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(54) **REFRIGERATOR INCLUDING A DEEP FREEZING UNIT**

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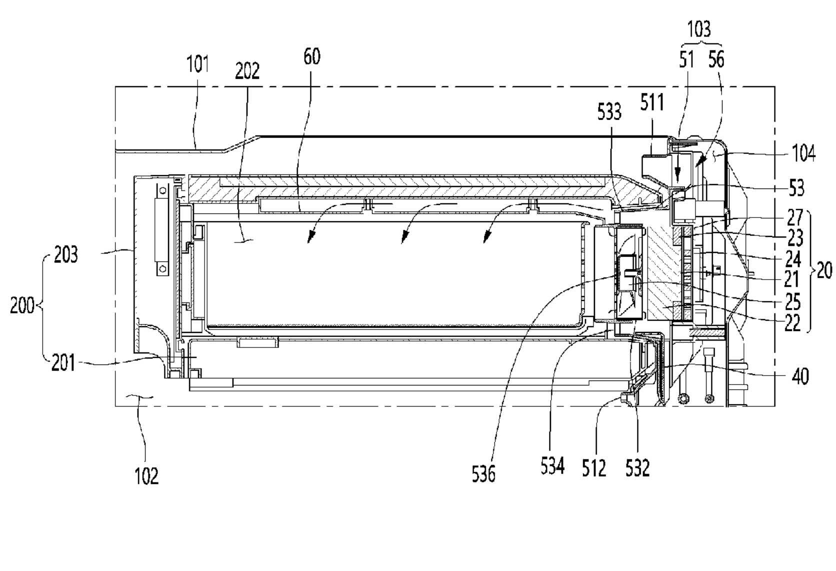
(57) **ABSTRACT**

A refrigerator includes a refrigerating compartment, a freezing compartment partitioned from the refrigerating compartment, a freezing unit mounted at one side of an inside of the freezing compartment, and the freezing unit including a cooling case defining a cooling compartment partitioned from the freezing compartment and a cooling drawer insertable into the cooling compartment. A guide duct is mounted on a ceiling of the cooling case and communicates with a grille, and the guide duct includes a bottom portion having a plurality of cold air discharge holes, where at least a portion of the bottom portion is spaced apart from the top portion at a lower side of the top portion to define a passage for guiding the cold air into the cooling compartment.

16 Claims, 5 Drawing Sheets



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F25D 17/08 (2006.01)
F25D 23/06 (2006.01)

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CPC ***F25D 17/08*** (2013.01); ***F25D 23/069*** (2013.01); *F25D 2317/0665* (2013.01)

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FIG. 1

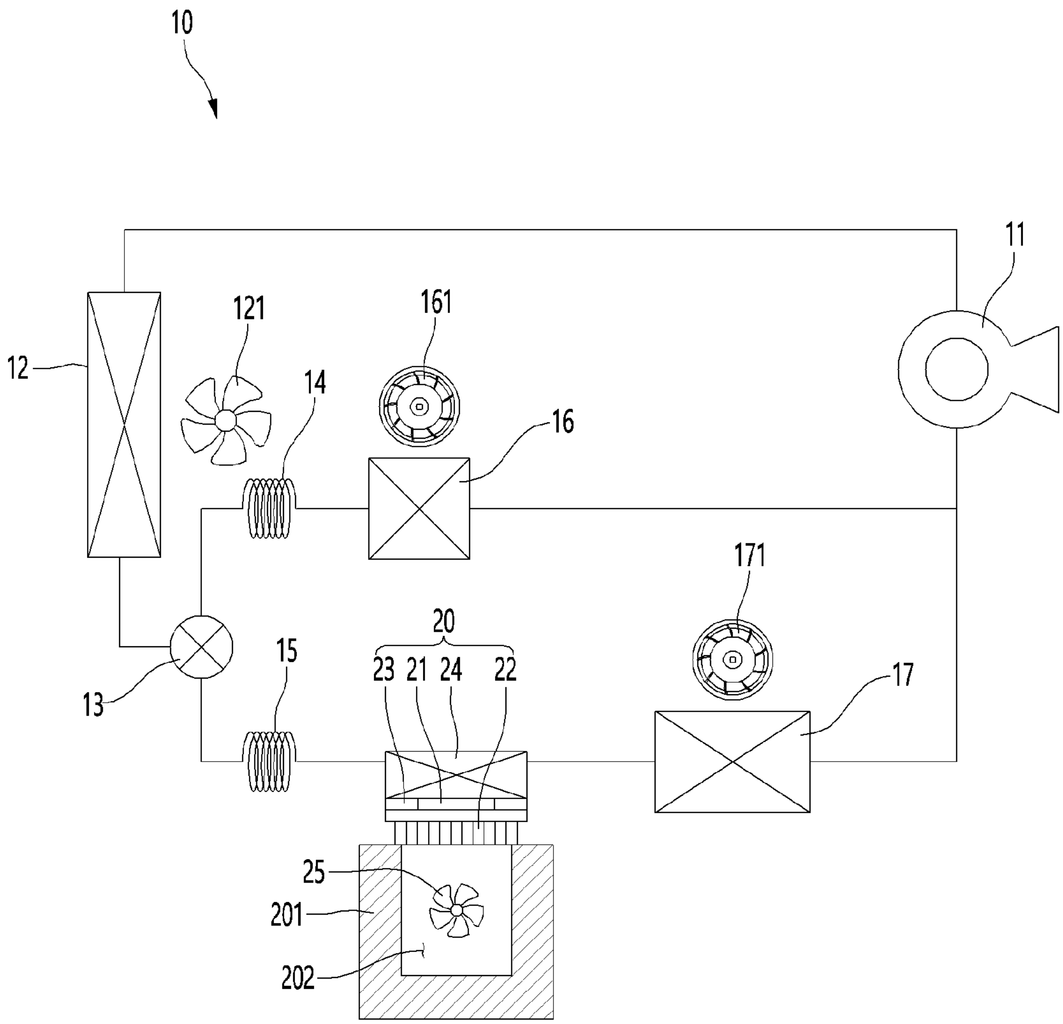


FIG. 2

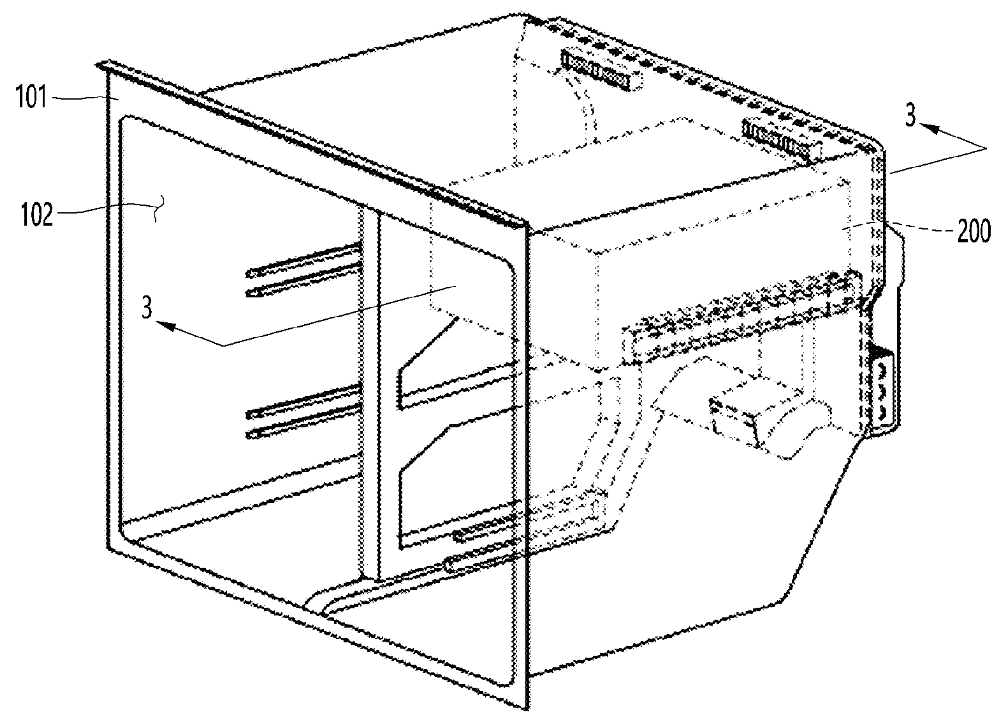

101
102
3
3
200

FIG. 3

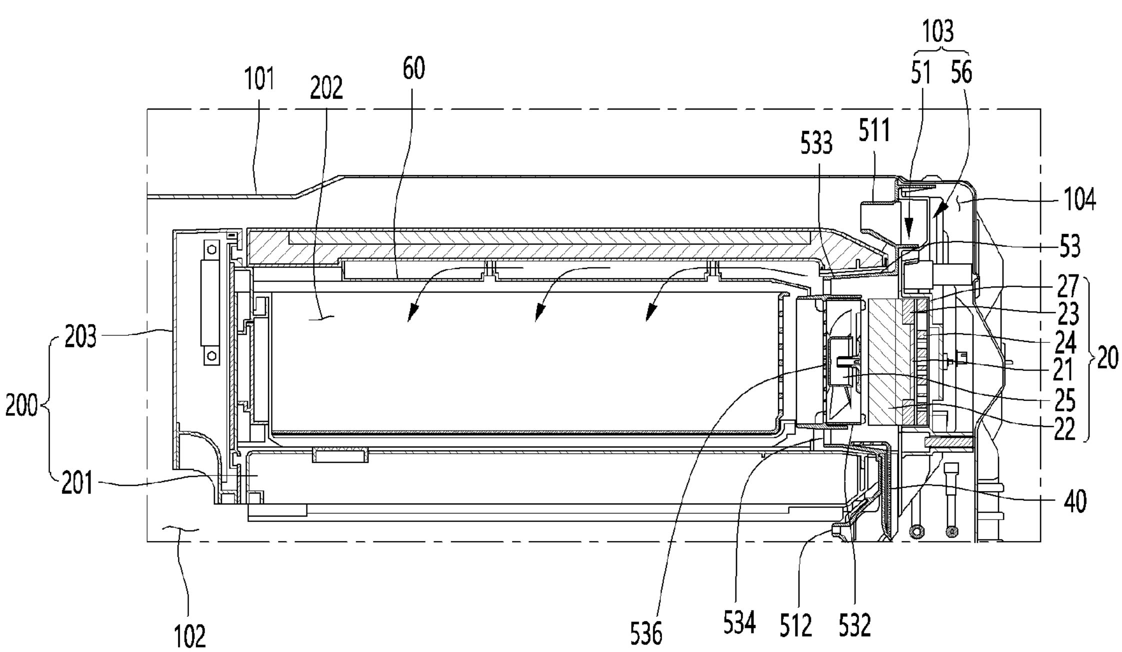

103
101
202
60
51
56
511
533
104
53
27
23
24
21
20
25
22
203
200
201
40
102
536
534
512
532

FIG. 4

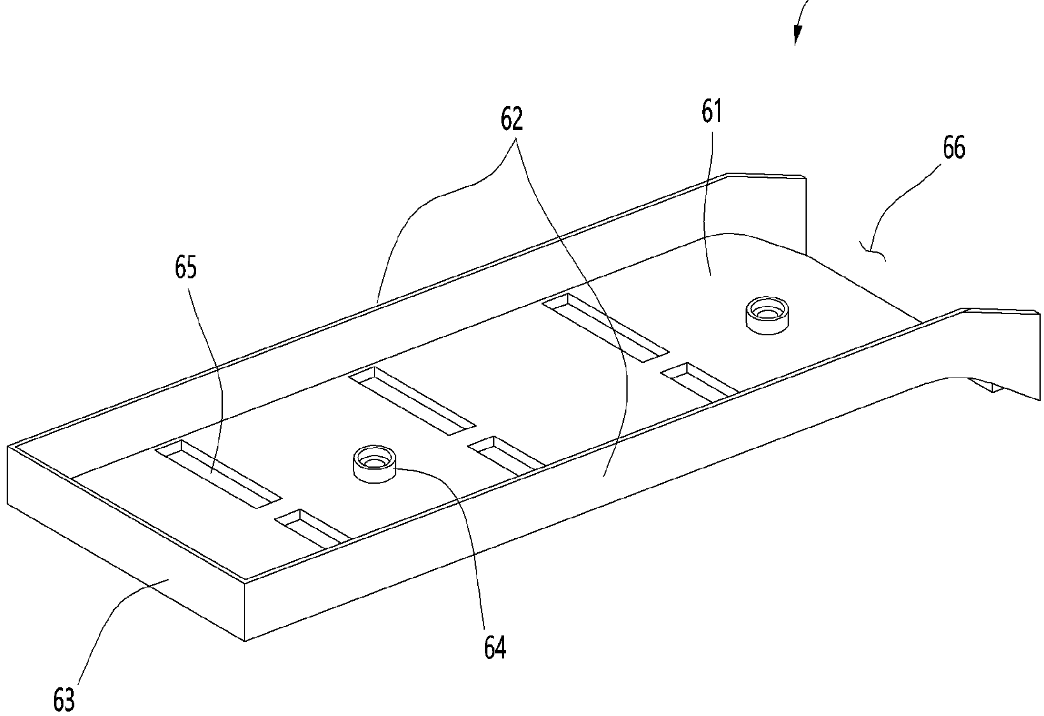


FIG. 5

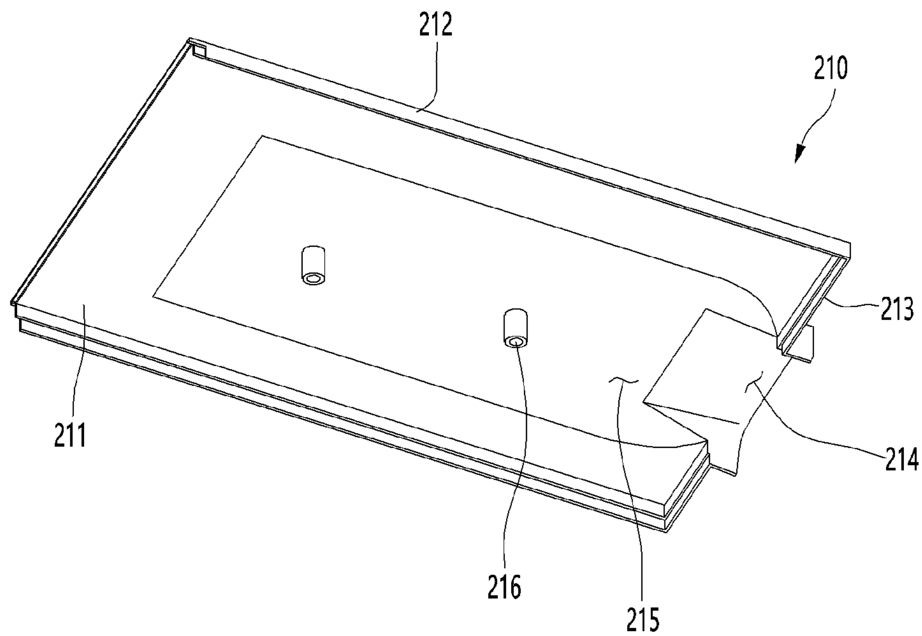


FIG. 6

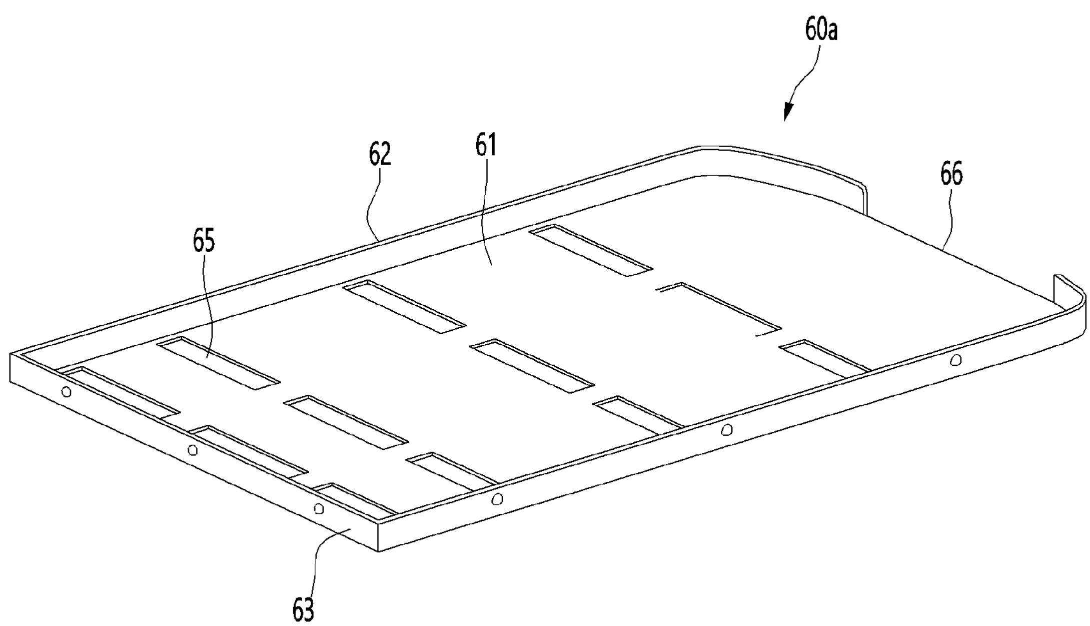
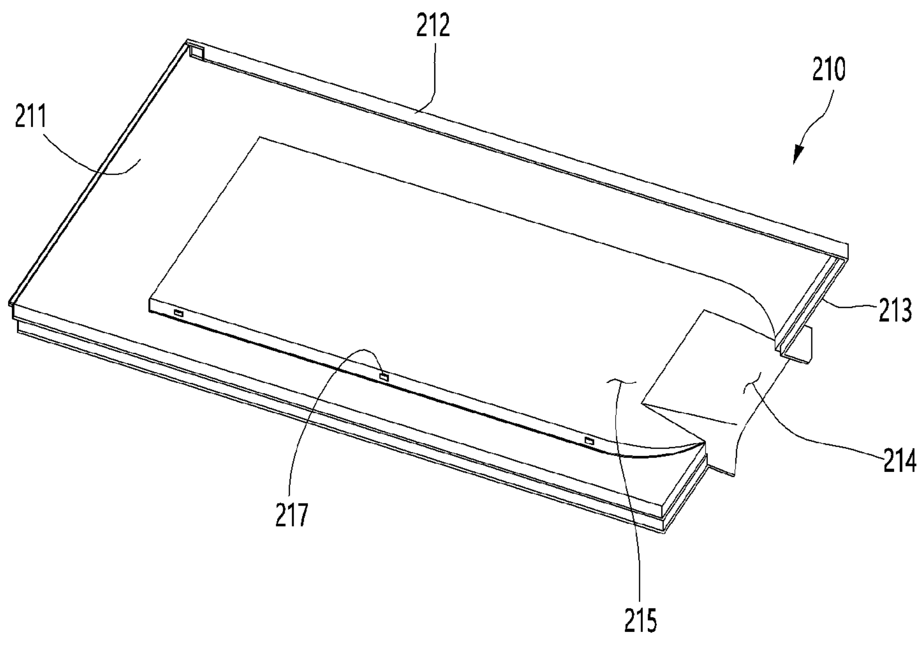


FIG. 7



REFRIGERATOR INCLUDING A DEEP FREEZING UNIT

This application is the National Stage filing under 35 U.S.C. 371 of International Application No. PCT/KR2020/002067, filed on Feb. 13, 2020, which claims the benefit of Korean Patent Application No. 10-2019-0023894, filed on Feb. 28, 2019, the contents of which are all hereby incorporated by reference herein in their entirety.

TECHNICAL FIELD

The present invention relates to a refrigerator.

BACKGROUND ART

In general, a refrigerator is a home appliance for storing food at a low temperature, and includes a refrigerating compartment for storing food in a refrigerated state in a range of 3° C. and a freezing compartment for storing food in a frozen state in a range of −20° C.

However, when food such as meat or seafood is stored in the frozen state in the existing freezing compartment, moisture in cells of the meat or seafood are escaped out of the cells in the process of freezing the food at the temperature of −20° C., and thus, the cells are destroyed, and taste of the food is changed during an unfreezing process.

However, destruction of cells may be minimized by setting a temperature condition of the storage compartment to a cryogenic state that is significantly lower than a temperature of the current freezing compartment so that food quickly passes through a freezing point temperature range when the food is changed to a frozen state. As a result, even after thawing, there is an advantage that meat quality and texture return to a state that is close to a state before freezing. The cryogenic temperature may be understood to mean a temperature in a range of −45° C. to −50° C.

For this reason, in recent years, the demand for a refrigerator equipped with a deep freezing compartment that is maintained at a temperature lower than a temperature of the freezing compartment is increasing.

Also, FIG. **2** is a perspective view of the refrigerator door according to an embodiment. In order to satisfy the demand for the deep freezing compartment, there is a limit to the cooling using an existing refrigerant. Thus, an attempt is made to lower the temperature of the deep freezing compartment to a cryogenic temperature by using a thermoelectric module (TEM).

In the prior art below, a deep freezing compartment is provided in a freezing compartment, and a thermoelectric module is employed so as to maintain the deep freezing compartment temperature at a cryogenic temperature that is significantly lower than the freezing compartment temperature.

Particularly, the contents are disclosed that an evaporator through which a refrigerant flows is employed as a heat dissipation means attached to a heat generation surface of the thermoelectric module.

Referring to FIG. **18** of Korean Patent Publication No. 2018-0131752 (Dec. 11, 2018), which is a prior art, a blower type cooling fan is applied to allow cold air in a deep freezing compartment to forcibly flow.

That is, the cold air is blown from the cooling fan so that the cold air flows into a drawer through a rear surface of the drawer, and the cold air inside the drawer flows to a rear side of the deep freezing compartment and then is suctioned into a cooling device of the thermoelectric module through a

suction portion provided at each of upper and lower sides of the deep freezing temperature storage compartment.

In the case of such a cold air circulation structure, when a lot of food is loaded at a rear side of the drawer, or a box-shaped object is stored at the rear side of the drawer, there is a problem in that circulation of cold air in the deep freezing compartment is not smoothly performed due to flow resistance.

Particularly, when a rear surface of the drawer is blocked by the food or storage items, the cold air discharged from the cooling fan does not flow into the drawer, and am amount of cold air returning to the suction portion is reduced. As a result, a discharge-side pressure in front of the cooling fan is high, and a suction-side pressure behind the cooling fan is low. Thus, there is a problem in that a load of the cooling fan excessively increases, and power consumption increases.

Above all, temperature distribution in the deep freezing compartment is not uniformly maintained, and a temperature at a rear side of the deep freezing compartment may be very low, but a temperature at a front side of the deep freezing compartment may be high.

DISCLOSURE OF THE INVENTION

Technical Problem

The present invention has been proposed to improve the above-described limitations.

Technical Solution

A refrigerator according to an embodiment of the present invention for achieving the above object includes: a refrigerating compartment; a freezing compartment partitioned from the refrigerating compartment; a deep freezing unit mounted at one side of an inside of the freezing compartment, the deep freezing unit comprising a deep freezing case configured to define a deep freezing compartment partitioned from the freezing compartment and a deep freezing drawer inserted into the deep freezing compartment; and a freezing evaporation compartment defined behind the deep freezing case.

In addition, a refrigerator according to an embodiment of the present invention includes: a partition wall; a freezing compartment evaporator accommodated in the freezing evaporation compartment to generate the cold air for cooling the freezing compartment; a freezing compartment fan driven to supply the cold air in the freezing evaporation compartment to the freezing compartment; a thermoelectric module configured to provide a temperature of the deep freezing compartment to a temperature lower than that of the freezing compartment; and a deep freezing compartment fan configured to allow air within the deep freezing compartment to forcibly flow.

The partition wall may include a deep freezing compartment-side discharge grille configured to discharge cold air into the deep freezing compartment and a freezing compartment-side discharge grille configured to discharge the cold air into the freezing compartment.

The thermoelectric module may include: a thermoelectric element having a heat absorption surface facing the deep freezing compartment and a heat generation surface defined as an opposite surface of the heat absorption surface; a cold sink that is in contact with the heat absorption surface and disposed behind the deep freezing compartment; and a heat sink that is in contact with the heat generation surface and defined as a deep freezing evaporator connected in series to the freezing compartment evaporator.

In addition, a refrigerator according to another embodiment of the present invention may further include a guide duct mounted on a ceiling of the deep freezing case to communicate with the deep freezing compartment-side discharge grille.

Advantageous Effects

The refrigerator according to embodiment of the present invention may have the following effects.

First, since the suction type cooling fan is applied, even if the amount of food or things stored in the deep freezing storage compartment is large, the flow resistance may be reduced when compared to the case in which the blower type cooling fan is applied.

Second, since the guide duct is mounted to smoothly supply the cool air forward from the rear side of the deep freezing compartment, the cold air cooled while passing through the cold sink of the thermoelectric module may be guided to the front of the deep freezing compartment without the flow resistance.

Third, regardless of the amount of food stored in the deep freezing compartment, the cold air cooled by the thermoelectric module may be guided to the front region of the deep freezing compartment, and thus, the temperature distribution inside the deep freezing compartment may be maintained uniformly.

Fourth, since the area of the cold air discharge hole formed in the guide duct gradually increases from the rear side to the front side of the deep freezing compartment, the amount of cold air discharged to the front side of the deep freezing compartment and the amount of cold air discharged to the intermediate point of the deep freezing compartment may be uniformly maintained.

In other words, there may be the advantage in that the decrease in amount of the discharged cold air as it moves away from the cooling fan is capable of being minimized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view illustrating a refrigerant circulation system of a refrigerator according to an embodiment of the present invention.

FIG. **2** is a perspective view illustrating structures of a freezing compartment and a deep freezing compartment of the refrigerator according to an embodiment of the present invention.

FIG. **3** is a longitudinal cross-sectional view taken along line **3-3** of FIG. **2**.

FIG. **4** is a perspective view of a guide duct mounted inside the deep freezing compartment according to an embodiment of the present invention.

FIG. **5** is a bottom perspective view illustrating a case cover forming a ceiling of a deep freezing case according to an embodiment of the present invention.

FIG. **6** is a perspective view of a guide duct according to another embodiment.

FIG. **7** is a bottom perspective view of a case cover according to another embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

Hereinafter, a refrigerator according to an embodiment of the present invention will be described in detail with reference to the accompanying drawings.

FIG. **1** is a view illustrating a refrigerant circulation system of a refrigerator according to an embodiment of the present invention.

Referring to FIG. **1**, a refrigerant circulation system according to an embodiment of the present invention includes a compressor **11** that compresses a refrigerant into a high-temperature and high-pressure gaseous refrigerant, a condenser **12** that condenses the refrigerant discharged from the compressor **11** into a high-temperature and high-pressure liquid refrigerant, an expansion valve that expands the refrigerant discharged from the condenser **12** into a low-temperature and low-pressure two-phase refrigerant, and an evaporator that evaporates the refrigerant passing through the expansion valve into a low-temperature and low-pressure gaseous refrigerant. The refrigerant discharged from the evaporator flows into the compressor **11**. Also, the components constituting the refrigerant circulation system are connected to each other by a refrigerant pipe to constitute a closed circuit.

In detail, the expansion valve may include a refrigerator compartment expansion valve **14** and a freezing compartment expansion valve **15**. Also, FIG. **2** is a perspective view of the refrigerator door according to an embodiment. The refrigerant pipe is divided into two branches at an outlet side of the condenser **12**, and the refrigerating compartment expansion valve **14** and the freezing compartment expansion valve **15** are respectively connected to the refrigerant pipe that is divided into the two branches. That is, the refrigerating compartment expansion valve **14** and the freezing compartment expansion valve **15** are connected in parallel at the outlet of the condenser **12**.

Also, a switching valve **13** is mounted at a point at which the refrigerant pipe is divided into the two branches at the outlet side of the condenser **12**. The refrigerant passing through the condenser **12** may flow through only one of the refrigerating compartment expansion valve **14** and the freezing compartment expansion valve **15** by an operation of adjusting an opening degree of the switching valve **13** or may flow to be divided into both sides.

The switching valve **13** may be a three-way valve, and a flow direction of the refrigerant is determined according to an operation mode. Here, one switching valve such as the three-way valve may be mounted at an outlet of the condenser to control the flow direction of the refrigerant, or alternatively, the switching valves are mounted at inlet sides of a refrigerator compartment expansion valve **14** and a freezing compartment expansion valve **15**, respectively.

The evaporator may include a refrigerating compartment evaporator **16** connected to an outlet side of the refrigerating compartment expansion valve **14** and a deep freezing compartment evaporator **24** and a freezing compartment evaporator **17**, which are connected in series to an outlet side of the freezing compartment expansion valve **15**. The deep freezing compartment evaporator **24** and the freezing compartment evaporator **17** are connected in series, and the refrigerant passing through the freezing compartment expansion valve passes through the deep freezing compartment evaporator **24** and then flows into the freezing compartment evaporator **17**.

Here, the deep freezing compartment evaporator **24** may be disposed at an outlet side of the freezing compartment evaporator **17** so that the refrigerant passing through the freezing compartment evaporator **17** flows into the deep freezing compartment evaporator **24**.

Also, it should be noted that the structure in which the deep freezing compartment evaporator **24** and the freezing compartment evaporator **17** are connected in parallel at an outlet end of the freezing compartment expansion valve **15** is not excluded, and a refrigerant circulation system from which the switching valve **13**, the refrigerating compartment expansion valve **14**, and the refrigerating compartment evaporator are removed is not also excluded.

Hereinafter, as an example, the description will be limited to the structure in which the heat sink and the freezing compartment evaporator **17** are connected in series.

In addition, it should be noted that a first storage compartment means a storage compartment that is capable of being controlled to a predetermined temperature by a first cooling device, a second storage compartment means a storage compartment that is capable of being controlled to a temperature lower than that of the first storage compartment by the second cooling device, and a third storage compartment is defined as a storage compartment that is capable of being controlled to a temperature lower than that of the storage compartment **2** by a third cooling device.

In addition, the first cooling device may be defined as a unit for cooling the first storage compartment including at least one of a first evaporator and a first thermoelectric element including a thermoelectric element. The first evaporator may include the refrigerating compartment evaporator **16**.

In addition, the second cooling device may be defined as a unit for cooling the second storage compartment including at least one of a second evaporator and a second thermoelectric element. The second evaporator may include the freezing compartment evaporator **17**.

In addition, the third cooling device may be defined as a unit for cooling the third storage compartment including at least one of a third evaporator and a third thermoelectric element.

In the present invention, as an example, the first storage compartment may be a refrigerating compartment that is controlled to a temperature of above zero by the first cooling device, the second storage compartment is a freezing compartment that is controlled to a temperature below zero by the second cooling device, and the third storage compartment is a deep freezing compartment that is maintained at a temperature of a cryogenic temperature or an ultrafrezing temperature, which will be described later, by the third cooling device.

In the present invention, a case in which all of the third to third storage compartments are controlled to a temperature below zero, a case in which all of the first to third storage compartments are controlled to a above zero temperature, and a case in which the first and second storage compartments are controlled to the above zero temperature, and the third storage compartment is controlled to the temperature below zero are not excluded.

Hereinafter, as an example, the description is limited to the case in which the first storage compartment is the refrigerating compartment, the second storage compartment is the freezing compartment, and the third storage compartment is the deep freezing compartment.

A condensing fan **121** is mounted adjacent to the condenser **12**, a refrigerating compartment fan **161** is mounted adjacent to the refrigerating compartment evaporator **16**, and a freezing compartment fan **171** is mounted adjacent to the freezing compartment evaporator **17**.

A refrigerating compartment maintained at a refrigerating temperature by cold air generated by the refrigerating compartment evaporator **16**, a freezing compartment maintained at a freezing temperature by cold air generated by the freezing compartment evaporator **16**, and a deep freezing compartment **202** maintained at a cryogenic or ultrafrezing temperature by a thermoelectric module to be described later are formed inside the refrigerator provided with the refrigerant circulation system according to the embodiment of the present invention.

The refrigerating compartment and the freezing compartment may be disposed adjacent to each other in a vertical direction or horizontal direction and are partitioned from each other by a partition wall. In addition, the deep freezing compartment may be provided at one side of the inside of the freezing compartment. In order to block the heat exchange between the cold air of the deep freezing compartment and the cold air of the freezing compartment, the deep freezing compartment **202** may be partitioned from the freezing compartment by a deep freezing case **201** having the high thermal insulation performance.

In addition, the thermoelectric module includes a thermoelectric element **21** having one side through which heat is absorbed and the other side through which heat is released when power is supplied, a cold sink **22** mounted on the heat absorption surface of the thermoelectric element **21**, a heat sink mounted on the heat generation surface of the thermoelectric element **21**, and an insulator **23** that blocks heat exchange between the cold sink **22** and the heat sink.

Here, the deep freezing compartment evaporator **24** is in contact with the heat generation surface of the thermoelectric element **21** to function as a heat sink. That is, the heat transferred to the heat generation surface of the thermoelectric element **21** is heat-exchanged with the refrigerant flowing inside the deep freezing compartment evaporator **24**. FIG. **2** is a perspective view of the refrigerator door according to an embodiment. The refrigerant flowing along the inside of the deep freezing compartment evaporator **24** and absorbing heat from the heat generation surface of the thermoelectric element **21** is introduced into the freezing compartment evaporator **17**. Hereinafter, the deep freezing compartment evaporator **24** is defined as a heat sink.

In addition, a cooling fan may be provided in front of the cold sink **22**, and the cooling fan may be defined as the deep freezing compartment fan **25** because the fan is disposed behind the inside of the deep freezing compartment.

The deep freezing compartment fan **25** may be a suction type centrifugal fan that suctions air in an axial direction and discharges the suctioned air in a radial direction, and specifically may include a turbo fan.

The cold sink **22** is disposed behind the inside of the deep freezing compartment **202** and configured to be exposed to the cold air of the deep freezing compartment **202**. Thus, when the deep freezing compartment fan **25** is driven to forcibly circulate cold air in the deep freezing compartment **202**, the cold sink **22** absorbs heat through heat-exchange with the cold air in the deep freezing compartment and then is transferred to the heat absorption surface of the thermoelectric element **21**. Also, the heat transferred to the heat absorption surface is transferred to the heat generation surface of the thermoelectric element **21**.

Also, FIG. **2** is a perspective view of the refrigerator door according to an embodiment. The heat sink functions to absorb the heat absorbed from the heat absorption surface of the thermoelectric element **21** and transferred to the heat generation surface of the thermoelectric element **21** again to release the heat to the outside of the thermoelectric module **20**.

FIG. **2** is a perspective view illustrating structures of the freezing compartment and the deep freezing compartment of the refrigerator according to an embodiment of the present invention, and FIG. **3** is a longitudinal cross-sectional view taken along line **3-3** of FIG. **2**.

Referring to FIGS. **2** and **3**, the refrigerator according to an embodiment of the present invention includes an inner case **101** defining the freezing compartment **102** and a deep freezing unit **200** mounted at one side of the inside of the freezing compartment **102**.

In detail, the inside of the refrigerating compartment is maintained to a temperature of about 3° C., and the inside of the freezing compartment **102** is maintained to a temperature of about −18° C., whereas a temperature inside the deep freezing unit **200**, i.e., an internal temperature of the deep freezing compartment **202** has to be maintained to about −50° C. Therefore, in order to maintain the internal temperature of the deep freezing compartment **202** at a cryogenic temperature of −50° C., an additional freezing means such as the thermoelectric module **20** is required in addition to the freezing compartment evaporator.

In more detail, the deep freezing unit **200** includes a deep freezing case **201** that forms a deep freezing compartment **202** therein, a deep freezing compartment drawer **203** slidably inserted into the deep freezing case **201**, and a thermoelectric module **20** mounted on a rear surface of the deep freezing case **201**.

In addition, the rear surface of the inner case **101** is stepped backward to form a freezing evaporation compartment **104** in which the freezing compartment evaporator **17** is accommodated. Also, an inner space of the inner case **101** is divided into the freezing evaporation compartment **104** and the freezing compartment **102** by the partition wall **103**. Also, the thermoelectric module **20** is fixedly mounted on a front surface of the partition wall **103**, and a portion of the thermoelectric module **20** passes through the deep freezing case **201** and is accommodated in the deep freezing compartment **202**.

In detail, the heat sink **24** constituting the thermoelectric module **20** may be a deep freezing compartment evaporator connected to the freezing compartment expansion valve **15** as described above.

In addition, the thermoelectric module **20** may further include a housing **27** accommodating the heat sink **24**. In addition, an insertion hole through which the housing **27** is inserted may be formed in the partition wall **103**.

Since the two-phase refrigerant cooled to a temperature of about −18° C. to −30° C. while passing through the freezing compartment expansion valve **15** flows inside the heat sink **24**, a surface temperature of the heat sink **24** may be maintained to a temperature of −18° C. to −30° C. Here, it is noted that a temperature and pressure of the refrigerant passing through the freezing compartment expansion valve **15** may vary depending on the freezing compartment temperature condition.

Also, when a rear surface of the thermoelectric element **21** is in contact with a front surface of the heat sink **24**, and power is applied to the thermoelectric element **21**, the rear surface of the thermoelectric element **21** becomes a heat generation surface.

Also, when the cold sink **22** is in contact with a front surface of the thermoelectric module, and power is applied to the thermoelectric element **21**, the front surface of the thermoelectric element **21** becomes a heat absorption surface.

The cold sink **22** may include a heat conduction plate made of an aluminum material and a plurality of heat exchange fins extending from a front surface of the heat conduction plate. Here, the plurality of heat exchange fins extend vertically and are disposed to be spaced apart from each other in a horizontal direction.

Also, the deep freezing compartment fan **25** is disposed in front of the cold sink **22** to forcibly circulate air inside the deep freezing compartment **202**.

In addition, the partition wall **103** may include a grille pan **51** exposed to cold air in the freezing compartment, and a shroud **56** attached to a rear surface of the grille pan **51**.

In addition, the insertion hole into which the housing **27** is inserted may be formed in the grille pan **51** corresponding to a direct rear side of the thermoelectric module.

Freezing compartment-side discharge grilles **511** and **512** are disposed to protrude from a front surface of the grille pan **51** so as to be vertically spaced apart from each other, and a module sleeve **53** protrudes from the front surface of the grille pan **51** corresponding between the freezing compartment-side discharge grilles **511** and **512**. A thermoelectric module accommodation space in which the thermoelectric module **20** is accommodated is formed in the module sleeve **53**.

In more detail, a flow guide **532** may be provided in a cylindrical or polygonal cylindrical shape inside the module sleeve **53**, and the inside of the flow guide **532** may be divided into a front space and a rear space by a fan grille part **536**. A plurality of air through-holes may be formed in the fan grille part **536**.

Also, deep freezing compartment-side discharge grilles **533** and **534** may be formed between the module sleeve **53** and the flow guide **532**, i.e., an upper side and a lower side of the flow guide **532**, respectively.

In addition, the deep freezing compartment fan **25** may be accommodated inside the flow guide **532** corresponding to the rear side of the fan grille part **536**. In addition, a portion of the flow guide **532**, which corresponds to a front space of the fan grille part **536** serves to guide a flow of cool air so that the cool air in the deep freezing compartment is suctioned into the deep freezing compartment fan **25**. That is, the cold air introduced into the inner space of the flow guide **532** to pass through the fan grille part **536** is discharged in a radial direction of the deep freezing compartment fan **25** and is heat-exchanged with the cold sink **22**. Then, the cold air that is cooled while being heat-exchanged with the cold sink **22** to flow in a vertical direction is discharged again to the deep freezing compartment through the deep freezing compartment-side discharge grills **533** and **534**.

In addition, the thermoelectric module accommodation space may be defined as a space between a rear end of the flow guide **532** (or a rear end of the deep freezing compartment fan **25**) and a rear surface of the grille pan **51**.

Here, the housing **27** accommodating the heat sink **24** protrudes backward from a rear surface of the partition wall **103** and is placed in the freezing evaporation compartment **104**. Thus, a rear surface of the housing **27** is exposed to the cold air of the freezing evaporation compartment **104**, and thus, a surface temperature of the housing **27** is substantially maintained at the same or similar level to the temperature of the cold air in the freezing evaporation compartment.

The cold sink **22** may be accommodated in the thermoelectric module accommodation space, and the heat insulator **23**, the thermoelectric element **21** and the heat sink **24** are accommodated in the housing **27**.

In addition, a drain heater **40** is mounted on a bottom portion of the thermoelectric module accommodation space to melt ice separated from the cold sink **22** during a defrost operation (deep freezing compartment defrost) of the thermoelectric module and then converted into defrost water.

The deep freezing compartment-side discharge grills **533** and **534** may include an upper discharge grille **533** and a lower discharge grille **534**. In addition, a guide duct **60** may be mounted at an outlet end of the upper discharge grille **533**, and a recess (described later) for accommodating the guide duct **60** is formed in the ceiling of the deep freezing case **201**.

Then, the cold air inside the deep freezing compartment **202** is suctioned in an axial direction of the deep freezing compartment fan **25**, heat-exchanged with the cold sink **22**, and then is discharged through the deep freezing compartment-side discharge grills **533** and **534**. Particularly, the cold air discharged through the upper discharge grille **533** is guided along the guide duct **60** to a front region of the deep freezing compartment **202**.

A front end of the guide duct **60** may be installed to be spaced a predetermined distance backward from the front end of the deep freezing case **201**.

The structure of the guide duct **60** and the ceiling portion of the deep freezing case **201** will be described in more detail with reference to the drawings below.

FIG. **4** is a perspective view of the guide duct mounted inside the deep freezing compartment according to an embodiment of the present invention.

Referring to FIG. **4**, the guide duct **60** according to an embodiment of the present invention is mounted on the ceiling of the deep freezing case **201** to communicate with a discharge end of the upper discharge grille **533**.

In detail, the guide duct **60** may include a bottom portion **61** in which a plurality of cold air discharge holes **65** are formed, a front surface portion **63** extending upward from a front end of the bottom portion **61**, and a side surface portion **62** extending upward both side ends of the bottom portion **61**.

The front surface portion and the side surface portion are provided in the form of a single rib and are surrounded along an edge of the bottom portion **61**. The front surface portion and the side surface portion may be defined as edge walls.

In addition, the rear surface portion of the guide duct **60** is opened to form a cold air inflow hole **66**, and a top surface portion of the guide duct **60** is opened and shielded by the ceiling of the deep freezing case **201**.

In addition, one or a plurality of coupling bosses **64** may protrude from the bottom portion **61**. For example, the coupling boss may protrude from a point that is close to a central rear end and a central front end of the bottom portion **61** and may also protrude from a center of the bottom portion **61**.

Also, as illustrated in the drawings, the plurality of cold air discharge holes **65** may be provided in a plurality of rows in a longitudinal direction of the bottom portion **61** from the rear end to the front end of the bottom portion **61**. In addition, for each row, two cold air discharge holes may be formed at left and right sides based on a line bisecting the bottom portion **61** in a width direction. However, a structure in which one cold air discharge hole is lengthily formed in the width direction of the bottom portion is not excluded, and also, a structure in which three of more cold air discharge holes are arranged in each row in the width direction of the bottom portion **61** is not excluded.

In addition, the plurality of cold air discharge holes **65** may be formed in such a manner in which an area thereof gradually increases from the rear end to the front end of the guide duct **60**.

This is because, as it goes away from the deep freezing compartment fan **25** toward the front end of the guide duct **60**, a wind pressure decreases, and thus, an amount of cold air discharged from the cold air discharge hole that is close to the rear end of the guide duct **60** and an amount of cold air discharged from the cold air discharge hole that is close to the front end of the guide duct **60** are not uniform.

In order to minimize this phenomenon, a size or area of the cold air discharge hole formed at a point that is close to the rear end of the guide duct **60**, that is, close to the deep freezing compartment fan **25** may be less than that of the cold air discharge hole formed at a point that is away from the deep freezing compartment fan **25**.

Alternatively, it is also possible to arrange a distance between the cold air discharge holes that is adjacent in the longitudinal direction of the guide duct **60** to be narrower in a direction that is away from the rear end of the guide duct **60**.

In addition, the rear end of the bottom portion **61** may be inclined downward or is formed to be rounded and thus may be coupled to be mounted on the upper end of the flow guide **532**. Then, the discharge hole of the upper discharge grille **533** and the cold air inflow hole **66** of the guide duct **60** are in contact with each other to communicate with each other.

FIG. **5** is a bottom perspective view illustrating a case cover forming the ceiling of the deep freezing case according to an embodiment of the present invention.

Referring to FIG. **5**, the guide duct **60** is fixedly mounted to a case cover **210** forming the ceiling of the deep freezing case **201**.

In detail, the case cover **210** includes a top surface portion **211**, a side surface portion **212** extending downward from each of both side ends of the top surface portion **211**, and a rear surface portion **213** extending downward from a rear end of the top surface portion **211**.

In addition, a cold air guide groove **214** may be formed to be depressed upward in a center of the rear surface portion **213**, and a duct coupling groove **215** in which the guide duct **60** is mounted is recessed or stepped in the top surface portion **211**.

In addition, the cold air guide groove **214** may be formed to extend by a predetermined length to the inside of the duct coupling groove **215**.

In addition, a width of the cold air guide groove **214** is formed to be the same as that of the upper discharge grille **533** or is formed to be slightly larger than that of the upper discharge grille **533**. Thus, the rear surface portion **213** may be designed to surround a top surface and side surface of the upper discharge grille **533**.

The duct coupling groove **215** may have a width and length corresponding to the width and length of the top surface of the guide duct **60** and may be formed to be recessed or stepped to a depth corresponding to a height of the front surface portion **63** and the side surface portion **62** of the guide duct **60**.

In addition, a plurality of coupling bosses **216** coupled to the coupling boss **64** of the guide duct **60** may be formed to protrude from the top surface of the case cover **210** corresponding to a center of the duct defect groove **215**.

Thus, a coupling member such as a screw may be inserted into the coupling boss **216** of the case cover **210** after passing through the coupling boss **64** from a lower side of the outside of the guide duct **60**.

In this manner, the duct coupling groove **215** is formed in the case cover **2110**, and the guide duct **60** is coupled to the duct coupling groove **215** to form an independent passage for supplying the cold air into the deep freezing compartment. In addition, since the independent passage does not undergo flow resistance due to food stored in the deep freezing compartment, there is an advantage in that the inside of the deep freezing compartment is uniformly cooled.

FIG. **6** is a perspective view of a guide duct according to another embodiment.

Referring to FIG. **6**, a guide duct **60***a* according to this embodiment may be the same as the guide duct **60** disclosed in FIG. **4** except for a width of the guide duct and a coupling method with the case cover.

In detail, the guide duct **60***a* includes a bottom portion **61**, a front surface portion **63**, a side surface portion **62**, and a rear surface portion **64**, and a cold air inflow hole **66** is formed in the rear surface portion. The front surface portion **63**, the side surface portion **62**, and the rear surface portion **64** may be defined as an edge wall.

In addition, a plurality of cold air discharge holes **65** are formed in the bottom portion **61**, and a method of forming the cold air discharge holes is the same as described with reference to FIG. **4**.

A plurality of coupling protrusions **67** may protrude from an outer surface of the side surface portion **62** of the guide duct **60***a*, and the plurality of coupling protrusions **67** are spaced apart from each other in a longitudinal direction of the guide duct **60**.

FIG. **7** is a bottom perspective view of a case cover according to another embodiment of the present invention.

The guide duct **60***a* illustrated in FIG. **6** is coupled to the case cover **210***a*.

Referring to FIG. **7**, the case cover **210***a* according to this embodiment has the same structure as the case cover **210** illustrated in FIG. **5**, but is different in some parts.

Specifically, a width of a duct coupling groove **215** formed in a top surface portion **211** of the case cover **210***a* may be larger than a width of the duct coupling groove **215** illustrated in FIG. **5**. This is because the width of the guide duct **60***a* illustrated in FIG. **6** is larger than the width of the guide duct **60** illustrated in FIG. **4**.

In addition, a plurality of protrusion insertion holes **217** are formed in a side surface of the duct coupling groove **215**, and the coupling protrusions **67** of the guide duct **60***a* are respectively inserted into the plurality of protrusion insertion holes **217**.

A coupling protrusion may also protrude from a front surface portion **63** of the guide duct **60***a*, and the protrusion protruding from the front surface portion **63** is inserted into a portion of the deep freezing case. Particularly, a groove for inserting the protrusion protruding from the front surface portion **63** may be formed in a front end of a ceiling of the deep freezing case **201** to which the case cover **210***a* is coupled.

The invention claimed is:

1. A refrigerator comprising:

a refrigerating compartment;

a freezing compartment partitioned from the refrigerating compartment;

a freezing unit mounted at one side of an inside of the freezing compartment, the freezing unit comprising a cooling case defining a cooling compartment partitioned from the freezing compartment and a cooling drawer insertable into the cooling compartment;

a freezing evaporation compartment disposed behind the cooling case;

a partition wall to partition the freezing evaporation compartment and the freezing compartment from each other, the partition wall comprising a first discharge grille to discharge cold air into the cooling compartment and a second discharge grille to discharge another cold air into the freezing compartment;

a freezing compartment evaporator accommodated in the freezing evaporation compartment to generate the another cold air for cooling the freezing compartment;

a freezing compartment fan to supply the another cold air in the freezing evaporation compartment to the freezing compartment;

a thermoelectric module comprising:

a thermoelectric element having a heat absorption surface facing the cooling compartment and a heat generation surface that is an opposite surface of the heat absorption surface;

a cold sink in communication with the heat absorption surface and disposed behind the cooling compartment; and

a heat sink in communication with the heat generation surface and functions as a cooling evaporator, the heat sink fluidly connected in series to the freezing compartment evaporator, the thermoelectric module configured to cool the cooling compartment to a temperature lower than that of the freezing compartment;

a cooling compartment fan to cause air within the cooling compartment to forcibly flow; and

a guide duct mounted on a ceiling of the cooling case and communicating with the first grille,

wherein the cooling compartment fan comprises a suction type centrifugal fan to suction the cold air of the cooling compartment in an axial direction of the centrifugal fan toward the thermoelectric module and discharge the suctioned cold air through the first discharge grille that is disposed above the thermoelectric module to the guide duct,

wherein the cooling case comprises

a case cover including a top portion to define the ceiling of the cooling case,

wherein the guide duct comprises a bottom portion having a plurality of cold air discharge holes,

wherein at least a portion of the bottom portion is spaced apart from the top portion at a lower side of the top portion to define a passage for guiding the cold air into the cooling compartment,

wherein the case cover comprises a duct coupling groove to mount the guide duct therein.

2. The refrigerator according to claim **1**, wherein the first discharge grille comprises:

an upper discharge grille at an upper side of a rear surface of the cooling compartment; and

a lower discharge grille at a lower side of the rear surface of the cooling compartment,

wherein the guide duct communicates with the upper discharge grille.

3. The refrigerator according to claim **2**, wherein the guide duct comprises:

an edge wall extending upward along an edge of the bottom portion; and

a cold air inflow hole defined at a rear surface portion of the guide duct,

wherein the cold air inflow hole is in communication with the upper discharge grille.

4. The refrigerator according to claim **1**, wherein the plurality of cold air discharge holes establish a plurality of rows in a direction from a rear end to a front end of the bottom portion, and

a cold air discharge hole defined in each row is provided in one or more in a width direction of the bottom portion.

5. The refrigerator according to claim **1**, wherein the plurality of cold air discharge holes comprises a first hole, a second hole and a third hole arranged in the direction from the rear end to the front end of the bottom portion,

the first hole is disposed closer to the first discharge grille than the third hole and the second hole is disposed between the first hole and the third hole,

a distance between the third hole and the second hole is less than a distance between the second hole and the first hole.

6. The refrigerator according to claim **1**, wherein the guide duct further comprises one or more of coupling bosses protruding from the bottom portion, and

the case cover comprises one or more of coupling bosses protruding from the duct coupling groove to be connected to the corresponding one or more of coupling bosses of the guide duct.

7. The refrigerator according to claim **1**, wherein the guide duct comprises

an edge wall extending upward along an edge of the bottom portion,

a plurality of protrusions disposed along an outer surface of the edge wall, and

the case cover comprises protrusion insertion holes which are disposed along a side surface portion of the duct coupling groove and into which the plurality of protrusions are inserted.

8. The refrigerator according to claim **1**, wherein a front end of the guide duct is spaced a predetermined distance backward from a front end of the cooling case.

9. The refrigerator according to claim **1**, wherein the thermoelectric module comprises a housing to accommodate the heat sink that protrudes backward from a rear surface of the partition wall and is placed in the freezing evaporation compartment.

10. A refrigerator comprising:

a refrigerating compartment;

a freezing compartment partitioned from the refrigerating compartment;

a freezing unit mounted at one side of an inside of the freezing compartment,

the freezing unit comprising a cooling case defining a cooling compartment partitioned from the freezing compartment and a cooling drawer insertable into the cooling compartment;

a freezing evaporation compartment disposed behind the cooling case;

a partition wall to partition the freezing evaporation compartment and the freezing compartment from each other, the partition wall comprising a first discharge grille to discharge cold air into the cooling compartment and a second discharge grille to discharge another cold air into the freezing compartment;

a freezing compartment evaporator accommodated in the freezing evaporation compartment to generate the another cold air for cooling the freezing compartment;

a freezing compartment fan to supply the another cold air in the freezing evaporation compartment to the freezing compartment;

a thermoelectric module comprising:

a thermoelectric element having a heat absorption surface facing the cooling compartment and a heat generation surface that is an opposite surface of the heat absorption surface;

a cold sink in communication with the heat absorption surface and disposed behind the cooling compartment; and

a heat sink in communication with the heat generation surface,

a cooling compartment fan to cause air within the cooling compartment to forcibly flow; and

a guide duct mounted on a ceiling of the cooling case and communicating with the first grille,

wherein the cooling case comprises

a case cover including a top portion to define the ceiling of the cooling case,

a duct coupling groove recessed upward from the top portion,

wherein the guide duct comprises a plurality of cold air discharge holes,

wherein at least a portion of the guide duct is received in the duct coupling groove at a lower side of the top portion such that a surface to define the duct coupling groove and the guide duct define a passage for guiding the cold air into the cooling compartment.

11. The refrigerator according to claim **10**, wherein the guide duct comprises

a bottom portion having the plurality of cold air discharge holes, and

an edge wall extending upward along an edge of the bottom portion,

wherein at least a portion of the edge wall is received in the duct coupling groove.

12. The refrigerator according to claim **11**, wherein the guide duct comprises one or more of coupling bosses protruding from the bottom portion, and

the case cover comprises one or more of coupling bosses protruding from the surface to define the duct coupling groove to be connected to the corresponding one or more of coupling bosses of the guide duct.

13. The refrigerator according to claim **10**, wherein a portion of the guide duct is positioned lower than the top portion.

14. A refrigerator comprising:

a refrigerating compartment;

a freezing compartment partitioned from the refrigerating compartment;

a freezing unit mounted at one side of an inside of the freezing compartment,

the freezing unit comprising a cooling case defining a cooling compartment partitioned from the freezing compartment and a cooling drawer insertable into the cooling compartment;

a freezing evaporation compartment disposed behind the cooling case;

a partition wall to partition the freezing evaporation compartment and the freezing compartment from each other, the partition wall comprising a first discharge grille to discharge cold air into the cooling compartment and a second discharge grille to discharge another cold air into the freezing compartment;

a freezing compartment evaporator accommodated in the freezing evaporation compartment to generate the another cold air for cooling the freezing compartment;

a freezing compartment fan to supply the another cold air in the freezing evaporation compartment to the freezing compartment;

a thermoelectric module comprising:

a thermoelectric element having a heat absorption surface facing the cooling compartment and a heat generation surface that is an opposite surface of the heat absorption surface;

a cold sink in communication with the heat absorption surface and disposed behind the cooling compartment; and a heat sink in communication with the heat generation surface,

a cooling compartment fan to cause air within the cooling compartment to forcibly flow; and

a guide duct disposed within the cooling compartment and mounted on a ceiling of the cooling case and communicating with the first grille,

wherein the guide duct comprises a bottom portion having the plurality of cold air discharge holes,

the plurality of cold air discharge holes comprises a first hole, a second hole and a third hole arranged in a first direction from a rear end to a front end of the bottom portion,

the first hole is disposed closer to the first discharge grille than the third hole and the second hole is disposed between the first hole and the third hole,

a distance between the third hole and the second hole the first direction is less than a distance between second hole and the first hole in the first direction,

wherein the case cover includes a duct coupling groove recessed upward from the top portion of the case cover to receive the guide duct.

15. The refrigerator according to claim **14**, wherein the cooling case comprises a case cover including a top portion to define the ceiling of the cooling case,

wherein at least a portion of the bottom portion is spaced apart from the top portion at a lower side of the top portion such that the bottom portion and the top portion define a passage for guiding the cold air into the cooling compartment.

16. The refrigerator according to claim **14**, wherein a portion of the guide duct is positioned lower than the top portion.

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