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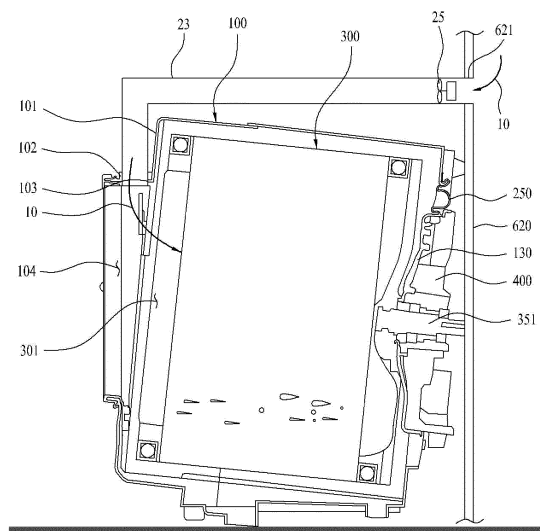
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(54) **WASHING DEVICE**

(57) The present invention relates to a washing device. The washing device comprises: a case; a tub supported by the case, the tub having a laundry entrance hole for taking laundry in or out in a front portion thereof and an external-air inflow hole for introducing external air therethrough; an external-air inflow tube passing through the case and connected to the external-air inflow hole so as to guide the external air outside the case into the external-air inflow hole; a drum having a laundry entrance hole corresponding to the laundry entrance hole of the tub, the drum being rotatably installed within the tub; a shaft connected to a rear portion of the drum; a bearing housing rotatably supporting the shaft; and a suspension assembly for decreasing the vibration of the drum and of a driving part comprising a motor for rotating the shaft. Thus, the washing device may be structured for increased washing capacity, and a pressurized environment within the tub may be improved so as to prevent the drum from being moved forward.

FIG. 3



Description

[Technical Field]

[0001] The present invention relates to a washing device and, more specifically, to a washing device provided with an improved structure to increase laundry capacity and preventing forward movement of a drum with an improved internal pressure environment of a tub.

[Background Art]

[0002] In general, a washing device is an appliance that removes various contaminants from clothing and bedding using the softening effect of the detergent, frictional effect of the water current according to rotation of the pulsator or drum and impact applied to the laundry. Electronic washing devices recently introduced automatically perform a series of operations of washing, rinsing and spin-drying without manipulation by the user during the operations.

[0003] Recently, demand for a drum type washing device has been increasing since the drum type washing device has a height less than that of a pulsator washing device, which has a washing tub rotating at an upright position, and rarely causes entanglement and creases of the laundry.

[0004] The drum type washing device generally includes a cabinet body forming the external appearance of the washing device, a tub arranged inside the cabinet body by being supported by a damper and a spring and configured to store washing water, and a cylindrical drum positioned inside the tub to allow laundry to be placed therein. The drum receives driving force from a driving unit to wash the laundry introduced into the drum.

[0005] The drum type washing device configured as above inevitably causes vibration due to rotational force of the drum and maldistribution of the laundry when the drum is rotated to wash and spin-dry the laundry in the drum. The vibration occurring during rotation of the drum is transferred to external parts through the tub and cabinet.

[0006] Accordingly, a spring and a damper to absorb and suppress vibration are essentially provided between the tub and the cabinet to prevent vibration transferred from the drum to the tub from being transferred to the cabinet.

[0007] In often cases, the drum type washing device as described above is installed in an existing installation environment (e.g., a sink environment or a built-in environment) rather than being separately installed. Accordingly, the size of the drum type washing device needs to be limited according to the installation environment where the washing device is installed.

[0008] In the case of the drum type washing device as described above, changing the internal structure of the washing device is limited by the structures of the spring and damper arranged between the tub and the cabinet

to suppress vibration. In addition, as the installation environments for the washing device are limited, changing the size of the washing device is limited.

[0009] Meanwhile, a lot of researches are recently being conducted to increase the laundry capacity of the washing device to handle the increased amount of laundry and provide convenience to the users. However, due to the constraints as described above, increasing the size of the tub to increase the laundry capacity is very difficult in the structure of a conventional drum type washing device.

[0010] In addition, when the drum of the drum type washing device rotates at high speed, flow of a gaseous fluid is created in the drum and the tub. Thereby, a pressure gradient may be created around the drum. This pressure gradient may cause the drum to move forward.

[0011] In a structure designed to allow the tub and drum to vibrate together, forward movement of the drum may not frequently occur. However, in the case that the tub is substantially separated from the drum in view of kinematics, the extent of forward movement of the drum may increase, and further the drum moving forward may strike the inner wall of the tub, causing problems.

[0012] Accordingly, washing devices having various structures to increase the laundry capacity and washing devices to prevent collision between the tub and the drum are currently being developed.

[Disclosure]

[Technical Problem]

[0013] An object of the present invention devised to solve the problem lies in a washing device which may increase the capacity of the tub with an improved support structure to support a tub and a drum. Specifically, an object of the present invention is to provide a drum type washing device which provides a support structure preventing transfer of vibration from the drum to the tub and have a new structure to support the drum in a shock-absorbing manner.

[0014] An object of the present invention is to provide a washing device which provides an improved pressure environment in the tub by adjusting the air pressure in the tub such that collision between the drum and the tub is prevented.

[Technical Solution]

[0015] The object of the present invention can be achieved by providing a washing device including a case, a tub supported by the case, the tub having a laundry entrance hole for taking in and out laundry at a front portion thereof and an external air introduction hole for introducing external air therethrough, an external air introduction tube passing through the case and connected to the external air introduction hole in order to guide the external air outside the case into the external air intro-

duction hole, a drum having, at a front portion thereof, a laundry entrance hole corresponding to the laundry entrance hole of the tub, the drum being rotatably installed within the tub, a driving unit including a shaft connected to a rear portion of the drum, a bearing housing rotatably supporting the shaft, and a motor for rotating the shaft, and a suspension assembly for attenuating vibration of the drum.

[0016] Preferably, the external air introduction hole is formed at a front of the tub, and the external air introduction tube is connected to the external air introduction hole and inclined upward as the external air introduction tube extends rearward in a longitudinal direction of the tub.

[0017] The external air introduction tube is preferably provided with a condensing plate to condense moisture contained in air flowing backward through the external air introduction tube.

[0018] Preferably, the washing device further includes a foam sensing means located within the tub and the external air introduction tube to sense foam produced in the tub.

[0019] Preferably, the washing device further includes a controller to control operation of the motor according to a result of sensing by the foam sensing means.

[0020] Preferably, the washing device further includes an air-blowing fan installed in a passage of the external air introduction tube to forcibly blow the external air into the external air introduction hole during operation of a spin-drying cycle.

[0021] Preferably, the washing device further includes a heater to heat the external air moving to the tub through the external air introduction tube.

[0022] Preferably, the tub further includes an exhaust part to discharge the external air introduced into the tub through the external air introduction tube.

[0023] Preferably, the external air introduction hole is formed to have an area greater than an area of an exhaust hole of the exhaust part such that a discharge flow rate of the external air in the exhaust part is greater than an introduction flow rate of the external air in the external air introduction hole during a spin-drying cycle.

[0024] Preferably, the washing device further includes a valve installed in a flow passage of the external air to allow flow of the external air into the tub and to prevent the foam produced in the tub from flowing backward through the flow passage of the external air.

[0025] Preferably, the washing device further includes at least one plate having a plurality of holes installed in the flow passage of the external air to the foam produced in the tub from flowing backward through the flow passage of the external air.

[0026] The external air introduction hole is preferably located further forward than the laundry entrance hole of the drum.

[0027] The suspension assembly is preferably connected to the bearing housing.

[0028] Preferably, the tub has an opening at a rear portion thereof and further includes a rear gasket to seal a

gap between the opening and the driving unit and allow relative movement of the driving unit with respect to the tub.

[0029] Preferably, the tub is fixedly supported compared to the drum.

[Advantageous Effects]

[0030] A washing device according to one embodiment of the present invention may provide an improved support structure that prevents transfer of vibration of the drum to the tub, and increase the size of the tub since the drum and tub can be separately supported in a shock-absorbing manner.

[0031] In addition, improvement of the pressure environment in the tub may prevent forward movement of the drum through adjustment of pressure in the tub, thereby preventing shock from being applied to the drum and the tub.

[0032] In addition, in a pressure environment created to prevent forward movement of the drum, leakage of fluid such as foam from the tub may be prevented.

[Description of Drawings]

[0033]

FIG. 1 is a partial exploded perspective view illustrating a washing device according to one embodiment of the present invention;

FIG. 2 is a perspective view illustrating a suspension assembly according to an embodiment of the present invention;

FIG. 3 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a first embodiment of the present invention;

FIG. 4 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a second embodiment of the present invention;

FIG. 5 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a third embodiment of the present invention;

FIG. 6 is a partial cross-sectional view illustrating a valve of an external air introduction tube according to the third embodiment;

FIG. 7 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a fourth embodiment of the present invention;

FIG. 8 is a partial cross-sectional view illustrating installation of a plate of an external air introduction tube according to the fourth embodiment;

FIGs. 9 and 10 are views schematically illustrating the plate of the external air introduction tube according to the fourth embodiment;

FIG. 11 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a fifth embodiment of the present invention; and

FIG. 12 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a sixth embodiment of the present invention.

[Best Mode]

[0034] Hereinafter, a washing device according to one embodiment of the present invention will be described in detail. In describing the present invention, the adopted names of the constituents have been defined in consideration of functions thereof in the present invention. Accordingly, they should not be understood as limiting the constituents. The names adopted to define the constituents can be replaced with other names used in the art.

[0035] A washing device according to one embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

[0036] FIG. 1 is a partial exploded perspective view illustrating a washing device according to one embodiment of the present invention, and FIG. 2 is a perspective view illustrating a suspension assembly according to an embodiment of the present invention.

[0037] As shown in FIG. 1, the washing device includes a cabinet 600 forming the external appearance of the washing device, a tub 100 fixedly installed and supported in the cabinet 600, a drum 300 positioned and rotatably installed in the tub 100, a shaft 351 connected to the drum 300 through the rear portion of the tub 100, a bearing housing 400 supporting the shaft 351, a driving motor (not shown) arranged in the bearing housing 400 to transfer the rotational force thereof to the shaft 351, and a suspension assembly coupled to the bearing housing 400 to support structures connected to the bearing housing 400 and absorb vibration and/or shock.

[0038] The cabinet 600 includes a base 610 on which constituents are supported and seated, and a front panel (not shown) having an opening for introduction of laundry. In addition, the cabinet 600 includes a left panel 640, a right panel 630, a rear panel 620 and a top panel (not shown). Herein, the opening of the front panel is provided with a door (not shown) to open and close the opening.

[0039] In addition, a water supply unit (not shown) is provided at the inner upper portion of the cabinet 600. The water supply unit includes a water supply hose allowing water to be supplied from an external water source into the tub 100 therethrough, a water supply valve installed on the water supply hose to control water flow, and a detergent supply device (not shown) into which detergent is introduced such that the water supplied through the water supply hose is introduced into the tub 100 along with the detergent. In addition, a drainage unit (not shown) is provided at the inner lower portion of the cabinet 600. The drainage unit is provided with a drainage

hose and a drainage pump to discharge the washing water used in washing and rising of the laundry to the outside.

[0040] The tub 100 includes a front tub 100 configuring the front part, and a rear tub 120 configuring the rear part. The front tub 100 and the rear tub 120 are coupled to each other by coupling members such as screws, and define a space therein to accommodate the drum 300.

[0041] Herein, the front tub 100 is provided with a laundry entrance hole 104 (see FIG. 3) open to the front side and arranged adjacent to the door to allow introduction of laundry. A rim 102 protruding forward of the tub 100 is formed on the inner circumferential surface the laundry entrance hole 104. The rim 102 is provided with a front gasket 200 formed at the front panel to seal the laundry entrance hole 104. The front gasket 200 further functions to prevent foreign substances from being introduced through the gap between the tub 100 and the drum 300.

[0042] In addition, the rear surface of the rear tub 120 is penetrated. An opening is formed in the rear surface of the rear tub 120. The rear surface of the rear tub 120 is provided with a tub back wall 130 and a rear gasket 250, which have a smaller size than the opening and are positioned at the inner side of the opening to close the rear surface of the rear tub 120. The rear gasket 250 is sealably connected to each of the tub back wall 130 and the rear tub 120 to prevent leakage of the washing water from the tub 100.

[0043] Herein, the tub back wall 130 and the drum 300 vibrate together when the drum 300 rotates. The tub back wall 130 is sufficiently spaced apart from rear tub 120 so as not to interfere with the rear tub 120. The rear gasket 250 is arranged between the tub back wall 130 and the rear tub 120 and is formed of a flexible material. Accordingly, the tub back wall 130 is not interfered by the rear tub 120 and is thus allowed to make relative movement. To allow such relative movement of the tub back wall 130, the rear gasket 250 may have a frilled portion which may extend a sufficient length.

[0044] The tub 100 is supported vertically upward by a supporter (not shown) provided to the base 610 of the cabinet 600 and fixed by separate coupling members (e.g., screws and bolts). Additionally, the tub 100 may be fixed to the front panel and the rear panel 620 of the cabinet 600, or the left panel 640 and the right panel 630 thereof by coupling members which are not shown.

[0045] The drum 300 includes a front drum 300, a center drum 320 and a rear drum 330. A drum laundry entrance hole 301 (see FIG. 3) corresponding to the laundry entrance hole 104 of the tub 100 is formed at the front of the front drum 300. A weight balancer to perform balancing operation to suppress vibration of the drum 300 is installed at the front portion or/and rear portion of each of the front drum 300 and the rear drum 330. In addition, the inner side surface of the center drum 320 is provided with a lift to move the laundry.

[0046] The rear drum 330 is connected to a spider 350. The spider 350 is connected to the shaft 351. The drum

300 is rotated in the tub 100 by the rotational force transferred thereto through the shaft 351.

[0047] Herein, the shaft 351 is directly connected to a driving motor through the tub back wall 130. Specifically, the rotor of the driving motor is directly connected to the shaft 351. The bearing housing 400 is coupled to the rear surface of the tub back wall 130.

[0048] The bearing housing 400 supports the shaft 351 between the driving motor and the tub back wall 130 such that the shaft 351 is rotatable. In addition, the bearing housing 400 is elastically supported by the base 610 through the suspension assembly.

[0049] Meanwhile, the tub back wall 130 disposed at the rear surface of the tub 100 is coupled to one surface of the bearing housing 400. The shaft 351 coupled to the drum 300 penetrates the interior of the bearing housing 400. The bearing housing 400 is provided with bearings (not shown) to allow smooth rotation of the shaft 351, the shaft 351 is supported by the bearings (not shown). In addition, the driving motor to rotate the shaft is fastened to the other surface of the bearing housing 400.

[0050] In addition, a first extension 420 and a second extension 421 are symmetrically formed in a laterally radial direction of the bearing housing 400. The suspension assembly is fastened to the first extension 420 and the second extension 421, and the bearing housing 400 is elastically supported through the suspension assembly.

[0051] Hereinafter, coupling of the suspension assembly will be described in detail with reference to FIG. 2.

[0052] As shown in FIG. 2, the suspension assembly includes first and second weights 430 and 431 respectively connected to the first and second extensions 420 and 421 of the bearing housing, first and second suspension brackets 440 and 450 connected to the first and second weights 430 and 431, first, second and third spring dampers 510, 520 and 500 connected to the first and second suspension brackets 440 and 450 and the bearing housing 400 to elastically support the bearing housing 400, and first and second dampers 530 and 540.

[0053] The first and second weights 430 and 431 function to balance the weight of the laundry accommodated in the drum 300, and also serve as a mass in a vibration system in which the drum 300 vibrates.

[0054] The first spring damper 510 is arranged between and connected to the first suspension bracket 440 and the base 610. In addition, the second spring damper 520 is arranged between and connected to the second suspension bracket 450 and the base 610. The third spring damper 500 is arranged between and directly connected to the bearing housing 400 and the base 610. The constituents are supported by the first, second and third spring dampers 510, 520 and 500 at one rear place and two front places on the left and right sides in a shock absorbing manner.

[0055] The first damper 530 is installed between the first suspension bracket 440 and the rear portion of the base 610 in an inclined manner, and the second damper 540 is installed between the second suspension bracket

450 and the rear portion of the base in an inclined manner.

[0056] Preferably, the first and second weights 430 and 431, the first and second suspension brackets 440 and 450, the first and second spring dampers 510 and 520, and the first and second dampers 530 and 540 are arranged laterally symmetric about the center of the shaft of the drum 300. Each of the dampers are connected and coupled to the base 610 via a separate rubber bushing so as to tilt at a predetermined angle. Thereby, the drum 300 and the bearing housing 400 are raised and supported by the first and second suspension brackets 440 and 450, and the first, second and third spring dampers 510, 520 and 50 in the tub 100.

[0057] The driving motor is fastened to the rear surface of the bearing housing 400 and is directly connected to the shaft. The driving motor is arranged such that the speed thereof is controlled by a controller, which is not shown. The structure and types of the driving motor are well known to those skilled in the art, and various embodiments thereof are possible. Therefore, a detailed description of the driving motor will be omitted.

[0058] In this embodiment, the tub 100 is fixedly installed in the cabinet 600, and the drum 300 is supported by the suspension assembly such that the vibration thereof is suppressed by the suspension assembly. The support structures of the tub 100 and the drum 300 are substantially separated from each other. In addition, the support structures are formed such that the tub 100 does not vibrate even when the drum 300 vibrates. Specifically, the tub 100 may be seated on the base 610 of the cabinet 600 such that the tub 100 maintains the standing position without assistance. The front surface of the tub may be fixedly connected to the front panel (not shown), and the rear surface thereof may be fixedly connected to the rear cabinet 600.

[0059] In the case of the washing machine according to the illustrated embodiment, high-speed rotation of the drum causes pressure difference between the interior of the drum 300 and the space between the drum 300 and the tub 100.

[0060] When pressure difference occurs between the interior of the drum 300 and the space between the drum 300 and the tub 100, the drum 300 supported by the suspension assembly is caused to move forward to the front side of the tub 100 in the tub 100. In the case that this forward movement of the drum 300 occurs, the central axis of the drum 300 may be displaced from the original center of rotation. Thereby, the drum 300 may rock in vertical and horizontal directions of the shaft of the drum 300.

[0061] When this event occurs, the drum 300 may move forward in the tube 100 to strike the inner front of the tub 100, or may rock vertically and laterally to strike the inner circumferential surface of the tub 100. Thereby, shock and noise may occur.

[0062] More specifically, the tub 100 is fixedly arranged in the cabinet 600, while the drum 300 is rotatably disposed inside the tub 100, and thus movably arranged in

the tub 100 by the suspension assembly, the tub back wall 130, and the rear gasket 250. In addition, this arrangement prevents vibration occurring during rotation of the drum 300 from being transferred to the tub 100 or the cabinet 600.

[0063] When the drum 300 arranged as above rotates at high speed (for example, during the spin-drying operation), the air staying in the drum 300 is moved to a space between the outer circumferential surface of the drum 300 and the inner circumferential surface of the tub 100 through a spin-drying hole (not shown) formed in the drum 300 or the gap defined between the drum 300 and the tub 100 by the centrifugal force produced according to high-speed rotation of the drum 300. The air rotates along the space between the drum 300 and the tub 100 according to rotation of the drum 300. Accordingly, the space in the drum 300 is set to a subvacuum state, and high pressure is created in the space between the outer circumferential surface of the drum 300 and the inner circumferential surface of the tub 100.

[0064] Meanwhile, the drum 300 movably supported by the suspension assembly draws the external air thereinto to compensate the subvacuum state. However, air is continuously discharged in the circumferential direction of the drum 300 by the centrifugal force according to rotation of the drum 300. Accordingly, inflow of air hardly occurs in circumferential direction of the drum 300, but occurs at the laundry entrance hole 301 of the drum 300.

[0065] However, the gap between the front opening of the drum 300 and the front opening of the tub 100 is very narrow, and the space in the tub 100 is already sealed by the door. Therefore, the rotating air discharged to the outer circumferential surface of the drum 300 by the centrifugal force of the drum 300 is difficult to enter the gap between the front of the drum 300 and the front of the tub 100.

[0066] Furthermore, the gap between the front of the drum 300 and the front of the tub 100 is formed to be narrow to prevent the laundry or foreign substances from being stuck therein. Accordingly, the speed of inflow of air into the gap between the front of the drum 300 and the front of the tub 100 increases. Therefore, the pressure in the gap between the front of the drum 300 and the front of the tub 100 decreases compared to the other portions.

[0067] Thereby, pressures are created between the rotating drum 300 and the tub 100 such that subvacuum is created in the drum 300, a higher pressure is created in the space between the outer circumferential surface of the drum 300 and the inner circumferential surface of the tub 100 than in the drum, and a lower pressure is created in the gap between the front of the drum 300 and the front of the tub 100 than in the space between the outer circumferential surface of the drum 300 and the inner circumferential surface of the tub 100. That is, the pressures are created such that the pressure of the interior of the drum 300 is less than the pressure of the gap between the front of the drum 300 and the front of the tub 100, and the pressure of the gap is less than the pressure of

the space between the outer circumferential surface of the drum 300 and the inner circumferential surface of the tub 100.

[0068] With this pressure condition maintained, if force produced by the lower pressure of the gap between the front of the drum 300 and the front of the tub 100 exceeds the supporting force of the suspension assembly to support the drum 300, the drum 300 will move forward to the front side of the tub 100.

[0069] That is, according to the illustrated embodiment of the present invention, the tub 100 is fixed to the cabinet 600, and the drum 300 is allowed to move. Accordingly, when pressure difference occurs between the interior and exterior of the tub 100 in the drum 300, the drum 300 may move forward. For the washing device, the tub 100 and the drum 300 are configured to vibrate together, and thus the drum 300 is less moved forward with respect to the tub 100.

[0070] Thereby, the front of the rotating drum 300 collides with the inner front of the tub 100 according to forward movement of the drum 300. In addition, the supporting condition of the suspension assembly is affected by the phenomenon of forward movement of the drum 300. Thereby, the drum 300 is not correctly supported, and the center of rotation of the drum 300 is changed, causing rocking of the drum 300 during rotation.

[0071] To prevent the forward movement and rocking of the drum 300 as described above, the present invention is provided with an external air introduction structure to introduce air into the tub 100 and the drum 300 from the outside of the tub 100 to stabilize the pressure inside the drum 300, the pressure in the space between the drum 300 and the tub 100, and the pressure in the gap between the front of the drum 300 and the front of the tub 100.

[0072] Hereinafter, a detailed description will be given of the external air introduction structure according to embodiments of the present invention with reference to the accompanying drawings.

[0073] First, an external air introduction structure according to a first embodiment will be described in detail with reference to FIG. 3.

[0074] FIG. 3 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to the first embodiment of the present invention.

[0075] As shown in FIG. 3, a front part 101 forming the front surface of the tub 100 is provided to the front of the tub 100. The front part 101 of the tub 100 is provided with a laundry entrance hole 104 through which laundry is introduced or retrieved. A rim 102 protruding forward from the front part 101 of the tub 100 is provided to the outer side of the laundry entrance hole 104 in a manner of surrounding the laundry entrance hole.

[0076] An external air introduction hole 103 is formed at the upper portion of the rim 102. In addition, an external air introduction tube 23 is connected to the external air introduction hole 103.

[0077] Herein, one end of the external air introduction tube 23 is connected to the external air introduction hole 103, and the other end thereof is connected to an external air hole 621 formed in the rear panel 620. Thereby, the external air 10 outside the cabinet 600 flows into the external air introduction tube 23 through the external air hole 621, and flows into the tub 100 through the external air introduction hole 103.

[0078] Meanwhile, the other end of the external air introduction tube 23 is not necessarily connected to the rear panel 620. That is, the external air introduction tube 23 may be connected to panels of the cabinet 600 other than the rear panel 620, such as the right panel 630, the left panel 640 and the top panel.

[0079] The external air introduction hole 103 is located farther forward than the laundry entrance hole 301 of the drum 300. Thereby, the external air 10 may directly flow into the drum 300 through the external air introduction hole 103 and through the laundry entrance hole 301 of the drum 300.

[0080] Meanwhile, the size of the external air introduction hole 103 may be determined according to the capacity of the washing device. The capacity of the washing device is associated with the volume of the tub 100 or the drum 300, and accordingly, the size of the external air introduction hole 103 may be determined according to the volume of the tub 100 or the drum 300.

[0081] That is, as the capacity of the washing device increase, the volume or size of the drum 300 and the tub 100 needs to correspondingly increase, the size of the external air introduction hole 103 and the external air introduction tube 23 for prevention of forward movement of the drum 300 may also need to increase. For example, a washing device having the laundry capacity of 11kg or 13kg may have a larger external air introduction hole 103 than a washing device having the laundry capacity of 9kg.

[0082] Meanwhile, the external air introduction tube 23 may be fixed to the tub 100. For the washing device according to embodiments of the present invention, the drum 300 is separated from the tub 100 in consideration of vibration. Accordingly, during the washing or spin-drying, vibration of the drum 300 is rarely transferred to the tub 100. Thereby, the external air introduction tube 23 may be directly fixed to the tub 100.

[0083] The external air introduction tube 23 may be installed at the upper central portion of the tub 100 to cross the tub 100 in the front-to-back direction. Alternatively, it may be installed at a position off the upper central portion of the tub 100 to the left side or right side to cross the tub 100 in the front-to-back direction. In the case that the external air introduction tube 23 is installed at a position off the central portion, the external air introduction hole 103 may also be formed at a position off the upper center of the rim 102 to the left side or right side.

[0084] An air-blowing fan 25 is installed in the external air introduction tube 23. The air-blowing fan 25 operates when the drum 300 rotates at high speed. That is, it may operate during the spin-drying operation. Otherwise, it

may operate when the rate of rotation of the drum is equal to or greater than 200 rpm or 400 rpm.

[0085] When forward movement of the drum 300 occurs according to pressure difference occurring between the interior of the drum 300 and the space between the drum 300 and the tub 100 according to a high rate of rotation of the drum, external air is introduced through the external air introduction tube 23 by the air-blowing fan 25. As the external air introduced through the external air introduction tube 23 flows into the drum 300 through the external air introduction hole 103, the pressures in the drum 300 and the space between the drum 300 and the tub 100 are stabilized and forward movement of the drum 300 is prevented.

[0086] Hereinafter, an external air introduction structure according to a second embodiment of the present invention will be described in detail with reference to the accompanying drawings. The second embodiment includes constituents similar to those of the first embodiment. Accordingly, a detailed description of the same constituents and functions as those of the previous embodiment will be omitted. They should be understood with reference to the drawings of the first embodiment.

[0087] FIG. 4 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to the second embodiment of the present invention.

[0088] As shown in FIG. 4, in the second embodiment, external air introduced into the tub 100 is converted into hot air to dry laundry in the drum 300.

[0089] That is, according to the second embodiment, the external air introduction tube 23 is provided with a heater 21 to heat external air passing through the external air introduction tube 23. Thereby, the external air passing through the external air introduction tube 23 is heated and converted into hot air, then flowing into the drum 300 through the external air introduction hole 103 to dry the laundry.

[0090] The heater 21 may operate when the spin-drying operation is performed, during which external air is introduced through the external air introduction hole 103. That is, when forward movement of the drum 300 occurs during the spin-drying operation according to a high rate of rotation of the drum 300, external air may be supplied and heated by the heater 21, thereby preliminarily drying the laundry.

[0091] Alternatively, the heater 21 may operate to dry the laundry. That is, when the drying operation is performed, the air-blowing fan 25 and the heater 21 may operate to cause inflow of the external air and convert the external air into hot air to dry the laundry.

[0092] In this case, the external air introduced into the tub 100 and used to prevent forward movement of the drum 300 and/or preliminarily dry the laundry needs to be discharged from the tub 100. Accordingly, an exhaust part to discharge the external air from the tub 100 is provided to the rear side of the tub 100.

[0093] The exhaust part includes an exhaust hole 622

formed at the upper rear side of the tub 100 and an exhaust pipe 22 connected to the exhaust hole 22 and extending toward the outside of the rear panel 620. Thereby, during the spin-drying operation and drying operation, the external air and hot air introduced into the drum 300 and the tub 100 are discharged through the exhaust hole 622 and the exhaust pipe 22.

[0094] Meanwhile, designing the inflow rate of the external air introduced through the external air introduction hole 10 to be greater than the discharge flow rate of the air discharged through the exhaust hole 622 may be more advantageous in reducing forward movement of the drum 300. That is, in this embodiment, the size or total area of the external air introduction hole 103 is preferably formed to be greater than that of the exhaust hole 622.

[0095] With the external air introduction tube allowing inflow of external air as in the first and second embodiments, fluids in the tub 100 such as washing water and detergent may be discharged through the external air introduction hole 103.

[0096] By forming the external air introduction hole 103 in an upper portion of the tub 100, the washing water in the tub 100 may be prevented from flowing out to some extent. However, foam possibly produced in the tub 100 may reach the top of the tub 100 and accordingly flow out through the external air introduction hole 103.

[0097] Hereinafter, a detailed description will be given of an external air introduction structure for preventing the foam from flowing out according to a fourth embodiment. The fourth embodiment includes constituents similar to those of the first embodiment. Accordingly, a detailed description of the same constituents and functions as those of the first embodiment will be omitted. They should be understood with reference to the drawings of the first embodiment.

[0098] FIG. 5 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a third embodiment of the present invention, and FIG. 6 is a partial cross-sectional view illustrating a valve of an external air introduction tube according to the third embodiment.

[0099] As shown in FIGs. 5 and 6, a valve 30a to prevent outflow of foam is installed in the external air introduction hole 103. Herein, the external air introduction hole 103 protrudes from the rim 102 upward, and the external air introduction tube 23 is connected to the external air introduction hole 103. The valve 30a is installed at the external air introduction tube 23 or a protrusion of the external air introduction hole 103.

[0100] A portion of the external air introduction tube 23 at least connected to the external air introduction hole 103 may be formed of a flexible material. For example, the hole may have a shape of a bellows formed of rubber or a gasket.

[0101] The valve 30a includes a pair of rotating plates 32a and 33a rotatably installed at both sides of a hinge axle 31 crossing the flow path of the external air. When the flow path is open, the rotating plates 32a and 33a is

arranged forming a certain angle therebetween.

[0102] Herein, when the flow path is open, each of the rotating plates 32a and 33a is inclined at a certain angle in the flow path. When produced foam reaches the external air introduction hole 103, the rotating plates 32a and 33a rotates to close the flow path by being pushed by the foam.

[0103] On the other hand, when the pressure by the foam disappears, the rotating plates 32a and 33a return to original positions at which they are inclined. In this embodiment, the restoring force to return the plates is the moment of inertia according to the weight of the rotating plates 32a and 33a.

[0104] That is, when there is no pressure from the foam, one end of each of the rotating plates 32a and 33a is connected to the hinge axle 31, and the other end thereof rotates downward by gravity to a drooping position.

[0105] Herein, a torsion spring (not shown) may be additionally provided to one end of each of the rotating plates 32a and 33a connected to the hinge axle 31. Thereby, restoring force may be supplemented. In this case, the valve 30a may be selectively installed in a vertical flow path or a non-vertical flow path of the flow paths along which the external air flows.

[0106] As described above, the valve 30a may prevent backflow of a fluid and foam produced in the tub 100 to and out of the external air introduction hole 103 and the external air introduction tube 23.

[0107] In the illustrated fourth embodiment, backflow of the foam is prevented by blocking the path of the foam. Alternatively, backflow of the foam may be prevented by eliminating the foam flowing backward.

[0108] Hereinafter, a detailed description will be given of an external air introduction structure for preventing outflow of foam according to a fifth embodiment of the present invention. The fifth embodiment includes constituents similar to those of the fourth embodiment. Accordingly, a detailed description of the same constituents and functions as those of the fourth embodiment will be omitted. They should be understood with reference to the drawings of the first and fourth embodiment.

[0109] FIG. 7 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to the fourth embodiment of the present invention, FIG. 8 is a partial cross-sectional view illustrating installation of a plate of an external air introduction tube according to the fourth embodiment, and FIGs. 9 and 10 are views schematically illustrating the plate of the external air introduction tube according to the fourth embodiment.

[0110] As shown in FIGs. 7 and 8, plates 30b and 30c for preventing outflow of foam are installed in the external air introduction hole 103. Herein, the external air introduction hole 103 protrudes upward from the rim 102, and the external air introduction tube 23 is connected to the external air introduction hole 103. The plates 30b and 30c are installed at the external air introduction tube 23 or the protrusion of the external air introduction hole 103.

[0111] A portion of the external air introduction tube 23 at least connected to the external air introduction hole 103 may be formed of a flexible material. For example, the hole may have a shape of a bellows formed of rubber or a gasket.

[0112] Herein, the plate 30b includes a plurality of holes 32b, as shown in FIG. 9. The external air may flow into the tub through the holes 32b. On the other hand, the foam produced in the tub 100 bursts as it touches a portion between the holes 32b of the plate 30b. Thereby, the foam may be eliminated or reduced to a size allowing the foam to pass through the holes. In the plate 30b, the holes 31b may be formed such that the total area thereof occupies half or more of the total area of the plate 30b.

[0113] Alternatively, the plate 30c has a latticed pattern formed by a plurality of wires 31c forming a mesh as shown in FIG. 8. The plate 30c includes a frame 33c and the plurality of wires 31c connected to each other by forming lattices in the frame 33c. The external air is allowed to pass through the hoses formed between the wires 31c.

[0114] A fluid and foam produced in the tub 100 may be prevented from flowing backward to the external air introduction hole 103 and the external air introduction tube 23 by the plates 30b and 30c as described above.

[0115] As in the first and second embodiments, the external air introduction tube for introducing the external air allows fluids in the tub 100 such as washing water and detergent to flow out through the external air introduction hole 103.

[0116] By forming the external air introduction hole 103 in an upper portion of the tub 100, the washing water in the tub 100 may be prevented from flowing out to some extent. However, foam possibly produced in the tub 100 may reach the top of the tub 100 and accordingly flow out through the external air introduction hole 103.

[0117] Hereinafter, a detailed description will be given of a foam sensing structure of the external air introduction structure according to the fifth embodiment of the present invention. 5. The fifth embodiment includes constituents similar to those of the first embodiment. Accordingly, a detailed description of the same structures and functions as those of the first embodiment will be omitted. They should be understood with reference to the drawings of the first embodiment.

[0118] FIG. 11 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a fifth embodiment of the present invention.

[0119] As shown in FIG. 11, the external air introduction structure according to the fifth embodiment is provided with a sensing means 40 to sense outflow of the foam flowing backward into the external air introduction tube 23 for introduction of external air.

[0120] The sensing means 40 includes at least one first electrode 41 installed at the external air introduction tube 23. In addition, a second electrode 42 is installed at the lower portion of the tub 100. Thereby, when an electrical current flowing through the first electrode 41 and

the second electrode 42 is sensed, outflow of foam or other fluids through the external air introduction hole 103 may be sensed.

[0121] Alternatively, both the first electrode 41 and the second electrode 42 may be installed at the external air introduction tube 23. Alternatively, the first electrode 41 and the second electrode 42 may be installed near the external air introduction hole 103 in the tub 100. That is, approach of a fluid may be sensed before the fluid flows out through the external air introduction hole 103.

[0122] Once outflow of the fluid is sensed by the sensing means 40, the controller (not shown) of the washing device may temporarily stop a process for washing in operation. In addition, the stopping may be maintained for a certain time.

[0123] Alternatively, when the foam is sensed, the controller may perform a separate operation to eliminate the foam. In addition, the controller may resume the stopped process after a certain time elapses or after the operation for elimination of the foam is performed. For example, in the case that outflow of foam is sensed during the washing operation, the washing operation may be stopped, the operation for elimination of the foam may be performed, and then the washing operation may be resumed.

[0124] As in the illustrated first and second embodiments, in the case of the external air introduction tube for introducing the external air, not only the fluids in the tub 100 such as the washing water and detergent but also the air containing moisture from the laundry (or steam) may be discharged through the external air introduction hole 103. In this case, the air containing water condenses in the external air introduction tube 23, and the condensed water remains in the external air introduction tube 23.

[0125] Hereinafter, a detailed description will be given of an external air introduction structure for eliminating the condensed water according to a sixth embodiment of the present invention. The sixth embodiment includes constituents similar to those of the first embodiment. Accordingly, the same constituents and functions as those of the first embodiment will be omitted. They should be understood with reference to the drawings of the first embodiment.

[0126] FIG. 12 is a partial cross-sectional view illustrating a washing device using an external air introduction structure according to a sixth embodiment of the present invention. Although not shown in FIG. 12, the sixth embodiment may further include a separate steam generating device.

[0127] As shown in FIG. 12, in the external air introduction structure according to the sixth embodiment, the external air introduction tube 23 allowing inflow of external air therethrough may be inclined downward toward the tub.

[0128] That is, the external air introduction tube 23 is connected to the external air introduction hole 103 formed at the rim 102 of the tub 100 and extends to the

edge of the front part 101 of the tub 100. In addition, the pipe extends rearward in the longitudinal direction of the tub 100. One end of the external air introduction tube 23 is connected to the hole formed in the rear panel 620. Herein, a portion of the external air introduction tube 23 extending in the longitudinal direction of the tub 100 is inclined upward as it extends rearward, as shown in FIG. 12.

[0129] Herein, a condensing plate 26 may be further installed in the external air introduction tube 23. The condensing plate 26 may be formed of a metallic material. Particularly, in the case that the external air introduction tube 23 is formed of a non-metallic material such as plastics, condensing of damp air or steam produced through drying of the laundry may be promoted by installing the condensing plate 26 formed of a metallic material. The external air introduction tube 23 may also be formed of a metallic material.

[0130] During the washing operation, steam may be supplied into the tub 100. Alternatively, in the case that the washing water in the tub 100 is at a high temperature, water vapor may be formed in the tub 100.

[0131] Such steam or water vapor may flow into the external air introduction tube 23 through the external air introduction hole 10. The temperature of the external air introduction tube 23 may be lower than in the tub 100, and thus the steam or water vapor may condense in the external air introduction tube 23. Or it may be condensed by the condensing plate. Herein, the condensed water return to the tub 100 since the external air introduction tube 23 is inclined.

[0132] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A washing device comprising:

a case;
a tub supported by the case, the tub having a laundry entrance hole for taking in and out laundry at a front portion thereof and an external air introduction hole for introducing external air therethrough;
an external air introduction tube passing through the case and connected to the external air introduction hole in order to guide the external air outside the case into the external air introduction hole;
a drum having, at a front portion thereof, a laundry entrance hole corresponding to the laundry entrance hole of the tub, the drum being rotatably

installed within the tub;

a driving unit comprising a shaft connected to a rear portion of the drum, a bearing housing rotatably supporting the shaft, and a motor for rotating the shaft; and

a suspension assembly for attenuating vibration of the drum.

2. The washing device according to claim 1, wherein the external air introduction hole is formed at a front of the tub, and the external air introduction tube is connected to the external air introduction hole and inclined upward as the external air introduction tube extends rearward in a longitudinal direction of the tub.

3. The washing device according to any one of claims 1 and 2, wherein the external air introduction tube is provided with a condensing plate to condense moisture contained in air flowing backward through the external air introduction tube.

4. The washing device according to any one of claims 1 to 3, further comprising a foam sensing means located within the tub and the external air introduction tube to sense foam produced in the tub.

5. The washing device according to claim 8, further comprising a controller to control operation of the motor according to a result of sensing by the foam sensing means.

6. The washing device according to any one of claims 1 to 5, further comprising an air-blowing fan installed in a passage of the external air introduction tube to forcibly blow the external air into the external air introduction hole during operation of a spin-drying cycle.

7. The washing device according to any one of claims 1 to 6, further comprising a heater to heat the external air moving to the tub through the external air introduction tube.

8. The washing device according to any one of claims 1 to 7, wherein the tub further comprises an exhaust part to discharge the external air introduced into the tub through the external air introduction tube.

9. The washing device according to claim 4, wherein the external air introduction hole is formed to have an area greater than an area of an exhaust hole of the exhaust part such that a discharge flow rate of the external air in the exhaust part is greater than an introduction flow rate of the external air in the external air introduction hole during a spin-drying cycle.

10. The washing device according to any one of claims

1 to 9, further comprising a valve installed in a flow passage of the external air to allow flow of the external air into the tub and to prevent the foam produced in the tub from flowing backward through the flow passage of the external air.

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11. The washing device according to any one of claims 1 to 10, further comprising at least one plate having a plurality of holes installed in the flow passage of the external air to the foam produced in the tub from flowing backward through the flow passage of the external air. 10
12. The washing device according to any one of claims 1 to 11, wherein the external air introduction hole is located further forward than the laundry entrance hole of the drum. 15
13. The washing device according to any one of claims 1 to 12, wherein the suspension assembly is connected to the bearing housing. 20
14. The washing device according to any one of claims 1 to 13, wherein the tub has an opening at a rear portion thereof and further comprises a rear gasket to seal a gap between the opening and the driving unit and allow relative movement of the driving unit with respect to the tub. 25
15. The washing device according to any one of claims 1 to 14, wherein the tub is fixedly supported compared to the drum. 30

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FIG. 1

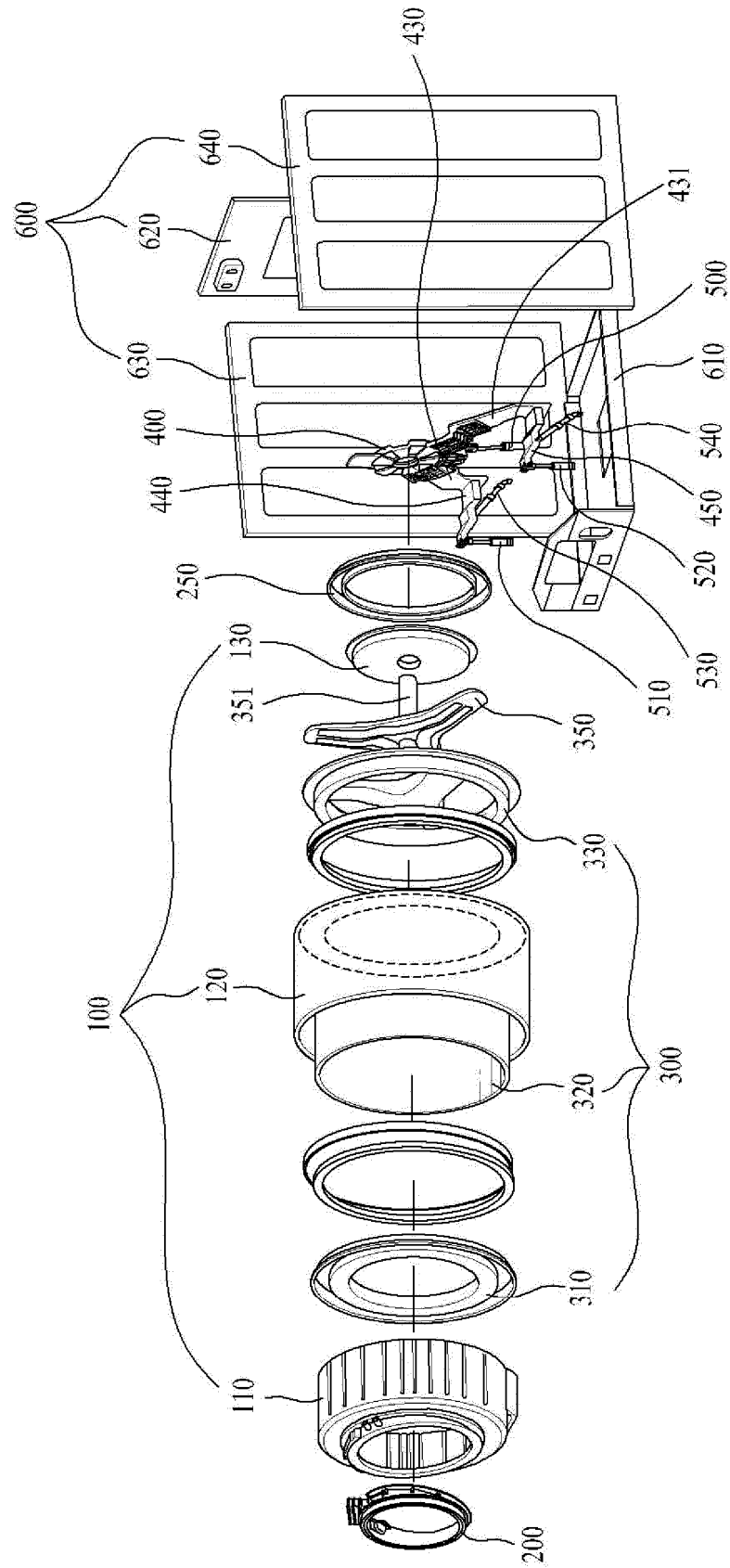


FIG. 2

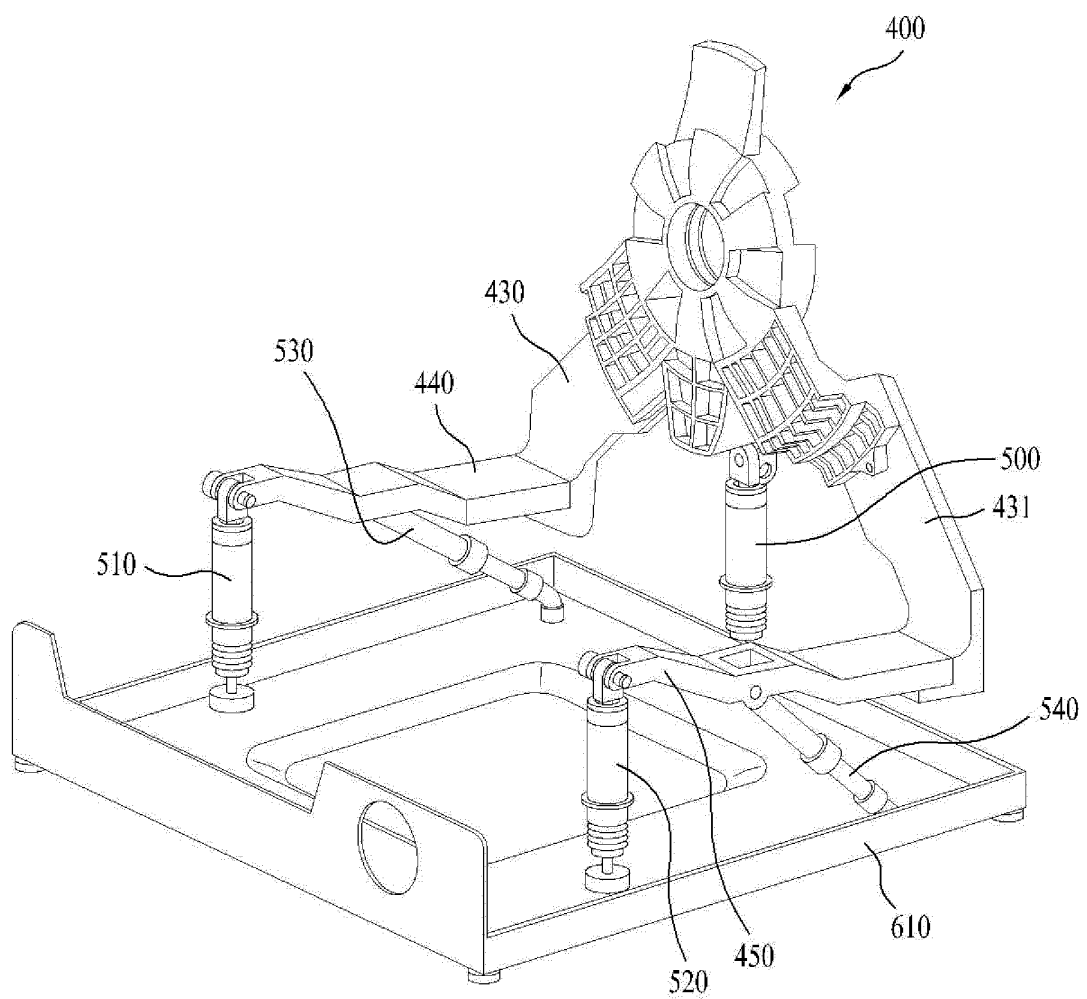


FIG. 3

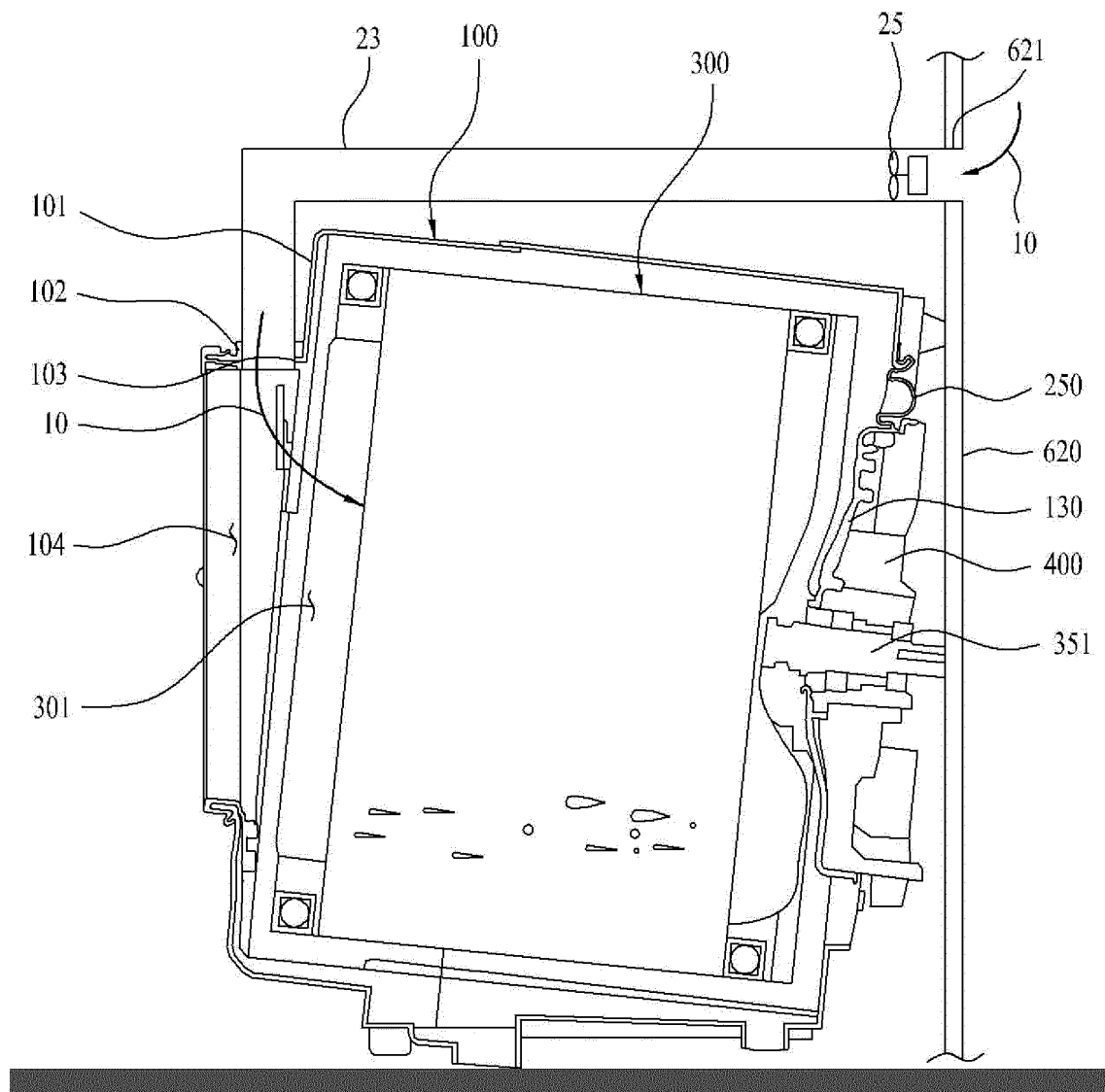


FIG. 4

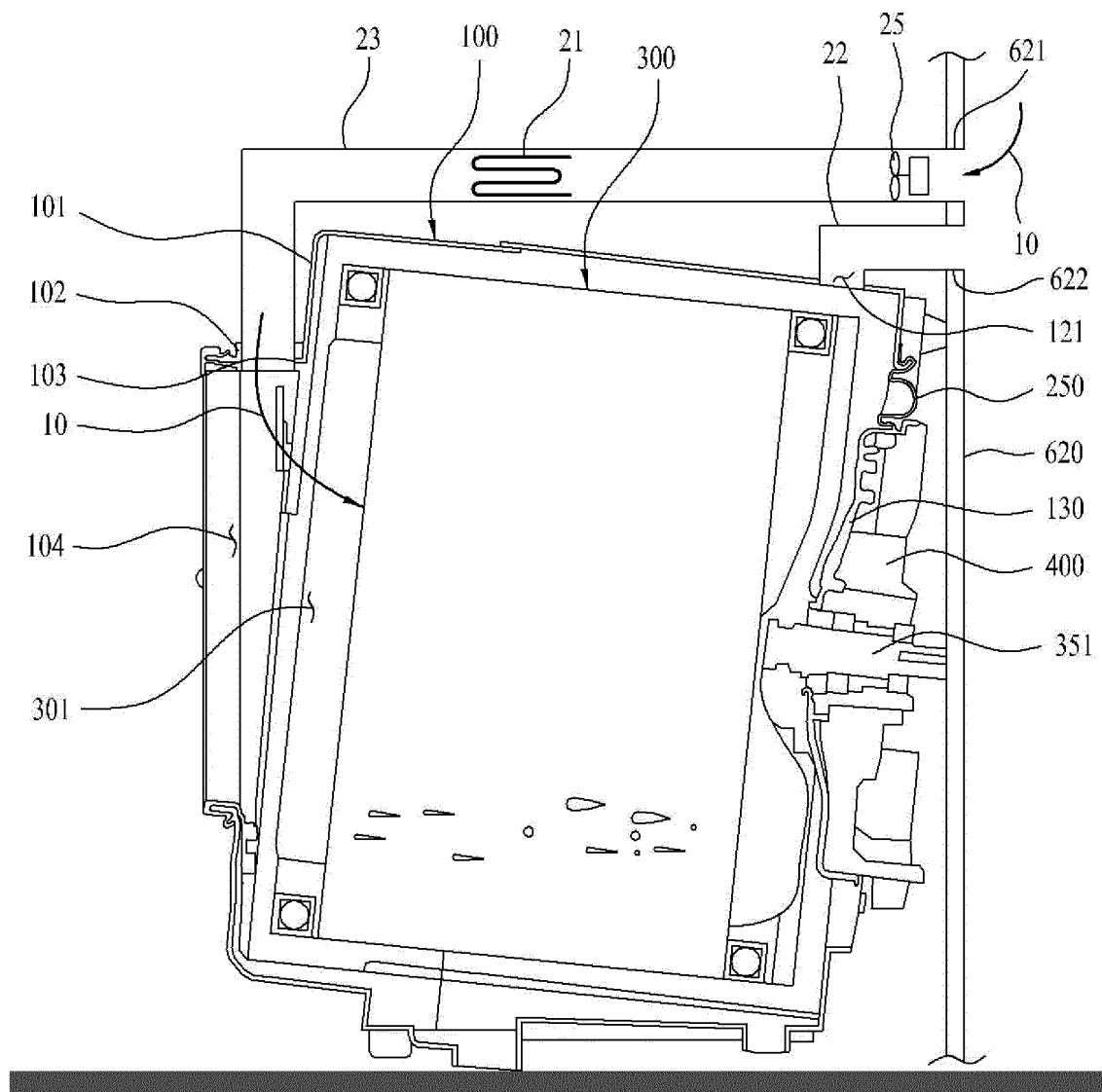


FIG. 5

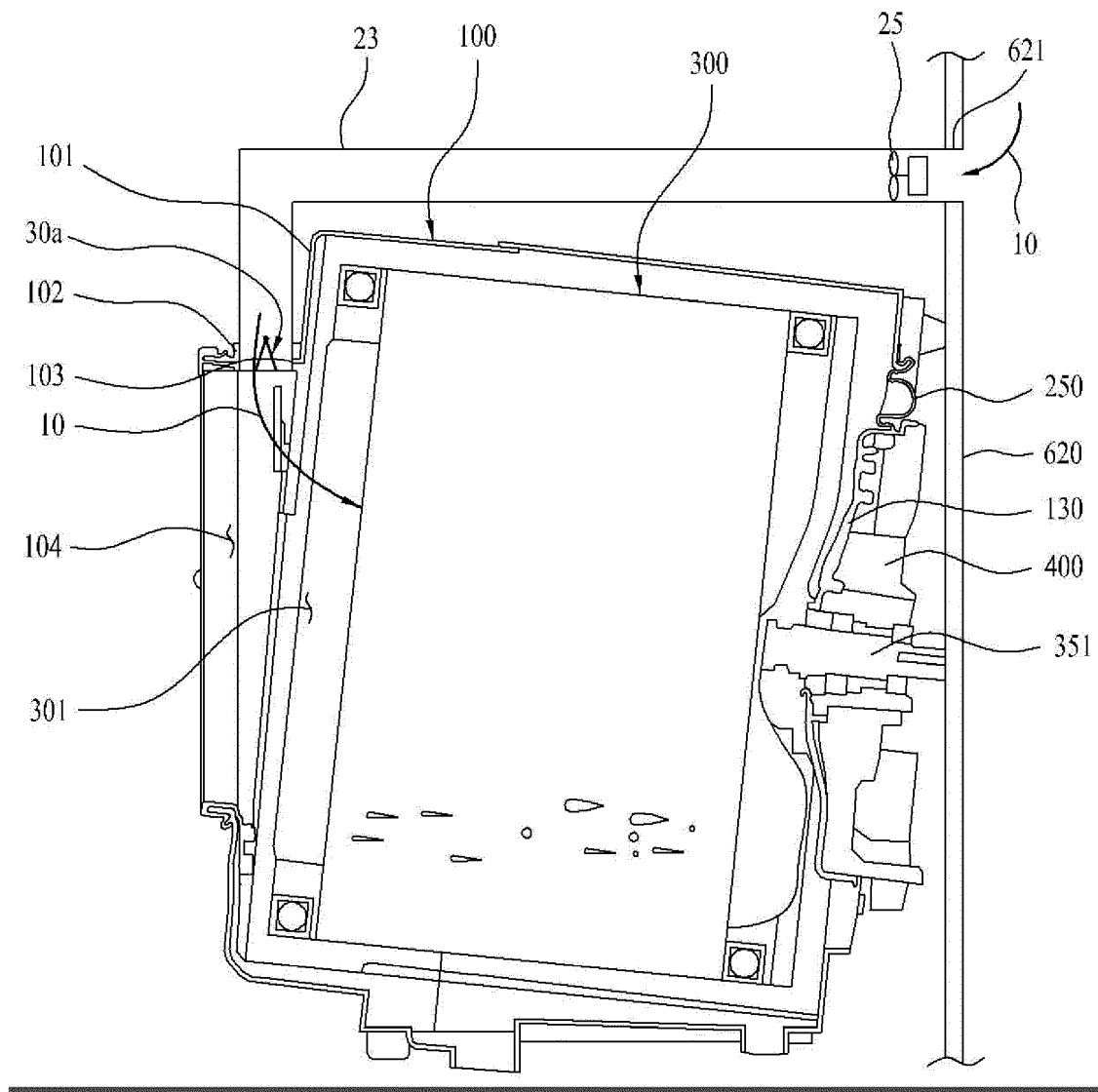


FIG. 6

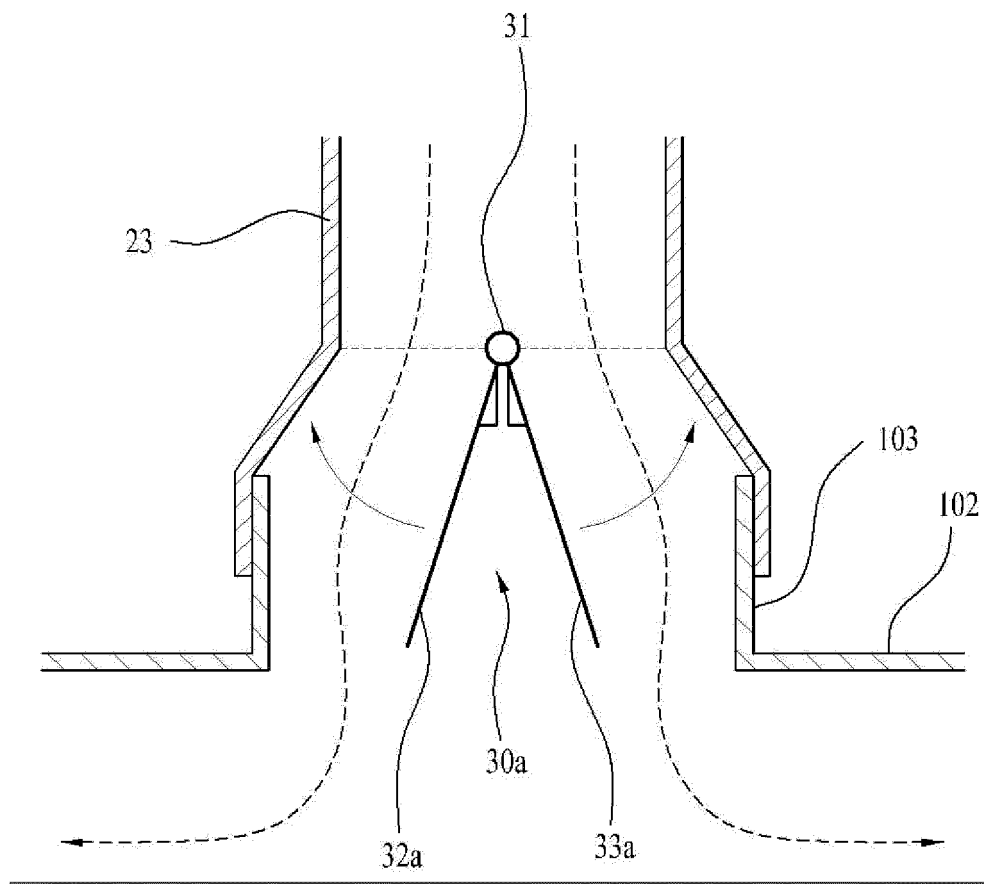


FIG. 7

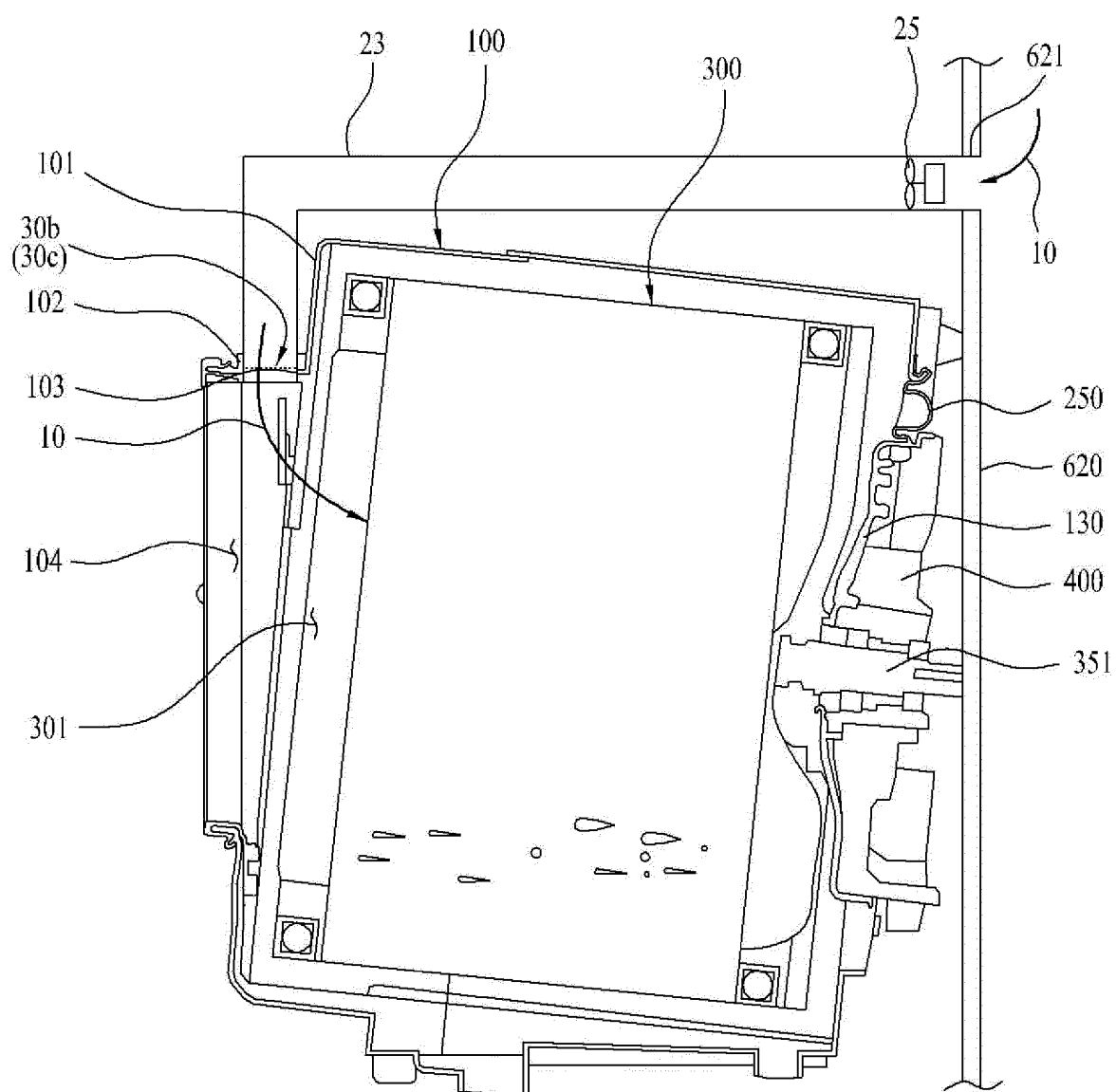


FIG. 8

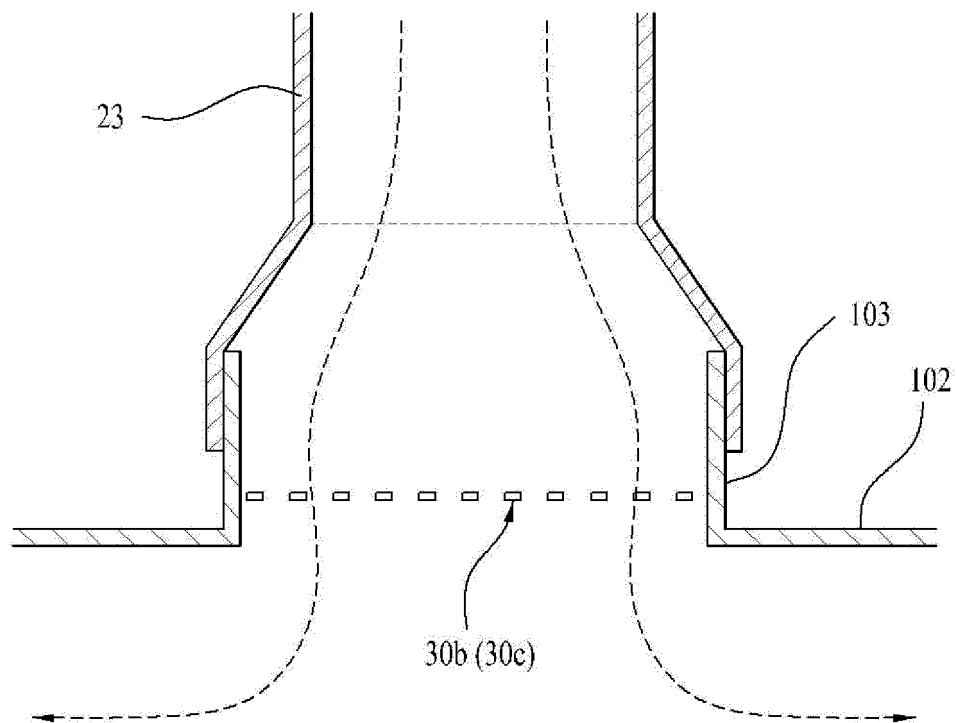


FIG. 9

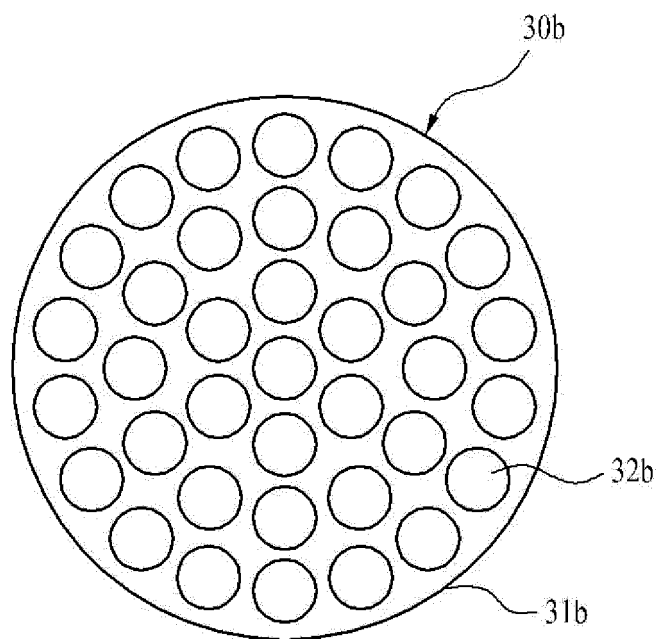


FIG. 10

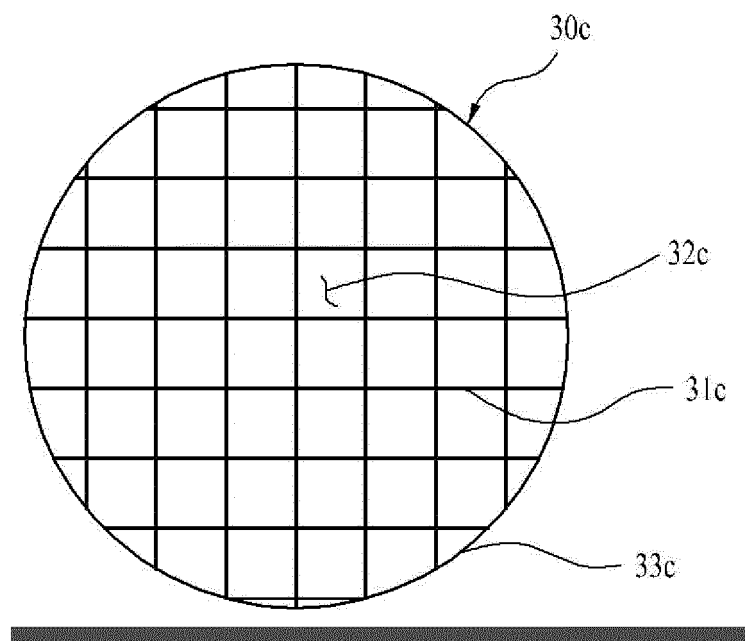


FIG. 11

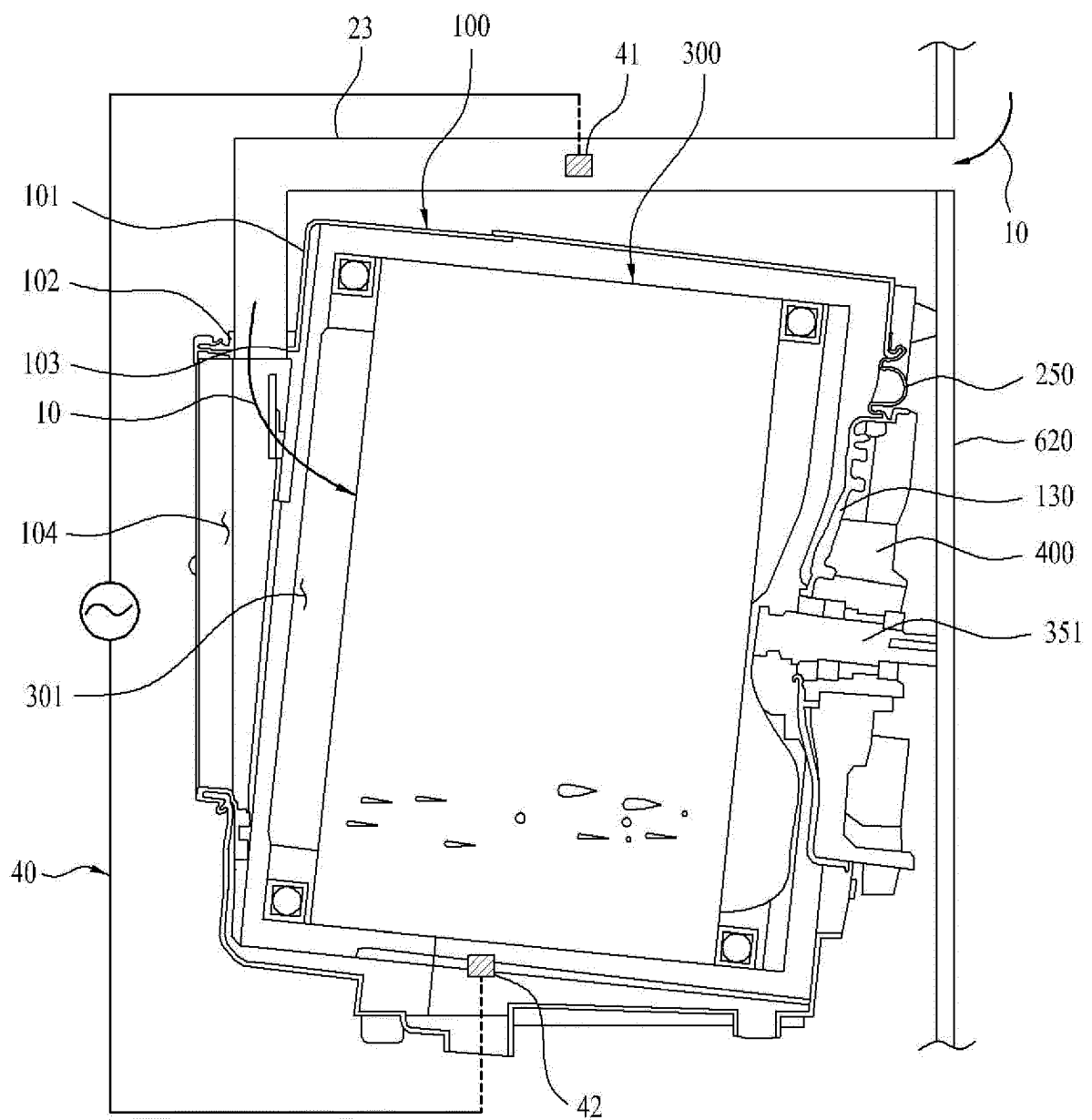


FIG. 12

