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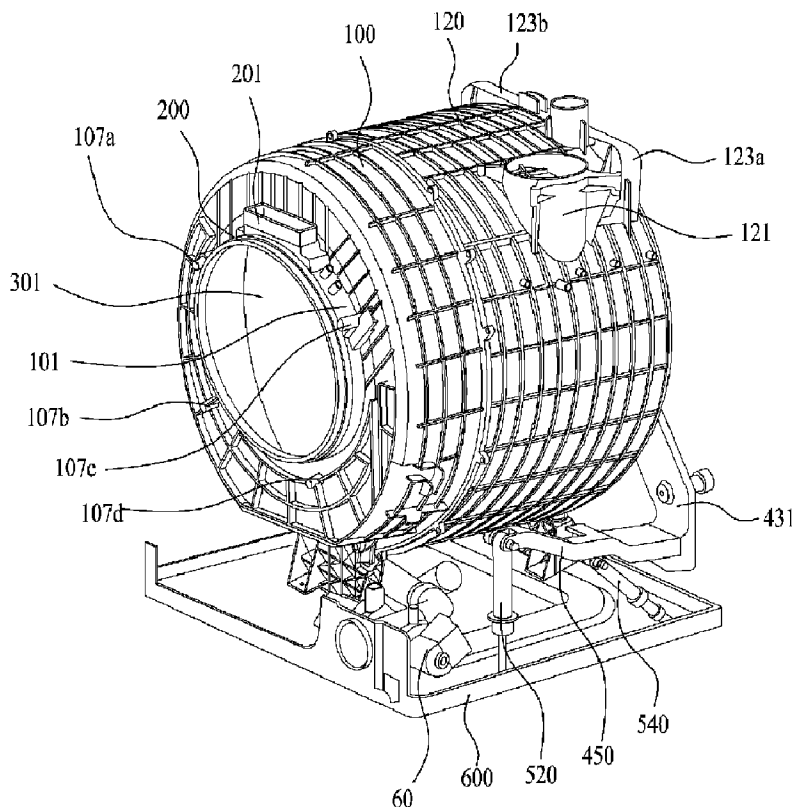
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(54) **Titre : MACHINE A LAVER A VIBRATION REDUITE DU TAMBOUR**

(54) **Title: LAUNDRY MACHINE WITH REDUCED DRUM VIBRATION**



(57) **Abrégé/Abstract:**

Disclosed is a laundry machine in which a tub (100, 120) is isolated from vibrations of a drum (301), ensuring an increasing size of the tub (100, 120) and an increasing volume of the tub (100, 120). This results in an increased capacity of the laundry machine.

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(57) **Abrégé(suite)/Abstract(continued):**

The increased size of the tub (100, 120) provides a sufficient space between the tub (100, 120) and a cabinet (600, 620, 630, 640) for installation of relevant constituent elements, thus accomplishing a compact interior structure of the laundry machine.

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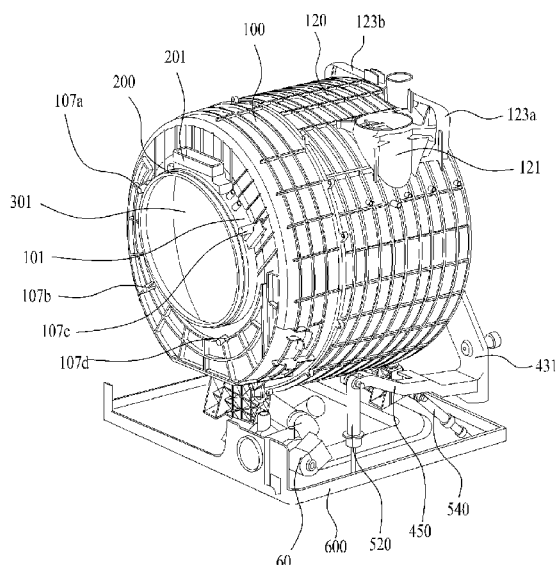
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(54) Title: LAUNDRY MACHINE

[Fig. 1]



(57) Abstract: Disclosed is a laundry machine in which a tub (100, 120) is isolated from vibrations of a drum (301), ensuring an increasing size of the tub (100, 120) and an increasing volume of the tub (100, 120). This results in an increased capacity of the laundry machine. The increased size of the tub (100, 120) provides a sufficient space between the tub (100, 120) and a cabinet (600, 620, 630, 640) for installation of relevant constituent elements, thus accomplishing a compact interior structure of the laundry machine.

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Description

Title of Invention: LAUNDRY MACHINE WITH REDUCED DRUM VIBRATION

Technical Field

- [1] The present invention relates to a laundry machine to process laundry.
- [2] In general, examples of laundry machines may include washing machines and drying machines. Washing machines may be classified into pulsator type washing machines and drum washing machines. Some of these washing machines may be combined washing and drying machines, which are capable of performing a drying operation, rather than performing only a washing operation.
- [3] Drying machines may be one kind of laundry machines to dry wet laundry using, for example, hot air.

Background Art

- [4] Drum washing machines may be configured in such a way that a tub may be horizontally arranged and in turn, a drum may also be horizontally arranged in the tub. Laundry may be accommodated within the drum, so as to be tumbled and washed during rotation of the drum.
- [5] The tub may serve to receive wash water therein, and the drum may accommodate laundry to enable laundry washing.
- [6] The drum may be rotatably installed within the tub.
- [7] A rotation shaft may be connected to a rear wall of the drum and may receive rotation power from a motor. Accordingly, the rotation power of the motor may be transmitted to the drum through the rotation shaft via rotation of the motor, causing rotation of the drum.
- [8] The drum may be rotated during a washing operation, a rinsing operation, and a dehydrating (drying) operation. This rotation, however, may entail vibration of the drum.
- [9] The rotation shaft may penetrate through a rear wall of the tub, thus protruding out of the tub. Some conventional washing machines may include a bearing housing insert-molded to the rear wall of the tub. Alternatively, a bearing housing may be pre-fabricated and fastened to the rear wall of the tub.
- [10] The bearing housing may serve to support the rotation shaft. Rotational vibration of the drum may be transmitted to the bearing housing and the tub through the rotation shaft.
- [11] Accordingly, the tub may be vibrated along with the drum. To alleviate the vibration, a damping supporting member may be connected to the tub.
- [12] In conventional washing machines, the vibration of the drum may be directly transmitted to the tub and the damping supporting member connected to the tub may

74420-507

act to support the transmitted vibration.

Disclosure of Invention

Technical Problem

- [13] In conventional laundry machines in which a tub is vibrated along with a drum, it may be necessary to provide predetermined gaps between the tub and the drum and between the tub and a cabinet, in order to prevent interference therebetween upon vibration. The provision of the predetermined gaps may make it difficult to increase sizes of the tub and the drum.
- [14] In one embodied laundry machine, a tub may be isolated from vibration of a drum, thus ensuring an increased size of the tub and an increased volume of the drum, whereby an increased capacity of the laundry machine may be accomplished.
- [15] It is noted that the greater the size of a tub, the smaller the volume of a space between a cabinet and the tub and this may cause problematic installation of relevant constituent elements. The present invention may accomplish a compact interior structure of the laundry machine via effective installation of those constituent elements.

Solution to Problem

- [16] A laundry machine may include a tub to hold water therein, a drum rotatably placed in the tub, a drive assembly to rotate the drum, and a suspension unit to reduce vibration the drum.
- [17] The tub may have a water supply hole and at least one hole for supplying steam or water circulated by a circulation pump.
- [18] The water supply hole and the at least one hole may be provided in a front upper portion of the tub.
- [19] A water supply hose may be connected to the water supply hole and a steam hose or a circulation hose may be connected to the at least one hole.
- [20] The suspension unit may comprise an axial bracket and a radial bracket.
- [21] The radial bracket is configured to extend in a radial direction with respect to a rotational axis of the shaft.
- [22] The axial bracket is configured to extend in the axis direction.
- [23] The laundry machine may comprise means for adding mass to the vibration system in which the drum is a vibrating object.
- [24] The means may be a single weight or a plurality of weights.
- [25] The weight may be attached to or integrally made with the radial bracket.
- [26] The front surface of the tub may include a forwardly extending rim portion so as to define the front opening, and the fluid supply unit may include a water supply hose connected to an upper position of the rim portion.
- [27] A fluid supply unit may include a circulation water hose or a steam hose connected

74420-507

to an upper position of the rim portion.

- [28] Although the increased size of the tub may reduce a space between the tub and a cabinet, the tilted front surface of the tub may ensure a sufficient space between the front surface of the tub and an upper portion of a front wall of the cabinet. The fluid supply unit may be connected to the tub via this space.
- [29] The water supply hose may be connected to the rim portion at a left position or a right position on the basis of a vertical center axis of the rim portion, and the circulation water hose or the steam hose may be connected to the rim portion at an opposite side of the water supply hose.
- [30] The suspension unit may include a first weight(a first radial bracket integrally made with a weight) and a second weight(a second radial bracket integrally made with a weight) connected respectively to left and right sides of the bearing housing, and the suspension unit may include a first axial bracket and a second axial bracket connected respectively to the first weight and the second weight.
- [31] The tilted rear surface of the tub may ensure a sufficient lower space between the rear surface of the tub and a rear wall of the cabinet, and the weight member may be located in this lower space.
- [32] The suspension unit may further include a third bracket provided in the rear of the lower portion of the rear surface of the tub and connected to the center of a lower portion of the bearing housing. With the tilted posture of the tub, a space may be defined between the lower portion of the rear surface of the tub and the rear wall of the cabinet, and the third bracket may be located in this space.
- [33] In the laundry machine, the tub may be fixedly supported, or be supported by a flexible support structure, such as the suspension unit.
- [34] Further, the tub may be supported in an interim state between the fixed support and the flexible support.
- [35] That is, the tub may be flexibly supported by the suspension unit or be rigidly supported. For example, the tub may be supported by the suspensions, be supported by rubber bushings to provide less flexible movement than when supported by the suspensions, or be fixedly supported by being fixed somewhere by screws or so.
- [36] For another instance, the cases where the tub is supported more rigidly than when supported by the suspension unit are as follows.
- [37] Firstly, the tub may be made integrally with the cabinet.
- [38] Next, the tub may be supported by being fastened by screws, ribets, rubber bushings, etc. Also, the tub may be welded or bonded to the cabinet. In this cases, the supporting or fastening members have larger stiffnesses than a stiffness of the suspension unit with respect to the main direction of the vibration of the drum.
- [39] The tub may be expanded within the limits of a space in which the tub is placed. That

74420-507

is, the tub may be expanded until the circumferential surface thereof reaches(or almost reaches) a side wall or a side frame (for example, a left or right plate of a cabinet) restricting the size of the space at least in the lateral direction (the direction laterally perpendicular to the axial direction of the rotary shaft when the rotary shaft is horizontally placed). The tub may be made integrally with the lateral side walls of the cabinet.

- [40] The tub may be formed to be closer in the lateral direction to the wall or the frame than the drum. For example, the tub may be spaced away from the wall or the frame by an interval of less than 1.5 times an interval with the drum. Under the condition that the tub is enlarged in the lateral direction, the drum may also be enlarged in the lateral direction. Further, if the lateral interval between the tub and drum is reduced, the drum may be expanded in the lateral direction in direct proportion. When the lateral interval between the tub and the drum is reduced, the vibration of the drum in the lateral direction may be considered. The weaker the vibration of the drum in the lateral direction, the more expanded is the diameter of the drum. Therefore, the suspension unit to reduce the vibration of the drum may be designed such that rigidity of the suspension unit in the lateral direction is greater than rigidities of the suspension unit in other directions. For example, the suspension unit may be designed such that rigidity of the suspension unit against displacement in the lateral direction is greatest compared with rigidities of the suspension unit against displacements in other directions.
- [41] Further, the suspension unit may be directly connected to the bearing housing supporting the rotary shaft. That is, the bearing housing comprises a supporting portion to rotatably support the shaft and an extended portion extended from the supporting portion, and the suspension unit is attached to the supporting portion of the bearing housing or the extended portion of the bearing housing.
- [42] The suspension unit may include brackets extended in the axial direction. In a front loading type laundry machine, the brackets may be extended forward, namely towards a door.
- [43] The suspension unit may comprises at least two suspensions which are arranged distant from each other in the axial direction of the shaft.
- [44] The suspension unit may comprise suspensions placed below the shaft for standing support. The supported object(for example, the drum) is supported by the suspensions to stand alone.
- [45] Alternately, the suspension unit may comprise suspensions placed over the shaft for hanging support. In this case, the supported object is supported to be hung.
- [46] The mass center of the vibrating object(for example, a combination of the drum, the shaft, the bearing housing, and the motor) may be located, with respect to the center of the longitudinal length of the drum, at a side where the motor is located. In a front loading type laundry machine, the mass center may be located behind the longitudinal

74420-507

center of the drum. In this case, at least one suspension may be placed in front of or behind the mass center. One suspension may be placed in front of the mass center and another suspension behind the mass center.

[47] The tub may be provided with an opening at a rear portion thereof. The drive
 5 assembly may be connected to the tub by a flexible member. The flexible member may seal between the tub and the drive assembly to prevent water from leaking through the opening of the rear portion of the tub, and allow the drive assembly to move relatively to the tub. The flexible member may be made of a flexible material which can do the sealing, for example, a gasket material like a front gasket. In this case, the flexible member may be referred to as a
 10 rear gasket for convenience. The rear gasket may be connected to the drive assembly under the condition that the rotation of the rear gasket at least in the rotational direction of the rotary shaft is constrained. In one embodiment, the flexible material may be directly connected to the shaft. In another embodiment, the flexible material may be connected to a portion of the bearing housing.

15 [48] Further, a portion of the drive assembly, which is located radially inside the rear gasket and thus is likely to be exposed to the water in the tub, may be made so as not to be corroded by the water. For example, the portion of the drive assembly may be coated, or be surrounded with a separate member made of plastic such as the tub back (which will be described below). In a case where the portion of the drive assembly is made of metal, the
 20 portion may not be directly exposed to water by the coating or the separate plastic member, and thus corrosion of the portion may be prevented.

[49] Further, the cabinet may not be necessary. For example, in a built-in laundry machine, the laundry machine without the cabinet may be installed within a space of a wall structure. However, even in this case, a front plate forming the front face of the laundry
 25 machine may be required.

[49a] There may also be provided a laundry machine comprising: a cabinet; a tub fixed to the cabinet to hold water therein, the tub having at a front upper portion thereof a water supply hole and at least one hole for supplying steam or water circulated by a

74420-507

circulation pump, the front portion of the tub including a forwardly extending a rim portion and the holes being provided in the rim portion; a drum rotatably placed in the tub; a drive assembly having a rotation shaft connected to the drum, a bearing housing to rotatably support the rotation shaft, and a motor connected to the rotation shaft; a suspension unit attached to the bearing housing behind the tub to reduce vibration of the drum and the drive assembly; a flexible material to prevent the water inside the tub from leaking toward the drive assembly and allow the drum and the drive assembly to move relatively to the tub; a base having a base front frame extending upward from a front end of the base; and a controller is mounted below a front side of the tub to the base front frame, wherein the tub is tilted so that a front end thereof is moved upward, and wherein a bottom of the front portion of the tub located above the controller defines a flat portion.

Advantageous Effects of Invention

[50] A laundry machine according to an exemplary embodiment of the present invention may be configured to substantially prevent vibration of a drum from being transmitted to a tub. This may ensure an increase in the size of the tub so that the tub is arranged close to an inner surface of a cabinet.

[51] Furthermore, it may be possible to accomplish a compact interior structure of the laundry machine by effectively acquiring a space between the increased size of the tub and the cabinet and utilizing the space for installation of relevant constituent elements.

Brief Description of Drawings

[52] The accompanying drawings, which are included to provide a further understanding of the invention, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention.

74420-507

- [53] In the drawings:
- [54] FIG. 1 is a partial perspective view illustrating a laundry machine according to an exemplary embodiment of the present invention.
- [55] FIG. 2 is a side view of the laundry machine shown in FIG. 1.
- [56] FIG. 3 is a front view of the laundry machine shown in FIG. 1.
- [57] FIG. 4 is a rear view of the laundry machine shown in FIG. 1.
- [58] FIGs. 5 and 6 are views illustrating a front tub constituting a part of a tub.
- [59] FIG. 7 is a view illustrating connected statuses of a water supply hose, a steam hose, and a circulation water hose, and an installed status of a main controller.
- [60] FIGs. 8 to 12 are views illustrating installation of the main controller.
- [61] FIG. 13 is a view illustrating a connection relationship between, for example, a bearing housing and a weight member.
- [62] FIG. 14 is a view illustrating connected statuses of a drying fan and a drying duct.

Best Mode for Carrying out the Invention

- [63] Reference will now be made in detail to the exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings.
- [64] FIG. 1 is a partial perspective view illustrating a laundry machine according to an exemplary embodiment of the present invention, and FIGs. 2 to 4 are respectively a side view, a front view, and a rear view of the laundry machine shown in FIG. 1. FIGs. 5 and 6 illustrate a front tub constituting a part of a tub. FIG. 7 is a view illustrating connected statuses of a water supply hose, a steam hose, and a circulation water hose and an installed status of a main controller. FIGs. 8 to 12 are views illustrating installation of the main controller. FIG. 13 is a view illustrating a connection relationship between, for example, a bearing housing and a weight member. In addition, FIG. 14 is a view illustrating connected statuses of a drying fan and a drying duct.
- [65] The laundry machine is configured in such a way that a tub is fixed to and supported by a cabinet. The tub may include a front tub 100 defining a front part of the tub and a rear tub 120 defining a rear part of the tub. The front tub 100 and the rear tub 120 may be assembled to each other using screws and may define a drum accommodation space therein.
- [66] The front tub 100 may have a forwardly extending rim portion 101 formed at a front surface 101a thereof to define a front opening. When viewed from the lateral side, a horizontal width of the rim portion 101 may gradually decrease from the top to the bottom. The front opening may serve as a laundry entrance/exit.
- [67] The rear tub 120 may have a rear surface 128 in which a rear opening is perforated. The rear opening may be substantially closed by a tub back plate 130 and a rear gasket 250 that will be described hereinafter.

74420-507

- [68] The rear gasket 250 may be made of a flexible material to prevent vibration of the tub back plate 130 from being transmitted to the rear tub 120.
- [69] The rear gasket 250 may be connected to both the tub back plate 130 and the rear tub 120 respectively to seal gaps therebetween, thus serving to prevent leakage of wash water from the tub. The tub back plate 130 may be vibrated along with a drum 301, which will be described hereinafter, during rotation of the drum 301. In this case, the tub back plate 130 may be spaced apart from the rear tub 120 by a sufficient distance so as not to interfere with the rear tub 120. The flexible rear gasket 250 may allow the tub back plate 130 to be moved relative to the rear tub 120 without interference with the rear tub 12. The rear gasket 250 may have a bellows-shaped portion 252, which may extend to a sufficient length to allow the relative motion of the tub back plate 130.
- [70] A foreign-substance anti-clogging member 200 may be connected to a front end of the front tub 100, to prevent foreign substances from entering a gap between the tub and the drum 301. The foreign-substance anti-clogging member 200 may be made of a flexible material and may be fixedly installed to the front tub 100. For example, the foreign-substance anti-clogging member 200 may be made of the same material as that of the rear gasket 250.
- [71] The drum 301 may consist of, for example, a front drum part, a central drum part, and a drum back plate. Although not shown, balance balls may be installed to front and rear positions of the drum 301. The drum back plate may be connected to a spider and in turn, the spider may be connected to a rotation shaft. Accordingly, the drum 301 may be rotated within the tub upon receiving rotation power transmitted through the rotation shaft.
- [72] The rotation shaft may penetrate through the tub back plate 130 so as to be directly connected to a motor. More specifically, the rotation shaft may be directly connected to a rotor 70 of the motor. A bearing housing 400 may be coupled to a rear surface of the tub back plate 130. The bearing housing 400 may serve to rotatably support the rotation shaft between the motor and the tub back plate 130.
- [73] A stator (not shown) of the motor may be fixedly installed to the bearing housing 400, and the rotor 70 may be located to surround the stator. As described above, the rotor 70 may be directly connected to the rotation shaft.
- [74] The bearing housing 400 may be supported on a cabinet base 600 using a suspension unit. The suspension unit may include three vertical suspensions and two longitudinally oblique suspensions. One of these suspensions may be arranged between a rear lower portion of the tub and a rear wall 620 of the cabinet, and the remaining four suspensions may be arranged two by two at left and right sides. More specifically, when viewed from the front side, the four suspensions may be arranged two by two in left and right spaces between the bottom of an outer circumferential surface of the tub

74420-507

and inner surfaces of the cabinet including inner surfaces of left and right walls 630 and 640 of the cabinet and an inner surface of the cabinet base 600. In the exemplary embodiment of the present invention, since the tub is tilted, as will be described below, a distance between the outer circumferential surface of the tub and the cabinet base 600 may gradually increase toward the front side of the tub. Therefore, it may be preferable to position the vertical suspensions at front positions of the tub. More specifically, assuming that the two vertical suspensions are arranged respectively at left and right sides, positions of these vertical suspensions may be longitudinally displaced forward from the center of the cabinet base 600 or the tub. Consequently, the three vertical suspensions may be located in spaces defined by the tilted posture of the tub, so that one suspension is located in the space defined between the rear lower portion of the tub and the rear wall 620 of the cabinet and the remaining two suspensions are located at front left and right positions of the space defined between the outer circumferential surface of the tub and the inner surface of the cabinet base 600.

[75] The suspension unit may also serve to support the drum 301 by alleviating vibration of the drum 301. In practice, the tub and the drum 301 may have discrete supporting structures and the tub may not be vibrated even if the drum is vibrated.

[76] Hereinafter, the above described configuration will be described in more detail on a per part basis.

[77] The front surface 101a of the front tub 100 may take the form of a doughnut-shaped flat surface defined at a front end of a cylindrical sidewall (i.e. a cylindrical outer circumferential surface) of the front tub 100. A rear end of the front tub 100 is open, so as to be coupled to a corresponding front end of the rear tub 120.

[78] The rim portion 101 may extend forward from the front surface 101a of the front tub 100, and the width of the rim portion 101 may gradually decrease from the top to the bottom. In practice, no rim portion 101 may be present at the bottom of the front surface 101a.

[79] The rim portion 101 may be provided with, for example, a water supply port 104, a hot air inlet 103, a circulation water port 106, and a steam port 105. The water supply port 104 may serve to supply wash water into the tub, and the hot air inlet 103 may be used assuming a drying function is provided. Also, wash water circulated by a circulation pump 60 may be introduced into the tub through the circulation water port 106, and steam may be introduced into the tub through the steam port 105. In the laundry machine according to the exemplary embodiment of the present invention in which the tub may have remarkably reduced vibration, for example, a water supply structure including a water supply hose 90, a drying structure including a drying duct 40, a steam supply structure, and a circulation water supply structure may be stably connected to and supported by the tub.

74420-507

- [80] The hot air inlet 103 may take the approximate form of a rectangular opening extending upward from the rim portion 101. Here, the hot air inlet 103 may be necessary if the laundry machine is a combined washing and drying machine. In other words, in the case of a washing machine having no drying function, the hot air inlet 103 may be omitted.
- [81] In the exemplary embodiment, supply of wash water, etc. may be carried out at the front side of the tub because the water supply port 104, etc. may be located in a front region of the front tub 100.
- [82] The water supply port 104, etc. may be located in front of a front end of the drum 301 accommodated in the tub. Accordingly, for example, wash water may be directly introduced into the drum 301 through a drum opening for laundry entrance/exit.
- [83] In addition, the water supply port 104, etc. may be located at an upper position of the rim portion 101. In the exemplary embodiment of the present invention, the tub is tilted rearward so that upper portions of the front surface 101a and the rear surface 128 of the tub are tilted to the rear. With this tilted posture of the tub, there may be defined a space between the upper portion of the front surface 101a and a front wall of the cabinet and a space between a lower portion of the rear surface 128 of the tub and the rear wall 620 of the cabinet. These resulting spaces may be used to accommodate, for example, the water supply port 104 and a weight member. In the present exemplary embodiment, as shown in the drawings, the front surface 101a and the rear surface 128 of the tub may be tilted to the rear. With this tilting of the front surface 101a and the rear surface 128 of the tub, even if the tub has a longitudinally increased size, it may be possible to effectively define spaces between the upper portion of the front surface 101a of the tub and the front wall of the cabinet and between the lower portion of the rear surface 128 of the tub and the rear wall 620 of the cabinet.
- [84] The rim portion 101 may be formed at a front end thereof with a coupler for coupling of the foreign-substance anti-clogging member 200. The coupler may extend forward from the front end of the rim portion 101 and may take the approximate form of a small diameter cylindrical ring. As the cylindrical ring-shaped coupler is inserted into the foreign-substance anti-clogging member 200, the foreign-substance anti-clogging member 200 may be coupled to the rim portion 101.
- [85] The front tub 100 may be fixedly connected to the front wall of the cabinet. To realize this connection, for example, four fastening bosses 107 may be formed at the front surface 101 of the front tub 100 around the rim portion 101.
- [86] A steam hose 96 may be connected to the steam port 105, and a circulation water hose 97 may be connected to the circulation water port 106. A steam generator may be located in the rear of a detergent box that will be described hereinafter, and the steam hose 96 may be connected to the steam generator. The circulation pump 60, which is

74420-507

- connected to the circulation water hose 97, may be located below the front tub 100 at a front left position of the cabinet base 600. The circulation pump 60 may also serve as a drain pump according to a valve switching operation.
- [87] A base coupler may be formed at the bottom of the front tub 100 so as to fixedly install the front tub 100 to the cabinet base 600.
- [88] The front tub 100 may be coupled with the rear tub 120 to define a drum accommodation space. In this case, the front tub 100 and the rear tub 120 may be screwed to each other. For this, a plurality of screw fastening holes may be circumferentially arranged at the rear end of the front tub 100. As described above, the tub may be installed on the cabinet base 600 such that the tub is tilted to allow the front end of the tub to be moved upward.
- [89] The drum 301 may also be tilted to allow the front end of the tub to be moved upward.
- [90] As described above, the rim portion 101 of the front tub 100 may be gradually reduced in width from the top to the bottom. With this shape of the rim portion 101, the front opening of the tub, through which laundry is put into or taken out of the drum 301, is oriented horizontally to face forward, rather than being tilted.
- [91] The foreign-substance anti-clogging member 200 may serve to prevent foreign substances from entering the gap between the tub and the drum 301.
- [92] In the laundry machine according to the exemplary embodiment of the present invention, it may be unnecessary to seal a gap between the front opening of the tub and the front wall of the cabinet differently from conventional laundry machines. For this reason, it may be possible to prevent foreign substances from entering the gap between the tub and the drum 301.
- [93] The foreign-substance anti-clogging member 200 may be made of the same material as the rear gasket 250. Hereinafter, for convenience of description, the foreign-substance anti-clogging member 200 will be designated as a front gasket 200, as opposed to the rear gasket 250.
- [94] The front gasket 200 may have a rim portion corresponding to the rim portion 101 of the front tub 100.
- [95] A duct connecting portion 201 for connection of the drying duct 40 may be formed at the top of the rim portion of the front gasket 200. As the drying duct 40 is partially inserted into the duct connecting portion 201, hot air may be guided to the hot air inlet 103. The hot air, passing through the drying duct 40, may be introduced into the tub through the duct connecting portion 201.
- [96] When the present exemplary embodiment is not applied to the combined washing and drying machine, it may be unnecessary to provide the duct connecting portion for the drying duct 40. Particularly, if the front tub 100 provided with the hot air inlet 103

74420-507

is still used, the duct connecting portion 201 may take the form of a blocked portion rather than taking the form of a hollow. In this case, the hot air inlet 103 may be closed at the stage of production. That is, the overall shape of the front gasket 200 may be changed depending on the use of the combined washing and drying machine.

[97] The hot air inlet 103 may be located at the top center of the rim portion 101 of the tub. The drying duct 40 may be connected to the top center of the outer circumferential surface of the tub so as to communicate with the hot air inlet 103. For this, one end of the drying duct 40 may be connected to the hot air inlet 103 and the other end of the drying duct 40 may be connected to a drying fan 41. In such a connected state, a middle region of the drying duct 40 may be longitudinally arranged on the top center of the outer circumferential surface of the tub. The drying fan 41 may be located above an upper left portion of the outer circumferential surface of the tub, so as to communicate with a hot air outlet 121 that will be described hereinafter.

[98] A door sealing member may be provided at a front end of the door gasket 200 so as to come into close contact with a door glass (not shown), thus serving to prevent leakage of water. When the door is closed, the door sealing member comes into close contact with the door glass to seal a gap between the door glass and the door gasket 200, thereby preventing leakage of water.

[99] In the laundry machine according to the exemplary embodiment of the present invention, the tub may have remarkably low vibration and therefore, may have no need for a gap as a vibration margin gap. This may allow the outer surface of the tub to be located close to the cabinet as possible. Consequently, it may be possible to increase the size of the tub even without increasing the size of the cabinet and consequently, it may be possible to enhance the capacity of the laundry machine without increasing the overall size of the laundry machine. In the exemplary embodiment of the present invention, a distance between the left wall 630 or the right wall 640 of the cabinet and the tub may be only approximately 5 mm, although conventional laundry machines, in which a tub is vibrated along with a drum, may require a distance of approximately 30 mm in order to prevent vibration of the tub from being transmitted to the cabinet. When converting this distance margin into a diameter of the tub, it will be appreciated that the diameter of the tub in the laundry machine according to the exemplary embodiment may be increased by 50 mm on the basis of the above conventional laundry machines. This may result in a remarkable improvement in that the capacity of the laundry machine can be upgraded one stage on the basis of the same external size of the laundry machine.

[100] In addition, when relevant constituent elements are appropriately arranged under the assumption that the size of the tub is increased to the maximum extent within an interior volume of the cabinet, the resulting laundry machine may achieve an enhanced

74420-507

capacity on the basis of the same exterior size of the laundry machine while ensuring a compact interior structure.

- [101] The water supply hose 90 may be connected to the detergent box 95. Also, the water supply hose 90 may be inserted into the water supply port 104 of the front tub 100.
- [102] The rear tub 120 may have a cylindrical shape to surround the drum 301. The rear tub 120 may have the open front end and the doughnut-shaped rear surface 128. The open front end of the rear tub 120 may be coupled to the front tub 100 in a sealing manner, and the doughnut-shaped rear surface 128 may have a rear opening. An inner diameter of the rear opening may be sufficiently greater than an outer diameter of the tub back plate 130. Accordingly, the tub back plate 130 may be spaced apart from the rear surface 128 of the rear tub 120 by a sufficient distance to prevent vibration of the tub back plate 130 from being transmitted to the rear surface 128. The rear gasket 250 may be provided in a gap between the rear surface 128 of the rear tub 120 and the tub back plate 130. The rear gasket 250 may serve to seal the gap between the rear surface 128 of the rear tub 120 and the tub back plate 130. The rear gasket 250 may have the bellows-shaped portion 252, which has sufficient flexibility to prevent the rear gasket 250 from interfering with vibration of the tub back plate 130.
- [103] In the case of the combined washing and drying machine, the hot air outlet 121 may be formed at a left position on an outer circumferential surface of the rear tub 120. Also, a cooling water injection port may be formed to supply cooling water into the tub. Of course, it will be appreciated that the hot air outlet 121 and the cooling water injection port may be omitted if a laundry machine has only a washing function and no drying function.
- [104] The rear tub 120 may have a coupler 123 to couple the rear tub 120 to the rear wall 620 of the cabinet.
- [105] The rear tub 120 may also be fixed to the cabinet base 600.
- [106] The tub back plate 130 may be centrally perforated with a hole, through which the rotation shaft to rotate the drum 301 penetrates. The tub back plate 130 may be coupled to a front surface of the bearing housing 400.
- [107] The bearing housing 400 may include a bearing supporting portion to support a bearing, and a stator fastening portion extending radially from the bearing supporting portion.
- [108] The stator fastening portion may have six stator fastening bosses for fastening of the stator, and tub back plate fastening holes for fastening of the tub back plate 130.
- [109] A first extension 406a and a second extension 406b may extend radially from left and right sides of the stator fastening portion. The first extension 406a and the second extension 406b may be connected respectively to a first connector 409a and a second connector 409b, which extend rearward perpendicular to the first and second ex-

74420-507

tensions 406a and 406b. In turn, a first weight fastening portion 410a and a second weight fastening portion 410b may radially extend respectively from the first connector 409a and the second connector 409b.

- [110] The stator may be located in the rear of the first extension 406a and the second extension 406b and in the front of the first and second connectors 409a and 409b. The rotor 70, which is directly connected to the rotation shaft, may also be located in the front of the first connector 409a and the second connector 409b. Specifically, the rotor 70 and the stator may be located in a space defined in the front of the first connector 409a and the second connector 409b and in the rear of the first extension 406a and the second extension 406b.
- [111] The first extension 406a and the second extension 406b may have fastening holes for fastening of the tub back-plate 130.
- [112] Upper surfaces of the first connector 409a and the second connector 409b may define tub back plate seats to support the tub back-plate 130 thereon.
- [113] The first extension 406a, the first connector 409a, and the first weight fastening portion 410a may respectively be symmetrical to the second extension 406b, the second connector 409b, and the second weight fastening portion 410b.
- [114] A third extension 408 may be provided between the first extension 406a and the second extension 406b and in turn, a third connector 408a may extend rearward perpendicular to the third extension 408. A third bracket 408b may extend from the third connector 408a. As will be described hereinafter, a third cylinder spring 500 may be connected to the third bracket 408b. The third bracket 408b, as shown in the drawings, may be provided with a fastening bolt to fasten or unfasten the third cylinder spring 500.
- [115] The bearing housing 400 may have an approximately horizontally symmetrical shape.
- [116] According to the above description, the space for installation of the motor may be defined in the front of the first connector 409a and the second connector 409b (in a longitudinal direction of the rotation shaft). Here, the bellows-shaped portion 252 of the rear gasket 250 may be located in the rear of the first connector 409a and the second connector 409b.
- [117] The weight member may include a first weight 431 and a second weight 430. The first weight 431 may be connected to the first weight fastening portion 410a, and the second weight 430 may be connected to the second weight fastening portion 410b. The first weight 431 and the second weight 430 may be arranged symmetrically to each other.
- [118] In addition to serving as mass members, the first weight 431 and the second weight 430 may serve to connect a first axial bracket 450 and a second axial bracket 440,

74420-507

which will be described hereinafter, to the bearing housing 400 respectively.

- [119] More specifically, the weights 430 and 431 may serve to prevent the front end of the drum 301 from being excessively lowered when laundry received in the drum is moved and gathered forward. Also, the weights 430 and 431 may serve as a balance mass with relation to a vibration system of the drum 301.
- [120] The first weight 431 and the second weight 430 respectively may consist of a radial portion extending from the rotation shaft and a bracket connecting portion extending forward from a distal end of the radial portion. These weights 431 and 430 may have fastening holes perforated in upper ends thereof to allow the weights 431 and 430 to be fastened to the respective weight fastening members 410a and 410b. For example, each weight may have four fastening holes.
- [121] The first weight 431 and the second weight 430 may be connected respectively to the first axial bracket 450 and the second axial bracket 440 via the bracket connecting portions thereof. The bracket connecting portion may be heavier than the remaining portion, i.e. the radial portion. This ensures that the weight has a lower center of gravity, resulting in enhanced stability against vibration.
- [122] The first weight 431 and the second weight 430 may be fabricated by casting. Also, the first weight 431 and the second weight 430 may be located in a lower region of a space between the rear surface 128 of the tub and an inner rear surface of the cabinet. More specifically, the first weight 431 and the second weight 430 may be located in the rear of a lower portion of the rear surface 128 of the tub. As the tub is installed in a tilted posture, the upper portion of the rear surface 128 of the tub may be tilted to the rear, whereby a space for installation of the weight member may be defined in the rear of the lower portion of the rear surface 128 of the tub.
- [123] The suspension unit may include the vertical suspensions to dampen a vertically applied force and the oblique suspensions to dampen a horizontally applied force. One of the vertical suspensions may be located in the rear of the center of the cabinet base 600, whereas the remaining two vertical suspensions may be located at left and rear positions in the front of the center of the cabinet base 600. The two oblique suspensions may be arranged at left and right positions respectively so as to be inclined in a longitudinal direction of the tub.
- [124] The suspension unit may include a first cylinder spring 520, a second cylinder spring 510, a third cylinder spring 500, a first cylinder damper 540, and a second cylinder damper 530.
- [125] The respective cylinder springs may be configured in such a way that a spring is installed between a cylinder and a piston. This configuration using the cylinder and the piston may ensure stable length variation upon damping. The cylinder may be connected to the corresponding axial bracket and the piston may be connected to the

74420-507

cabinet base 600.

- [126] The respective cylinder dampers may be configured to achieve damping effects by frictional resistance caused as a piston moves inside a cylinder.
- [127] The first cylinder spring 520 may be connected between the first axial bracket 450 and the base 600, and the second cylinder spring 510 may be connected between the second axial bracket 440 and the base 600.
- [128] The third cylinder spring 500 may be directly connected between the bearing housing 400 and the base 600.
- [129] With use of the cylinder springs 520, 510 and 500, the tub may be supported in a damping manner at one rear position and two front left and right positions thereof.
- [130] The first cylinder damper 540 may extend obliquely between the first axial bracket 450 and a rear end of the cabinet base 600, and the second cylinder damper 530 may extend obliquely between the second axial bracket 440 and the rear end of the cabinet base 600.
- [131] The third cylinder spring 500 may be located at a rear center position of the cabinet base 600, and the first and second cylinder springs 520 and 510 may be located at front left and right positions of the cabinet base 600. Also, the first cylinder damper 540 and the second cylinder damper 530 may be located between the rear position of the third cylinder spring 500 and the front positions of the first and second cylinder springs 520 and 510. The first cylinder damper 540 and the second cylinder damper 530 may be horizontally symmetric to each other.
- [132] All the cylinder springs 520, 510 and 500 may be connected to the cabinet base 600 with rubber bushings interposed therebetween.
- [133] The cylinder springs may be fabricated to exhibit damping force. Similar to the cylinder dampers, the cylinder springs may be fabricated to exhibit damping effects by frictional resistance caused as a piston slides along an inner wall of a cylinder. The cylinder damper may be provided with a spring. Similar to the cylinder springs, the cylinder dampers may be configured in such a way that a spring is connected between a piston and a cylinder to elastically support the piston, thus applying spring elasticity to the vibrating drum 301.
- [134] The second axial bracket 440 may be symmetric to the first axial bracket 450.
- [135] The first axial bracket 450 may take the form of a U-shaped channel. More specifically, the axial bracket 450 may consist of an upper wall and a pair of sidewalls perpendicularly extending downward from left and right sides of the upper wall. Also, a width of the first axial bracket 450 may gradually decrease from the rear to the front.
- [136] The first axial bracket 450 may have four fastening holes perforated in a rear end portion thereof for connection of the first weight 431. Once seated on the first weight 431, the first axial bracket 450 may be bolted thereto.

74420-507

- [137] The cabinet base 600 may include a base front frame 602 perpendicularly extending upward from a front end of the base 600.
- [138] The base front frame 602 may include a lower frame portion 602a for installation of a drain filter.
- [139] Hereinafter, operation of the laundry machine having both washing and drying functions will be described in more detail.
- [140] As shown in FIG. 14, the drying fan 41 may be installed above the hot air outlet 121 of the rear tub 120, and the drying duct 40 may be connected to the duct connecting portion 201 of the front gasket 200. A heater to generate hot air may be mounted in the drying duct 40. Upon operation of the fan 41, interior air of the tub having passed through the hot air outlet 121 may be returned into the tub by passing through the drying duct 40 and the duct connecting portion 201.
- [141] The hot air outlet 121 may be located closer to the rear surface 128 of the tub than a middle position between the front surface 101a and the rear surface 128 of the tub and the drying fan may also be located at a corresponding position. With the tilted posture of the tub, a space between the top of the outer circumferential surface of the tub and an inner ceiling surface of the cabinet may be gradually widened rearward. The drying fan may be located in a wider rear region of the space.
- [142] The combined washing and drying machine may adopt a circulative drying system using circulation of hot air. In this case, a condensing duct, which has been conventionally installed above the tub, may be unnecessary. A space between the drum and the tub may serve as a condensing space. To enhance condensing effects, with relation to this condensing space, a metallic condensing plate may be installed to an inner wall surface of the tub.
- [143] Hereinafter, installation of a main controller 650 will be described. The main controller 650 may control general operations of the laundry machine, such as, e.g., a drum driving operation, upon receiving a user command from a control panel. Here, the control panel may correspond to a user interface, serving to receive a user command.
- [144] The main controller 650 may be located at a front left position on the cabinet base 600 and thus, may be located below a front portion of the tub.
- [145] The tilted posture of the tub may provide a space between the bottom of the front portion of the tub and the base 600, so that the main controller 650 may be installed in this space.
- [146] The bottom of the front portion of the tub may have a flat portion 101c. Although the outer circumferential surface of the tub has the approximately cylindrical contour, the flat portion 101c may define a flat plane. To form the flat portion 101c, a lower end of the front surface 101a of the front tub 100 may be cut to define a flat end portion 101b.

74420-507

The front surface 101a may have approximately a circular contour except for the flat end portion 101b.

- [147] In the tilted posture of the tub, the flat portion 101c may be tilted so that a front end thereof becomes higher than a rear end thereof. A heater may be mounted in the tub at a position in the rear of the flat portion 101c. For this, a heater insertion space may be defined in the bottom of the tub so as to extend downward from a rear end of the flat portion 101c. The heater insertion space may have an opening for insertion of the heater.
- [148] The heater may be located in the rear of the main controller 650. In this case, a rear surface of the main controller 650 may interfere with the heater if the main controller 650 is pushed rearward upon installation thereof. In particular, since the heater may be provided at electric terminals at a front surface thereof and therefore, it may be necessary to protect the heater from interference with the main controller 650. For this, a stopper 101d may be provided at a lower surface of the flat portion 101c, to prevent the main controller 650 from being pushed rearward. The stopper 101d may take the form of a rib extending downward from the lower surface of the flat portion 101c.
- [149] The base front frame 602 of the base 600 in the form of a front flange may have a heater mount. The heater mount may have a vertically extending coupling post 602e provided at a left end of the base front frame 602. A distance between the coupling post 602e and the lower frame portion 602a provided at a right end of the base front frame 602 may be greater than a longitudinal length of the main controller 650, to assure easy insertion of the main controller 650. A portion of the base front frame 602 between the coupling post 602e and the lower frame portion 602a (hereinafter, referred to as a middle coupling portion) may have a lower height than those of the coupling post 602e and the lower frame portion 602a. Specifically, the height of the middle coupling portion may be a half or one third or less the height of the coupling post 602e. This height may serve to allow the main controller 650 to be easily installed below the tub in a state wherein the tub was previously mounted on the base 600.
- [150] The main controller 650 may have a plurality of hooks to be caught by the base front frame 602. The plurality of hooks may include a first hook 651c provided at a left end of the main controller 650 corresponding to the coupling post 602e, and a second hook 651a and a third hook 651b arranged near a lower end of the main controller 650 with a predetermined interval therebetween. The respective hooks may be shaped to extend first forward from a front surface of the main controller 650 and then, be bent leftward. Of course, alternatively, the hooks may be bent rightward after extending forward.
- [151] To correspond to the hooks, the base front frame 602 may have hook couplers to be inserted between the bent portions of the respective hooks and the front surface of the main controller 650. As shown in FIG. 12, a first hook coupler 602d may be formed at

74420-507

an upper end of the coupling post 602e. The first hook coupler 602d may be formed by cutting an upper portion of a right edge of the coupling post 602e, such that a vertical right edge of the first hook coupler 602d may be displaced farther leftward than the right edge of the coupling post 602e. The first hook coupler 602d may be inserted between the bent portion of the first hook 651c and the front surface of the main controller 650, thereby being coupled with the first hook 651c.

- [152] The middle coupling portion may be provided with a second hook coupler 602c and a third hook coupler 602b. The second hook coupler 602c or the third hook coupler 602b may be formed by cutting a vertical slit from an upper edge of the middle coupling portion by a predetermined length and a predetermined width and then, cutting a horizontal slit leftward from a lower end of the vertical slit. Accordingly, the second hook coupler 602c and the third hook coupler 602b may take the form of an approximately inverted L-shaped slit (when viewed from the rear).
- [153] To couple the second hook 651a with the second hook coupler 602c, the second hook 651a is inserted into the second hook coupler 602c so as to be first moved downward along the vertical slit and then, be moved leftward along the horizontal slit. The coupling between the third hook 651b and the third hook coupler 602b may be accomplished in the same manner.
- [154] A second upright supporting rib 651d and a third upright supporting rib 651e may protrude forward from the front surface of the main controller 650, so as to be located respectively between the bent portions of the second hook 651a and the third hook 651b and the front surface of the main controller 650. In a state wherein the second and third hooks 651a and 651b are coupled with the second and third hook couplers 602c and 602b, front ends of the supporting ribs 651d and 651e may come into contact with a rear surface of the middle coupling portion. With use of the hooks and the supporting ribs, it may be possible to prevent the main controller 650 mounted on the base 600 from being unintentionally rotated and separated forward or rearward.
- [155] In addition, once coupled with the hook couplers, the hooks may come into contact at lower surfaces thereof with corresponding edges of the hook couplers, thus serving to support the main controller 650.
- [156] With the above described coupling configuration, the main controller 650 may be kept at a fixed position while being coupled to the base front frame 602.
- [157] The main controller 650 may be fixedly coupled to the cabinet by screw fastening. As shown in FIGs. 9 and 11, the main controller 650 may have a first boss 652a formed at an upper left end thereof and a second boss 652b formed at a lower right end thereof. The first boss 652a may be screwed to the coupling post 602e of the base front frame 602, or may be screwed to a front flange of the left wall 630 of the cabinet. The second boss 652b may be screwed to the base front frame 602.

74420-507

- [158] The main controller 650 may be spaced apart from the bottom of the base 600 by a predetermined distance. This may serve to prevent a lower surface of the main controller 650 from coming into contact with the bottom of the base 600 because water may be present on the bottom of the base 600.

Industrial Applicability

- [159] The present invention provides a laundry machine, in which, as a result of substantially preventing vibration of a drum from being transmitted to the tub, the size of a tub may be increased so that the tub is arranged close to an inner surface of a cabinet. Furthermore, it may be possible to accomplish a compact interior structure of the laundry machine by effectively acquiring a space between the increased size of the tub and the cabinet and utilizing the space for installation of relevant constituent elements.
- [160] 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 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.

74420-507

CLAIMS:

1. A laundry machine comprising:

a cabinet;

5 a tub fixed to the cabinet to hold water therein, the tub having at a front upper portion thereof a water supply hole and at least one hole for supplying steam or water circulated by a circulation pump, the front portion of the tub including a forwardly extending a rim portion and the holes being provided in the rim portion;

a drum rotatably placed in the tub;

10 a drive assembly having a rotation shaft connected to the drum, a bearing housing to rotatably support the rotation shaft, and a motor connected to the rotation shaft;

a suspension unit attached to the bearing housing behind the tub to reduce vibration of the drum and the drive assembly;

a flexible material to prevent the water inside the tub from leaking toward the drive assembly and allow the drum and the drive assembly to move relatively to the tub;

15 a base having a base front frame extending upward from a front end of the base; and

a controller is mounted below a front side of the tub to the base front frame,

20 wherein the tub is tilted so that a front end thereof is moved upward, and wherein a bottom of the front portion of the tub located above the controller defines a flat portion.

2. The laundry machine according to claim 1, wherein the water supply hole and the least one hole are placed opposite to each other with respect to a rotational axis of the shaft.

74420-507

3. The laundry machine according to claim 1, wherein the tub has a hot-air inlet at the rim portion.

4. The laundry machine according to claim 1, wherein the tub is placed tilted.

5. The laundry machine according to claim 1, wherein a main controller is placed
5 below the front portion of the tub.

6. The laundry machine according to claim 1, wherein the suspension unit comprises:

one or more radial brackets radially extended behind the tub;

one or more axial brackets extended in the axial direction of the drum; and

10 suspensions connected to the axial brackets.

7. The laundry machine according to claim 6, wherein:

the one or more radial brackets are composed of a couple of radial brackets radially extended from the center of the bearing housing, and

15 the one or more axial brackets are composed of a couple of axial brackets extended from the rotation axis of the drum in parallel.

8. The laundry machine according to claim 6, wherein the suspension unit further includes a suspension placed under the rotational axis and behind the tub.

9. The laundry machine according to claim 3, further comprising:

20 a detergent box located at an upper left or right position on an outer circumferential surface of the tub; and

a drying fan located at an opposite side of the detergent box.

10. The laundry machine according to claim 1, wherein the tub is supported more rigidly than the drum is.

74420-507

11. The laundry machine according to claim 1, wherein:

the base front frame includes a lower frame portion provided at one side thereof, a coupling post provided at the other side thereof, and a middle coupling portion to connect the lower frame portion and the coupling post; and

5 the middle coupling portion has a height a half or less a height of the coupling post, and a distance between the coupling post and the lower frame portion is longer than a longitudinal length of the controller.

12. The laundry machine according to claim 11, wherein a front surface of the controller is hook-coupled to the coupling post or the middle coupling portion.

10 13. The laundry machine according to claim 12, wherein:

the controller is provided at the front surface thereof with at least one hook, the hook consisting of a forwardly extending portion protruding from the front surface and a bent portion extending leftward or rightward from an end of the forwardly extending portion; and

15 the base front frame includes at least one hook coupler, the hook coupler being inserted between the bent portion of the hook and the front surface of the controller as the controller is moved in a bending direction of the hook.

14. The laundry machine according to claim 12, wherein:

a first hook is provided at an upper portion of the front surface of the controller;

20 a second hook is provided at a lower portion of the front surface of the controller so as to be arranged farther inward than the first hook;

a first hook coupler corresponding to the first hook is formed in the coupling post; and

a second hook coupler corresponding to the second hook is formed in the

74420-507

middle coupling portion.

15. The laundry machine according to claim 14, wherein:

the first hook and the second hook respectively consist of a forwardly
extending portion protruding from the front surface of the controller and a bent portion
5 extending leftward or rightward from an end of the forwardly extending portion;

the first hook coupler is indented in an upper end of the coupling post such that
a vertical inner edge of the first hook coupler is located farther outward than a vertical inner
edge of the coupling post; and

the second hook coupler is formed by cutting a vertical slit from an upper edge
10 of the middle coupling portion and then, cutting a horizontal slit from a lower end of the
vertical slit, the horizontal slit extending in a bending direction of the second hook.

16. The laundry machine according to claim 15, wherein at least one supporting rib
is formed at the front surface of the main controller so as to be seated on a rear surface of the
middle coupling portion.

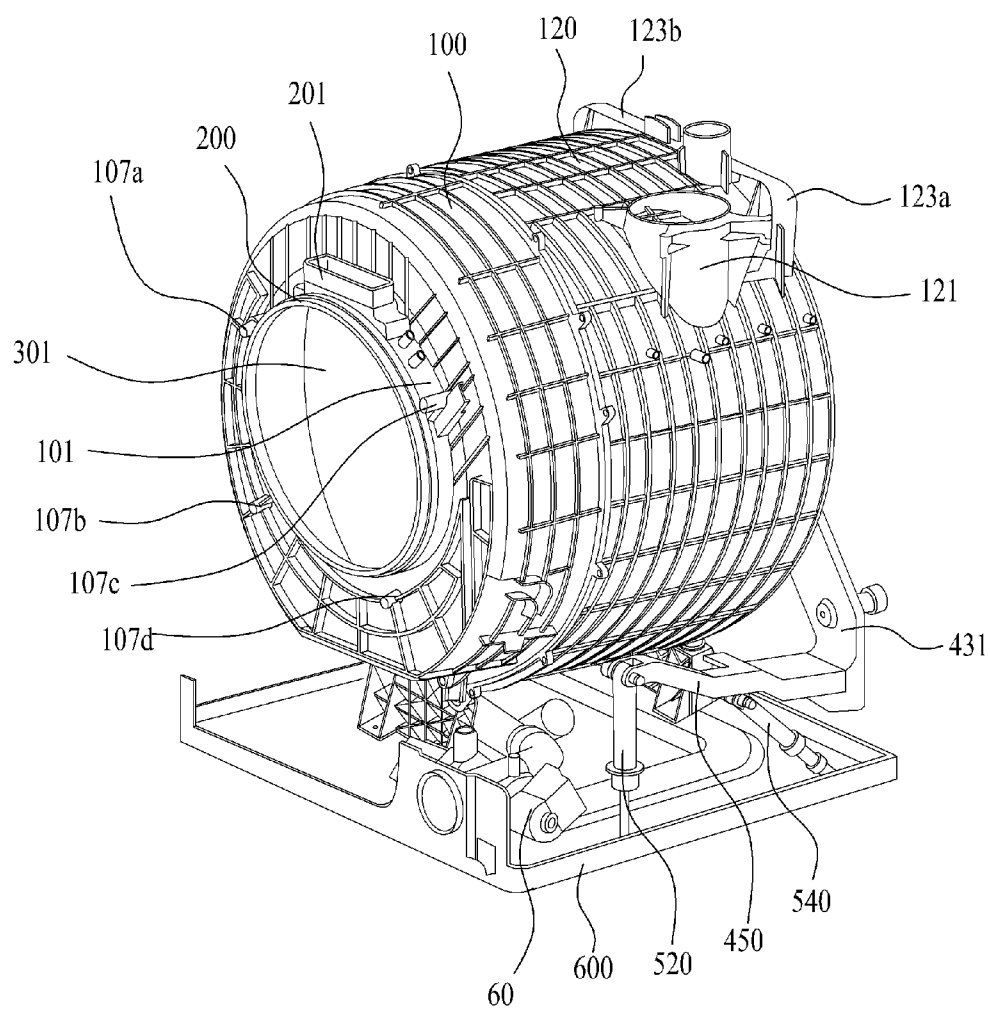
15 17. The laundry machine according to claim 12, wherein the controller has at least
one boss to be screwed to a front flange of a cabinet right wall or the base front frame.

18. The laundry machine according to claim 1, wherein:

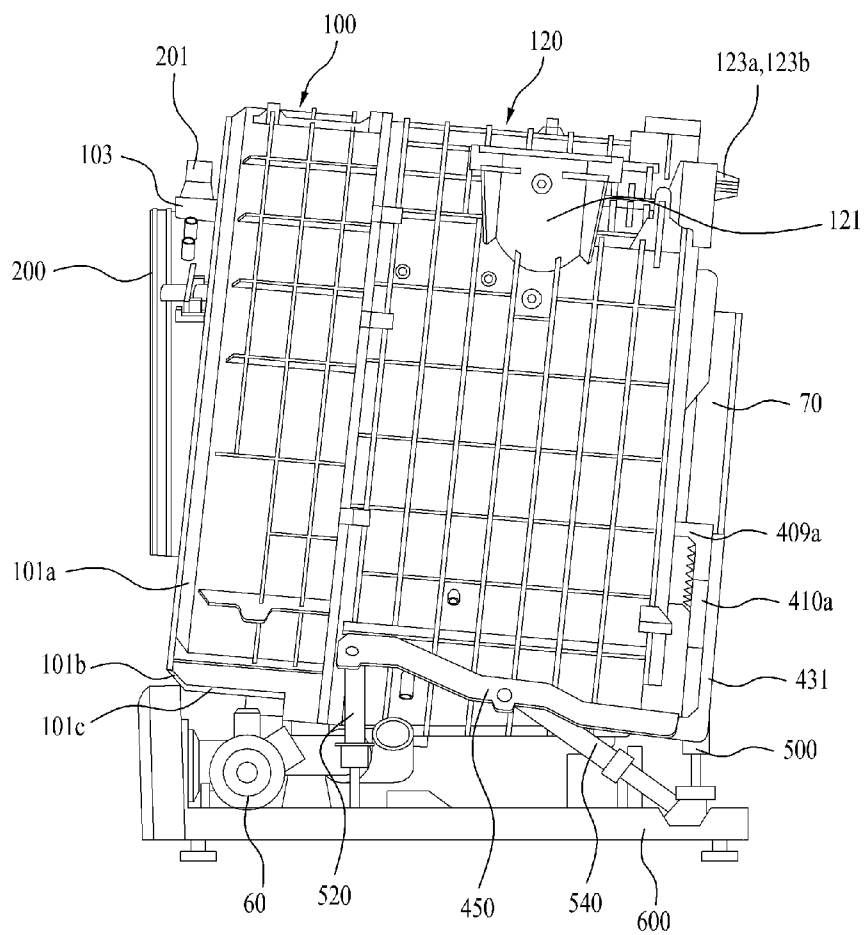
a heater is inserted in the tub at a position in the rear of the controller; and

a stopper is formed at a lower surface of the flat portion to limit rearward
20 movement of the controller.

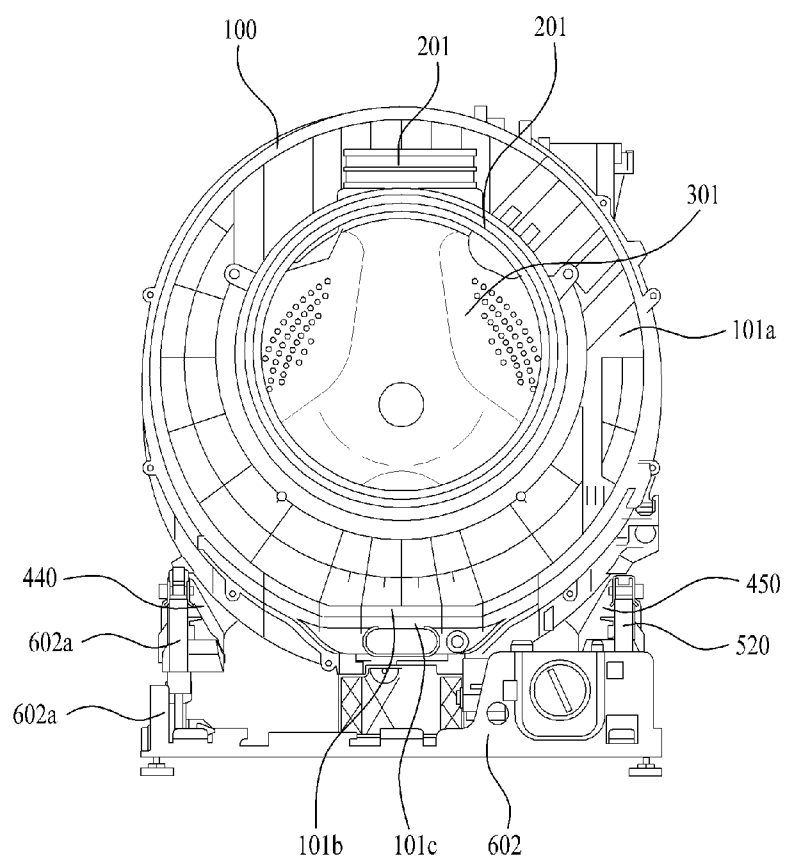
[Fig. 1]



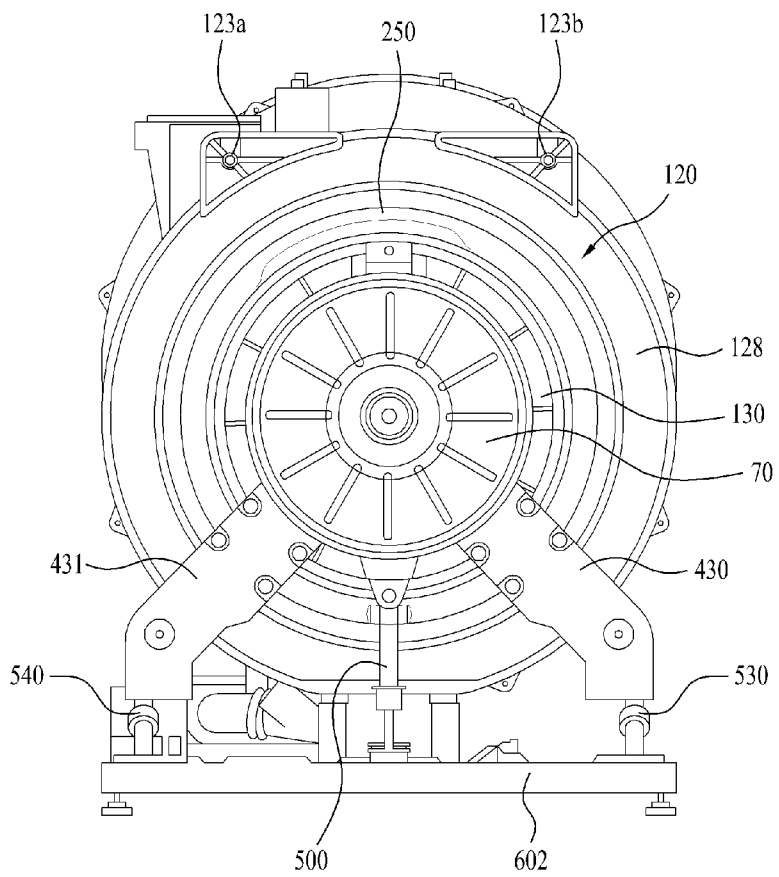
[Fig. 2]



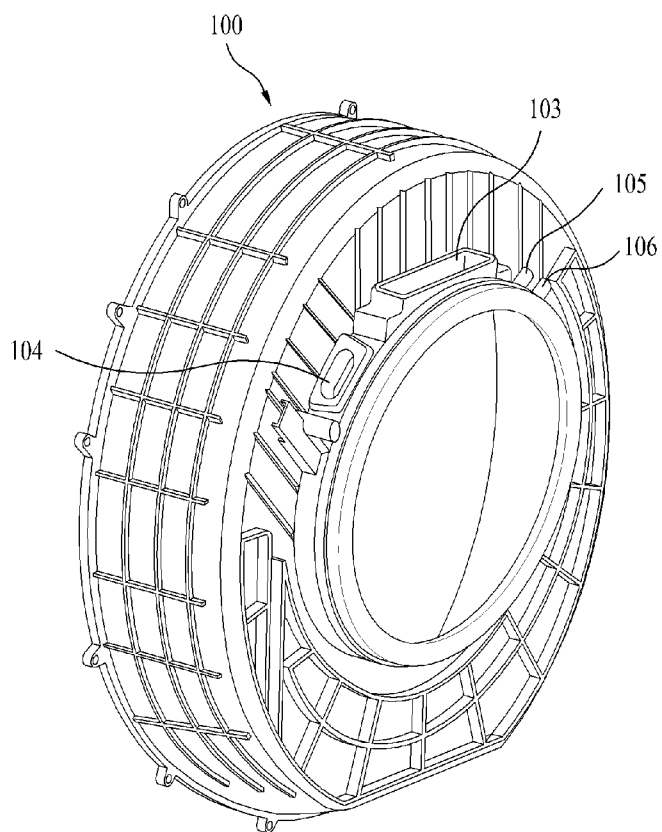
[Fig. 3]



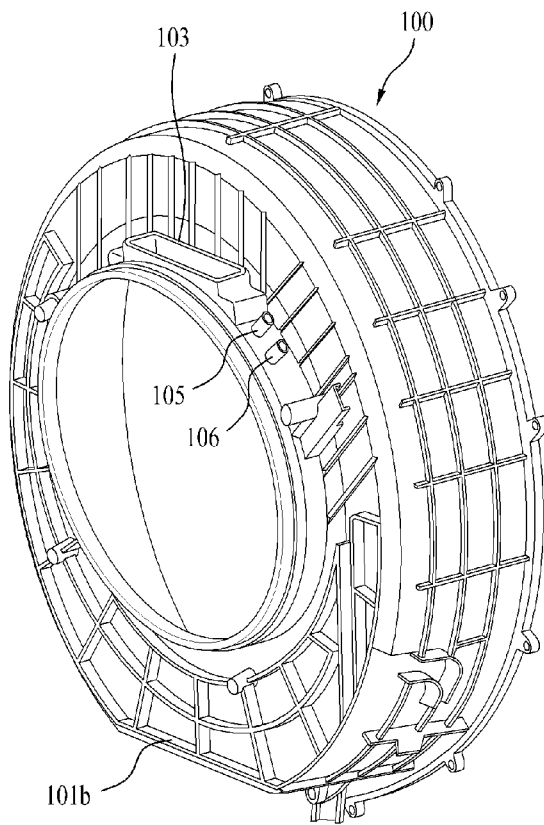
[Fig. 4]



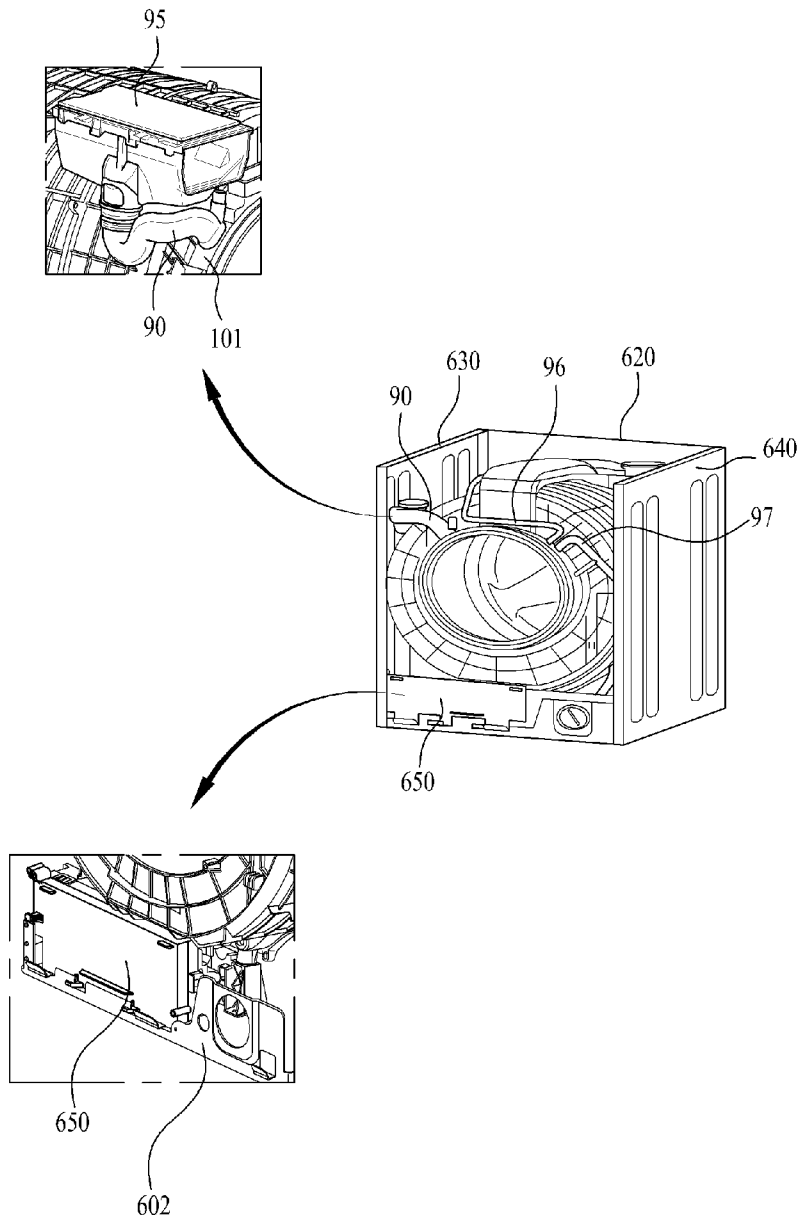
[Fig. 5]



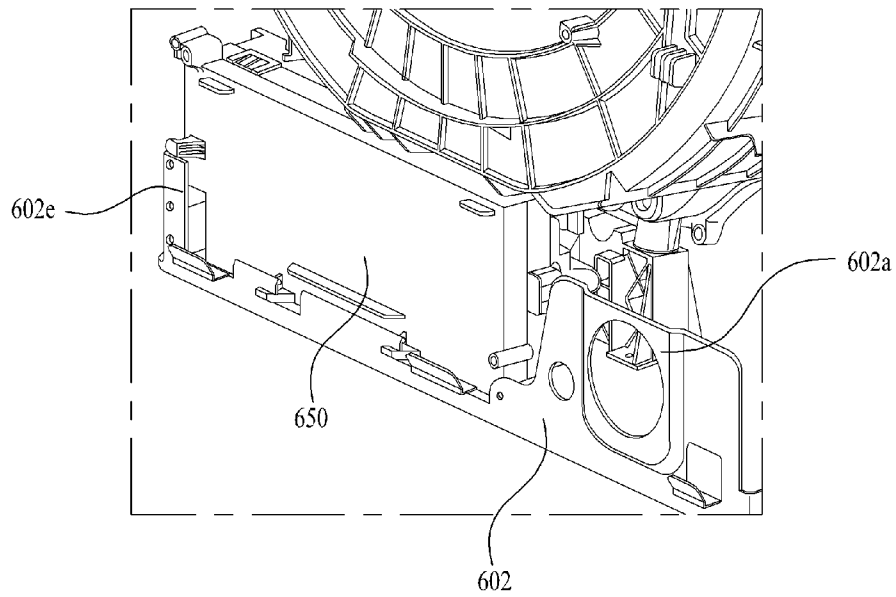
[Fig. 6]



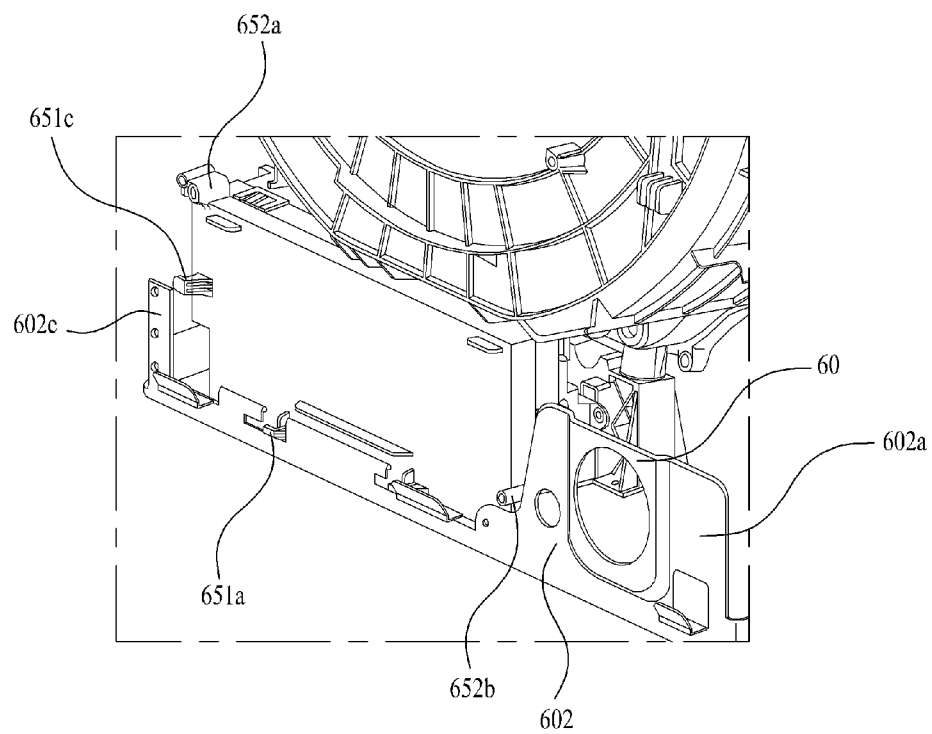
[Fig. 7]



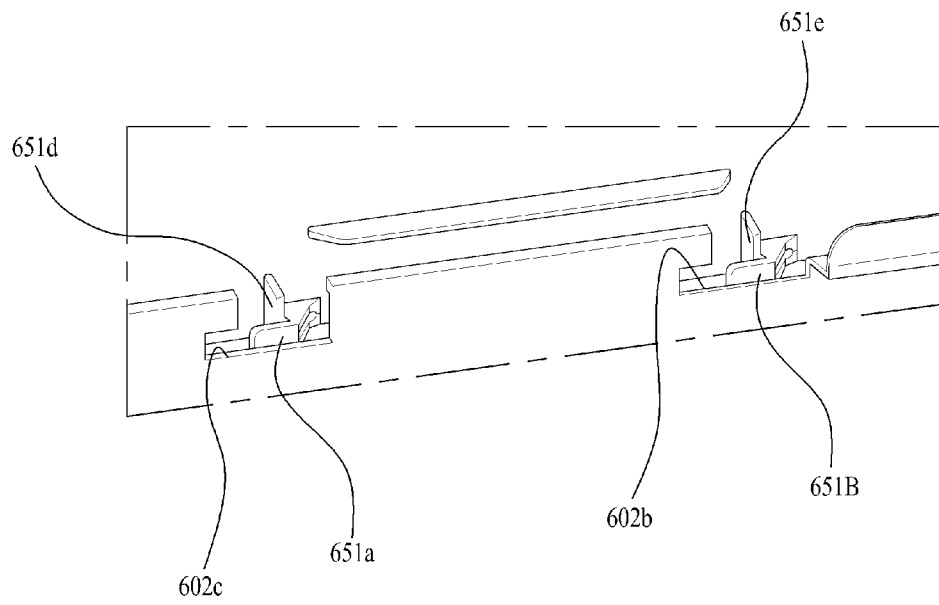
[Fig. 8]



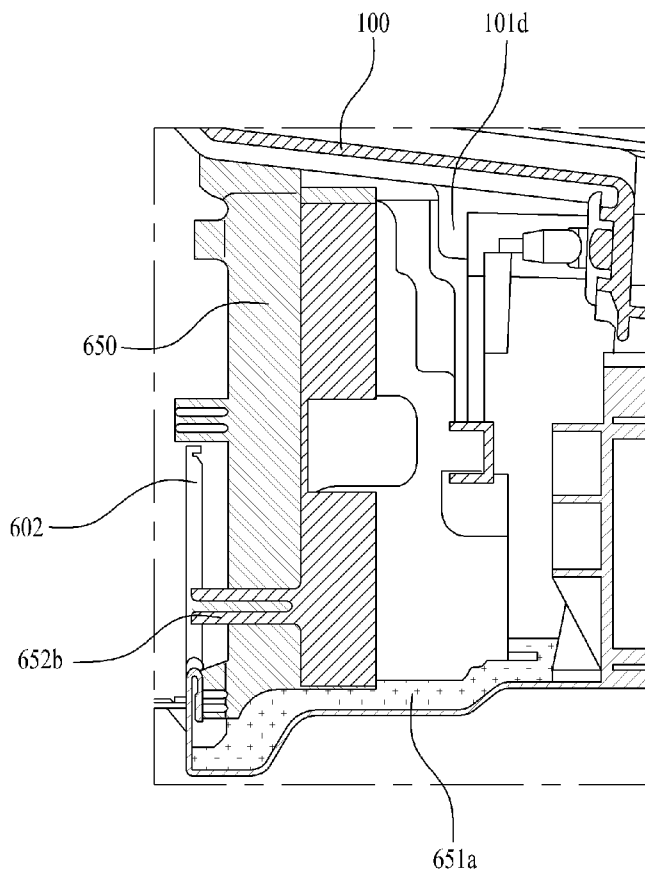
[Fig. 9]



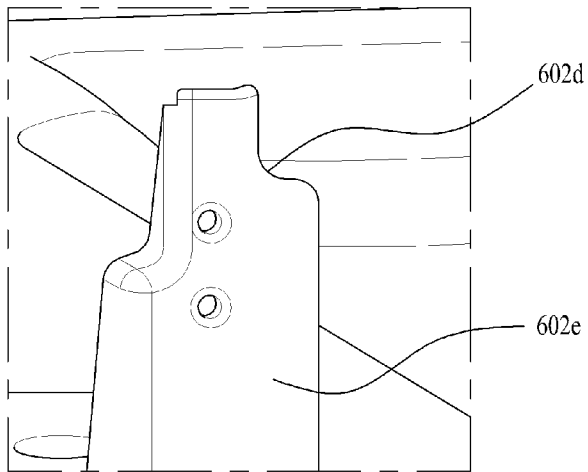
[Fig. 10]



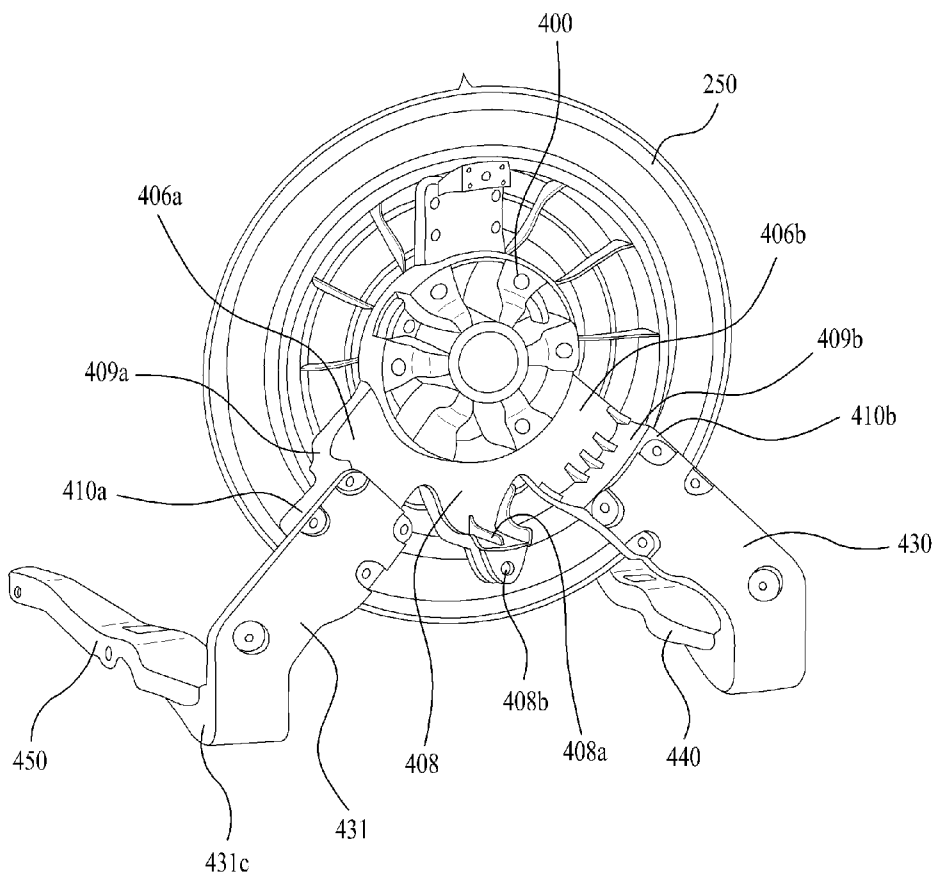
[Fig. 11]



[Fig. 12]



[Fig. 13]



[Fig. 14]

