US009879896B2

(12) **United States Patent**
Koo

(10) **Patent No.: US 9,879,896 B2**
(45) **Date of Patent: Jan. 30, 2018**

(54) **ICE MAKING SYSTEM AND METHOD FOR A REFRIGERATOR**

(71) Applicant: **Dongbu Daewoo Electronics Corporation**, Seoul (KR)

(72) Inventor: **Min Bon Koo**, Seoul (KR)

(73) Assignee: **Dongbu Daewoo Electronics Corporation**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 147 days.

(21) Appl. No.: **14/836,854**

(22) Filed: **Aug. 26, 2015**

(65) **Prior Publication Data**

US 2016/0370078 A1 Dec. 22, 2016

(30) **Foreign Application Priority Data**

Jun. 16, 2015 (KR) 10-2015-0085389

(51) **Int. Cl.**

F25C 1/00	(2006.01)
F25C 5/18	(2006.01)
F25C 5/00	(2006.01)
F25D 23/02	(2006.01)

(52) **U.S. Cl.**

CPC ***F25C 5/182*** (2013.01); ***F25C 5/005*** (2013.01); ***F25D 23/028*** (2013.01); *F25C 2400/10* (2013.01); *F25D 2317/061* (2013.01); *F25D 2317/062* (2013.01); *F25D 2317/063* (2013.01); *F25D 2317/0671* (2013.01)

(58) **Field of Classification Search**

CPC F25C 1/00; F25C 5/005
USPC 62/66, 340, 344, 441, 449
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,993,347	A *	7/1961	Muffly	F25B 49/02 62/159
3,568,465	A	3/1971	Jung	
8,434,322	B2	5/2013	Lee et al.	
2005/0210909	A1	9/2005	Kim et al.	
2005/0252232	A1 *	11/2005	Lee	F25D 17/065 62/340
2010/0011796	A1	1/2010	Lee	
2010/0096887	A1 *	4/2010	Mori	B62D 21/152 296/203.02
2010/0101260	A1	4/2010	Lee et al.	
2010/0326096	A1	12/2010	Junge et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

KR	10-2000-0034758	A	6/2000
KR	10-2005-0094673	A	9/2005

(Continued)

OTHER PUBLICATIONS

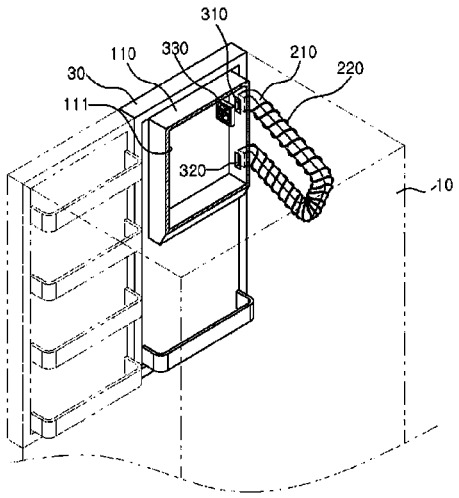
Extended European Search Report dated Nov. 15, 2016 issued in corresponding European Patent Application No. 15186857.7.

Primary Examiner — Melvin Jones

(57) **ABSTRACT**

Ice making system and method for a refrigerator is disclosed. The ice making system includes an ice making unit that makes ice cubes, a cold air generator that cools air inside a cooling duct so as to produce cold air, a cold air circulation unit that supplies the cold air from the cold air generator to the ice making unit, and discharges the cold air from the ice making unit to the cold air generator, and a cold air guiding unit that circulates the cold air inside the ice making unit.

17 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2011/0011118	A1*	1/2011	Cho	F25D 17/065 62/419
2013/0167576	A1	7/2013	Kim et al.	

FOREIGN PATENT DOCUMENTS

KR	10-2005-0098135	10/2005
KR	10-2006-0039169 A	5/2006

* cited by examiner

FIG. 1

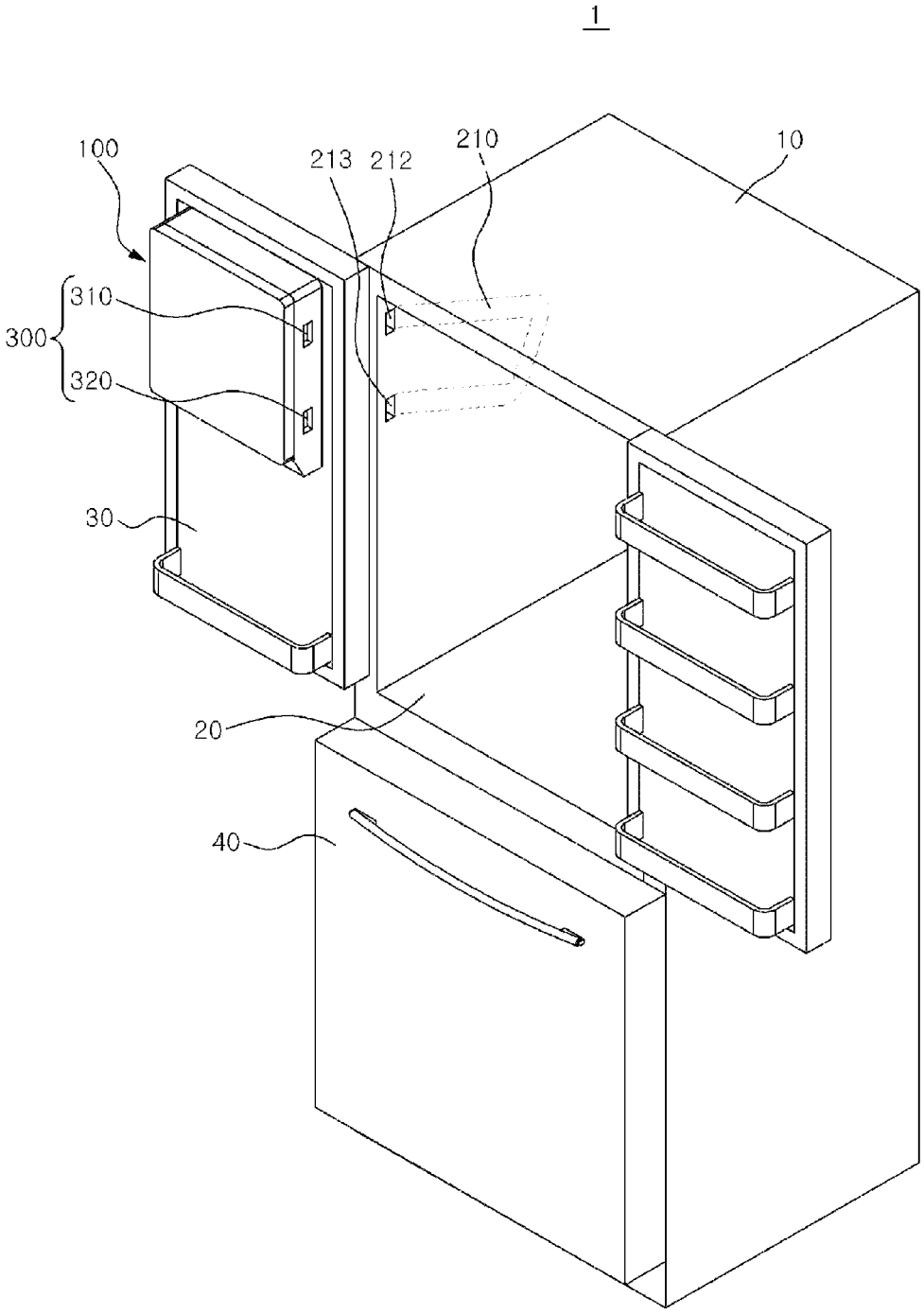


FIG. 2

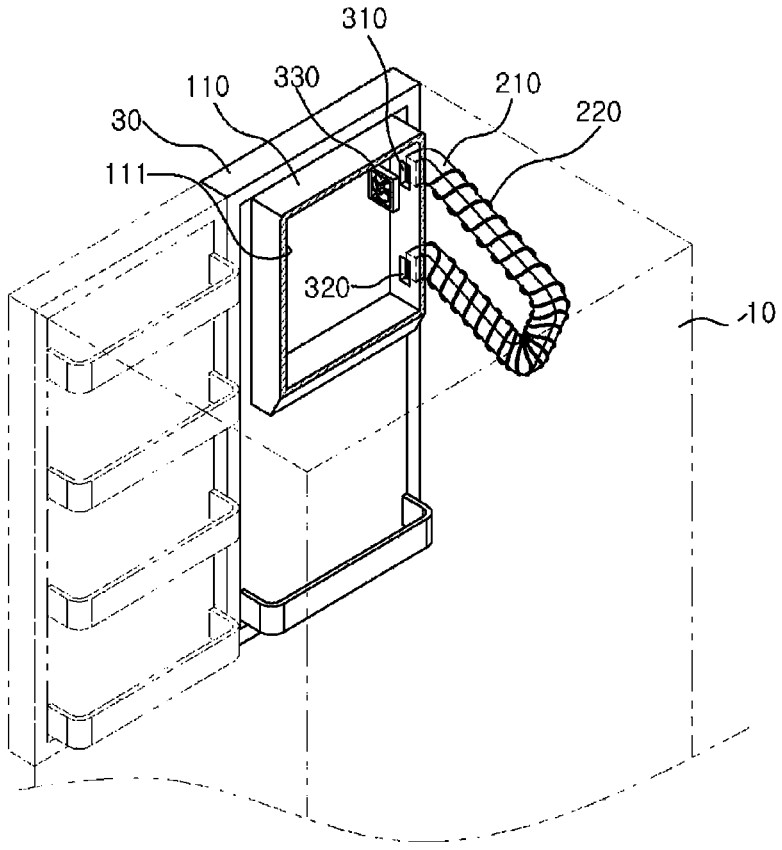


FIG. 3

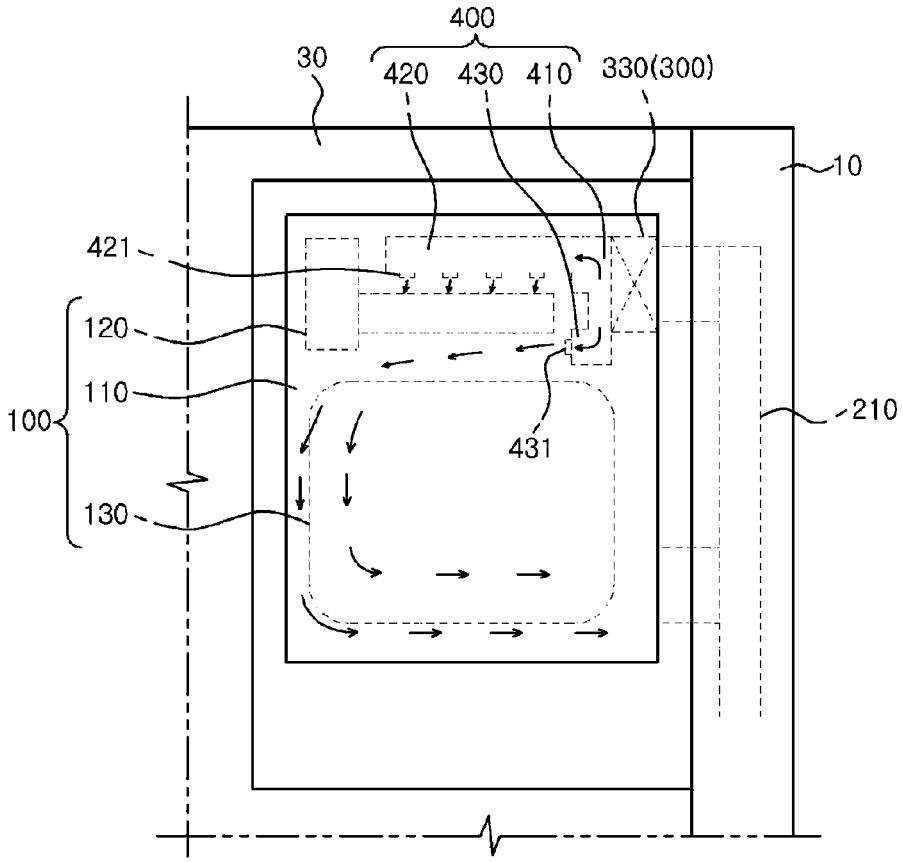


FIG. 4

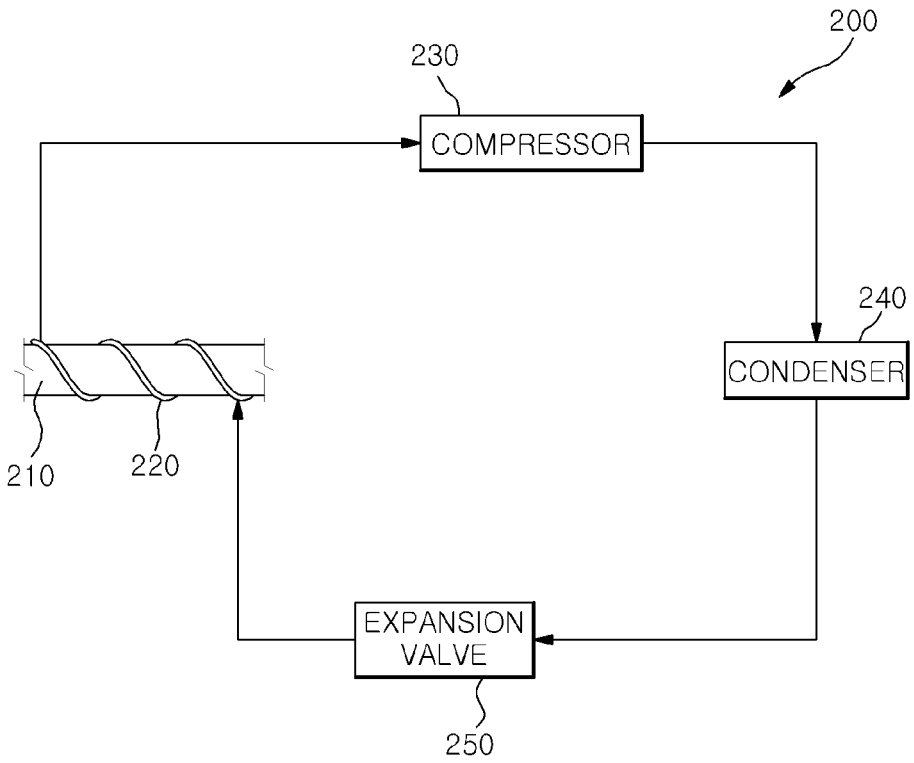

200
230
COMPRESSOR
240
CONDENSER
210
220
EXPANSION VALVE
250

FIG. 5

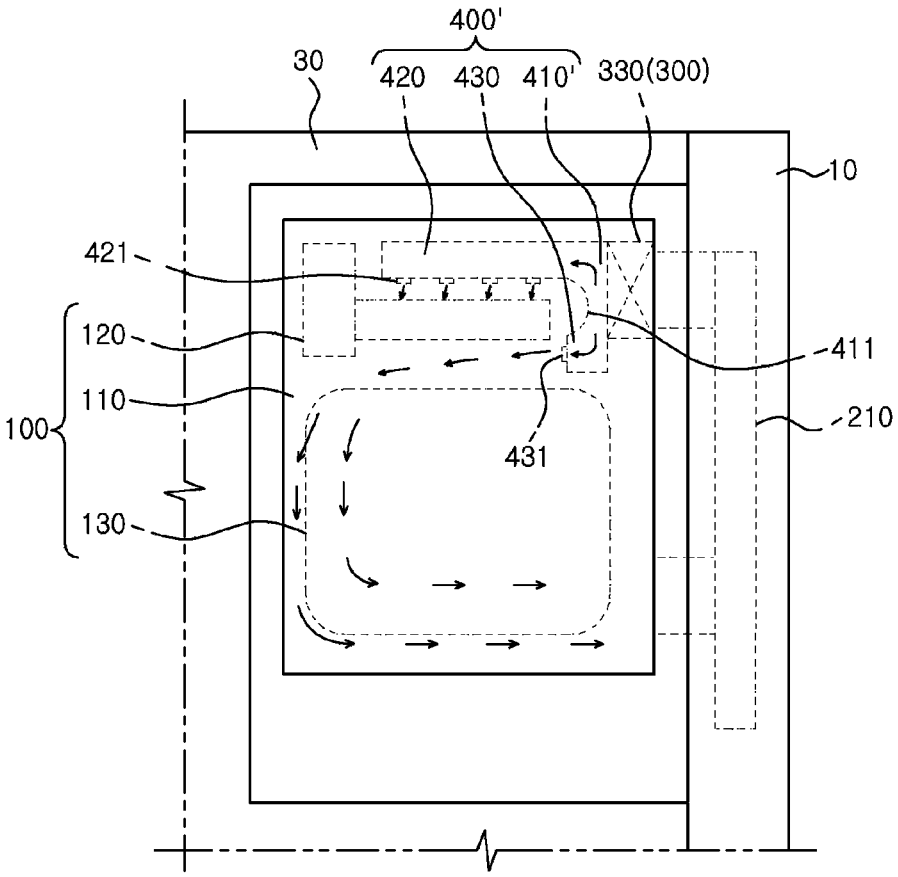


FIG. 6

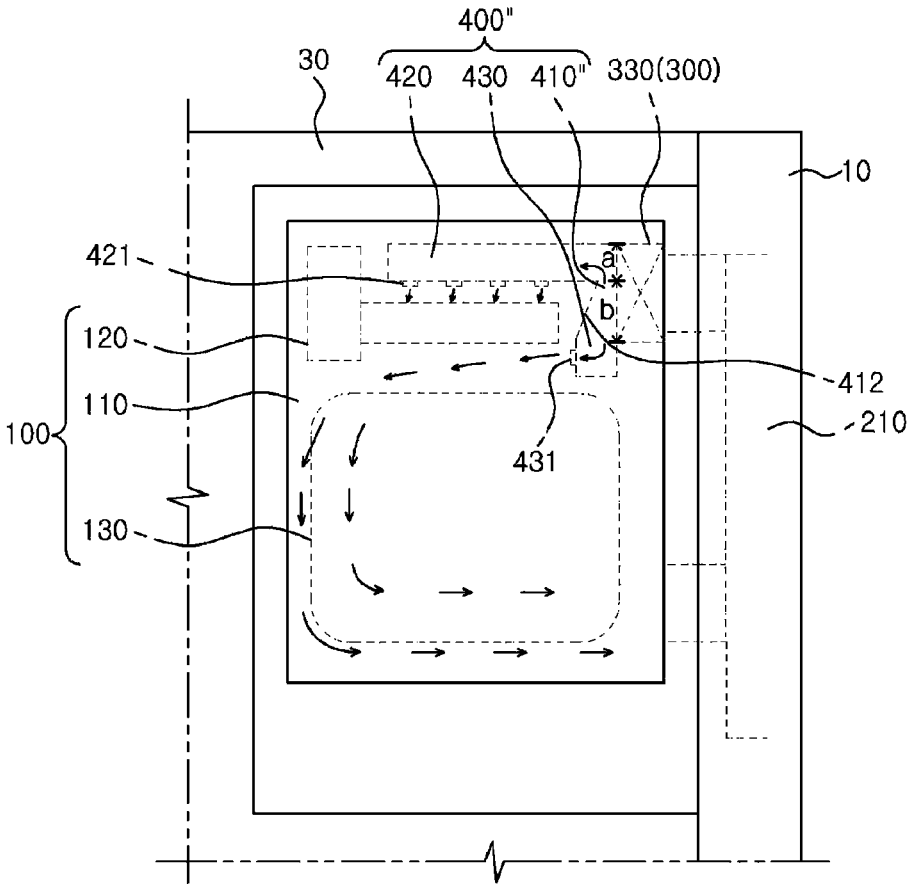
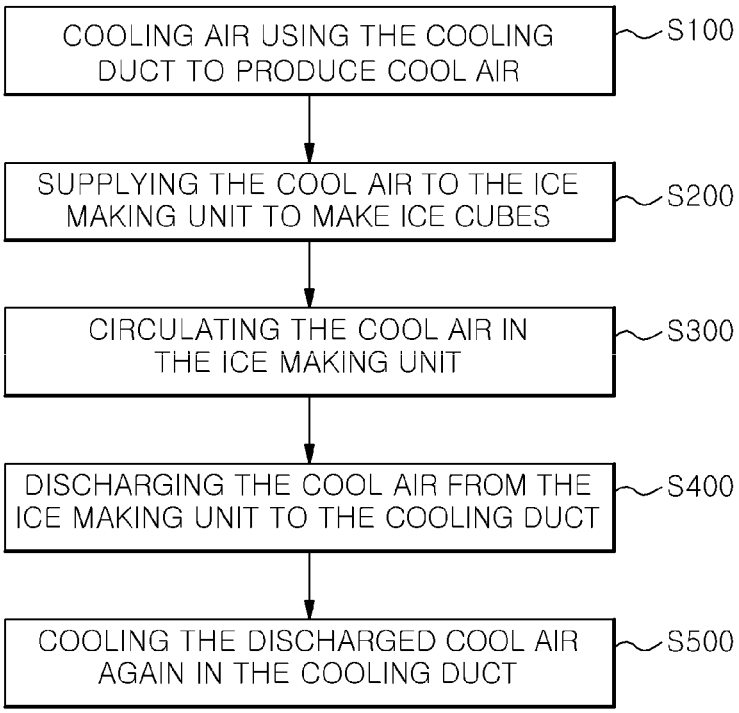


FIG. 7


COOLING AIR USING THE COOLING DUCT TO PRODUCE COOL AIR
S100
SUPPLYING THE COOL AIR TO THE ICE MAKING UNIT TO MAKE ICE CUBES
S200
CIRCULATING THE COOL AIR IN THE ICE MAKING UNIT
S300
DISCHARGING THE COOL AIR FROM THE ICE MAKING UNIT TO THE COOLING DUCT
S400
COOLING THE DISCHARGED COOL AIR AGAIN IN THE COOLING DUCT
S500

ICE MAKING SYSTEM AND METHOD FOR A REFRIGERATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to and the benefit of the Republic of Korea Patent Application Serial Number 10-2015-0085389, having a filing date of Jun. 16, 2015, filed in the Korean Intellectual Property Office, the disclosure of which is herein incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to an ice maker for refrigerators and a method for manufacturing the same.

BACKGROUND

A refrigerator unit is an apparatus intended to store food items at low temperatures. The refrigerator unit may store foods in a frozen or refrigerated state according to the type of food intended to be stored.

The interior of the refrigerator unit is cooled by cold air that is constantly supplied. The cold air is constantly generated through a heat exchanging operation with a refrigerant based on a refrigeration cycle. The cycle includes a process of compression-condensation-expansion-evaporation that are sequentially performed. The cold air supplied to the inside of the refrigerator unit is evenly transferred by convection to store food, drink, and other items within the refrigerator unit at desired temperatures.

In general, a main body of the refrigerator unit has a rectangular, hexahedral shape which is open at a front surface. The front surface may provide access to a refrigeration compartment and a freezer compartment located within the body of the refrigerator unit. Further, hinged doors may be fitted to the front side of the refrigerator body in order to selectively open and/or close openings to the refrigeration compartment and the freezer compartment. In addition, a number of drawers, racks, shelves, storage boxes, and the like may be provided in the refrigeration compartment and the freezer compartment within the refrigerator unit that are configured for optimally storing various foods, drinks, and other items within a storage space inside the refrigerator unit.

Conventionally, refrigerator units were configured as a top mount type in which a freezer compartment is positioned above a refrigeration compartment. Recently, bottom freezer type refrigerator units position the freezer compartment below the refrigeration compartment to enhance user convenience. In the bottom freezer type refrigerator unit, the more frequently used refrigeration compartment is advantageously positioned at the top so that a user may conveniently access the compartment without bending over at the waist, as previously required by the top mount type refrigerator unit. The less frequently used freezer compartment is positioned at the bottom.

However, a bottom freezer type refrigerator unit may lose its design benefits when a user wants to access the lower freezer compartment on a more frequent basis. For example, prepared ice that is stored in the freezer compartment may be a popular item accessed frequently by a particular user. In a bottom freezer type refrigerator unit, since the freezer compartment is positioned below the refrigeration compartment, the user would have to bend over at the waist in order to open the freezer compartment door to access the ice.

In order to solve such a problem, bottom freezer type refrigerators may include a dispenser configured for dispensing ice that is provided in a refrigeration compartment door. In this case, the ice dispenser is also positioned in the upper portion of the refrigerator unit, and more specifically is located above the freezer compartment. In this case, an ice maker for generating ice may be provided in the refrigeration compartment door or in the interior of the refrigeration compartment.

For example, in a bottom freezer type refrigerator having an ice making device in the refrigeration compartment door, cold air that has been produced by an evaporator is divided and discharged both into the freezer compartment and into the refrigeration compartment. Here, cold air that was discharged into the freezer compartment flows to the ice making device via a cold air supply duct arranged in a sidewall of the body of the refrigerator unit, and then freezes water while circulating inside the ice making device. Thereafter, the cold air is discharged from the ice making device into the refrigeration compartment via a cold air restoration duct arranged in the sidewall of the body of the refrigerator unit, so the cold air can reduce the temperature inside the refrigeration compartment.

However, when the cold air of the freezer compartment is introduced into the ice making device via the cold air supply duct, a large amount of cold air may be discharged from the ice making device into the refrigeration compartment via the cold air restoration duct without being used to make ice cubes. This may reduce the efficiency of the ice making device, and negatively affect the overall performance of the ice making device and/or the refrigerator unit.

What is needed is an efficient way to make ice within a refrigerator unit.

SUMMARY

In view of the above, therefore, embodiments of the present invention provide an ice making system and method for a refrigerator unit in which cold air produced from a cooling duct can efficiently circulate through an ice making unit.

In accordance with one embodiment of the present invention, there is provided an ice making system for a refrigerator unit. The ice making system may include an ice making unit that makes ice cubes; a cold air generator that cools air inside a cooling duct so as to produce cold air; a cold air circulation unit that supplies the cold air from the cold air generator to the ice making unit, and discharges the cold air from the ice making unit to return to the cold air generator; and a cold air guiding unit that circulates the cold air inside the ice making unit.

Exemplary embodiments of the present invention are advantageous in that the cold air can efficiently circulate inside an ice making unit while branching. In that manner, embodiments of the present invention are capable of supplying a larger amount of cold air to an ice making space rather than to an ice storage space.

Another advantage of exemplary embodiments of the present invention include a refrigerator unit that is capable of preventing cold air from being prematurely discharged from an ice making unit to a cooling duct without first being used to make ice cubes. This increases the performance and efficiency of the ice making unit when operating to make ice.

A further advantage of exemplary embodiments of the present invention include the ability for an ice making unit to make ice cubes using the cold air directly produced from the cooling duct. This increases the efficiency of efficiency

of the ice making unit when making ice, and also increases the efficiency of generating and supplying cold air from the cold air generator.

Still another advantage of exemplary embodiments of the present invention include a refrigerator unit that is capable of circulating cold air a short distance within an ice making space defined between a cooling duct and a refrigeration compartment door. The distance the cold air travels is relatively shorter than the conventional technique in which cold air is produced from a lower part of a bottom freezer type refrigerator flows to an ice making space defined in a refrigeration compartment door. As a result, embodiments of the present invention can reduce the loss of cold air by significantly reducing the distance the cold air travels before it is used to make ice, thereby making the ice making unit more efficient. This increase in efficiency of the ice making unit allows the refrigerator unit to save electricity during its operation.

In accordance with another embodiment of the present invention, a method of manufacturing ice is disclosed, and includes cooling air using a cooling duct so as to produce cold air; supplying the cold air to an ice making unit so as to make ice cubes; circulating the cold air in the ice making unit; discharging the cold air from the ice making unit to the cooling duct; and cooling the discharged cold air again in the cooling duct.

In accordance with another embodiment, a refrigerator is disclosed and includes a freezer compartment located within a main body of the refrigerator, and a refrigeration compartment located within the main body of the refrigerator, wherein the freezer compartment is located below the refrigeration compartment. The refrigerator includes an ice making unit that makes ice cubes; a cold air generator that cools air inside a cooling duct so as to produce cold air; a cold air circulation unit that supplies the cold air from the cold air generator to the ice making unit and discharges the cold air from the ice making unit to the cold air generator; and a cold air guiding unit that circulates the cold air inside the ice making unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification and in which like numerals depict like elements, illustrate embodiments of the present disclosure and, together with the description, serve to explain the principles of the disclosure.

FIG. **1** is a perspective view of a refrigerator unit showing an ice making system, in accordance with one embodiment of the present disclosure.

FIG. **2** is a view showing a connection between an ice making unit and a cooling duct of a cold air generator in the ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure.

FIG. **3** is a cross-sectional view showing an internal construction of an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure.

FIG. **4** is a block diagram illustrating a refrigeration cycle of a cold air generator of an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure.

FIG. **5** is a cross-sectional view showing another internal construction of an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure.

FIG. **6** is a cross-sectional view showing still another internal construction of an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure.

FIG. **7** is a flow diagram illustrating a method for making ice within a refrigerator unit, in accordance with one embodiment of the present disclosure.

DETAILED DESCRIPTION

Reference will now be made in detail to the various embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings. While described in conjunction with these embodiments, it will be understood that they are not intended to limit the disclosure to these embodiments. On the contrary, the disclosure is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the disclosure as defined by the appended claims. Furthermore, in the following detailed description of the present disclosure, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be understood that the present disclosure may be practiced without these specific details. In other instances, well-known methods, functions, constituents, procedures, and components have not been described in detail so as not to unnecessarily obscure aspects and/or features of the present disclosure.

FIG. **1** is a perspective view showing an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure. FIG. **2** is a view showing a connection between an ice making unit and a cooling duct of a cold air generator in the ice making system for the refrigerator unit of FIG. **1**, in accordance with one embodiment of the present disclosure. FIG. **3** is a cross-sectional view showing an internal construction of an ice making system for the refrigerator unit of FIG. **1**, in accordance with one embodiment of the present disclosure.

As shown in FIGS. **1** to **3**, the ice making system for the refrigerator unit according to exemplary embodiments of the present invention can efficiently circulate cold air produced from a cooling duct **210** inside an ice making cabinet **110** of the ice making unit **100**.

Here, the refrigerator unit **1** may include a refrigerator body **10** that defines an external appearance or exterior. A barrier **20** is configured for dividing the interior cavity of the refrigerator body **10** into a refrigeration compartment at the top thereof, and a freezer compartment at the bottom thereof. One or more doors may be configured to selectively isolate the interiors of the compartments from the surrounding environment. For example, a pair of refrigeration compartment doors **30** may be hinged to opposite edges of the front of the refrigeration compartment, and are configured through rotation thereof to selectively open and close the refrigeration compartment.

Although the refrigerator **1** of the exemplary embodiments of the present invention is a bottom freezer type refrigerator in which the freezer compartment is provided in the lower part of the refrigerator body, it should be understood that the present invention may be adapted to various types of refrigerators without being limited to the bottom freezer type refrigerator

The ice making system of the present invention includes an ice making unit **100**, a cold air generator **200**, a cold air circulation unit **300**, and a cold air guiding unit **400**.

Described in detail, the ice making unit **100** changes the phase of water to ice using cold air. The ice making unit may

be provided on an inner surface of the refrigeration compartment door **30**. Although the ice making unit **100** of the present embodiment is provided on the upper part or portion of the refrigeration compartment door **30**, the location is provided merely for illustration purposes only. It should be understood that the ice making unit **100** may be provided on another position of the refrigeration compartment door **30**, in a different position within the interior of the refrigeration compartment, and the like.

The ice making unit **100** may include an ice making cabinet **110**, an ice maker **120**, and an ice bank **130**.

Here, the ice making cabinet **110** may be provided on the inside surface of the refrigeration compartment door **30**, and may define an ice making space **111** in which ice cubes are produced. The ice maker **120** can freeze water using cold air flowing into the ice making space **111**, such as when making ice cubes. The ice maker **120** can discharge the ice cubes into the ice bank **130**. The ice bank **130** is provided at a location below the ice maker **120** and is configured to receive ice cubes discharged from the ice maker **120**. The ice bank **130** can store the ice cubes discharged from the ice maker **120**, and can dispense ice cubes to users using an ice dispenser unit (not shown).

The cold air circulation unit **300** functions to introduce cold air from the cold air generator **200** into the ice making space **111** of the ice making unit **100**. The cold air circulation unit **300** is also configured to discharge the cold air from the ice making space **111** to the cold air generator **200**, to undergo a new refrigeration cycle.

For example, the cold air circulation unit **300** may include an inlet hole **310** provided on an upper part of the ice making unit **100** and an outlet hole provided on a lower part of the ice making unit **100**. The inlet hole **310** in the ice making unit **100** may be provided at a location corresponding to a first duct hole **212** of the cooling duct **210**. The outlet hole **320** may be provided at a location corresponding to a second duct hole **213** of the cooling duct **210**. A circulation fan **330** may be configured to circulate cold air from the inlet hole **310** to the outlet hole **320** through the ice making unit **100**.

In particular, the cooling duct **210** is provided in the refrigerator body **10**, and the ice making unit **100** is provided on the refrigeration compartment door **30** of the refrigerator unit **1**. As such, when the refrigeration compartment door **30** is closed onto the refrigerator body **10**, the first duct hole **212** of cooling duct **210** may be aligned with the inlet hole **310** of the ice making unit **100**, and the second duct hole **213** of cooling duct **210** may be aligned with the outlet hole **320** of the ice making unit **100**.

Further, when the refrigeration compartment door **30** is closed onto the refrigerator body **10**, the cold air inside the cooling duct **210** flows into the inlet hole **310** of the ice making unit **100** via the first duct hole **212**. In the ice making unit **100**, the cold air introduced from the cooling duct **210** circulates inside the ice making space **111** by the operation of the circulation fan **330**. In that manner, water inside the ice making space **111** gradually freezes, and given enough refrigeration cycles ice cubes may be formed. Thereafter, the cold air inside the ice making unit **100** is discharged into the second duct hole **213** of the cooling duct **210** via the outlet hole **320**. The cold air discharged from the ice making unit **100** is cooled again inside the cooling duct **210**, and via the first duct hole **212** being reintroduced into the inlet hole **310** of the ice making unit **100**.

The cold air guiding unit **400** may guide the flow of the cold air such that the cold air can circulate inside the ice making unit **100** while branching. The cold air guiding unit **400** may be provided at a position in front of the inlet hole **310** through which the cold air flows into the ice making space **111**. Described in detail, the cold air guiding unit **400** may be provided at a position in front of the circulation fan **330**.

The cold air guiding unit **400** may include a main guide **410** that introduces the cold air from the cooling duct **210** into the cold air guiding unit **400**. A first sub-guide **420** extends upward from the main guide **410** so as to guide the cold air upward to a position above the ice maker **120** of the ice making unit **100**. A second sub-guide **430** extends downward from the main guide **410** so as to guide the cold air downward to a position below the ice maker **120** of the ice making unit **100**. Here, the first sub-guide **420** is provided with a plurality of first guide holes **421** that discharges the cold air over water contained in an ice making tray (not shown) of the ice maker **120**. The second sub-guide **430** is provided with a second guide hole **431** that discharges the cold air to a position below the ice making tray.

Thus, the first sub-guide **420** is configured to guide a portion of the cold air collected inside the main guide **410** to a position above the ice maker **120**. The second sub-guide **430** can guide a remaining portion of the cold air collected inside the main guide **410** to a position below the ice maker **120**.

In other words, the cold air that has been introduced into the cold air guiding unit **400** branches towards positions above and below the ice maker **120** via the first sub-guide **420** and the second sub-guide **430**. In that manner, cold air can efficiently cool the upper and lower parts of the ice cubes produced by the ice maker **120**. After passing through the ice maker **120**, the cold air flows along the inner surface of the ice making cabinet **110**, thus being efficiently discharged from the ice making cabinet **110** via the outlet hole **220**.

FIG. **4** is a block diagram showing the construction of the cold air generator **200** of the ice making system for the refrigerator unit **1**, in accordance with one embodiment of the present disclosure.

As shown in FIG. **4**, the cold air generator **200** can cool air flowing through the cooling duct **210**, thereby producing cold air. The cold air generator **200** can supply the cold air to the ice making unit **100**. The cold air generator **200** may be provided inside the refrigerator body **10** of the refrigerator unit **1**. More specifically, the cold air generator **200** may be provided on the sidewall of the refrigerator body **10**, in one embodiment. In another embodiment, the cold air generator **200** may be provided in the lower part of the refrigerator body **10**.

The cold air generator **200** includes the cooling duct **210** that is provided in the sidewall of the refrigerator body. The cooling duct is configured to form a cooling line through which air flows. An evaporation coil **220** is configured to be wound around the cooling duct **210**, such that the air inside and traveling through the cooling duct is cooled by a heat exchanging operation between the air and a refrigerant. A compressor **230** is configured to compresses the refrigerant discharged from the evaporation coil **220** so as to change the refrigerant to a high temperature and high pressure vapor or gas refrigerant. A condenser **240** is configured to condense the gas refrigerant so as to change the gas refrigerant to a high pressure liquid refrigerant. An expansion valve **250** is configured to perform adiabatic expansion of the liquid refrigerant, and supplies the liquid refrigerant to the evaporation coil **220**.

The first duct hole **212** may be provided on the upper end of the cooling duct **210**, such that the first duct hole **212** can communicate with, or is connected to, the inlet hole **310** of the ice making unit **100** when the refrigeration compartment

door **30** is closed. The second duct hole **213** may be provided on the lower end of the cooling duct **210**, such that the second duct hole **213** can communicate with, or is connected to, the outlet hole **320** of the ice making unit **100** when the refrigeration compartment door **30** is closed.

In some embodiments, the compressor **230**, the condenser **240**, the expansion valve **250**, and the evaporation coil **220** are configured to implement a refrigeration cycle for the purpose of supplying cold air. The refrigeration cycle composed of four processes (e.g., compression, condensation, expansion, and evaporation) is performed in which a heat exchanging operation between air and refrigerant is implemented. Accordingly, air inside the cooling duct **210** may be cooled to become cold air by a heat exchanging operation performed, in part, between the air inside the cooling duct **210** and the refrigerant inside the evaporation coil **220**. In particular, the evaporation coil **220** cools the cooling duct **210** through heat conduction. Further, the cooling channel defined by and within the cooling duct **210** is sufficiently long such that air inside the cooling line can be efficiently cooled. That is, when the air flows through the cooling line for a predetermined period of time (dependent in part on the length of and flow of air through the cooling duct **210**), the air can be cooled to a predetermined temperature (for example, 14 degrees Fahrenheit below zero or lower) at which the cold air can efficiently make ice cubes.

Accordingly, the refrigerant may be used in a refrigeration cycle performed by the evaporation coil **220**, the compressor **230**, the condenser **240**, and the expansion valve **250**. In that manner, the refrigerant may cool the air in the cooling duct, thereby supplying cold air to the ice making unit **100**.

Although the compressor **230**, the condenser **240**, and the expansion valve **250** in the exemplary embodiment of the present invention form a refrigeration cycle that can be implemented to supply cold air to the ice making unit **100**, other embodiments are well suited to supporting a refrigeration cycle that may supply cold air to both the refrigeration compartment and the freezer compartment of a refrigerator unit. In still another embodiment, the compressor **230**, the condenser **240**, and the expansion valve **250** may use the refrigerant used in an evaporator (not shown) to supply cold air to both the refrigeration compartment and the freezer compartment.

FIG. **5** is a cross-sectional view showing another internal construction of an ice making system for a refrigerator unit, in accordance with one embodiment of the present disclosure. The internal construction of the ice making system of FIG. **5** is different than the internal construction of the ice making system of FIG. **3**. Similarly numbered elements in FIGS. **3** and **5** perform essentially the same functionality.

As shown in FIG. **5**, a cold air guiding unit **400'** is configured such that cold air flowing from the cooling duct **210** can more efficiently flow to branches due to the presence of a round surface **411**.

For example, inside the main guide **410'** of the cold air guiding unit **400'**, a round surface **411** is provided at a branching point from which the first sub-guide **420** and the second sub-guide **430** branch from each other. The round surface **411** can minimize frictional contact of cold air inside the cold air guiding unit **400'**. In that manner, the cold air can more efficiently flow inside the cold air guiding unit **400'**, for example when compared to a flat surface at the branching point of the cold air guiding unit **400** of FIG. **3**.

FIG. **6** is a view showing still another internal construction of an ice making system for a refrigerator, in accordance with one embodiment of the present disclosure. The internal construction of the ice making system of FIG. **6** is different than the internal construction of the ice making system of FIG. **3**, and is different than the internal construction of the ice making system of FIG. **5**. However, each of the ice making systems in FIGS. **3**, **5**, and **6** are implementable within the refrigerator unit **1** of FIG. **1**. Similarly numbered elements in FIGS. **3**, **5**, and **6** perform essentially the same functionality

As shown in FIG. **6**, a cold air guiding unit **400"** is configured such that when cold air flows from the cooling duct **210** into the cold air guiding unit **400"** the guide unit **400"** can control the amounts of cold air guided to the first sub-guide **420** and the second sub-guide **430**. In particular, to control the amounts of cold air guided to the first sub-guide **420** and the second sub-guide **430**, an inclined surface **412** is provided in the guide unit **400"**.

For example, when the inclined surface **412** is inclined towards the second sub-guide **430** by a surface area of "b" as shown in FIG. **6**, the cold air flowing from the cooling duct **210** may be guided to the second sub-guide **430** by an amount corresponding to the surface area of "b". Also, the cold air flowing from the cooling duct **210** may be guided to the first sub-guide **420** by an amount corresponding to a surface area of "a".

More specifically, the direction of inclination of the inclined surface **412** in the cold air guiding unit **400"** is configured such that the amount of cold air guided to the second sub-guide **430** is greater than the amount of cold air guided to the first sub-guide **420**. In that manner, the cold air can circulate in the ice making cabinet **110** in a direction in which the cold air is discharged from the second sub-guide **430**. However, it should be understood that the direction of inclination of the inclined surface **411** in the cold air guiding unit **400"** may be freely changed as desired without being limited to the embodiment shown in FIG. **6**

FIG. **7** is a flow diagram illustrating a method of making ice in a refrigerator unit, in accordance with one embodiment of the present disclosure.

As shown in FIG. **7**, the ice making method for the refrigerator unit may include: a step of cooling air using a cooling duct so as to produce cold air (S**100**); a step of supplying the cold air to the ice making unit to make ice cubes (S**200**); a step of circulating the cold air in the ice making unit (S**300**); a step of discharging the cold air from the ice making unit to the cooling duct (S**400**); and a step of cooling the discharged cold air again in the cooling duct (S**500**).

In the step of cooling air using the cooling duct so as to produce cold air (S**100**), air is cooled to become cold air by making the air flow through the cooling duct on which the evaporation coil is wound. In this case, the air inside the cooling duct flows through the cooling line for a predetermined period of time while losing heat by the refrigerant flowing in the evaporation coil. In that manner, the air discharged from the cooling line can be cooled to a predetermined temperature (for example, 14 degrees Fahrenheit below zero or lower) at which the cold air can efficiently make ice cubes.

In the step of supplying the cold air to the ice making unit so as to make ice cubes (S**200**), the cold air cooled in the cooling duct is supplied to the ice making space of the ice making unit through the inlet hole of the ice making unit. Here, the cold air supplied to the ice making space circulates in the ice making space by the operation of the circulation fan, and can freeze water inside the ice making space, thereby making ice cubes.

In the step of circulating the cold air in the ice making unit (S**300**), the cold air inside the ice making unit is partially

guided to a position above the ice maker, and a remaining part of the cold air is guided to a position below the ice maker.

In the step of discharging the cold air from the ice making unit to the cooling duct (S**400**), the cold air is discharged from the ice making space into the cooling duct through the outlet hole of the ice making unit.

In the step of cooling the discharged cold air again in the cooling duct (S**500**), the cold air discharged into the cooling duct flows through the cooling line of the cooling duct for a predetermined period of time, thereby being cooled to a predetermined temperature or lower at which the cold air can freeze water to make ice cubes.

The foregoing description, for purpose of explanation, has been described with reference to specific embodiments of an ice maker and a method for deodorizing the same. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. It should be construed that the present invention has the widest range in compliance with the basic idea disclosed in the invention. Many modifications and variations are possible in view of the above teachings. Although it is possible for those skilled in the art to combine and substitute the disclosed embodiments to embody the other types that are not specifically disclosed in the invention, they do not depart from the scope of the present invention as well. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention. Further, 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.

The process parameters and sequence of steps described and/or illustrated herein are given by way of example only and can be varied as desired. For example, while the steps illustrated and/or described herein may be shown or discussed in a particular order, these steps do not necessarily need to be performed in the order illustrated or discussed. The various example methods described and/or illustrated herein may also omit one or more of the steps described or illustrated herein or include additional steps in addition to those disclosed.

Embodiments according to the invention are thus described. While the present disclosure has been described in particular embodiments, it should be appreciated that the invention should not be construed as limited by such embodiments.

What is claimed is:

1. An ice making system for a refrigerator, the ice making system comprising:
- an ice making unit that makes ice cubes;
- a cold air generator that cools air inside a cooling duct so as to produce cold air;
- a cold air circulation unit that supplies the cold air from the cold air generator to the ice making unit and discharges the cold air from the ice making unit to the cold air generator; and
- a cold air guiding unit that circulates the cold air inside the ice making unit,
- wherein the cold air guiding unit comprises:
  - a main guide that introduces the cold air from the cooling duct into the cold air guiding unit;
  - a first sub-guide that extends upward from the main guide so as to guide the cold air upward to a position above an ice maker of the ice making unit; and
  - a second sub-guide that extends downward from the main guide so as to guide the cold air downward to a position below the ice maker of the ice making unit.

2. The ice making system for the refrigerator according to claim **1**, wherein the cold air generator comprises:
- the cooling duct through which the air flows;
- an evaporation coil wound around the cooling duct such that the air is cooled by a heat exchanging operation between the air and a refrigerant;
- a compressor that compresses the refrigerant discharged from the evaporation coil so as to change the refrigerant to a high temperature and high pressure gas refrigerant;
- a condenser that condenses the gas refrigerant so as to change the gas refrigerant to a high pressure liquid refrigerant; and
- an expansion valve that performs adiabatic expansion of the liquid refrigerant and supplies the refrigerant to the evaporation coil.

3. The ice making system for the refrigerator according to claim **1**, wherein the ice making unit comprises:
- an ice making cabinet defining an ice making space;
- the ice maker making the ice cubes using the cold air; and
- an ice bank storing the ice cubes.

4. The ice making system for the refrigerator according to claim **1**, wherein the cold air circulation unit comprises:
- an inlet hole provided on an upper part of the ice making unit such that the cold air flows from the cooling duct into the ice making unit;
- an outlet hole provided on a lower part of the ice making unit such that the cold air is discharged from the ice making unit into the cooling duct; and
- a circulation fan that circulates the cold air from the inlet hole to the outlet hole.

5. The ice making system for the refrigerator according to claim **1**, wherein:
- the cooling duct is provided in a refrigerator body, and the ice making unit is provided on a refrigeration compartment door of the refrigerator, and
- the cooling duct connects with the ice making unit when the refrigeration compartment door is closed.

6. The ice making system for the refrigerator according to claim **2**, wherein the evaporation coil functions as an evaporator of a refrigeration cycle, and cools the cooling duct through heat conduction.

7. An ice making method for a refrigerator, the method comprising:
- cooling air using a cooling duct so as to produce cold air;
- supplying the cold air to an ice making unit so as to make ice cubes;
- circulating the cold air in the ice making unit;
- discharging the cold air from the ice making unit to the cooling duct; and
- cooling the discharged cold air again in the cooling duct, wherein said circulating the cold air in the ice making unit further comprises:
  - guiding the cold air to a position above an ice maker of the ice making unit and to a position below the ice maker.

8. The ice making method of claim **7**, further comprising:
- providing a main guide in a cold air guiding unit configured to introduce the cold air from the cooling duct into the cold air guiding unit, wherein the cold air guiding unit is configured to circulate the cold air in the ice making unit;

providing a first sub-guide that extends upward from the main guide so as to guide the cold air upward to a position above an ice maker of the ice making unit; and

providing a second sub-guide that extends downward from the main guide so as to guide the cold air downward to a position below the ice maker of the ice making unit.

9. The ice making method for the refrigerator according to claim **7**, wherein the cooling of the air using the cooling duct so as to produce the cold air further comprises:

circulating the air through a cooling line of the cooling duct for a predetermined period of time, thereby cooling the air to a predetermined temperature or lower and producing the cold air.

10. The ice making method for the refrigerator according to claim **7**, further comprising:

circulating air from the cooling duct to the ice making unit via an inlet hole provided on an upper part of the ice making unit;

discharging air from the ice making unit into the cooling duct via an outlet hole provided on a lower part of the ice making unit; and

circulating the cold air from the inlet hole to the outlet hole in the ice making unit.

11. The ice making method for the refrigerator according to claim **7**, further comprising:

providing the cooling duct in a refrigerator body;

providing the ice making unit on a refrigeration compartment door; and

connecting the cooling duct with the ice making unit when the refrigeration compartment door is closed.

12. A refrigerator, comprising:

a freezer compartment located within a main body of the refrigerator;

a refrigeration compartment located within the main body of the refrigerator, wherein the freezer compartment is located below the refrigeration compartment;

an ice making unit that makes ice cubes;

a cold air generator that cools air inside a cooling duct so as to produce cold air;

a cold air circulation unit that supplies the cold air from the cold air generator to the ice making unit and discharges the cold air from the ice making unit to the cold air generator; and

a cold air guiding unit that circulates the cold air inside the ice making unit, wherein the cold air guiding unit comprises:

a main guide that introduces the cold air from the cooling duct into the cold air guiding unit;

a first sub-guide that extends upward from the main guide so as to guide the cold air upward to a position above an ice maker of the ice making unit; and

a second sub-guide that extends downward from the main guide so as to guide the cold air downward to a position below the ice maker of the ice making unit.

13. The refrigerator according to claim **12**, wherein the cold air generator includes:

the cooling duct through which the air flows;

an evaporation coil wound around the cooling duct such that the air is cooled by a heat exchanging operation between the air and a refrigerant;

a compressor that compresses the refrigerant discharged from the evaporation coil so as to change the refrigerant to a high temperature and high pressure gas refrigerant;

a condenser that condenses the gas refrigerant so as to change the gas refrigerant to a high pressure liquid refrigerant; and

an expansion valve that performs adiabatic expansion of the liquid refrigerant and supplies the refrigerant to the evaporation coil.

14. The refrigerator according to claim **13**, wherein the evaporation coil functions as an evaporator of a refrigeration cycle, and cools the cooling duct through heat conduction.

15. The refrigerator according to claim **12**, wherein the ice making unit comprises:

an ice making cabinet defining an ice making space;

the ice maker making the ice cubes using the cold air; and

an ice bank storing the ice cubes.

16. The refrigerator according to claim **12**, wherein the cold air circulation unit comprises:

an inlet hole provided on an upper part of the ice making unit such that the cold air flows from the cooling duct into the ice making unit;

an outlet hole provided on a lower part of the ice making unit such that the cold air is discharged from the ice making unit into the cooling duct; and

a circulation fan that circulates the cold air from the inlet hole to the outlet hole.

17. The refrigerator according to claim **12**, wherein:

the cooling duct is provided in a refrigerator body, and

the ice making unit is provided on a refrigeration compartment door of the refrigerator, and the cooling duct connects with the ice making unit when the refrigeration compartment door is closed.

* * * * *