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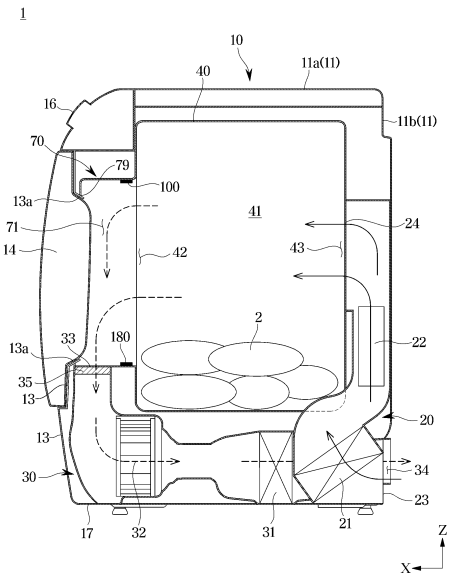
(54) CLOTHES DRYER

(57) A clothes dryer comprising: a cabinet including a front panel on which an inlet is formed, a drum rotatably arranged in the cabinet and having a front opening and a rear opening, a front cover linking the inlet of the cabinet and the front opening of the drum, and including a slope portion having a diameter decreasing as being directed toward the inlet of the cabinet from the front opening of the drum, a rear cover connected to the rear opening of the drum and having an air inlet formed at the rear cover to allow air to be supplied toward the rear opening of the drum, and a sensing device arranged on the slope portion for sensing humidity in air discharged from the front opening of the drum.

FIG. 3



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Description

[Technical Field]

[0001] The disclosure relates to a clothes dryer, and more particularly, to a clothes dryer including a sensing device capable of sensing humidity of clothes.

[Background Art]

[0002] In general, dryers are devices capable of drying a wet object contained in a drum by rotating the drum while forcing hot and dry air to pass through the interior of the drum. As a common example of the dryer, clothes dryers targeting wet clothes are often used.

[0003] The dryer may control a time for a dry course by detecting whether the object is dried, and terminate the dry course when the drying is completed. Hence, a sensor may be required for sensing humidity of the object.

[Disclosure]

[Technical Problem]

[0004] The disclosure may provide a clothes dryer including a sensor capable of sensing humidity of clothes.

[0005] The disclosure may also provide a clothes dryer capable of increasing accuracy in dryer operation time of the dryer required for drying by sensing humidity of clothes.

[Technical Solution]

[0006] In accordance with an embodiment of the disclosure, a clothes dryer includes a cabinet including a front panel having an inlet through which objects are placed, a drum rotatably arranged in the cabinet and having a front opening and a rear opening, the drum configured to have air flow along an interior of the drum from the rear opening to the front opening; a front cover formed to link the inlet of the cabinet and the front opening of the drum, the front cover including a slope portion formed to have a diameter decreasing the inlet of the cabinet from the front opening of the drum, a rear cover formed to connect to the rear opening of the drum and having an air inlet formed at the rear cover to guide the air to flow toward the rear opening of the drum from an exterior of the drum, and a sensing device arranged on the slope portion for sensing humidity in air discharged from the front opening of the drum.

[0007] The clothes dryer may include a fan configured to move the air into the drum, a heat exchanger arranged in the cabinet to cool the air discharged from the front opening of the drum, and an air outlet formed in a lower portion of the front cover so that the air discharged from the front opening of the drum flows to the heat exchanger, and the sensing device may be arranged in an upper portion of the front cover.

[0008] The drum may be rotated counterclockwise while the drum is viewed from front to back of the drum, and the sensing device may be arranged to lean to a right side when the drum is viewed from front to back of the drum.

[0009] The clothes dryer may further include a lighting device adjacent to be close to the sensing device.

[0010] The clothes dryer may further include an electrode sensor coupled to a lower portion of the slope portion to sense humidity of objects in the interior of the drum, and a controller configured to determine an operation time for the clothes dryer based on one of humidity sensed by the electrode sensor or humidity sensed by the sensing device.

[0011] The sensing device may include a sensor including a sensing surface facing inside of the slope portion; and a cover coupled to an inner wall of the slope portion to cover the sensor.

[0012] The cover may include a cover surface arranged on the inner wall of the slope portion, and a through hole penetrating the cover surface for the sensing surface to be exposed to the inside of the slope portion.

[0013] The sensing device may further include a filter arranged between the cover surface and the sensor to protect the sensor from foreign materials.

[0014] The cover may be a first cover, and the sensing device couplable to the inner wall of the slope portion and includes a second cover having a space to the first cover for receiving the sensor and the filter.

[0015] The sensing device may include a printed circuit board (PCB) wherein the sensor is mounted on the printed circuit board (PCB), wherein the printed circuit board (PCB) is placed on the second cover to be received between the first cover and the second cover.

[0016] The first cover may include a first guide passing through the slope portion and formed to extend to outside of the slope portion from the cover surface to guide a wire electrically connected to the PCB.

[0017] The second cover may include a second guide couplable to the first guide, passing through the slope portion and formed to extend to outside of the slope portion to guide the wire between the first guide and the second guide.

[0018] In accordance with an embodiment of the disclosure, a clothes dryer may include a cabinet, a drum arranged in the cabinet to receive clothes and having an air inlet formed in the back, a front cover arranged in front of the drum in the cabinet and forming a flow path linked to the interior of the drum, and a sensing device mounted in an upper portion of the front cover and including a sensor facing the flow path to sense humidity in air discharged from the interior of the drum.

[0019] The air inlet may be formed on one side on a rear surface of the drum, and the sensing device may be arranged to match the air inlet in a front-back direction.

[0020] The front cover may include a cover part couple to the sensing device and formed to slopingly extend from

back to front of the front cover to form the flow path.

[0021] The clothes dryer may further include an electrode sensor coupled to a lower portion of the cover part to sense humidity of the objects in the interior of the drum, and a controller configured to determine an operation time for the clothes dryer based on one of humidity sensed by the electrode sensor or humidity sensed by the sensing device.

[0022] In accordance with an embodiment of the disclosure, a clothes dryer may include a cabinet having an inlet formed on a front, a drum arranged in the cabinet for allowing air to flow from back to front of the drum, a front cover arranged in front of the drum in the cabinet and forming a flow path to link the inlet and the interior of the drum, the front cover slopingly arranged for the flow path to have smaller cross-sections toward the front, and a sensing device mounted on the front cover to sense humidity in air discharged from the front of the drum, the sensing device including a sensor facing the flow path, a cover surface arranged on an inner wall of the front cover to cover the sensor, a cover including a hole penetrating the cover surface for part of the sensor to be exposed to the flow path, and a filter located between the sensor and the cover surface to protect the sensor from foreign materials.

[0023] The cover may be a first cover, and the sensing device may be coupled to the inner wall of the front cover and may include a second cover for receiving the sensor and the filter between the first cover and the second cover.

[0024] The sensing device may include a PCB on which the sensor is mounted and which is placed on the second cover to be received between the first cover and the second cover.

[0025] The sensing device may further include a first guide passing through the front cover from the cover surface of the first cover and extending to outside of the front cover to guide a wire electrically connected to the PCB, and a second guide coupled to the first guide, passing through the front cover from the second cover and extending to outside of the front cover to guide the wire between the first guide and the second guide.

[Advantageous Effects]

[0026] The disclosure may provide a clothes dryer including a sensor capable of sensing humidity of clothes by sensing a humidity of an air discharged from a drum.

[0027] The disclosure may provide a clothes dryer capable of properly controlling a drying time depending on a dried state of clothes.

[Description of Drawings]

[0028]

FIG. 1 is a perspective view illustrating a clothes dryer, according to an embodiment of the disclosure.

FIG. 2 is a perspective view illustrating the clothes dryer of FIG. 1 viewed from a different angle.

FIG. 3 is a side cross-sectional view schematically illustrating the clothes dryer of FIG. 1.

FIG. 4 is a front view schematically illustrating the clothes dryer of FIG. 1.

FIG. 5 is a perspective view of the clothes dryer of FIG. 1 with a cabinet omitted from the clothes dryer.

FIG. 6 is a perspective view of the clothes dryer of FIG. 2 with a cabinet omitted from the clothes dryer.

FIG. 7 is a perspective view illustrating a drum and a front cover of the clothes dryer of FIG. 6.

FIG. 8 is a perspective view illustrating a front cover and a sensing device of the clothes dryer of FIG. 1.

FIG. 9 is a perspective view illustrating the front cover and the sensing device of FIG. 8 viewed from a different angle.

FIG. 10 is a perspective view illustrating the sensing device of the clothes dryer of FIG. 5.

FIG. 11 is an exploded view of the sensing device shown in FIG. 10.

FIG. 12 is a perspective view illustrating the sensing device of FIG. 10 viewed from a different angle.

FIG. 13 is an exploded view of the sensing device shown in FIG. 12.

FIG. 14 is a control block diagram of a clothes dryer, according to an embodiment of the disclosure.

[Mode for Invention]

[0029] Embodiments and features as described and illustrated in the disclosure are merely examples, and there may be various modifications replacing the embodiments and drawings at the time of filing this application.

[0030] Throughout the drawings, like reference numerals refer to like parts or components.

[0031] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the disclosure. It is to be understood that the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0032] The terms including ordinal numbers like "first" and "second" may be used to explain various components, but the components are not limited by the terms. The terms are only for the purpose of distinguishing a component from another. Thus, a first element, component, region, layer or room discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the disclosure. Descriptions shall be understood as to include any and all combinations of one or more of the associated

listed items when the items are described by using the conjunctive term "~ and/or ~," or the like.

[0033] The terms "front", "rear", "left" and "right" as herein used are defined with respect to the drawings, but the terms may not restrict the shape and position of the respective components.

[0034] The following description will be focused on a clothes dryer, but the disclosure is not limited thereto and may be applied to a washer and dryer combined machine. Furthermore, a clothes dryer 1 according to an embodiment of the disclosure will be described as a vented dryer that sucks in outside air, uses the air for drying and then discharges the air, but is not limited thereto and a condenser type dryer or a circulating dryer may also be used.

[0035] Embodiments of the disclosure will now be described in detail with reference to accompanying drawings.

[0036] FIG. 1 is a perspective view illustrating a clothes dryer, according to an embodiment of the disclosure. FIG. 2 is a perspective view illustrating the clothes dryer of FIG. 1 viewed from a different angle.

[0037] Referring to FIGS. 1 and 2, the clothes dryer according to an embodiment of the disclosure may include a main body 10. The main body 10 may include a cabinet. The cabinet 11 may be formed in the shape of substantially a rectangular solid. The cabinet 11 may include a top cover 11 a, a side and rear cover 11b, and a front panel 13.

[0038] A display 15 and a turnable switch 16 of the dryer 1 may be arranged in an upper portion of the front panel 13. The turnable switch 16 may be arranged for the user to select a mode of the dryer 1 by grasping and turning the tunable switch 16. The display 15 may display e.g., an operation state of the dryer 1.

[0039] An inlet 13a (see FIG. 3) formed in substantially a circular shape when viewed from the front may be arranged at the front panel 13 of the main body 10, and the inlet 13a may be opened or closed by a door 14 turnably installed on the main body 10. A drum 40 (see FIG. 3) may be rotatably installed in the main body 10. The drum 40 may receive objects to be dried, e.g., clothes. The interior of the drum 40 is connected to the inlet 13a, through which the object to be dried may be thrown into the drum 40 and taken out when dried, while the inlet 13a is opened by the door 14.

[0040] A suction port 23 for sucking in air for drying and an exhaust port 34 for discharging air that has been used up for drying may be arranged on the rear surface of the dryer 1, e.g., the rear cover 11b of the cabinet. A suction port cover 231 may be arranged to be detached from and attached to the suction port 23. When foreign materials are sucked into the suction port 23, the interior may be cleaned after detachment of the suction port cover 231.

[0041] FIG. 3 is a side cross-sectional view schematically illustrating the clothes dryer of FIG. 1.

[0042] Referring to FIG. 3, the clothes dryer according to an embodiment of the disclosure may include an air supply unit 20 and an air discharge unit 30. The air supply unit 20 may include a condenser 21, a heater 22, the suction port 23, and an air inlet 24. The air supply unit 20 may bring air into the drum 40. For example, the air inlet 24 may be linked to a rear opening 43. The air supply unit 20 may be located on the upstream side of an interior 41 of the drum. Furthermore, the air supply unit 20 may be located on the upstream side of the rear opening 43 of the drum 40. The air discharge unit 30 may include an evaporator 31, a blower fan 32, an outlet 33, the exhaust port 34, and a filter 35. The air discharge unit 30 may make the air that has passed the drum 40 and the interior of a front cover 70 to be discharged out of the main body 10. For example, the outlet 33 may be linked to the front opening 42. The air discharge unit 30 may be located on the downstream side of the interior 41 of the drum 40 and the front opening 42. For example, the air discharge unit 30 may be arranged on the downstream side of a flow path 71 formed in the front cover 70.

[0043] The clothes dryer according to an embodiment of the disclosure may include the front cover 70. The front cover 70 may be arranged between the front panel 13 and the drum 40 in the front-back direction. The front cover 70 may be coupled to internal components of the main body 10 and/or the cabinet 11, and may guide rotation of the drum 40. The front cover 70 may be a front duct 70 within which the flow path 71 is formed.

[0044] The clothes dryer according to an embodiment of the disclosure may include a heat pump device. The heat pump device may include a compressor 51, the condenser 21, an expansion device 52, and the evaporator 31. A refrigerant may flow in the heat pump device. Accordingly, the refrigerant may circulate in a series of processes including compression, condensation, expansion, and evaporation. The condenser 21 and the evaporator 31 may correspond to a heat exchanger for exchanging heat with air.

[0045] The compressor 51 compresses a refrigerant gas into a high-temperature and high-pressure state and discharges the refrigerant gas, and the discharged refrigerant gas flows into the condenser 21. The condenser 21 may condense the compressed refrigerant into a liquid state and radiate heat around through the condensation process. The expansion device 52 expands the high-temperature and high-pressure liquid refrigerant condensed by the condenser 21 to low-pressure liquid refrigerant. The evaporator 31 evaporates the refrigerant expanded by the expansion device 52 and returns the low-temperature and low-pressure refrigerant gas to the compressor 51. The evaporator 31 may take heat from the surroundings through an evaporation process that changes a refrigerant liquid to a refrigerant gas.

[0046] Arrows shown in FIG. 3 indicate flows of air, and solid line arrows show flows of air supplied to the interior 41 of the drum through the air inlet 24. Air outside the main body 10 may be brought into the main body 10 through the air suction port 23. The air brought into the main body 10 may pass the condenser 21 and/or the

heater 22 arranged to be adjacent to the air suction port 23. Accordingly, the outside air having relatively low temperature may be relatively heated while passing the condenser 21 and/or the heater 22. That is, the cool and dry air outside the main body 10 turns into hot and dry air while passing the condenser 21. The hot and dry air may contain a lot of steam.

[0047] This hot and dry air may be bought in through the rear opening 43 of the drum 40 through the air suction port 23 to dry clothes 2. Air that has taken moisture from the clothes 2 may contain lots of steam again. The air inside the drum containing lots of stem may flow toward the air discharge unit 30 from the front opening 42 of the drum 40.

[0048] Dotted arrows show flows of air discharged from the interior 41 of the drum, and the hot and humid air discharged from the drum 40 may pass the front cover 70 and the outlet 33 formed at the side of the front cover 70 and then pass through the evaporator 31 arranged in the air discharge unit 30. The air robbed of heat while passing the evaporator 31 may be cooled down and may have less moisture. That is, the hot and humid air discharged from the drum 40 may turn to cool and dry air while passing the evaporator 31. The air that has become cool and dry after passing the evaporator 31 is discharged out of the main body 10.

[0049] Suction and discharging of the air may be performed by the blower fan 32 arranged in the air discharge unit 30. For example, the blower fan 32 may blow the air inside the main body 10 so that the air passes the interior 41 of the drum. The air discharged to the air discharge unit 30 from the drum 40 may contain various foreign materials such as lint produced in the drying process, which may be filtered out by the filter 35 arranged at the entrance of the air discharge unit 30.

[0050] Condensate water may be produced in the process where the hot and humid air discharged from the drum 40 is cooled and dehydrated in the evaporator 31. The condensate water may fall down from the evaporator 31 and be collected by a water collector bin 61.

[0051] An embodiment of the disclosure will now be described from a different perspective.

[0052] The hot and dry air that has passed the condenser 21 may flow to the interior 41 of the drum that receives the clothes 2 through the air inlet 24. Humidity and/or moisture of the air may increase while the air is passing the clothes 2. The air may pass a front portion of the drum 40 and flow to the front cover 70 arranged in front of the drum 40. In other words, the front cover 70 may be arranged on the downstream side of the drum 40 from the point of air flow.

[0053] In this case, a sensing device 100 arranged in an upper portion of the front cover 70 may sense humidity in air discharged from the drum 40. For example, as the sensing device 100 is arranged in the downstream side of the drum 40, the sensing device 100 may sense temperature and relative humidity of the air having passed the clothes 2 and then discharged from the drum 40. Furthermore, the sensing device 100 may be arranged at a position matching the air inlet 24. For example, the air inlet 24 may be formed on the left side from the rear surface of the drum 40, and the sensing device 100 may be coupled to an upper left portion of the front cover 70 to match the air inlet 24 in the front-back direction. For example, the drum 40 may be rotated counterclockwise when viewed from front to back of the drum 40, and the sensing device 100 may be arranged to lean to the right side when viewed from front to back of the drum 40. Accordingly, the air of the interior 41 of the drum may not stagnate but flow to the sensing device 100 through the clothes 2.

[0054] The clothes dryer may sense moisture or humidity of the clothes 2 by sensing humidity in air being discharged from the drum 40. In addition, the moisture or humidity of the clothes 2 may be sensed by an electrode sensor 180 arranged in a lower portion of the front cover 70. For example, when touching the object to be dried, the electrode sensor 180 may sense moisture or humidity of the clothes.

[0055] A controller as will be described later may properly control an operation time for the dryer 1 based on the moisture or humidity of an object to be dried (e.g., the clothes 2) sensed by the sensing device 100 or the electrode sensor 180.

[0056] FIG. 4 is a front view schematically illustrating the clothes dryer of FIG. 1.

[0057] Referring to FIG. 4, according to an embodiment of the disclosure, the clothes dryer may include the drum 40 rotatably arranged in the cabinet, the front panel 13 arranged in front of the drum 40 and having the inlet 13a formed thereon, and a front cover 70 coupled to the sensing device 100. The sensing device 100 may be coupled to an upper portion of the front cover 70. For example, the sensing device 100 may be coupled to an upper left portion of the front cover 70.

[0058] The interior 41 of the drum may receive the clothes 2. The interior 41 of the drum may also be referred to as a receiving chamber 41.

[0059] In an embodiment, the drum 40 of the clothes dryer 1 may be rotated in one direction. For example, the drum 40 may be rotated clockwise when viewed from the front of the clothes dryer. In this case, the clothes 2, which are objects to be dried, may also be rotated clockwise, and the rotating clothes 2 may fall to the bottom from an upper portion of the interior 41 of the drum due to the gravity. For example, the clothes 2 may fall to the bottom from about twelve o'clock direction. The sensing device 100 is coupled to the upper left portion of the front cover 70, so the sensing device 100 may be least affected by the clothes 2 that are moving.

[0060] FIG. 5 is a perspective view of the clothes dryer of FIG. 1 with a cabinet omitted from the clothes dryer. FIG. 6 is a perspective view of the clothes dryer of FIG. 2 with a cabinet omitted from the clothes dryer.

[0061] Referring to FIGS. 5 and 6, the clothes dryers according to an embodiment of the disclosure may in-

clude the drum 40, the front cover 70, a rear cover 90 and a lighting device 80.

[0062] The interior space 41 of the drum 40 may receive the clothes 2. The front cover 70 may be arranged in front of the drum 40, and the rear cover 90 may be arranged behind the drum 40. The front cover 70 and the rear cover 90 are described as separate components from the drum 40, but are not limited thereto. For example, the front cover 70 and the rear cover 90 may be integrated in the drum 40. For example, the rear cover 90 may form the rear side of the drum 40. The rear cover 90 may be a rear panel 90.

[0063] The air inlet 24 may be formed at the rear cover 90. For example, the air inlet 24 may be formed on the rear side of the drum 40. Air may be brought into the interior 41 of the drum 40 through the air inlet 24. The air may flow toward the front of the drum 40 via the interior 41 of the drum. The air that has passed the interior 41 of the drum may flow to the front cover 70. The flow path 71 may be formed in the front cover 70. The front cover 70 may also be referred to as a front duct 70. For example, a cover part 72 may form the flow path 71. The cover part 72 may also be referred to as a duct part 72. The air discharged from the drum 40 may flow into the flow path 71. In other words, the flow path 71 may be arranged on the downstream side of the interior 41 of the drum from the point of air flows. The air flowing in the flow path 71 may flow to the evaporator 31 through the outlet 33 arranged in a lower portion of the cover part 72.

[0064] As the interior 41 of the drum receives the clothes 2, the air flowing into the interior 41 of the drum may pass the clothes 2. The air may absorb moisture from the clothes 2 while passing the clothes 2, and thus, humidity in the air may increase. The sensing device 100 may be mounted on the cover part 72. The sensing device 100 may include the sensor 110. The sensor 110 may face the flow path 71 formed in the front cover 70. Furthermore, the sensor 110 may face the interior of the cover part 72 and/or the interior 41 of the drum. The air may flow to the front cover 70 and thus pass the flow path 71. In other words, the sensor 110 of the sensing device 100 may face the flow path 71 and come into contact with the air in the flow path 71. The sensor 110 may contact the air in the flow path 71 and sense temperature and/or humidity of the air. However, how the sensor 110 senses humidity in air is not limited to the above example.

[0065] The lighting device 80 may illuminate the interior 41 of the drum and/or the interior of the front cover 70. The sensing device 80 may be coupled to the front cover 70. For example, the lighting device 80 may be coupled to the cover part 72 at a position near the sensing device 100. Accordingly, like the sensing device 100, the lighting device 80 may be least affected by the clothes. However, the position of the lighting device 80 is not limited to this example.

[0066] In an embodiment of the disclosure, the clothes dryer may include an air inlet duct 24a coupled to the rear side of the rear cover 90 to cover the air inlet 24. The air inlet duct 24a may be connected to the air suction port 23. Furthermore, the clothes dryer may include an air suction port cover 231 to cover an air suction port duct 23a arranged in a rear portion of the main body 10 to form the air suction port 23, and the air suction port 23.

[0067] FIG. 7 is a perspective view illustrating a drum and a front cover of the clothes dryer of FIG. 6.

[0068] Referring to FIG. 7, the front cover 70 may include the flow path 71 formed in the interior of the front cover 70 to connect the inlet 13a of the front panel 13 to the interior 41 of the drum, the cover part 72 forming the flow path 71, a panel part 73, and an insertion part 74 inserted to the interior of the drum. The cover part 72 may guide air flowing in the flow path 71. The insertion part 74 may be inserted to the interior 41 of the drum from the perimeter of the drum 40. The cover part 72 may be coupled to outlet ducts 33a and 33b by which the outlet 33 is formed.

[0069] The clothes dryer according to an embodiment of the disclosure may include the sensing device 100 and the electrode sensor 180.

[0070] The sensing device 100 may be coupled to an upper portion of the cover part 72 and the electrode sensor 180 may be coupled to a lower portion of the cover part 72. The sensing device 100 may be coupled to an inner wall 72a of the cover part. The sensing device 100 may sense humidity in air that are passing the flow path 71 through clothes in the interior 41 of the drum. Accordingly, the sensing device 100 may indirectly sense moisture or humidity of the clothes 2. Although not shown, the electrode sensor 180 may sense humidity and/or moisture of the clothes 2 by contacting the clothes 2. Accordingly, the clothes dryer according to an embodiment of the disclosure may sense humidity of the clothes 2 through the sensing device 100 and the electrode sensor 180.

[0071] FIG. 8 is a perspective view illustrating a front cover and a sensing device of the clothes dryer of FIG. 1. FIG. 9 is a perspective view illustrating the front cover and the sensing device of FIG. 8 viewed from a different angle.

[0072] Referring to FIGS. 8 and 9, the clothes dryers according to an embodiment of the disclosure may include the front cover 70, the lighting device 80, and the sensing device 100.

[0073] The front cover 70 may form the flow path 71 that connects the inlet 13a formed at the front panel 13 to the interior 41 of the drum. The front cover 70 may include the cover part 72 forming the flow path 71, the panel part 73 arranged in the back of the cover part 72, the insertion part 74 extending rearward from the panel part 73 and inserted to the interior 41 of the drum, an air supply unit coupler 78 to be coupled to the air supply unit 20, and a front panel receiver 79 receiving part of the front panel 13 forming the inlet 13a. The flow path 71 may be formed in the cover part 72. The cover part 72 may also be referred to as a duct part 72. The flow path

71 may connect the front opening 42 of the drum 40 to the inlet 13a of the cabinet 11. Furthermore, the flow path 71 may guide the air discharged from the drum 40 to the outlet 33. The inner wall 72a of the cover part may form the flow path 71.

[0074] The cover part 72 may be arranged between the front panel 13 and the front of the drum 40 to form the flow path 71 that connects the front opening 42 of the drum 40 to the inlet 13a of the cabinet 11. The cover part 72 may be arranged between the inlet 13a and the front opening 42. For example, the cover part 72 may be formed from the insertion part 78 to be inserted to the interior 41 of the drum from the front of the drum 40 to be coupled to the drum 40 to the front panel receiver 79 to which part of the front panel 13 that forms the inlet 13a is inserted.

[0075] The cover part 72 may be coupled to the lighting device 80, the sensing device 100, a sensor filter 120, the outlet ducts 23a and 23b, and the air supply unit 20. The lighting device 80 and the sensing device 100 may be coupled to an upper portion of the cover part 72. For example, the lighting device 80 and the sensing device 100 may be coupled to an upper left portion of the cover part 72. The lighting device 80 and the sensing device 100 may be coupled to a first cover part 75. However, the coupling positions of the lighting device 80 and the sensing device 100 are not limited thereto.

[0076] An air outlet 77 may be formed in a lower portion of the cover part 72. The air outlet 77 may be formed by being opened in the lower portion of the cover part 72. The air outlet 77 may match the outlet 33. The air in the flow path 71 may flow to the air discharge unit 30 through the air outlet 77.

[0077] The air supply unit coupler 78 may protrude forward from the panel part 73. The air supply unit coupler 78 may be arranged in a lower portion of the panel part 73. The air supply unit coupler 78 may have the form of a hook.

[0078] The cover part 72 may be slopingly arranged such that the flow path 71 has smaller cross-sections toward the front. The cover part 72 may also be referred to as a slope portion 72. The cover part 72 may include the first cover part 75 and a second cover part 76. The first cover part 75 may adjoin the drum 40, and the second cover part 76 may be arranged to adjoin the front panel 13. The sensing device 100 may be coupled to the inner wall 75a of the first cover part. With this, a sensing surface 111 of the sensor 110 may face the flow path 71. As the sensing surface 111 faces the flow path 71 formed in the downstream side of the interior 41 of the drum, the sensor 110 may sense humidity of the air in the flow path 71. The coupling position of the sensing device 100 is not, however, limited thereto, and it is also possible for the sensing device 100 to be coupled to an inner wall 76a of the second cover part.

[0079] The front panel receiver 79 may receive part of the front panel 13 that forms the inlet 13a (see FIG. 3). The front panel receiver 79 may be arranged at one end of the front cover 70. For example, the front panel receiver 79 may be formed at one end of the front cover 70 in direction X.

[0080] FIG. 10 is a perspective view illustrating the sensing device of the clothes dryer of FIG. 5. FIG. 11 is an exploded view of the sensing device shown in FIG. 10. FIG. 12 is a perspective view illustrating the sensing device of FIG. 10 viewed from a different angle. FIG. 13 is an exploded view of the sensing device shown in FIG. 12.

[0081] In FIGS. 10 to 13, for explanation, upward, downward, left and right sides are defined with respect to direction A that is assumed to be a forward direction. Shapes and positions of respective components are not, however, limited by these terms. For example, the direction A may correspond to a direction toward the flow path 71 of the front cover 70.

[0082] Referring to FIGS. 10 and 13, the clothes dryer according to an embodiment of the disclosure may include the sensing device 100. The sensing device 100 may include the sensor 110, the sensor filter 120, a printed circuit board (PCB) 130, a wire 140, a first cover 150, a second cover 160, and a connector 170.

[0083] The sensor 110 may sense temperature and/or humidity of the air passing the flow path 71. The sensor 110 may include the sensing surface 111. The sensing surface 111 may face the flow path 71. For example, the sensing surface 111 may face the interior of the cover part 72. It is also possible for the sensing surface 111 to be arranged to face the interior 41 of the drum. The sensing surface 111 may face the flow path 71 through a through hole at the first cover 150.

[0084] The sensor 110 may be covered by the sensor filter 120 arranged in the front. The sensor 110 may be mounted on the PCB 130. Furthermore, the sensor 110 may be received between the first cover 150 and the second cover 160.

[0085] The sensor filter 120 may be arranged in front of the sensor 110 to cover the sensor 110. The sensor filter 120 may protect the sensor 110 from foreign materials in the main body 10. For example, the sensor filter 120 may protect the sensor 110 and/or the sensing surface 111 from dust in the interior 41 of the drum. The sensor filter 120 may be formed in a size and/or shape matching a through hole 151a of the first cover 150.

[0086] The sensor 110 may be mounted on the PCB 130, and may be connected to the controller 200 in the main body 10 through the wire 140. The sensor 110 may be electrically connected to the PCB 130. The sensor 110 may be mounted on a mounting surface of the PCB 130. The mounting surface 130a may be the front surface. The PCB 130 may be connected on a side 130b to the wire 140.

[0087] The PCB 130 may be received between the first cover 150 and the second cover 160. The PCB 130 may be placed on the second cover 160 arranged in the back. For example, the PCB 130 may be placed in placement parts 164a and 164b.

[0088] The wire 140 may be electrically connected to the PCB 130. The wire 140 may pass the hole 167 of the second cover 160 to be connected to the connector 170. The connector 170 may be connected to the main body 10. Information about the air in the flow path 71 sensed by the sensor 110 may be sent to the controller 200 through the wire 140 and the connector 170.

[0089] The first cover 150 may include a cover surface 151, the through hole 151a, a first guide 152, a first coupling projection 152a, a joint 153, and a second coupling projection 154.

[0090] The cover surface 151 may cover the sensor 110 received between the first cover 150 and the second cover 160 from the interior of the front cover 70. Referring to FIG. 9, the cover surface 151 may be arranged on the inner wall 72a of the cover part 72. The cover surface 151 may be arranged farther inside the cover part 72 than the sensor 110. The cover surface 151 may extend in direction B.

[0091] The through hole 151a may be formed at the cover surface 151. The through hole 151a may be formed on one side of the cover surface 151. The through hole 151a may be formed at a position matching the sensor 110. For example, the through hole 151a may be formed at the cover surface 151 to match arrangement of the sensing surface 111 and/or the sensor filter 120. The through hole 151a may be arranged with the sensing surface 111 and the sensor filter 120 in direction A. The through hole 151a may allow the sensing surface 111 and/or the sensor filter 120 to be exposed to the interior of the cover part 72. The through hole 151a may make the air in the flow path 71 reach the sensing surface 111.

[0092] The first guide 152 may guide the wire 140 such that the wire 140 extends to the outside of the front cover 70. The first guide 152 may penetrate the cover part 72. The first guide 152 may extend to direction -A from the cover surface 151. The first guide 152 may penetrate and be inserted to the second guide 162 of the second cover 160. For example, the second guide 162 may form the hole 167, and the first guide 152 may be inserted to the hole 167 of the second cover 160.

[0093] The first coupling projection 152a may make the first cover 150 coupled to the second cover 160. The first coupling projection 152a may be coupled to a first coupling hole 166a formed at the second guide 162. The first coupling projection 152a of the first cover 150 may be formed at an end of the first guide 152. For example, the first coupling projection 152a may protrude to direction C and/or direction -C from an end of the first guide 152 in direction -A. The first coupling projection 152a may be provided in the plural. The first coupling projection 152a may be inserted to the first coupling hole 166a formed at the second guide 162.

[0094] A joint 153 may make the first cover 150 and the second cover 160 fastened to each other by a screw (not shown). Furthermore, the joint 153 may make the sensing device 100 screw-coupled to the cover part 72. The joint 153 may include a hole. The joint 153 of the first cover 150 may be formed at a position and in the number matching a joint 163 of the second cover 160. The joint 153 may be formed on the rear side of the cover surface 151. The joint 153 may be provided in the plural. However, the position, the number, and the shape of the joint 153 are not limited to the above example.

[0095] The second coupling projection 154 may make the first cover 150 coupled to the second cover 160. The second coupling projection 154 may protrude rearward from the cover surface 151 and be inserted to a second coupling hole 166b. The second coupling projection 154 may be arranged on one side of direction -B, and the first guide 152 and the first coupling projection 152a may be arranged on one side of direction B.

[0096] The second cover 160 may be coupled to the first cover 150. The second cover 160 may include a cover surface 161, the second guide 162, the joint 163, a placement part, a fixing part, and a coupling hole.

[0097] The cover surface 161 of the second cover 160 may be placed on an inner side of edges 150a of the first cover 150. The cover surface 161 may make the sensor 110 received between the first cover 150 and the second cover 160. The cover surface 161 of the second cover 160 may cover the PCB 130 from direction -A. The cover surface 161 of the second cover 160 may be formed in a size and shape matching the cover surface 151 of the first cover 150.

[0098] The second guide 162 may guide the wire 140 such that the wire 140 extends to the outside of the front cover 70. The second guide 162 may penetrate the cover part 72. The second guide 162 may extend to direction -A from the cover surface 161. The second guide 162 may form the hole 167 to which the first guide 152 and the wire 140 are inserted.

[0099] The joint 163 may make the first cover 150 and the second cover 160 fastened to each other by the screw. Furthermore, the joint 163 may make the sensing device 100 screw-coupled to the cover part 72. The joint 163 may include a hole. The joint 163 of the second cover 160 may be formed at a position and in the number matching the joint 153 of the first cover 150.

[0100] The placement parts 164a and 164b may allow the PCB 130 to be placed on the cover surface 161 of the second cover 160. The placement parts 164a and 164b may include first and second placement parts 164a and 164b. The first placement part 164a may make both ends of the PCB 130 settled in direction B. The first placement part 164a may be formed to correspond to the shape of the PCB 130. The second placement part 164b may prevent the PCB 130 that is placed in the first placement part 164a from getting out of the first placement part 164a to direction B. The second placement part 164b may protrude to direction A from the cover surface 161 of the second cover 160. The second placement part 164b may be arranged between the first placement part 164a and the hole 167.

[0101] The fixing part 165 may minimize swaying of the sensing device 100 while the sensing device 100 is

coupled to the cover part 72. The fixing part 165 may contact the outer surface of the cover part 72. For example, the fixing part 165, the inner wall 72a of the cover part, and the edges 150a of the first cover 160 may be sequentially arranged toward the inside of the cover part 72. The fixing part 165 may be formed at the second guide 162. For example, the fixing part 165 may protrude to direction B and/or direction - B from the circumference of the second guide 162.

[0102] The coupling holes 166a and 166b may make the first cover 150 coupled to the second cover 160. The coupling holes 166a and 166b may be coupled to the first coupling projection 152a of the first cover 150 and the second coupling projection 154. For example, the first coupling projection 152a of the first cover 150 may be inserted to the first coupling hole 166a, and the second coupling projection 154 of the second cover 160 may be inserted to the second coupling hole 166b. The first coupling hole 166a may be formed in direction C of the second guide 162. The second coupling projection 154 may be provided in the plural. The first coupling hole 166a may be formed on one side of the cover surface 161 in direction B and the second coupling hole 166b may be formed on one side of the cover surface 161 in direction -B.

[0103] The connector 170 may be electrically connected to the PCB 130 through the wire 140. The connector 170 may be electrically connected to the controller 200 provided in the main body 10.

[0104] FIG. 14 is a control block diagram of a clothes dryer, according to an embodiment of the disclosure.

[0105] Referring to FIG. 14, the clothes dryer according to an embodiment of the disclosure may include the controller 200. The sensing device 100 or the electrode sensor 180 may sense humidity of the clothes 2 and send information about the humidity to the controller 200. For example, the sensing device 100 may sense temperature and relative humidity in air and send the information to the controller 200. The controller 200 may change the information received from the sensing device 100 to an absolute humidity value. The controller 200 may estimate humidity and/or moisture of the clothes 2 based on the absolute humidity value and control an operation time for the clothes dryer. For example, the controller 200 may reduce the operation time for clothes dryer when less time than a preset time is enough to make the clothes 2 reach a target dry level, and may operate the clothes dryer for a longer time when more time than the preset time is required.

[0106] Several embodiments of the disclosure have been described above, but a person of ordinary skill in the art will understand and appreciate that various modifications can be made without departing from the scope of the disclosure. Thus, it will be apparent to those or ordinary skill in the art that the true scope of technical protection is only defined by the following claims.

Claims

1. A clothes dryer comprising:

a cabinet including a front panel having an inlet through which objects are placed;
a drum rotatably arranged in the cabinet and having a front opening and a rear opening, the drum configured to have air flow along an interior of the drum from the rear opening to the front opening;
a front cover formed to link the inlet of the cabinet and the front opening of the drum, the front cover including a slope portion formed to have a diameter decreasing toward the inlet of the cabinet from the front opening of the drum;
a rear cover formed to connect to the rear opening of the drum and having an air inlet formed at the rear cover to guide the air to flow toward the rear opening of the drum from an exterior of the drum; and
a sensing device arranged on the slope portion for sensing humidity in air discharged from the front opening of the drum.

2. The clothes dryer of claim 1, further comprising:

a fan configured to move the air into the drum;
a heat exchanger arranged in the cabinet to cool the air discharged from the front opening of the drum; and
an air outlet formed in a lower portion of the front cover so that the air discharged from the front opening of the drum flows to the heat exchanger,
wherein the sensing device is arranged in an upper portion of the front cover.

3. The clothes dryer of claim 2,

wherein the drum is rotated counterclockwise while the drum is viewed from front to back of the drum, and
wherein the sensing device is arranged to lean to a right side when the drum is viewed from front to back of the drum.

4. The clothes dryer of claim 3, further comprising:
a lighting device adjacent to the sensing device.

5. The clothes dryer of claim 4, further comprising:

an electrode sensor coupled to a lower portion of the slope portion to sense humidity of the objects in the interior of the drum; and
a controller configured to determine an operation time for the clothes dryer based on one of humidity sensed by the electrode sensor or humidity sensed by the sensing device.

6. The clothes dryer of claim 1, wherein the sensing device includes

a sensor including a sensing surface facing inside of the slope portion; and
a cover coupled to an inner wall of the slope portion to cover the sensor.

7. The clothes dryer of claim 6, wherein the cover includes

a cover surface arranged on the inner wall of the slope portion; and
a through hole penetrating the cover surface for the sensing surface to be exposed to the inside of the slope portion.

8. The clothes dryer of claim 7, wherein the sensing device further includes
a filter arranged between the cover surface and the sensor to protect the sensor from foreign materials.

9. The clothes dryer of claim 8, wherein the cover is a first cover, and
wherein the sensing device is couplable to the inner wall of the slope portion and includes a second cover receiving the sensor and the filter between the first cover and the second cover.

10. The clothes dryer of claim 9,

wherein the sensing device includes a printed circuit board (PCB),
wherein the sensor is mounted on the printed circuit board (PCB),
wherein the PCB is placed on the second cover to be received between the first cover and the second cover.

11. The clothes dryer of claim 10,
wherein the first cover includes a first guide passing through the slope portion and formed to extend to outside of the slope portion from the cover surface to guide a wire electrically connected to the PCB.

12. The clothes dryer of claim 11,
wherein the second cover includes a second guide couplable to the first guide and passing through the slope portion and formed to extend to outside of the slope portion to guide the wire between the first guide and the second guide.

13. The clothes dryer of claim 1,

wherein the front cover is arranged in front of the drum in the cabinet and forms a flow path connected to an interior of the drum, and
wherein the sensing device includes a sensor facing the flow path, and is arranged to match the air inlet along a front-back direction.

14. The clothes dryer of claim 13, wherein the front cover includes
a cover part couplable to the sensing device and formed to slopingly extend from back to front of the front cover to form the flow path.

15. The clothes dryer of claim 14, further comprising:

an electrode sensor coupled to a lower portion of the cover part to sense humidity of the objects in the interior of the drum, and
a controller configured to determine an operation time for the clothes dryer based on one of humidity sensed by the electrode sensor or humidity sensed by the sensing device.

FIG. 1

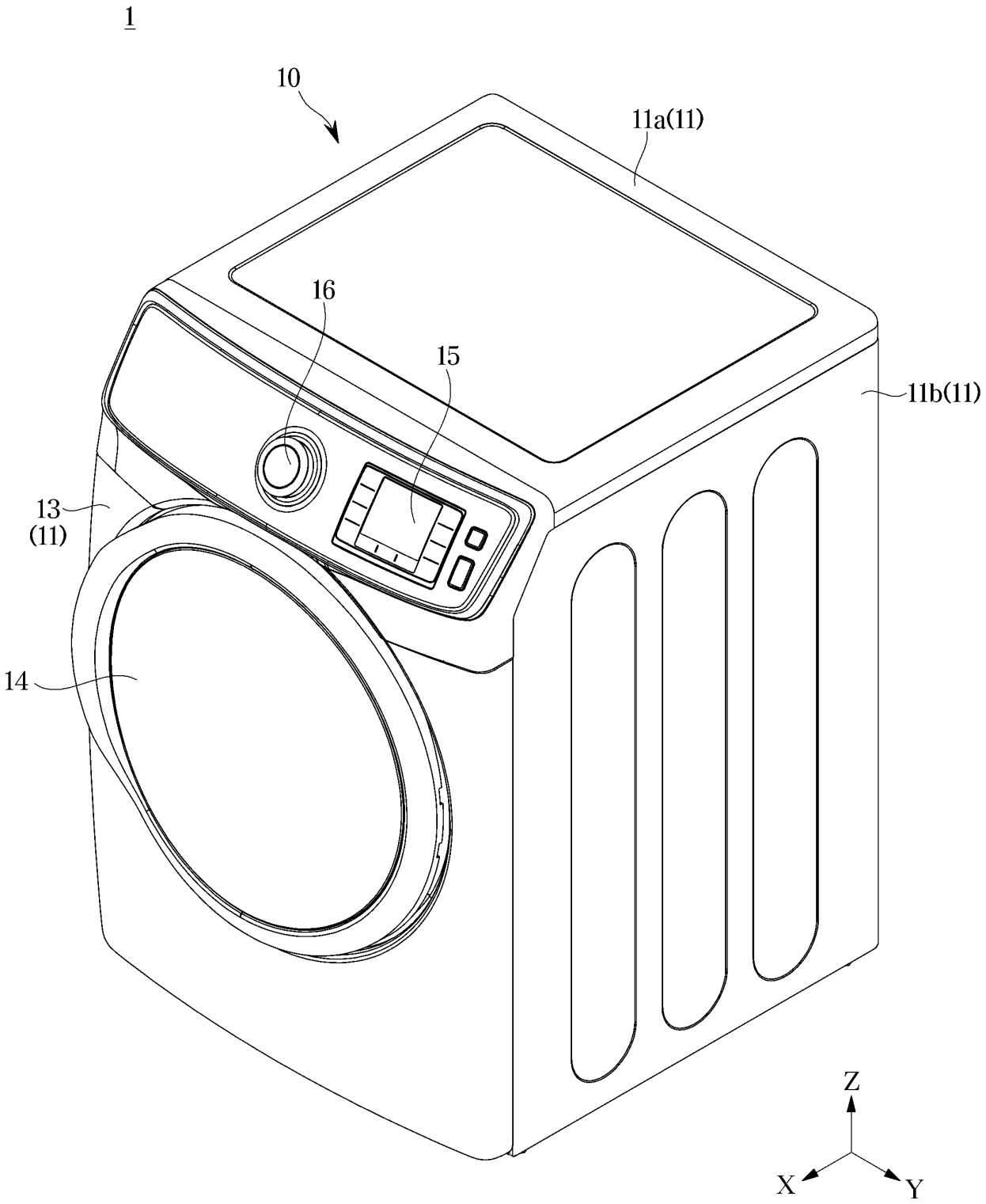


FIG. 2

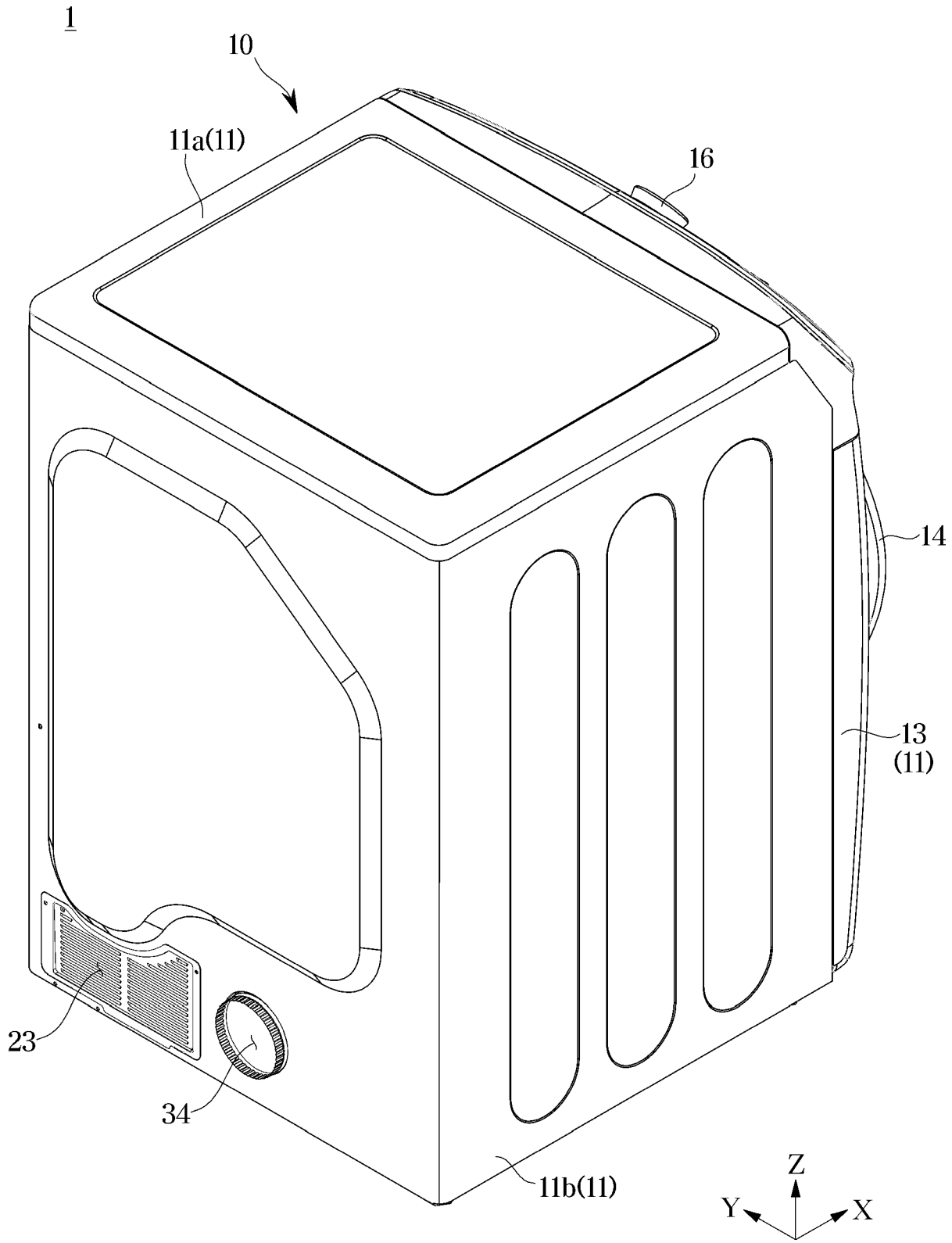
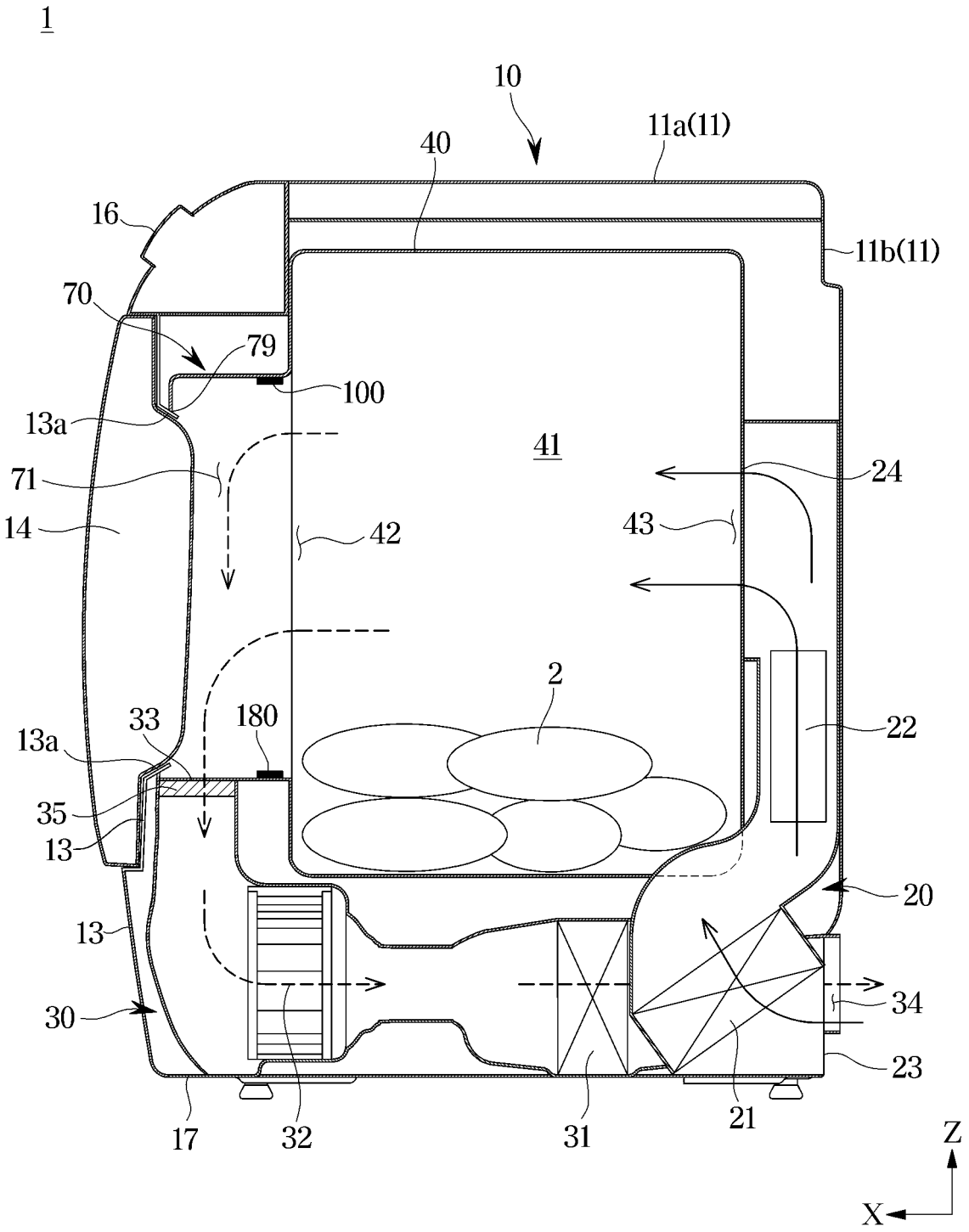


FIG. 3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10
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40
16
11b(11)
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79
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13a
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71
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14
42
43
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21
Z
X

FIG. 4

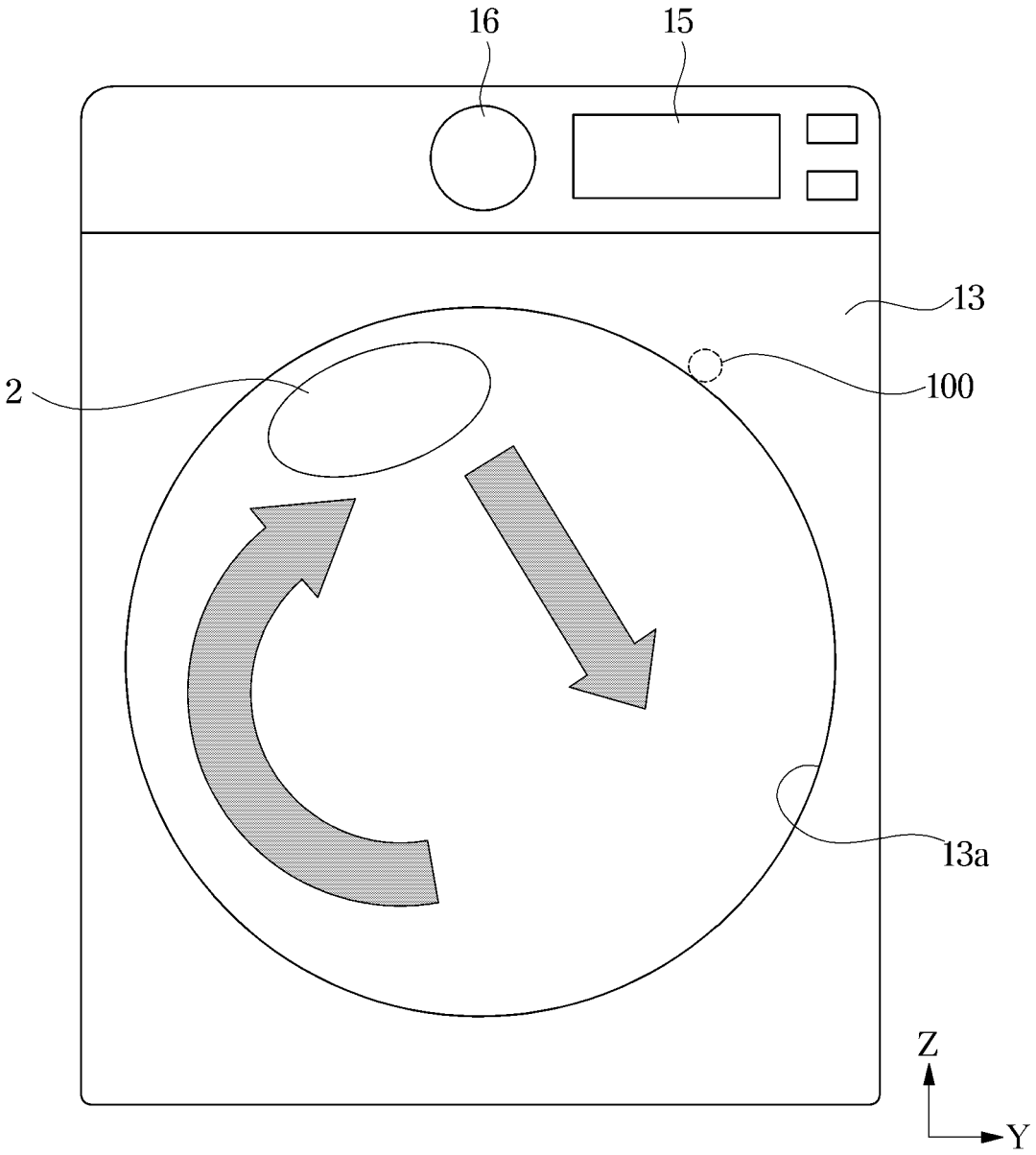


FIG. 5

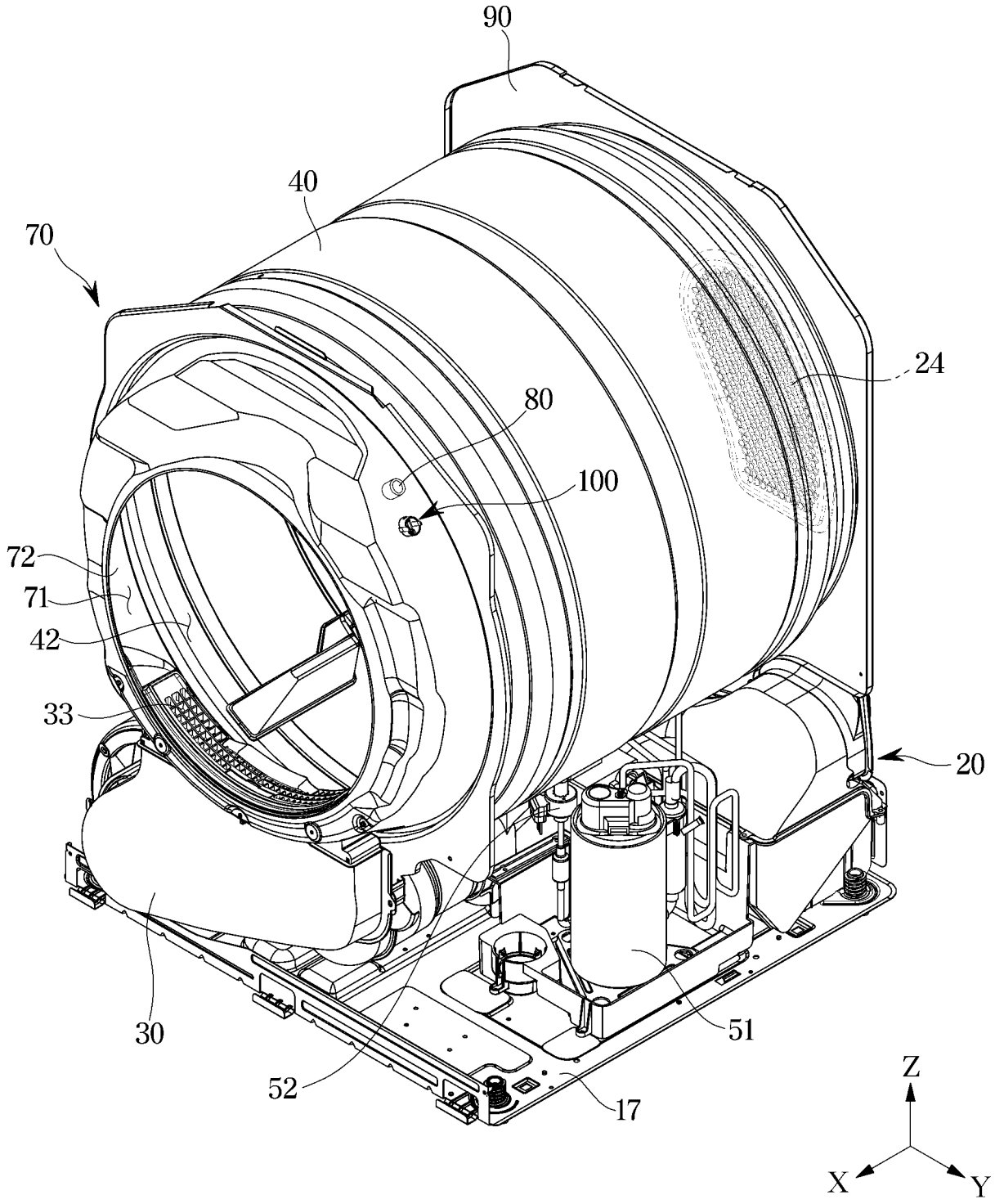


FIG. 6

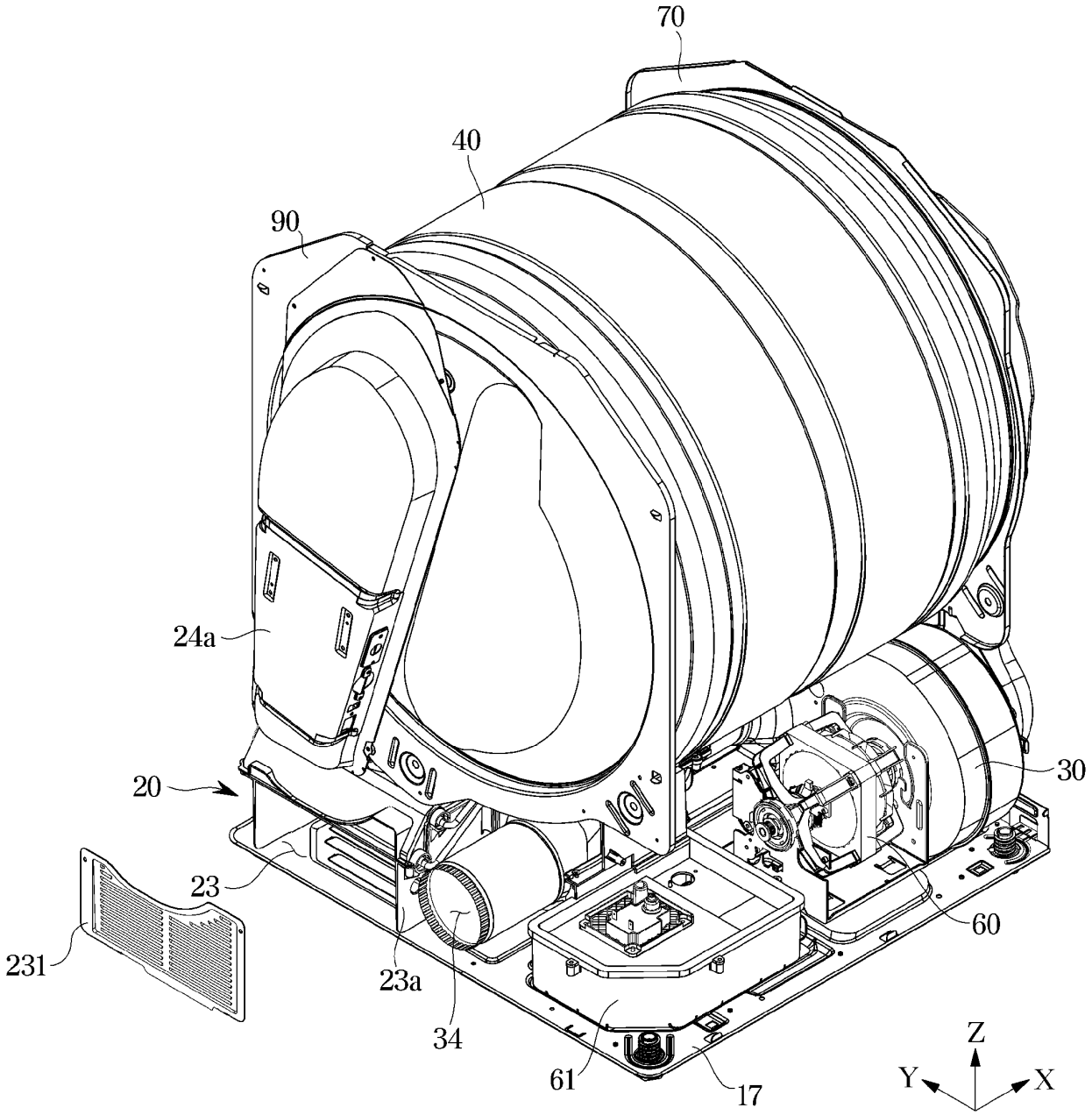


FIG. 7

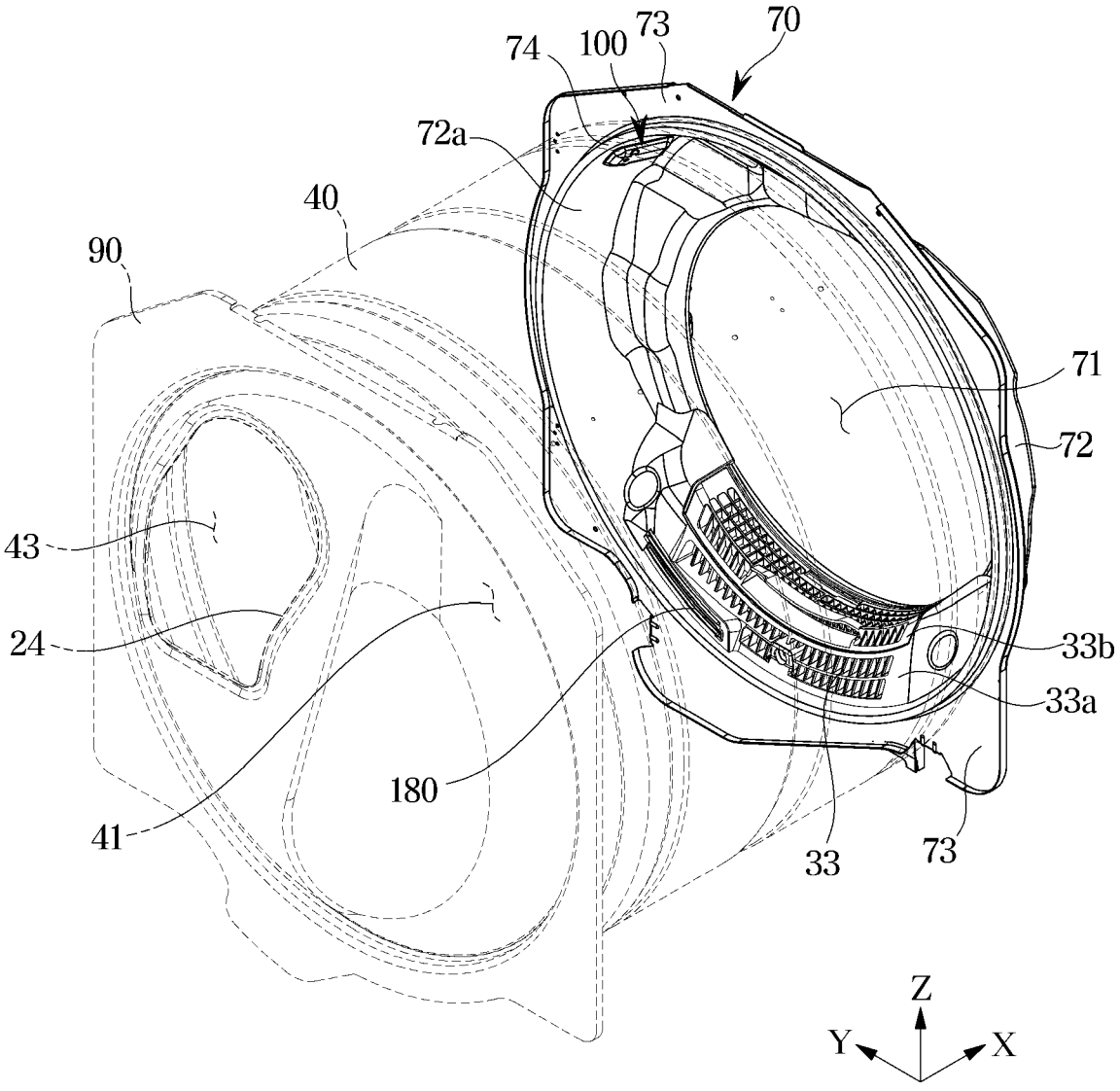


FIG. 8

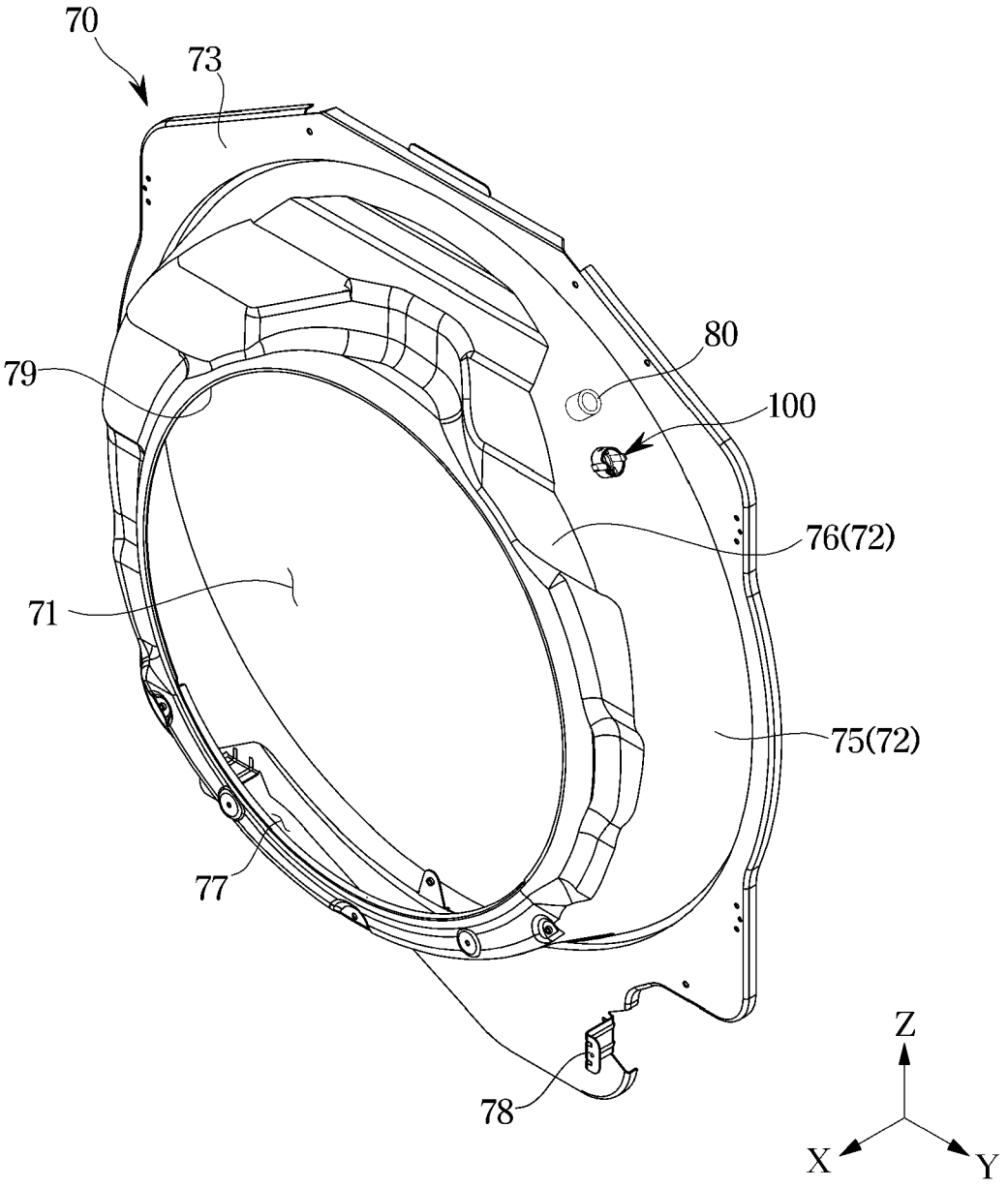


FIG. 9

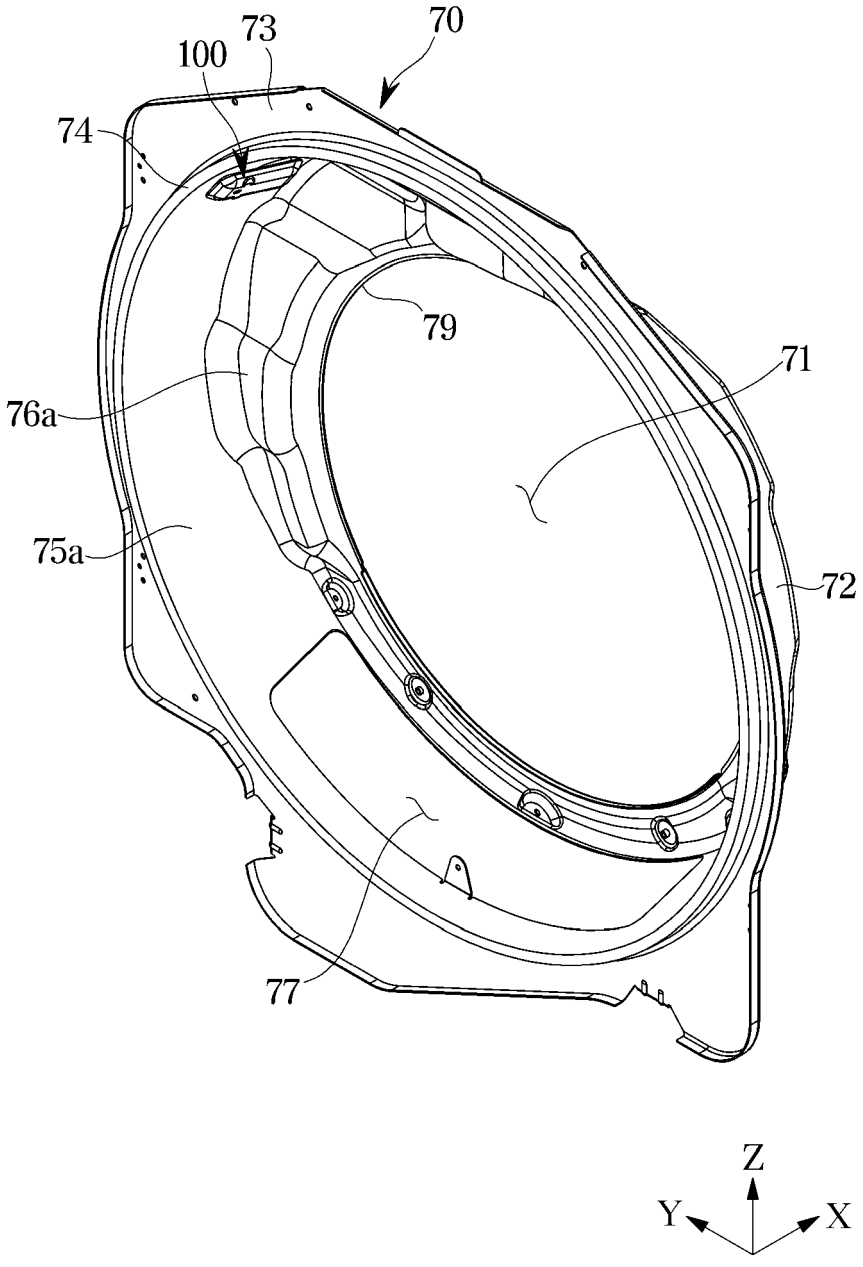


FIG. 10

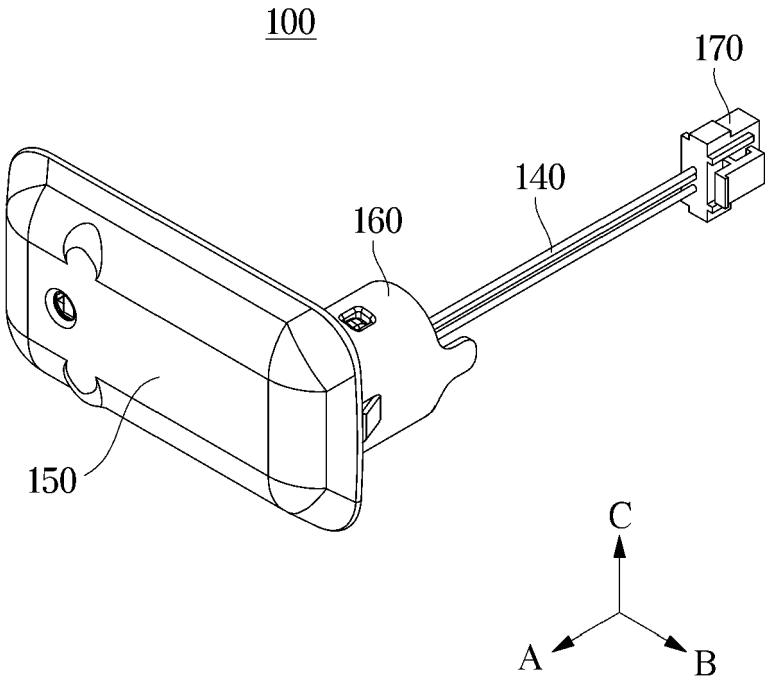
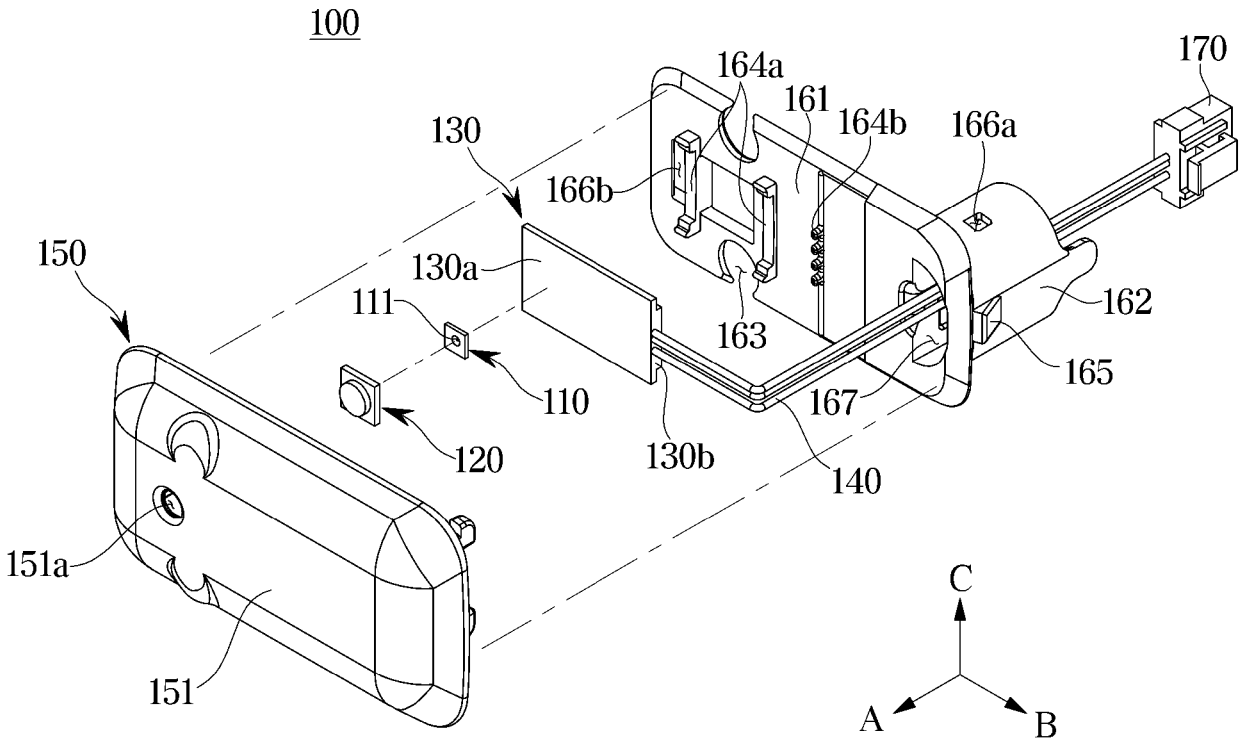


FIG. 11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B

FIG. 12

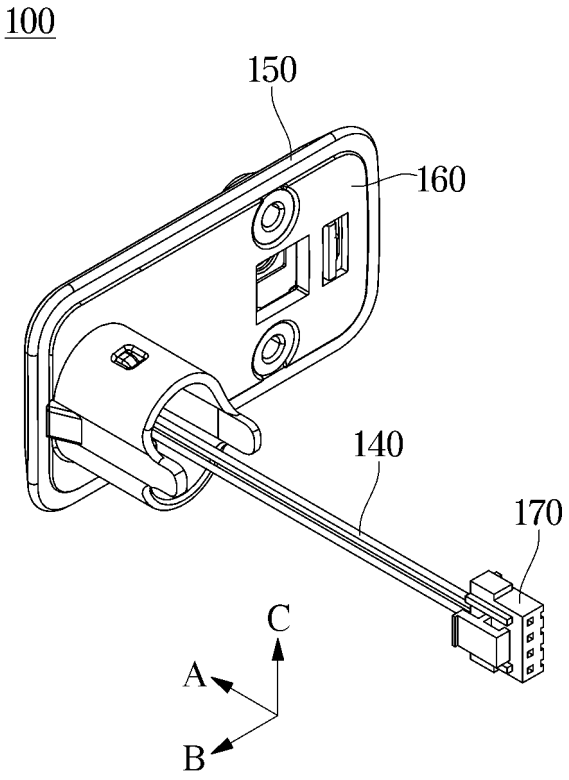
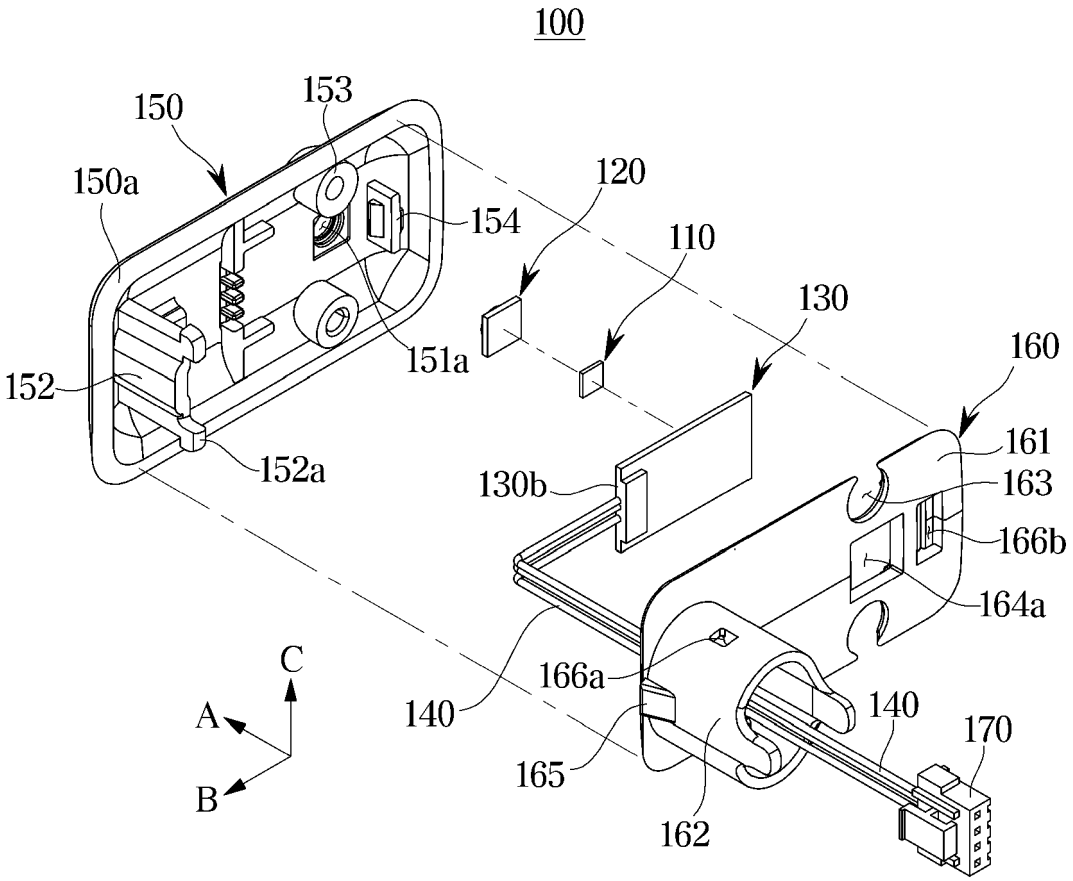


FIG. 13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B
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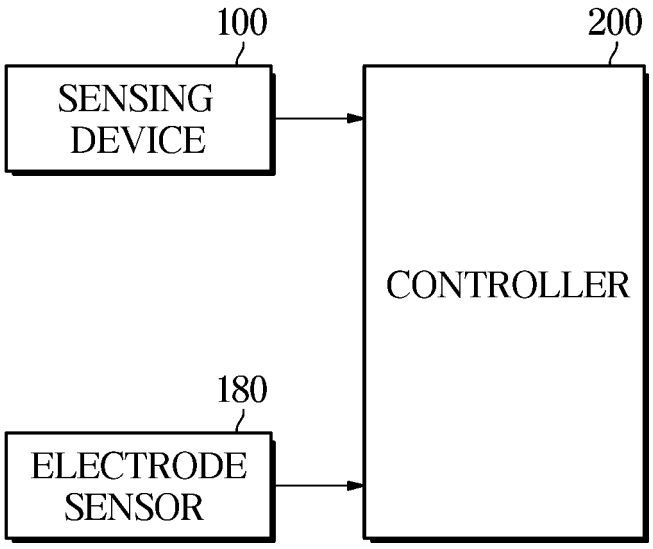
162

FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/009169

A. CLASSIFICATION OF SUBJECT MATTER

D06F 34/26(2020.01)i; **D06F 58/46**(2020.01)i; **D06F 58/22**(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 34/26(2020.01); D06F 58/02(2006.01); D06F 58/04(2006.01); D06F 58/20(2006.01); D06F 58/28(2006.01); F26B 25/00(2006.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 건조기(dryer), 의류(clothes), 센서(sensor), 공기(air), 드럼(drum), 커버(cover), 온도(temperature), 습도(humidity)

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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Y	KR 10-2011-0087926 A (LG ELECTRONICS INC.) 03 August 2011 (2011-08-03) See paragraphs [0023], [0025]-[0026], [0029] and [0036]-[0037] and figures 4-6a and 10.	1-15
A	EP 3175032 B1 (ELECTROLUX APPLIANCES AKTIEBOLAG) 12 September 2018 (2018-09-12) See paragraph [0060] and figure 1.	1-15
A	JP 2013-169328 A (RINNAI CORP.) 02 September 2013 (2013-09-02) See paragraph [0046] and figure 1.	1-15
A	JP 07-289797 A (SANYO ELECTRIC CO., LTD.) 07 November 1995 (1995-11-07) See paragraphs [0026]-[0027] and figure 3.	1-15

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 October 2022	**26 October 2022**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2022/009169

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