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(54) WASHING MACHINE

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(52) **U.S. Cl.**
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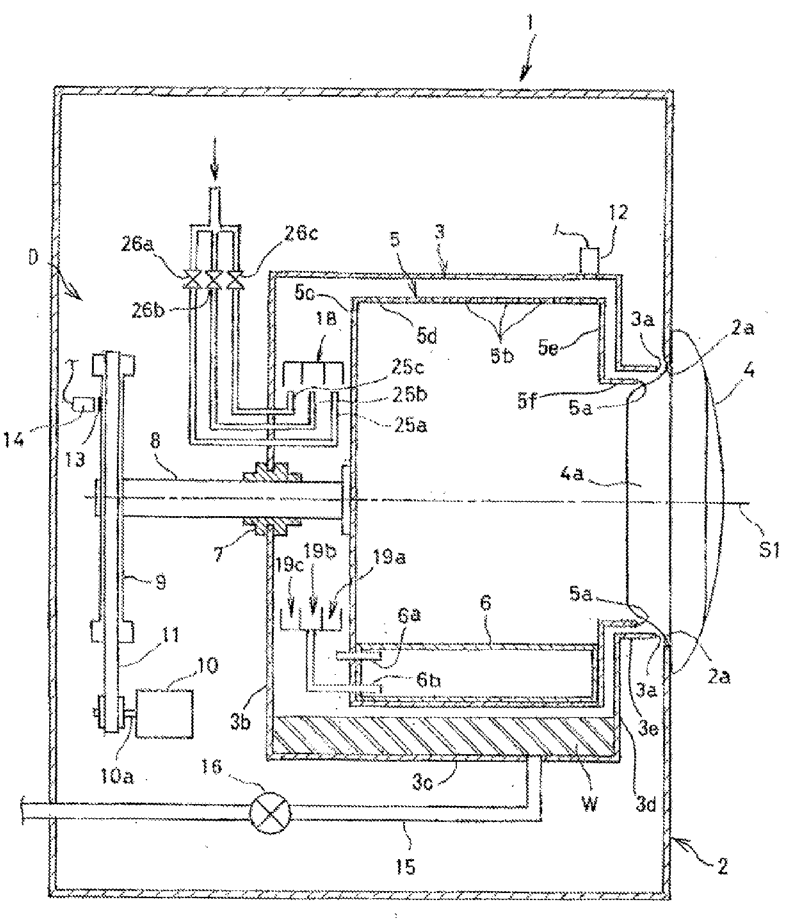
(57) **ABSTRACT**

A washing machine is provided. The washing machine includes: a washing drum; a plurality of hollow balancers arranged on an inner circumferential surface of the washing drum in an axis direction of the washing drum; a water receiving ring unit, 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, 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 with the balancers corresponding to the water guiding grooves; and a nozzle unit for separately injecting adjustment water into the water guiding grooves.



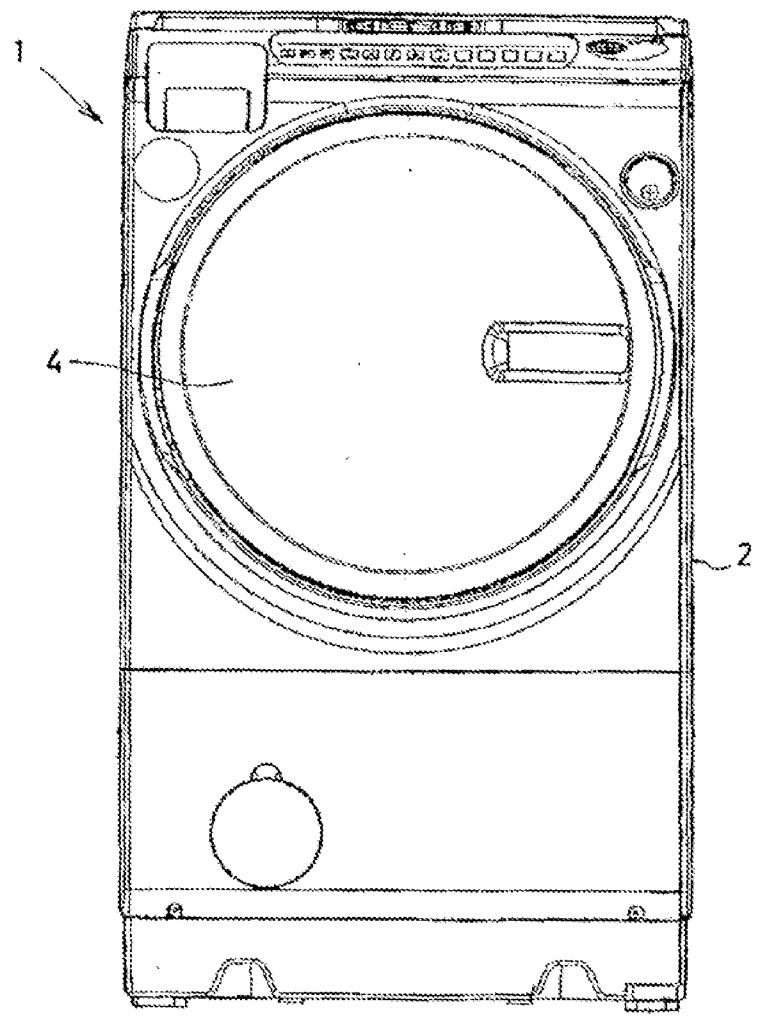


FIG. 1

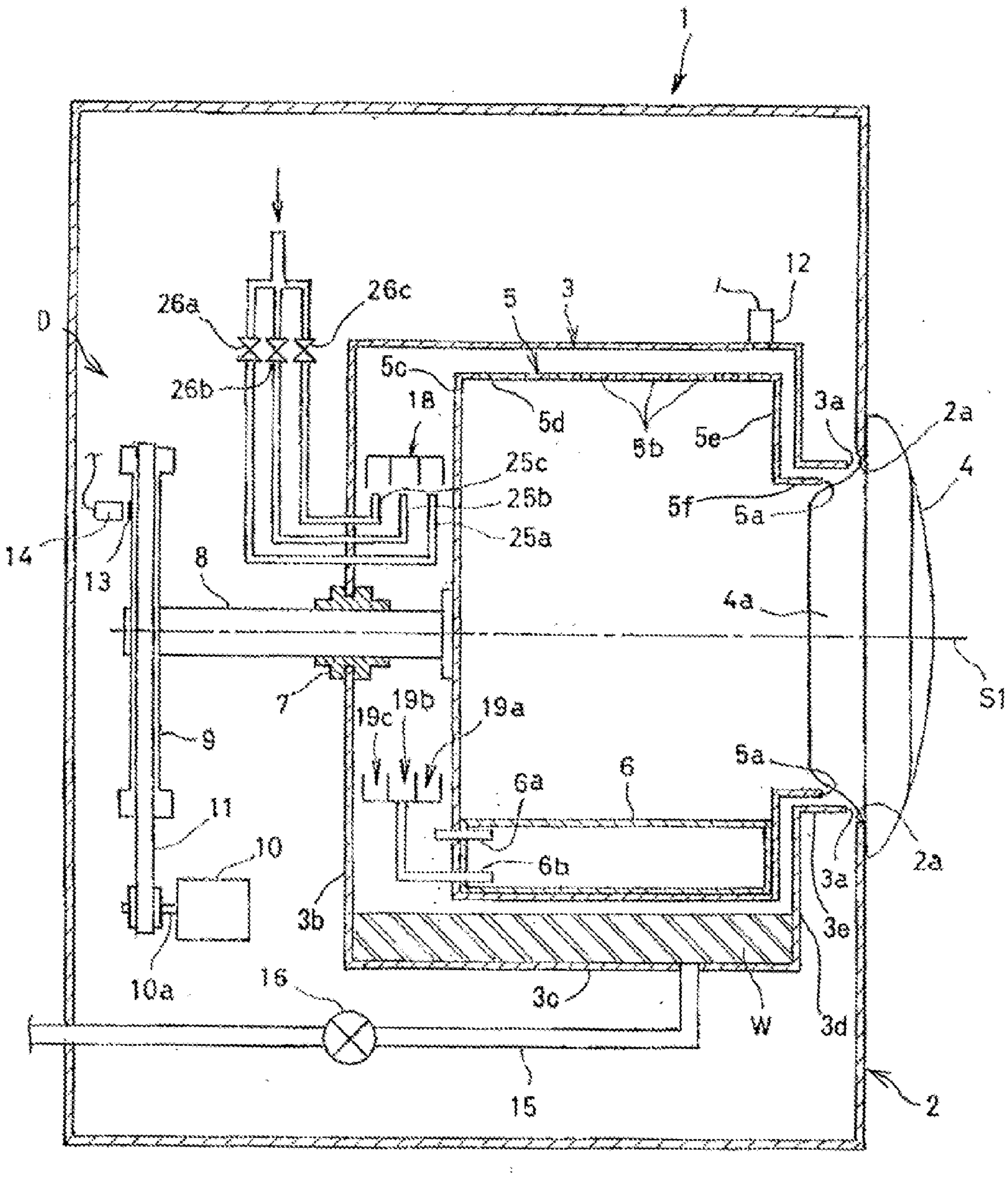


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FIG. 2

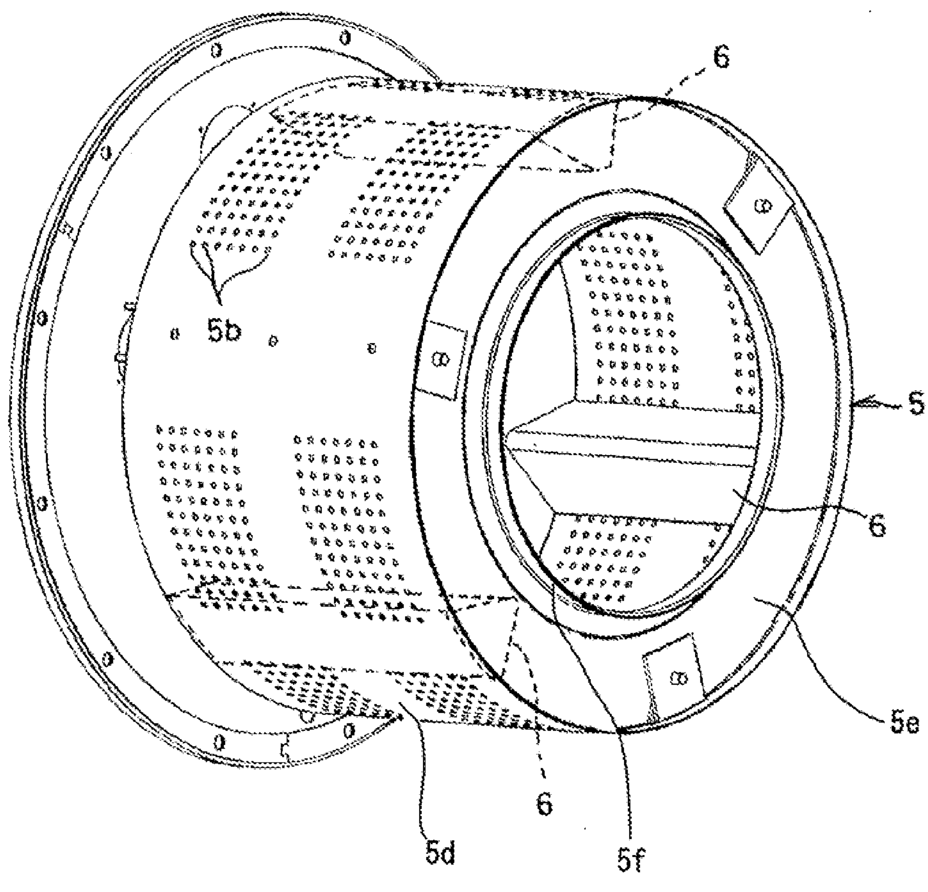

FIG. 3

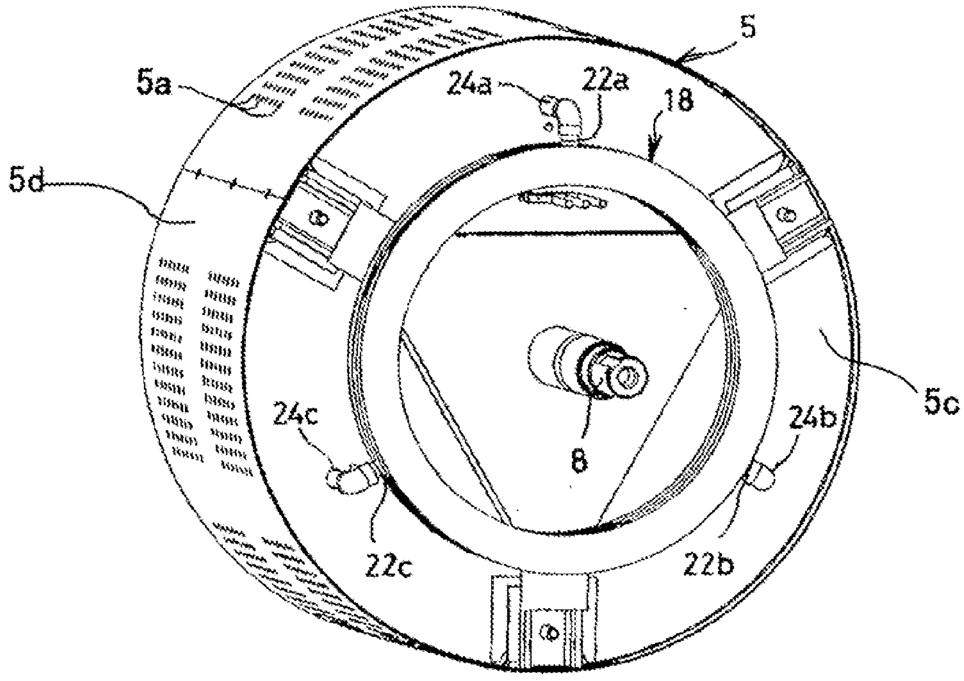

FIG. 4

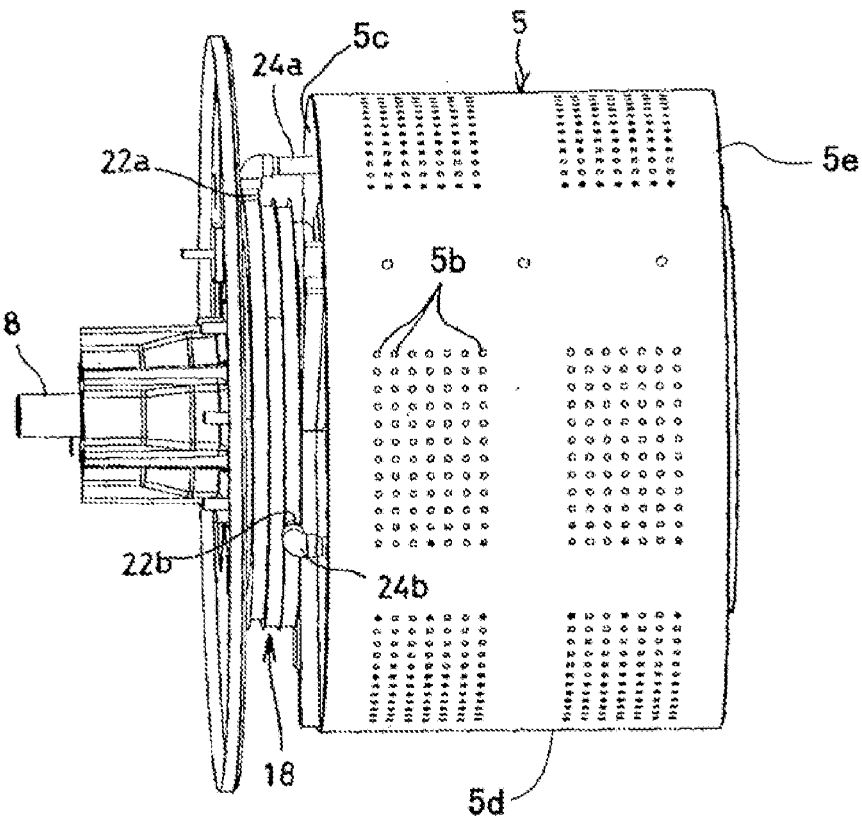

FIG. 5

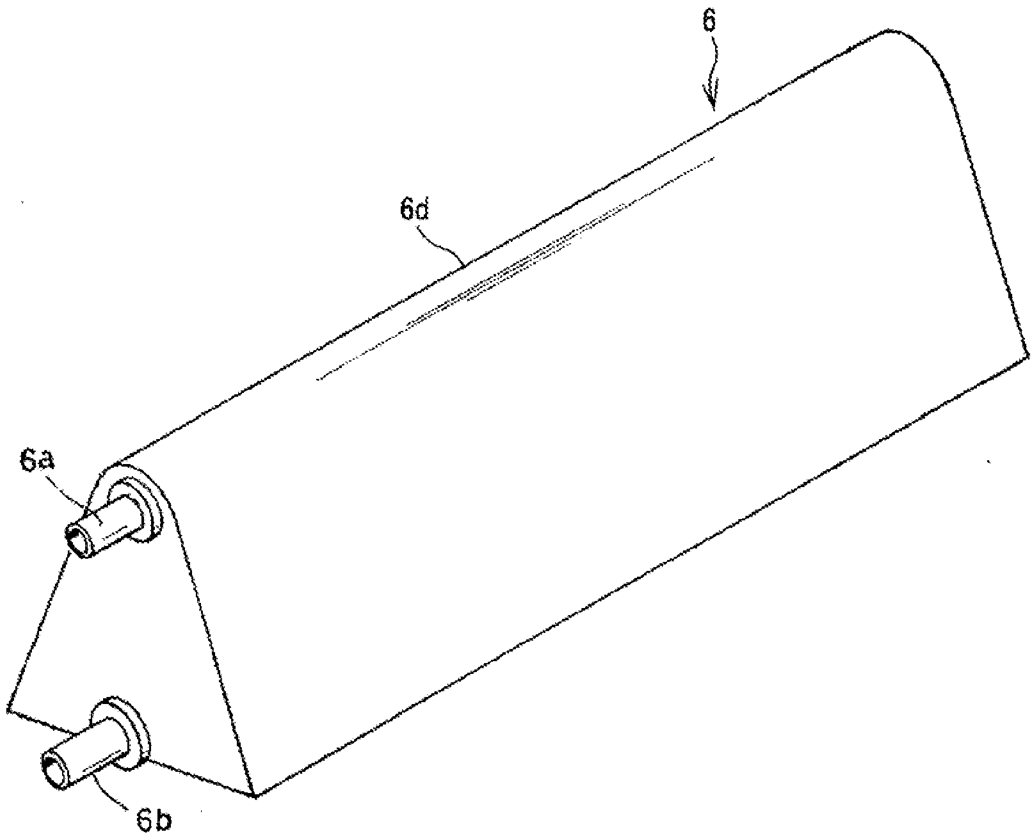

FIG. 6

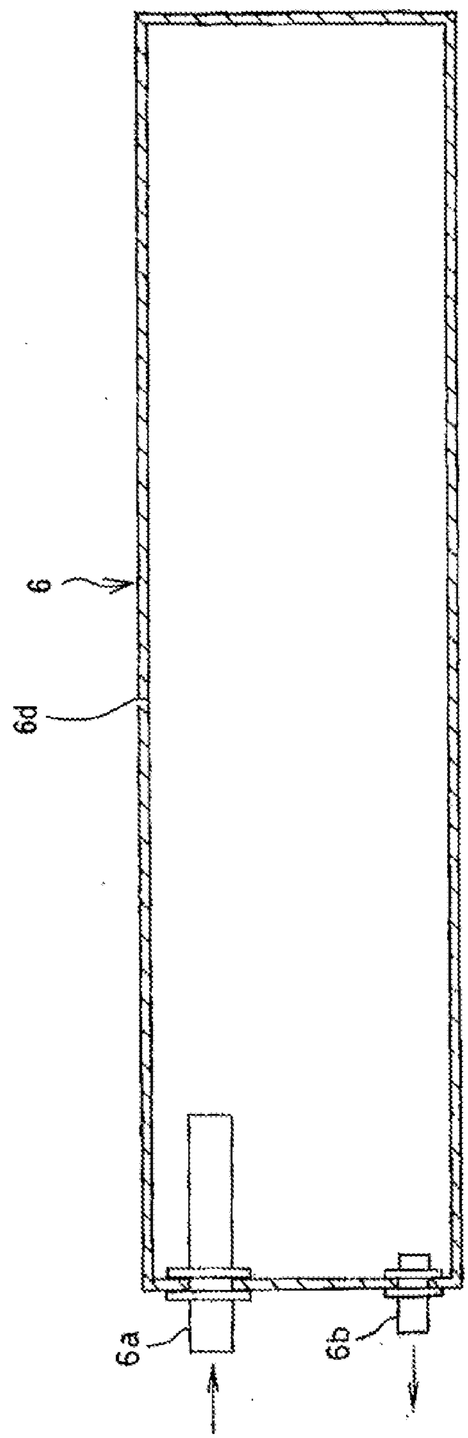

FIG. 7

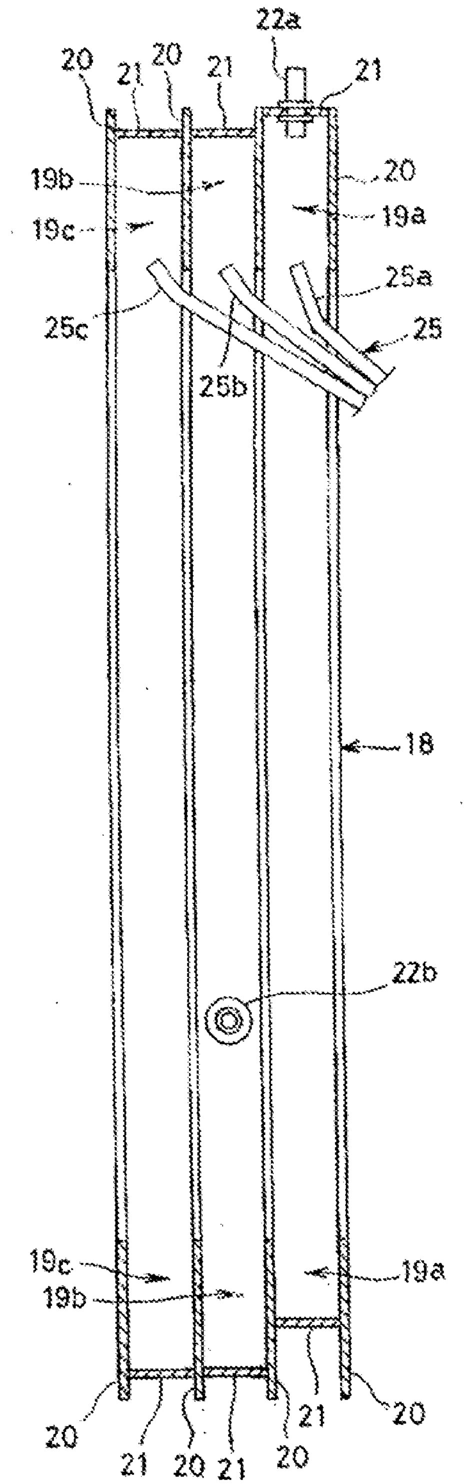
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FIG. 8

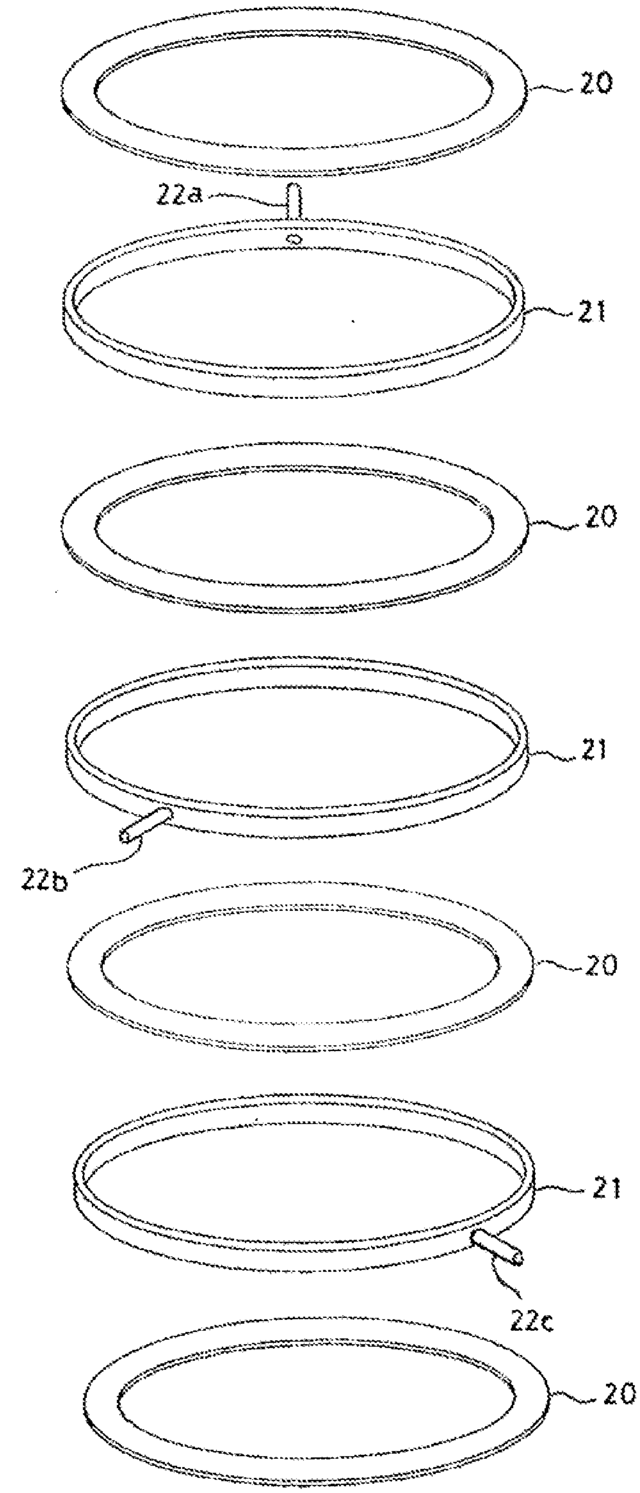


FIG. 9

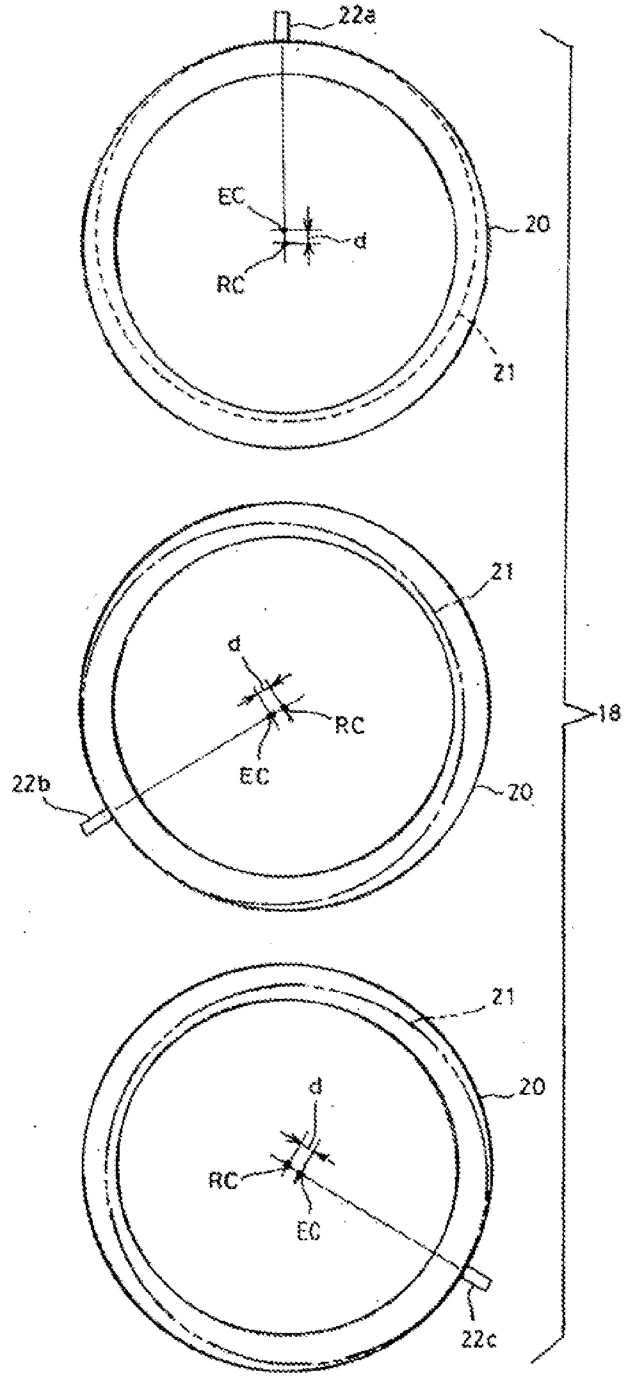


FIG. 10

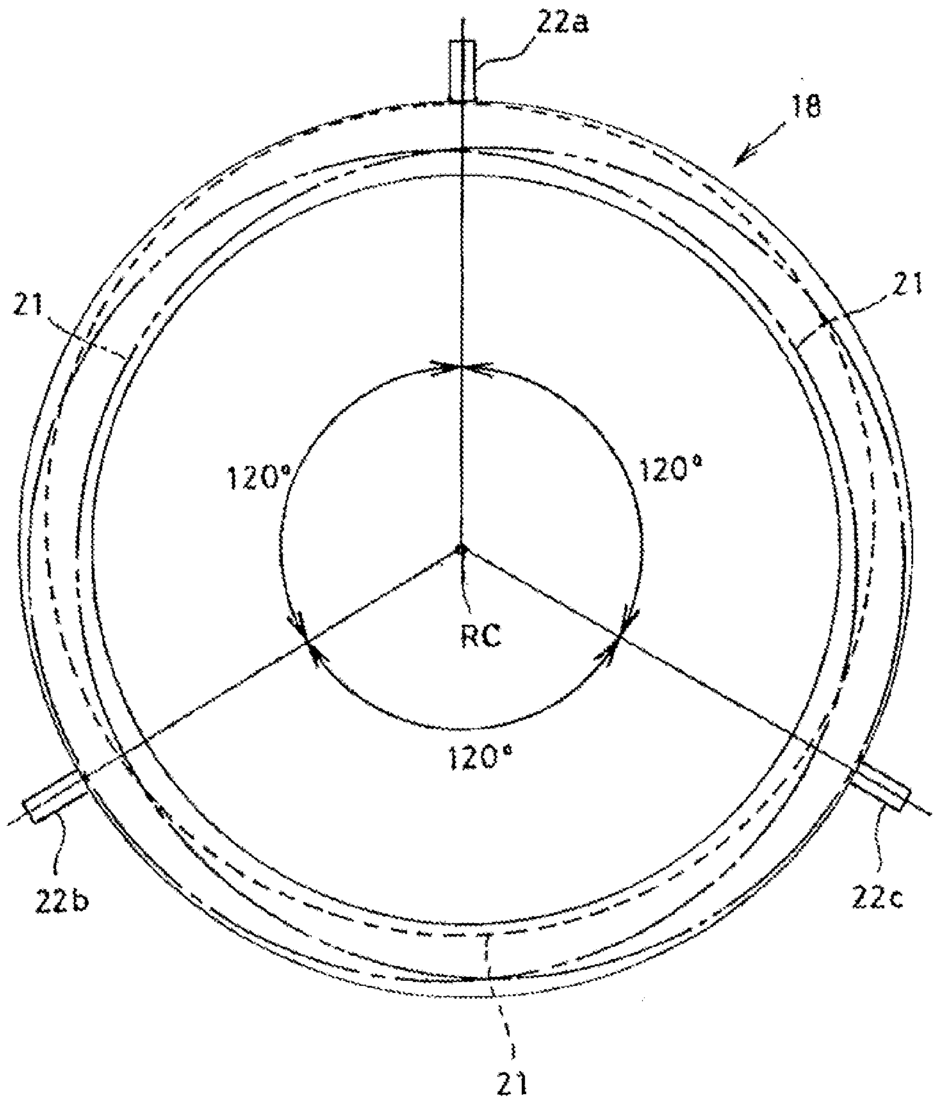


FIG. 11

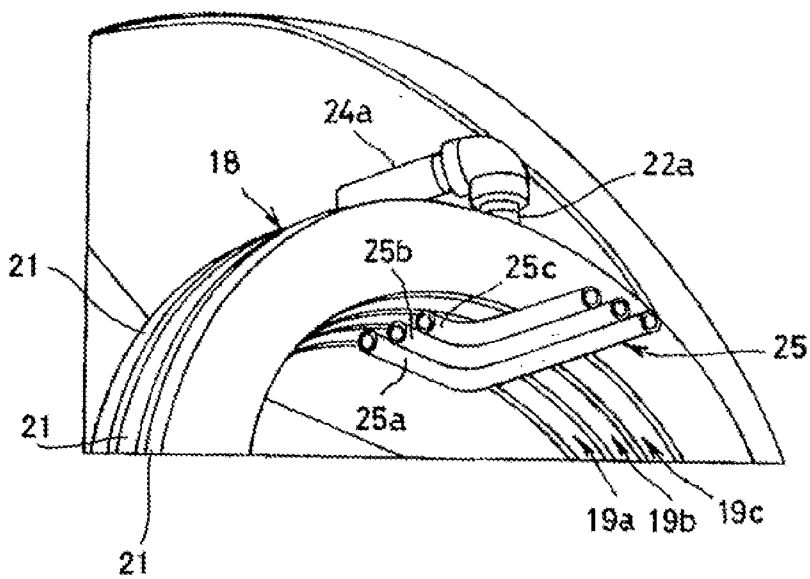
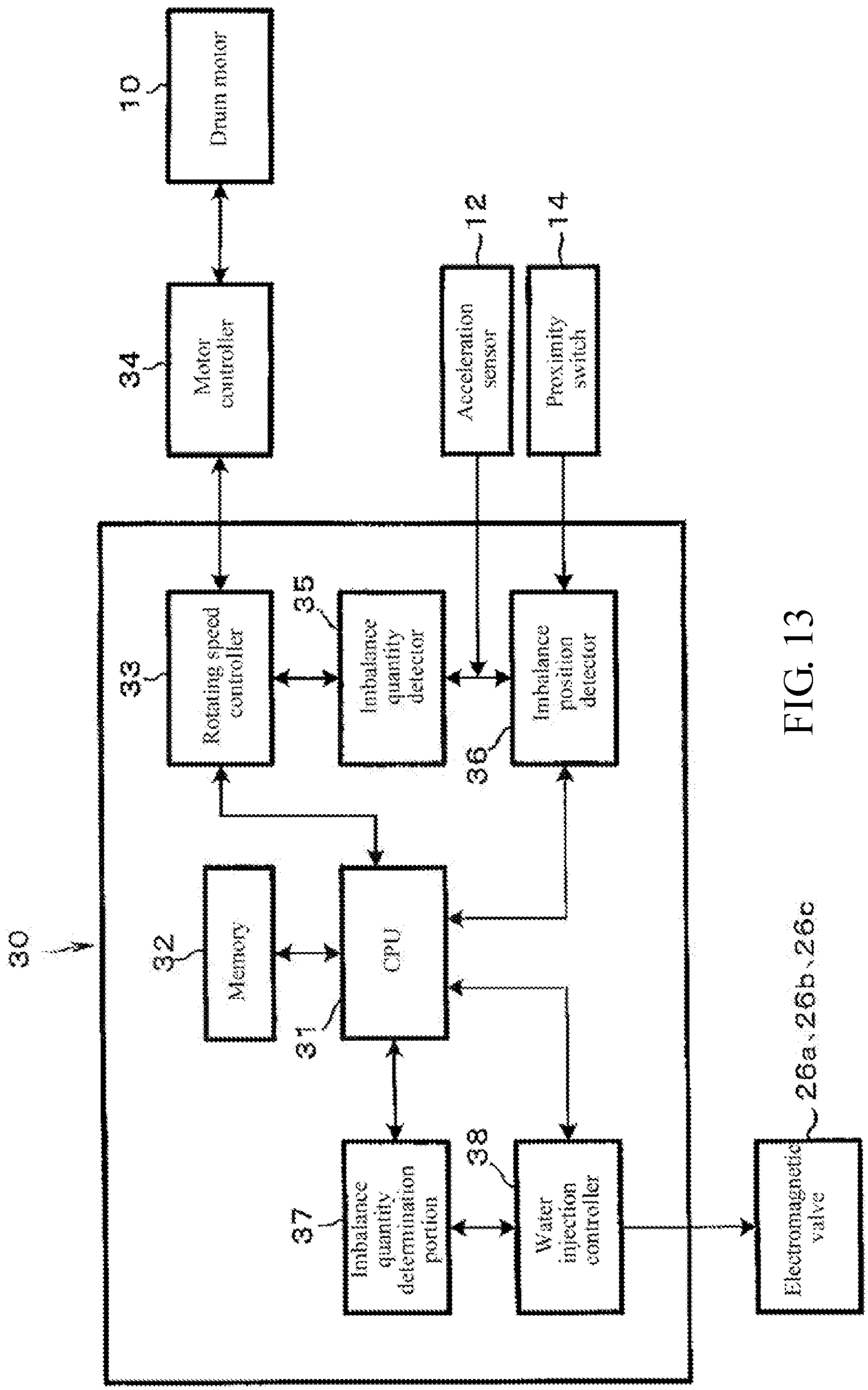


FIG. 12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Drum motor
34
Motor controller
12
Acceleration sensor
14
Proximity switch
30
33
Rotating speed controller
35
Imbalance quantity detector
36
Imbalance position detector
32
Memory
31
CPU
37
Imbalance quantity determination portion
38
Water injection controller
26a, 26b, 26c
Electromagnetic valve

FIG. 13

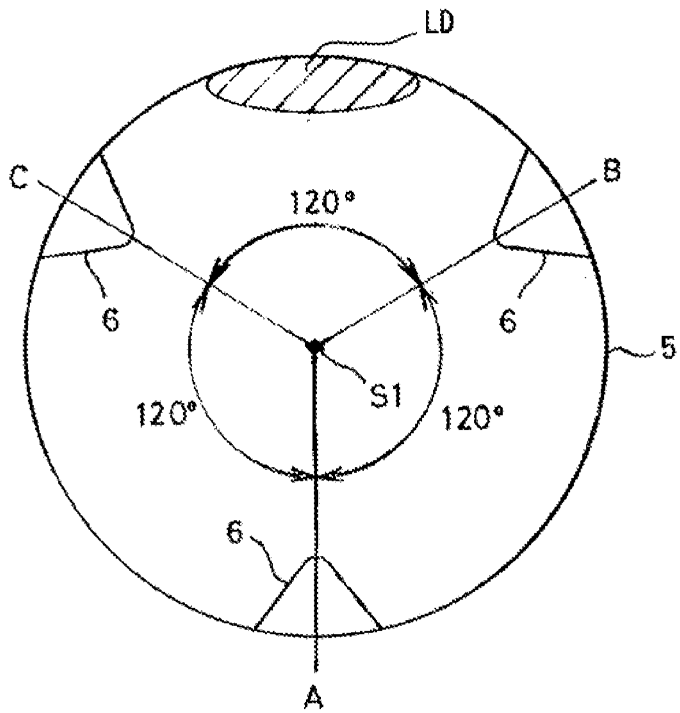

FIG. 14

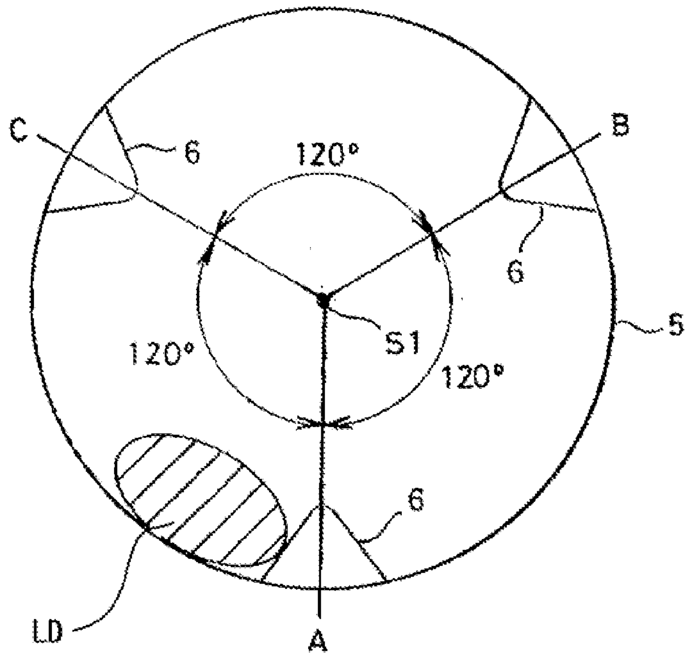

FIG. 15

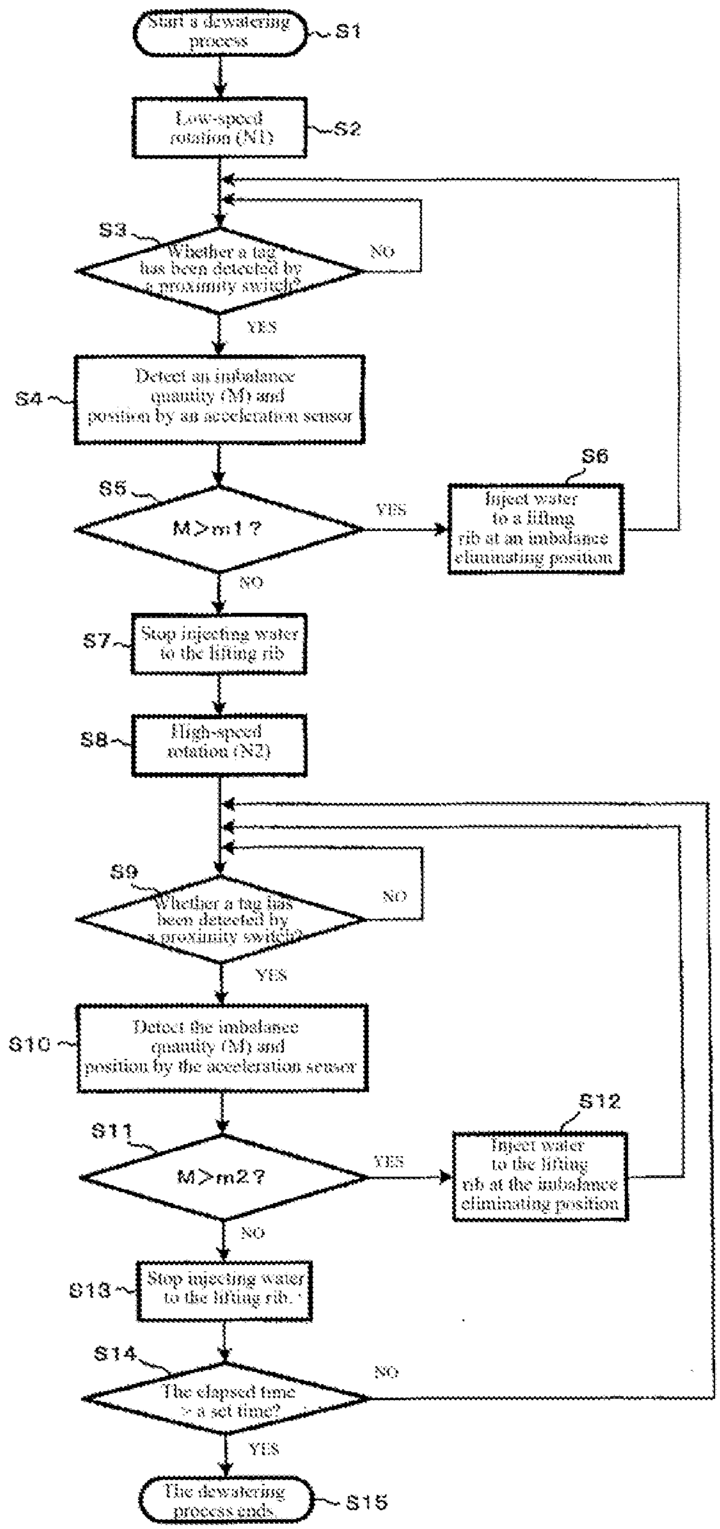
Start a dewatering process
S1
Low-speed rotation (N1)
S2
S3
Whether a tag has been detected by a proximity switch?
NO
YES
S4
Detect an imbalance quantity (M) and position by an acceleration sensor
S5
M>m1?
YES
S6
Inject water to a lifting rib at an imbalance eliminating position
NO
S7
Stop injecting water to the lifting rib
S8
High-speed rotation (N2)
S9
Whether a tag has been detected by a proximity switch?
NO
YES
S10
Detect the imbalance quantity (M) and position by the acceleration sensor
S11
M>m2?
YES
S12
Inject water to the lifting rib at the imbalance eliminating position
NO
S13
Stop injecting water to the lifting rib.
S14
The elapsed time > a set time?
NO
YES
The dewatering process ends
S15

FIG. 16

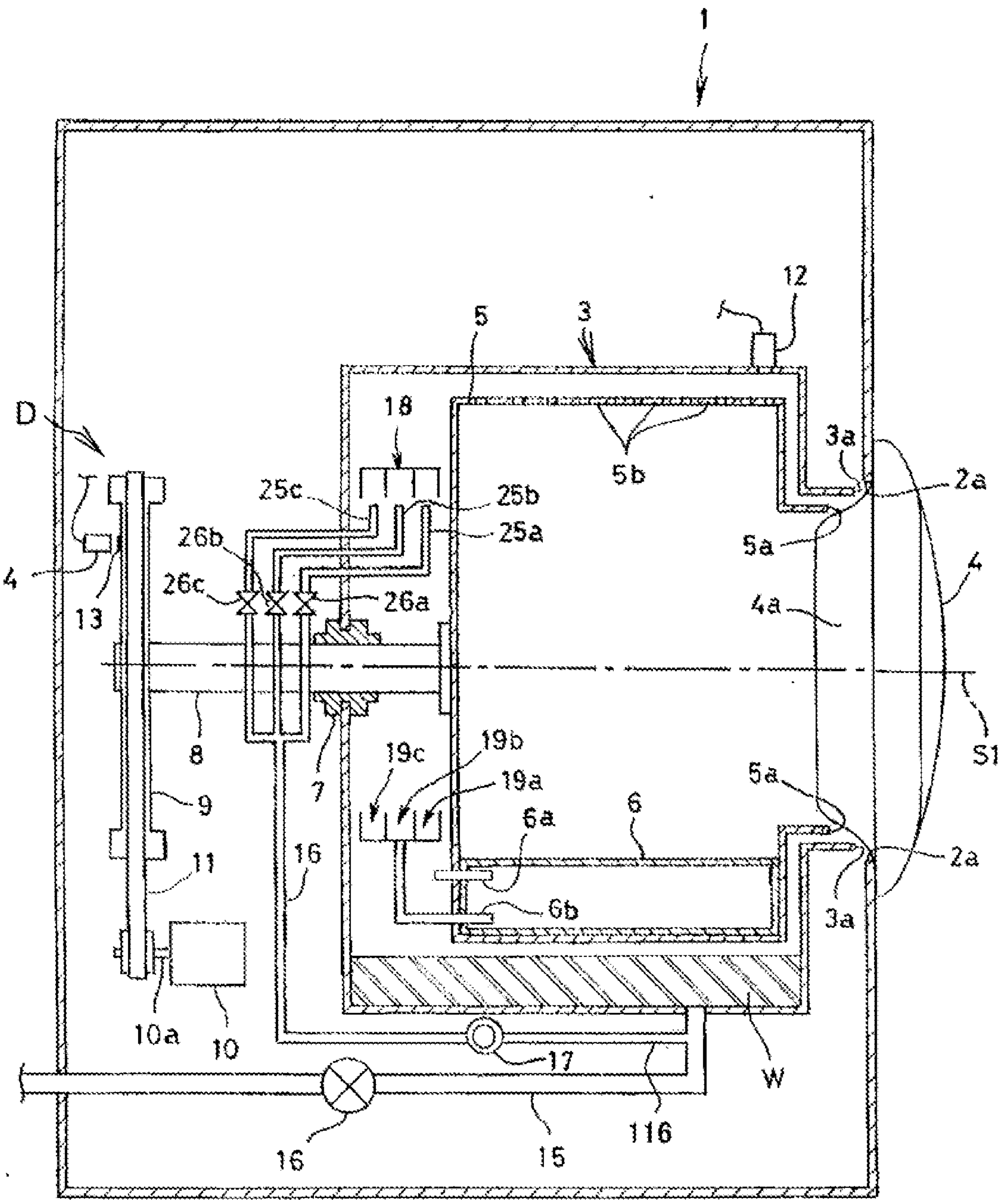
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FIG. 17

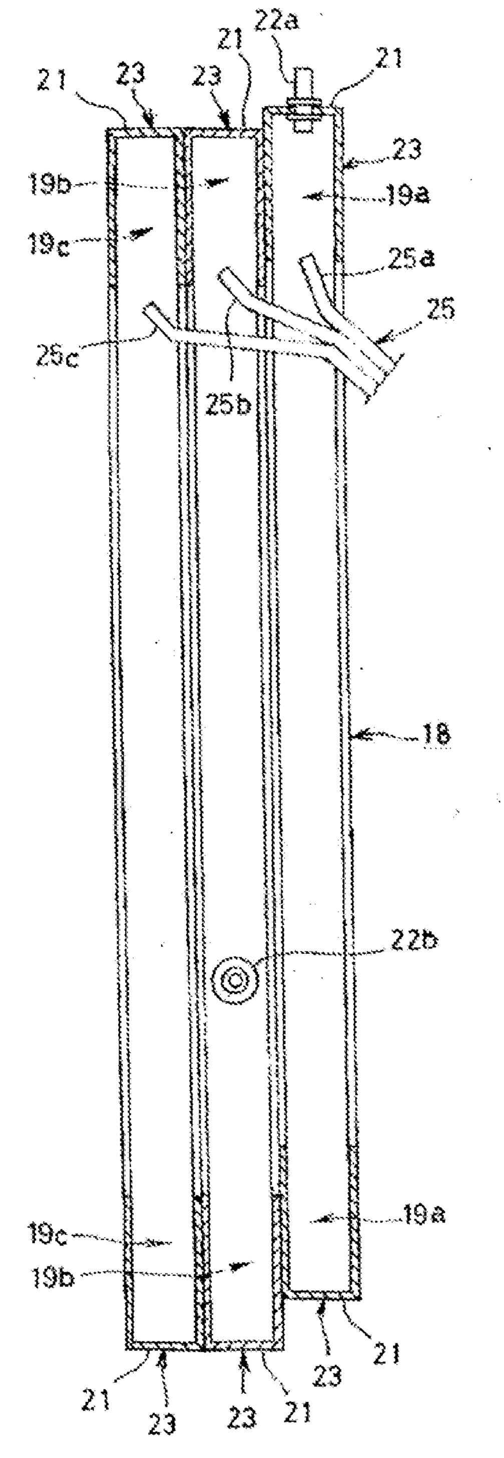
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FIG. 18

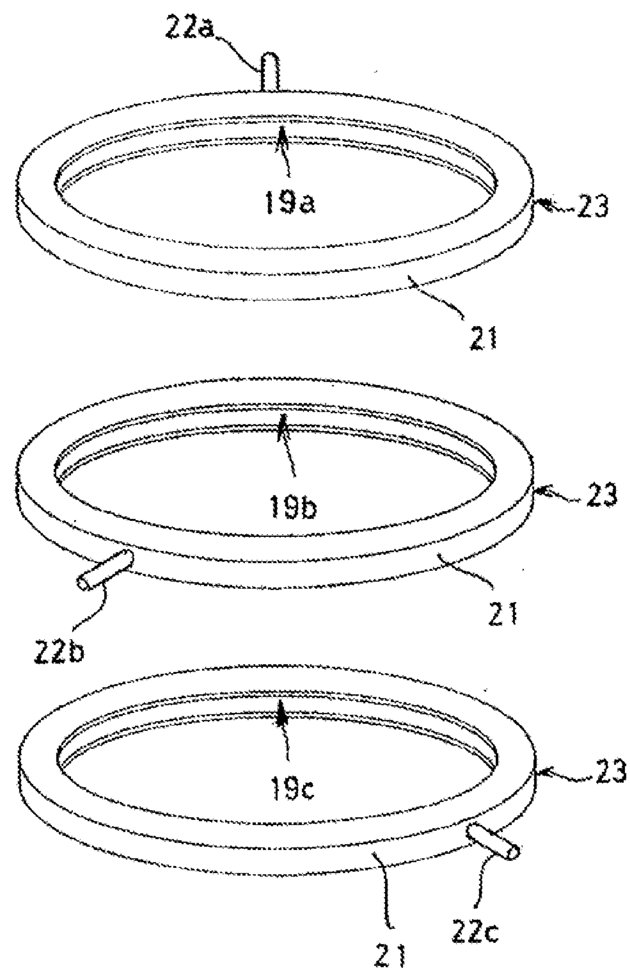

FIG. 19

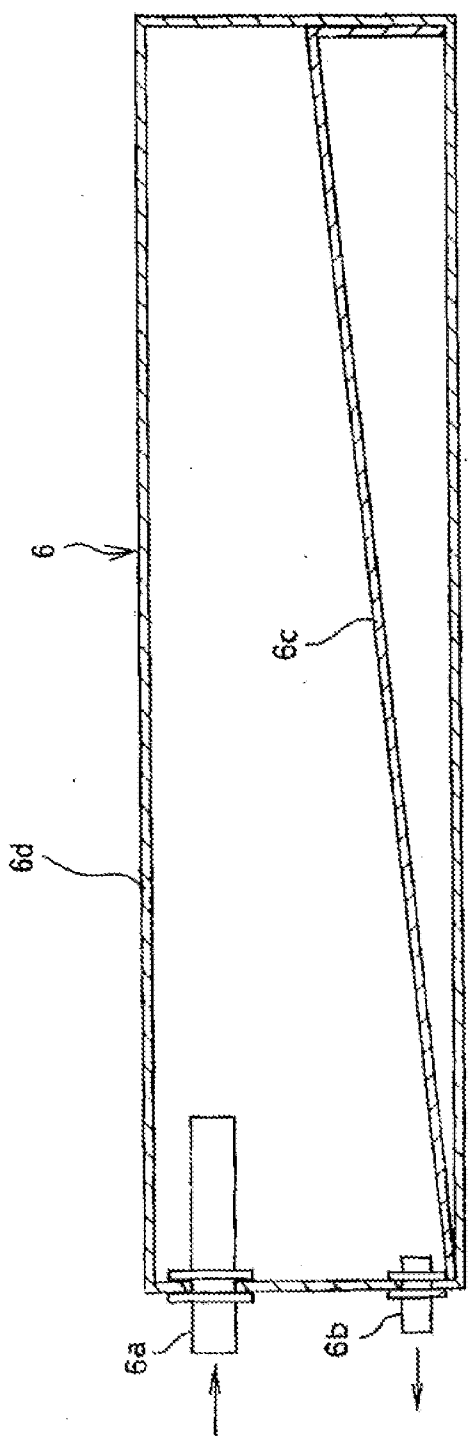

FIG. 20

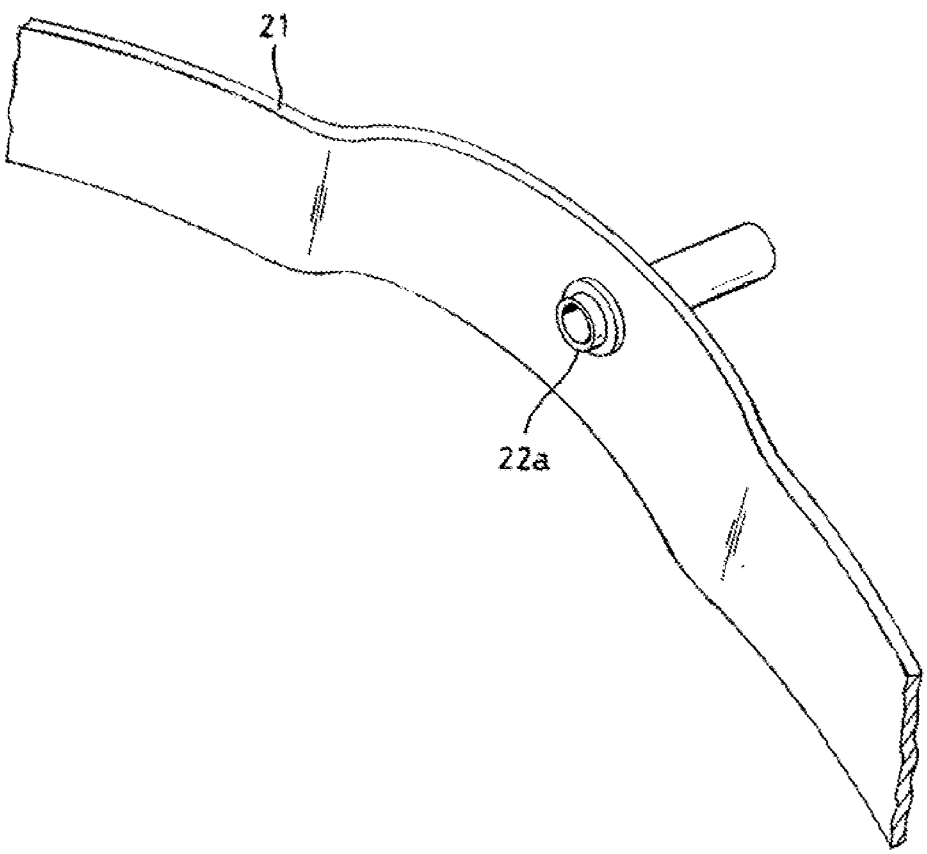

FIG. 21

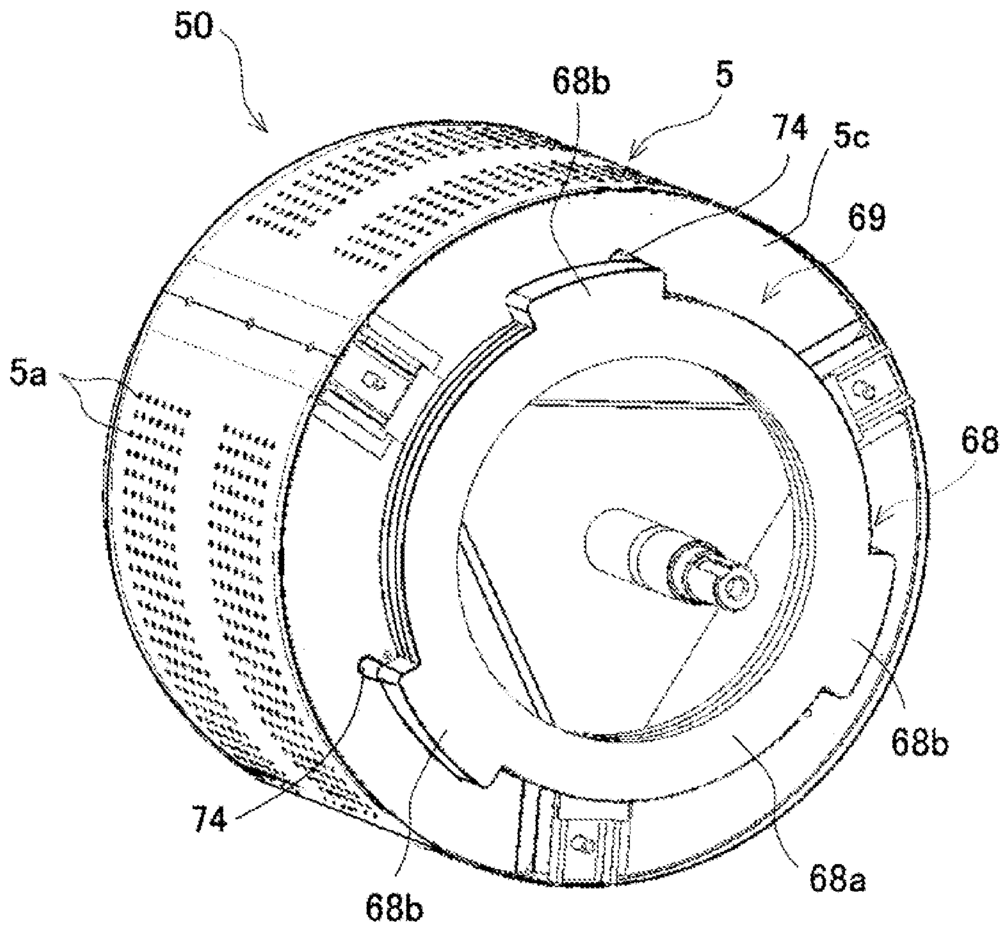

FIG. 22

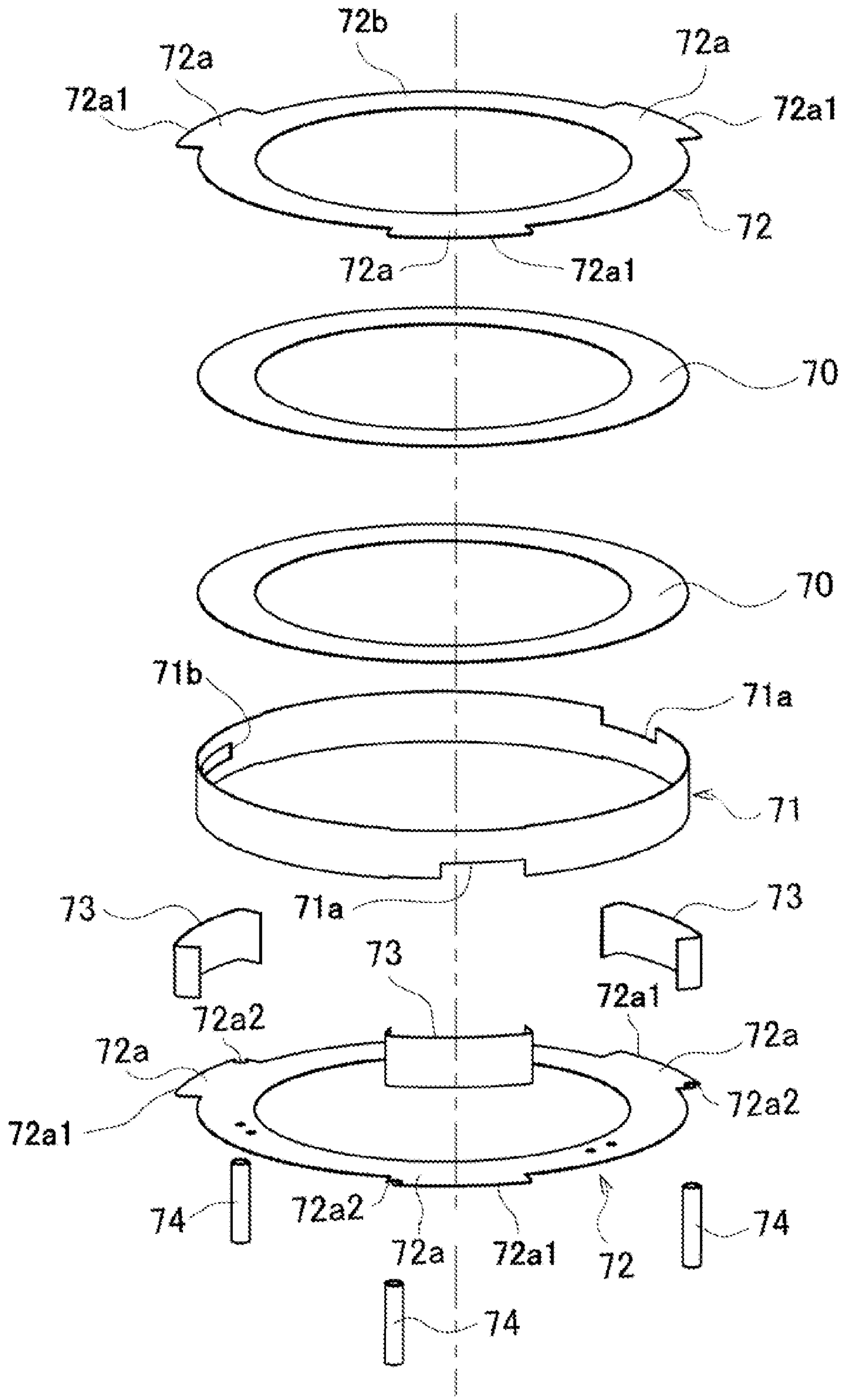
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FIG. 23

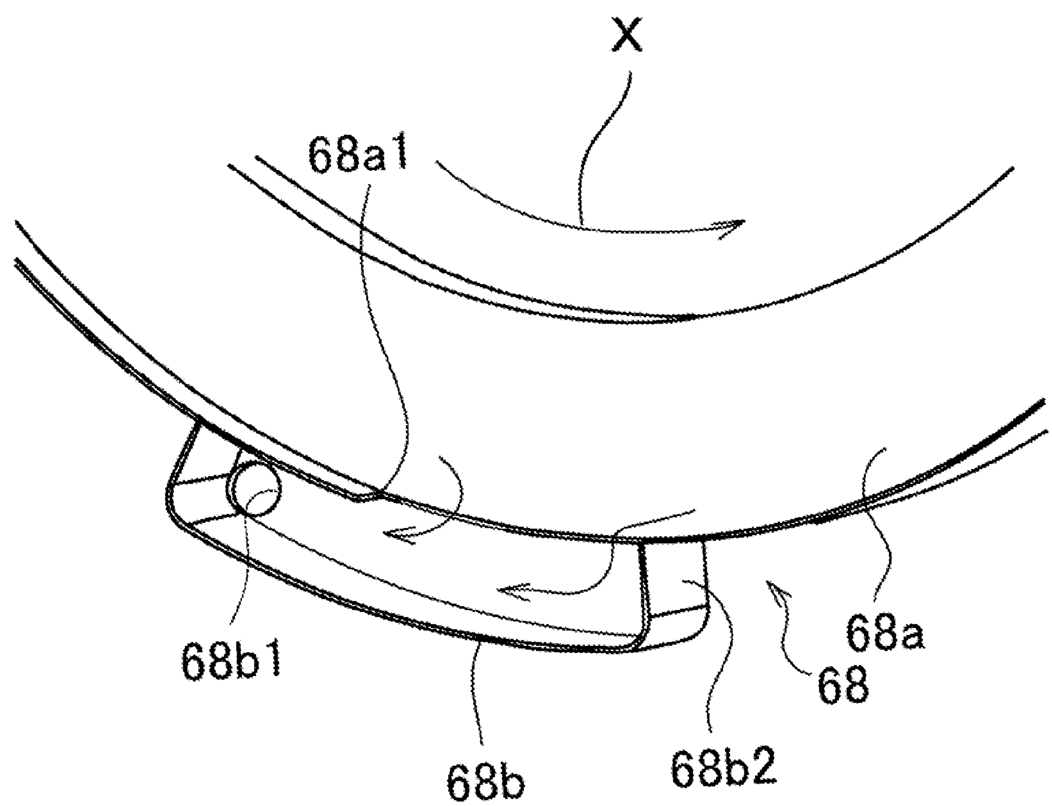


FIG. 24

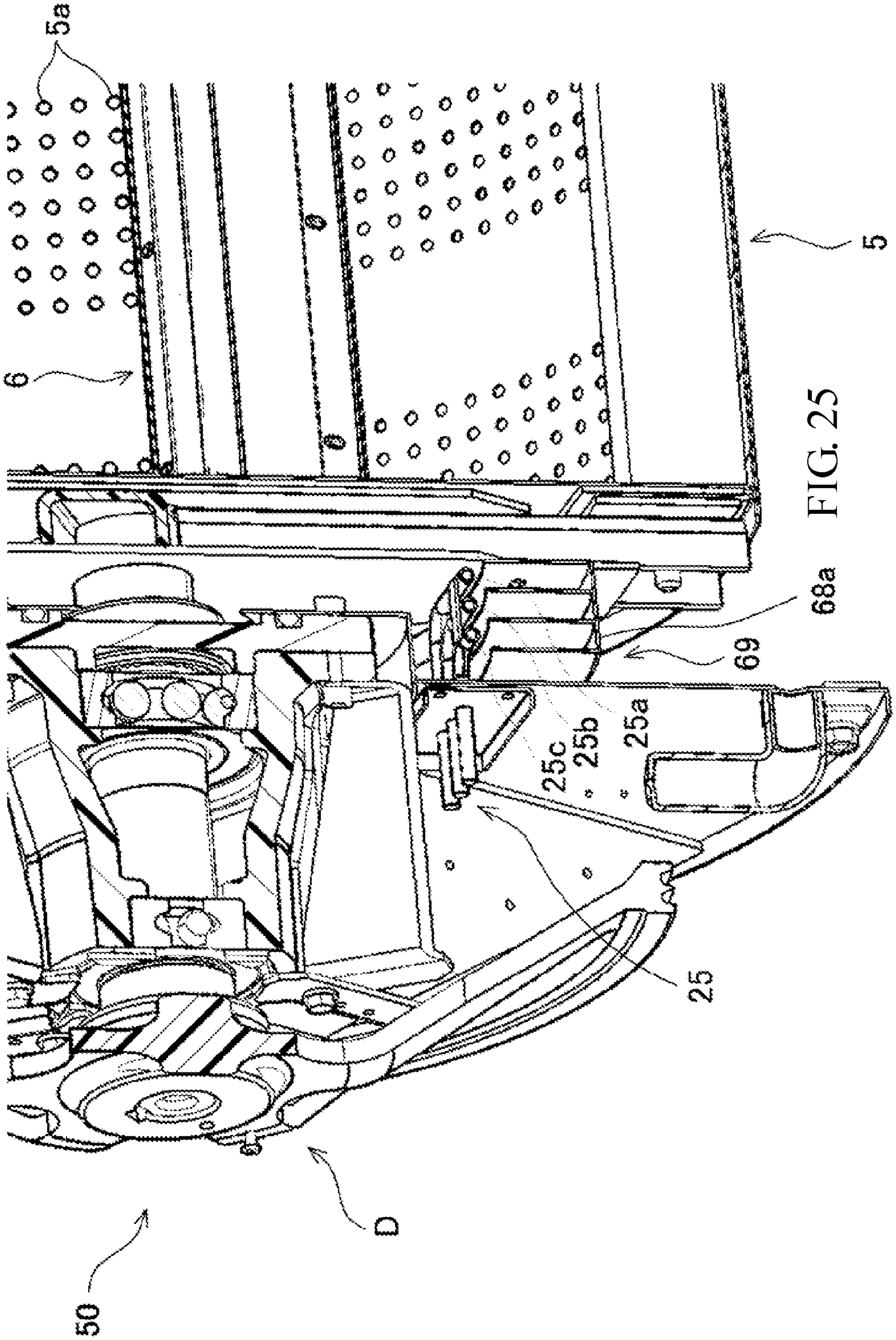


FIG. 25

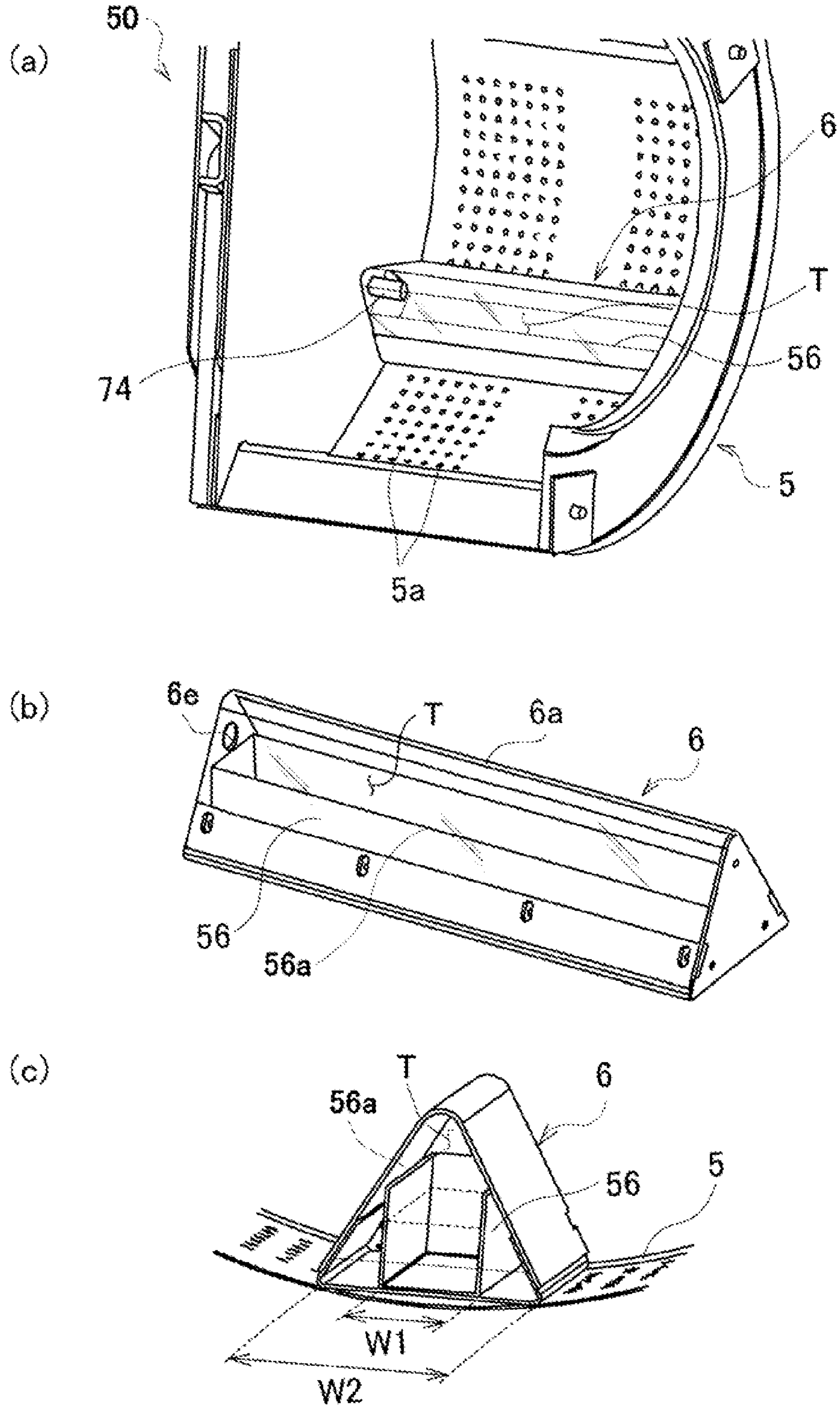
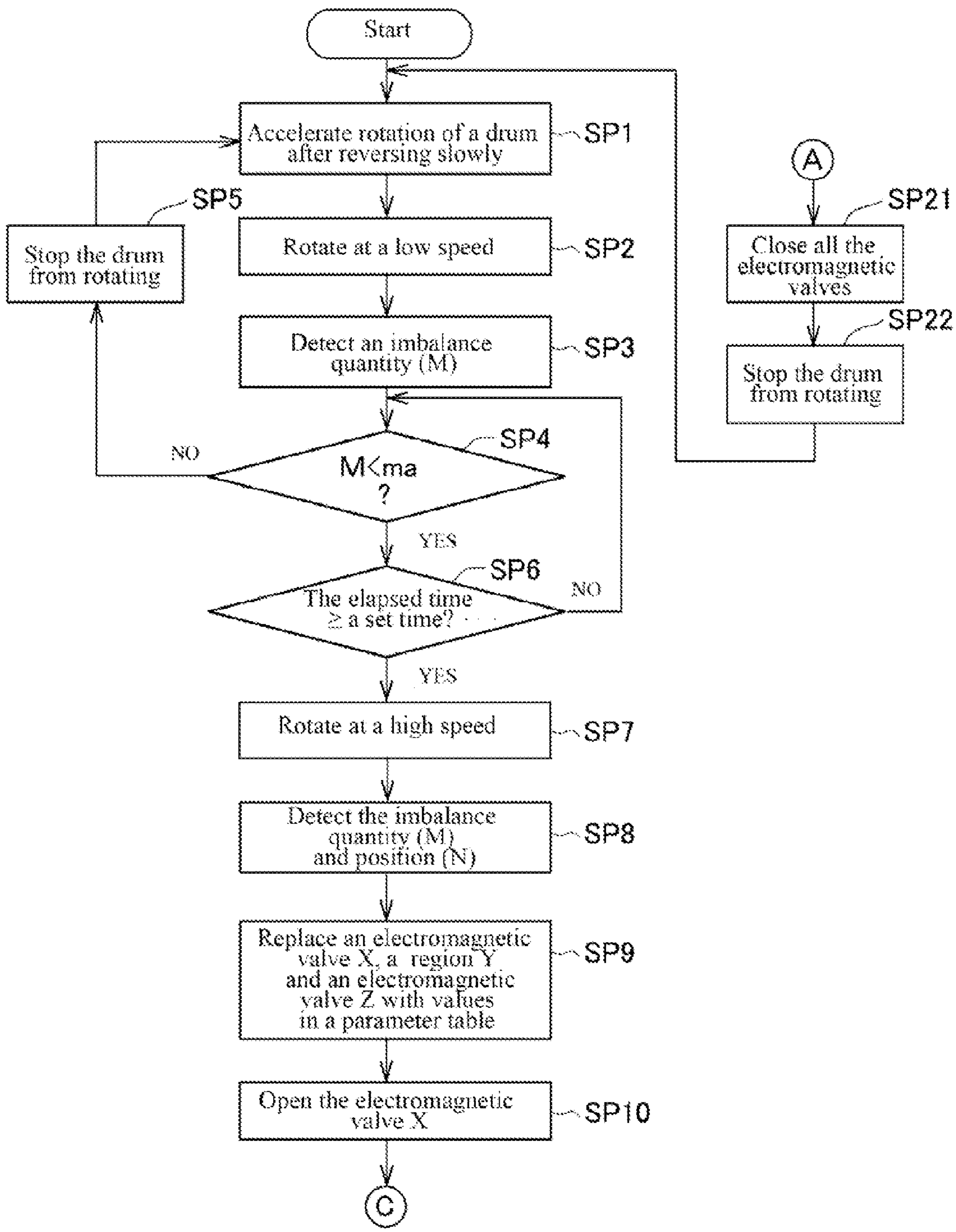


FIG. 26



Start
Accelerate rotation of a drum after reversing slowly
SP1
Rotate at a low speed
SP2
Detect an imbalance quantity (M)
SP3
M<ma ?
SP4
NO
YES
Stop the drum from rotating
SP5
The elapsed time ≥ a set time?
SP6
NO
YES
Rotate at a high speed
SP7
Detect the imbalance quantity (M) and position (N)
SP8
Replace an electromagnetic valve X, a region Y and an electromagnetic valve Z with values in a parameter table
SP9
Open the electromagnetic valve X
SP10
C
A
Close all the electromagnetic valves
SP21
Stop the drum from rotating
SP22

FIG. 27

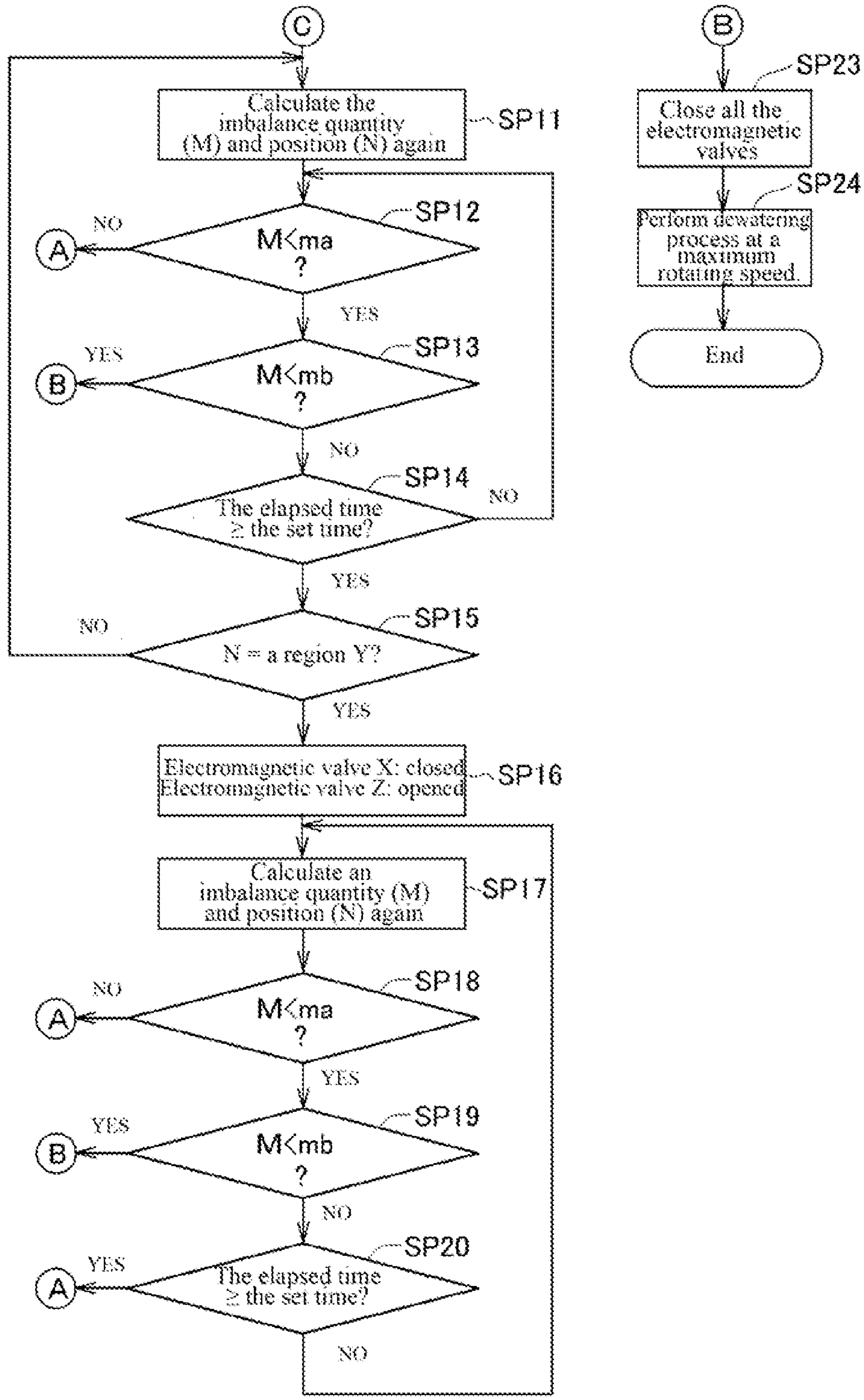
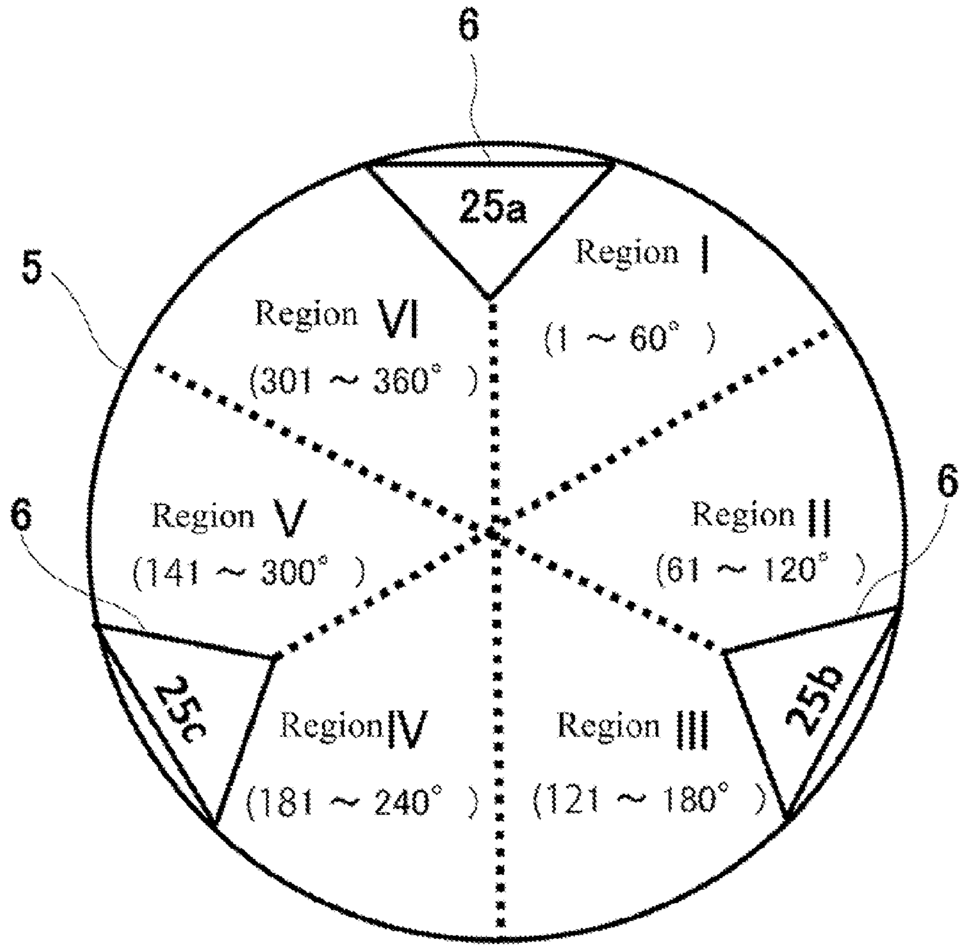

C
Calculate the imbalance quantity (M) and position (N) again
SP11
M<ma ?
SP12
NO
A
YES
M<mb ?
SP13
YES
B
NO
The elapsed time ≥ the set time?
SP14
NO
YES
N = a region Y?
SP15
NO
YES
Electromagnetic valve X: closed
Electromagnetic valve Z: opened
SP16
Calculate an imbalance quantity (M) and position (N) again
SP17
M<ma ?
SP18
NO
A
YES
M<mb ?
SP19
YES
B
NO
The elapsed time ≥ the set time?
SP20
YES
A
NO
B
Close all the electromagnetic valves
SP23
Perform dewatering process at a maximum rotating speed.
SP24
End

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

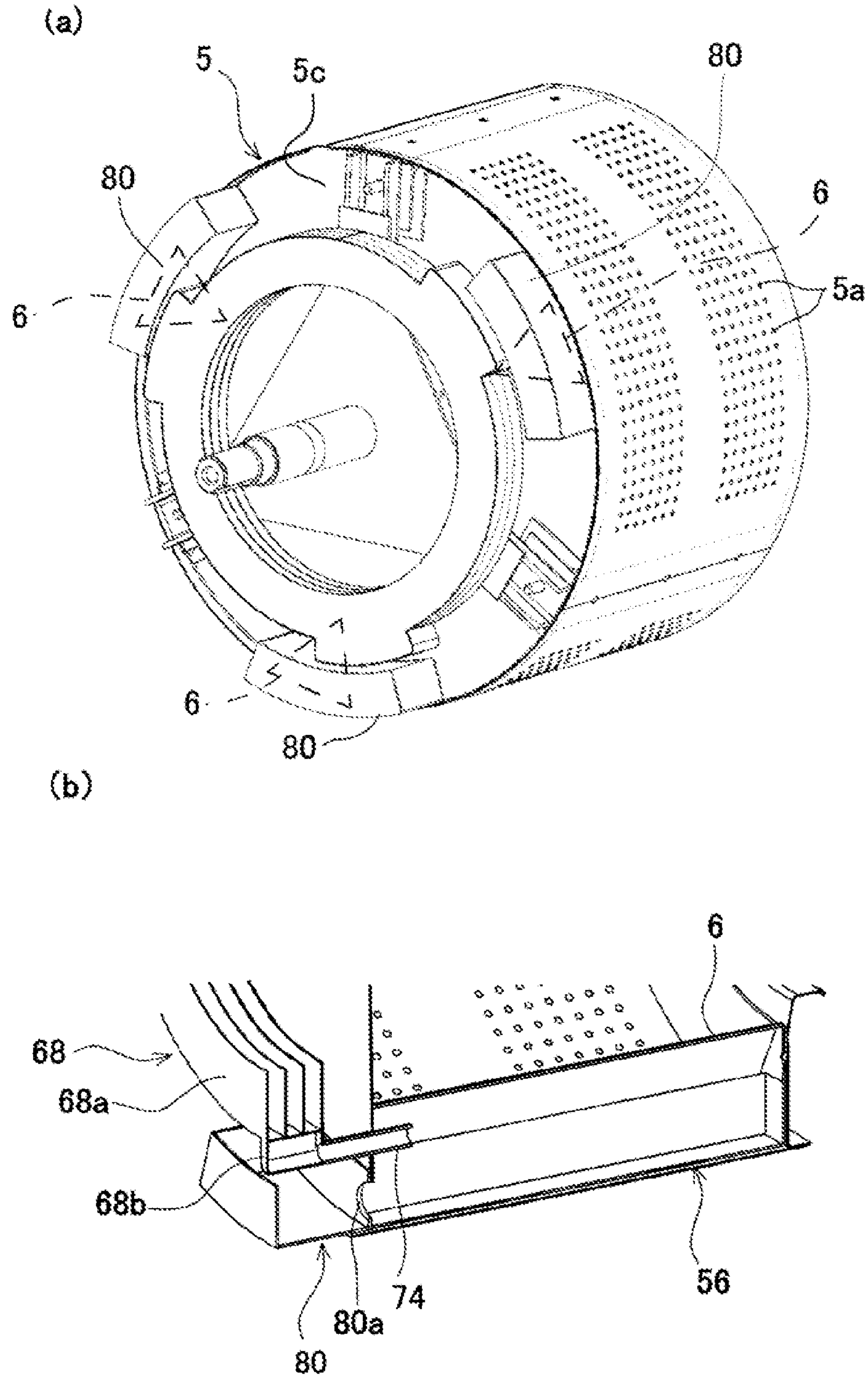


FIG. 30

WASHING MACHINE

FIELD OF THE INVENTION

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

BACKGROUND OF THE INVENTION

[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

[0007] Patent Literature 2: Japanese Laid-Open Patent Publication No. 2009-82558

SUMMARY OF THE INVENTION

Problems to be Solved

[0008] 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.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] 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.

[0013] 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

[0014] 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 corresponding to the water guiding grooves; and a nozzle unit for separately injecting adjustment water into the water guiding grooves.

[0015] 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

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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 THE DRAWINGS

[0031] FIG. **1** is a front view illustrating an appearance of a washing machine **1** according to a first embodiment of the present disclosure;

[0032] FIG. **2** is a schematic view illustrating an internal structure of the washing machine **1** of the present disclosure;

[0033] 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;

[0034] 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;

[0035] FIG. **5** is a side view illustrating the rotating drum **5** adopted by the washing machine **1** of the present disclosure;

[0036] 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;

[0037] 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;

[0038] 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;

[0039] FIG. **9** is a perspective view illustrating an assembly of the water receiving ring unit **18** in FIG. **8**;

[0040] FIG. **10** is a view illustrating a structure of the water receiving ring unit **18** in FIG. **8**;

[0041] FIG. **11** is a view illustrating an assembled state of the water receiving ring unit **18** in FIG. **8**;

[0042] FIG. **12** is a view illustrating a state of injecting adjustment water into a nozzle unit **25** of the water receiving ring unit **18**;

[0043] FIG. **13** is a block view illustrating an electrical system of the washing machine **1** of the present disclosure;

[0044] FIG. **14** is a view illustrating an imbalance state of the rotating drum **5**;

[0045] FIG. **15** is a view illustrating an imbalance state of the rotating drum **5**;

[0046] FIG. **16** is a flow chart illustrating a control flow of dewatering operation of the washing machine **1** of the present disclosure;

[0047] FIG. **17** is a schematic view illustrating an internal structure of a modified embodiment according to the first embodiment of the present disclosure;

[0048] 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;

[0049] FIG. **19** is a perspective view illustrating an assembly of the water receiving ring unit **18** shown in FIG. **18**;

[0050] FIG. **20** is a sectional view illustrating a modified embodiment of lifting ribs according to the first embodiment of the present disclosure;

[0051] 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;

[0052] 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;

[0053] FIG. **23** is an exploded perspective view illustrating a water receiving ring unit **69** shown in FIG. **22**;

[0054] 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 **68***b;*

[0055] FIG. **25** is a longitudinal sectional perspective view illustrating the washing machine **50** cut near the nozzle unit **25**;

[0056] FIG. **26** is a view illustrating a lifting rib **6** arranged in the rotating drum **5** of the washing machine **50**;

[0057] FIG. **27** is a flow chart illustrating a control flow of dewatering operation of the washing machine **50** according to the second embodiment;

[0058] FIG. **28** is a flow chart illustrating a control flow of dewatering operation of the washing machine **50** according to the second embodiment;

[0059] FIG. **29** is a view illustrating a control flow of dewatering operation of the same washing machine **50**; and

[0060] FIG. **30** is a view illustrating a modified embodiment of the washing machine **50** of the second embodiment.

DETAILED DESCRIPTION OF THE INVENTION

The First Embodiment

[0061] 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**.

[0062] 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 **2***a* 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 **2***a* and can be opened or closed freely, so as to maintain the opening in a closed state or an opened state.

[0063] 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 **3***b;* a cylindrical side wall **3***c* connected with an outer edge of the bottom **3***b;* an annular throttle portion **3***d* connected with the side wall **3***c;* and a cylindrical opening wall **3***e* connected with the throttle portion **3***d* and forming an opening **3***a* opposite to the opening **2***a* of the main body **2**. The outer drum **3** has an axis **51** extending in a substantially horizontal direction. The outer drum **3** is arranged so that the opening **3***a* is opposite to the opening **2***a* of the main body **2**.

[0064] 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 **5***c;* a cylindrical side wall **5***d* connected with an outer edge of the bottom **5***c;* an annular throttle portion **5***e* connected with the side wall **5***d;* and a cylindrical opening wall **5***f* forming an opening **5***a* connected with the throttle portion **5***e*. An axis center of the rotating drum **5** is consistent with the axis **51** of the outer drum **3**. A plurality of through holes **5***b* penetrating through the entire side wall **5***d* are formed in the side wall **5***d* of the rotating drum **5**.

[0065] The door body **4** is arranged on the opening **2***a* 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 **2***a* of the main body **2** so that a convex portion **4***a* on a back surface of the door body **4** enters the opening **3***a* of the outer drum **3** and the opening **5***a* of the rotating drum **5** to prevent the washings in the rotating drum **5** from flying out.

[0066] 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 **3***b* of the outer drum **3**. The bearing **7** is arranged at the center of the bottom **5***c* of the rotating drum **5**. One end of the main shaft **8** is fixed to the bottom **5***c* 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 S**1**.

[0067] The drum motor **10** has an output shaft **10***a*. The transmission belt **11** is erected between the belt pulley **9** and the output shaft **10***a*. 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**.

[0068] 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**.

[0069] 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**.

[0070] As shown in FIG. **6**, the lifting rib **6** includes: a lifting rib body **6***d;* a tubular rod **6***a* connected with any one of water passing components **24***a,* **24***b* and **24***c* shown in FIG. **4** for supplying adjustment water described later; and a tubular rod **6***b* 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 S**1** (with reference to FIG. **2**). Each lifting rib body **6***d* is formed as a hollow body triangularly protruding from the side wall **5***d* of the rotating drum **5** to the axis S**1**, 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°.

[0071] 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 Si as the above structure. It should be noted that the tubular rod **6***b* 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**.

[0072] 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**.

[0073] 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 **19***a,* **19***b* and **19***c* with an opened inner circumferential surface and an outer circumferential surface closed by a bottom plate along the direction of the axis Si (with reference to FIG. **2**) of the rotating drum **5**.

[0074] 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 **19***a,* **19***b* and **19***c* 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.

[0075] 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 **22***a,* **22***b* and **22***c* connected with the water passing components **24***a,* **24***b* and **24***c* (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 S**1** (with reference to FIG. **2**) of the rotating drum **5**. Thus, each of the bottom plates **21** of each of the water guiding grooves **19***a,* **19***b* and **19***c* is eccentrically configured about the axis S**1** of the rotating drum **5** at the angle difference of 120°.

[0076] The tubular rods **22***a,* **22***b* and **22***c* of the water receiving ring unit **18** adopting the above structure are connected with one end of the water passing components **24***a,* **24***b* and **24***c* as shown in FIG. **4** respectively, and the other ends of the water passing components **24***a,* **24***b* and **24***c* are connected to the tubular rods **6***a* of the lifting ribs **6** respectively. It should be noted that the lifting ribs **6** are mounted to the water passing components **24***a,* **24***b* and **24***c* 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.

[0077] With such a structure, when the adjustment water is injected into the water guiding grooves **19***a,* **19***b* and **19***c* 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 **19***a,* **19***b* and **19***c* flows down to the tubular rods **22***a,* **22***b* and **22***c* while being subjected to a load in the centrifugal direction.

[0078] The water receiving ring unit **18** is provided with three water guiding grooves **19***a,* **19***b* and **19***c* 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 **19***a*, **19***b* and **19***c* having the axis Si 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 **19***a,* **19***b* and **19***c* 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.

[0079] The adjustment water injected into the water guiding grooves **19***a,* **19***b* and **19***c* 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 **22***a,* **22***b* and **22***c* to the lifting ribs **6** through the water passing components **24***a,* **24***b* and **24***c.* 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.

[0080] 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 **6***b* by the gravity.

[0081] Next, a nozzle unit **25** for injecting the adjustment water into the water guiding grooves **19***a*, **19***b* and **19***c* 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 **25***a*, **25***b* and **25***c* configured toward the bottom plates **21** of the water guiding grooves **19***a*, **19***b* and **19***c* as shown in FIG. **12**. The nozzles **25***a*, **25***b* and **25***c* 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 **25***a*, **25***b* and **25***c*, the adjustment water is injected along curved surfaces of the bottom plates **21** of the water guiding grooves **19***a*, **19***b* and **19***c*, thus the adjustment water will not scatter in the water guiding grooves **19***a*, **19***b* and **19***c* and can be injected successfully.

[0082] The adjustment water is tap water supplied to the nozzles **25***a*, **25***b* and **25***c* through electromagnetic valves **26***a*, **26***b* and **26***c* shown in FIG. **2**. It should be noted that the electromagnetic valves **26***a*, **26***b* and **26***c* can also be reversing electromagnetic valves.

[0083] 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.

[0084] 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**.

[0085] 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**.

[0086] 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 **26***a*, **26***b* and **26***c* 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 **25***a*, **25***b* and **25***c* to the water guiding grooves **19***a*, **19***b* and **19***c* 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**.

[0087] 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.

[0088] 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.

[0089] <Step S1>

[0090] 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.

[0091] <Step S2>

[0092] 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.

[0093] <Step S3>

[0094] 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.

[0095] <Step S4>

[0096] 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 S**5**.

[0097] <Step **5**>

[0098] In step S**5**, 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 S**6**. When M is not greater than m1, the process proceeds to step S**7**. 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 S**5**, 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.

[0099] <Step S**6**>

[0100] In step S**6**, 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 **26***a* to **26***c* opened in the initial step S**6** kept opened.

[0101] 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 **26***a* to **26***c* 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.

[0102] 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 **26***a* to **26***c* 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.

[0103] <Step S7>

[0104] In step S7, the CPU notifies the water injection controller **38** of an instruction for closing the electromagnetic valves **26***a* to **26***c*, and stops supplying the adjustment water to the lifting ribs. Then, the process proceeds to step S**8**. It should be noted that the electromagnetic valves **26***a* to **26***c* are in a closed state when step S6 is not carried out, so the process directly proceeds to step S**8** without any operation.

[0105] <Step S8>

[0106] In step S**8**, 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.

[0107] <Step S9>

[0108] In step S**9**, 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 S**10**. When it is determined that the sensor tag **13** has not been detected by the proximity switch **14**, step S**9** is repeated.

[0109] <Step S**10**>

[0110] In step S**10**, 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 S**11**.

[0111] <Step S**11**>

[0112] In step S**11**, 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 S**12**. When M is not greater than m2, the process proceeds to step S**13**.

[0113] 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 S**11**, 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 m**2** 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.

[0114] <Step S12>

[0115] In step S**12**, 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 **26***a* to **26***c* opened in the initial step **12** kept opened.

[0116] Specifically, when the detection result of the imbalance position in step S**10** 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 **26***a* to **26***c* 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.

[0117] In addition, when the detection result of the imbalance position in step S**10** 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 **26***a* to **26***c* 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 S**9**.

[0118] <Step S13>

[0119] In step S**13**, the CPU **31** notifies the water injection controller **38** of the instruction for closing the electromagnetic valves **26***a* to **26***c*, and stops supplying the adjustment water to the lifting ribs **6**. Then, the process proceeds to step S**14**. It should be noted that the electromagnetic valves **26***a* to **26**c are in the closed state when step S**12** is not carried out, so the process directly proceeds to step S**8** without any operation.

[0120] <Step S**14**>

[0121] In step S**14**, 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 S**15**. When the elapsed time does not exceed the set time for the dewatering operation, the process returns to step S**9**.

[0122] <Step **15**>

[0123] 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.

[0124] 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.

[0125] 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.

[0126] 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 **25**a, **25**b and **25**c through the electromagnetic valves **26**a, **26**b and **26**c.

[0127] It should be noted that a structure that the water receiving ring unit **18** is composed of three water guiding grooves **19**a, **19**b and **19**c 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.

[0128] As described in detail above, the washing machine **1** of the present disclosure can provide the adjustment 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.

[0129] 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**.

[0130] The water receiving ring unit **18** adopts a water guiding groove integrally formed a circular water guide ring **23** having a "コ"-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 **19**a, **19**b and **19**c, thereby forming a water receiving ring unit **18**A. The water guide rings **23** formed in this way have the same shape. Therefore, similar to the first embodiment, the water guiding grooves **19**a, **19**b and **19**c are eccentrically configured at the angle difference of 120° about the axis S1 of the rotating drum **5**; and the tubular rods **22**a, **22**b and **22**c 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.

[0131] 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 **6**c 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 **6**b. At this time, the inclined plate **6**c 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**.

[0132] 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 **22**a, **22**b and **22**c, so as to improve retention of the adjustment water.

The Second Embodiment

[0133] FIGS. **22-26** are views illustrating a washing machine **50** of the second embodiment of the present disclosure. 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.

[0134] 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 **68**a and bulging portions **68**b. The water guide bodies **68**a are components which have an annular shape, opened inner circumferential surfaces and substantially "コ"-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 **68***b* are formed from bottoms of the water guide bodies **68***a* in a circumferential direction at equal intervals in a protruding manner. The bulging portions **68***b* 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 **5***c* of the rotating drum **5** in an stacking state.

[0135] 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 **72***b* and protruding portions **72***a*, and bulging components **73** formed by two ends of bent belt-like plates.

[0136] Openings **71***b* or notches **71***a* 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 **71***b* are formed at central portions in an axis direction of the ring plates **71**. The notches **71***a* are formed at two ends in the axis direction of the ring plates **71**.

[0137] Each of the second side plates **72** includes: side plate bodies **72***b* having an outer circumference and an inner circumference substantially the same as those of the first side plates **70** in length; and protruding portions **72***a* protruding to radial outer side of the side plate bodies **72***b*. The protruding portions **72***a* are formed at a plurality of (three in the present embodiment) positions in the circumferential direction of the side plate bodies **72***b* in an approximately rectangular shape in which protruding ends **72***a***1** outline a gentle arc. In addition, an arc-shaped notch **72***a***2** constituting a water passing port **68***b***1** described later is formed at one end side of the protruding end **72***a***1** of the protruding portion **72***a* of one of the pair of second side plates **72**. The notch **72***a***2** is connected with a water passing component **74**.

[0138] These plates are integrated in such a manner that the protruding portions **72***a* are overlapped with the openings **71***b* or the notches **71***a*, 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 **72***a* and **72***a*. 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 **68***b* are formed by the protruding portions **72***a* and the bulging components **73** are stacked, thereby forming the water receiving ring unit **69**.

[0139] FIG. **24** is a local sectional perspective view illustrating the water guiding grooves **68** cut in cross section positions including the bulging portions **68***b*. The bulging portions **68***b* 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 **68***a***1** communicated with interiors of the water guide bodies **68***a* on a lagging side in the rotating direction X of the rotating drum **5**. The connecting openings **68***a***1** are opened to a degree greater than the water passing ports **68***b***1**, and are opened at about two thirds of the bulging portions **68***b* from one end of each of the bulging portions **68***b* to the rotating direction X.

[0140] The adjustment water is injected into the water guiding groove body **68***a* 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 **68***a* rotating at a high speed, and most adjustment water may be retained at lower portions of the water guiding groove body **68***a*. Moreover, when the bulging portions **68***b* are rotated to positions of the lower portions constituting the water receiving ring unit **69**, the adjustment water flows down to the bulging portions **68***b* through the connecting openings **68***a***1**. Then, the adjustment water is pushed to side walls **68***b***2** of the bulging portions **68***b* located on the lagging side in the rotating direction X, smoothly flows into the water passing ports **68***b***1** 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.

[0141] In this way, the water guiding grooves **68** have the annular water guiding groove body **68***a* and the bulging portions **68***b* protruding from the water guiding groove body **68***a* to a radial outer side. The bulging portions **68** is provided with the openings **68a1** connected with the water guiding groove body **68***a* 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 **68***b* 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.

[0142] 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 **25***a* to **25***c* 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 **68***a* in the rotating direction X through the nozzles **25***a* to **25***c* 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 **68***a* 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.

[0143] 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.

[0144] 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 **6***e* 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 **56***a* of the separation components **56** as shown in FIG. **26**(*a*).

[0145] 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 **56***a* 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**.

[0146] 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.

[0147] 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**.

[0148] 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 SP**1**, 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.

[0149] <Step SP**1**>

[0150] In step SP**1**, the CPU **31** controls the rotating drum **5** to accelerate after the rotating drum **5** reverses slowly.

[0151] <Step SP**2**>

[0152] In step SP**2**, the CPU **31** controls the rotating drum **5** to rotate at a low speed based on the low-speed rotation setting value (N1).

[0153] <Step SP**3**>

[0154] In step SP**3**, 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**.

[0155] <Step SP**4**>

[0156] In step SP**4**, 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 SP**6**. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP**5**. 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 SP**5** 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**.

[0157] <Step SP**5**>

[0158] In step SP**5**, the process returns to step SP**1** after the rotation of the rotating drum **5** is stopped by the CPU **31**, and repeats the steps SP**1** to SP**4**.

[0159] <Step SP**6**>

[0160] In step SP**6**, the process proceeds to step SP**7** 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.

[0161] <Step SP**7**>

[0162] In step SP**7**, the CPU **31** controls the rotating drum **5** to rotate at the high speed based on the high-speed rotation setting value (N2).

[0163] <Step SP**8**>

[0164] In step SP**8**, 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**.

[0165] <Step SP**9**>

[0166] In step SP**9**, 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 positional relationship relative to the lifting ribs **6** is schematically shown. The lifting rib **6** marked as **25***a* indicates the lifting rib **6** which is supplied with the adjustment water through the nozzle **25***a* shown in FIG. **25**. Similarly, the lifting rib **6** marked as **25***b* indicates the lifting rib **6** which is supplied with the adjustment water through the nozzle **25***b* shown in FIG. **25**; and the lifting rib **6** marked as **25***c* indicates the lifting rib **6** which is supplied with the adjustment water through the nozzle **25***c* shown in FIG. **25**.

[0167] <Step SP**10**>

[0168] In step SP**10**, 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 **25***c* 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.

[0169] <Step SP**11**>

[0170] In step SP**11** 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**.

[0171] <Step SP**12**>

[0172] In step SP**12**, 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 SP**13**. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP**21** 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 SP**21**.

[0173] <Step SP**13**>

[0174] In step SP**13**, 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 SP**23** described later. On the other hand, when it is determined that M is not less than mb, the process proceeds to step SP**14** 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 SP**23**.

[0175] <Step SP**14**>

[0176] In step SP**14**, 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 SP**15**. Herein, the set time is a time required for one lifting rib **6** being filled with the adjustment water.

[0177] <Step SP**15**>

[0178] In step SP**15**, 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 SP**16**. When it is determined that the imbalance position (N) is not the region Y, the process returns to step SP**11**. For example, if the initial imbalance position (N) in step SP**11** 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 SP**16**. Since a result of the recalculation in step SP**16** 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 **25***c* is increased, and the imbalance position (N) is changed to the region Y when step SP**15** is repeated multiple times.

[0179] <Step SP**16**>

[0180] In step SP**16**, 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.

[0181] For example, when the initial imbalance position (N) is the region I, the electromagnetic valve X is the electromagnetic valve **25***c* corresponding to the lifting rib **6** arranged opposite to the region I, and the electromagnetic valve Z is the electromagnetic valve **25***b* 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 **25***c*. 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.

[0182] <Step SP**17**>

[0183] In step SP**17**, 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**.

[0184] <Step SP**18**>

[0185] In step SP**18**, 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 SP**19**. On the other hand, when it is determined that M is not less than ma, the process proceeds to step SP**21** 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 SP**21**.

[0186] <Step SP**19**>

[0187] In step SP**19**, 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 SP**23** 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 SP**23**. On the other hand, when it is determined that M is not less than mb, the process proceeds to step SP**20**.

[0188] <Step SP**20**>

[0189] In step SP**20**, 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 SP**21**. On the other hand, the process returns to step SP**17** when it is determined that the elapsed time from which the electromagnetic valve Z is opened is not greater than the set time.

[0190] <Step SP**21**>

[0191] In step SP**21** shown in FIG. **27**, the CPU **31** enables all the electromagnetic valves X, Y and Z to be in the closed state.

[0192] <Step SP**22**>

[0193] In step SP**22**, the process returns to step SP**1** after the CPU **31** controls the rotating drum **5** to stop rotating.

[0194] 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 SP**21** and **22** are performed, and the dewatering process is restarted from the first step.

[0195] <Step SP**23**>

[0196] In step SP**23** shown in FIG. **28**, the CPU **31** enables all the electromagnetic valves X, Y and Z to be in the closed state.

[0197] <Step SP**24**>

[0198] In step SP**24** 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.

[0199] 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.

[0200] 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.

[0201] 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 **5***c* 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 **5***c* 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 **80***a*. 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 **80***a* when the rotating speed of the rotating drum **5** is reduced to reduce the centrifugal force.

[0202] In this way, the plurality of water storage tanks **80** as the water storage portions are mounted on the end surface in the axis **51** direction of the outer surface of the rotating drum **5**, specifically mounted on the bottom **5***c* 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.

[0203] 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.

[0204] 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

[0205] **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; **19***a*: water guiding groove; **19***b*: water guiding groove; **19***c*: water guiding groove; **20**: ring plate; **21**: bottom plate; **22***a*: tubular rod; **22***c*: tubular rod; **23**: water guide ring; **24***a*: water passing component; **24***b*: water passing component; **24***c*: water passing component; **25**: nozzle unit; **26***a*: electromagnetic valve; **26***b*: electromagnetic valve; **26***c*: electromagnetic valve; **30**: controller; **56**: separation component; **68**: water guiding groove; **68***a*: water guiding groove body; **68***a***1**: connecting opening; **68***b*: bulging portion; **74**: water passing component; **80**: water storage tank (water storage portion); and T: water storage region.

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 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 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**, 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 an 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**, 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**, 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**, 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.

9. The washing machine according to claim **1**, 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.

10. The washing machine according to claim **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.

11. The washing machine according to claim **10**, wherein the bottom plates are funnel-shaped at mounting positions of the water passing components for being mounted on the bottom plates.

12. The washing machine according to claim **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.

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

14. The washing machine according to claim **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.

15. The washing machine according to claim **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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