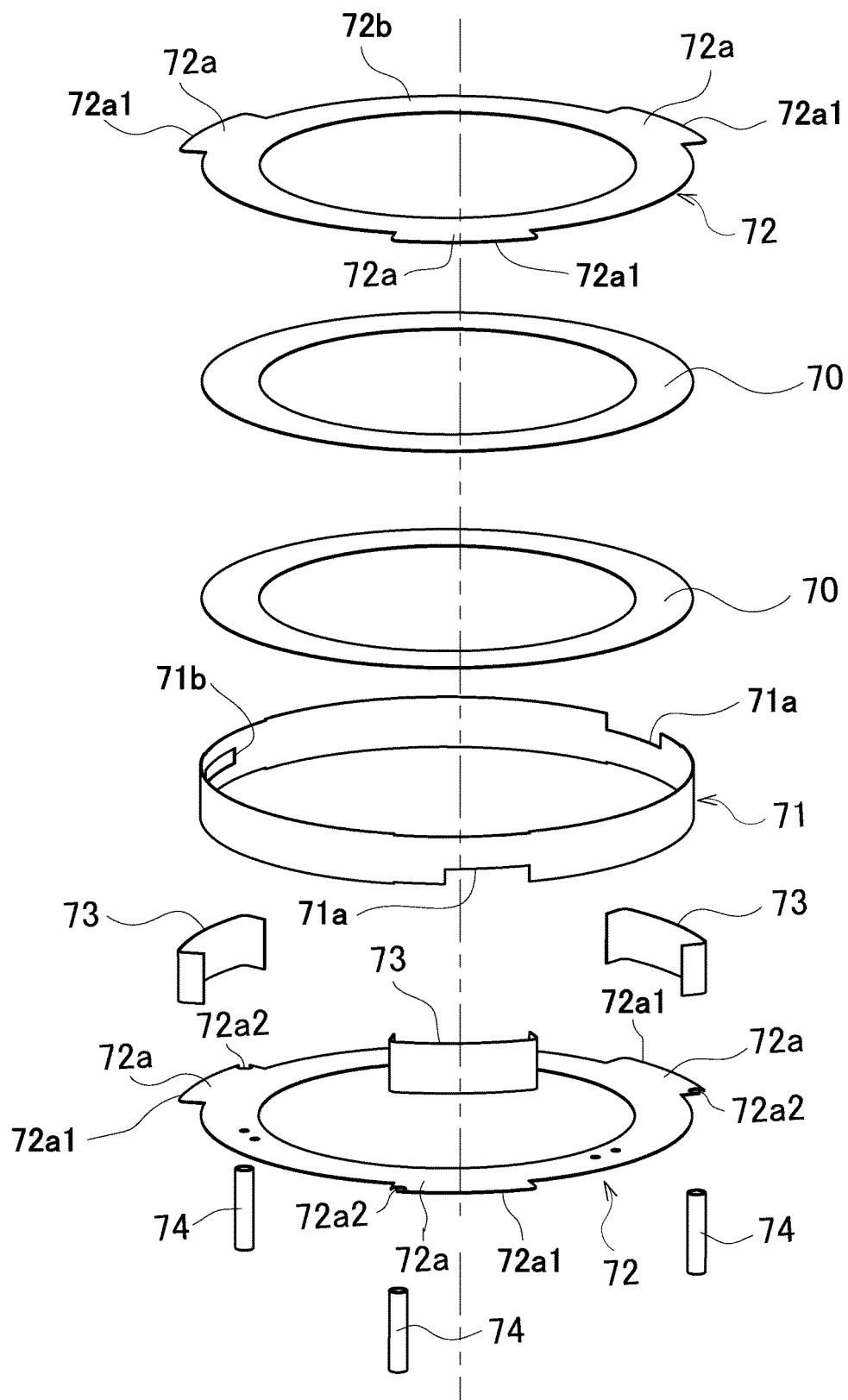


FIG. 23

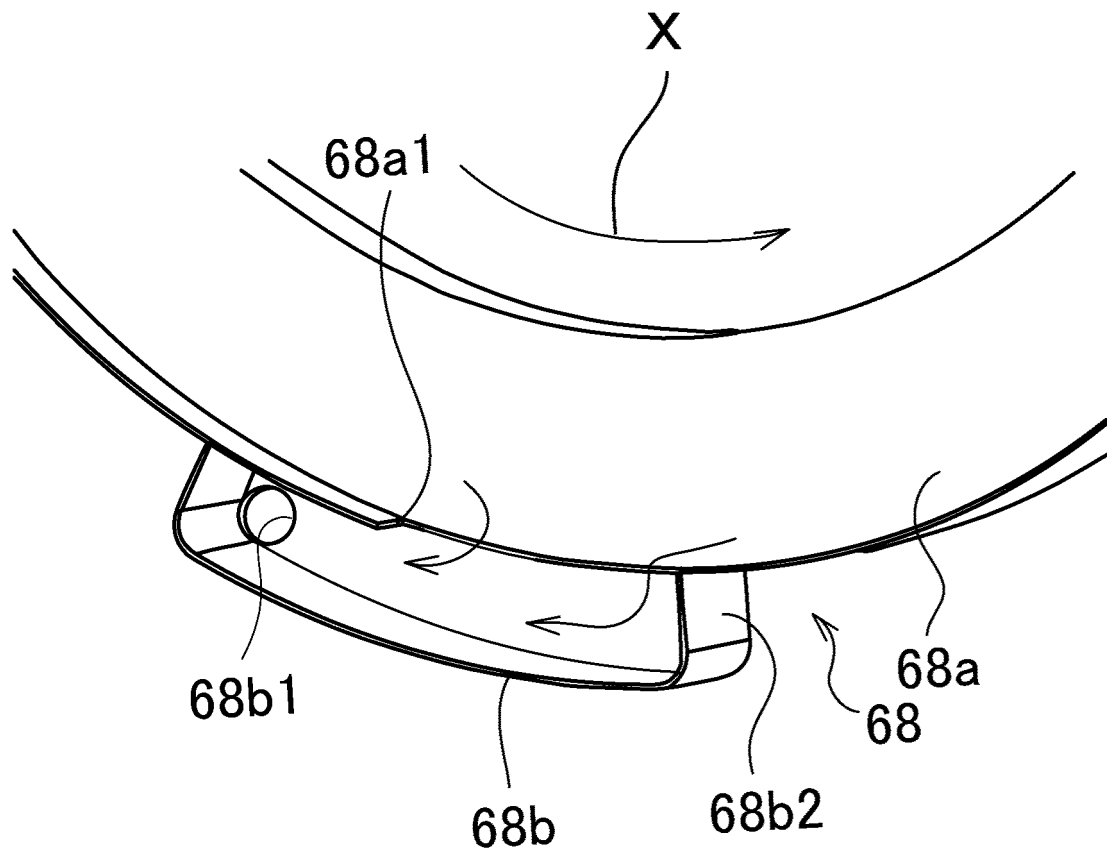
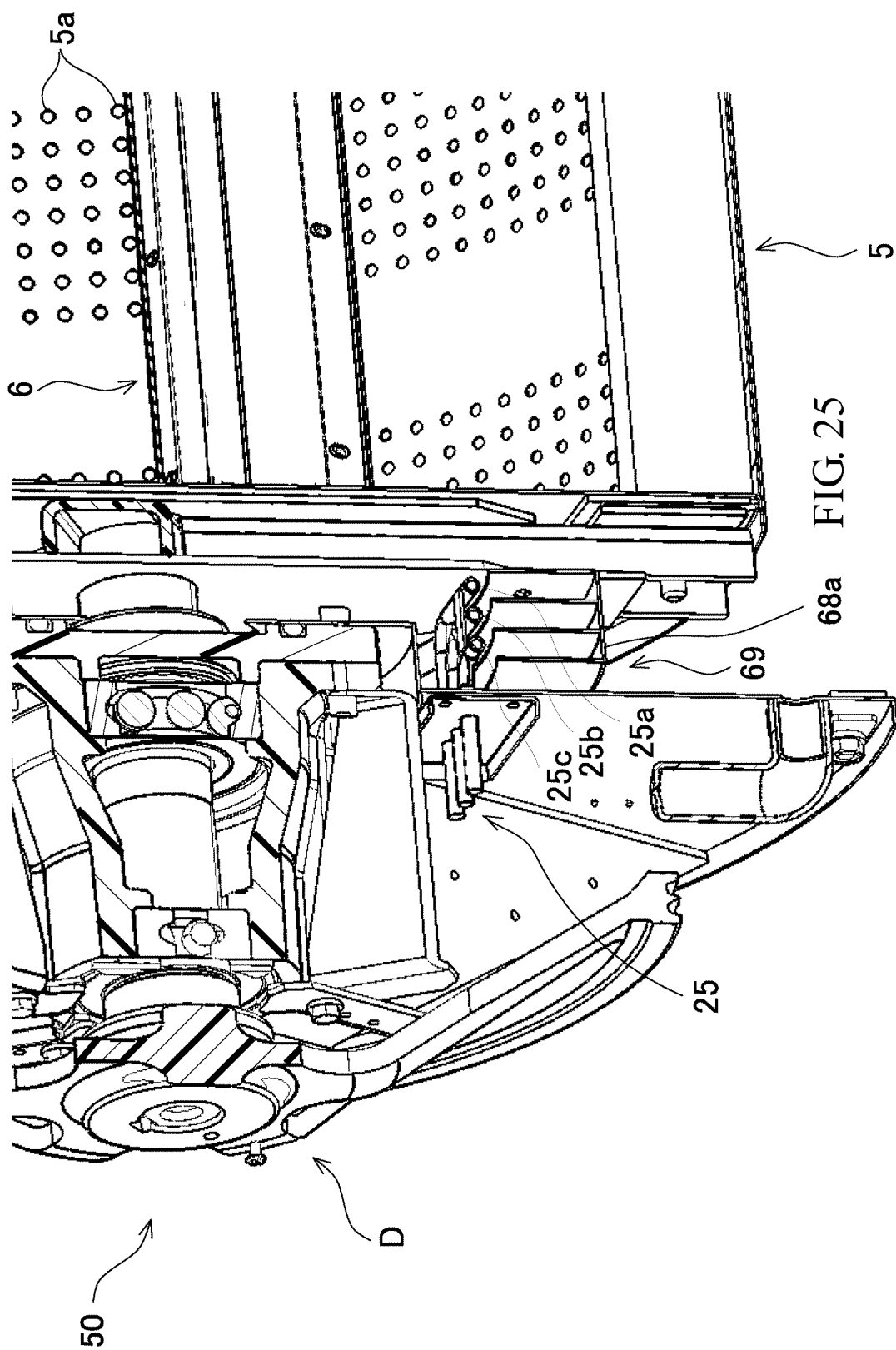


FIG. 24



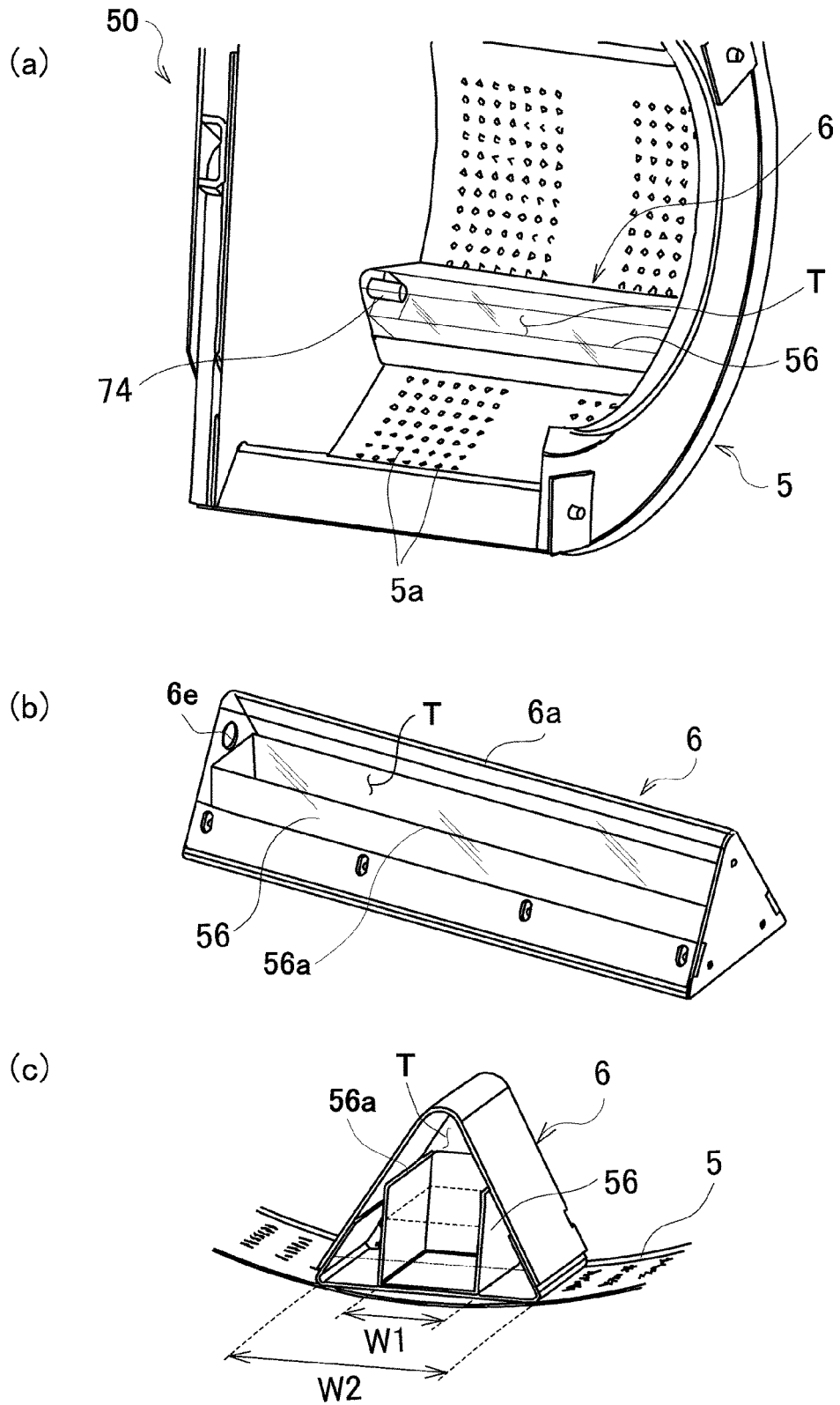


FIG. 26

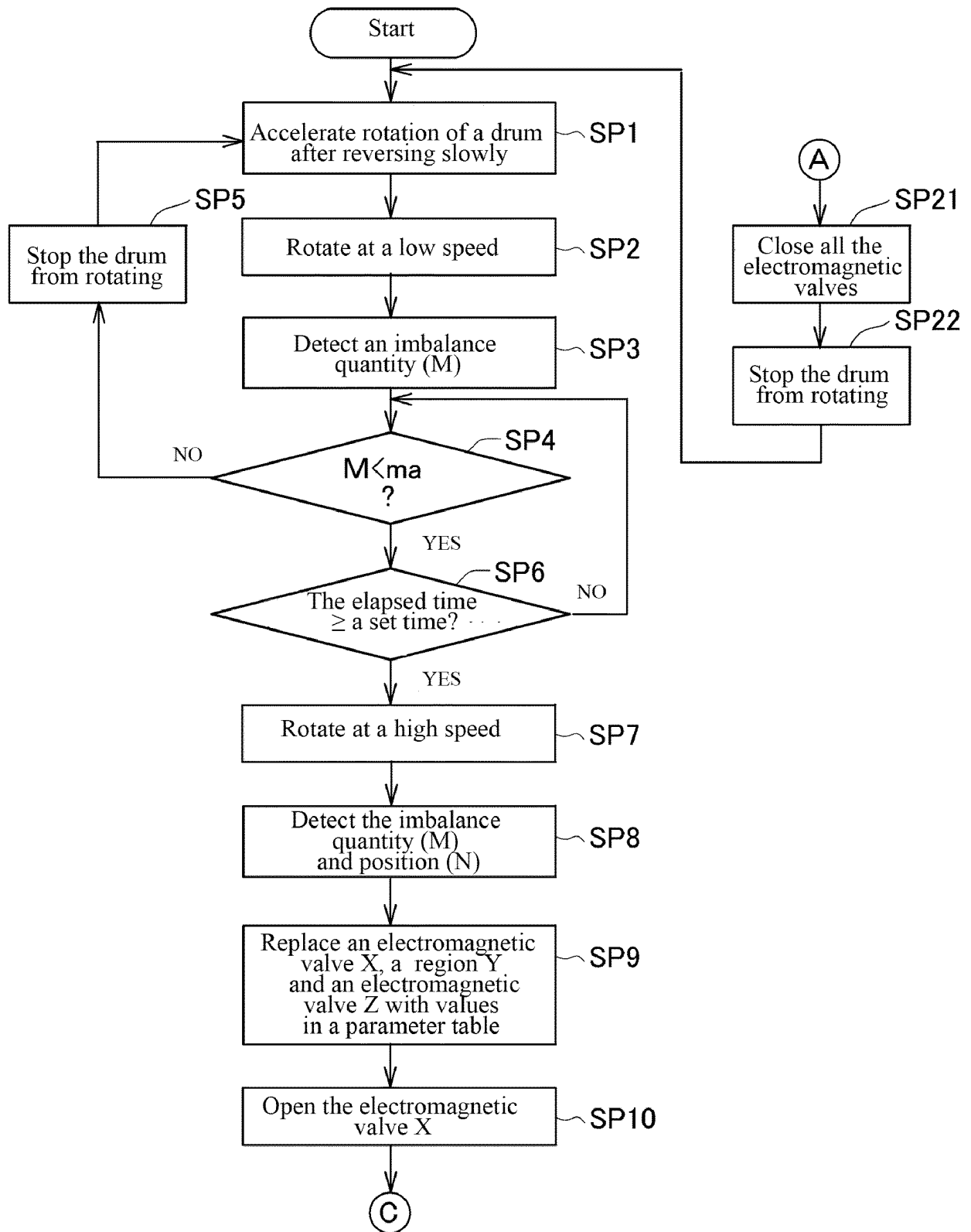


FIG. 27

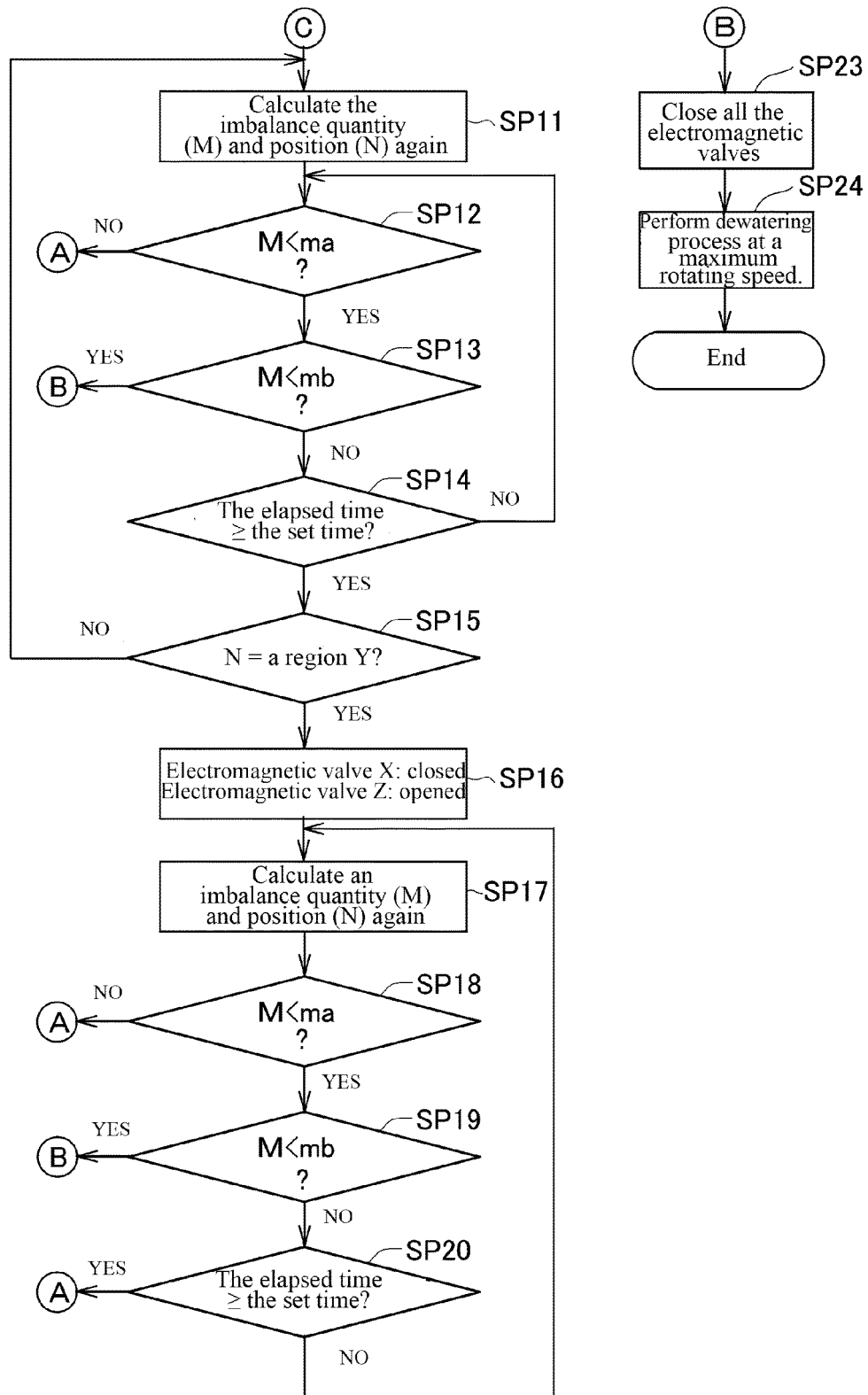
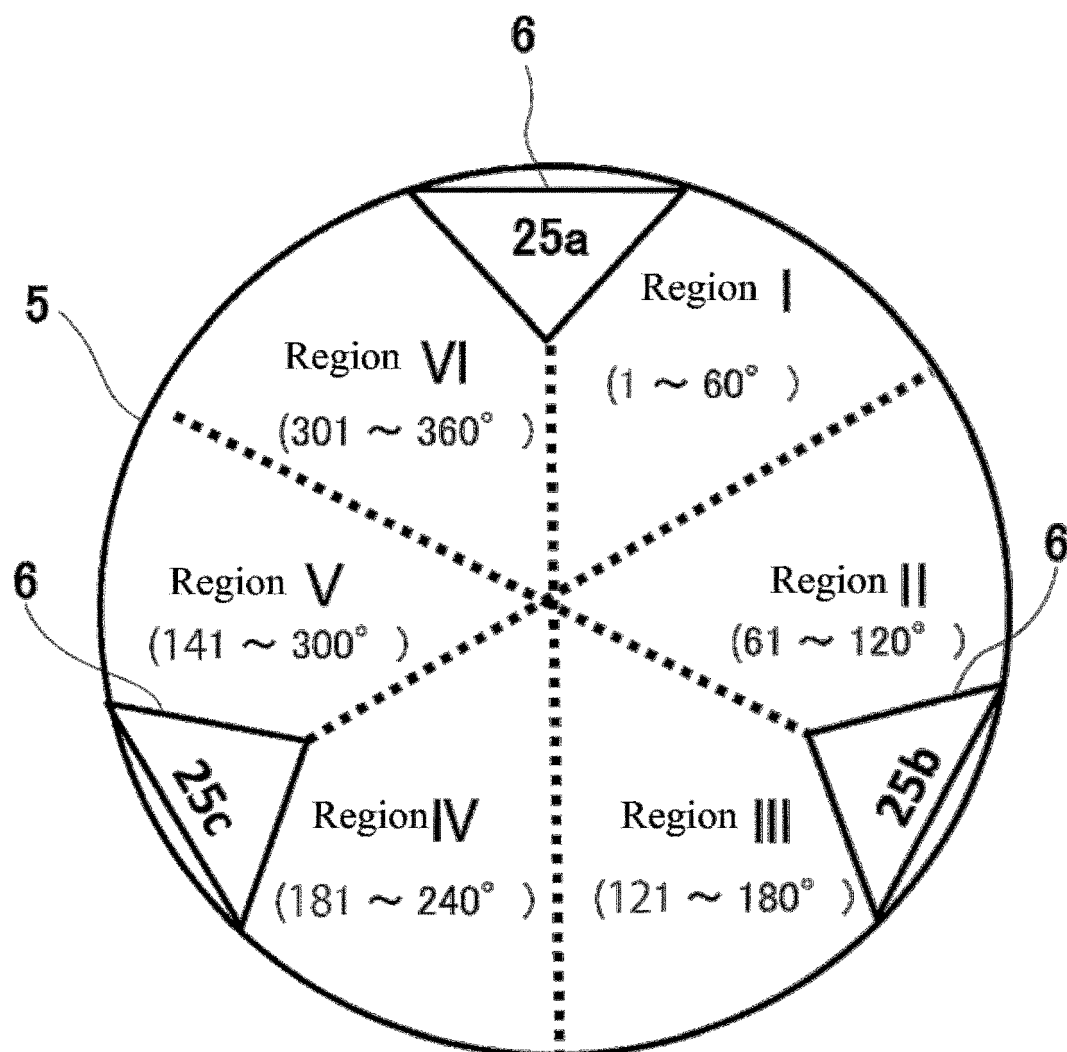


FIG. 28



Parameter table

N	Electromagnetic valve X	Region Y	Electromagnetic valve Z
Region I	Electromagnetic valve 25c	Region V	Electromagnetic valve 25b
Region II	Electromagnetic valve 25c	Region IV	Electromagnetic valve 25a
Region III	Electromagnetic valve 25a	Region I	Electromagnetic valve 25c
Region IV	Electromagnetic valve 25a	Region VI	Electromagnetic valve 25b
Region V	Electromagnetic valve 25b	Region III	Electromagnetic valve 25a
Region VI	Electromagnetic valve 25b	Region II	Electromagnetic valve 25c

FIG. 29

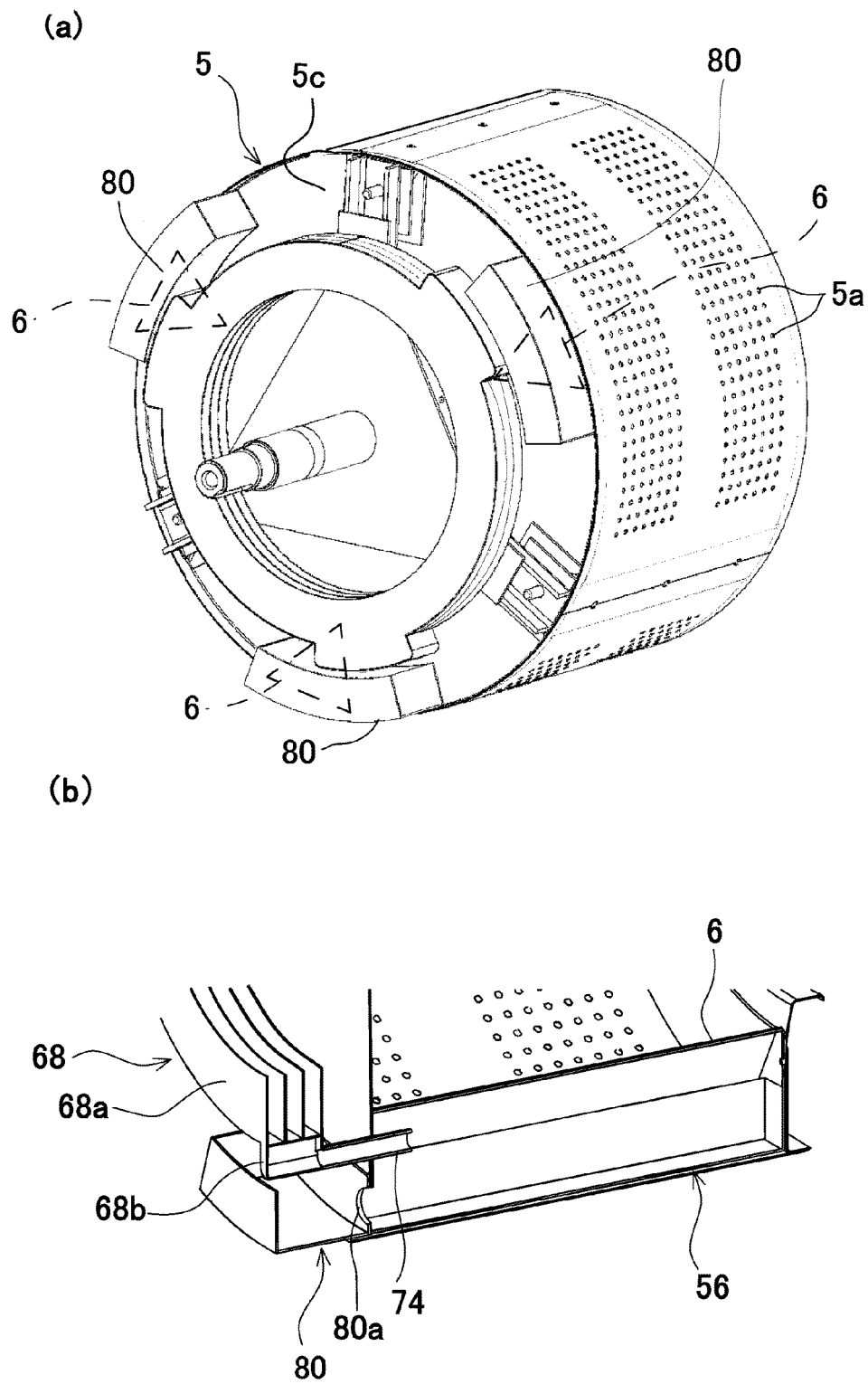


FIG. 30

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/082110

A. CLASSIFICATION OF SUBJECT MATTER

D06F 37/12 (2006.01) i; D06F 49/02 (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)

D06F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CNABS; CNTXT; WPI, EPODOC; CNKI: dehydration, eccentric load, polarization, lift, water repellent, washer, washing w machine, dryer, balanc+, ring, annul+, spin+, rotat+, eccentric, lifter?, beater?, baffle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11169595 A (INAMOTO SEISAKUSHO K.K.), 29 June 1999 (29.06.1999), description, paragraphs [0007]-[0021], and figures 1 and 2	1, 2, 9
Y	JP 11169595 A (INAMOTO SEISAKUSHO K.K.), 29 June 1999 (29.06.1999), description, paragraphs [0007]-[0021], and figures 1 and 2	4, 7
Y	CN 1509359 A (SANYO ELECTRIC CO., LTD.), 30 June 2004 (30.06.2004), description, page 3, paragraph 2 and page 5, paragraphs 10-11, and figure 5	4, 7
PX	JP 2016000197 A (HAIER ASIA CO., LTD.), 07 January 2016 (07.01.2016), claims 1-9	1-9
A	JP 2000157788 A (SANYO ELECTRIC CO.), 13 June 2000 (13.06.2000), the whole document	1-9
A	JP 1176687 A (SANYO ELECTRIC CO.), 23 March 1999 (23.03.1999), the whole document	1-9
A	JP 4411451 B2 (YASKAWA ELECTRIC CORP. et al.), 10 February 2010 (10.02.2010), the whole document	1-9

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

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"E" earlier application or patent but published on or after the international filing date	"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
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"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	"&" document member of the same patent family

Date of the actual completion of the international search 09 August 2016 (09.08.2016)	Date of mailing of the international search report 22 August 2016 (22.08.2016)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer LIU, Jing Telephone No.: (86-10) 62084545

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/082110

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Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9290089 A [0006]
- JP 2009082558 A [0006]