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(71) Applicant: **LG Electronics Inc.**
Yeongdeungpo-gu
Seoul 07336 (KR)

(72) Inventors:

- JE, Haeyoon
08592 Seoul (KR)
- LEE, Junseok
08592 Seoul (KR)
- JUNG, Sungchan
08592 Seoul (KR)
- JUNG, Haneul
08592 Seoul (KR)
- NAM, Hyunsu
08592 Seoul (KR)

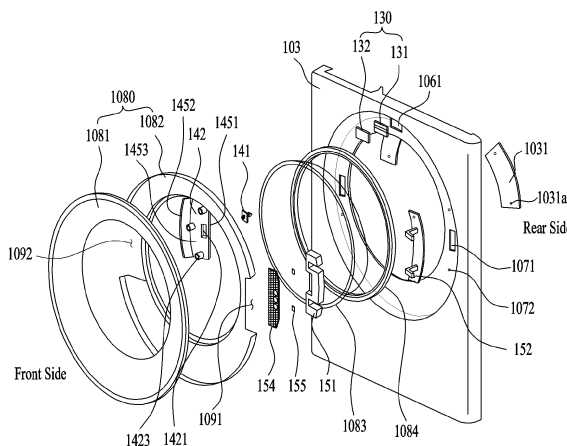
(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

(54) LAUNDRY TREATMENT APPARATUS COMPRISING A DOOR WITH A MAGNET UNIT

(57) Disclosed is a laundry treatment apparatus comprising a cabinet (101) comprising a laundry introduction opening (106) formed in a front surface of the cabinet; a cylinder-shaped drum (110) provided in the cabinet (101) and configured to accommodate laundry; a duct (320) configured to form a path for circulating air inside the drum (110); a heat pump (340) provided in the duct (320) and comprising an evaporator (342) and a condenser (343) configured to exchange heat between the circulating air and a flammable refrigerant and a compressor (349) provided outside the duct (320) and configured to compress the flammable refrigerant having passed the

evaporator (342); a door (108) coupled to the front surface of the laundry introduction opening (106) and configured to open and close the laundry introduction opening (106); a hinge assembly (150) configured to rotatably connect the door (108) to the cabinet (101); a latch assembly (140) configured to detachably secure the door (108) to the cabinet (101); a door rear surface located towards the laundry introduction opening; a magnet unit (120) provided in the door rear surface; and a sensing unit (130) provided in the front surface of the cabinet (101) and configured to sense a magnetic force of the magnet unit (120) to determine the opening and closing of the door (108).

【FIG. 4】



Description

FIELD

[0001] Embodiments of the present disclosure relate to a laundry treatment apparatus.

BACKGROUND

[0002] A laundry treatment apparatus uses a heater or heat pump to dry laundry. Especially, the laundry treatment apparatus using the heat pump is structured to supply high-temperature dry air to the laundry by heating the air that is dried after dehumidified and chilled through an evaporator and a condenser. Compared with the laundry treatment apparatus using the heater, such the laundry treatment apparatus may generate high-temperature heat by using less processes and it has been used a lot in terms of energy efficiency.

[0003] A refrigerant is required so as to realize a freezing cycle of such the heat pump. Such a refrigerant is a working fluid that is easy to evaporate in the freezing cycle and functioned to transfer the heat from a low-temperature part to a high-temperature part.

[0004] The refrigerant includes a natural refrigerant. The natural refrigerant may be categorized into a first-generation CFC (Chlorofluorocarbon), a second-generation CFC (Hydro Chlorofluorocarbon), a third generation HFC (Hydrofluorocarbon) and a fourth generation HFO (Hydrofluoroolefin). A CFC-based and HCFC-based refrigerant is known as one of ozone depleting substances and then regulated under the Montreal Protocol on substances that deplete the ozone layer.

[0005] The HFC-based refrigerant is a global warming material, not an ozone depleting material. One typical example of such global warming materials may be R-134a that is used for a vehicle and a home electric appliance. Such the refrigerant is sorted as one of six global warming materials under Kyoto Protocol to the United Nations Framework Convention on Climate Change but it can be used because Kyoto Protocol is non-forceable. However, the Montreal Protocol in 1987 regulates it as the ozone depleting materials. Developed countries will forbid the use of R-134 refrigerant before 2020 and developing countries will forbid it before 2030. In addition, the HFC-based refrigerant is involved in 2006 Europe F-gas (Fluorinated gas) regulation and an HFC-based refrigerant having a low GWP has emerged as the next generation refrigerant.

[0006] GWP (Global Warming Potential) refers to a degree that other greenhouse gases contribute to the global warming with respect to the effect of carbon dioxide on the global warming. In other words, the solar energy absorptions from 1kg of respective greenhouse gases is divided by the solar energy absorption from 1kg of carbon dioxide. The global warming effect per unit mass is indexed. As one example, when carbon dioxide is 1, methane is 21 and nitrous oxide is 310 and hydrogen fluoride

is 1,300 and sulfa hexafluoride is 23,900.

[0007] Especially in Europe (EU), sales for the closed refrigeration equipment for commercial use having 150 or more GWP are prohibited from 2020. Sales for the centralized refrigeration equipment for commercial use having more than 150GWP and more than 40kW are prohibited from 2022.

[0008] To deal with that are developing a heat pump using R-290 and a laundry treatment apparatus including the heat pump. However, R-290 is a high purity propane gas with flammability and it has a risk of explosion. Especially, if R-290 leaks and the concentration of R-290 becomes 1.8% or more, there might be a risk of ignition or explosion in use.

[0009] Accordingly, the laundry treatment apparatus has to be structured to sense leakage of a flammable refrigerant during the operation of the heat pump, especially, a compressor. Particularly, an electrical contact switch configured to sense and inform the opening of a door that is typically used in a conventional laundry treatment apparatus has to be replaced by a new one. That is because an electrical spark occurs in an electrical contact area when the door is closed and the spark is likely to ignite the leaking refrigerant.

[0010] To prevent such ignition, a part that uses a magnetic force may be used, not the switch that is likely causes a spark such as the electrical contact switch. When it is sensed that the door approaches the cabinet by using a magnet that is installed in the door and a sensor configured to sense the magnetic force, the sensor may sense the approach and the opening/closing of the door.

[0011] Korean Open-laid Patent No. 2003-0089090 discloses a laundry treatment apparatus that uses the magnetic force in sensing the opening and closing of the door. However, the cited reference discloses a top-loaded type laundry treatment apparatus that uses the magnetic force in the opening and closing of the door. Accordingly, as gravity is applied to the opening and closing of the door, it may be difficult to assume improper door closing. In addition, no magnetic force is applied to the opening and closing of the door because a flammable refrigerant is used.

[0012] Specifically, a front-loaded type laundry treatment apparatus having a door loaded in a front side that uses the magnetic force in opening and closing the door might have a problem when sensing the opening of the door. While, the door of the top-loaded type may be closed by gravity, no such an external force is applied to the door of the front-loaded type. In addition, the magnetic force sensing method, which is different from the electrical contact switch, may sense a corresponding magnetic force when a magnet provided in the door is located in a preset range of magnetic force sensing areas sensed by a magnetic force sensor. Accordingly, it might happen to determine that the door is closed, even if it is not closed substantially.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

[0013] To overcome the disadvantages, an object of the present invention is to address the above-noted and other problems and to provide a front-loaded type laundry treatment apparatus that may prevent the explosion of the refrigerant leaking by an electrical spark when a heat pump using a flammable refrigerant is operated. For that, the conventional electrical contact system configured to inform opening and closing of a door may be changed into a magnetic force sensing system so as to reduce inaccuracy of determination about the opening and closing of the door based on a distance between the door and a door sensor.

TECHNICAL SOLUTION

[0014] To achieve these objects and other advantages and in accordance with the purpose of the embodiments, as embodied and broadly described herein, a display device may be provided.

[0015] If a spark occurs in electrical contact and a flammable refrigerant (e.g., R-290) leaks, the flammable refrigerant is likely to explode. To prevent that, the present disclosure may provide a laundry treatment apparatus which may determine the opening and closing of a door by using a non-contact type door opening and closing that using the magnetic force. For that, the laundry treatment apparatus may include a sensing unit having a magnet and a reed switch configured to sense a magnetic force of the magnet.

[0016] In addition, only when a distance between the magnet and the sensing unit is a preset distance or less, the controller may determine that the door is closed and an elastic member may be provided in a hinge area of the door.

[0017] Accordingly, as the door approaches the cabinet in a preset distance, the reed switch may be switched on by the magnet provided in the door and a controller may determine that the door is closed. In addition, the controller may implement a function of alarming a lamp to be turned off in the inside of the drum when the door is closed so as to visually inform the user of the door closing, such that a washing or drying course selected by the user may start.

[0018] In addition, considering that the door is a reversible one, the laundry treatment apparatus may include a magnet provided in an upper end of the door or a middle of the lower middle area of the door, regardless of left and right sides; and a sensing sensor provided in the front surface of the cabinet, corresponding to the magnet.

[0019] The front-loaded type laundry treatment apparatus may further provide a damper to a hinge area to prevent the drum from rotating as the selected washing or drying course starts, in a state where the door is not

closed completely. Specifically, if the door is not closed completely, the door may be pushed and the controller may determine that the door is open such that it may notify the user of the opening of the door, without rotating the drum based on the determination of the controller that the door is open.

[0020] More specifically, the laundry treatment apparatus may include a cabinet comprising a laundry introduction opening formed in a front surface of the cabinet; a cylinder-shaped drum provided in the cabinet and configured to accommodate laundry; a duct configured to form a path for circulating air inside the drum;; a hinge assembly configured to rotatably connect the door to the cabinet; a latch assembly configured to detachably secure the door to the cabinet; a door rear surface located towards the laundry introduction opening; a magnet unit provided in the door rear surface; and a sensing unit provided in the front surface of the cabinet and configured to sense a magnetic force of the magnet unit to determine the opening and closing of the door.

[0021] The laundry treatment apparatus may include a heat pump provided in the duct and comprising an evaporator and a condenser configured to exchange heat between the circulating air and a flammable refrigerant and a compressor provided outside the duct and configured to compress the flammable refrigerant having passed the evaporator; a door coupled to the front surface of the cabinet and configured to open and close the laundry introduction opening.

[0022] The hinge assembly may include an elastic member, and when a distance between the magnet unit and the sensing unit is a preset first distance or less, elastic force of the elastic member may act to push the door.

[0023] When the distance between the magnet unit and the sensing unit is a preset second distance or more and the first distance or less and the elastic force of the elastic member is larger than the external force applied to the door, the door may be pushed a distance that is more than the first distance by the elastic force of the elastic member.

[0024] The door may include a first door frame located towards the front surface of the cabinet; and a second door frame coupled to the first door frame to contact with the laundry treatment opening when the door is closed, and the second door frame is partially cut away to form a first disposing portion and a second disposing portion having the hinge assembly and the latch assembly are disposed, and the size of the first disposing portion is equal to that of the second disposing portion.

[0025] Accordingly, the hinge assembly and the latch assembly may be coupled to any of the first and second disposing portions and the laundry treatment apparatus may include the reversible door.

[0026] The latch assembly may comprise a latch cover coupled to the second door frame; and a latch projectedly coupled to the latch cover, and the front surface of the cabinet may include a latch coupling portion coupled to

the latch and configured to secure the door, and when the distance between the magnet unit and the sensing unit is less than a preset third distance, the latch may be coupled to the latch coupling portion to secure the door to the cabinet even if the elastic force of the elastic member acts.

[0027] The hinge assembly may include a hinge cover coupled to the second door frame; a hinge body rotatably coupled to the hinge cover; and a hinge base disposed on the hinge cover therein, and the elastic member is coupled to the hinge base.

[0028] Accordingly, only if they could be coupled to any of the first and second disposing portions, the hinge cover and the latch cover may form an outer circumferential surface of the door, without a step.

[0029] Each of the hinge cover and the latch cover may include a first latch cover portion partially forming a rear surface of the second door frame; and a second latch cover portion bending from one side edge of the first latch cover portion to partially form a circumferential surface of the door.

[0030] The front surface of the cabinet may include a sensing unit installation hole that penetrates the front surface of the cabinet to install the sensing unit, and the sensing unit may include a sensing unit cover body configured to protect the sensing unit; a plurality of guide ribs projected from the sensing unit cover body; and a reed switch PCB guided by the plurality of the guide ribs to be located in the sensing unit cover body and comprising a reed switch. When the magnet unit approaches to the sensing unit, the reed switch may sense the opening and closing of the door.

[0031] The magnet unit may include a first projected surface provided in the second door frame and projected from the second door frame towards the laundry introduction opening; a second projected surface forming a side surface of the first projected surface; a recessed portion recessed from an inner surface of the first projected surface towards the laundry introduction opening; and a magnet coupled to the recessed portion.

[0032] The plurality of the reed switch PCBs may be provided, and the plurality of the reed switch PCBs may be vertically installed in the cabinet.

[0033] Accordingly, the controller may determine that the door is closed after the plurality of the reed switches should sense the magnet of the magnet unit such that the accuracy of the determination about the door opening and closing.

[0034] Meanwhile, the front surface of the cabinet may include a first coupling hole coupled to the hinge body; and a second coupling hole coupled to the latch, and the first coupling hole and the second coupling hole may be provided on respective left and right sides of the laundry introduction opening with respect to a line passing through the center of the laundry introduction opening and configured to exchange the position of the hinge assembly with that of the latch assembly.

[0035] The magnet unit may be located at a region at

which an imaginary line passing through the center of the second door frame meets the second door frame, that is, an upper end of the door center or a lower end of the door center.

[0036] The sensing unit may be located at the same height, corresponding to the magnet unit, and when the door is closed, the distance between the sensing unit and the magnet unit may be spaced a preset distance apart from each other.

[0037] The flammable refrigerant may be R-290.

ADVANTAGEOUS EFFECTS

[0038] Accordingly, the embodiments have following advantageous effects.

[0039] According to at least one embodiment of the present disclosure, the laundry treatment apparatus may fundamentally prevent a spark from occurring in electrical contact by using a non-contact door opening/closing sensor device including a magnet and a magnetic force sensor (e.g., a reed switch). Accordingly, even if the flammable refrigerant leaks, explosion may be prevented.

[0040] Furthermore, the door of the laundry treatment apparatus may include the damper (or the elastic member) such that it may be pushed not over a distance the magnetic force sensor is not capable of sensing unless the door is closed completely, so as to determine that the door is closed only when the distance between the magnet and the magnetic force sensor is in a preset range or less.

[0041] Still further, the laundry treatment apparatus may achieve the improved accuracy of the door opening and closing. Accordingly, it may provide the user with convenience and durability and reliability of the product may be enhanced.

[0042] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043]

FIG. 1 (a) is an illustration of one embodiment of a laundry treatment apparatus according to the present disclosure and FIG. 1 (b) is an enlarged view of a sensing area (A area) provided in the laundry treatment apparatus;

FIG. 2 (a) is a top view illustrating a magnet unit provided in an upper end of a door center and a sensing unit, and FIG. 2 (b) is an enlarged view of B area shown in FIG. 2 (a) to show a state where the magnet

unit and the sensing unit are spaced apart from each other when the door is closed completely and FIG. 2 (c) is a diagram illustrating a state where the magnet unit and the sensing unit are spaced apart when the door is open a preset angle and FIG. 2 (d) is a sectional diagram of FIG. 2 (a) along A-A'; FIG. 3 (a) is a diagram illustrating a state where a latch and a latch guide are provided in a latch coupling unit are completely coupled to each other and FIG. 3 (b) is an enlarged view of a coupling area shown in FIG. 3 (a) and FIG. 3 (c) is a diagram illustrating the latch and the latch guide of the latch coupling unit when the door starts to be closed and FIG. 3 (d) is an enlarged view of the coupling area shown in FIG. 3 (c) and FIG. 3 (e) is a diagram illustrating a coupling state between the latch and the latch coupling unit when the door is spaced apart a preset distance or more and FIG. (f) is an enlarged view of the coupling area;

FIG. 4 is an exploded perspective diagram partially illustrating a front of a cabinet and the door;

FIG. 5 is an exploded perspective diagram of a hinge assembly; and

FIG. 6 is a diagram illustrating an evaporator, a condenser, a compressor and a fan that are provided in a base portion of the laundry treatment apparatus.

DESCRIPTION OF SPECIFIC EMBODIMENTS

[0044] Description will now be given in detail according to exemplary embodiments disclosed herein, with reference to the accompanying drawings. For the sake of brief description with reference to the drawings, the same or equivalent components may be provided with the same reference numbers, and description thereof will not be repeated.

[0045] Terminology that is used in the present disclosure is limited to only for embodiments herewith but made only to make it easy to understand the present disclosure. As one example, terms expressing relative or absolute arrangement such as "in one direction", "along a direction", "parallelly", "orthogonally", "centrally" or "coaxially" refer to not only such arrangement but also a state that relatively displaces with a preset angle or distance getting the same function.

[0046] As one example, terms expressing the same state such as "the same", "equal" or "uniform" refer not only the same state but also a state where some tolerance or difference exists enough to achieve the same function.

[0047] As one example, terms expressing a rectangular or cylinder shape refer not only a geometric shape but also a shape having unevenness or chamfer in a preset range.

[0048] Meanwhile, terms such as "prepare", "include" or "has" are used herein and should be understood that they are intended to indicate an existence of several components, functions or steps, disclosed in the specifica-

tion, and it is also understood that greater or fewer components, functions, or steps may likewise be utilized.

[0049] Regardless of numeral references, the same or equivalent components may be provided with the same reference numbers and description thereof will not be repeated.

[0050] The structure applied to one embodiment may be equally applied to another embodiment unless it is structurally or functionally contradictory.

[0051] A singular element may include a plurality of elements unless it refers to obvious difference.

[0052] In the present disclosure, that which is well-known to one of ordinary skill in the relevant art has generally been omitted for the sake of brevity.

[0053] The accompanying drawings are used to help easily understand various technical features and it should be understood that the embodiments presented herein are not limited by the accompanying drawings. As such, the present disclosure should be construed to extend to any alterations, equivalents and substitutes in addition to those which are particularly set out in the accompanying drawings. Terms of respective elements used in the following description are terms defined taking into consideration of the functions obtained in the present invention. Therefore, these terms do not limit technical elements in the present invention. Further, the defined terms of the respective elements will be called other terms in the art.

[0054] FIG. 1 (a) is a diagram schematically illustrating an exterior design of a laundry treatment apparatus 100 including a heat pump (340, see FIG. 6) using R-290 or R-600a to perform a drying function. Referring to FIG. 1, the laundry treatment apparatus may include a cabinet 101 formed in an approximately cuboid shape as main body; and a circular laundry introduction opening 106 provided in a front surface 103 of the cabinet.

[0055] A control panel 104 may be provided in an upper area of the cabinet front surface 103 and configured to control diverse functions of a dryer and display an operation state.

[0056] A controller (not shown) may be provided in a rear surface of the control panel 104, in other words, a surface that is arranged in the cabinet. The controller (not shown) may be provided not only in a rear surface of the control panel 104 but also a predetermined empty space formed in the cabinet to execute and control the functions of the laundry treatment apparatus based on a user's input. In addition, the controller may control a display 109 provided in the control panel 104 to display door opening and send a warning message of door opening to the user via wireless communication (e.g., WIFI).

[0057] A door 108 may be rotatably coupled to the front surface 103 of the cabinet and configured to open and close the laundry introduction opening 106. Replacing the conventional electrical contact type, a sensor using a magnet may be provided to sense the opening and closing of the door. That is to prevent a risk of explosion of a leaking flammable refrigerant, when a refrigerant is

flammable R-290. Specifically, the conventional electrical contact type is likely that a spark might occur when an electrical contact point is pressed and that the refrigerant might be ignited and exploded by the spark. To prevent that, the laundry treatment apparatus may include a magnet unit 120 provided in a predetermined area not using electrical contact; and a sensing unit 130 provided in the front surface 103, corresponding to the magnet unit 120. The sensing unit 130 may include a magnetic force sensor configured to sense magnetism or a magnetic force of the magnet unit 120 (e.g., a reed sensor). Accordingly, the reed switch is configured to be switched on as the door approaches to the laundry introduction opening 106, even without the contact of the magnet unit 120 with the sensing unit 130, and then it may sense the door.

[0058] In addition, the door 108 may include a hinge assembly 150 rotatably coupled to the cabinet; and a latch assembly 140 provided to close and couple the door to the cabinet 101. In the front surface 103 of the cabinet may be provided a latch coupling portion 1064 coupled to the latch assembly; and a first coupling hole (1071, see FIG. 4) and a second coupling hole (1072, see FIG. 4) formed to couple the cabinet 101 to the hinge assembly 150 and the cabinet 101 to the latch assembly 140.

[0059] A cylinder-shaped drum 110 may be provided in the cabinet and configured to accommodate laundry, in communication with the laundry introduction opening 106. A base portion (330, see FIG. 6) may be provided in a lower area of the drum 110. Mechanical elements including a duct (320, see FIG. 6) for circulating air inside the drum 110 and a heat pump (340, see FIG. 6) configured to re-heat after dehumidifying and chilling air inside the duct may be provided in the base unit. The base portion may provide a bottom of the cabinet 101 and a predetermined space for installing the mechanical elements configured to perform the functions of the laundry treatment apparatus 100.

[0060] In addition, the door 108 may include a transparent portion. Accordingly, even while the door 108 is closed, the inside of the drum 110 may be visually exposed through the transparent portion, which will be described later in reference to FIG. 4.

[0061] FIG. 1 (b) is an enlarged view of A that is shown in FIG. 1 (a) to illustrate the sensing unit 130. The cabinet 101 may include a sensing unit install-hole (1061, see FIG. 4) penetrating the front surface 103 to install the sensing unit 130. The sensing unit 130 may include a sensing unit cover body 132 provided to cover the sensing unit install-hole (1061, see FIG. 4) so as to protect a reed switch PCB (131, see FIG. 2) provided in the sensing unit 130 and provide a predetermined space for installing the reed switch PCB (131, see FIG. 2).

[0062] The sensing unit 130 may be arranged in a center of an upper end of the laundry introduction opening 106. Accordingly, the sensing unit 130 may be arranged at the same height with the magnet unit 120 provided in the door 108. The location of the sensing unit 130 is not

limited to the center of the upper end. In other words, the sensing unit may be provided in any areas corresponding to the magnet unit 120 of the door, only if it senses the magnetic force of the magnet unit 120.

[0063] It is preferred that the sensing unit may be provided in the center of the upper end of the laundry introduction opening 106. Although FIG. 1 shows that they are located to left and right in the laundry introduction opening 106 when the door 106 is closed, the positions of the hinge assembly 150 and the latch assembly 140 may be exchanged. Specifically, the shape of the door 106 may be in symmetric and the exterior designs of the hinge assembly 150 and the latch assembly 140 may be equal to each other such that the positions of them may be exchanged in the left and right sides of the door. That door may be referred to as reversible door.

[0064] Accordingly, an opening and closing direction of such the reversible door may be set based on a user's request and the positions of the hinge assembly 150 and the latch assembly 140 may be exchanged based on the preset direction. In addition, an exterior design of a second door frame 1082 may be also in right and left symmetry. A first coupling hole 1071 (see FIG. 4) and a second coupling hole (1072, see FIG. 4) that are provided for the coupling between the hinge assembly 150 and the latch assembly 140 may be also formed in the left and right side of the laundry introduction opening 106 in symmetry.

[0065] Accordingly, the magnet unit 120 for the reversible door may be located on a central line of the door rear surface and the sensing unit 130 may be provided in a corresponding position.

[0066] Referring to FIGS. 2 and 3, the operation principle of the magnet unit 120 and the sensing unit 130.

[0067] FIG. 2 (a) is a top view illustrating the magnet unit 120 provided in an upper end of a door center and the sensing unit 130 provided in a corresponding position of the cabinet 101 to the magnet unit 120. In other words, FIG. 2 (a) shows that the door 108 is rotatably coupled to the laundry introduction opening 106 of the cabinet to be completely closed. At this time, the magnet unit 120 may be located in a rear surface of the door 108, specifically, a rear surface of a second door frame (1082, see FIG. 4) provided towards the laundry introduction opening 106, when the door 108 is closed. The magnet unit 120 may be projected from the second door frame 1082.

[0068] FIG. 2 (d) is a sectional diagram of FIG. 2 (a) along A-A'. referring to FIG. 2 (d), the magnet unit 120 may include a first projected surface 1211 provided in the second door frame (1082, see FIG. 4) and projected from the second door frame towards the laundry introduction opening to form a plane; a second projected surface 1212 defining a side surface of the first projected surface 1211; a recessed portion 1213 recessed from an inner surface of the first projected surface 1211 towards the laundry introduction opening 106; and a magnet 1214 coupled to the recessed portion 1213.

[0069] Referring to FIG. 2 (d), the sensing unit 130a

may include a reed switch PCB 1311 including a reed switch 1311a, 1311b, 1312a or 1312b configured to sense a magnetic force of the magnet 1214; a sensing unit cover body 132 provided to protect the reed switch PCB 1311; and a plurality of guide ribs 134 projected from the sensing unit cover body 132 and providing an installation space of the reed switch PCB, together with the sensing unit cover body 132. The plurality of the reed switch PCBs 131 may be provided. As shown in FIG. 2 (d), a first reed switch PCB 1311 and a second reed switch PCB 1311 may be aligned vertically and installed between the guide ribs 134. One surface of the reed switch 1311 may contact with the sensing unit cover body 132.

[0070] The reason why the plurality of the reed switch PCBs 131 is aligned is that accuracy may be enhanced when sensing the magnetic force of the magnet 1214 along the approach of the magnetic unit 120, compared with an example using one reed switch PCB. In other words, the controller may determine that the door is closed, only when both the first reed switch PCB 1311 and the second reed switch PCB 13 sense the magnetic force of the magnet 1214.

[0071] FIG. 2 (b) is an enlarged view of B area shown in FIG. 2 (a) to show a state where the magnet unit 120 and the sensing unit 130 are spaced apart from each other when the door is closed completely. The magnet unit 120 and the sensing unit 130 may not contact with each other when the door is closed, because they are configured to sense the magnetic force. In addition, when they contact with each other, the magnet unit 120 and the sensing unit 130 are likely to damage. To prevent that, the magnet unit 120 and the sensing unit 130 may be spaced a preset distance from each other. The reed switch 1311a of the reed switch PCB 131 may be spaced a preset distance from the sensing unit cover body 132.

[0072] At this time, the distance between the magnet unit and the sensing unit 130 may be defined as "L" for convenience sake. It is preferred that a horizontal distance from the reed switch 1311a to a front surface center of the magnet 1214, in other words, a center of the surface coupled to the recessed portion 1213 may be defined as "L". In contrast, a horizontal distance from the sensing unit cover body 132 to a front surface center of the magnet 1214, in other words, a center of the surface coupled to the recessed portion 1213 may be defined as "L". That is the definition that will be needed when describing a first distance, a second distance and a third distance which will be described later. However, even if the definition of the distance "L" is different from what is described, the first, second and third distances may be changed correspondingly. It may be possible to define the distance L as the distance between the magnet unit 120 and the sensing unit 130 without defining it specifically.

[0073] FIG. 2 (c) is an enlarged view of B area to exaggeratingly illustrate a state where the magnet unit and the sensing unit are spaced apart when the door is open

a preset angle. Accordingly, even when a horizontal distance from the reed switch 1311a to a front surface center of the magnet 1214, in other words, a center of the surface coupled to the recessed portion 1213 may be defined as "L", a difference between the distance from the reed switch 1311a to a front surface edge of the magnet 1214 and a distance to the front surface center of the magnet may be in an error range.

[0074] The sensing unit 130 configured to sense the magnet force may be contactlessly spaced apart a preset distance from the door even when the door is completely closed. At this time, the length of the distance L may be defined as a third distance. In other words, the third distance means the length of the distance L that facilitates the complete coupling of a latch with respect to a latch coupling portion to couple the door 108 to the cabinet 101. It is preferred that the third distance is 11mm. The sensing unit 130 may sense the magnetic force of the magnet 1214 in the first distance or less to switch on the reed switch of the reed switch PCB 131 such that it may be determined that the door is closed.

[0075] When describing that in reference with FIG. 3 (a) and FIG. 3 (b), the latch 141 may be coupled along the guide of the latch guide portion 1065 provided in the latch coupling portion 1064. It is preferred that the latch 141 and the latch guide portion 1065 may be hook-coupled to each other. For the hook-coupling that facilitates the opening and closing of the door, the latch 141 may include a diamond-shaped threshold portion 143. In other words, the latch 141 may be released through a first inclined portion 1431 inclined to guide the latch 141 along the inclined latch guide portion 1065 when closing the door 108 and a second inclined portion 1432 inclined when opening the door 108. When opening the door 108, an inclined surface of the latch guide portion 1065 may become small or not exist such that the opening of the door may require more power, different from when closing the door 108. That is to prevent the door 108 from moving easily when rotating the drum 110 after securing the door 108. In addition, even if elastic force or restoring force of an elastic member or a damper (155, see FIG. 5) that is provided in the hinge assembly 150 may act as reaction for opening the door, after the door 108 is secured, the force for securing the door is stronger enough not to open the door 108.

[0076] In addition, the latch 141 may include a hooking portion 144 provided between the second inclined portion 1432 and the third inclined portion 1433. When the door 108 is closed, the latch guide portion 1065 may be located in the hooking portion 144. In addition, the inclination of the third inclined portion 1433 may be larger than that of the first inclined portion 1431 and the latch guide portion 1065 may be located in the third inclined portion 1433, such that it may be difficult to secure the door. In other words, when the door 108 is closed, the latch guide portion 1065 may be mainly secured to the hooking portion 144.

[0077] Also, the latch 141 may include a stopping por-

tion 146 expanded from the third inclined portion 1433 to form an extended surface. The stopping portion 146 may be provided to prevent the latch from being exposed outside via a latch hole any further when the latch 141 is assembled to a latch hole 1421 of the latch cover (142, see FIG. 4). Also, the stopping portion 146 may be configured to guide the latch 141 when the latch 141 is assembled to the latch cover 142. The latch 141 may be coupled to the latch cover 142 through a circular latch securing portion 147 provided behind the stopping portion 146 (an inner area of the latch cover). Accordingly, the latch 141 may be coupled to the latch cover 142 through the latch securing portion 147 to be assembled as the latch assembly 140.

[0078] FIG. 3 (c) and FIG. 3 (d) illustrate the point when the latch 141 starts to contact with the latch coupling portion 1064 for the contact. Specifically, they illustrate that the first inclined portion 1431 of the latch 141 contacts with the latch guide 1065. At this time, the length of the distance L may be defined as the second distance. In other words, the second distance may mean the length of the distance L in which the latch 141 starts to contact with the latch coupling portion 1064 for the coupling. It is preferred that the second distance is 15.5mm.

[0079] In more than the third distance and the second distance or less, the sensing unit 140 may still sense the magnetic force of the magnet 1214. In other words, the reed switch of the reed switch PCB 131 may be switched on and the controller may then determine that the door 108 is closed.

[0080] However, when the distance L is over the third distance or the second distance or less, the latch 141 may be coupled to the latch coupling portion 1064. Accordingly, this section may be an instable section in which the latch 141 may be completely coupled or pushed by the latch guide portion 1065. In this instable section, the latch 141 may not exist substantially. Accordingly, it may be even no problem that the sensing unit 130 still senses the magnetic force of the magnet 1214 in over the third distance and the second distance or less.

[0081] FIG. 3 (e) and FIG. 3 (f) illustrate a state the latch 141 is completely separated from the latch coupling portion 1064. Accordingly, the sensing unit 130 may not sense the magnetic force of the magnet 1214. As the reed switch of the reed switch PCB 131 is switched off, the controller may determine that the door is open. The maximum length of the distance L that allows the sensing unit 130 to sense the magnetic force of the magnet 1214 may be defined as the first distance. It is preferred that the first distance is 21mm. accordingly, when the distance is over the first distance, the sensing unit 130 may not sense the magnetic force of the magnet 1214.

[0082] However, when the distance L is over the second distance and the first distance or less, the sensing unit 130 may sense the magnetic force of the magnet 1214. However, in this section, the latch 141 may be separated from the latch coupling portion 1064 and the door 108 may not be closed. Accordingly, when the distance

L is over the second distance and the first distance or less, the door 108 may not be closed and the controller may make an error that the door 108 is closed.

[0083] Accordingly, to solve such an error, when the distance L is over second distance and the first distance or less, the door may be pushed for the distance L to be over the first distance. For that, the hinge assembly 150 may include the elastic member (or the damper 155) to push the door 108 by using the elastic force of the elastic member when the distance L is over the second distance and the first distance or less.

[0084] In addition, when the distance L is the first distance or less, the elastic force may always act. However, when it is the third distance or less, the latch 141 may be coupled and secured to the latch coupling portion 1064 and the opening of the door may not occur even if the elastic force acts.

[0085] Hereinafter, referring to FIGS. 4 and 5, the door 108 and the hinge assembly 150 will be described.

[0086] FIG. 4 is an exploded perspective diagram partially illustrating the front surface 103 of the cabinet and the door.

[0087] The front surface of the cabinet may mean the front surface in which the laundry introduction opening is integrally formed but a front surface of a front cover having the laundry introduction opening formed therein that is assembled to form the cuboid cabinet. Accordingly, the front surface 103 of the cabinet may be shown as the front surface of a front cover in FIG. 4 and embodiments are not limited thereto.

[0088] In this embodiment of the present disclosure, the door 108 of the laundry treatment apparatus 100 may include a door cover (not shown) that defines the door front; a door frame 1080 secured to a rear surface of the door cover (not shown); a door transparent surface 1083 secured to a hole formed in the door frame 1080; a sealing member 1084 disposed along a circumference of the door transparent surface 1083; the hinge assembly 150 secured to one of the left and right edge areas of the door frame 1080; and the latch assembly 140 secured to the other one of the left and right edge areas of the door frame 1080.

[0089] The door cover (not shown) may be made of transparent or opaque glass or plastic. At this time, the door cover may be omitted to show the door frame 1080 and other elements. The door frame 1080 may be made of plastic with a predetermined strength. Alternatively, the sealing member 1084 may be made of rubber or silicone. The door transparent surface 1083 may be made of transparent glass or plastic.

[0090] The door frame 1080 may include a first door frame 1081 arranged towards the front surface of the cabinet; and a second door frame 1082 coupled to the first door frame 1080 and configured to contact with the laundry introduction opening 106 when the door 108 is closed. The second door frame 1082 may be partially cut away to form a first disposing portion 1091 and a second disposing portion 1092 for disposing the hinge assembly

150 and the latch assembly 140. The first disposing portion 1091 and the second disposing portion 1092 may be arranged in symmetry with respect to an imaginary straight line passing the center of the second door frame 1092, with the same size. The hinge assembly 150 and the latch assembly 140 are coupled to each other through the first disposing portion 1091 and the second disposing portion 1092, so as to form the rear surface of the door 108. The rear surface of the door may be smooth without a step by a hinge cover 151 and a latch cover 142 which will be described later.

[0091] The latch assembly 150 may include a latch cover 141 fixed to the door frame 1980; and a latch 141 projected from the latch cover 141. The latch 141 may be fixedly inserted in the latch coupling portion 1064 formed in the front surface 103 of the cabinet when the door 108 is closed. A first coupling hole 1071 to insert the latch 141 therein may be formed in an outer edge of the laundry introduction opening 106 formed in the front 103 of the cabinet. Considering the reversible door, the first coupling hole may be formed in symmetry to left and right.

[0092] In addition, the first disposing portion 1091 and the second disposing portion 1092 may be provided in respective left and right sides of the second door frame 1082. At this time, the first disposing portion 1091 and the second disposing portion 1092 may be defined as the cover disposing portions formed in respective left and right edge areas of the door 108, viewed towards the front surface of the door 108.

[0093] The first disposing portion 1091 and the second disposing portion 1092 may be in symmetry to left and right with respect to a line passing the center of the door 108 and also vertically in symmetry with respect to a horizontal line passing the center of the door 108. Accordingly, the hinge assembly 150 disposed one of the first and second disposing portions 1091 and 1092 or the latch assembly 140 may be rotated 180 degrees in a clockwise or counter-clockwise direction. After that, it may be properly disposed in the other one of the first and second disposing portions 1091 and 1092.

[0094] The hinge cover 151 of the hinge assembly 150 and the latch cover 142 of the latch assembly 140 may be coupled to the first disposing portion 1091 and the second disposing portion 1092, respectively, to form the rear surface of the door without a step, together with the second door frame 1082.

[0095] The hinge assembly 150 may be coupled to the first door frame 1081 through a hinge base boss hole 1541 and a hinge base coupling hole 1542 that are formed in a hinge base 154.

[0096] Meanwhile, the magnet unit 120 may be projected from an edge of a rear surface of the door frame 1080. When the door 108 is closed, the magnet unit 120 may be sensed by the sensing unit 130 provided in the front surface 103 of the cabinet and the controller may determine the opening and closing of the door.

[0097] In addition, to provide the reversible door, one

or more holding grooves (not shown) may be recessed a predetermined depth from a circumferential surface of the door 108 and configured as a handle. Specifically, the position of the holding groove (not shown) may be determined based on which one of the left and right edge areas of the door the hinge assembly 150 is coupled to.

[0098] The latch cover 142 may have a contour shape that is equal to the cut-away shape of the cover disposing portion 1091 and 1092 to open and close the first and second disposing portions 1091 and 1092.

[0099] The latch cover 142 may include a first latch cover portion 1451 forming some area of a rear surface of the door frame 1080; a second latch cover portion 1452 bending from an outer edge of the first latch cover portion 1451 and forming some area of a side surface of the door frame 1080; and a third latch cover portion 1453 provided in the opposite to the first latch cover portion 1451. In addition, the latch cover 142 may be in symmetry with respect to a line dividing the latch cover 142 into upper and lower parts.

[0100] A latch hole 1421 may be formed on the line dividing the latch cover 142 into the upper and lower parts and the hook-shaped latch 141 may be securely inserted in the latch hole 406. The latch 141 may be inserted in the second coupling hole 107 formed in the front surface of the cabinet 101 when the door 108 is closed.

[0101] An inner surface of the cabinet front surface 103, in other words, an inner surface of the cabinet front surface 103 arranged in the cabinet may be coupled to a bracket 1031. A hinge body fixing hook (152b, see FIG. 5) may be fitted to a bracket 1031 through the first coupling hole 1072 of the front surface 103.

[0102] In addition, a coupling member penetrating a hinge body coupling hole 1524 may be fitted to a bracket coupling hole 1031a through the first coupling hole 1072 of the cabinet front surface 103.

[0103] FIG. 5 is an exploded perspective diagram illustrating the hinge assembly 150.

[0104] The hinge assembly 150 according to one embodiment of the present disclosure may include a hinge base 154 disposed in the first disposing portion 1091 or the second disposing portion 1092 of the second door frame 1082; a hinge cover 151 coupled to the hinge base 154; a hinge body 152 rotatably coupled to the hinge cover 151; and a hinge bearing 153 coupled to the hinge body 152.

[0105] The hinge base 154 may be configured as one module and secured to the rear surface of the door frame 22 and the front surface 103 of the cabinet, respectively.

[0106] The hinge base 154 may be a metal plate. A plurality of hinge base boss holes 1541, the hinge base coupling hole 1542, the hinge bearing disposing groove 1543 and the elastic member disposing groove 1544 may be formed in the hinge base. The elastic member 155 may be coupled to the elastic member disposing groove 1544. The elastic member 155 may be made of any materials only if they provide elastic force (e.g., nylon or rubber).

[0107] The hinge body 152 may include a hinge head 1521 having a rear surface that is coupled to a left or right area of the laundry introduction opening (106, see FIG); one or more hinge legs 1522 that extends from a front surface of the hinge head 1521; and a one or more hinge shaft 1523 formed in respective ends of the hinge legs 1522.

[0108] Some of the hinge legs 1522 may be provided in an upper area and a lower area of the hinge head 1521 to stand the load of the door 108 stably. Preferably, two hinge legs may be provided in the respective upper and lower areas. The hinge leg 1522 may be designed to bend a preset angle to enlarge the rotation of the door 108.

[0109] The elastic member 155 may be coupled to the elastic member disposing groove 1544. When the door is closed, the hinge leg 1522 of the hinge body 152 may press the elastic member 154. When the distance between the magnet unit 120 and the sensing unit 130 is the first distance or less, the elastic member may generate elastic force. Accordingly, when the distance between the magnet unit 120 and the sensing unit 130 is more than the second distance and the first distance or less, the door may be pushed outwardly as far as the first distance by the elastic force unless no external force is applied to the door. Accordingly, the error made by the controller determining that the door is closed even when it is substantially open may be solved.

[0110] When determining that the door 108 is closed, the controller may turn off a lamp (not shown) that is provided in the drum to implement the course selected by a user. In this instance, the user may be provided with an alarm that the door is safely closed and unnecessary power consumption may be prevented. If determining that the door is open, the controller may give an alarm for noticing that the door is open via the display 109. When the warning alarm is made via a speaker, a door opening warning may be transmitted to the user's mobile terminal via wireless communication.

[0111] The hinge shaft 1523 may be formed in one direction that is vertical with respect to an extended direction of the hinge leg 1522. Specifically, the hinge shaft 1523 may extend from upper end and a lower end of the hinge leg 1522.

[0112] As the hinge bearing 153 is fitted to an outer circumferential surface of the hinge shaft 1523, the rotation of the hinge body 152 may be performed smoothly. In addition, the hinge bearing 153 may be disposed in the bearing disposing groove 1543 formed in the hinge base 154.

[0113] A hinge body coupling hole 1523 may be formed in an edge of upper and lower ends of the hinge head 1521. The plurality of the hinge body securing hooks 1525 may be projected from a rear surface of the hinge head 321. The hinge body securing hook 1525 may be inserted in an outer area of the laundry introduction opening 106 formed in the cabinet front surface 103 and a coupling member may be coupled to the cabinet front surface 103

through the hinge body coupling hole 1524 from the front surface of the hinge head 1521.

[0114] As mentioned above, an inner surface of the cabinet front surface 103, in other words, an inner surface of the cabinet may closely contact with the bracket 1031 (that may be a metal plate that is equal or similar to the hinge head). The hinge body securing hook 1521b may be fitted to the bracket coupling hole 1031a formed in the bracket 1031 through the front surface 103 of the cabinet.

[0115] The coupling member penetrating the hinge body coupling hole 1524 may be coupled to the front surface 103 of the cabinet through a second coupling hole 1072 formed in the front surface 103 of the cabinet.

[0116] FIG. 6 is a diagram illustrating arrangement of a duct 320, a heat pump 340 including a compressor 349, an evaporator 342 and a condenser 343, a drum motor 380 and a fan 350 that are provided in a base portion of the laundry treatment apparatus.

[0117] The duct 320 may be provided in the base portion 330 to circulate air. When specified, the duct may include a second path for the evaporator 342 and the condenser 343; a first path connecting the air discharged from the drum 110 with the second path; and a third path drawing the air having passed the first path and the second path into the drum again.

[0118] A bottom of the second path may be a bottom surface of the base portion 330. The second path may be formed by using a cover plate (not shown) covering the evaporator 342 and the condenser 343 and then forming an upper surface of the second path and a cover side surface (not shown). Different from that, the second path may be any types or structures only if they are made of one member.

[0119] FIG. 6 illustrates that the evaporator 342 and the condenser 343 are exposed after the cover plate (not shown) forming the top of the duct 320 is removed.

[0120] The heat pump may mean a device configured to exchange heat with the air circulating a circulation channel and chill and heat the heat-exchanged air. The evaporator 342, the compressor 349 and the condenser 343 of such the heat pump may be sequentially connected with each other by a refrigerant pipe 346 in which a refrigerant flow. The elements of the heat pump that directly exchange heat with the circulating air may include the evaporator 342 and the condenser 343.

[0121] The refrigerant circulating the heat pump may absorb and evaporate heat from the high-temperature humid air discharged from the drum. Accordingly, the circulating air may be chilled and the moisture contained in the air may be condensed to fall down to a bottom surface of the circulation channel formed in a duct type by gravity.

[0122] Meanwhile, the refrigerant circulating the refrigerant pipe 346 of the heat pump may be evaporated in the evaporator 342 and compressed into a high-temperature-and-high-pressure gas in the compressor 349. After that, heat is transmitted to the air having passed the evaporator 342 and condensed to generate a conden-

sate in the condenser 343. Accordingly, the air having passed the evaporator 342 may be heated into high-temperature and dry air and re-drawn into the drum 110 by the third path (not shown).

[0123] The drum motor 380 may be configured to generate a driving force for rotating the drum 110. A belt (not shown) for transmitting the driving force of the drum motor 380 to the drum 110 may be connected with the drum motor 380. The belt may be arranged to surround an outer circumference of the drum 110.

[0124] A pulley 181 and a spring (not shown) may be provided to adjust a tension applied to the belt. The pulley 181 may be configured to apply a predetermined tension to the belt. The pulley 181 may be rotatably provided in a drum motor mounting portion arranged in the base portion 330 where the drum motor is mounted or a bracket (not shown) mounted in the drum motor mounting portion.

[0125] To adjust the tension of the belt, the drum motor 380 may rotate with respect to one axis in a preset range of angles and restitute to its original position by the elastic force of the spring. For that, the drum motor 380 may be rotatable with respect to one axis in the drum motor mounting portion located in the lower portion of the drum motor 380. The spring may be connected with the drum motor mounting portion and the drum motor 380.

[0126] Meanwhile, a blowing fan 3273 may be mounted to a shaft of the drum motor 380. In one embodiment of the present disclosure, the belt may be connected to a shaft provided in one side of the drum motor 380 and the fan 3273 may be mounted to a shaft provided in the other side of the drum motor 380. The fan 3273 may be installed in the fan installing portion 327 and to blow the air discharged to a lower portion of the drum to the duct 320 in which the evaporator 342 and the condenser 343 are arranged through the fan 3273.

[0127] Accordingly, the shafts provided in respective sides of the drum motor 380 may be rotatable in the same direction at the same speed. If two shafts are provided in one drum motor 380, there may be more advantages in terms of power consumption improvement of the laundry treatment apparatus 100. Basically, compared with that one drum motor 380 for rotating the drum 110 and another drum motor for rotating the fan 3273 are provided, the power consumption of the drum motor according to the present disclosure may be reduced in half.

[0128] The point at which the rotation of the fan 3273 is required may be equal to the point at which the drum 110 is rotated. While the drum is rotating, the high-temperature and dry air may be supplied to the drum 110 and the high-temperature and humid air may be discharged from the drum 110. In addition, even when only air circulation is performed in a chilling cycle after a drying cycle, the fan 3273 may be operated to circulate air and the drum 110 may be rotated. Accordingly, a state that requires no rotation of the drum 110 or the fan 3273 may not occur.

[0129] Specifically, the laundry treatment apparatus may include a drying cycle for compressing the refriger-

ant by using the compressor 349 of the heat pump and make the high-temperature dry air by using the evaporator 342 and the condenser 343 to dry the laundry inside the drum 110; and a chilling cycle for gradually chilling the high-temperature air without using the heat pump. The drying cycle and the chilling cycle may require the rotation of the drum and the circulation of the air. Accordingly, there may be no state where the rotation of the drum motor 380 or the fan 3273 is unnecessary.

[0130] The fan 350 may be installed adjacent to the compressor 349. The fan 350 may be configured to blow the wind towards the compressor 349 or suck the air near the compressor 349 to blow. The temperature of the compressor 349 may be lowered by the fan 350 and the compression efficiency may be enhanced accordingly. In one embodiment of the present disclosure, the fan 350 may be located in a rear area of the compressor 349 to be located close to the rear surface of the cabinet. A cabinet discharge hole (not shown) may be formed in the cabinet 101 in which the fan 350 is provided to exchange external air outside the cabinet with internal air inside the cabinet. It is preferred that the cabinet discharge hole (not shown) may be formed in the rear surface of the cabinet in which the fan 350 is arranged. However, the structure of the cabinet 101 is not closed. Accordingly, an aperture generated during the assembling process may be the cabinet discharge hole and the internal air of the cabinet may be exchanged with external air.

[0131] In addition, the fan 350 may be used in diluting the leaking refrigerant to prevent explosion of a flammable refrigerant (e.g., R-290). When R-290 leaks which is the flammable refrigerant, R-290 might be collected in a specific position inside the cabinet, because the density of R-290 is heavier than air and an electrical spark might explode R-290. To prevent such explosion, air blow may be provided to an area in which the flammable refrigerant is expected to collect to lower the density of the flammable refrigerant under the limit of inflammability or discharge the flammable refrigerant outside the cabinet. The limit of inflammability means a range of densities or pressures that are needed when a flammable gas and an oxygen compounds are ignited and exploded.

[0132] Specifically, a high-purity propane gas of R-290 is likely to have a risk of ignition or explosion if it leaks to occupy 1.8% or more of density contained in the air. The gas having such the density has to be diluted with ambient air or discharged outside the cabinet as soon as possible. For that, the fan 350 may be used.

[0133] As the present features may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be considered broadly within its scope as defined in the appended claims. Therefore, all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds, are therefore intended to be embraced by the appended

claims.

INDUSTRIAL APPLICABILITY

[0134] The above-mentioned features and characteristics may be applied to all types of display devices partially and entirely.

Claims

1. A laundry treatment apparatus comprising:

a cabinet (101) comprising a laundry introduction opening (106) at a front surface of the cabinet;
 a cylinder-shaped drum (110) provided in the cabinet and configured to accommodate laundry;
 a duct (320) configured to form a path for circulating air inside the drum;
 a heat pump (340) provided in the duct and comprising an evaporator (342), a condenser (343) configured to exchange heat between the circulating air and a flammable refrigerant, and a compressor (349) provided outside the duct and configured to compress the flammable refrigerant having passed the evaporator;
 a door (108) coupled to the front surface of the cabinet and configured to open and close the laundry introduction opening;
 a hinge assembly (150) configured to rotatably connect the door to the cabinet;
 a latch assembly (140) configured to detachably secure the door to the cabinet;
 a door rear surface located towards the laundry introduction opening;
 a magnet unit (120) provided at the door rear surface; and
 a sensing unit (130) provided at the front surface of the cabinet and configured to sense magnetic force of the magnet unit to determine the opening and closing of the door.

2. The laundry treatment apparatus of claim 1, wherein the hinge assembly (150) comprises an elastic member (155), and
 wherein the elastic member is adapted to, when a distance between the magnet unit and the sensing unit is equal to a preset first distance or less, push the door.

3. The laundry treatment apparatus of claim 2, wherein the elastic member (155) is adapted to, when the distance between the magnet unit (120) and the sensing unit (130) is equal to a preset second distance or more and equal to the first distance or less and elastic force of the elastic member (155) is larger

than external force applied to the door (108), push the door (108) a distance that is bigger than the first distance.

4. The laundry treatment apparatus of any one of the preceding claims, wherein the door comprises: a first door frame (1081); and a second door frame (1082) coupled to the first door frame, being located behind the first door frame to contact with the laundry treatment opening when the door is closed, wherein the second door frame is partially cut away, defining a first disposing portion (1091) and a second disposing portion (1092) for having the hinge assembly and the latch assembly disposed therein, and wherein the size of the first disposing portion is equal to that of the second disposing portion.

5. The laundry treatment apparatus of claim 4, insofar as dependent upon claim 2, wherein the latch assembly comprises :

a latch cover (142) coupled to the second door frame; and
 a latch (141) projectedly coupled to the latch cover,
 wherein the front surface of the cabinet comprises a latch coupling portion (1064) configured to be coupled to the latch and to secure the door, and
 wherein the latch and the latch coupling portion are configured to, when the distance between the magnet unit and the sensing unit is less than a preset third distance, be coupled with each other, so as to secure the door to the cabinet in resistance to the elastic force of the elastic member.

6. The laundry treatment apparatus of any one of claims 2 to 5, wherein the hinge assembly comprises,
 a hinge cover (151) coupled to the second door frame;
 a hinge body (152) rotatably coupled to the hinge cover; and
 a hinge base (154) having the hinge cover disposed thereon, and
 wherein the elastic member is coupled to the hinge base.

7. The laundry treatment apparatus of claim 6, insofar as dependent upon claim 5, wherein each of the hinge cover and the latch cover comprises:

a first latch cover portion (1451) partially forming a rear surface of the second door frame; and
 a second latch cover portion (1452) bent from one side edge of the first latch cover portion, partially forming a circumferential surface of the

door.

8. The laundry treatment apparatus of any one of the preceding claims, wherein the front surface of the cabinet comprises a sensing unit installation hole that penetrates the front surface of the cabinet, having the sensing unit installed therein, and wherein the sensing unit comprises:

a sensing unit cover body (132) configured to protect the sensing unit;
a plurality of guide ribs (134) projecting from the sensing unit cover body; and
a reed switch PCB (131) comprising a reed switch (1311a), being adapted for being guided by the plurality of the guide ribs to be located in the sensing unit cover body, and wherein the reed switch is configured to, when the magnet unit approaches the sensing unit, sense the opening and closing of the door.

9. The laundry treatment apparatus of any one of claims 4 to 8, insofar as dependent upon claim 4, wherein the magnet unit comprises:

a first projected surface (1211) provided at the second door frame and projecting from the second door frame towards the laundry introduction opening;
a second projected surface (1212) forming a side surface of the first projected surface;
a recessed portion (1213) provided on an inner surface of the first projected surface in a direction opposite to the projection direction of the first projected surface; and
a magnet (1214) coupled to the recessed portion.

10. The laundry treatment apparatus of claim 8 or 9, insofar as dependent upon claim 8, wherein the reed switch PCBs is provided in plurality, and the plurality of the reed switch PCBs is installed in the cabinet vertically with respect to each other.

11. The laundry treatment apparatus of any one of claims 6 to 10, insofar as dependent upon claim 6, wherein the front surface of the cabinet comprises:

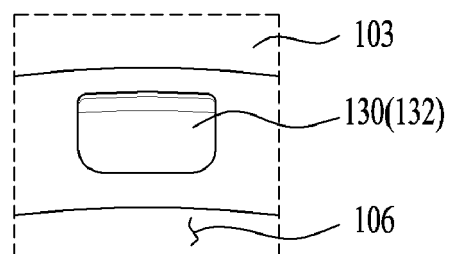
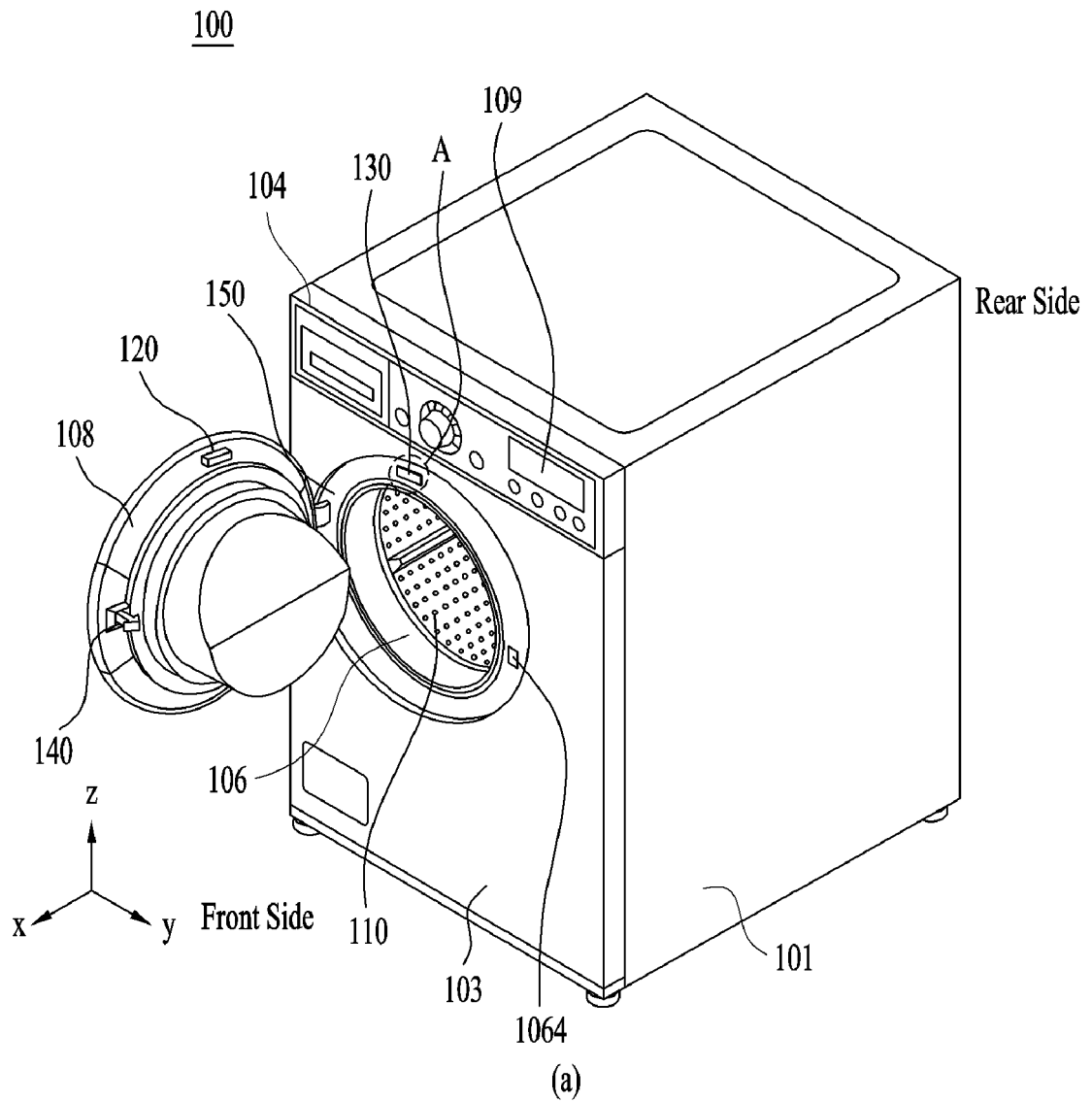
a first coupling hole (1071) for being coupled to the hinge body; and
a second coupling hole (1072) for being coupled to the latch, and
wherein the first coupling hole and the second coupling hole are provided at both left and right sides of the laundry introduction opening, such that the position of the hinge assembly and the latch assembly can be exchanged.

12. The laundry treatment apparatus of any one of claims 4 to 11, insofar as dependent upon claim 4, wherein the magnet unit is located at a region at which an imaginary line passing through the center of the second door frame meets the second door frame.

13. The laundry treatment apparatus of any one of the preceding claims, wherein the sensing unit is located at a height corresponding to the magnet unit, and wherein the sensing unit and the magnet unit are adapted to, when the door is closed, be spaced apart from each other at a preset distance.

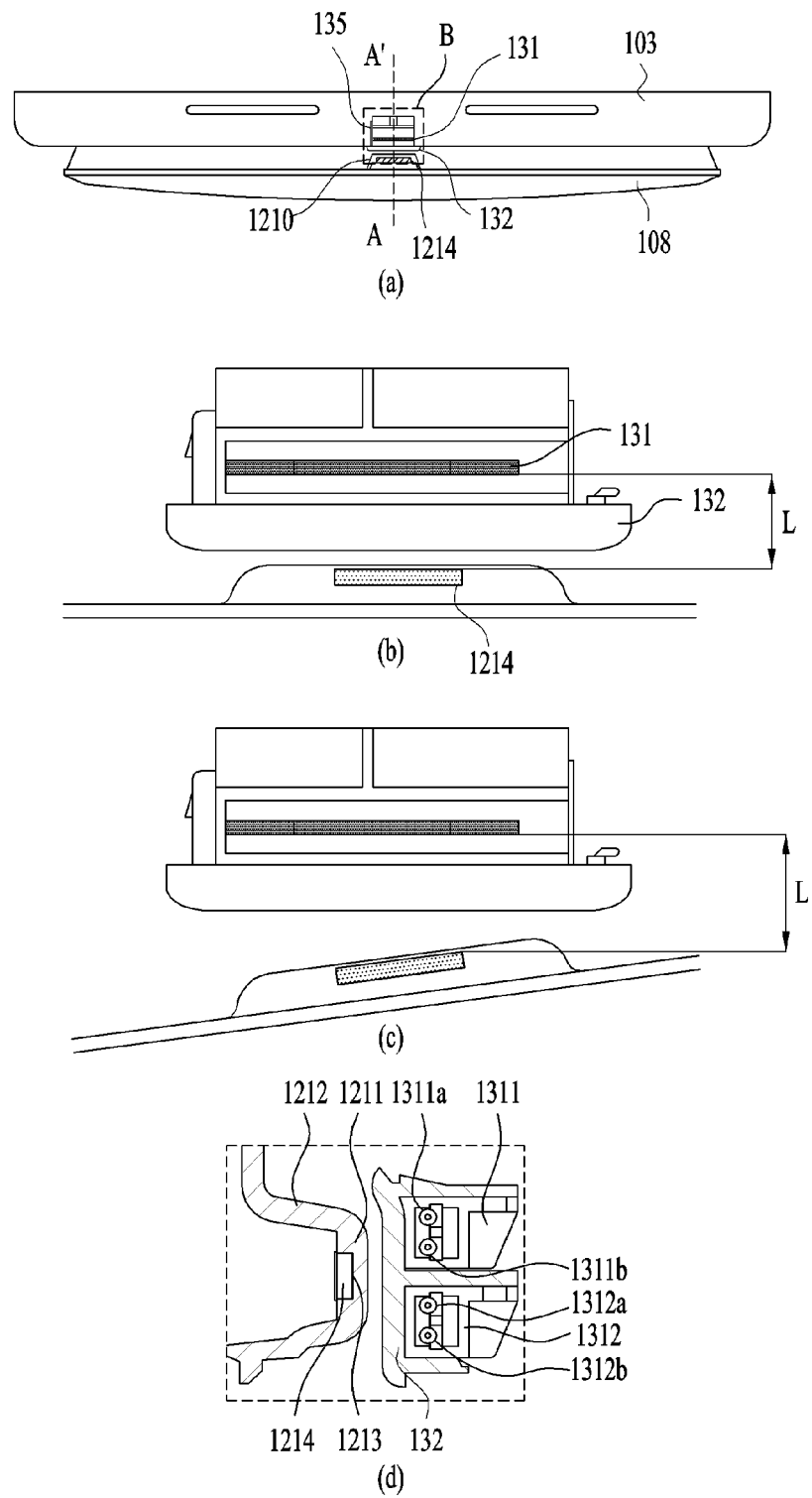
14. The laundry treatment apparatus of any one of the preceding claims, being configured to be operable with R-290 as the flammable refrigerant.

【FIG. 1】

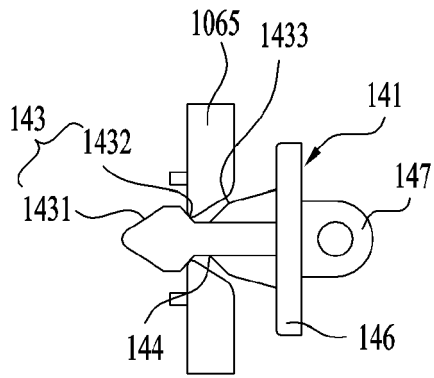


(b)

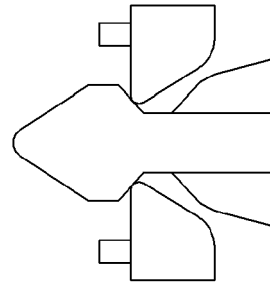
【FIG. 2】



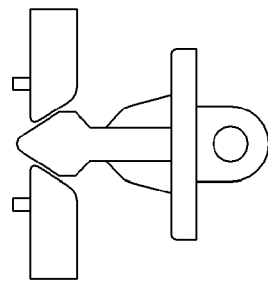
【FIG. 3】



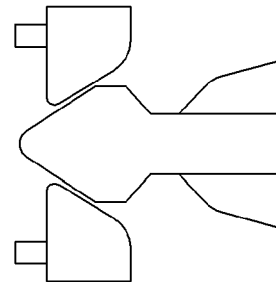
(a)



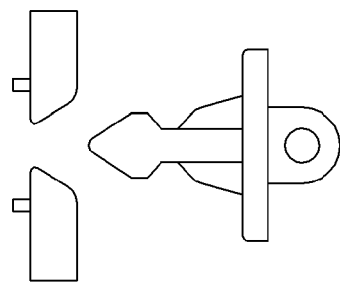
(b)



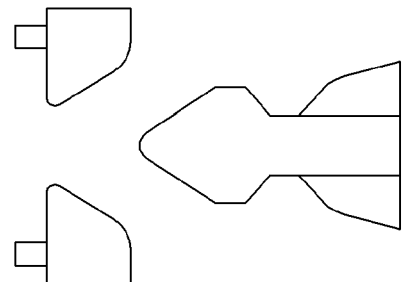
(c)



(d)

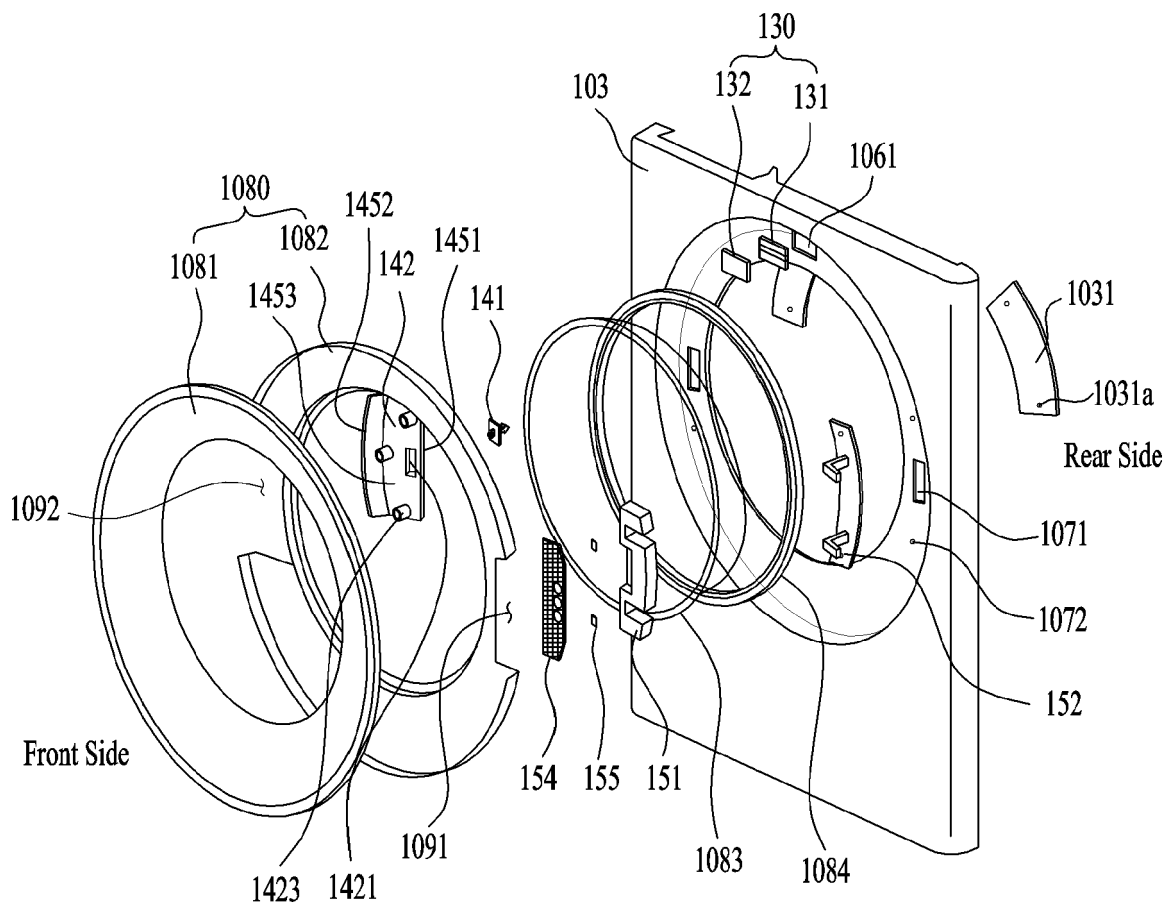


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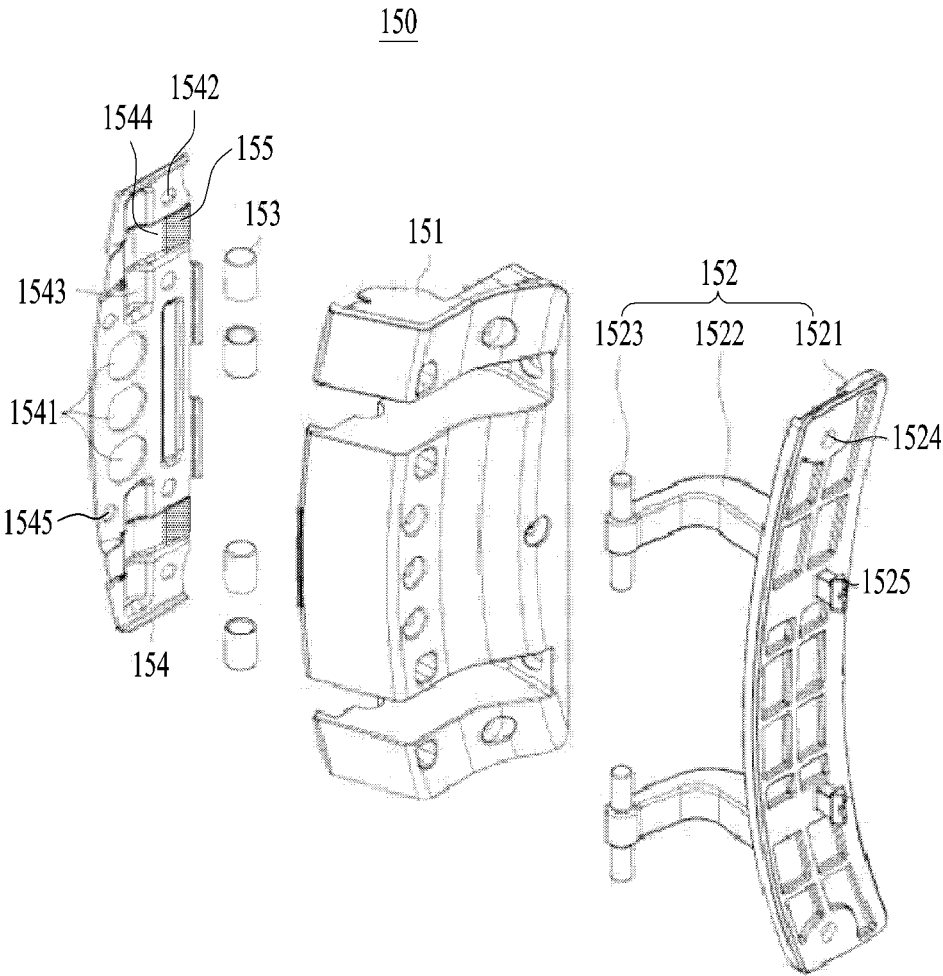


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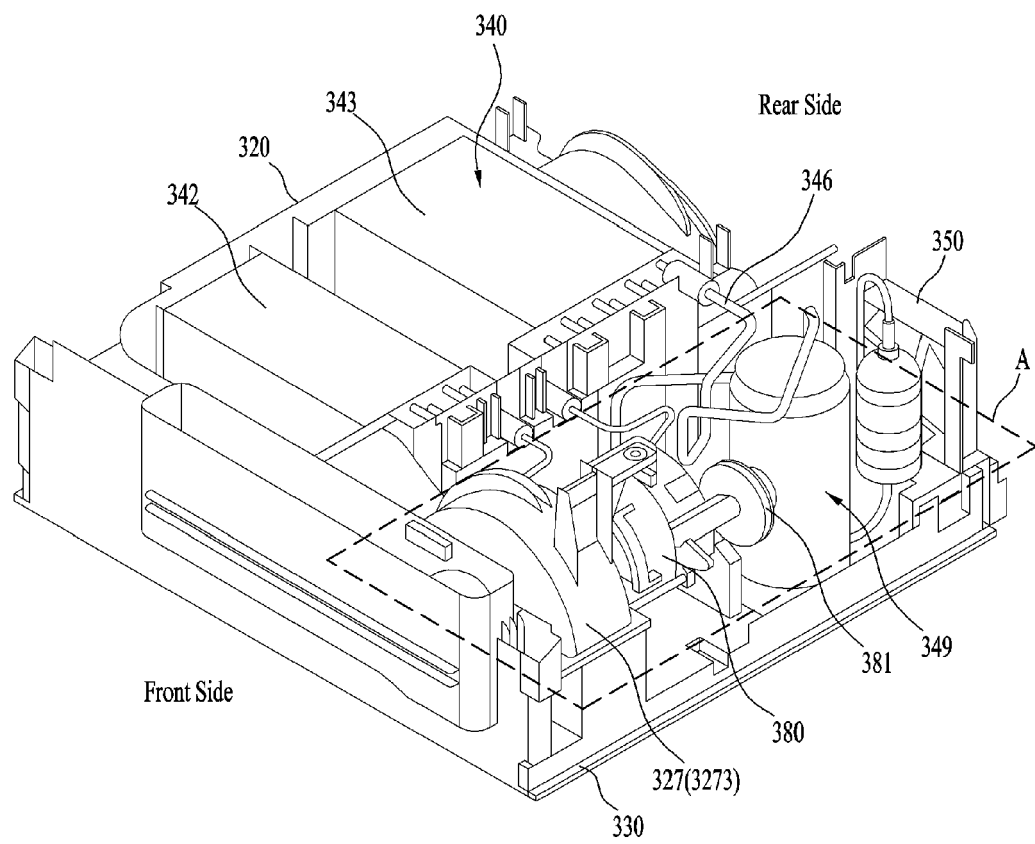
【FIG. 4】



【FIG. 5】



【FIG. 6】





EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 3 489 410 A1 (LG ELECTRONICS INC [KR]) 29 May 2019 (2019-05-29)	1-7, 11-14	INV. D06F39/14
A	* paragraph [0017]; claims; figures * * paragraph [0032] - paragraph [0045] *	8-10	ADD. D06F103/40 D06F58/20
Y	CN 106 948 141 A (WUXI LITTLE SWAN CO LTD) 14 July 2017 (2017-07-14)	1-7, 11-14	
A	* paragraphs [0038], [0046]; figures *	8-10	
Y	EP 3 333 305 A1 (BSH HAUSGERAETE GMBH [DE]) 13 June 2018 (2018-06-13)	14	
A	* paragraph [0023]; claims *	1-13	
A	US 10 145 053 B2 (LG ELECTRONICS INC [KR]) 4 December 2018 (2018-12-04)	1-14	
	* claims; figures 3,4 *		
A,P	WO 2020/101349 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 22 May 2020 (2020-05-22)	1-14	
	* paragraphs [0091], [0092]; claims; figures *		
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 August 2020	Examiner Popara, Velimir
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 20 18 2581

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-08-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3489410 A1	29-05-2019	EP 3489410 A1	29-05-2019
		TW 201925569 A	01-07-2019
		US 2019161904 A1	30-05-2019
		WO 2019107857 A1	06-06-2019
CN 106948141 A	14-07-2017	NONE	
EP 3333305 A1	13-06-2018	NONE	
US 10145053 B2	04-12-2018	CN 103726265 A	16-04-2014
		EP 2730692 A1	14-05-2014
		KR 20140047430 A	22-04-2014
		US 2014103788 A1	17-04-2014
WO 2020101349 A1	22-05-2020	KR 20200055545 A	21-05-2020
		US 2020149212 A1	14-05-2020
		WO 2020101349 A1	22-05-2020

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 20030089090 [0011]