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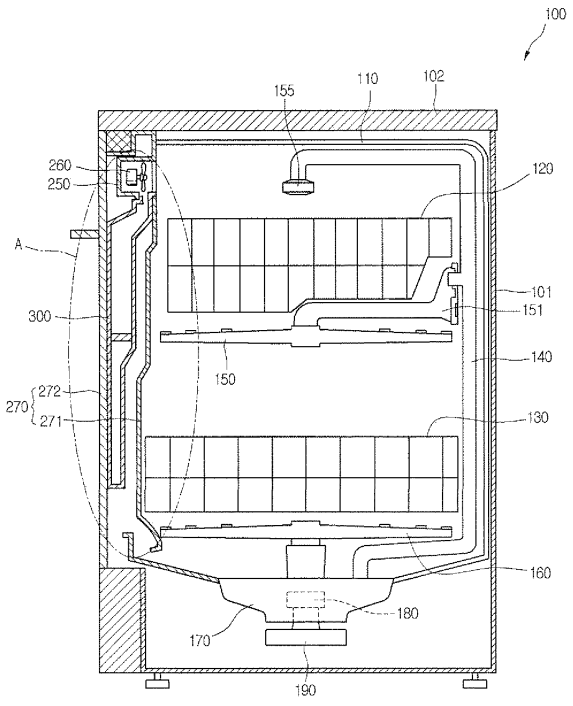
## (54) Dishwasher with condenser in the door

(57) A dishwasher (100) includes a tub (110) defining a washing chamber, and a door (270) rotatably connected to the tub. The door includes a door cover (272) and a door liner (271) connected to a rear side of the door cover. A condenser (300) is disposed between the door cover (272) and the door liner (271) to condense stream, and a fan assembly (260) sucks steam inside the tub and supplies the sucked steam to the condenser (300).

FIG.1




EP 1 905 341 A2

## Description

**[0001]** This application claims the benefit of Korea Patent Application No. 10-2006-0093869, filed September 27, 2006, which is hereby incorporated by reference for all purposes as if fully set forth herein.

**[0002]** The present application is related to a dishwasher that sprays wash liquid through spray nozzles under high pressure to remove food residue left on dishes.

**[0003]** The dishwasher includes a tub defining a washing chamber and a sump mounted on a bottom of the tub to contain the wash liquid. A washing pump is installed inside the sump to pump the wash liquid to the spray nozzles. The wash liquid is sprayed under high pressure through spray holes formed the ends of the spray nozzles. The wash liquid sprayed under high pressure collides against the surfaces of the dishes, so that food residue and impurities on the dishes are washed away to the tub.

**[0004]** High-temperature steam in the dishwasher can be processed using a ventilation-type drying method and a circulation-type drying method.

**[0005]** According to the ventilation-type drying method, a dry fan discharges moist air out of the tub. According to the circulation-type drying method, steam is condensed by a condenser provided inside the tub and is again introduced into the tub.

**[0006]** However, a dishwasher using the ventilation-type drying method has a drawback in that high-temperature, high-humidity air is directly discharged out of the tub, creating a hot and humid environment that would make a user feel uncomfortable. Also, due to the direct discharge of the high-temperature, high-humidity air, the user or child may be scalded.

**[0007]** During the discharge of the high-temperature, high-humidity air, steam may condense around a steam outlet and drip down to the floor, so that the floor becomes wet. Further, there is a danger that the user slips down onto the floor due to the condensed water collected on the floor. Moreover, mildew may form from the collected the condensed water on the floor or corner.

**[0008]** A dishwasher using the circulation-type drying method has a drawback in that steam is not condensed sufficiently because the condenser is small in size. Due to the small-sized condenser, it takes a long time to dry the dishes and an additional condenser is required.

**[0009]** Accordingly, a dishwasher that substantially obviates one or more problems due to limitations and disadvantages of the related art would be beneficial.

**[0010]** An object of the present invention is to provide a dishwasher having an improved condenser that rapidly condenses steam.

**[0011]** Another object of the present invention is to provide a dishwasher that shortens a drying time by rapidly condensing steam discharged during a dry cycle.

**[0012]** Another object of the present invention is to provide a dishwasher that rapidly condenses steam, so that a user does not feel uncomfortable and the danger of a scalding injury can be eliminated.

**[0013]** Yet another object of the present invention is to provide a dishwasher that has an improved condenser, so that an additional condenser is may not be required.

**[0014]** Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

**[0015]** To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a dishwasher including: a tub defining a washing chamber; a door rotatably connected to the tub, the door including a door cover defining a front appearance and a door liner connected to a rear side of the door cover; a condenser disposed between the door cover and the door liner to condense steam; and a fan assembly for sucking steam inside the tub and supplying the sucked steam to the condenser.

**[0016]** According to another aspect of the present invention, there is provided a dishwasher including: a tub; a door for selectively opening/closing a front side of the tub; a fan assembly including a fan mounted inside the door to suck steam inside the tub, a fan housing in which the fan is received and the steam and outside air are mixed with each other, and an opening/closing member for selectively communicating the tub with the fan housing; and a condenser provided inside the door to condense a fluid discharged from the fan assembly by heat conduction through the door.

**[0017]** According to another aspect of the present invention, there is provided a dishwasher including: a tub; a door rotatably connected to a front side of the tub; a fan assembly provided inside the door to suck steam inside the tub, the fan assembly having an outside air inlet at one side; and a condenser connected to the fan assembly, the condenser defining a condensation space for condensation of the steam.

**[0018]** According to another aspect of the present invention, the steam discharged during the dry cycle may be rapidly condensed.

**[0019]** Also, the drying time may be shortened because the steam discharged during the dry cycle is rapidly cooled.

**[0020]** The user does not feel uncomfortable because the steam discharged during the dry cycle is rapidly cooled.

**[0021]** In addition, the danger of a scalding injury may be eliminated because the steam discharged during the dry cycle is rapidly cooled.

**[0022]** Further, no additional condenser may be required because a portion of the door performs a function

of the condenser.

**[0023]** Furthermore, condensation does not occur near the steam outlet and thus condensed water does not drip down to the floor. Therefore, it is possible to prevent the user from slipping down onto the floor.

**[0024]** Moreover, it is possible to prevent mildew from forming at a corner due to the condensed water collecting on the floor.

**[0025]** It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and should not be construed as limiting the scope of the claims.

**[0026]** The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention. In the drawings:

**[0027]** Fig. 1 is a side sectional view of a dishwasher according to an embodiment of the present invention;

**[0028]** Fig. 2 is an enlarged view of a portion A of Fig. 1;

**[0029]** Fig. 3 is a front view of a door liner of a dishwasher according to a first embodiment of the present invention;

**[0030]** Fig. 4 is a perspective view of a condenser structure of the dishwasher according to the first embodiment of the present invention;

**[0031]** Fig. 5 is a front view of a door liner of a dishwasher according to a second embodiment of the present invention;

**[0032]** Fig. 6 is a front view a door liner of a dishwasher according to a third embodiment of the present invention; and

**[0033]** Fig. 7 is a perspective view of a condenser structure of the dishwasher according to the third embodiment of the present invention.

**[0034]** Reference will now be made in detail to the various embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

**[0035]** Fig. 1 is a side sectional view of a dishwasher according to an embodiment of the present invention, and Fig. 2 is an enlarged view of a portion A of Fig. 1.

**[0036]** Referring to Figs. 1 and 2, the dishwasher 100 includes a cabinet 101 defining an outer frame, a tub 110 protected by the cabinet 101 and forming a washing chamber, a door 270 rotatably mounted at a front side of the tub 110 to open/close the washing chamber, and a sump 170 disposed at a bottom center portion of the tub 110 to contain wash liquid.

**[0037]** In addition, the dishwasher 100 includes a washing pump 180 installed inside the sump 170 to pump wash liquid under high pressure, a motor 190 connected to a shaft of the washing pump 180 to drive the washing pump 180, and a door 270 rotatably connected to the tub 110.

**[0038]** The door 270 includes a door cover 272 defining a front appearance and a door liner 271 connected to a rear side of the door cover 272. A condenser is interposed between the door cover 272 and the door liner 271, which will be described later.

**[0039]** The washing pump 180 is designed to stop its operation when the opening of the door 270 is detected during a high-temperature wash cycle. Also, the washing pump 180 is designed to restart its operation when a predetermined time has elapsed after the closing of the door 270 is detected.

**[0040]** In addition, the dishwasher 100 includes a water guide 140, a bottom nozzle 160, a middle nozzle 150, and a top nozzle 155. The water guide 140 provides a flow path for wash liquid pumped by the washing pump 180. The bottom nozzle 160 is disposed on the bottom of the tub 110 above the sump 170 to spray wash liquid upwards. The middle nozzle 150 is branched from a predetermined portion of the water guide 140 and is disposed near a center portion of the tub 110. The top nozzle 155 is disposed near a ceiling of the tub 110 to spray wash liquid downwards.

**[0041]** The condenser 300 is disposed between the door cover 272 and the door liner 271, and a fan assembly is connected to an upper portion of the condenser 300 to suck in steam from the tub 110. The fan assembly includes a fan 260 for sucking air inside the tub 110 and discharging the sucked air into the condenser 300, and a fan housing 250 is provided for receiving the fan 260. The fan 260 may be a double-suction centrifugal type fan. A discharge duct 290 is connected to another side of the fan housing 250 so as to discharge steam.

**[0042]** The condenser 300 is tightly attached to a rear side of the door cover 272, so that outside air and steam inside the condenser 300 heat-exchange with each other through the door cover 272. That is, air outside the door 270 and steam inside the condenser 300 heat-exchange with each other by heat conduction through walls of the door cover 272 and the condenser 300. A front side of the condenser 300 is open. The open front side of the condenser 300 is tightly sealed by the door cover 272, such that heat conduction is achieved rapidly. That is, the door cover 272 may form a portion of the condenser 300.

**[0043]** The front side of the door cover 272 is exposed to the outside. The rear surface of the door cover 272 is tightly contacted with the front surface of the condenser 300, or it is exposed to high-temperature steam flowing through the condenser 300. Therefore, room-temperature outside air and high-temperature steam inside the condenser 300 are condensed through heat exchange through the door cover 272.

**[0044]** Since the door cover 272 of the door 270 is tightly contacted with one side of the condenser 300 or forms a portion of the condenser 300, no additional condensation component is required, and thus the condenser structure can be simplified.

**[0045]** Although the condenser 300 is provided inside

the door as seen in one embodiment of the present invention, this is only shown for illustrative purposes. According to another embodiment, the condenser 300 may be attached to one side of the cabinet 101, or the cabinet 101. may be formed as one component of the condenser 300. In this case, the condenser 300 is installed between the cabinet 101 and the tub 110.

**[0046]** An operation of the dishwasher 100 illustrated in Fig. 1 will be described below.

**[0047]** The user opens the door 270 of the dishwasher 100 and pulls an upper rack 120 and/or a lower rack 130 out of the washing chamber. The user places the dishes on the upper and/or lower racks 120 and 130. Then, the user closes the door 270 and operates the dishwasher 100 by switching it on.

**[0048]** When the dishwasher 100 performs a wash cycle, wash liquid is supplied to the sump 170. After the supply of the wash liquid is completed, the motor 190 begins to operate. An impeller (not shown) is provided inside the washing pump 180 connected to the shaft of the motor 190. As the impeller (not shown) is rotating, the wash liquid is alternately pumped to the bottom nozzle 160 or the water guide 140.

**[0049]** The wash liquid pumped to the water guide 140 flows to the top nozzle 155 and the middle nozzle 150 and is finally sprayed into the washing chamber. The dishes received in the upper and/or lower racks 120 and 130 are washed by the sprayed wash liquid.

**[0050]** However, when the door 270 is opened during a high-temperature wash cycle, the washing pump 180 restarts its operation after a predetermined time elapses so as to prevent the wash liquid contained in the sump 170 from overflowing due to the expansion of cold air introduced into the tub 110.

**[0051]** In other words, when the sprayed high-temperature wash liquid comes in contact with low-temperature air, the wash liquid contained in the sump 170 overflows due to air expansion. In order to prevent this phenomenon, the washing pump 180 stops its operation when the opening/closing of the door 270 is detected during the high-temperature wash cycle. Then, the washing pump 180 restarts its operation after a predetermined time elapses.

**[0052]** The top nozzle 155 sprays the wash liquid downwards and the middle nozzle 150 sprays the wash liquid upwards, so that the dishes received in the upper rack 120 are washed.

**[0053]** In addition, the bottom nozzle 160 sprays the wash liquid upwards, so that the dishes received in the lower rack 130 are washed. Spray holes can also be formed at the bottom of the middle nozzle 150. In this case, because the middle nozzle 150 sprays the wash liquid upwards and downwards, the upper surfaces of the dishes received in the lower rack 130 can also be washed, while the lower surfaces of the dishes received in the upper rack 120 are washed.

**[0054]** The dirty wash liquid collected in the sump 170 during the wash cycle is filtered by a filter (not shown). When the dishwasher 100 finishes the wash cycle and begins a discharge cycle, a discharge pump (not shown) pumps the filtered wash liquid out of the dishwasher 100.

**[0055]** After the wash liquid is discharged, the dishwasher 100 performs a rinse cycle. That is, clean wash liquid is supplied to the sump 170 through an inlet and is sprayed through the nozzles 150 and 160 similar to the wash cycle, so that the dishes are rinsed by the sprayed clean wash liquid.

**[0056]** After the rinse cycle, the dishwasher 100 performs a drying operation to dry the dishes and then its dishwashing operation is finished.

**[0057]** Fig. 3 is a front view of a door liner of a dishwasher according to a first embodiment of the present invention, and Fig. 4 is a perspective view of a condenser structure of the dishwasher according to the first embodiment of the present invention.

**[0058]** Referring to Figs. 3 and 4, steam discharged from the tub 110 is introduced into a condenser 300 in such a manner that it is mixed with outside air.

**[0059]** Specifically, a fan assembly sucks in the wet vapor from the tub 110 and a condenser 300 is fluidly connected to a side of the fan assembly and the wet vapor entering the condenser 300 is condensed therein. The fan assembly and condenser 300 are mounted to a front surface of the door liner 271, which is configured to form a rear part of the door 270.

**[0060]** More in detail, the fan assembly includes a fan housing 250, a fan 260 received in the fan housing 250, a blower cover 256, and an actuator 257 for driving the blower cover 256. The blow cover 256 is provided for selectively opening/closing holes formed in the fan housing 250 and door liner 271. An outside air inlet 255 is formed in a portion of a front surface of the fan housing 250, and a mixed gas outlet 254 is formed in another portion of the fan housing 250.

**[0061]** The indoor air is introduced through the outside air inlet 255 into the fan housing 250. The indoor air is air that exists in a space between a door cover 272 and the door liner 271. A mixed gas outlet 254 is fluidly connected to the condenser 300.

**[0062]** As described before, the condenser 300 directly contacts a rear surface of the door cover 272. Alternatively, a front side of the condenser 300 may be open. The open front side of the condenser 300 is then tightly sealed to the door cover 272.

**[0063]** The condenser 300 includes a condensation chamber 310, an inlet 320, and an outlet 330. The condensation chamber 310 has a hollow case shape. The inlet 320 is formed in one side, preferably an upper portion, of the condensation chamber 310. The outlet 330 is formed in another side, preferably a lower portion, of the condensation chamber 310.

**[0064]** As illustrated in Figures, it is preferable that the lower portion of the condensation chamber 310 is sloped downward toward the outlet 330 such that the condensed water is guided to the outlet 330.

**[0065]** In addition, at least one flow guide 340 is formed

inside the condensation chamber 310. Alternatively in another embodiment, a plurality of flow guides extending from left and right sides of the condensation chamber 310 may be alternately arranged. It is desirable that the flow guide 340 is arranged such that the flow path inside the condensation chamber 310 is formed in an S shape.

**[0066]** Meanwhile, the inlet 320 is connected to the mixed gas outlet 254 of the fan housing 250, and the outlet 330 extends to a lower portion of the door such that it is directed to a bottom of the tub 110. In other words, gas containing the condensed gas discharged through the outlet 330 is again introduced to the bottom of the tub 110.

**[0067]** A dry cycle of the above-described dishwasher will be described below.

**[0068]** When the dry cycle begins, high-temperature steam is formed inside the tub 110. When the fan 260 operates, the steam inside the tub 110 is sucked into the fan housing 250, and outside air is sucked through the outside air inlet 255 of the fan housing 250.

**[0069]** The steam and the outside air are combined in the fan housing 250 to create a mixed fluid, and the mixed fluid is introduced into the condenser 300 through the outlet 254 of the fan housing 250. The mixed fluid introduced into the condenser 300 is cooled as it descends along the flow guide 340. Because the front side of the condenser 300 is tightly attached to or tightly sealed as a part of the door cover 272, the outside air and the mixed fluid exchange heat by heat conduction through door cover 272.

**[0070]** As a result of the heat exchange, some of the mixed fluid is condensed and descends down to the bottom of the condenser 300. The condensed water and the steam are again introduced into the tub 110 through the outlet 330 of the condenser 300. That is, the dry cycle is performed through a circulation process in which the steam inside the tub 110 passes through the fan housing 250 and the condenser 300 and is again introduced into the tub 110.

**[0071]** Fig. 5 is a front view of a door liner of a dishwasher according to a second embodiment of the present invention.

**[0072]** Referring to Fig. 5, the dishwasher includes an outside air guide 280 that is separately provided to suck in outside air.

**[0073]** In the first embodiment, the steam inside the tub 110 is first condensed and then is mixed with the indoor air sucked in through the outside air guide 280. On the other hand, in this embodiment, the steam inside the tub 110 is mixed with the indoor air sucked in through the outside air guide 280 and then it is condensed.

**[0074]** In the dishwasher of Fig. 5, a fan assembly is attached to a front side of a door liner 271 to suck in steam from inside the tub 110. A condenser is connected to an outlet 254 of the fan assembly. An outside air guide 280 is connected to one side of the fan assembly to suck in outside air.

**[0075]** In the first embodiment (FIG.3), the outside air inlet 255 is formed in a portion of the front surface of the fan housing 250. In this embodiment (FIG.5), an outside air guide 280 is connected to the outside air inlet 255.

**[0076]** The outside air guide 280 is separately provided in the front side of the door liner 271, and the outlet is provided under the door 270. Therefore, it is easy to suck in outside air existing in the space where the dishwasher is installed.

**[0077]** Since the other components and the stream condensation process are identical to those of the second embodiment, their detailed description will be omitted for conciseness.

**[0078]** Fig. 6 is a front view of a door liner of a dishwasher according to a third embodiment of the present invention, and Fig. 7 is a perspective view of a condenser structure of the dishwasher according to the third embodiment of the present invention.

**[0079]** Referring to Figs. 6 and 7, outlet duct 430 of a condenser 400 has an expanding cross section, thus coagulation or condensation does not occur near the outlet.

**[0080]** A fan assembly sucks in steam from inside the tub 110, and an outside air guide 280 is connected to one side of the fan assembly to suck in outside air. A condenser 400 is connected to the outlet 254 of the fan assembly. Since such a structure is identical to that of the second embodiment, its detailed description will be omitted for conciseness.

**[0081]** Meanwhile, the condenser 400 includes a condensation chamber 410, an inlet 420 formed in an upper portion of the condensation chamber 410, an outlet formed in a lower portion of the condensation chamber 410, and at least one flow guide 440 formed inside the condensation chamber 410.

**[0082]** As seen in the Figs. 6 and 7, the outlet duct 430 of the condensation 400 has an expanding cross section and cross section of the discharge portion 431 is configured to be larger than that of the beginning portion of the outlet duct 430. The discharge portion 431 is exposed to the indoor space, not the inside of the tub 110. Therefore, gas discharged through the outlet duct 430 is not again introduced into the tub 110, but is discharged to the indoor space.

**[0083]** Further more, the pressure of the mixed gas falling along the outlet duct 430 drops while passing the discharge portion 431. As a result, the fluid discharged through the discharge portion 431 is sustained in a condition of gas. Therefore, condensation does not happen near the discharge portion 431.

## Claims

**1.** A dishwasher comprising:

a tub defining a washing chamber;
a door rotatably connected to the tub, the door including a door cover and a door liner connected to a rear side of the door cover;

a condenser disposed between the door cover and the door liner to condense steam; and
a fan assembly that sucks in steam from inside the tub and supplying the sucked steam to the condenser.

**2.** The dishwasher according to claim 1, wherein the condenser comprises at least one flow guide that forms a steam flow path.

**3.** The dishwasher according to claim 1 or 2, wherein the condenser has one side communicating with an outlet of the fan assembly and another side communicating with the tub.

**4.** The dishwasher according to claim 1, 2, or 3, wherein the condenser is attached to a rear surface of the door cover.

**5.** The dishwasher according to any of claims 1 to 4, wherein a front side of the condenser is opened, the opened front side being sealed by the door cover.

**6.** The dishwasher according to any of claims 1 to 5, further comprising an outside air inlet formed at one side of the fan assembly such that outside air is sucked in.

**7.** The dishwasher according to any of claims 1 to 6, further comprising an outside air guide connected to one side of the fan assembly such that outside air is sucked into the fan assembly.

**8.** The dishwasher according to any of claims 1 to 7, wherein the condenser comprises an inlet connected to an outlet of the condenser, and an outlet extending under the door.

**9.** The dishwasher according to claim 8, wherein the outlet of the condenser has an expanding cross section that is wider at an end portion thereof.

**10.** A dishwasher comprising:

a tub;
a door that selectively opens/closes a front side of the tub;
a fan assembly including a fan mounted inside the door to suck in steam from inside the tub, a fan housing in which the fan is received and the steam and outside air are mixed with each other, and an opening/closing member that selectively allows the tub to communicate with the fan housing; and
a condenser provided inside the door to condense a fluid discharged from the fan assembly by heat conduction through the door.

**11.** The dishwasher according to claim 10, wherein the fan is a double-suction centrifugal fan.

**12.** The dishwasher according to claim 10 or 11, further comprising an outside air inlet at one side of the fan housing at a position spaced apart from a center of the fan, such that steam and outside air are mixed and sucked into the fan.

**13.** The dishwasher according to claim 12, further comprising an outside air guide having one end connected to the outside air inlet and another end exposed to an installation space of the tub.

**14.** The dishwasher according to any of claims 10 to 13, wherein a lower portion of the condenser is inclined downward.

**15.** The dishwasher according to any of claims 10 to 14, further comprising a plurality of flow guides extending slopingly downward to guide a flow of a mixed fluid introduced into the condenser.

**16.** The dishwasher according to claim 15, wherein the flow guide alternately extends from a left side and a right side of the condenser.

**17.** The dishwasher according to any of claims 10 to 16, wherein the door comprises:

a door cover exposed to an outside; and
a door liner exposed to an inner space of the tub.

**18.** The dishwasher according to claim 17, wherein the condenser is disposed between the door liner and the door cover.

**19.** The dishwasher according to claim 17 or 18, wherein a mixed fluid inside the condenser is condensed by heat conduction with outside air through the door cover.

**20.** The dishwasher according to any of claims 10 to 19, wherein the condenser comprises an outlet connected to an inside of the tub or exposed to an outer space.

**21.** A dishwasher comprising:

a tub;
a door rotatably connected to a front side of the tub;
a fan assembly provided inside the door to suck in steam from inside the tub, the fan assembly having an outside air inlet at one side; and
a condenser connected to the fan assembly, the condenser forming a condensation space for condensation of the steam.

**22.** The dishwasher according to claim 21., further comprising a flow guide provided inside the condenser to provide an S-shaped steam flow path.

**23.** The dishwasher according to claim 23, wherein the flow guide is inclined downward from one side to another side of the condenser.

FIG.1

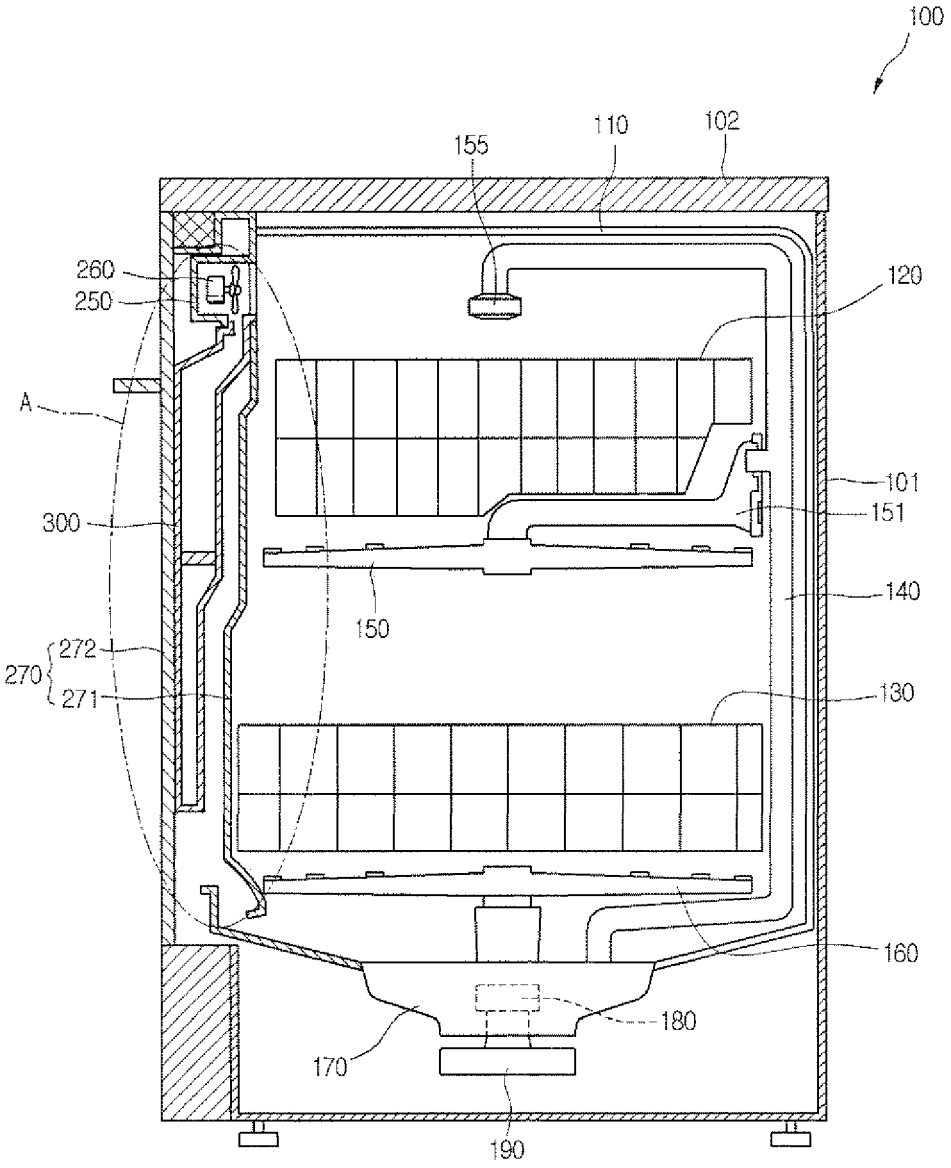

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FIG.2

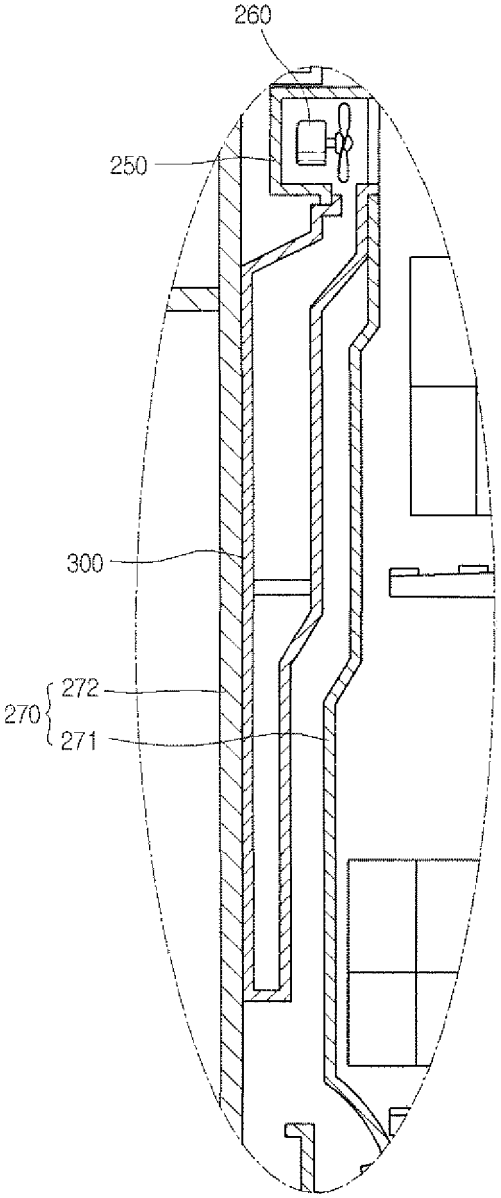


FIG.3

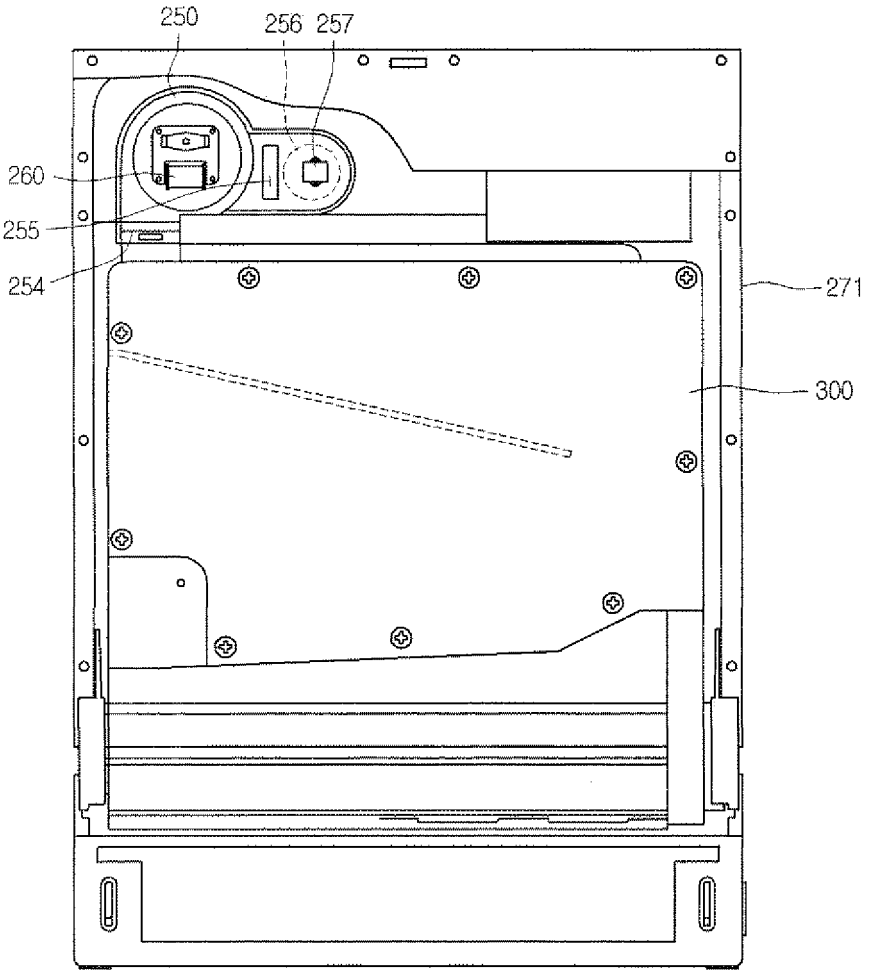


FIG.4

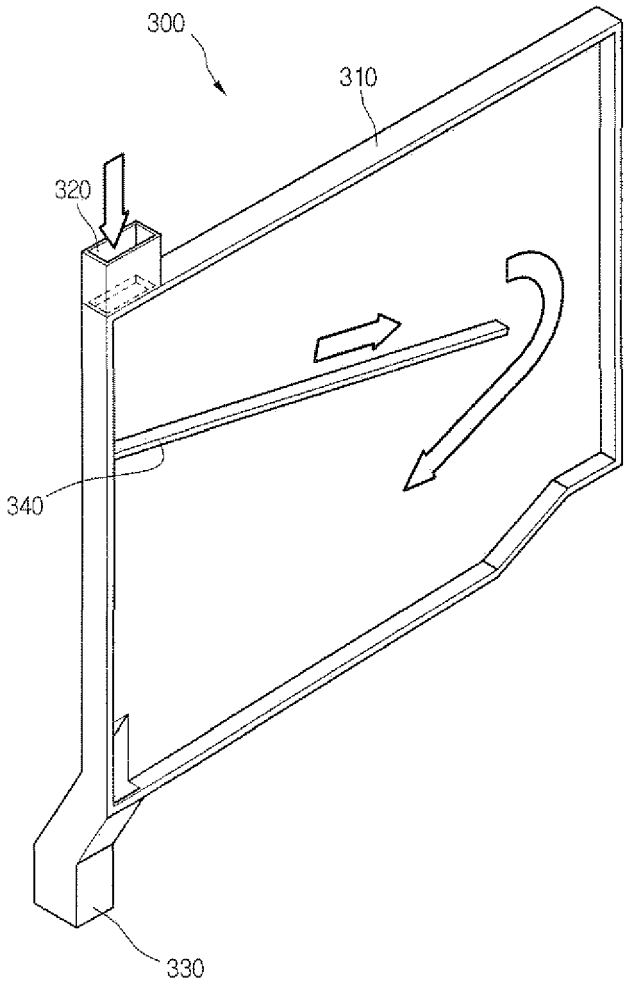


FIG.5

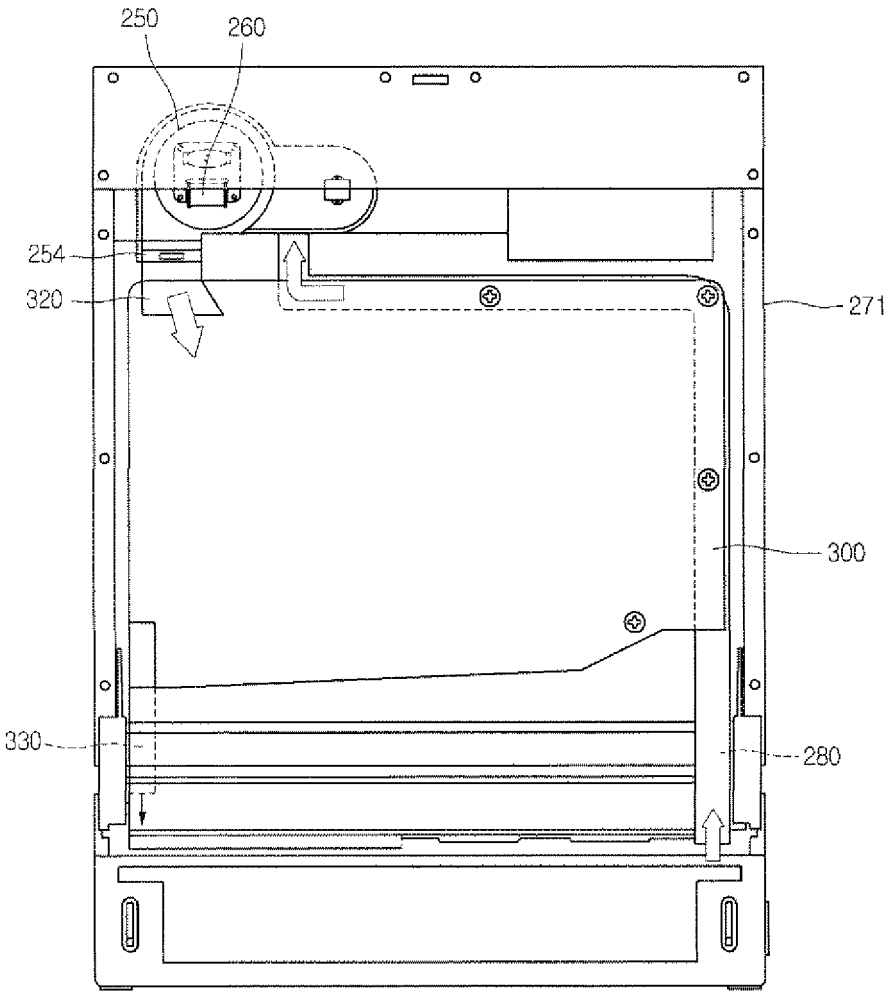


FIG.6

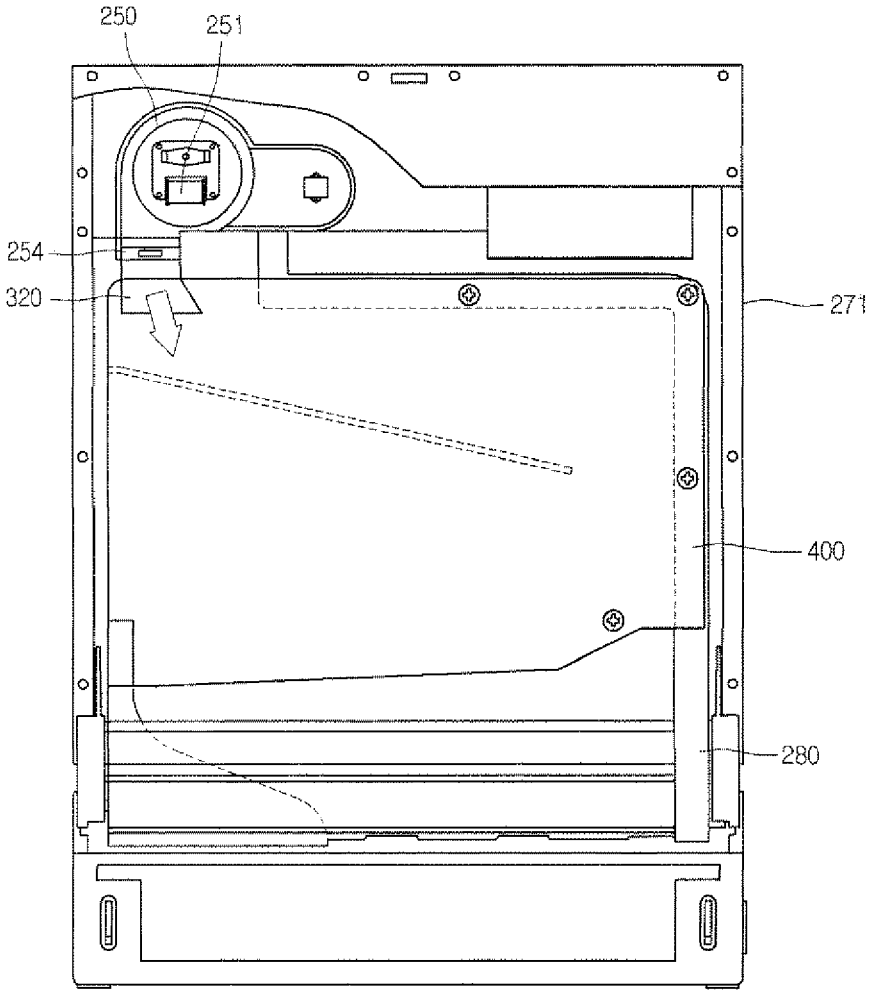
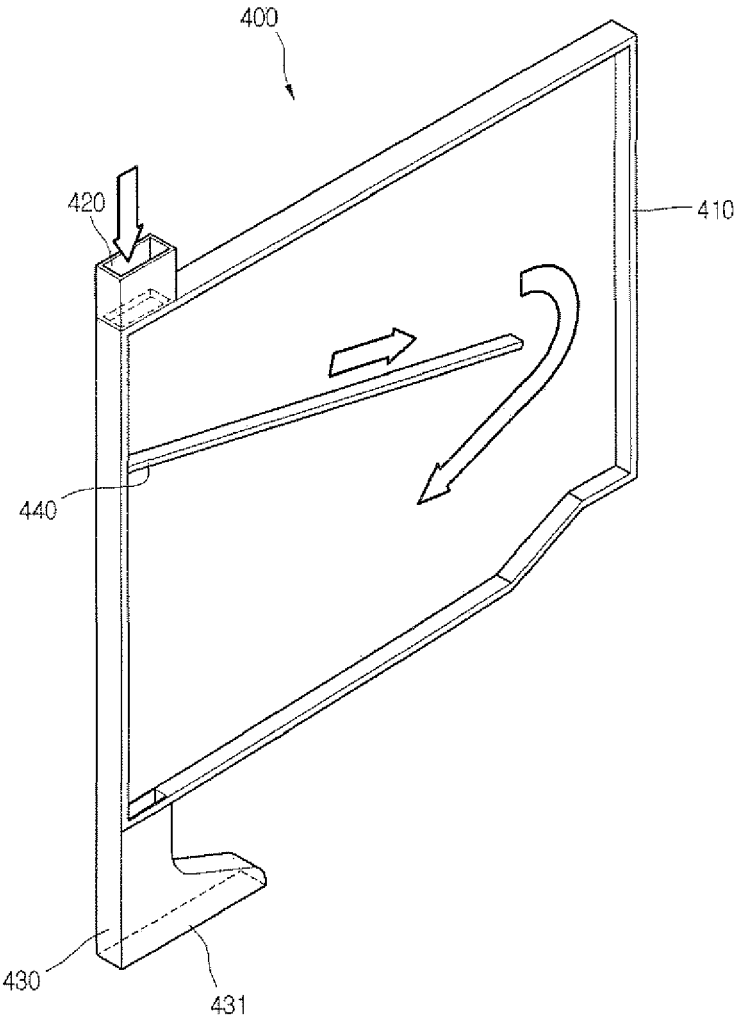


FIG.7



## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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