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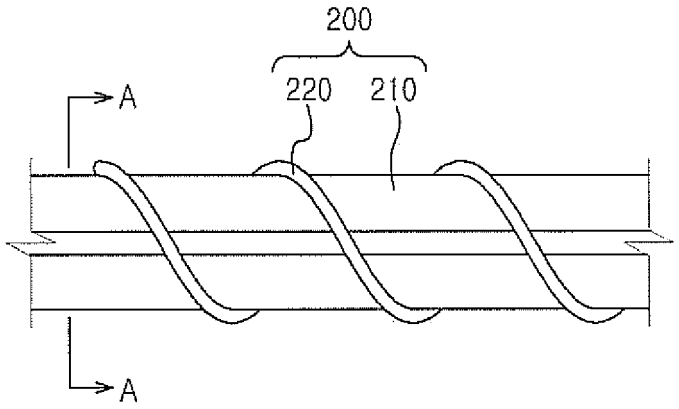
(54) ICE MAKING DUCT FOR REFRIGERATOR AND ICE MAKING METHOD OF USING THE SAME

(57) An ice making duct (200) for a refrigerator (1) and an ice making method using the same are disclosed. The ice making duct (200) for a refrigerator (1) comprises a cooling duct (210) configured to allow cooling air to flow in a longitudinal direction therein, and to have both ends connected to the ice making compartment (110) such that the cooling air circulates to the ice making compartment (110), an evaporation coil (220) installed to be wound around the cooling duct (210) and configured to cool air by heat exchange with a refrigerant, and a heat transfer fin provided within the cooling duct (210).

FIG. 1



EP 3 106 784 A1

Description

Related Applications

[0001] This application is based on and claims priority to Korean Patent Application No. 10-2015-0085324, filed on June 16, 2015 for inventor Min Bon Koo. The disclosure of this application is incorporated herein in its entirety by reference.

Field of the Invention

[0002] The present invention relates to an ice making duct for a refrigerator and an ice making method using the same.

Background of the Invention

[0003] A refrigerator is an appliance that serves to store food at low temperatures; it may be configured to store food at temperatures below freezing or at low but above freezing temperatures.

[0004] The temperature inside the refrigerator is maintained at the desired level by cool air that is continuously supplied to the refrigerator. The cool air is continuously produced by a heat exchange operation between air and a refrigerant performed in a refrigeration cycle comprising four sequential phases: compression, condensation, expansion, and evaporation. Cool air is channeled to the inside of the refrigerator and is evenly distributed inside the refrigerator by convection.

[0005] The body of a refrigerator typically has a rectangular hexahedral shape that opens frontward, with a refrigerator compartment and a freezer compartment defined and isolated from one another within the refrigerator body. The open front of the refrigerator body may comprise both a refrigerator compartment door and a freezer compartment door that can open or close the refrigerator compartment and the freezer compartment, respectively. The storage space defined inside the refrigerator may comprise a plurality of drawers, shelves, and boxes designed to store various kinds of food in various optimal states.

[0006] In the related art, a top mount type refrigerator in which the freezer compartment is provided in the upper part of the refrigerator body and the refrigerator compartment is provided in the lower part of the refrigerator body is well known. However, in recent years, for greater convenience to users, a bottom freezer type refrigerator in which the freezer compartment is provided in the lower part of the refrigerator body has been proposed and used. The bottom freezer type refrigerator may be preferable since the more frequently used refrigerator compartment is located in the upper part of the refrigerator body and the less frequently used freezer compartment is located in the lower part of the refrigerator body. However, the bottom freezer type refrigerator is problematic in that to take ice cubes from the freezer compartment, a user must open the freezer compartment door and collect ice cubes while bending.

[0007] In an effort to solve the problem, in recent years, a refrigerator in which an ice dispenser for dispensing ice cubes is provided in a refrigerator compartment door placed in the upper part of a bottom freezer type refrigerator has been proposed and used. In such a refrigerator, an ice making device for making ice cubes may be provided in the refrigerator compartment door or inside the refrigerator compartment.

[0008] For example, in the bottom freeze type refrigerator in which the ice making device is installed in the refrigerating compartment door, air (cooling air) cooled by an evaporator is separately discharged to the freezing compartment and the refrigerating compartment. The cooling air discharged to the freezing compartment side flows to the ice making device along a cooling air supply duct embedded in a sidewall of a main body of the refrigerator and subsequently freezes water, while flowing within the ice making device. Thereafter, the cooling air within the ice making device is discharged to the refrigerating compartment through a cooling air reducing duct embedded in the sidewall of the main body of the refrigerator, lowering an internal temperature of the refrigerating compartment.

[0009] However, since the cooling air of the freezing compartment is channeled to the ice making device via the cooling air supply duct and the cooling air reducing duct, the supply efficiency of the cooling air may be suboptimal.

[0010] In addition, since the cooling air of the freezing compartment side should be moved to the ice making device of the refrigerating compartment door, when the refrigerator is continuously operated, power consumption may increase significantly.

Summary of the Invention

[0011] In view of the above, embodiments of the present invention provide an ice making duct for a refrigerator in which air cooled in a cooling air duct can be directly used to generate ice.

Brief Description of the Drawings

[0012] The above and other aspects and features of the present invention will become apparent from the following description of embodiments, given in conjunction with the accompanying drawings, in which:

Fig. 1 is a view illustrating a configuration of an ice making duct of a refrigerator in accordance with an embodiment of the present invention;

Fig. 2 is a cross-sectional view taken along line A-A of Fig. 1;

Fig. 3 is a block diagram illustrating a refrigerating cycle of the ice making duct of the refrigerator in accordance with an embodiment of the present inven-

tion;

Fig. 4 is a perspective view illustrating the refrigerator in accordance with an embodiment of the present invention;

Fig. 5 is a view illustrating a state of connection between an ice making compartment and a cooling duct in the refrigerator in accordance with an embodiment of the present invention;

Fig. 6 is a view illustrating an internal configuration of the ice making compartment of the refrigerator in accordance with an embodiment of the present invention; and

Fig. 7 is a flowchart illustrating an ice making method using an ice making duct of a refrigerator in accordance with an embodiment of the present invention.

Detailed Description of the Embodiments

[0013] Hereinafter, embodiments of the present invention will be described in detail with the accompanying drawings.

[0014] As illustrated in Figs. 1 to 4, an ice making duct 200 of the refrigerator in accordance with an embodiment of the present invention may generate ice using air cooled in a cooling duct 210.

[0015] The refrigerator 1 may include a main body 10, a barrier 20 that separates the inside of the main body 10 into a refrigerating compartment and a freezing compartment, a refrigerating compartment door 30 for selectively closing the refrigerating compartment on both edges of a front surface of the main body 10, and a freezing compartment door 40 for closing a front opening of the freezing compartment. The refrigerator 1 in accordance with this embodiment is a bottom freeze type refrigerator in which the freezing compartment is positioned in a lower portion thereof, but the present invention is not limited thereto and may be applied to various types of refrigerators.

[0016] The ice making duct 200 may include a cooling duct 210 in which cooling air can flow in a longitudinal direction, an evaporation coil 220 for cooling the cooling duct 210 through conduction, and heat transfer fins provided within the cooling duct 210.

[0017] The cooling duct 210 may include a cooling channel 211, a first duct hole 212, and a second duct hole 213.

[0018] The cooling channel 211, a passage in which cooling air flows, may extend in a longitudinal direction within the cooling duct 210. In particular, the cooling channel 211 has a length sufficient for cooling air; thus, the air, while moving in the cooling channel 211 for a predetermined period of time, may be cooled to a temperature suitable to make ice.

[0019] Further, the first duct hole 212 may be provided at one end of the cooling channel 211 to supply the cooling air to the ice making compartment 110, and the second duct hole 213 may be provided at the other end of the cooling channel 211 to receive the cooling air from the ice making compartment 110. For example, the first duct hole 212 may be connected to an upper portion of the ice making compartment 110 and the second duct hole 213 to a lower portion of the ice making compartment 110, and the cooling air within the cooling duct 210 may move from a lower end of the cooling duct 210 to an upper end thereof.

[0020] The cooling duct 210 may extend to be bent in a vertical direction of the main body 10 such that the cooling duct 210 is sloped in a forward direction of the main body 10 within the main body 10. For example, the cooling duct 210 may be bent to have a "C" shape in a forward direction of the main body 10.

[0021] In this manner, since the cooling duct 210 is bent to have a "C" shape, when defrosted water is generated within the cooling duct 210, the defrosted water may move to the lowermost portion of the cooling duct 210 and may be subsequently discharged to the outside through a separate draining device (not shown).

[0022] The cooling duct 210 is installed in the main body 10 of the refrigerator 1, and the ice making compartment 110 is provided within the refrigerating compartment door 30 of the refrigerator 1. The first duct hole 212 and the second duct hole 213 of the cooling duct 210 may be selectively connected to an inlet 310 and an outlet 320 of the ice making compartment 110, respectively, depending on the open or closed state of the refrigerating compartment door 30.

[0023] That is, when the refrigerating compartment door 30 is closed, cooling air within the cooling duct 210 may be introduced to the inlet 310 of the ice making compartment 110 through the first duct hole 212, and the cooling air introduced to the ice making compartment 110 may circulate within the ice making compartment 110 to freeze water within the ice making compartment 110 to make ice. Thereafter, the cooling air within the ice making compartment 110 may be discharged to the second duct hole 213 of the cooling duct 210 through the outlet 320, and the cooling air discharged from the ice making compartment 110 may be re-cooled in the cooling duct 210 and then introduced again to the inlet 310 of the ice making compartment 110.

[0024] The evaporation coil 220 may cool air within the cooling duct 210 by heat exchange with a refrigerant. To this end, the evaporation coil 220 is installed to be wound around the cooling duct 210, and thus, when the refrigerant circulates, depending on the refrigerating cycle, the evaporation coil 220 may cool the cooling duct 210 through conduction.

[0025] The evaporation coil 220 may serve as an evaporator of the refrigerating cycle. For example, the evaporation coil 220 may implement the refrigerating cycle including a process of compression-condensation-expansion-evaporation, together with a compressor 11, a condenser 12, and an expansion valve 13.

[0026] In this embodiment, the configuration of the compressor 11, the condenser 12, the expansion valve 13, and the evaporation coil 220 are provided as a refrig-

erating cycle for providing cooling air to the ice making compartment 110, but the configuration may also provide the cooling air to the refrigerating compartment and the freezing compartment of the refrigerator as well. In addition, the configuration of the compressor 11, the condenser 12, and the expansion valve 13 may also share a refrigerant with an evaporator (not shown) for providing cooling air to the refrigerating compartment and the freezing compartment.

[0027] The heat transfer fins may be formed of a plurality of radiating fins that protrude inside the cooling duct 210. The plurality of radiating fins may be arranged to be spaced apart at predetermined intervals within the cooling duct 210.

[0028] The heat transfer fins serve to increase an area in which heat is exchanged between air moving in the cooling channel 211 within the cooling duct 210 and a refrigerant moving in the evaporation coil 220, thereby effectively transferring cold and heat from the refrigerant to the air.

[0029] Fig. 5 is a view illustrating a state of connection between the ice making compartment and the cooling duct in the refrigerator in accordance with an embodiment of the present invention. Fig. 6 is a view illustrating an internal configuration of the ice making compartment of the refrigerator in accordance with an embodiment of the present invention.

[0030] As illustrated in Figs. 5 and 6, the ice making compartment 110 may be provided in the refrigerating compartment door 30 of the refrigerator 1. In this embodiment, a case in which the ice making compartment 110 is provided in an upper portion of the refrigerating compartment door 30 is presented as an example, but this is merely illustrative and the ice making compartment 110 may be installed in other position of the refrigerating compartment door 30.

[0031] The ice making compartment 110 may provide an ice making space 111 in which ice is generated. In addition, an ice maker 120, an ice bank 130, and a circulation fan 330 may be provided within the ice making compartment 110.

[0032] The ice maker 120 may freeze water using cooling air channeled to the ice making space 111 and dispense the ice to the ice bank 130. The ice bank 130 may be positioned below the ice maker 120 from which it is dispensed, and the ice bank 130 may store the dispensed ice and provide the ice to a user through a dispenser unit (not shown). The circulation fan 330 may move the cooling air from the inlet 310 to the outlet 320.

[0033] Fig. 7 is a flowchart illustrating an ice making method using an ice making duct of a refrigerator in accordance with an embodiment of the present invention.

[0034] As illustrated in Fig. 7, the ice making method of the refrigerator in accordance with an embodiment of the present invention may include the steps of supplying a refrigerant to an evaporation coil (step S100), supplying air to a cooling duct with the evaporation coil wound therearound (step S200), cooling the air by heat transfer fins provided within the evaporation coil (step S300), supplying the cooling air to an ice making compartment for generating ice (step S400), discharging the cooling air within the ice making compartment to the cooling duct (step S500), and re-cooling the discharged cooling air in the cooling duct (step S600).

[0035] In step S100 of supplying a refrigerant to the evaporation coil, a refrigerant of a refrigerating cycle may be supplied to the evaporation coil. Here, the evaporation coil may form a refrigerating cycle including a process of compression-condensation-expansion-evaporation, together with a compressor, a condenser, and an expansion valve.

[0036] In step S200 of supplying air to the cooling duct with the evaporation coil wound therearound, air may be supplied to the cooling duct to cool the air. The air supplied to the interior of the cooling duct may move from a lower end to an upper end of the cooling duct.

[0037] In step S300 of cooling air by heat transfer fins provided within the evaporation coil, air is moved within the cooling duct around which an evaporation coil is wound so as to be cooled.

[0038] Air within the cooling duct may move along a cooling channel, in which the heat transfer fins protrude, while being exchanged with the refrigerant of the evaporation coil for a predetermined period of time. As a result, the air discharged from the cooling duct may be cooled to a temperature (e.g., 14 degrees or lower below zero) suitable to make ice.

[0039] In step S400 of supplying cooling air to the ice making compartment to generate ice, the air cooled in the cooling duct may be supplied to an ice making space of the ice making compartment through an inlet of the ice making compartment. The cooling air introduced into the ice making space may circulate in the ice making space through the operation of a circulation fan, freezing water within the ice making space.

[0040] In step S500 of discharging cooling air from the ice making compartment to the cooling duct, the cooling air within the ice making space may be discharged to the cooling duct through an outlet of the ice making compartment.

[0041] In step S600 of re-cooling the discharged cooling air in the cooling duct, the cooling air introduced to the cooling duct is moved again along the cooling channel of the cooling duct for a predetermined period of time so as to be re-cooled to a temperature lower than necessary for making ice.

[0042] In accordance with the embodiments of the present invention, since ice is generated using cooling air directly cooled in a cooling duct, the cooling efficiency can be enhanced and the supply efficiency of cooling air can be increased.

[0043] In addition, in accordance with the embodiments of the present invention, since cooling air circulates between the cooling duct and an ice making space of the refrigerator door for a short period of time, the loss of cooling air can be effectively reduced and power con-

sumption can also be reduced.

[0044] While the invention has been shown and described with respect to the embodiments, the present invention is not limited thereto. It will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. An ice making duct for a refrigerator, comprising:

a cooling duct configured to allow cooling air to flow in a longitudinal direction therein, and to have both ends connected to the ice making compartment such that the cooling air circulates to the ice making compartment;
an evaporation coil installed to be wound around the cooling duct and configured to cool air by heat exchange with a refrigerant; and
a heat transfer fin provided within the cooling duct.

2. The refrigerator of claim 1, wherein a plurality of heat transfer fins are arranged to be spaced apart within the cooling duct.

3. The refrigerator of claim 2, wherein a first duct hole is connected to an upper portion of the ice making compartment and a second duct hole is connected to a lower portion of the ice making compartment.

4. The refrigerator of claim 1, wherein the cooling duct comprises:

a cooling channel configured to extend in a longitudinal direction within the cooling duct such that the cooling air can flow;
a first duct hole provided at one end of the cooling channel to supply the cooling air to the ice making compartment; and
a second duct hole provided at another end of the cooling channel to receive the cooling air from the ice making compartment; and

5. The refrigerator of claim 1, wherein the cooling duct is configured to extend to be bent in a vertical direction of the main body such that the cooling duct is sloped in a forward direction of the main body of the refrigerator within a main body of a refrigerating compartment.

6. The refrigerator of claim 1, wherein the cooling duct is installed in the main body of the refrigerator and the ice making compartment is installed in a refrigerating compartment door of the refrigerator, and wherein one end portion and the other end portion of the cooling duct are selectively connected to the ice making compartment depending on the opened or closed status of the refrigerating compartment door.

7. The refrigerator of claim 1, wherein the evaporation coil is configured to serve as an evaporator of a refrigerating cycle and to cool the cooling duct through conduction.

8. An ice making method using an ice making duct of a refrigerator, the method comprising:

supplying a refrigerant to an evaporation coil;
supplying air to a cooling duct with the evaporation coil wound therearound;
cooling the air via heat transfer fins provided within the evaporation coil such that heat is exchanged between the air and the refrigerant;
supplying the cooling air to an ice making compartment for making ice;
discharging the cooling air within the ice making compartment to the cooling duct; and
re-cooling the discharged cooling air in the cooling duct.

9. The method of claim 8, wherein, in the cooling of the air by heat exchange between the air and the refrigerant, the cooling air is moved along a cooling channel of the cooling duct for a predetermined period of time so as to be cooled to a temperature lower than a predetermined temperature.

10. An ice making duct means for a refrigerator, comprising:

a cooling duct configured to allow cooling air to flow in a longitudinal direction therein, and to have both ends connected to the ice making compartment such that the cooling air circulates to the ice making compartment;
an evaporation coil means installed to be wound around the cooling duct and configured to cool air by heat exchange with a refrigerant; and
a heat transfer fin means provided within the cooling duct.

11. The refrigerator of claim 10, wherein a plurality of heat transfer fin means are arranged to be spaced apart within the cooling duct means.

12. The refrigerator of claim 11, wherein a first duct hole is connected to an upper portion of the ice making compartment and a second duct hole is connected to a lower portion of the ice making compartment.

13. The refrigerator of claim 10, wherein the cooling duct comprises:

a cooling channel configured to extend in a longitudinal direction within the cooling duct such that the cooling air can flow;
a first duct hole provided at one end of the cooling channel to supply the cooling air to the ice making compartment; and
a second duct hole provided at another end of the cooling channel to receive the cooling air from the ice making compartment; and

14. The refrigerator of claim 10, wherein the cooling duct is configured to extend to be bent in a vertical direction of the main body such that the cooling duct is sloped in a forward direction of the main body of the refrigerator within a main body of a refrigerating compartment.

15. The refrigerator of claim 10, wherein the cooling duct is installed in the main body of the refrigerator and the ice making compartment is installed in a refrigerating compartment door of the refrigerator, and wherein one end portion and the other end portion of the cooling duct are selectively connected to the ice making compartment depending on the opened or closed status of the refrigerating compartment door.

FIG. 1

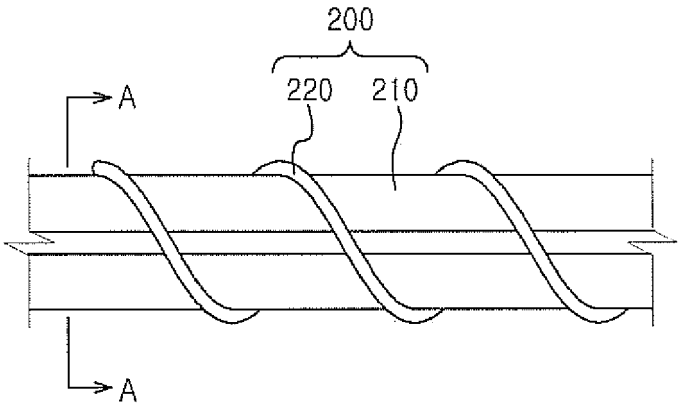


FIG. 2

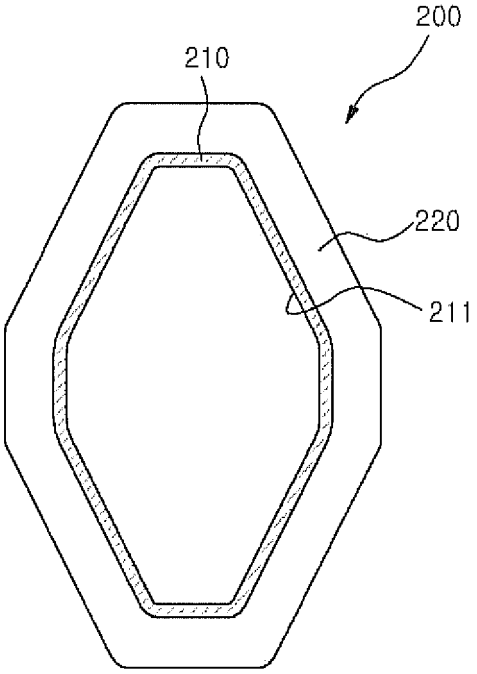


FIG. 3

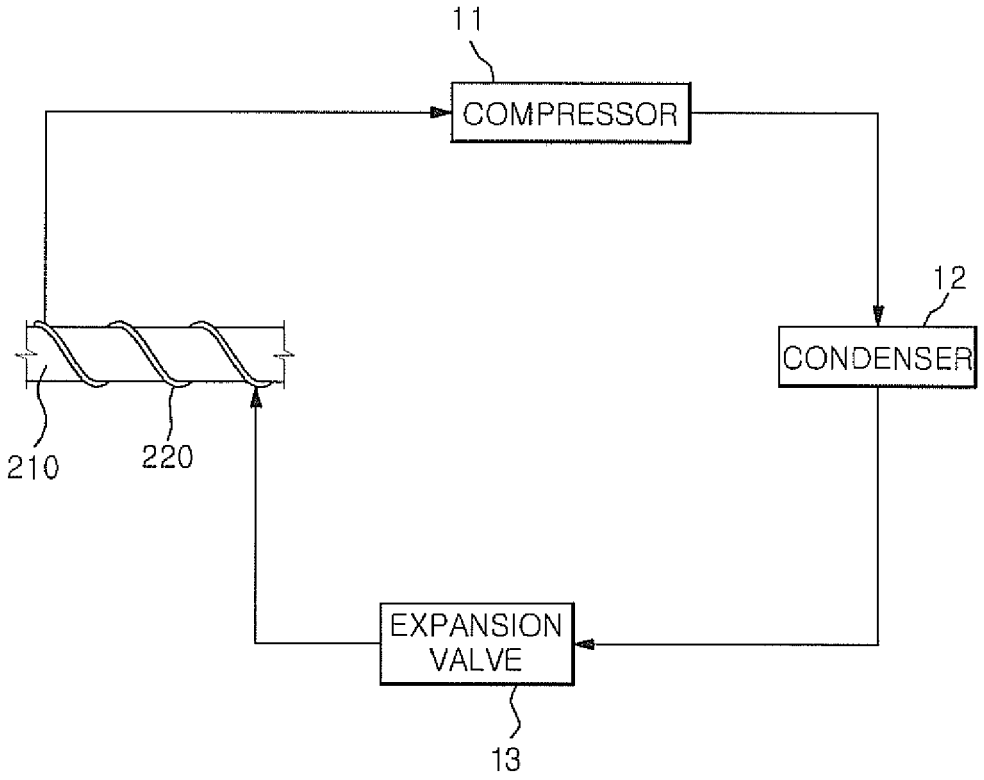


FIG. 4

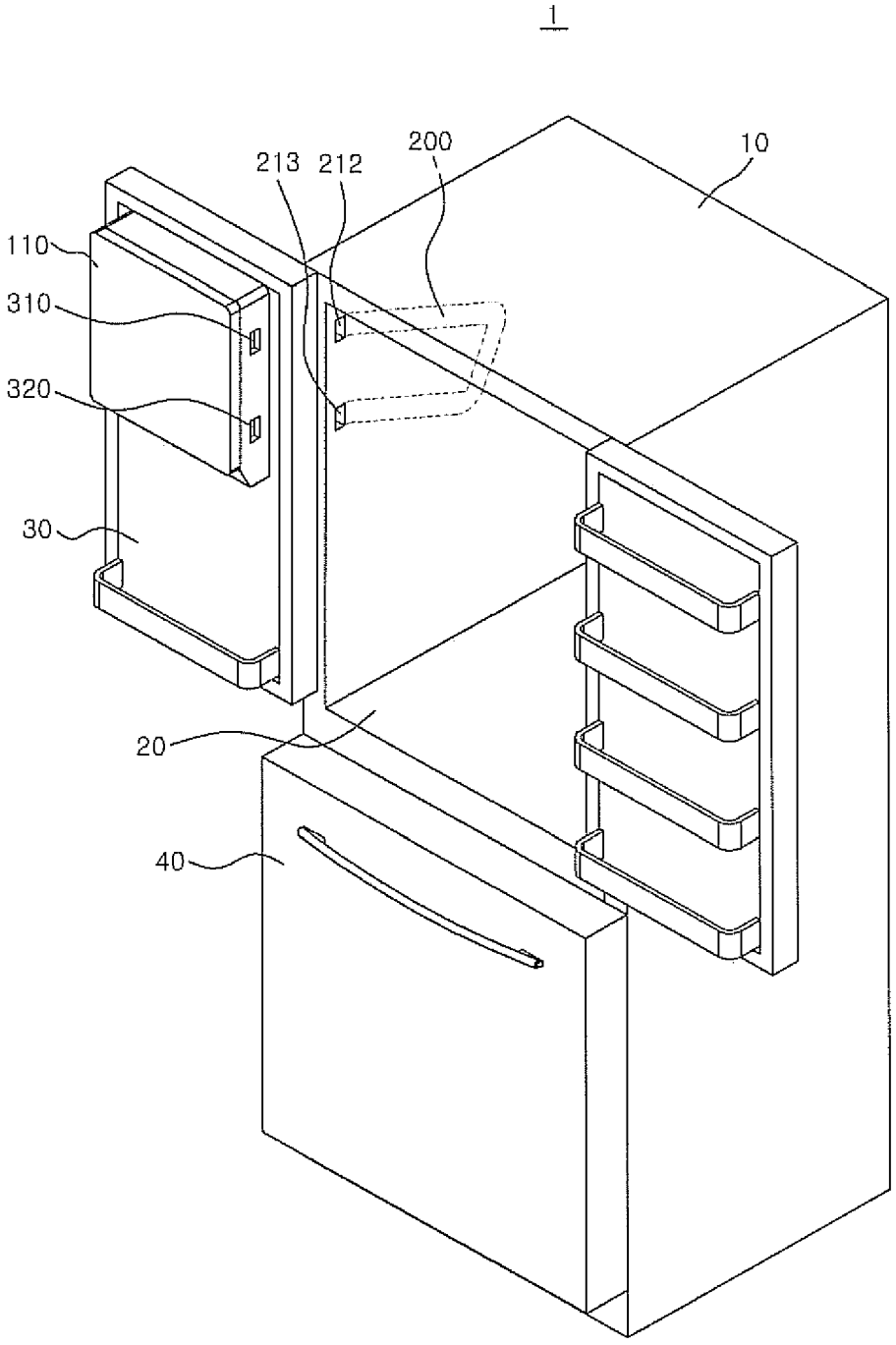


FIG. 5

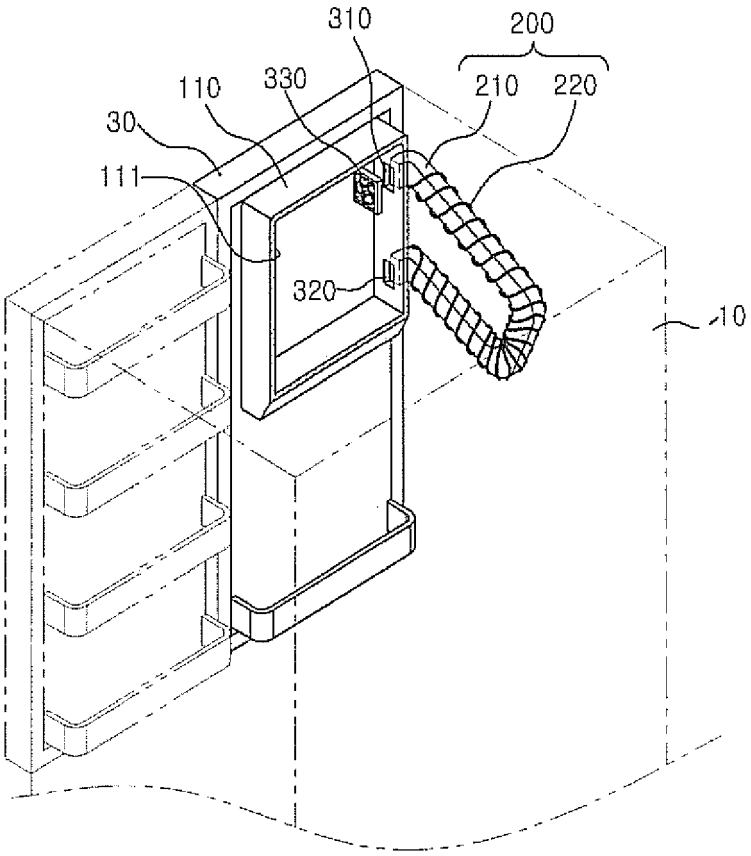


FIG. 6

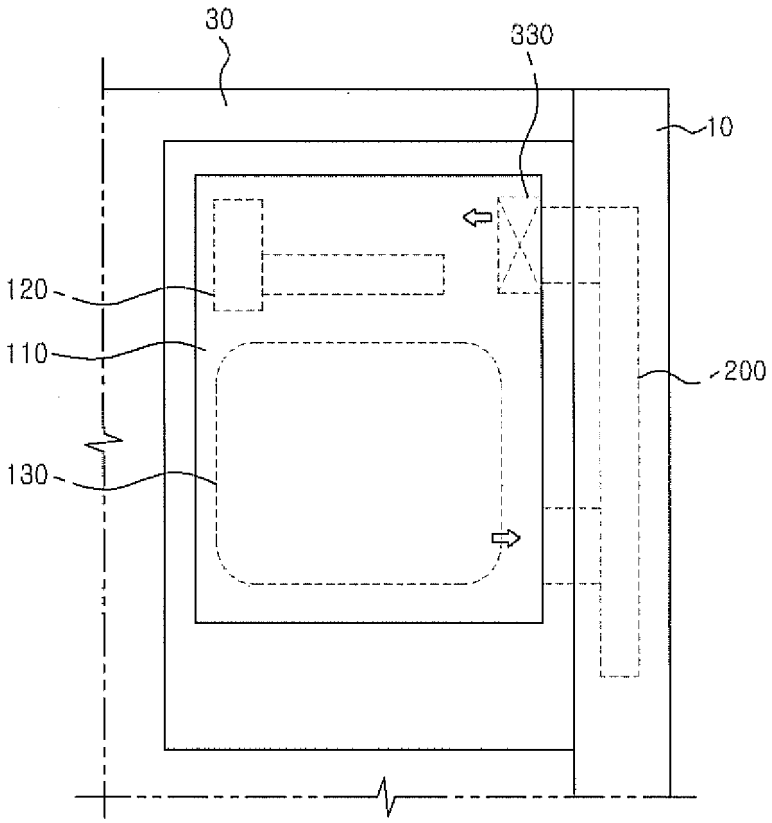
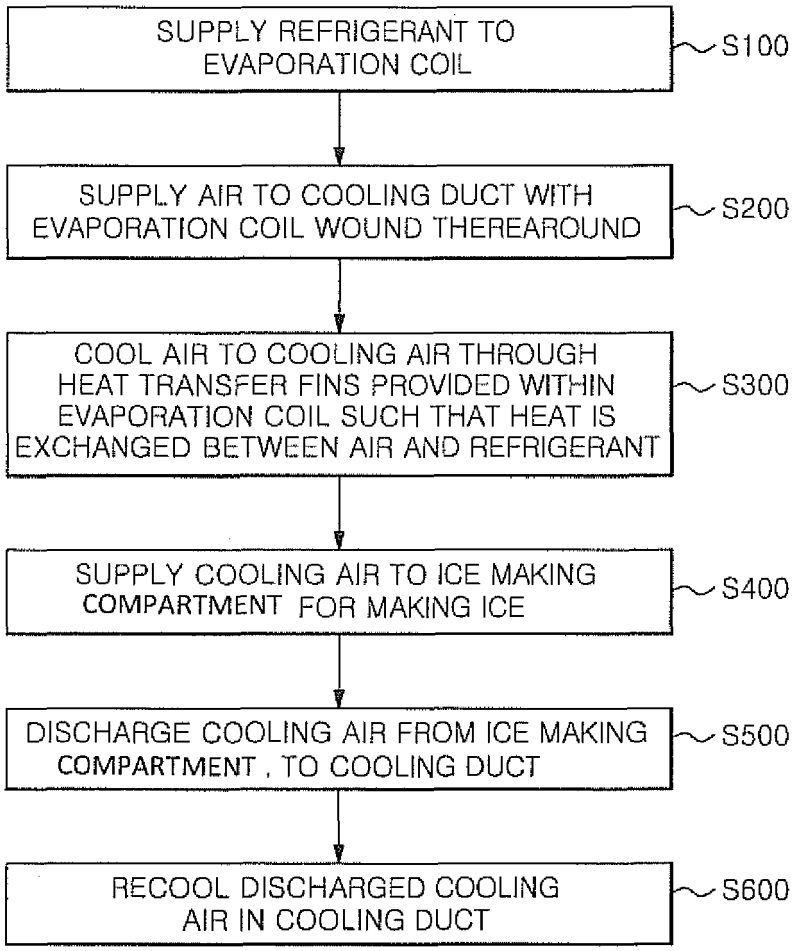


FIG. 7


SUPPLY REFRIGERANT TO EVAPORATION COIL
S100
SUPPLY AIR TO COOLING DUCT WITH EVAPORATION COIL WOUND THEREAROUND
S200
COOL AIR TO COOLING AIR THROUGH HEAT TRANSFER FINS PROVIDED WITHIN EVAPORATION COIL SUCH THAT HEAT IS EXCHANGED BETWEEN AIR AND REFRIGERANT
S300
SUPPLY COOLING AIR TO ICE MAKING COMPARTMENT FOR MAKING ICE
S400
DISCHARGE COOLING AIR FROM ICE MAKING COMPARTMENT , TO COOLING DUCT
S500
RECOOL DISCHARGED COOLING AIR IN COOLING DUCT
S600

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6859

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	US 2 013 134 A (COLLINS WILLIAM D) 3 September 1935 (1935-09-03) * column 1, line 3 - column 2, line 27; figures 1-4 * -----	1,2,7,8, 10,11	F25D21/08 F25D23/04
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TECHNICAL FIELDS SEARCHED (IPC)

F25C
F25B
F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 October 2016	Kolev, Ivelin

CATEGORY OF CITED DOCUMENTS

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17-10-2016

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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