(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 435 355 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
25.09.2024 Bulletin 2024/39

(21) Application number: **22894688.5**

(22) Date of filing: **09.11.2022**

(51) International Patent Classification (IPC):
F25D 11/02 *(2006.01)* ***F25D 23/02*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F25D 11/02; F25D 17/06; F25D 21/04; F25D 23/00; F25D 23/02; F25D 23/12

(86) International application number:
PCT/CN2022/130926

(87) International publication number:
WO 2023/088151 (25.05.2023 Gazette 2023/21)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **16.11.2021 CN 202111355815**

(71) Applicants:
- **Qingdao Haier Refrigerator Co., Ltd**
  Qingdao, Shandong 266101 (CN)
- **Haier Smart Home Co., Ltd.**
  Qingdao, Shandong 266101 (CN)

(72) Inventors:
- **ZHAO, Zhenyu**
  Qingdao, Shandong 266101 (CN)
- **ZHU, Xiaobing**
  Qingdao, Shandong 266101 (CN)
- **ZHANG, Yanqing**
  Qingdao, Shandong 266101 (CN)
- **SONG, Xiangpeng**
  Qingdao, Shandong 266101 (CN)
- **ZHAO, Bintang**
  Qingdao, Shandong 266101 (CN)
- **LU, Yong**
  Qingdao, Shandong 266101 (CN)

(74) Representative: **Winter, Brandl - Partnerschaft mbB**
Alois-Steinecker-Straße 22
85354 Freising (DE)

(54) **REFRIGERATOR**

(57) This application provides a refrigerator, comprising: a cabinet; a door; a refrigeration system, which comprises a compressor, a condenser, and a door evaporator connected in sequence; the condenser is connected to the door evaporator via an intake pipe, and the door evaporator is connected to the compressor via a return pipe; the cabinet is provided with a pipe port, and the return pipe passes through the pipe port into a thermal insulation layer of the cabinet after passing out of a hinge axis on the door side; the refrigerator further comprises a thermally insulated hinge cover plate, wherein the hinge cover plate at least covers the return pipe between the hinge axis and the pipe port.

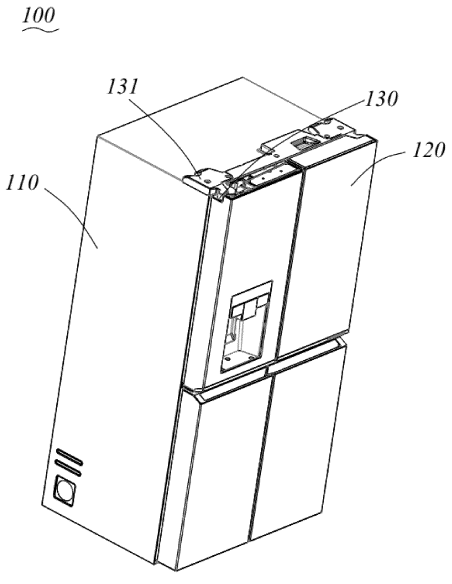

FIG.1

EP 4 435 355 A1

Description

TECHNICAL FIELD

[0001] This application relates to the field of home appliances, particularly to a refrigerator.

BACKGROUND

[0002] To meet users' ice needs, some refrigerators have an ice-making compartment provided on a refrigeration door, the ice-making compartment is equipped with an ice-making device and an independent ice-making evaporator that supplies cold air to the ice-making compartment. The compressor and condenser are often located in the compressor compartment on a cabinet side. The ice-making evaporator is connected to the compressor via a return pipe, the return pipe passes out of the hinge axis of the refrigeration door and enters the thermal insulation layer of the cabinet. However, due to the low temperature of the refrigerant in the return pipe and the exposure of the return pipe between the refrigeration door and the cabinet, condensation occurs.

SUMMARY

[0003] To solve the above problems, the present application proposes a refrigerator that can prevent condensation on the return pipe between the cabinet and the door.

[0004] This application provides refrigerator, comprising:

a cabinet;
a door, wherein the door is pivotally connected to the cabinet via a hinge;
a refrigeration system, which comprises a compressor, a condenser, and a door evaporator connected in sequence, wherein the compressor and the condenser are located on the cabinet side, and the door evaporator is located inside the door; the condenser is connected to the door evaporator via an intake pipe, and the door evaporator is connected to the compressor via a return pipe;
characterized in that, the cabinet is provided with a pipe port, and the return pipe passes through the pipe port into a thermal insulation layer of the cabinet after passing out of a hinge axis on the door side;
the refrigerator further comprises a thermally insulated hinge cover plate, wherein the hinge cover plate at least covers the return pipe between the hinge axis and the pipe port

[0005] As a further improvement of an embodiment of the present application, characterized in that the refrigeration system further comprises a capillary tube, which is located on the door side and positioned between the condenser and the door evaporator.

[0006] As a further improvement of an embodiment of the present application, characterized in that the intake pipe passes through the pipe port into the thermal insulation layer of the cabinet after passing out of the hinge axis on the door side, and the hinge cover plate at least covers the intake pipe between the hinge axis and the pipe port.

[0007] As a further improvement of an embodiment of the present application, characterized in that the cabinet comprises an outer shell and an inner liner, the thermal insulation layer is located between the outer shell and the inner liner, and the inner liner forms a storage compartment.

[0008] As a further improvement of an embodiment of the present application, characterized in that the return pipe between the hinge axis on the door side and the pipe port comprises a flexible return pipe, and the intake pipe between the hinge axis on the door side and the pipe port comprises a flexible intake pipe, wherein the flexible return pipe is placed inside the flexible intake pipe.

[0009] As a further improvement of an embodiment of the present application, characterized in that the return pipe between the hinge axis on the door side and the pipe port comprises a flexible return pipe, and a wall of the flexible return pipe is embedded with a heating wire.

[0010] As a further improvement of an embodiment of the present application, characterized in that the hinge cover plate comprises a hinge shell and a thermal insulation foam fixed to the inside of the hinge shell.

[0011] As a further improvement of an embodiment of the present application, characterized in that an axis of the pipe port is parallel to an axis of the hinge axis, and the hinge cover plate covers both the hinge axis and the pipe port.

[0012] As a further improvement of an embodiment of the present application, characterized in that the cabinet side is provided with a compressor compartment for installing the compressor, and the return pipe comprises a flexible return pipe and a return copper pipe, wherein the flexible return pipe passes out of the hinge axis on the door side, passes through the pipe port, enters the thermal insulation layer of the cabinet, and then enters the compressor compartment to connect with the return copper pipe.

[0013] As a further improvement of an embodiment of the present application, characterized in that the intake pipe comprises a flexible intake pipe and an intake copper pipe, wherein the flexible intake pipe passes through the pipe port from the hinge axis on the door side and enters into the thermal insulation layer of the cabinet and enters into the compressor compartment through the thermal insulation layer of the cabinet to connect with the intake copper pipe.

[0014] As a further improvement of an embodiment of the present application, characterized in that the cabinet side is provided with a compressor compartment for installing the compressor, and the return pipe comprises

a flexible return pipe and a return copper pipe, wherein the return copper pipe passes through the thermal insulation layer of the cabinet from the compressor compartment and passes out from the pipe port, and the flexible return pipe passes out from the hinge axis and extends to the cabinet side to connect with the return copper pipe.

[0015] As a further improvement of an embodiment of the present application, characterized in that the intake pipe comprises an flexible intake pipe and an intake copper pipe, wherein the intake copper pipe passes through the thermal insulation layer of the cabinet from the compressor compartment and passes out from the pipe port, and the intake copper pipe passes out from the hinge axis and extends to the cabinet side to connect with the intake copper pipe; the cabinet is provided with a pipeline accommodation groove and a thermal insulation cover that closes the pipeline accommodation groove; the pipe port is located inside the pipeline accommodation groove, and an interface between the flexible intake pipe and the intake copper pipe and an interface between the flexible return pipe and the return copper pipe are located inside the pipeline accommodation groove.

[0016] As a further improvement of an embodiment of the present application, characterized in that the thermal insulation cover is integrally formed with the hinge cover plate, and the thermal insulation cover is a part of the hinge cover plate.

[0017] As a further improvement of an embodiment of the present application, characterized in that the storage compartment formed inside the cabinet comprises a refrigeration compartment and a freezing compartment, a refrigeration door for opening and closing the refrigeration compartment is provided with an ice-making compartment, and the door evaporator is located inside the ice-making compartment.

[0018] As a further improvement of an embodiment of the present application, characterized in that the hinge cover plate is provided with a guide groove for accommodating the return pipe.

[0019] The present application provides a refrigerator by providing an insulated hinge cover plate on the refrigerator and making the hinge cover plate cover the return pipe, avoiding the return pipe between the hinge axis of the door and the pipeline opening of the cabinet to be exposed on the outside to produce condensation, and in the process of assembly and manufacture of the refrigerator, it is only necessary to assemble the cabinet, the door, the refrigeration system, and so on, and install the hinge cover plate, and the overall occupation of space is small, and it is easy to operate and beautiful.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Figure 1 is a perspective view of a refrigerator according to an embodiment of the present application;
Figure 2 is an exploded view of the refrigerator shown in Figure 1;
Figure 3 is a schematic diagram of the refrigeration system of the refrigerator shown in Figure 1;
Figure 4 is an exploded view of a refrigerator according to another embodiment of the present application;
Figure 5 is a cross-sectional view of the flexible return pipe according to yet another embodiment of the present application;
Figure 6 is a partial schematic view according to yet another embodiment of the present application;
Figure 7 is a cross-sectional schematic view of the flexible intake pipe and flexible return pipe shown in Figure 6.

DETAILED DESCRIPTION OF EMBODIMENTS

[0021] In order to enable those skilled in the art to better understand the technical solutions in the present application, the technical solutions in the embodiments of the present application will be clearly and completely described below with reference to the drawings in the embodiments of the present application. Obviously, the described embodiments are only a part of the embodiments of the present application, not all embodiments. Based on the embodiments in the present application, all other embodiments obtained by those skilled in the art without creative efforts should fall within the protection scope of the present application.

[0022] Referring to Figures 1 and 2, a refrigerator 100 according to an embodiment of the present application is provided, refrigerator 100 comprises a cabinet 110 and a door 120 for opening and closing the cabinet 110. The door 120 can be pivotally connected to the cabinet 110 via a hinge 130, the hinge 130 has a hinge plate fixedly connected to the cabinet 110 and a hinge axis 132 pivotally connected to the door 120. The door 110 is provided with a door axis, and the hinge axis 132 is connected to the door axis, so that the door can rotate relative to the cabinet. Both the cabinet 110 and the door 120 can be provided with thermal insulation layers to prevent the loss of cold air inside the refrigerator 100. Specifically, the cabinet 110 can comprise an outer shell and an inner liner, with a thermal insulation layer provided between the outer shell and the inner liner. The door 120 can comprise a door shell and a door liner, with a thermal insulation layer provided between the door shell and the door liner. The thermal insulation layer can be made of foam material. The inner liner of the cabinet 110 forms a storage compartment, the storage compartment can comprise a refrigeration compartment and a freezing compartment.

[0023] The door 120 of the refrigeration compartment can be provided with an ice-making compartment and an ice-making door for opening and closing the ice-making compartment. The ice-making door is filled with thermal insulation material to isolate the ice-making compartment from the refrigeration compartment. The ice-making

compartment can be equipped with an ice-making device and an ice storage device.

[0024] The refrigerator 100 also comprises a refrigeration system 200. Referring to Figures 2 and 3, the refrigeration system 200 can comprise a compressor 230, a condenser 240, a door capillary tube 250, and a door evaporator 260 connected in sequence. The compressor 230 and the condenser 240 can be installed on a cabinet side, such as in a compressor compartment provided on the cabinet side, which can be located at the bottom of the cabinet 110. The compressor 230 and the condenser 240 can be installed inside the compressor compartment.

[0025] In this embodiment, the door evaporator 260 can be installed inside the door 120. Specifically, the door evaporator 260 can be installed inside the ice-making compartment to supply cold air to the ice-making compartment. The cabinet side is also provided with a cabinet evaporator 280 and a cabinet capillary tube 270. The cabinet evaporator 280 can supply cold air to the refrigeration compartment and the freezing compartment. The cabinet evaporator 280 and the door evaporator 260 can share the compressor 230 and the condenser 240. Specifically, the compressor 230 is connected to the condenser 240 via a refrigerant pipe. The condenser 240 is connected to a one-in-two-out solenoid valve 290, which supplies refrigerant to both the door evaporator 260 and the cabinet evaporator 280. The refrigerant flowing through the door evaporator 260 and the cabinet evaporator 280 returns to the compressor 230 in the compressor compartment.

[0026] In this embodiment, the condenser 240 is connected to the door evaporator 260 via an intake pipe 210, and the door evaporator 260 is connected to the compressor 230 via a return pipe 220. The intake pipe 210 can pass through the thermal insulation layer of the cabinet 110 from the compressor compartment and then enter the thermal insulation layer of the door 120 to connect with the door evaporator 260. One end of the return pipe 220 is connected to the door evaporator 260 and passes through the thermal insulation layer of the door 120, then enters the thermal insulation layer of the cabinet 110, and finally enters the compressor compartment to connect with the compressor 230.

[0027] In one embodiment of the present application, a pipe port 111 is provided on the cabinet 110. The pipe port 111 can be provided at the top of the cabinet 110. The return pipe 220 enters the door shaft on the door side from the thermal insulation layer of the door 120, passes out through the hinge axis 132 on the door side, and then enters the thermal insulation layer of the cabinet 110 from the pipe port 111 on the cabinet 110. The refrigerator 100 also comprises a thermally insulated hinge cover plate 131. The hinge cover plate 131 at least covers the exposed return pipe 220 between the hinge axis 132 and the pipe port 111. The hinge cover plate 131 can be directly installed on the cabinet 110 using screws or other fasteners. Since the hinge cover plate 131 is thermally insulated and covers the part of the return pipe 220 exposed outside the cabinet 110 and the door 120, the return pipe 220 does not directly contact the outside, and therefore, condensation will not occur on the exterior of the low-temperature return pipe 220. The hinge cover plate 131 covers the return pipe 220, making the overall appearance more aesthetically pleasing and the structure compact and easy to install and manufacture.

[0028] In this embodiment, the hinge cover plate 131 comprises a hinge shell and thermal insulation foam fixed to the inside of the hinge shell. The thermal insulation foam can be snap-fitted and fixed inside the hinge shell. In the manufacturing process, after the installation of the refrigeration system 200, the hinge cover plate 131 can be directly installed, making the installation process simple.

[0029] A pipeline guide box 140 can also be provided on the cabinet 110. Specifically, the pipeline guide box 140 can be provided at the top of the cabinet 110 near the edge of an opening side. The pipeline guide box 140 comprises a pipeline guide groove 141 provided close to the hinge 130 side. The intake pipe 210 and the return pipe 220 can pass through the pipeline guide groove 141 and then enter the pipe port 111. The hinge cover plate 131 covers the pipeline guide groove 140 and abuts against the sidewall of the pipeline guide groove 141. The pipeline guide groove 141 can guide and position the pipelines while also limiting the position of the hinge cover plate 131.

[0030] Further, a guide groove for accommodating the return pipe 220 can be provided on the hinge cover plate 131. Specifically, the guide groove can be provided on the thermal insulation foam. When the hinge cover plate 131 is installed on the door 120, the return pipe 220 passes out from the hinge axis 132 on the door side, passes through the guide groove of the hinge cover plate 131, and then enters the thermal insulation layer of the cabinet 110 from the pipe port 111 on the cabinet 110. The guide groove can position the return pipe 220, making the covering of the return pipe 220 tighter and enhancing the anti-condensation effect.

[0031] Further, in one embodiment of the present application, the door capillary tube 250 can be set inside the door 120. Specifically, the door capillary tube 250 can be set inside the thermal insulation layer of the door 120. The condenser 240 is connected to the door capillary tube 250 via a first intake pipe, and the door capillary tube 250 is connected to the door evaporator 260 via a second intake pipe. The first intake pipe exits the thermal insulation layer of the cabinet 110 and enters the door shaft of the door 120 from the hinge axis 132 on the door side, and then connects to the door capillary tube 250 inside the thermal insulation layer of the door 120. The door capillary tube 250 can also partially extend into the door shaft of the door 120. The first intake pipe connects to the door capillary tube 250 inside the door shaft after passing through the hinge axis 132 on the door 120 side. The door capillary tube 250 and the return pipe 220 form at least a part of the tube bundle, ensuring heat exchange

effectiveness.

[0032] The portion of the first intake pipe disposed between the door 120 and the cabinet 110 is exposed outside of the door 120 and the cabinet 110, but since the door capillary tube 250 is located inside the door 120, the refrigerant flowing through the first intake pipe is at room temperature, so the first intake pipe does not have a condensation problem.

[0033] Further, the intake pipe 210 can pass out from the pipe port 111 on the cabinet 110 and enter the door shaft of the door 120 from the hinge axis 132 on the door side, then enter the thermal insulation layer of the door 120. The thermally insulated hinge cover plate 131 can cover the intake pipe 210 between the hinge axis 132 and the pipe port 111. Thus, even if the door capillary tube 250 is located on the cabinet side, the intake pipe 210 will not have a condensation problem.

[0034] The return pipe 220 can comprise a flexible return pipe 221 and a return copper pipe 222 connected to the flexible return pipe 221. The intake pipe 210 can comprise a flexible intake pipe 211 and an intake copper pipe 212. The flexible intake pipe 211 and the flexible return pipe 221 at least extend from the hinge axis 132 on the door side to the cabinet side, so they do not hinder the opening and closing of the door 120, and the flexible pipes are flexible, not easily damaged by the rotation of the door 120. The intake copper pipe 212 and the return copper pipe 222 ensure good heat exchange.

[0035] Specifically, the intake pipe 210 can comprise an intake copper pipe on the door side and an intake copper pipe 212 on the cabinet side. The intake copper pipe on the door side can be embedded in the thermal insulation layer of the door 120. Both ends of the flexible intake pipe 211 can be connected to the intake copper pipe on the door side and the intake copper pipe 212 on the cabinet side. The flexible intake pipe 211 can enter the door shaft of the door 120 from the hinge axis on the door side and connect to the intake copper pipe inside the door shaft, the intake copper pipe set on the door side, or the flexible intake pipe 211 can directly extend into the thermal insulation layer of the door 120 and connect to the intake copper pipe inside the thermal insulation layer, the intake copper pipe is set on the door side. The intake copper pipe 212 on the cabinet side can connect to the condenser 240 inside the compressor compartment, and the intake copper pipe on the door side can connect to the door capillary tube 250.

[0036] The return copper pipe 222 also comprises a return copper pipe 222 on the cabinet side and a return copper pipe on the door side. The return copper pipe 222 on the cabinet side connects to the refrigerant inlet of the compressor 230, and the return copper pipe on the door side connects to the refrigerant outlet of the door evaporator 260. Both ends of the flexible return pipe 221 can be connected to the intake copper pipe 212 on the cabinet side and the return copper pipe on the door side. The flexible return pipe 221 can enter the door shaft of the door 120 from the hinge axis on the door side, and inside the door shaft the flexible return pipe 221 connect to the return copper pipe on the door side. The flexible return pipe 221 can also enter the thermal insulation layer of the door 120 after entering the door shaft and connect to the return copper pipe on the door side inside the thermal insulation layer.

[0037] Further, in one embodiment of the present application, the axis of the pipe port 111 on the cabinet 110 is parallel to the axis of the hinge axis 132. The hinge cover plate 131 covers both the hinge axis 132 and the pipe port 111.

[0038] In this embodiment, both the return pipe 220 and the intake pipe 210 can pass out from the hinge axis 132 of the door 120 and then enter the interior of the cabinet 110 from the pipe port 111. The axis of the pipe port 111 is parallel to the hinge axis 132, which can reduce damage to the return pipe 220 and the intake pipe 210 during the rotation of the door 120.

[0039] The flexible intake pipe 211 and the flexible return pipe 221 both pass out from the hinge axis 132 on the door side and enters into the thermal insulation layer of the cabinet 110 through the pipe port 111, and then enters into the compressor compartment to connect with the intake copper pipe 212 and the return copper pipe 222 inside the compressor compartment, respectively. The refrigerator 100 can also be equipped with a water supply device, which can supply water to the ice-making device inside the ice-making compartment. The water pipe of the water supply device can also pass out from the thermal insulation layer of the door 120 through the hinge axis 132 on t the door side and enter the thermal insulation layer of the cabinet 110 through the pipe port 111. The water pipe, flexible return pipe 221, and flexible intake pipe 211 can form a bundle, which is convenient for installation and manufacturing. The interface between the flexible return pipe 221 and the return copper pipe 222 on the cabinet side, and the interface between the flexible intake pipe 211 and the intake copper pipe 212 are both located inside the compressor compartment, eliminating the need for additional connection space on the cabinet 110. The hinge cover plate 131 directly covers the area between the hinge axis 132 on the door side and the pipe port 111, achieving anti-condensation for the return pipe 220 with a compact overall structure.

[0040] Referring to Figure 4, in another embodiment of the present application, the cabinet 110 is provided with a pipeline accommodation groove 112 and a thermal insulation cover 113 that closes the pipeline accommodation groove 112. The pipe port 111 can be set inside the pipeline accommodation groove 112. Both the intake copper pipe 212 and the return copper pipe 222 pass through the thermal insulation layer of the cabinet 110 from the compressor compartment and exit from the pipe port 111 on the cabinet 110, and then connect to the flexible intake pipe 211 and the flexible return pipe 221, respectively. The interface between the flexible intake pipe 211 and the intake copper pipe 212, and the interface between the flexible return pipe 221 and the return

copper pipe 222 are both located inside the pipeline accommodation groove 112.

[0041] In this embodiment, the top of the cabinet 110 is recessed to form the pipeline accommodation groove 112, and the pipe port 111 is set on the sidewall of the pipeline accommodation groove 112. The thermal insulation cover 113 and the hinge cover plate 131 can be set separately. The flexible return pipe 221 passes into the hinge cover plate 131 from the hinge axis 132 of the door 120, then exits from the hinge cover plate 131 and enters the thermal insulation cover 113. The thermal insulation cover 113 and the hinge cover plate 131 together cover the return pipe 220 between the hinge axis 132 on the door side and the pipe port 111. The thermal insulation cover1 13 can be a part of the hinge cover plate 131, or the thermal insulation cover 113 can be integrally formed with the hinge cover plate 131, making installation and manufacturing more convenient.

[0042] Thus, since the price of flexible pipes is higher than that of copper pipes, this configuration can reduce the length of the flexible pipes, lowering production and manufacturing costs, and making installation and manufacturing more convenient.

[0043] Referring to Figure 5, in another embodiment of the present application, a heating wire 223 is embedded in the wall of the flexible return pipe 221 at least between the hinge axis 132 on the door side and the pipe port 111 of the cabinet 110. The flexible return pipe 221 extends from the hinge axis 132 on the door side to the cabinet side to avoid hindering the opening and closing of the door 120 and to extend the lifespan of the return pipe 220.

[0044] The heating wire 223 can exit from the end surface of one end of the flexible return pipe 221 and connect to a wire harness, the wire harness can enter the interior of the cabinet 110 or the door 120 of the refrigerator 100 and connect to the control board of the refrigerator 100. The control board can control the on/off state of the heating wire 223, such as turning on the heating wire 223 only when the compressor 230 is operating to supply refrigerant to the door evaporator 260.

[0045] The portion of the flexible return pipe 221 between the hinge axis 132 on the door side and the pipe port 111 of the cabinet 110 is exposed to the external environment. Since the refrigerant flowing through the flexible return pipe 221 is at a low temperature, the exterior of the flexible return pipe 221 is prone to condensation. By embedding the heating wire 223 in the wall of the flexible return pipe 221 in this portion, and integrating the heating wire 223 with the flexible return pipe 221, the condensation problem of the flexible return pipe 221 can be solved. Additionally, the heating wire 223 is embedded in the wall of the flexible return pipe 221, occupying a small overall space and being convenient for installation. The closure of the flexible return pipe 221 can protect the heating wire 223, and the high toughness of the heating wire 223 can also enhance the toughness of the flexible return pipe 221, increasing its lifespan.

[0046] Furthermore, in one embodiment of the present application, a heating wire 223 of the same length as the flexible return pipe 221 is embedded in the wall of the flexible return pipe 221, meaning the entire wall of the flexible return pipe 221 has an embedded heating wire 223, making manufacturing more convenient and improving the anti-condensation effect.

[0047] The heating wire 223 comprises multiple resistance wires set at intervals along the circumference of the return pipe 220. The resistance wires have good toughness, are not easily broken, and can better enhance the toughness of the flexible return pipe 221. The multiple resistance wires are set at intervals along the circumference of the return pipe 220, and the distance between any two adjacent resistance wires can be equal, which can make the heating of the return pipe 220 more uniform, improving the anti-condensation effect.

[0048] Referring to Figures 6 and 7, another embodiment of the present application provides a refrigerator 100. In this embodiment, the compressor 230 and the condenser 240 of the refrigeration system 200 are installed inside the compressor compartment on the cabinet side, and both the door capillary tube 250 and the door evaporator 260 are installed inside the door 120. In this way, during the refrigeration process, the refrigerant flowing through the intake pipe 210 between the condenser 240 and the door capillary tube 250 is at room temperature, so the intake pipe 210 will not have a condensation problem.

[0049] In this embodiment, both the intake pipe 210 and the return pipe 220 pass out from the hinge axis 132 on the door side and enter the thermal insulation layer of the cabinet 110 through the pipe port 111. The intake pipe 210 comprises at least a flexible intake pipe 211 extending from the hinge axis 132 on the door side to the cabinet side. The return pipe 220 comprises at least a flexible return pipe 221 extending from the hinge axis 132 on the door side to the cabinet side, and at least the flexible return pipe 221 between the hinge axis 132 on the door side and the pipe port 111 is placed inside the flexible intake pipe 211.

[0050] The refrigerant inside the flexible return pipe 221 between the hinge axis 132 on the door side and the pipe port 111 is at a low temperature. If the flexible return pipe 221 is directly exposed to the external environment, it may produce condensation. Placing the flexible return pipe 221 inside the flexible intake pipe 211 can avoid direct exposure of the flexible return pipe 221 to the external environment, and the exterior of the flexible return pipe 221 is simultaneously wrapped by the flexible intake pipe 211 and the room-temperature refrigerant, so the flexible return pipe 221 will not have condensation. The overall structure is compact, does not occupy additional space, and the nesting of the flexible intake pipe 211 and the flexible return pipe 221 does not affect the opening and closing of the door 120 or the lifespan of the pipelines.

[0051] Furthermore, the return pipe 220 comprises a return copper pipe 222 connected to the flexible return

pipe 221, and the intake pipe 210 comprises an intake copper pipe 212 connected to the flexible intake pipe 211. The flexible return pipe 221 is entirely placed inside the flexible intake pipe 211, which facilitates connection and manufacturing and can enhance the anti-condensation effect.

[0052] The flexible return pipe 221 and the flexible intake pipe 211 can be integrally formed, and support ribs 224 can be set between the flexible return pipe 221 and the flexible intake pipe 211, so that the return pipe 220 is fixed relative to the intake pipe 210. The pipelines between the return pipe 220 and the intake pipe 210 are relatively fixed, and the refrigerant from the compressor 230 can smoothly flow through the channel between the intake pipe 210 and the return pipe 220 into the door capillary tube 250, without affecting the refrigeration effect. At the same time, the support ribs 224 can also enhance the stability of the overall structure and the strength of the pipelines, facilitating installation and manufacturing.

[0053] Furthermore, in one embodiment of the present application, the refrigerator 100 also comprises a diversion connector 300, which connects the flexible intake pipe 211, intake copper pipe 212, flexible return pipe 221, and return copper pipe 222. The diversion connector 300 can comprise a diversion connector 300 on the cabinet side and a diversion connector 300 on the door side. During the refrigeration process, the refrigerant from the compressor 230 enters the flexible intake pipe 211 through the intake copper pipe 212 via the diversion connector 300, then enters the intake copper pipe on the door side through the diversion connector 300, flows through the door capillary tube 250 and the door evaporator 260, enters the return copper pipe on the door side, passes through the diversion connector 300 on the door side, enters the flexible return pipe 221, passes through the diversion connector 300 on the cabinet side, enters the return copper pipe 222 on the cabinet side, and returns to the compressor 230.

[0054] The diversion connector 300 comprises a fluid chamber 310 and a flexible intake pipe connection part 320 penetrating the fluid chamber 310 and a return pipe connection part 330. The end of the flexible intake pipe 211 is connected to the flexible intake pipe connection part 320, and the flexible return pipe 221 passes through the fluid chamber 310 from the flexible intake pipe connection part side and connects to the return pipe connection part 330. A space is formed between the flexible return pipe 221 and the sidewall of the fluid chamber 310, the space communicates with the flexible intake pipe 211. The diversion connector 300 also comprises an intake copper pipe connection part 340 penetrating the fluid chamber 310, the intake copper pipe 212 is connected to the intake copper pipe connection part 340.

[0055] In this embodiment, the fluid chamber 310 is cylindrical, and the inner diameter of the fluid chamber 310 is larger than the outer diameter of the flexible return pipe 221. The two ends of the fluid chamber 310 are open and provided with the flexible intake pipe connection part 320 connecting to the flexible intake pipe 211 and the return pipe connection part 330 connecting to the return pipe 220 respectively. An opening is formed on the sidewall of the fluid chamber 310 for connecting the intake copper pipe 212 to the intake copper pipe connection part 340. The return copper pipe 222 can connect directly to the flexible return pipe 221 or through the return pipe connection part 330. Figure 6 shows a schematic diagram of the connection of the diversion connector on the cabinet side, where the arrows represent the direction of the refrigerant flow. During the refrigeration process, the refrigerant flows from the intake copper pipe 212 to space between the flexible return pipe 221 and the fluid chamber 310, then flow into between the flexible intake pipe 211 and the flexible return pipe 221 directly. The refrigerant in flexible return pipe 221 can flow directly into return copper pipe 222 connected to it.

[0056] The return pipe connection part 330 can include a connecting pipe sleeve 331 placed on one side of fluid chamber 310. The flexible return pipe 221 passes through the fluid chamber 310 and is placed inside the connecting pipe sleeve 331. The flexible return pipe 221 and the connecting pipe sleeve 331 have an interference fit, and the return copper pipe 222 can be placed inside the flexible return pipe 221 with an interference fit as well. Specifically, both the return copper pipe 222 and the flexible return pipe 221 can be placed inside the connecting pipe sleeve 331, the return copper pipe 222 can be placed inside the flexible return pipe 221. The arrangement from outside to inside is the connecting pipe sleeve 331, the flexible return pipe 221, and the return copper pipe 222, and they are interference fit with each other through mechanical compression.

[0057] The flexible intake pipe connection part 320 includes a threaded connecting sleeve 321, one end of the threaded connecting sleeve 321 mating with the flexible intake pipe 211, and the other end threaded to the outer wall of the fluid chamber 310. In this embodiment, the threaded connecting sleeve 321 can mate with the flexible intake pipe 211 directly or through threaded connection. The end of the flexible intake pipe 211 and the threaded connecting sleeve 321 are both mounted on the outer wall of the fluid chamber 310, the outer wall of the fluid chamber 310 is provided with external threads, the threaded connecting sleeve 321 is provided with internal threads. During installation, the flexible intake pipe 211 can be connected to the diversion connector 300 by the threaded connecting sleeve 321. The intake copper pipe connection part 340 can be an opening on a side wall of the fluid cavity 310, and the intake copper pipe 212 can be directly bonded to the intake copper pipe connection part 340 using metal adhesive. Furthermore, in one embodiment of the present application, the diversion connector 300 on the cabinet side is located in the compressor compartment on the cabinet side. In this embodiment, both the flexible intake pipe 211 and the flexible return pipe 221 pass out from the hinge axis 132 on

the door side and through the pipe port 111 on the cabinet 110, then through the thermal insulation layer of the cabinet 110 and into the compressor compartment on the cabinet side. Inside the compressor compartment, the flexible intake pipe 211 and the flexible return pipe 221 connect to the intake copper pipe 212 and the return copper pipe 222 through the diversion connector 300.

[0058] In this embodiment, only one refrigerant pipe needs to be installed through the interior of the cabinet 110 during the manufacturing process, which simplifies the manufacturing process. The return pipe 220 is placed inside the intake pipe 210 and directly enters the foam layer through the pipe port 111 on the cabinet 110. There are no parts of the return pipe 220 exposed on the exterior, so there is no risk of condensation, and no additional structures are required.

[0059] In another embodiment of the present application, the cabinet 110 is provided with a pipeline accommodation groove 112 and a thermal insulation cover 113 that seals the pipeline accommodation groove 112. The diversion connector 300 is located inside the pipeline accommodation groove 112. Both the intake copper pipe 212 and the return copper pipe 222 pass through the thermal insulation layer of the cabinet 110 from the compressor compartment, enter the pipeline accommodation groove 112 through the pipe port 111, and connect to the diversion connector 300. Both the flexible return pipe 221 and the flexible intake pipe 211 extend from the hinge axis 132 on the door side to the cabinet side and connect to the diversion connector 300.

[0060] In this embodiment, the length of the flexible return pipe 221 and the flexible intake pipe 211 is reduced, which can lower costs. However, condensation may occur at the diversion connector 300. Therefore, by setting the pipeline accommodation groove 112 on the cabinet 110 and sealing it with the thermal insulation cover 113, and placing the diversion connector 300 inside the pipeline accommodation groove 112, condensation at the diversion connector 300 can be avoided.

[0061] It should be understood that although the present application has been described in accordance with the embodiments, not every embodiment contains only one independent technical solution. The description in the specification is merely for clarity, and those skilled in the art should consider the specification as a whole. The technical solutions in the various embodiments may also be appropriately combined to form other embodiments that can be understood by those skilled in the art.

[0062] The series of detailed explanations listed above are merely specific descriptions of feasible embodiments of the present application and are not intended to limit the scope of protection of the present application. Any equivalent embodiments or changes made without departing from the spirit of the present application should be comprised within the scope of protection of the present application.

Claims

1. A refrigerator, comprising:

   a cabinet;
   a door, wherein the door is pivotally connected to the cabinet via a hinge;
   a refrigeration system, which comprises a compressor, a condenser, and a door evaporator connected in sequence, wherein the compressor and the condenser are located on the cabinet side, and the door evaporator is located inside the door; the condenser is connected to the door evaporator via an intake pipe, and the door evaporator is connected to the compressor via a return pipe;
   characterized in that, the cabinet is provided with a pipe port, and the return pipe passes through the pipe port into a thermal insulation layer of the cabinet after passing out of a hinge axis on the door side;
   the refrigerator further comprises a thermally insulated hinge cover plate, wherein the hinge cover plate at least covers the return pipe between the hinge axis and the pipe port.

2. The refrigerator according to claim 1, **characterized in that** the refrigeration system further comprises a capillary tube, which is located on the door side and positioned between the condenser and the door evaporator.

3. The refrigerator according to claim 1, **characterized in that** the intake pipe passes through the pipe port into the thermal insulation layer of the cabinet after passing out of the hinge axis on the door side, and the hinge cover plate at least covers the intake pipe between the hinge axis and the pipe port.

4. The refrigerator according to claim 1, **characterized in that** the cabinet comprises an outer shell and an inner liner, the thermal insulation layer is located between the outer shell and the inner liner, and the inner liner forms a storage compartment.

5. The refrigerator according to claim 3, **characterized in that** the return pipe between the hinge axis on the door side and the pipe port comprises a flexible return pipe, and the intake pipe between the hinge axis on the door side and the pipe port comprises a flexible intake pipe, wherein the flexible return pipe is placed inside the flexible intake pipe.

6. The refrigerator according to claim 1, **characterized in that** the return pipe between the hinge axis on the door side and the pipe port comprises a flexible return pipe, and a wall of the flexible return pipe is embedded with a heating wire.

7. The refrigerator according to claim 1, **characterized in that** the hinge cover plate comprises a hinge shell and a thermal insulation foam fixed to the inside of the hinge shell.

8. The refrigerator according to claim 3, **characterized in that** an axis of the pipe port is parallel to an axis of the hinge axis, and the hinge cover plate covers both the hinge axis and the pipe port.

9. The refrigerator according to claim 8, **characterized in that** the cabinet side is provided with a compressor compartment for installing the compressor, and the return pipe comprises a flexible return pipe and a return copper pipe, wherein the flexible return pipe passes out of the hinge axis on the door side, passes through the pipe port, enters the thermal insulation layer of the cabinet, and then enters the compressor compartment to connect with the return copper pipe.

10. The refrigerator according to claim 9, **characterized in that** the intake pipe comprises a flexible intake pipe and an intake copper pipe, wherein the flexible intake pipe passes through the pipe port from the hinge axis on the door side and enters into the thermal insulation layer of the cabinet and enters into the compressor compartment through the thermal insulation layer of the cabinet to connect with the intake copper pipe.

11. The refrigerator according to claim 3, **characterized in that** the cabinet side is provided with a compressor compartment for installing the compressor, and the return pipe comprises a flexible return pipe and a return copper pipe, wherein the return copper pipe passes through the thermal insulation layer of the cabinet from the compressor compartment and passes out from the pipe port, and the flexible return pipe passes out from the hinge axis and extends to the cabinet side to connect with the return copper pipe.

12. The refrigerator according to claim 11, **characterized in that** the intake pipe comprises an flexible intake pipe and an intake copper pipe, wherein the intake copper pipe passes through the thermal insulation layer of the cabinet from the compressor compartment and passes out from the pipe port, and the intake copper pipe passes out from the hinge axis and extends to the cabinet side to connect with the intake copper pipe; the cabinet is provided with a pipeline accommodation groove and a thermal insulation cover that closes the pipeline accommodation groove; the pipe port is located inside the pipeline accommodation groove, and an interface between the flexible intake pipe and the intake copper pipe and an interface between the flexible return pipe and the return copper pipe are located inside the pipeline accommodation groove.

13. The refrigerator according to claim 12, **characterized in that** the thermal insulation cover is integrally formed with the hinge cover plate, and the thermal insulation cover is a part of the hinge cover plate.

14. The refrigerator according to claim 1, **characterized in that** the storage compartment formed inside the cabinet comprises a refrigeration compartment and a freezing compartment, a refrigeration door for opening and closing the refrigeration compartment is provided with an ice-making compartment, and the door evaporator is located inside the ice-making compartment.

15. The refrigerator according to claim 1, **characterized in that** the hinge cover plate is provided with a guide groove for accommodating the return pipe.

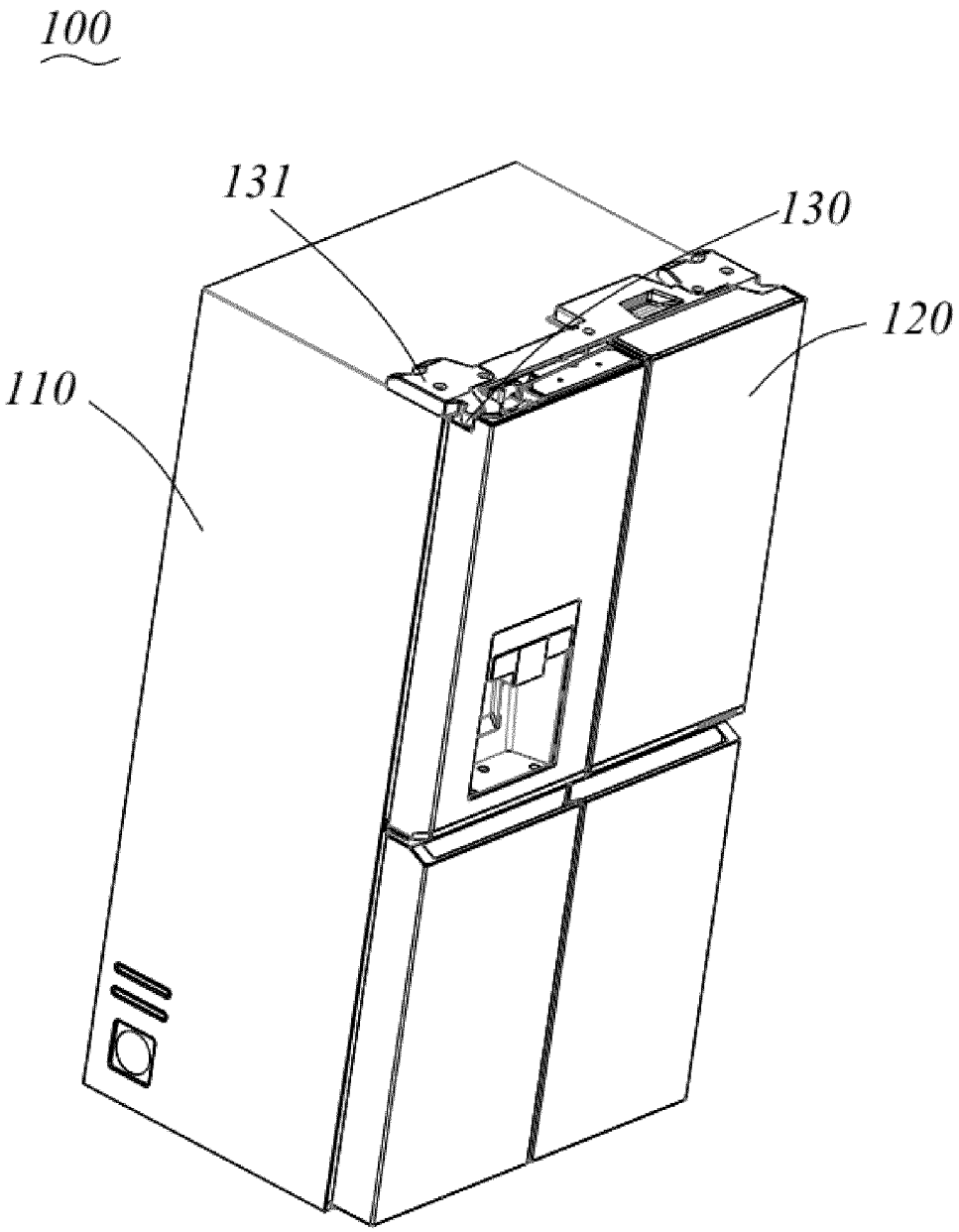

FIG.1

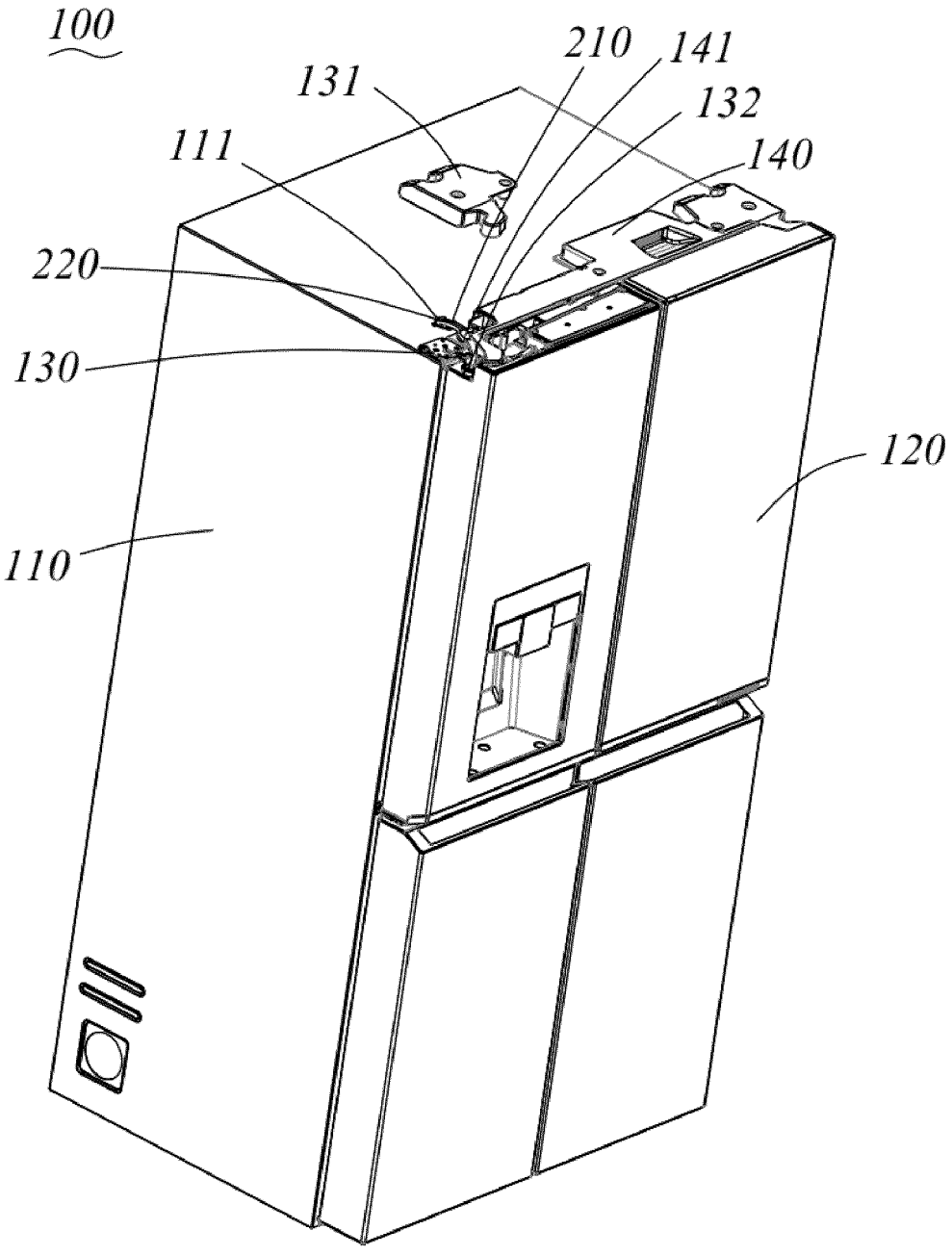

FIG.2

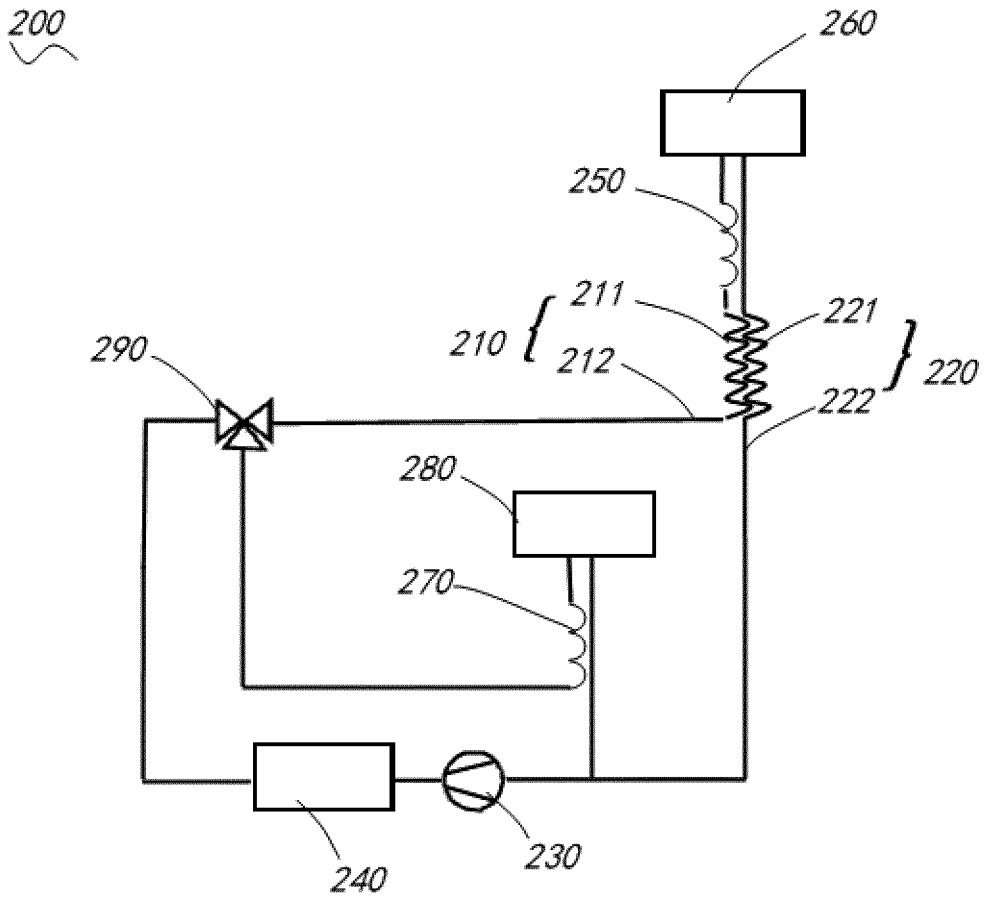

FIG.3

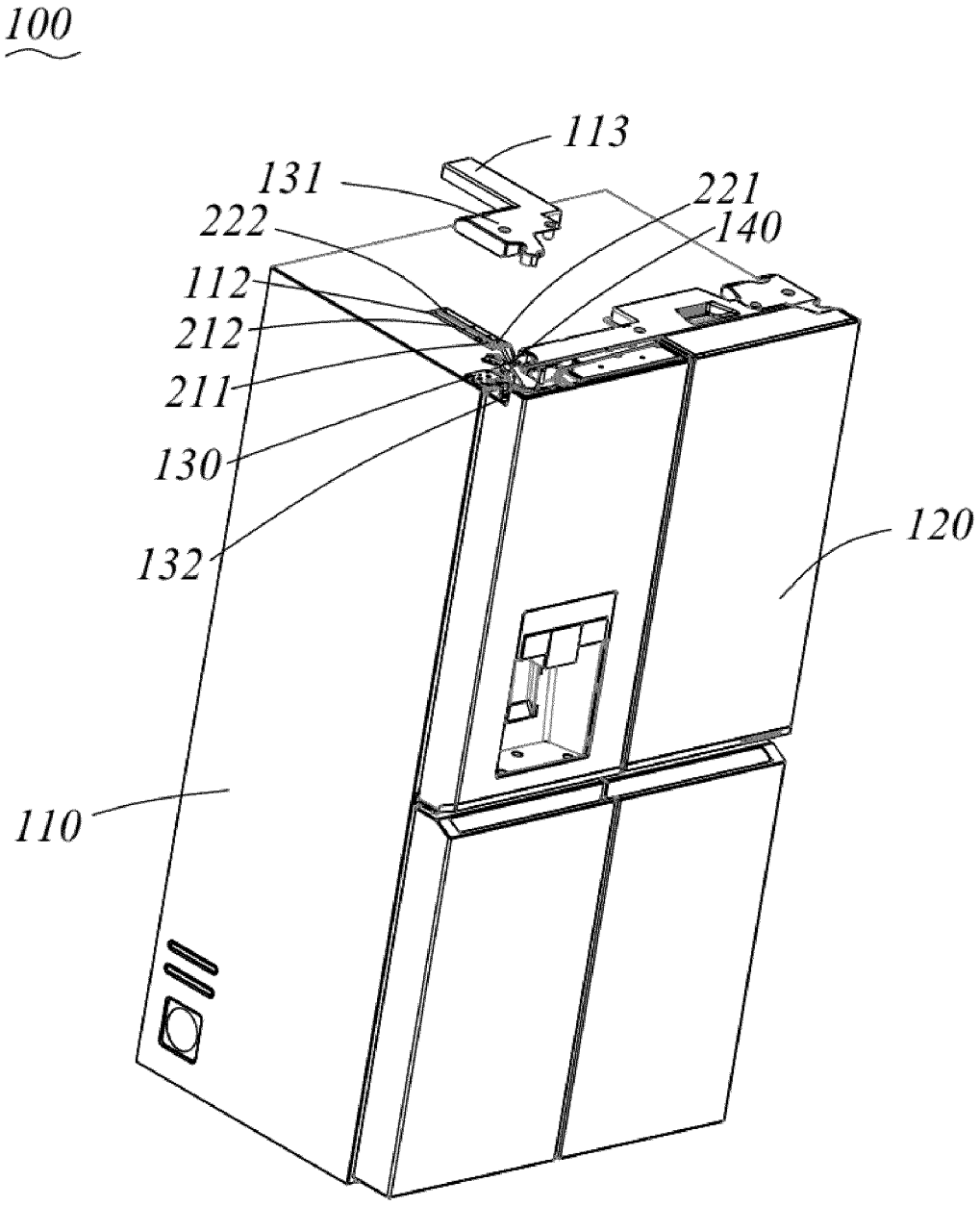

FIG.4

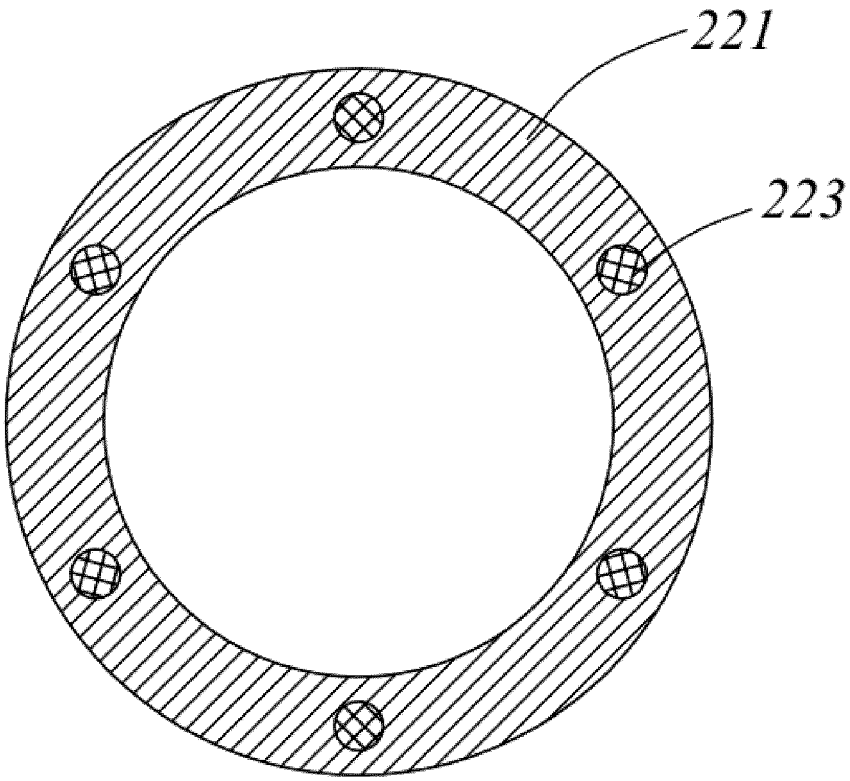

FIG.5

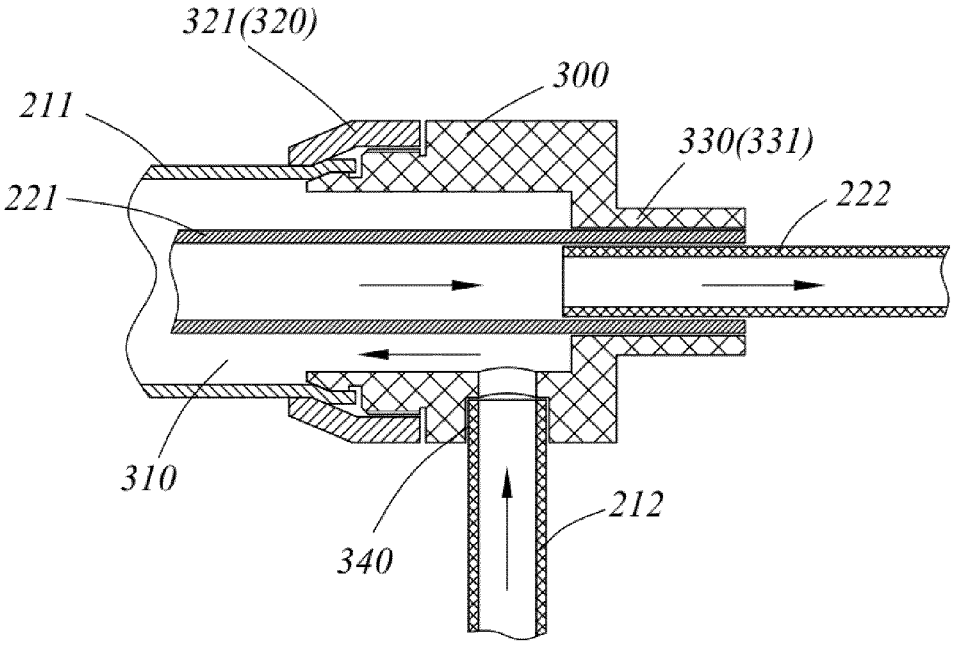

FIG.6

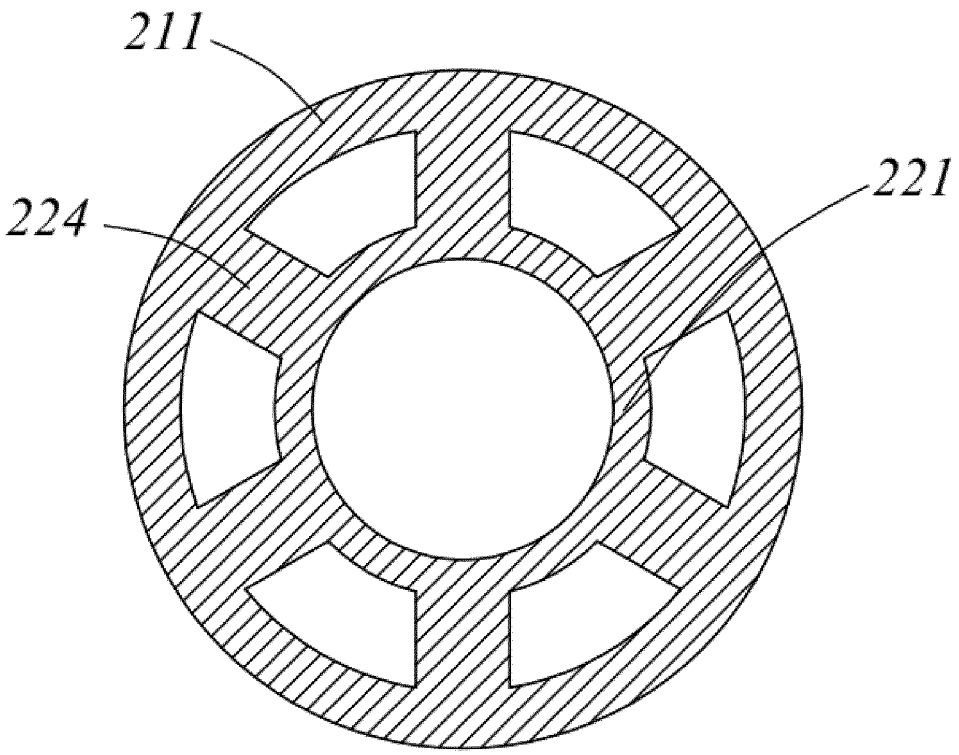

FIG.7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/130926

A. CLASSIFICATION OF SUBJECT MATTER

F25D11/02(2006.01)i;F25D23/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F25D E05D

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

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

CNABS, CNTXT, CNKI, DWPI: 门 铰链 管 隔热 绝热 保温 加热 door hinge tube pipe conduit insulat+ heat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 207778907 U (QINGDAO HAIER CO., LTD.) 28 August 2018 (2018-08-28) description, paragraphs [0048]-[0083], and figures 1-7	1-4, 6-15
Y	CN 113048693 A (QINGDAO HAIER REFRIGERATOR CO., LTD.; HAIER SMART HOME CO., LTD.) 29 June 2021 (2021-06-29) description, paragraphs [0023]-[0045], and figures 1-6	1-4, 6-15
Y	CN 113623917 A (QINGDAO HAIER INTELLIGENT TECHNOLOGY RESEARCH AND DEVELOPMENT CO., LTD.; HAIER SMART HOME CO., LTD.) 09 November 2021 (2021-11-09) description, paragraphs [0036]-[0062], and figures 1-7	9-13
A	CN 113482473 A (QINGDAO HAIER REFRIGERATOR CO., LTD.; HAIER SMART HOME CO., LTD.) 08 October 2021 (2021-10-08) entire document	1-15
A	US 2010147007 A1 (FROELICHER STEVE B.; DAVIS MATTHEW WILLIAM; JESSIE JEFFREY LYNN; KURHEKAR AMIT; MILLER JOSEPH MURPHY; ROETKER JOHN JOSEPH; TARR RONALD SCOTT; WATKINS DEREK LEE;) 17 June 2010 (2010-06-17) entire document	1-15

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
29 January 2023	**11 February 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/130926

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017292750 A1 (DONGBU DAEWOO ELECTRONICS CORP.) 12 October 2017 (2017-10-12) entire document	1-15

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/130926

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 207778907 U	28 August 2018	None	
CN 113048693 A	29 June 2021	None	
CN 113623917 A	09 November 2021	None	
CN 113482473 A	08 October 2021	None	
US 2010147007 A1	17 June 2010	US 8136367 B2	17 June 2010
US 2017292750 A1	12 October 2017	EP 3232140 A2	18 October 2017
		EP 3232140 A3	18 October 2017
		US 10119740 B2	12 October 2017
		KR 20170116493 A	19 October 2017
		KR 101883436 B1	19 October 2017

Form PCT/ISA/210 (patent family annex) (July 2022)