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(54) **CLOTHES WASHING AND DRYING MACHINE**

(57) A washing and drying machine capable of improving drying efficiency is provided. A fully automatic washing and drying machine (1) includes an outer tub (20) elastically supported in a housing (10); a washing/dewatering tub (24) rotatably arranged in the outer tub (20); a hot air supplying unit (50) including a heater and a fan, and air heated by the heater is supplied into the washing/dewatering tub (24) by the fan from an upper part of the outer tub (20); and a discharging port (20c) arranged at a lower part of the outer tub (20) and configured to discharge the air which has been in contact with washings in the washing/dewatering tub (24). The discharging port (20c) is connected to an exhaust duct (80) extending upward, and an exhaust port (83) is formed in the exhaust duct (80). The discharging port (83) is located at a position higher than a water overflowing level at which water overflows from the outer tub (20).

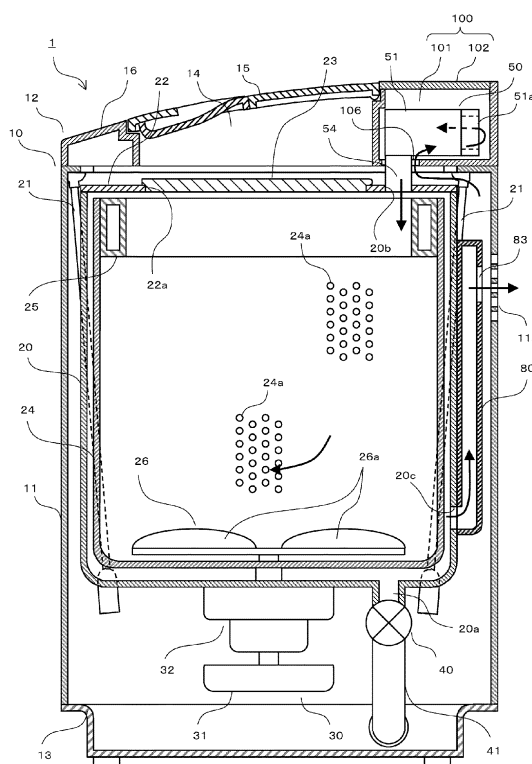


FIG. 1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a washing and drying machine.

BACKGROUND

[0002] In the past, a washing and drying machine implemented by adding a drying function to a so-called swirl type washing machine (fully automatic washing machine), in which clothes are washed by a water flow generated in a washing/dewatering tub through a pulsator disposed at the bottom of the washing/dewatering tub, is known. An example of such a washing and drying machine is disclosed in Patent Document 1, for example.

[0003] In the washing and drying machine disclosed in Patent Document 1, a hot air supplying unit for supplying high-temperature air into the washing/dewatering tub is disposed on a top plate having a loading port for washings. An opening of the upper surface of an outer tub equipped with the washing/dewatering tub is covered by an outer tub cover having an inner lid. The hot air generated by the hot air supplying unit is blown into the washing/dewatering tub from the above of the outer tub through a hot air duct connected to the outer tub cover. The inner lid is formed with an exhaust hole through which the hot air supplied to the washing tub flows to the outside of the outer tub and is discharged to the outside of the machine through a vent hole or the like on the back of an outer box.

[0004] In the above configuration, since the exhaust hole is formed in the inner lid of the upper surface of the outer tub, the hot air supplied from the above of the outer tub is easily released to the exhaust hole before spreading to the lower part of the washing/dewatering tub. For this reason, in the washing/dewatering tub, the hot air easily contacts the upper surface of the washings, and the hot air hardly permeates the washings. Therefore, in the above configuration, there is concern that the drying efficiency is low.

Related Technical Literature

Patent Literature

[0005] Patent Literature 1: Japanese Laid-Open Patent Publication No. 2007-44228

SUMMARY

Problem to be solved by the present disclosure

[0006] The present disclosure is made in view of the above problem, and aims to provide a washing and drying machine capable of improving the drying efficiency.

Solution to the technical problem

[0007] A washing and drying machine according to a first aspect of the present disclosure includes an outer tub elastically supported in a housing; a washing/dewatering tub rotatably arranged in the outer tub; a hot air supplying portion including a heater and a fan, where air heated by the heater is supplied into the washing/dewatering tub by the fan from an upper part of the outer tub; and a discharging port arranged at a lower part of the outer tub and configured to discharge the air which has been in contact with washings in the washing/dewatering tub.

[0008] According to the above configuration, since the discharging port for the air inside the outer tub is formed at the lower part of the outer tub, the hot air fed into the outer tub from the above easily spreads to the lower part of the washing/dewatering tub. As a result, the hot air easily permeates the washings in the washing/dewatering tub, so that an improvement in drying efficiency can be expected.

[0009] The washing and drying machine according to this aspect further includes an exhaust portion through which no water stored in the outer tub leaks during a washing process, and the air flowing from the discharging port is discharged during a drying process. For example, the exhaust portion may include an exhaust duct connected to the discharging port and extending upward. In this case, an exhaust port is formed in the exhaust duct at a position higher than a water overflowing level at which the water overflows from the outer tub.

[0010] According to the above configuration, it is possible to provide a discharging port at the lower part of the outer tub without concerning water leakage during the washing process.

[0011] In the washing and drying machine according to this aspect, the housing includes a top plate having a loading port for washings. The hot air supplying portion is disposed in an accommodating chamber provided on the top plate. An air inlet of the hot air supplying portion is arranged to be opposed to and separated from an inner wall surface of the accommodating chamber. The air flowing in the accommodating chamber is taken into the air inlet by the fan.

[0012] According to the above configuration, since the air heated by the heat generated from the hot air supplying portion can be heated by the heater, it is possible to suppress the heating amount of the heater and suppress the power consumption of the washing and drying machine during the drying process.

[0013] In the above configuration, the accommodating chamber further includes an opening communicating with a space between the housing and the outer tub, and the air in the space is taken into the accommodating chamber by the fan and flows in the accommodating chamber.

[0014] With such a configuration, since the air heated by the heat generated from the outer tub can be taken

into the accommodating chamber, the further heated air can be taken into the intake port of the hot air supplying portion, and it is possible to further suppress the heating amount.

[0015] In the washing and drying machine according to this aspect, the housing may include a top plate having a loading port for washings. The hot air supplying portion may be disposed in an accommodating chamber provided on the top plate. The accommodating chamber has an opening communicating with a space between the housing and the outer tub. The air inlet of the hot air supplying portion is arranged to be opposed to the opening, and the air in the space is taken into the air intake port by the fan.

[0016] According to the above configuration, since the air heated by the heat generated from the outer tub can be taken into the hot air supplying portion, the power consumption of the washing and drying machine during the drying step can be suppressed.

[0017] As described above, in the case that the washing and drying machine is configured to heat the air taken into the hot air supplying portion with the heat from the outer tub and the hot air supplying portion, the washing and drying machine further includes a controller configured to carry out a first drying operation and a second drying operation. In the first drying operation, the heater and the fan are operated to supply the air heated by the heater into the outer tub from the hot air supplying portion. The second drying operation follows the first drying operation. In the second drying operation, the heater is stopped and the fan is operated, so that the air being not heated by the heater is supplied into the outer tub from the hot air supplying portion.

[0018] With such a configuration, the washings can be dried by using the residual heat of the hot air supplying portion and the outer tub, so that it is possible to suppress the power consumption of the washing and drying machine in the drying process.

Effect of the present disclosure

[0019] According to the present disclosure, it is possible to provide a washing and drying machine capable of improving the drying efficiency.

[0020] The effect or the significance of the present disclosure will be further clarified by the description of the embodiments described below. It is to be noted that the following embodiments are merely examples for implementing the present disclosure, and the present disclosure is not limited to the ones described in the following embodiments.

BRIEF DESCRIPTION OF DRAWINGS

[0021]

FIG. 1 is a side sectional view illustrating a fully automatic washing and drying machine according to

an embodiment.

FIG. 2 is a top view illustrating a fully automatic washing and drying machine with a rear cover being removed and an upper cover being opened according to an embodiment.

FIG. 3 is a top view illustrating a fully automatic washing and drying machine shown in FIG. 2 with a hot air supplying unit, a water supply unit and a water level sensor being further removed according to an embodiment.

FIG. 4 is a view illustrating an outer tub to which an exhaust duct is attached, as viewed from the rear, according to an embodiment.

FIG. 5 is a longitudinal sectional view illustrating essential parts of the embodiment in which the outer tub and the exhaust duct are cut at the central portion in the left-right direction of the exhaust duct.

FIG. 6(a) is a sectional view of the exhaust duct taken along line A-A' in FIG. 5 according to the embodiment, and FIG. 6(b) is a sectional view of the exhaust duct taken along line B-B' in FIG. 5 according to the embodiment.

FIG. 7 is a block diagram illustrating a configuration of a fully automatic washing and drying machine according to an embodiment.

FIG. 8 is a flowchart illustrating operation control actions in a drying process according to an embodiment.

FIG. 9 is a sectional view illustrating main parts in a configuration of a fully automatic washing and drying machine according to modification I.

FIG. 10 is a sectional view illustrating main parts in a configuration of a fully automatic washing and drying machine according to modification II.

FIG. 11 is a side sectional view of a fully automatic washing and drying machine according to modification III.

List of reference numerals

[0022] 1: Fully automatic washing and drying machine (washing and drying machine); 10: Housing; 12: Top plate; 14: Loading port; 20: Outer tub; 20c: Discharging port; 24, Washing/dewatering tub; 50: Hot air supplying unit (hot air supplying portion); 50A: Hot air supplying unit (hot air supplying portion); 51a: Air inlet; 52: Fan; 53: Heater; 80: Exhaust duct (exhaust portion); 83: Exhaust port; 100: Accommodating chamber; 106: First opening

(opening); 107: Second opening (opening); 108: Third opening (opening); 109: Fourth opening (opening); 110: Opening/closing valve (exhaust portion); 130: Air intake (opening); 201: Controller

DETAILED DESCRIPTION

[0023] Hereinafter, a washing and drying machine according to an embodiment of the present disclosure will be described with reference to the drawings.

[0024] FIGS. 1 to 3 are views illustrating a configuration of a fully automatic washing and drying machine 1. FIG. 1 is a side sectional view of the fully automatic washing and drying machine 1, and FIG. 2 is a top view of the fully automatic washing and drying machine 1 with a rear cover 102 being removed and an upper cover 15 being opened. FIG. 3 is a top view of the fully automatic washing and drying machine 1 shown in FIG. 2 with a hot air supplying unit 50, a water supply unit 60 and a water level sensor 70 being further removed.

[0025] The fully automatic washing and drying machine 1 includes a housing 10 constituting an external appearance. The housing 10 includes a body portion 11 in a rectangular barrel shape with upper and lower surfaces open, a top plate 12 for covering the upper surface of the body portion 11, and a base 13 for supporting the body portion 11. A loading port 14 is formed in the top plate 12. The loading port 14 is covered with an openable and closable top cover 15.

[0026] An outer tub 20 is elastically suspended and supported in the housing 10 by four hanging bars 21 having a vibration isolating device. The upper surface of the outer tub 20 is covered with an outer tub cover 22. An opening 22a having substantially the same size as the loading port 14 is formed in the outer tub cover 22 at a position opposite to the loading port 14. The opening 22a is covered with an inner cover 23 so that the opening 22a is opened or closed.

[0027] A washing/dewatering tub 24 is disposed in the outer tub 20. The washing/dewatering tub 24 rotates around a rotation axis extending in the vertical direction. A plurality of dewatering holes 24a are formed on the entire inner peripheral surface of the washing/dewatering tub 24. A balance ring 25 is provided on the upper portion of the washing/dewatering tub 24. A pulsator 26 is disposed at the bottom of the washing/dewatering tub 24. A plurality of blades 26a are radially provided on the surface of the pulsator 26.

[0028] A driving unit 30 configured to generate torques for driving the washing/dewatering tub 24 and the pulsator 26 is disposed at the outer bottom of the outer tub 20. The driving unit 30 includes a driving motor 31 and a transmission mechanism 32. The transmission mechanism 32 includes a clutch mechanism 32a. By switching the clutch mechanism 32a, the torque of the driving motor 31 is only transferred to the pulsator 26 in a washing process/a rinsing process so as to only rotate the pulsator 26, and the torque of the driving motor 31 is transferred

to the pulsator 26 and the washing/dewatering tub 24 in the dewatering process so as to integrally rotate the pulsator 26 and the washing/dewatering tub 24.

[0029] A drain outlet 20a is formed at the outer bottom of the outer tub 20. The drain outlet 20a is provided with a drain valve 40 which is connected to a drain hose 41. When the drain valve 40 is opened, water stored in the washing/dewatering tub 24 and the outer tub 20 is discharged to the outside of the machine through the drain hose 41.

[0030] An operation portion 16 is provided on the front portion of the top plate 12. Various operation buttons such as a power button 16a, a start button 16b, a mode selection button 16c, etc. are arranged in the operation portion 16. The power button 16a is a button for turning on and turning off the power of the fully automatic washing and drying machine 1. The start button 16b is a button for starting operations. The mode selection button 16c is a button for selecting an arbitrary operation mode from a plurality of operation modes related to a washing operation, a washing and drying operation and a drying operation.

[0031] An accommodating chamber 100 is provided at the rear portion of the top plate 12, and is closed from the outside. The accommodating chamber 100 is composed of an accommodating recess 101 and a rear cover 102. The accommodating recess 101 has a bottom surface 101a, a front side surface 101b, a rear side surface 101c, a left side surface 101d and a right side surface 101e. The top surface of the accommodating recess 101 is open and covered with the rear cover 102. A hot air supplying unit 50, a water supply unit 60, a water level sensor 70 and the like are arranged in the accommodating chamber 100.

[0032] As shown in FIG. 2, the hot air supplying unit 50 is disposed on the left side of the center in the accommodating chamber 100. The hot air supplying unit 50 includes a casing 51, a fan 52, a heater 53 and a hot air duct 54. The hot air supplying unit 50 is a hot air supplying portion of the present disclosure.

[0033] The casing 51 is in a substantially L-shaped rectangular shape which extends rightward and then bends forward. In the casing 51, an air inlet 51a is formed on the rear surface on the left end side and an air outlet 51b is formed on the bottom surface on the right end side. The air inlet 51a and the rear side face 101c of the accommodating recess 101 are opposed and separated from each other, and no opening communicated with the outside (such as an air intake) is formed in a region opposed to the air inlet 51a. Further, a plurality of first attachment portions 51c used for fixing the hot air supplying unit 50 are provided at appropriate positions of the casing 51.

[0034] The fan 52 is a centrifugal fan, and includes a blower 52a and a motor 52b for rotating the blower 52a. The blower 52a is arranged in the casing 51 so as to face the air inlet 51a. The heater 53 is disposed downstream of the blower 52a in the casing 51. The heater 53 is a

self-temperature controllable PCT heater (a semiconductor heater) for which the lower the temperature of the air to be heated is, the larger the amount of heat generated will be. It is noted that a fan other than the centrifugal fan and a heater other than the PCT heater may be used for the hot air supplying unit 50.

[0035] The hot air duct 54 is formed of an elastic member or the like to have flexibility, and has an end connected to the exhaust port 51b of the casing 51 and the other end connected to the air outlet 20b formed in the outer tub cover 22. The air outlet 20b faces the interior of the washing/dewatering tub 24.

[0036] The water supply unit 60 is disposed on the right side of the center in the accommodating chamber 100. The water supply unit 60 includes a water injection portion 61, a water supply valve 62, a bath water pump 63 and a water supply duct 64. The water injection portion 61 is in a rectangular shape which is long in the front-to-rear direction. A first influx port 61a and a second influx port 61b for taking in tap water and a third influx port 61c for taking in the bath water are formed on the upper surface of the water injection portion 61, and a water injection port 61d is formed at the bottom of the water injection portion 61. In addition, a softener box (not shown) into which the softener is charged is accommodated in the water injection portion 61 so that the softener box can be pulled out from the front. Furthermore, a plurality of second attachment portions 61e used for fixing the water supply unit 60 are provided at appropriate positions in the water injection portion 61.

[0037] The water supply valve 62 is a dual valve having a first outflux port 62a connected to the first influx port 61a and a second outflux 62b connected to the second influx port 61b. A first connection port 62c is formed on the upper surface of the water supply valve 62. The first connection port 62c faces outside while the accommodating recess 101 is covered with the rear cover 102, and a water supply hose (not shown) extending from a faucet is connected to the first connection port 62c.

[0038] A bath water supply hose 63a of the bath water pump 63 is connected to the third influx port 61c. A second connection port 63b is formed on the upper surface of the bath water pump 63. The second connection port 63b faces outside while the accommodating recess 101 is covered with the rear cover 102, and the bath water hose (not shown) is connected to the second connection port 63b. When bath water is supplied from a bathtub, a water inlet at the top end of the bath water hose is immersed in the bathtub.

[0039] The water supply duct 64 is formed of an elastic member or the like to have flexibility. An end of the water supply duct 64 is connected to the water injection port 61d, and the other end of the water supply duct 64 is connected to a water supply port (not shown) formed in the outer tub cover 22.

[0040] When a valve on the side of the first outflux port 62a of the water supply valve 62 is opened, the tap water is taken into the water injection portion 61 through the

first influx port 61a. The taken-in tap water is discharged from the water injection port 61d without passing through the softener box. Likewise, the bath water taken into the water injection portion 61 through the third influx port 61c by the bath water pump 63 is also discharged from the water injection port 61d without passing through the softener box. On the other hand, when a valve on the second outflux port 62b side of the water supply valve 62 is opened, the tap water is taken into the water injection portion 61 through the second influx port 61b. The taken-in tap water passes through the softener box, and is discharged from the water injection port 61d while being mixed with the softener. The tap water and the bath water discharged from the water injection port 61d are supplied into the outer tub 20 via the water supply duct 64.

[0041] The water level sensor 70 is disposed on the right side of the water supply valve 62 in the accommodating chamber 100. An air trap (not shown) is formed at the bottom of the outer tub 20, and the water level sensor 70 and the air trap are connected through an air hose 71. The water level sensor 70 is configured to detect the water level in the washing/dewatering tub 24 (the outer tub 20).

[0042] As shown in FIG. 3, on the bottom surface 101a of the accommodating recess 101, a plurality of first attachment projections 103 corresponding to the first attachment portions 51c are formed at a position where the hot air supplying unit 50 is disposed, and a plurality of second attachment projections 104 corresponding to the second attachment portions 61e are formed at a position where the water supply unit 60 is disposed. Further, on the bottom surface 101a, a sensor mounting portion 105 is formed at a position where the water level sensor 70 is disposed. Moreover, the following openings are formed on the bottom surface 101a: a first opening 106 through which the hot air duct 54 and the water supply duct 64 are passed; a second opening 107 through which electric wires from the hot air supplying unit 50 are passed; a third opening 108 through which electric wires from the water supply unit 60 and the water level sensor 70 are passed and a fourth opening 109 through which the air hose 71 extending from the water level sensor 70 is passed. The first opening 106, the second opening 107, the third opening 108, and the fourth opening 109 correspond to the opening of the present disclosure.

[0043] The first attachment portion 51c is fixed to the first attachment projection 103 by a screw. Thus, the hot air supplying unit 50 is fixed in the accommodating chamber 100 without contacting the bottom surface 101a of the accommodation recess 101. Further, the second attachment portion 61e of the water supply unit 60 is fixed to the second attachment projection 104 by a screw or the like, so that the water supply unit 60 is fixed in the accommodating chamber 100 without contacting the bottom surface 101a of the accommodating recess 101. Moreover, the water level sensor 70 is fixed to the sensor attachment portion 105 without contacting the bottom surface 101a of the accommodating recess 101. In this

manner, since none of the hot air supplying unit 50, the water supply unit 60 and the water level sensor 70 contacts the bottom surface 101a, the first opening 106, the second opening 107, the third opening 108 and the fourth opening 109 are hardly blocked by the hot air supplying unit 50, the water supply unit 60 and the water level sensor 70.

[0044] In the accommodating chamber 100, no intake port for taking air into the accommodating chamber 100 is actively formed on any of the front, rear, right and left, and up and down wall surfaces. However, in the first opening 106, the second opening 107, the third opening 108, and the fourth opening 109 formed in the bottom face 101a of the accommodating recess 101, gaps are generated between these openings 106-109 and the hot air duct 54, the water supply duct 64, various electrical wires, the air hose 71 and the like passing through these openings 106-109. Therefore, in the drying process, these openings 106-109 are served as air intake for taking air into the accommodating chamber 100.

[0045] As shown in FIG. 1, at the side surface on the rear side of the outer tub 20, a discharging port 20c is formed at a lower portion. The discharging port 20c is connected to an exhaust duct 80. The exhaust duct 80 extends upward, and an exhaust port 83 is formed near the upper end thereof. The exhaust duct 80 is the exhaust portion of the present disclosure.

[0046] At a position, which is opposed to the exhaust port 83, on the rear surface of the body portion 11 of the housing 10, an external exhaust port 11a constituted by a plurality of holes are formed. Ideally, even if the vertical position of the outer tub 20 changes depending on the weight of the washings thrown into the washing/dewatering tub 24 while the vertical position of the exhaust port 11a of the exhaust duct 80 is varied accordingly, at least a part of the exhaust port 83 does not deviate from the external exhaust port 11a, and preferably, the whole exhaust port 83 does not deviate from the external exhaust port 11a.

[0047] FIG. 4 is a view illustrating the outer tub 20 to which the exhaust duct 80 is attached as viewed from the rear. FIG. 5 is a longitudinal sectional view of essential parts of the outer tub 20 and the exhaust duct 80 cut at the central portion in the left-right direction of the exhaust duct 80. FIG. 6(a) is a sectional view of the exhaust duct 80 taken along line A-A' in FIG. 5, and FIG. 6(b) is a sectional view of the exhaust duct 80 taken along line B-B' in FIG. 5. It is noted that, the exhaust port 83 is drawn with a dot dash line in FIG. 6(a) for convenience.

[0048] A detailed configuration of the exhaust duct 80 is described with reference to FIGS. 4 to 6.

[0049] The exhaust duct 80 is formed by overlapping a first casing 81 facing the housing 10 and a second casing 82 facing the outer tub 20 in the front and rear direction, and bonding a flange portion 81a of the first casing 81 to a flange portion 82a of the second casing 82 through a bonding method such as vibration welding to seal water. The exhaust duct 80 has a substantially

cuboid shape that is long in the vertical direction and flat in the front-rear direction. On a surface facing the housing 10 of the exhaust duct 80, a substantially rectangular exhaust port 83 is formed at the upper end of the exhaust duct 80. On a surface facing the outer tub 20 of the exhaust duct 80, an intake port 84 is formed at the lower end of the exhaust duct 80. The intake port 84 has a cylindrical shape and protrudes into the exhaust duct 80. The width of the lower end of the exhaust duct 80 in the left-right direction gradually decreases toward the intake port 84.

[0050] The discharging port 20c formed at the lower portion of the side surface of the outer tub 20 has a cylindrical shape and protrudes outward. The outer diameter of the discharging port 20c is equal to the inner diameter of the intake port 84 of the exhaust duct 80. The exhaust duct 80 is fixed to the outer tub 20 in such a manner that the intake port 84 is fitted into the discharging port 20c of the outer tub 20 and the surface facing the outer tub 20 is brought into close contact with the outer tub 20. At this time, the discharging port 20c and the intake port 84 are connected in a water-sealed state by using a sealing element or the like.

[0051] An overflow chamber 90 is formed at the upper part of the outer tub 20. For the overflow chamber 90, the upper side of a front wall 91 is opened toward the outer tub 20. When the water level in the outer tub 20 exceeds the height of the front wall 91, the water overflowing from the outer tub 20 flows into the overflow chamber 90. An overflow opening 92 is formed at the bottom of the overflow chamber 90. A tip end 93a of an overflow pipe 93 extending from the overflow opening 92 is connected to an overflow hose (not shown) extending to the drain hose 41. The water overflowing the overflow chamber 90 is discharged from the overflow opening 92, and is guided to the drain hose 41 through the overflow pipe 93 and the overflow hose. The exhaust port 83 of the exhaust duct 80 is formed at a position the height of which is higher than that of the front wall 91, i.e. overflow water level L_{ofw}. Since the overflow level L_{ofw} is higher than the highest water level L_{max} among the water levels determined according to the amount of the washings, the position of the exhaust port 83 is higher than the maximum water level L_{max}.

[0052] The water accumulated in the exhaust duct 80 has the same level as the level of the water stored in the outer tub 20 during the washing process. In the present embodiment, since the exhaust port 83 of the exhaust duct 80 is formed at a position higher than the overflow level L_{ofw}, it is possible to prevent the water from leaking from the exhaust port 83 during the washing process.

[0053] Two first barriers 85 and two second barriers 86 are arranged inside the exhaust duct 80. The first barriers 85 protrude from the left or right inner wall surface at the upper side of the exhaust duct 80, the second barriers 86 protrude from the left or right inner wall surface at the lower side of the exhaust duct 80. The protrusion length of the first barriers 85 is smaller than the protrusion

length of the second barriers 86. Moreover, the first barrier 85, the second barrier 86 on the right side and the first barrier 85, the second barrier 86 on the left side are formed at different height positions of the exhaust duct 80.

[0054] When the pulsator 26 rotates during the washing process, since the surface of the water fluctuates in the outer tub 20 and the exhaust duct 80, the water may rise to a higher position in the exhaust duct 80. However, in the present embodiment, since the first barriers 85 and the second barriers 86 can suppress the rise of water due to the fluctuation, the water is more difficult to leak from the exhaust port 83 during the washing.

[0055] It is desirable that at least the first barriers 85 located at the highest position in the exhaust duct 80 is arranged at a position higher than the overflow water level Lofw. In addition, the protrusion length of the first barriers 85 and the protrusion length of the second barriers 86 may be the same. Further, the first barrier 85, the second barrier 86 on the right side and the first barrier 85, the second barrier 86 on the left side may be formed at the same height position of the exhaust duct 80.

[0056] FIG. 7 is a block diagram illustrating a configuration of the fully automatic washing and drying machine 1.

[0057] The fully automatic washing and drying machine 1 further includes a controlling unit 200 in addition to the components described above. The controlling unit 200 includes a controller 201, a memory 202, a motor driver 203, a clutch driver 204, a water supply driver 205, a pump driver 206, a drain driver 207, a fan driver 208, and a heater driver 209.

[0058] The operation portion 16 outputs, to the controller 201, a signal input from a button operated by the user among various buttons such as the power button 16a, the start button 16b, the mode selection button 16c and the like. The water level sensor 70 is configured to detect the water level in the outer tub 20 and output a water level detection signal corresponding to the detected water level to the controller 201.

[0059] The motor driver 203 is configured to drive a driving motor 31 according to a control signal from the controller 201. The clutch driver 204 is configured to drive a clutch mechanism 32a according to the control signal output from the controller 201.

[0060] The water supply driver 205 is configured to drive the water supply valve 62 according to a control signal from the controller 201. The pump driver 206 is configured to drive the bath water pump 63 according to a control signal from the controller 201. The drain driver 207 is configured to drive the drain valve 40 according to a control signal from the controller 201.

[0061] The fan driver 208 is configured to drive the fan 52 according to a control signal output from the controller 201. The heater driver 209 is configured to drive the heater 53 according to a control signal output from the controller 201.

[0062] The memory 202 includes an electrically eras-

able programmable read-only memory (EEPROM), a random access memory (RAM) and the like. A program for executing a washing operation, a washing-drying operation, and a drying operation of various operation modes is stored in the memory 202. In addition, various parameters and various control flags used for executing these programs are stored in the memory 202.

[0063] Based on signals from the operation portion 16, the water level sensor 70 and the like, the controller 201 controls the motor driver 203, the clutch driver 204, the water supply driver 205, the pump driver 206, the drain driver 207, the fan driver 208, the heater driver 209, and the like according to the program stored in the memory 202.

[0064] In the fully automatic washing and drying machine 1, the washing operation, the washing-drying operation, or the drying operation of various operation modes is performed. The washing operation is an operation in which only the washing is performed, and a washing process, an intermediate dewatering process, a rinsing process and a final dewatering process are sequentially executed. The washing-drying operation is an operation in which the washing process and the drying process are performed continuously, that is, the drying process is performed immediately after the final dewatering process. The drying operation is an operation in which only the drying process is performed.

[0065] In the washing process and the rinsing process, the pulsator 26 rotates in the right direction and the left direction while the water is stored in the washing/dewatering tub 24. A water flow is generated in the washing/dewatering tub 24 by the rotation of the pulsator 26. During the washing process, the washings are washed by the water flow generated and the detergent contained in the water. During the rinsing process, the washings are rinsed by the water flow generated.

[0066] In the intermediate dewatering process and the final dewatering process, the washing/dewatering tub 24 and the pulsator 26 integrally rotate at a high speed. The washings are dewatered by the action of the centrifugal force generated in the washing/dewatering tub 24.

[0067] In the drying process, the hot air is supplied from the hot air supplying unit 50 into the outer tub 20 by operating the fan 52 and the heater 53. In the washing/dewatering tub 24, the pulsator 26 repeatedly rotates clockwise and counterclockwise. The washings in the washing/dewatering tub 24 contact the hot air guided into the washing/dewatering tub 24 while being stirred by the pulsator 26, and thus are dried.

[0068] FIG. 8 is a flowchart illustrating operation control actions in the drying process.

[0069] In the present embodiment, a heating-drying operation and a residual heat drying operation following the heating-drying operation are performed during the drying process. Hereinafter, the drying process will be described in detail with reference to FIG. 8.

[0070] When the drying process is started, the controller 201 first executes the heating-drying operation. That

is, the controller 201 controls the fan driver 208 to operate the fan 52 at a first rotation speed (S1), and controls the heater driver 209 to operate the heater 53 (S2). The first rotation speed is, for example, 3500 rpm. Further, the controller 201 controls the motor driver 203 to operate the driving motor 31, so as to drive the pulsator 26 to perform an inverse operation in left- right direction (S3). For example, the ON/OFF time of the inversion operation is set as follows: ON for 3 seconds, and OFF for 1.5 seconds. The ON time in the drying process is longer than the ON time of the usual washing process or the rinsing process, and the washings are actively moved in the washing/dewatering tub 24 by the inversion operation of the pulsator 26 having such long ON time.

[0071] When the fan 52 rotates, the air is taken into the accommodating chamber 100 from the space between the housing 10 and the outer tub 20 through the first opening 106, the second opening 107, the third opening 108, and the fourth opening 109 on the bottom surface 101a of the accommodating chamber 100. The taken-in air flows in the accommodating chamber 100, and flows toward the air inlet 51a provided in the casing 51 of the hot air supplying unit 50, and is sucked into the casing 51 from the air inlet 51a. The sucked air is heated by the heater 53 to become hot air, and is blown into the outer tub 20 from the above through the hot air duct 54. In the outer tub 20, the washings in the washing/dewatering tub 24 are stirred by repeating the right-left inversion operation of the pulsator 26. The hot air blown into the outer tub 20 is blown into the washing/dewatering tub 24 from the above, and comes in contact with the washings stirred in the washing/dewatering tub 24 to take away moisture from the washings. As a result, the washings are dried. The air that has taken away moisture from the washings passes through the dewatering holes 24a and the like of the washing/dewatering tub 24, flows between the washing/dewatering tub 24 and the outer tub 20, and is discharged from the discharging port 20c provided at the lower portion of the side surface of the outer tub 20. The discharged air flows in the exhaust duct 80, and is discharged out of the machine through the exhaust port 83 of the exhaust duct 80 and the external exhaust port 11a of the housing 10. It is noted that a flow of air in the heating-drying operation is indicated by arrows in FIG. 1.

[0072] As the heating-drying operation proceeds, the casing 51 of the hot air supplying unit 50 and the outer tub 20 are heated by the heat of the hot air. In this way, the air heated by the heat emitted from the outer tub 20 is taken into the accommodating chamber 100, and the air flowing in the accommodating chamber 100 is further heated by the heat emitted from the casing 51. In this manner, the air having a higher temperature than the air outside the fully automatic washing and drying machine 1 is taken into the air inlet 51a of the hot air supplying unit 50. As a result, as compared with the case where the external air is directly taken into the hot air supplying unit 50, the amount of heating of the heater 53 is suppressed and the power consumption is suppressed.

[0073] The controller 201 determines whether a preset heating-drying time has elapsed (S4). When the preset heating-drying time has elapsed (S4: YES), the controller 201 stops the heater 53 (S5). At this time, the heating-drying operation is completed.

[0074] Next, the controller 201 executes the residual heat drying operation. The controller 201 controls the rotation speed of the fan 52 to increase, so as to cause the fan 52 to operate at a second rotation speed higher than the first rotation speed (S6). The second rotation speed is, for example, 5000 rpm.

[0075] The air heated by the residual heat of the outer tub 20 and the casing 51 is taken into the air inlet 51a of the hot air supplying unit 50, and the air is supplied to the outer tub 20 as air having residual heat without being heated by the heater 53. The washings in the washing/dewatering tub 24 come into contact with the air having residual heat, and are dried. Herein, since the rotation speed of the fan 52 is increased, the volume of the air having residual heat is larger than the volume of the hot air during the heating-drying operation. Therefore, it is possible to compensate for the decrease in drying efficiency due to a decrease in the temperature of the air contacting the washings by increasing the volume of the air.

[0076] The controller 201 determines whether a preset residual heat drying time has elapsed (S7). When the residual heat drying time has elapsed (S7: YES), the controller 201 stops the fan 52 (S8), and stops the driving motor 31 to stop the pulsator 26 (S9). At this time, the residual heat drying operation is completed, and the drying process is completed.

Effect of the Present Embodiment

[0077] As described above, according to the present embodiment, since the discharging port of the air from the outer tub 20 is formed at the lower part of the outer tub 20, the hot air fed into the outer tub 20 from the above easily travels to the lower part of the water tub 24. As a result, the hot air easily permeates the washings in the washing/dewatering tub 24 so that the improvement in drying efficiency can be expected.

[0078] Further, according to the present embodiment, the exhaust duct 80 connected to the discharging port 20c and extending upward is provided, and the exhaust port 83 is provided at a position higher than the overflow water level Lofw where water is overflowed from the outer tub 20. Thus, the water accumulated in the outer tub 20 will not leak during the washing process, and the air exhausted from the discharging port 20c can be discharged during the drying process. Thereby, it is possible to provide the air discharging port 20c at the lower part of the outer tub 20 without considering the water leakage during the washing process.

[0079] Furthermore, according to the present embodiment, the air inlet 51a of the hot air supplying unit 50 is arranged to be opposed to and separated from the rear

side face 101c of the accommodating chamber 100, so that the air flowing in the accommodating chamber 100 is taken into the air inlet 51a by operating the fan 52. As a result, since the heater 53 is used to heat the air heated by the heat from the hot air supplying unit 50, the heating amount of the heater 53 can be suppressed, and the power consumption of the heater 53, that is, the fully automatic washing and drying machine, can be suppressed.

[0080] Furthermore, according to the present embodiment, through the first opening 106, the second opening 107, the third opening 108, and the fourth opening 109 formed in the bottom surface 101a of the accommodating chamber 100, the air heated by the heat from the outer tub is taken into the accumulating chamber 100 from the space between the housing 10 and the outer tub 20. As a result, the further heated air can be taken into the air inlet 51a of the hot air supplying unit 50, and the heating amount of the heater 53 can be further suppressed.

[0081] Furthermore, according to the present embodiment, during the drying process, the residual heat drying operation, in which the air heated by the residual heat of the hot air supplying unit 50 and the outer tub 20 is supplied to the outer tub 20 as air having residual heat, is performed immediately after the heating-drying operation, in which the air heated by the heater 53 is supplied to the outer tub 20 as the hot air. As a result, the residual heat of the hot air supplying unit 50 and the outer tub 20 can be used to dry the washings. Therefore, the power consumption of the fully automatic washing and drying machine 1 during the drying process can be suppressed.

[0082] Although the embodiment of the present disclosure has been described above, the present disclosure is not limited by the above-described embodiment. In addition, various modifications can be made to the embodiments besides the above embodiment.

<Modification I>

[0083] FIG. 9 is a sectional view illustrating main parts of the fully automatic washing and drying machine 1 according to modification I.

[0084] In the above embodiment, the exhaust duct 80 is provided on the downstream of the discharging port 20c of the outer tub 20. In contrast, in this modification, an opening/closing valve 110 for opening and closing the discharging port 20c is arranged at the discharging port 20c to replace the exhaust duct 80, as shown in FIG. 9. Under the control of the controller 201, the opening/closing valve 110 is closed in the washing process, the rinsing process, the intermediate dewatering process and the final dewatering process, and is opened in the drying process. In this modification, the opening/closing valve 110 is the exhaust portion of the present disclosure.

[0085] Similar to the embodiment described above, with the configuration of this modification, the water stored in the outer tub 20 will not leak during the washing process, and the air flowing from the discharging port

20c can be discharged during the drying process.

<Modification II>

[0086] FIG. 10 is a sectional view illustrating main parts of the fully automatic washing and drying machine 1 according to modification II.

[0087] In this modification, as shown in FIG. 10, the exhaust port 83 is provided with an exhaust fan 120. For example, an axial flow fan is used as the exhaust fan 120. In the drying process, the exhaust fan 120 operates under the control of the controller 201.

[0088] With the configuration of this modification, the air in the outer tub 20 can be drawn strongly into the exhaust duct 80 through the discharging port 20c, thus the air in the outer tub 20 easily flows to the discharging port 20c. As a result, the heat air fed into the outer tub 20 from the above is more easily distributed to the lower portion of the washing/dewatering tub 24 so that a further improvement in drying efficiency can be expected.

<Modification III>

[0089] FIG. 11 is a side sectional view of the fully automatic washing and drying machine 1 according to modification III.

[0090] In the above embodiment, the air is taken into the accommodating chamber 100 from the space between the housing 10 and the outer tub 20, and the air flowing in the accommodating chamber 100 is taken into the air inlet 51a of the hot air supplying unit 50. In contrast, in this modification, a hot air supplying unit 50A having the air inlet 51a on the lower surface of the casing 51A is disposed in the accommodating chamber 100. An air intake 130 connected to the space between the housing 10 and the outer tub 20 is formed on the bottom surface 101a in the accommodating chamber 100, so that the air intake 130 and the air inlet 51a are opposed to each other. In this configuration, the air passes the air intake 130 through the space between the housing 10 and the outer tub 20, and is directly taken into the air inlet 51a of the hot air supplying unit 50A. The air intake 130 is the opening of the present disclosure.

[0091] According to the configuration of this modification, the air heated by the heat from the outer tub 20 can also be taken into the hot air supplying unit 50A. Therefore, similar to the above embodiment, the power consumption of the fully automatic washing and drying machine during the drying process can be suppressed.

<Other Modifications>

[0092] In the above embodiment, the air is taken into the accommodating chamber 100 from the space between the housing 10 and the outer tub 20 through the first opening 106 and the like. However, an intake port for taking in the air outside the fully automatic washing and drying machine 1 may be provided at a position distant

from the hot air supplying unit 50, that is, the position in the vicinity of the right side surface 101e, the rear side surface 101c of the accommodating chamber 100. In this case, the external air taken into the accommodating chamber 100 through the air inlet is heated by the heat generated by the casing 51 of the hot air supplying unit 50, and then taken into the air inlet 51a of the hot air supplying unit 50. Therefore, even with such a configuration, the power consumption of the fully automatic washing and drying machine 1 during the drying process can be suppressed.

[0093] In the above-described embodiment, the discharging port 20c and the exhaust duct 80 are provided at the lower portion of the side surface of the outer tub 20 facing the rear surface of the housing 10. However, the discharging port 20c and the exhaust duct 80 may be provided at the lower portion of the side surface of the outer tub 20 facing the right side surface or the left side surface of the housing 10. In addition, the discharging port 20c may be provided at any position at the lower portion of the outer tub 20. For example, it may be provided at the bottom face instead of the side face of the outer tub 20.

[0094] Furthermore, in the embodiment described above, the fully automatic washing and drying machine 1 with the washing/dewatering tub 24 rotating about the rotation axis extending in the vertical direction has been exemplified. However, the present disclosure may also be applied to a fully automatic washing and drying machine with a washing/dewatering tub which rotates about a rotation axis inclined with respect to the vertical direction.

[0095] Moreover, the embodiments of the present disclosure can be variously modified within the scope of the technical idea disclosed in the claims.

Claims

1. A washing and drying machine, comprising:

an outer tub elastically supported in a housing;
a washing/dewatering tub rotatably arranged in the outer tub;
a hot air supplying portion comprising a heater and a fan, wherein air heated by the heater is supplied into the washing/dewatering tub by the fan from an upper part of the outer tub; and
a discharging port arranged at a lower part of the outer tub and configured to discharge the air that has been in contact with washings in the washing/dewatering tub.

2. The washing and drying machine according to claim 1, further comprising an exhaust portion, wherein no water stored in the outer tub leaks through the exhaust portion during a washing process, and the air discharged from the discharging port is discharged

through the exhaust portion during a drying process.

3. The washing and drying machine according to claim 2, wherein the exhaust portion comprises an exhaust duct connected to the discharging port and extending upward, and the exhaust duct has an exhaust port located at a position higher than a water overflowing level at which the water overflows from the outer tub.

4. The washing and drying machine according to any one of claims 1 to 3, wherein the housing comprises a top plate having a loading port for the washings, the hot air supplying portion is disposed in an accommodating chamber provided on the top plate, and an air inlet of the hot air supplying portion is arranged to be opposed to and separated from an inner wall surface of the accommodating chamber, wherein the air flowing in the accommodating chamber is taken into the air inlet by the fan.

5. The washing and drying machine according to claim 4, wherein the accommodating chamber has an opening communicating with a space between the housing and the outer tub, and the air in the space is taken into the accommodating chamber by the fan and flows in the accommodating chamber.

6. The washing and drying machine according to any one of claims 1 to 3, wherein the housing comprises a top plate having a loading port for washings, the hot air supplying portion is disposed in an accommodating chamber provided on the top plate, the accommodating chamber has an opening communicating with a space between the housing and the outer tub, and an air inlet of the hot air supplying portion is arranged to be opposed to the opening, and the air in the space is taken into the air inlet by the fan.

7. The washing and drying machine according to any one of claims 4 to 6, further comprising a controller configured to perform a first drying operation and a second drying operation, wherein in the first drying operation, the heater and the fan are operated to supply the air heated by the heater into the outer tub from the hot air supplying portion, and the second drying operation follows the first drying operation, in the second drying operation, the heater is stopped and the fan is operated, so that the air being not heated by the heater is supplied into the outer tub from the hot air supplying portion.

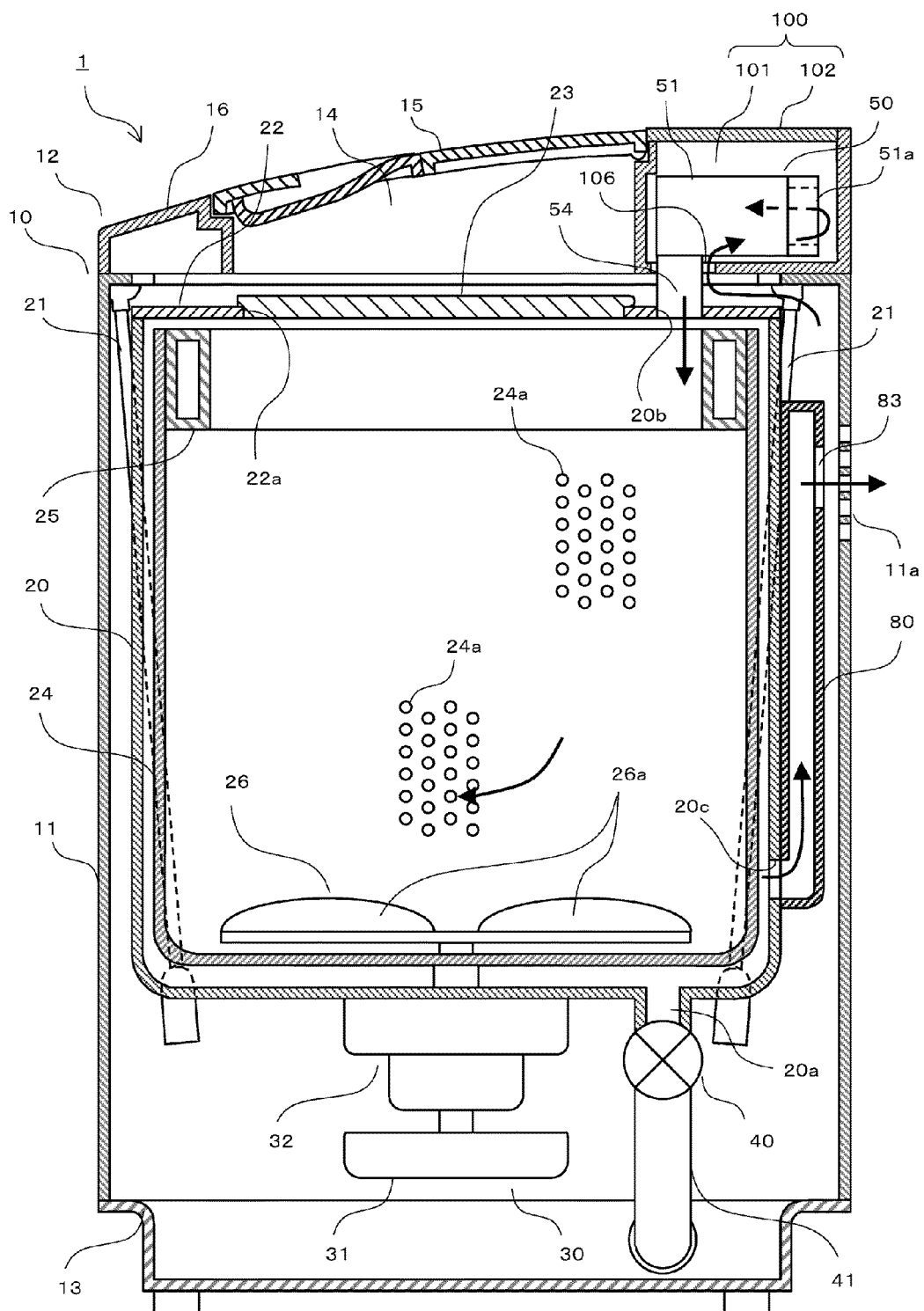


FIG. 1

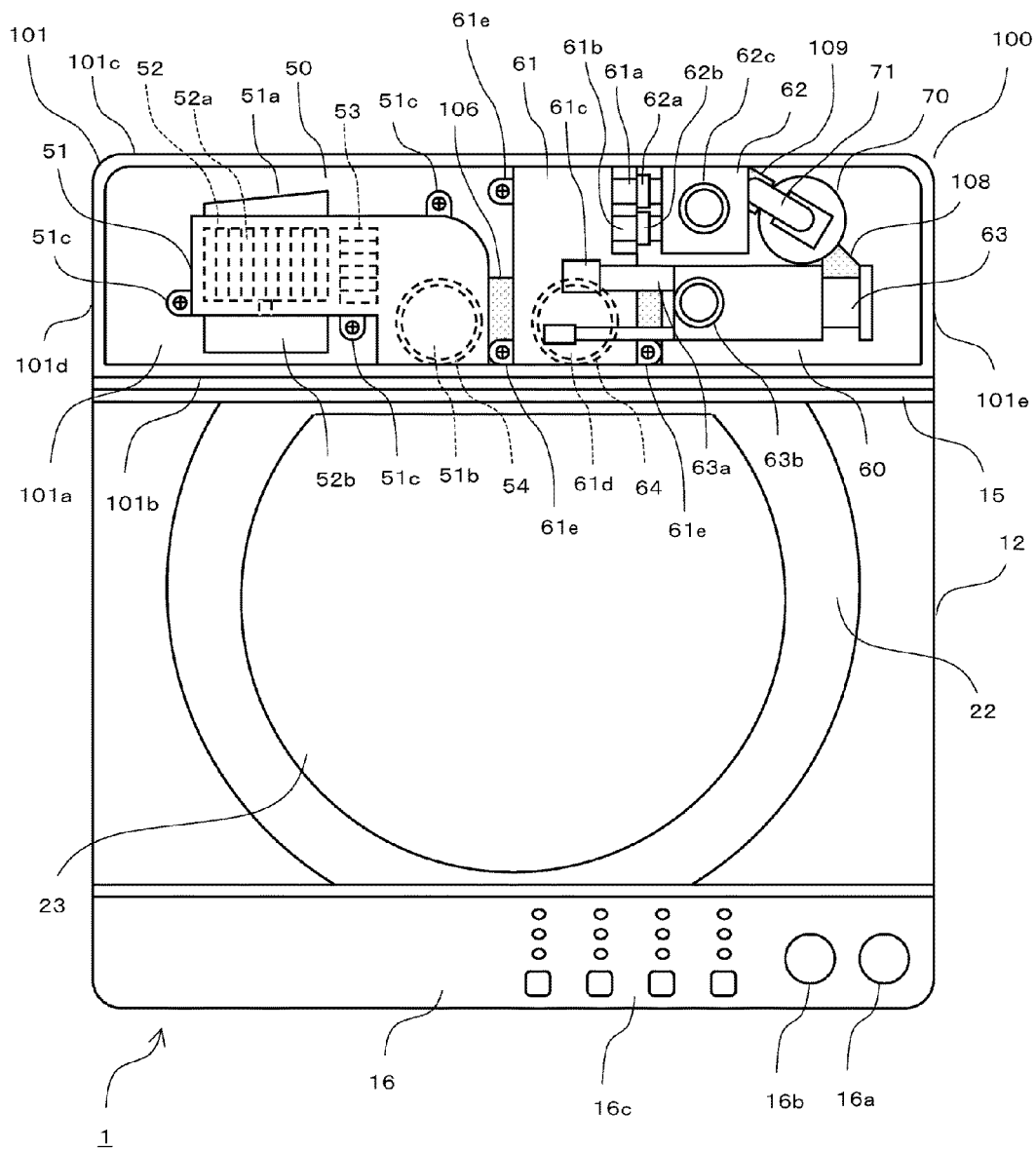


FIG. 2

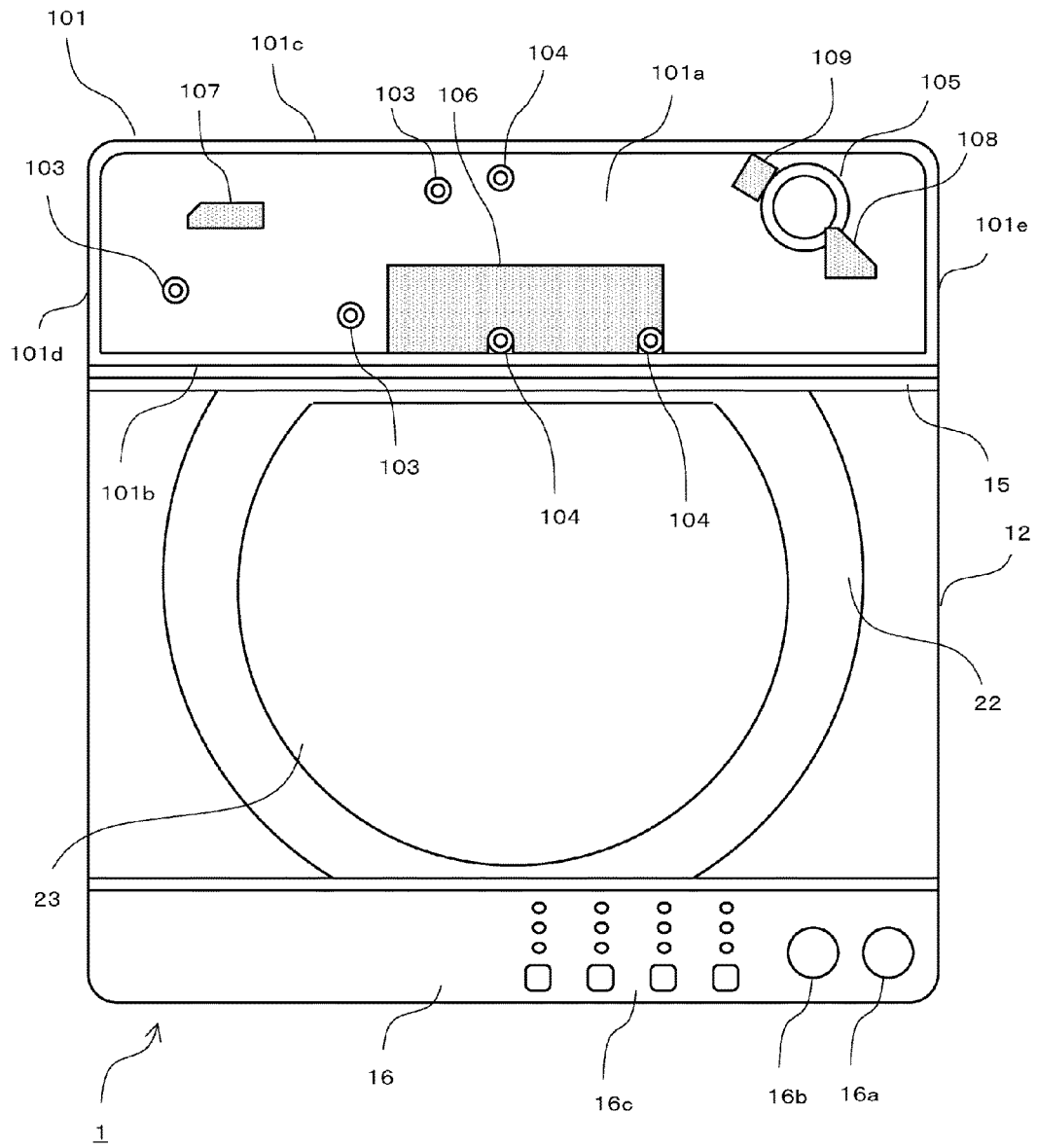


FIG. 3

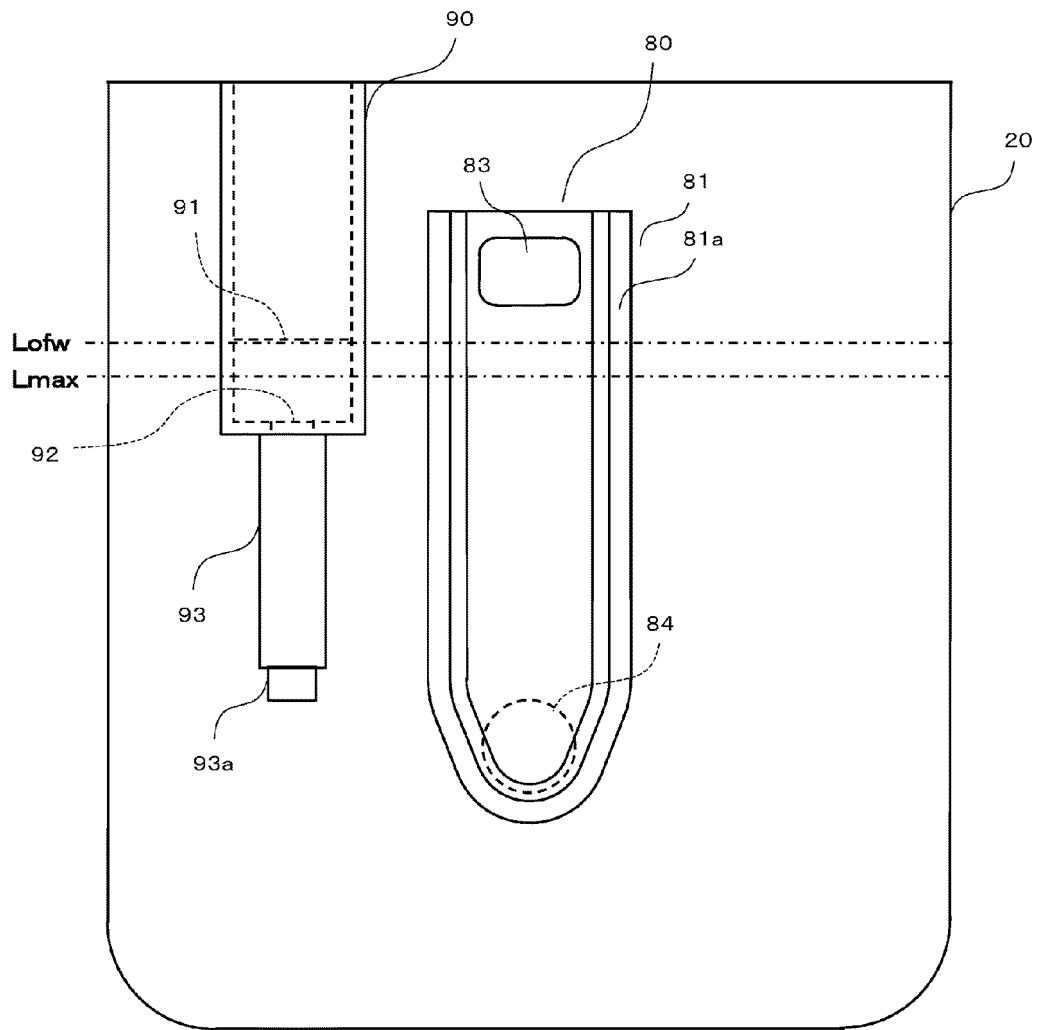


FIG. 4

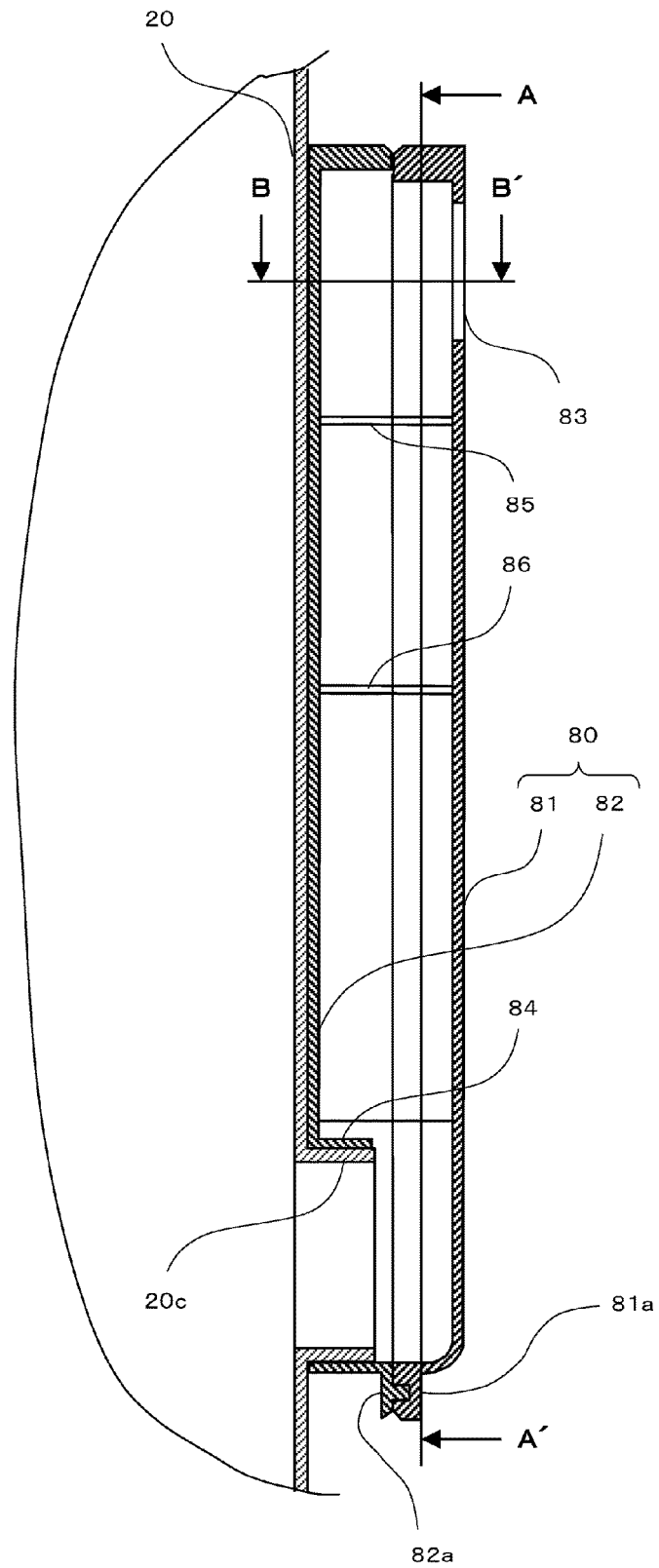


FIG. 5

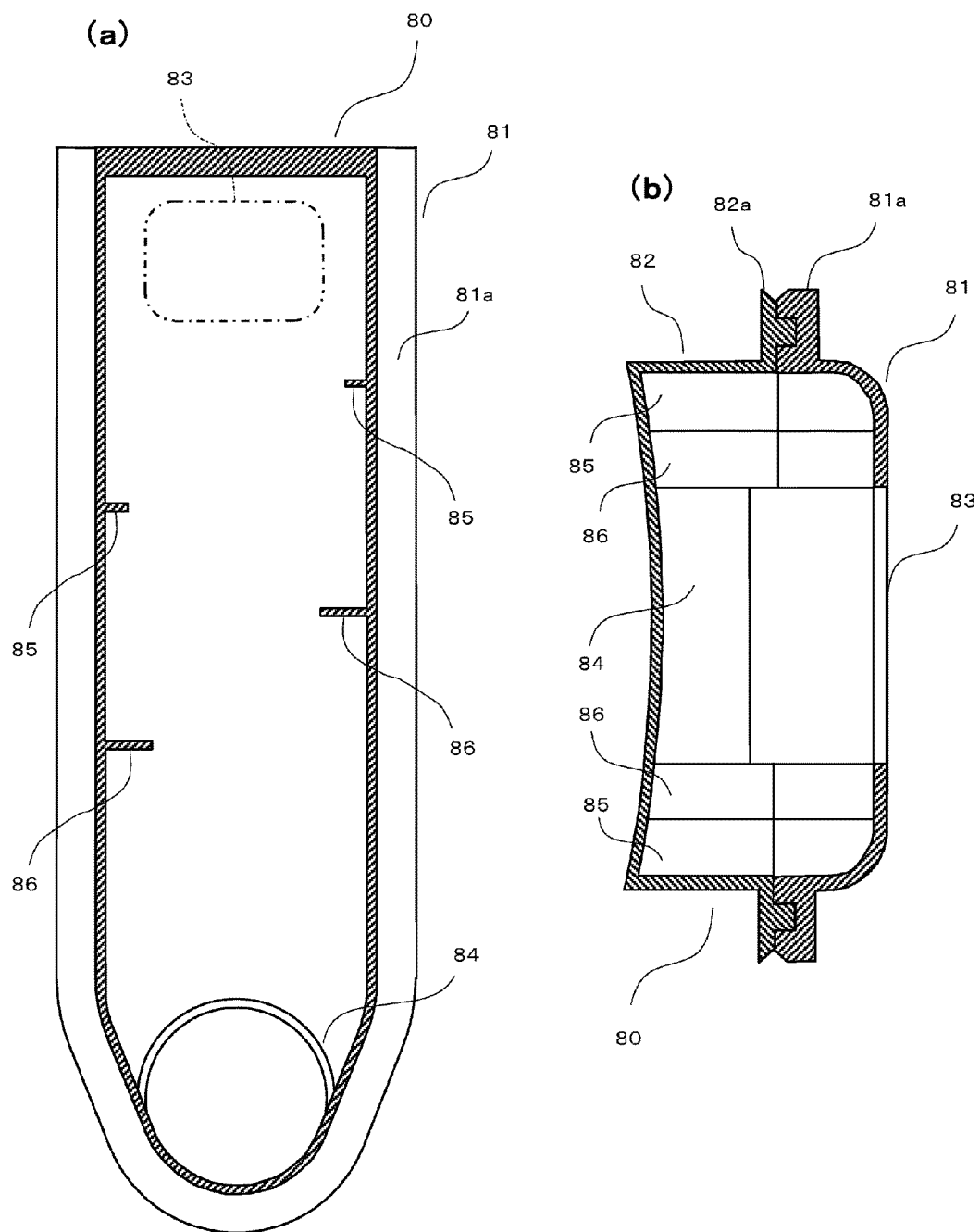


FIG.6

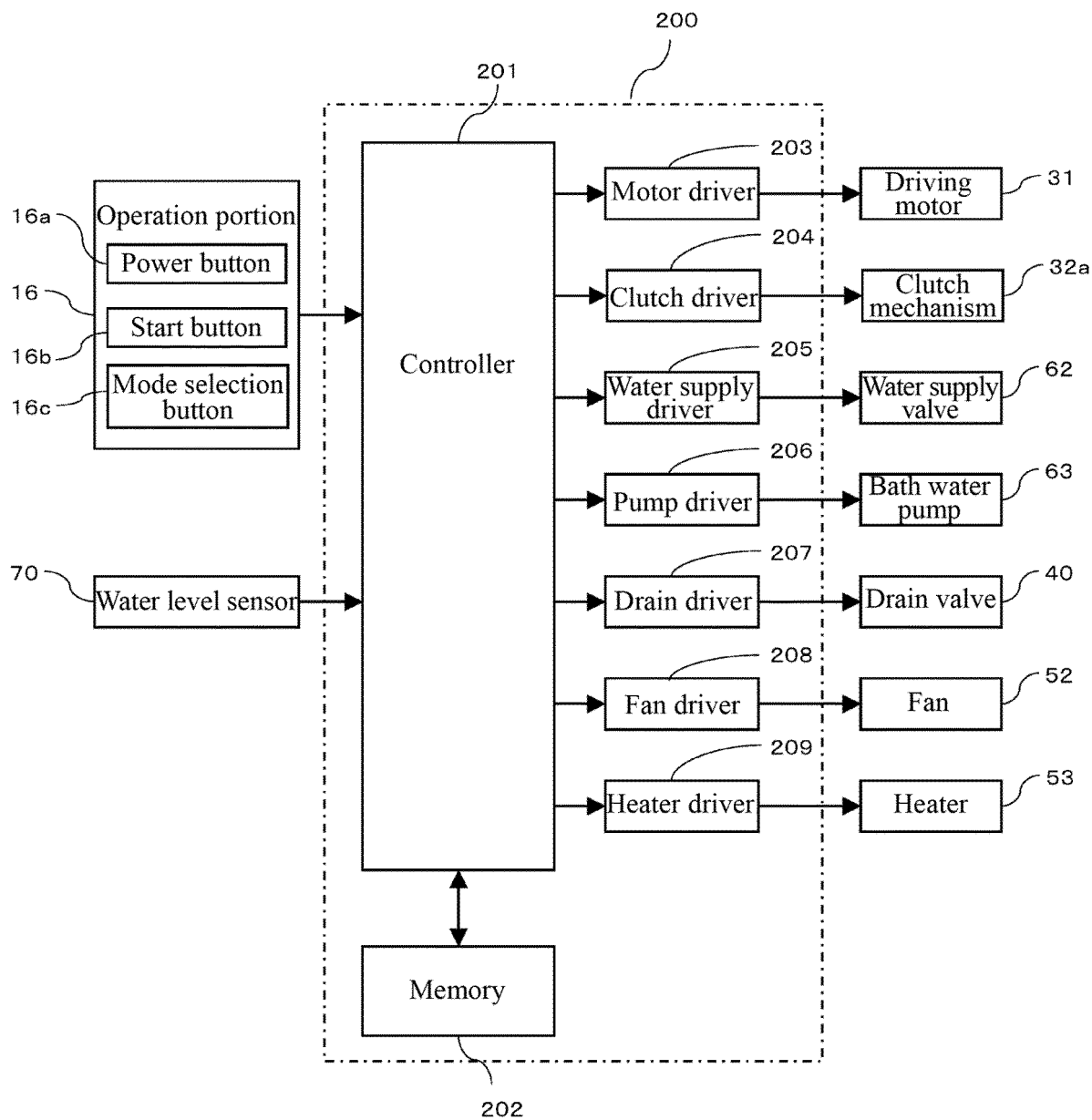
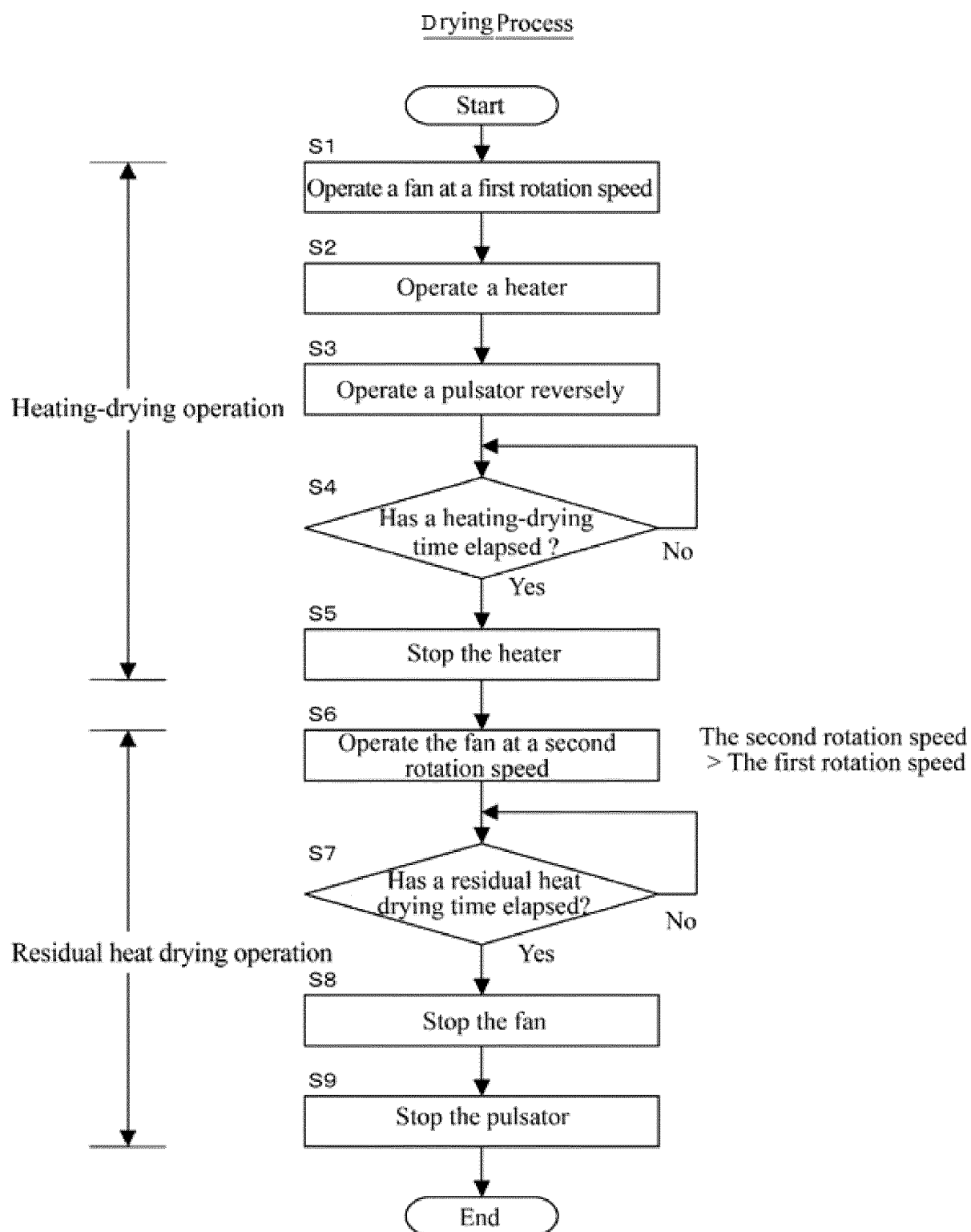


FIG.7

**FIG.8**

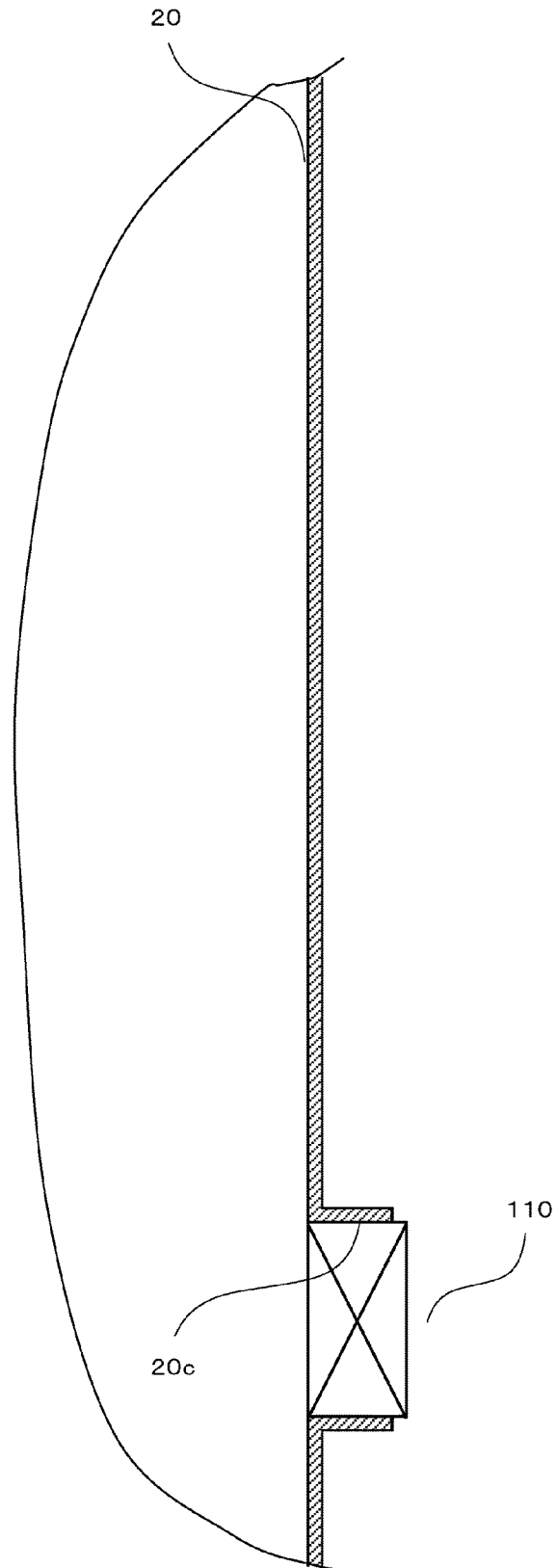


FIG.9

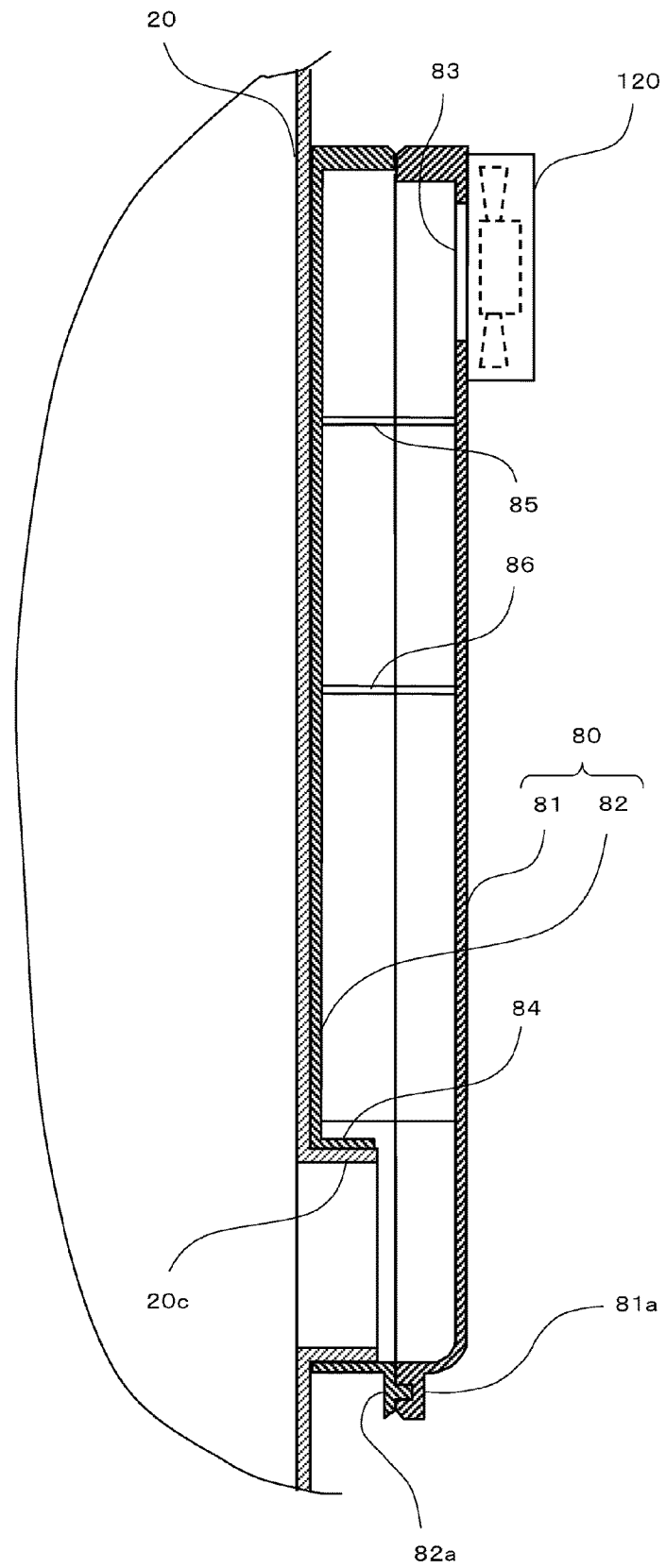


FIG.10

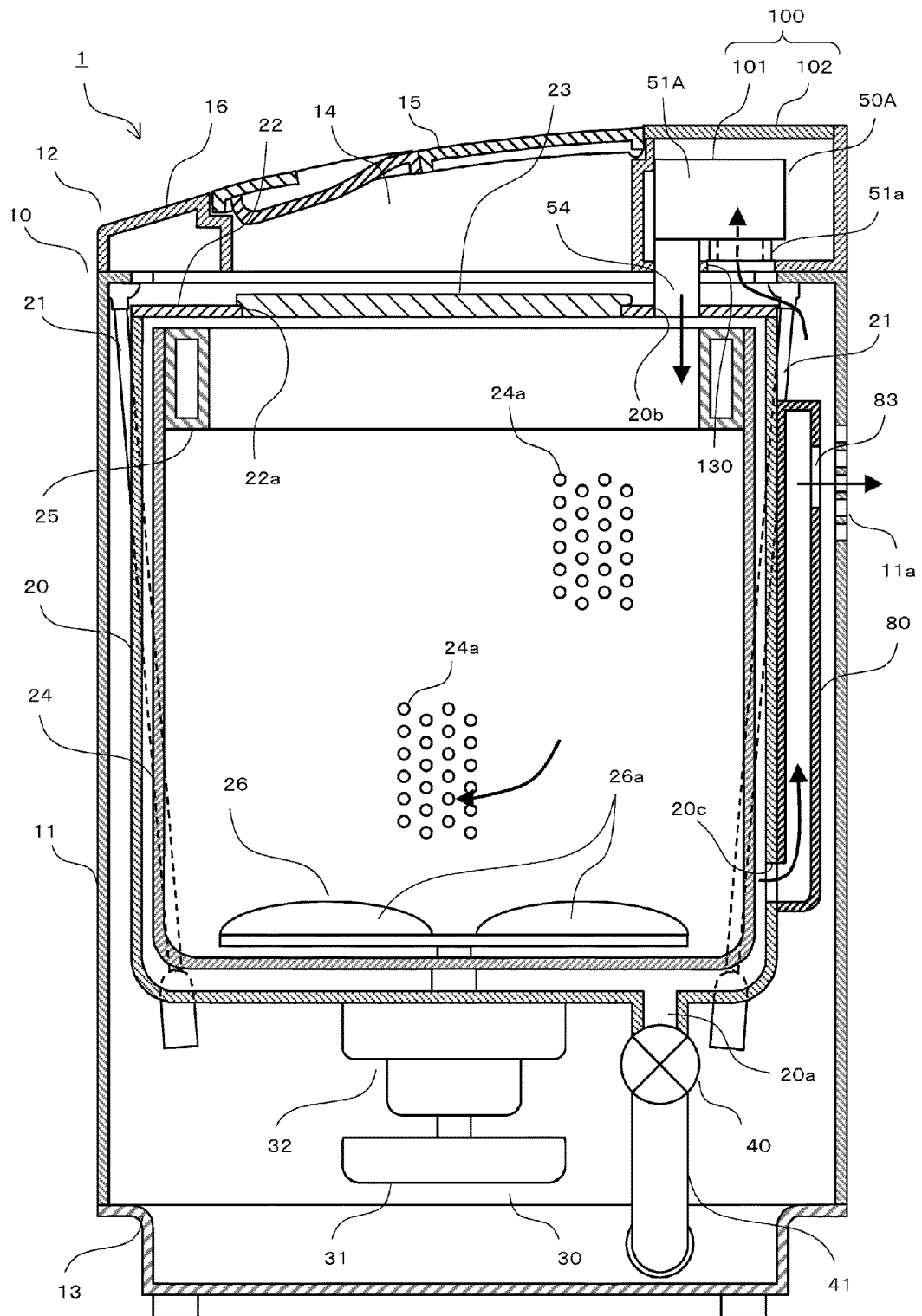


FIG.11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/101566

A. CLASSIFICATION OF SUBJECT MATTER

D06F 25/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, DWPI, SIPOABS: lower, upper, inner barrel, barrel, discharge, wind, air, upper, top, bottom, under+, inlet, outlet, dry???, tub, drum

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	CN 104593992 A (HAIER ELECTRONICS GROUP CO., LTD. et al.), 06 May 2015 (06.05.2015), description, paragraphs 8-12, and figure 1	1-3
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☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT
 Information on patent family members

International application No.

PCT/CN2016/101566

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