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(54) METHOD FOR CONTROLLING OPERATION OF REFRIGERATOR WITH TWO EVAPORATORS

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(57) **ABSTRACT**

A method for controlling operation of a refrigerator having two evaporators is provided which allows food to be effectively stored in refrigerating and freezing chambers of the refrigerator. A Refrigerating-Freezing (RF) cycle and/or a Freezing (F) cycle of the refrigerator and compressor operation are controlled based on temperatures of various chambers within the refrigerator. This may be further enhanced by also controlling operation of the evaporators and their respective evaporator fans to further optimize cooling output and efficiency. In this manner, the various refrigerating and freezing chambers of the refrigerator can be maintained at an appropriate temperature, power consumption is minimized, and load on the compressor can be adequately managed so as to provide for effective food storage.

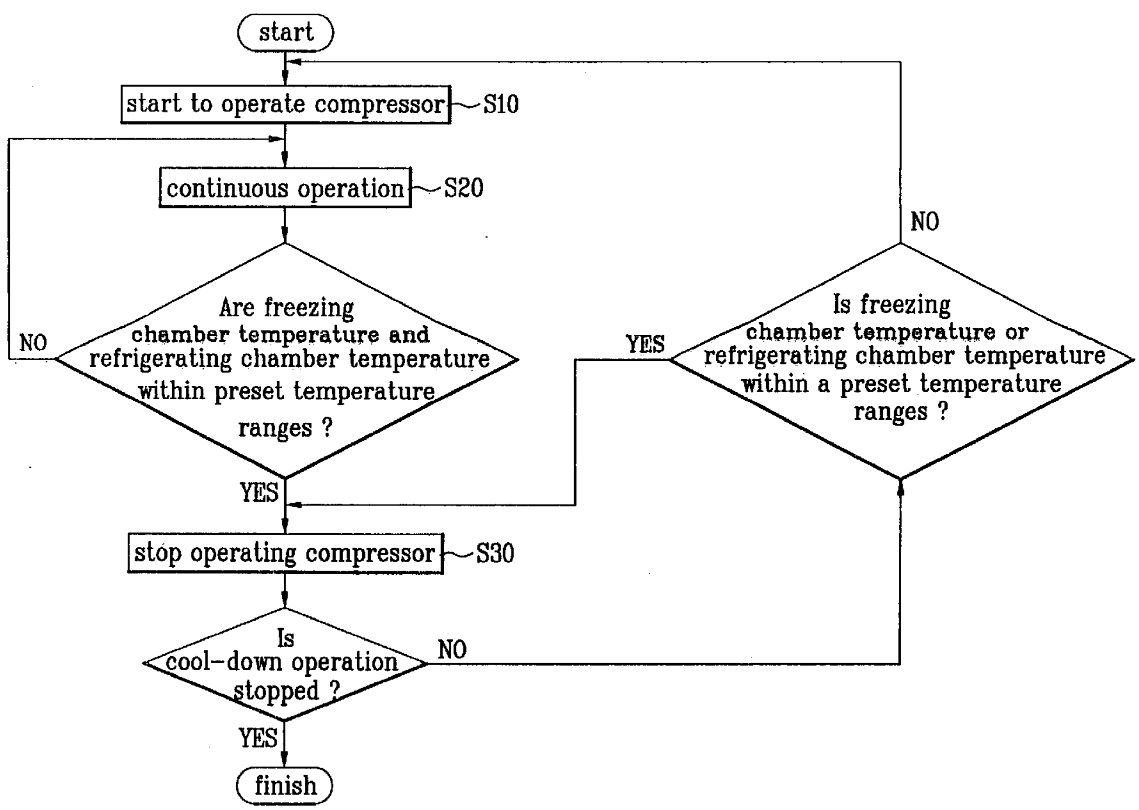


FIG.1A
Related art

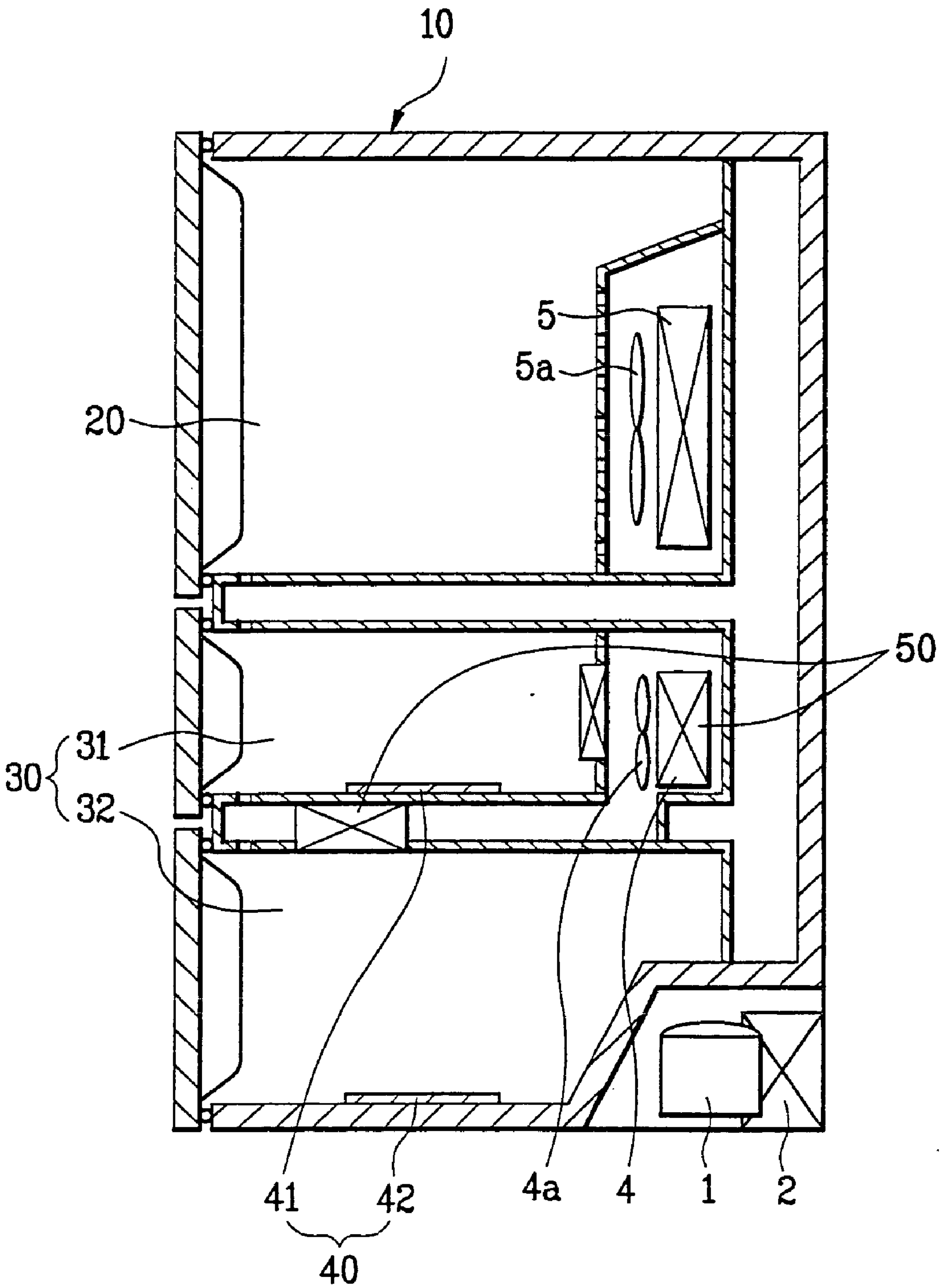


FIG.1B
Related art

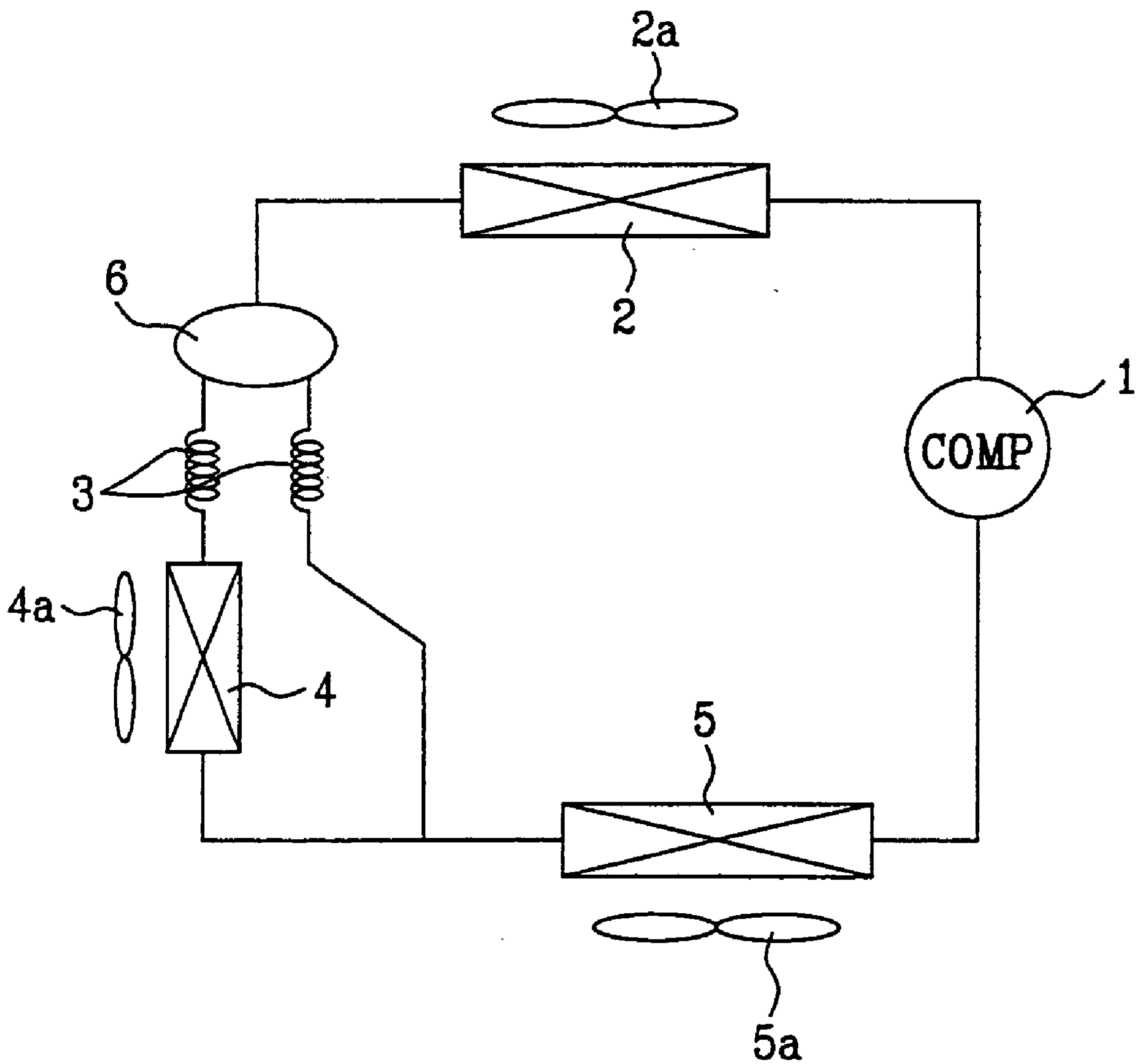


FIG. 2
Related art

freezing chamber	refrigerating chamber	compressor
>	>	ON (operation start)
	<	
<	>	OFF (operation stop)
	<	

> : When temperatures of respective chambers exceed upper limits of preset temperature ranges

< : When temperatures of respective chambers are within preset temperature ranges

FIG. 3

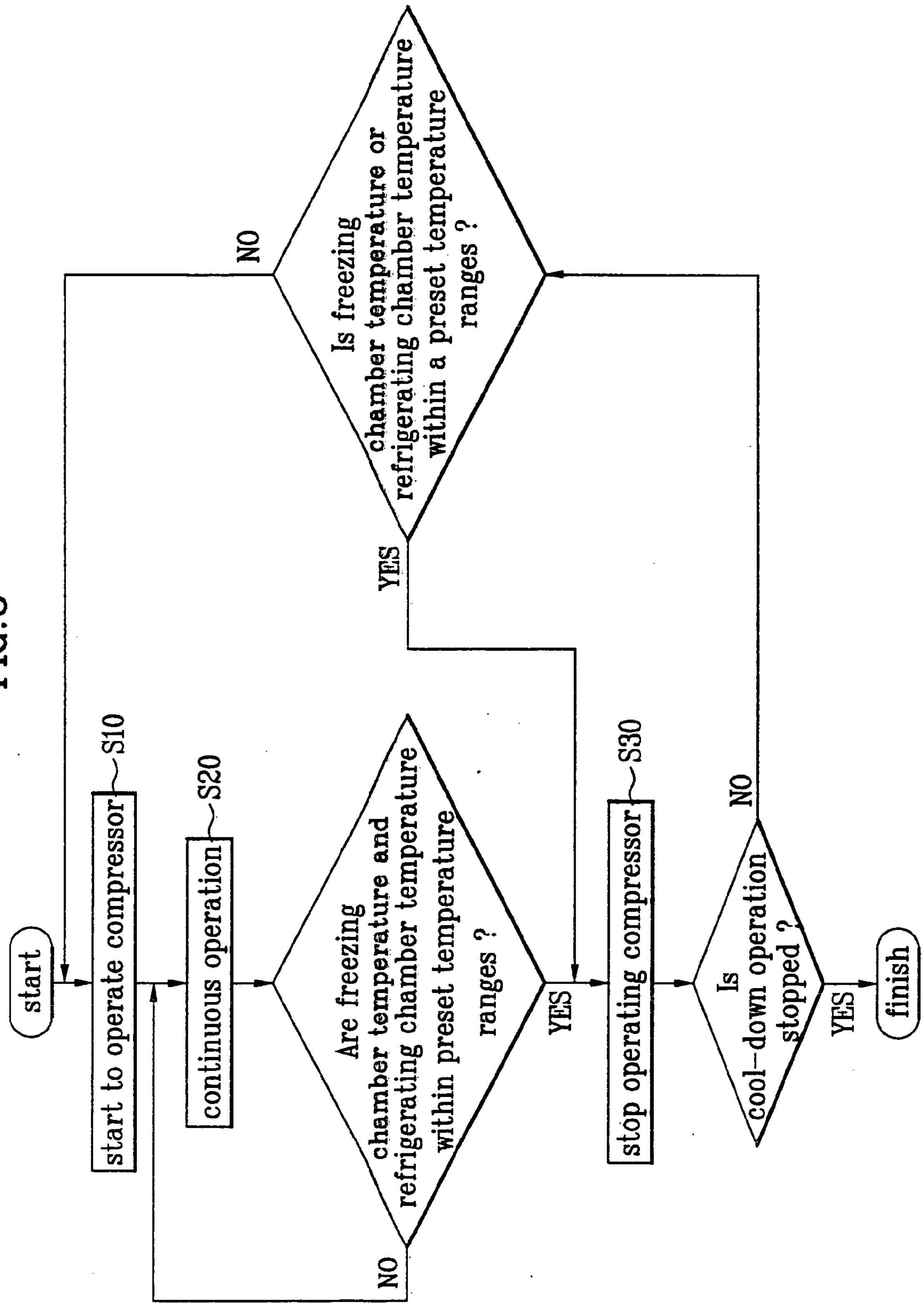

start
start to operate compressor
S10
continuous operation
S20
Are freezing chamber temperature and refrigerating chamber temperature within preset temperature ranges ?
YES
NO
stop operating compressor
S30
Is cool-down operation stopped ?
YES
NO
finish
Is freezing chamber temperature or refrigerating chamber temperature within a preset temperature ranges ?
YES
NO

FIG. 4

freezing chamber	refrigerating chamber	compressor
>	>	ON (operation start)
	<	
<	>	ON (continuous operation)
	<	OFF (operation stop)

> : When temperatures of respective chambers exceed upper limits of preset temperature ranges

< : When temperatures of respective chambers are within preset temperature ranges

FIG. 5A

freezing chamber	refrigerating chamber	compressor
>	>	ON (operation start)
	<	
<	>	
	<	OFF (operation stop)

> : When temperatures of respective chambers exceed upper limits of preset temperature ranges

< : When temperatures of respective chambers are within preset temperature ranges

FIG. 5B

<table>
<tr><th rowspan="2">freezing chamber</th><th colspan="2">refrigerating chamber</th><th rowspan="2">compressor</th></tr>
<tr><th>upper part (designated)</th><th>lower part</th></tr>
<tr><td rowspan="4">></td><td rowspan="2">></td><td>></td><td rowspan="6">ON (operation start)</td></tr>
<tr><td><</td></tr>
<tr><td rowspan="2"><</td><td>></td></tr>
<tr><td><</td></tr>
<tr><td rowspan="4"><</td><td rowspan="2">></td><td>></td></tr>
<tr><td><</td></tr>
<tr><td rowspan="2"><</td><td>></td><td>ON (continuous operation)</td></tr>
<tr><td><</td><td>OFF (operation stop)</td></tr>
</table>

>: When temperatures of respective chambers exceed upper limits of preset temperature ranges

<: When temperatures of respective chambers are within preset temperature ranges

FIG.5C

<table>
<tr><th rowspan="2">freezing chamber</th><th colspan="2">refrigerating chamber</th><th rowspan="2">compressor</th></tr>
<tr><th>upper part</th><th>lower part (designated)</th></tr>
<tr><td rowspan="4">></td><td rowspan="2">></td><td>></td><td rowspan="5">ON (operation start)</td></tr>
<tr><td><</td></tr>
<tr><td rowspan="2"><</td><td>></td></tr>
<tr><td><</td></tr>
<tr><td rowspan="4"><</td><td rowspan="2">></td><td>></td></tr>
<tr><td><</td><td>ON (continuous operation)</td></tr>
<tr><td rowspan="2"><</td><td>></td><td>ON (operation start)</td></tr>
<tr><td><</td><td>OFF (operation stop)</td></tr>
</table>

> : When temperatures of respective chambers exceed upper limits of preset temperature ranges

< : When temperatures of respective chambers are within preset temperature ranges

FIG. 6

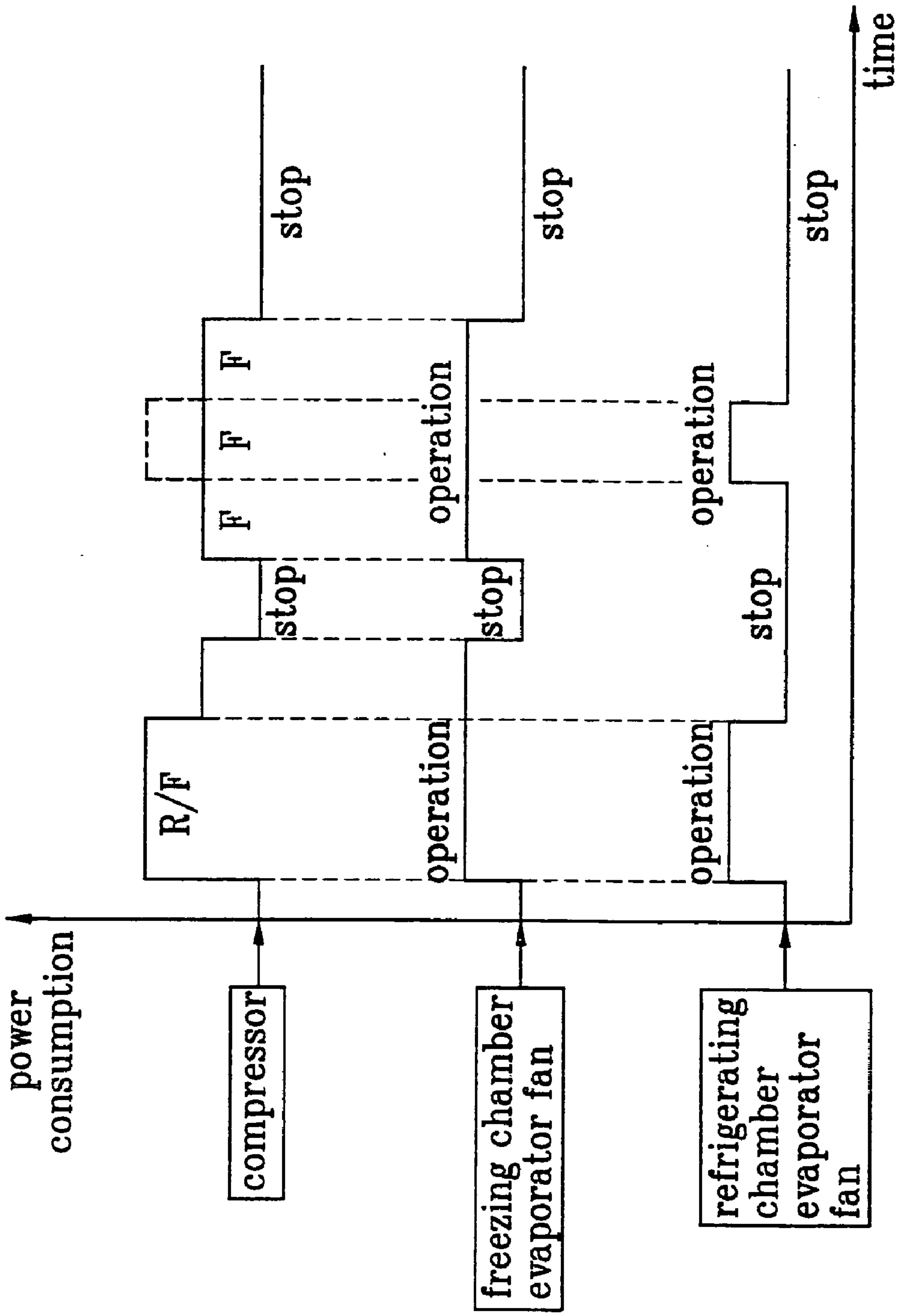

power consumption
compressor
freezing chamber evaporator fan
refrigerating chamber evaporator fan
R/F
F
F
F
operation
operation
operation
operation
stop
stop
stop
stop
stop
stop
time

FIG.7

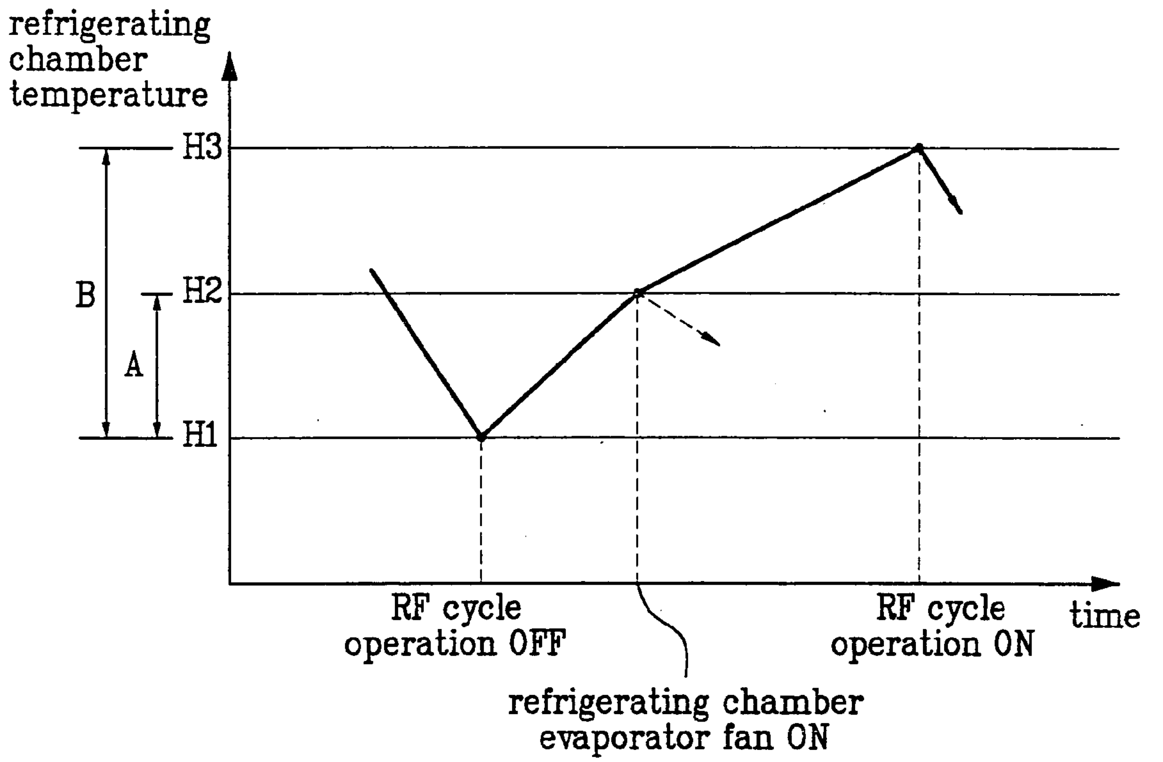

refrigerating
chamber
temperature
H3
H2
H1
B
A
RF cycle
operation OFF
RF cycle
operation ON
time
refrigerating chamber
evaporator fan ON

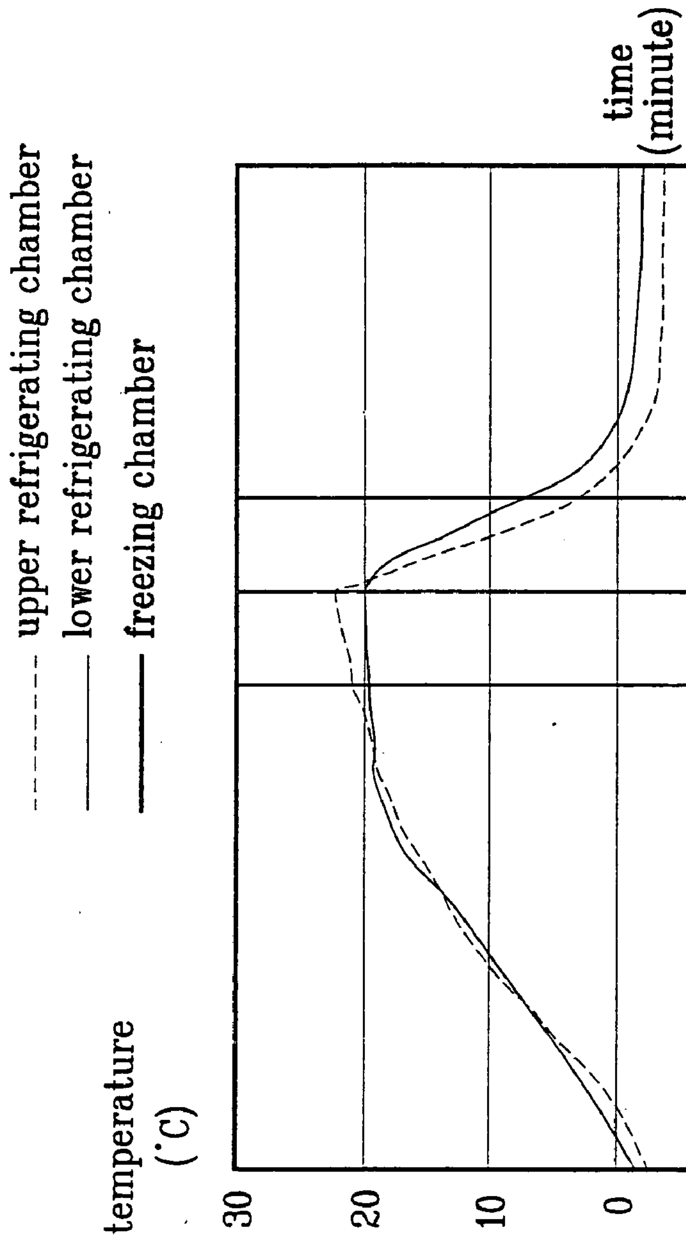
FIG. 8

upper refrigerating chamber	lower refrigerating chamber	freezing chamber	compressor	upper refrigerating chamber fermenting heater	lower refrigerating chamber fermenting heater
>	>	>	ON	OFF	OFF
		<			
	<	>			ON
		<			
<	>	>		ON	OFF
		<			
	<	>			ON
		<	OFF		

>: When temperatures of respective chambers are higher than preset fermenting temperatures

<: When temperatures of respective chambers are lower than preset fermenting temperatures

FIG. 9


upper refrigerating chamber
lower refrigerating chamber
freezing chamber
temperature (°C)
30
20
10
0
−10
−20
−30
time (minute)
C1
C2
C3

METHOD FOR CONTROLLING OPERATION OF REFRIGERATOR WITH TWO EVAPORATORS

[0001] This application claims the benefit of the Korean Application No. P2001-24932 filed on May 8, 2001, No. P2001-24875 filed on May 8, 2001, No. P2001-24874 filed on May 8, 2001, No. P2001-25494 filed on May 10, 2001, and No. P2001-25792 filed on May 11, 2001, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a refrigerator, and more particularly, to a method for controlling an operation of a refrigerator with two evaporators.

[0004] 2. Discussion of the Related Art

[0005] Generally, a refrigerator is an appliance used for fresh storage of food for a prolonged time period, and a recent trend has been development of a refrigerator for effective storage of Kimchi, a Korean specialty.

[0006] Referring to **FIG. 1A**, the refrigerator is provided with a body **10**, a freezing chamber **20** for frozen storage of food, a refrigerating chamber **30** for cold storage of food, and a refrigerating cycle for cooling the freezing chamber and the refrigerating chamber. The unexplained reference symbols **40** and **50** are a fermenting heater operative in a fermenting mode, and a damper, respectively.

[0007] Referring to **FIG. 1B**, the refrigerating cycle is provided with a compressor **1** for compressing refrigerant, a condenser **2** for isobaric condensing of the compressed refrigerant, a capillary tube **3** for adiabatic expansion of the condensed refrigerant, evaporators for the refrigerating chamber and for the freezing chamber, **4** and **5**, respectively, provided at the refrigerating chamber **30** and the freezing chamber **20**, respectively, for isobaric evaporation of the expanded refrigerant.

[0008] The refrigerating cycle is also provided with a three-way valve **6** at a branched point of a flow passage for selective introduction of the refrigerant condensed at the condenser **2** into the evaporators for the refrigerating chamber **4** or the freezing chamber **5** along the branched flow passage, a condenser fan **2*a*** at the condenser **2** for cooling the condenser or the compressor **1**, a refrigerating chamber evaporator fan **4*a*** at the refrigerating chamber evaporator **4** for accelerating heat exchange by forcible circulation of air heat-exchanged at the refrigerating chamber evaporator **4**, and a freezing chamber evaporator fan **5*a*** at the freezing chamber evaporator **5** for accelerating heat exchange by forcible circulation of air heat-exchanged at the freezing chamber evaporator **5**.

[0009] Hereinafter, referring to **FIG. 1B**, the operation of the refrigerator having the refrigerating cycle will be explained.

[0010] First, in Refrigerating-Freezing (RF) cycle operation, in which both the refrigerating chamber evaporator **4** and the freezing chamber evaporator **5** are operative, the three-way valve **6** is opened to introduce the refrigerant into the refrigerating chamber evaporator **4**, and the gaseous refrigerant compressed at the compressor **1** undergoes a phase conversion into a liquid refrigerant as it passes through the condenser **2**, a pressure drop as the refrigerant passes through the capillary tube **3**, a phase conversion into gaseous refrigerant as it passes through the refrigerating chamber evaporator **4** and the freezing chamber evaporator **5** sequentially, conducting a heat exchange with air in the refrigerating chamber **30** and the freezing chamber **20**, respectively, and is then introduced into the compressor **1**.

[0011] Second, in Freezing (F) cycle operation, in which only the freezing chamber evaporator **5** is operative, the three-way valve **6** is opened to introduce the refrigerant into the freezing chamber evaporator **5**, and the gaseous refrigerant compressed in the compressor **1** is involved in a phase conversion into a liquid refrigerant as it passes through the condenser, a pressure drops as it passes through the capillary tube **3**, and a phase conversion into gaseous refrigerant as it passes through the freezing chamber evaporator **5**, conducting a heat exchange with air in the freezing chamber **20**, and is then introduced into the compressor **1**.

[0012] In the meantime, referring to **FIG. 2**, in a related art refrigerator, a Freezing (F) control method is employed in which the compressor **1** is turned on/off according to a temperature of the freezing chamber **20**. That is, if the freezing chamber **20** temperature exceeds an upper limit of a preset temperature range, the compressor **1** is put into operation, to start the RF cycle operation or the F cycle operation, and if the freezing chamber temperature is within the preset temperature range, the compressor **1** is stopped, to stop the RF cycle operation or the F cycle operation.

[0013] However, the foregoing related art method for controlling operation of a refrigerator has the following problems.

[0014] First, the stop of the compressor **1** under the F control method has the following problem. If the compressor **1** is stopped in the middle of the F cycle operation because the freezing chamber **20** temperature is within the preset temperature range in accordance with the F control method as discussed, but the refrigerating chamber **30** temperature exceeds an upper limit of its preset temperature range due to internal and external loads during a time period from when the RF cycle operation is stopped to a time when the compressor **1** comes into operation again, there is a problem with the cold storage of food.

[0015] That is, if the RF cycle operation is stopped as the refrigerating chamber **30** temperature is within the preset temperature range, the compressor **1** is stopped, and the F cycle operation is also stopped as the freezing chamber **20** temperature is within the preset temperature range. In this instance, if an external air temperature is high above a designed value due to abnormally high temperature due to weather, there is an excessive heat exchange between external air and internal air of the freezing chamber **20** and the refrigerating chamber **30**, causing a temperature rise of the refrigerating chamber **30** from a point in time when the RF cycle operation is stopped. This increase in temperature occurs at a rate higher than in the freezing chamber **20**, as a surface area of the refrigerating chamber is larger than that of the freezing chamber **20**, and an insulation thickness of the refrigerating chamber **30** is thinner than that of the freezing chamber **20**.

[0016] Eventually, because the refrigerating chamber **30** is in a state in which the temperature thereof exceeds the preset temperature range from a point in time when the RF cycle operation is stopped to a point in time when the RF cycle operation is started again and the compressor **1** is put into operation again, there is a problem with the cold storage of food.

[**0017**] Also, since the compressor **1** is stopped if the freezing chamber **20** temperature is within the preset temperature range, when hot food is put in the refrigerating chamber **30** after the RE cycle operation is stopped, the refrigerating chamber **30** temperature exceeds the upper limit of the preset temperature range.

[**0018**] According to this, since the refrigerating chamber **30** temperature exceeds the upper limit of the preset temperature range from a moment when hot food is put in the refrigerating chamber **30** to a moment when the RF cycle operation starts again by putting the compressor **1** into operation again, there is a problem with the cold storage of food.

[**0019**] Second, if the compressor **1** is controlled under the F control method, the following problem is caused.

[**0020**] If operation of the compressor **1** is determined only by the freezing chamber **20** temperature, that is, if the compressor **1** is put into operation only when the freezing chamber **20** temperature exceeds the upper limit of the preset temperature range, there is a problem with cold storage of food when the refrigerating chamber **30** temperature exceeds the upper limit of the preset temperature range due to said the foregoing various factors (the external air temperature, or hot food temperature) or frequent opening/closing of the refrigerating chamber **30**.

SUMMARY OF THE INVENTION

[**0021**] Accordingly, the present invention is directed to a method for controlling operation of a refrigerator with two evaporators that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[**0022**] An object of the present invention is to provide a method for controlling operation of a refrigerator with two evaporators, in which food can be effectively stored in a cold or frozen even in the presence of internal and external loads which influence a refrigerating chamber or a freezing chamber.

[**0023**] Another object of the present invention is to provide a method for controlling operation of a refrigerator with two evaporators, which can effectively ferment food that requires fermentation, and prevent a temperature rise of a freezing chamber when a fermenting mode is finished.

[**0024**] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[**0025**] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a method for controlling operation of a refrigerator with two evaporators includes the steps of (a) starting step for starting the compressor; (b) continuous operation step for carrying out the RF cycle operation or the F cycle operation depending on a temperature of the freezing chamber or the refrigerating chamber after the compressor is started; and (c) operation stopping step for stopping operation of the compressor if the freezing chamber temperature and the refrigerating chamber temperature are within respective preset temperature ranges.

[**0026**] At this time, the step (a) includes a step for starting the compressor when the freezing chamber temperature exceeds an upper limit of a preset temperature range as one embodiment, and includes a step for starting the compressor when either the freezing chamber temperature or the refrigerating chamber temperature exceeds an upper limit of a preset temperature range as another embodiment.

[**0027**] The step (b), as one embodiment, includes a step for selectively operating a step including a first step for making the RF cycle operation if the freezing chamber temperature and the refrigerating chamber temperature exceed upper limits of the respective preset temperature ranges, a second step for making the F cycle operation if the refrigerating chamber temperature is within a preset temperature range and the freezing chamber temperature exceeds an upper limit of a preset temperature range, and a third step for making the F cycle operation if the freezing chamber temperature is within a preset temperature range and the refrigerating chamber temperature exceeds an upper limit of a preset temperature range.

[**0028**] Also, the step (b), as another embodiment, includes a RF cycle operation step for making the RF cycle operation if the freezing chamber temperature and the refrigerating chamber temperature exceed upper limits of the respective preset temperature ranges, an F cycle operation step for making the F cycle operation if the refrigerating chamber temperature is within a preset temperature range and the freezing chamber temperature exceeds an upper limit of a preset temperature range, and a continuous F cycle operation step for making the F cycle operation continuously even if the freezing chamber temperature is within a preset temperature range and the refrigerating chamber temperature exceeds an upper limit of a preset temperature range.

[**0029**] In the meantime, it is preferable that a method for controlling operation of a refrigerator according to the present invention further includes a multiple stage load responding step for operating the refrigerating chamber evaporator fan only or making the RF cycle operation again under a state the RF cycle operation is stopped by setting a temperature range of the refrigerating chamber in multiple stages for multiple stage control of the refrigerating chamber temperature varied under influences from internal and external loads during the step (b) is carried out.

[**0030**] Herein, it is preferable that the step (d) further includes a first stage load responding step for operating the refrigerating chamber evaporator fan at the refrigerating chamber evaporator when the refrigerating chamber temperature exceeds the upper limit of the first preset temperature range due to the internal and external loads after the RF cycle operation is stopped; and a second stage load responding step for operating the RF cycle after the RF cycle operation is stopped so as to introduce refrigerant to the refrigerating chamber evaporator in case that the refrigerating chamber temperature exceeds the upper limit of the second preset temperature range higher than that of the first preset temperature range.

[0031] In another meantime, it is preferable that a method for controlling operation of a refrigerator according to the present invention further includes the step (e) for stopping the compressor when the freezing chamber temperature and the refrigerating chamber temperature are lower than respective preset fermenting temperatures and for operating the compressor when at least one chamber temperature is higher than a preset fermenting temperature in a fermenting mode by a fermenting heater provided at the refrigerating chamber during the steps (a), (b), and (c) are repeated as a series of cycles.

[0032] Also, it is preferable that a method for controlling operation of a refrigerator further includes a first pre-cooling step for making the F cycle operation for a preset time period before the fermenting mode operation is stopped to cool down the freezing chamber in advance; and a second pre-cooling step for making the RF cycle operation to cool down the refrigerating chamber and the freezing chamber on the same time when the fermenting mode operation is stopped.

[0033] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0035] **FIG. 1A** illustrates a schematic sectional view showing a related art refrigerator;

[0036] **FIG. 1B** illustrates a block diagram showing a refrigerating cycle of a related art refrigerator;

[0037] **FIG. 2** illustrates a method for controlling operation of a related art refrigerator, showing conditions in which a compressor is turned on/off depending on a freezing chamber temperature;

[0038] **FIG. 3** illustrates a flow chart showing the steps of a method for controlling operation of a refrigerator in accordance with a preferred embodiment of the present invention;

[0039] **FIG. 4** illustrates conditions a compressor is turned on/off depending on temperatures of a freezing chamber and a refrigerating chamber according to an embodiment of the present invention;

[0040] **FIG. 5A** illustrates conditions a compressor is turned on/off depending on temperatures of a freezing chamber and a refrigerating chamber according to another embodiment of the present invention;

[0041] **FIG. 5B** illustrates detailed conditions of **FIG. 5A** showing turning on/off of the compressor depending on temperatures of the freezing chamber and an upper refrigerating chamber, in case that the refrigerator has two refrigerating chambers;

[0042] **FIG. 5C** illustrates detailed conditions of **FIG. 5A** showing turning on/off of the compressor depending on temperatures of the freezing chamber and a lower refrigerating chamber, in case that the refrigerator has two refrigerating chambers;

[0043] **FIG. 6** illustrates a state diagram showing a cycle in the step for continuous operation in a method for controlling operation of a refrigerator according to the present invention;

[0044] **FIG. 7** illustrates a graph showing a temperature variation of a refrigerating chamber by time depending on internal and external loads of the present invention;

[0045] **FIG. 8** illustrates turning on/off conditions of the compressor in a fermenting mode according to the present invention; and

[0046] **FIG. 9** illustrates a graph showing a temperature variation of a freezing chamber by time at the time when the fermenting mode ends according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0047] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0048] Since a Refrigerating-Freezing (RF) cycle of a refrigerator is described in the related art, the explanation will be omitted, and the same reference symbols will be used for the parts identical to the related art.

[0049] Referring to **FIGS. 3**, and **4** to **6**, a method for controlling operation of a refrigerator in accordance with a preferred embodiment of the present invention having an RF cycle operation in which a refrigerating chamber evaporator **4** and a freezing chamber evaporator **5** are put into operation in succession upon starting the compressor **1**, and an F cycle operation in which only the freezing chamber evaporator **5** is put into operation upon starting the compressor **1**, includes the steps of starting a compressor (S**10**), continuous operation of the compressor **1** for carrying out the RF cycle operation or the F cycle operation, depending on temperatures of the freezing chamber **20** and the refrigerating chamber **30** after the compressor is started (S**20**), and stopping operation of the compressor **1** in case that the freezing chamber **20** temperature and the refrigerating chamber **30** temperature are within preset temperature ranges, respectively (S**30**).

[0050] Various embodiments of the step of starting a compressor (S**10**) for the method for controlling operation of a refrigerator as shown in **FIG. 3** and in accordance with the present invention will be explained. These will be discussed with respect to **FIGS. 4 and** **5**A-**5**C.

[0051] First, the step of starting a compressor (S**10**) may be a step for starting a compressor **1** when a temperature of the freezing chamber **20** exceeds an upper limit of the preset temperature range, as shown in **FIG. 4**. Starting a compressor (**S10**) may also be a step for starting a compressor **1** when a temperature of either the freezing chamber **20** or the refrigerating chamber **30** exceeds an upper limit of a respective preset temperature range, as shown in **FIG. 5A**.

[**0052**] Herein, the step of starting a compressor (S**10**) as illustrated in **FIG. 4** has an advantage of reducing a number of turning on times, since operation of the compressor **1** depends only on a freezing chamber **20** temperature.

[**0053**] Also, the step of starting a compressor (S**10**) as illustrated in **FIG. 5A** has an advantage of effective frozen/cold storage of food because the starting of the compressor **1** is dependent both on the freezing chamber **20** temperature and the refrigerating chamber **30** temperature. So, even if the freezing chamber **20** temperature is within its preset temperature range, the compressor **1** remains operative if the refrigerating chamber **30** temperature exceeds the upper limit of its preset temperature range. Additionally, even if the refrigerating chamber **30** temperature is within its preset temperature range, the compressor **1** remains operative if the freezing chamber **20** temperature exceeds the upper limit of its preset temperature range.

[**0054**] Along with this, there may be other embodiments of the step of starting a compressor (S**10**) shown in **FIG. 3**, depending on a number of refrigerating chambers **30**. These will be discussed with respect to **FIGS. 5B and 5C**.

[**0055**] That is, if there are plural refrigerating chambers **30**, the compressor **1** may be put into operation if a temperature of at least one designated refrigerating chamber **30** or the freezing chamber **20** exceeds an upper limit of its respective preset temperature range. In this instance, it is preferable that there be at least one designated refrigerating chamber which has a greater temperature variation than the other refrigerating chambers **30** in view of characteristics of food storage for different types of food.

[**0056**] In detail, the at least one designated refrigerating chamber **30** may be a refrigerating chamber **30** which stores food requiring fermenting, such as Kimchi. The reason is because the temperature variation can be great, since a fermenting heater **40** is operated in the refrigerating chamber **30** when it is in the fermenting mode. Or, the at least one designated refrigerating chamber **30** may be one that requires frequent opening of the door.

[**0057**] In more detail, in a case in which the refrigerating chamber **30** is divided into an upper part **31** and a lower part **32**, the step for starting a compressor (S**10**) shown in **FIG. 3** may be conducted in two different manners, which will be discussed with respect to **FIGS. 5B and 5C**.

[**0058**] First, referring to **FIG. 5B**, the step of starting a compressor (S**10**) may be a step for starting the compressor **1** when a temperature of either the upper refrigerating chamber **31** or the freezing chamber **20** exceeds an upper limit of its preset temperature range if the upper refrigerating chamber **31** is the designated one. Of course, in this instance, the upper refrigerating chamber **31** has the greater temperature variation.

[**0059**] Second, referring to **FIG. 5C**, the step of starting a compressor (S**10**) may be a step for starting the compressor **1** when a temperature of either the lower refrigerating chamber **32** or the freezing chamber **20** exceeds an upper limit of its preset temperature range if the lower refrigerating chamber **32** is the designated one. Of course, in this instance, that the lower refrigerating chamber **32** has the greater temperature variation.

[**0060**] Thus, when there are plural refrigerating chambers **30**, since operation of the compressor **1** is dependent on the temperatures of the freezing chamber **20** and at least one designated refrigerating chamber (a refrigerating chamber having a greater temperature variation), starting the compressor **1** is dependent not only on the freezing chamber **20** temperature, but also on the refrigerating chamber **30** temperature. Thus, the step of starting a compressor (S**10**), when conducted in the manner described, has an advantage of permitting perfect frozen/cold storage of food.

[**0061**] Hereinafter, various embodiments of the step of continuous operation (**S20**) in the method for controlling operation of a refrigerator of the present invention shown in **FIG. 3** will be explained.

[**0062**] First, the step for continuous operation (S**20**) may include a first step for conducting an RF cycle operation if the freezing chamber **20** temperature and the refrigerating chamber **30** temperature exceed the upper limits of each preset temperature range, a second step for conducting an F cycle operation if the refrigerating chamber **30** temperature is within its preset temperature range and the freezing chamber **20** temperature exceeds an upper limit of its preset temperature range, and a third step for making an RF cycle operation if the freezing chamber **20** temperature is within its preset temperature range and the refrigerating chamber **30** temperature exceeds an upper limit of its preset temperature range.

[**0063**] Along with this, it is preferable that the third step further includes a step for suppressing heat exchange of the freezing chamber evaporators by stopping a freezing chamber evaporator fan Sa in order to maintain the freezing chamber **20** temperature within the preset temperature range.

[**0064**] Herein, this embodiment of the step for continuous operation (S**20**) will be explained in more detail.

[**0065**] Once the compressor **1** is put into operation, it is determined whether an RF cycle operation or an F cycle operation is conducted based on the freezing chamber **20** temperature and the refrigerating chamber **30** temperature. If the freezing chamber **20** temperature and the refrigerating chamber **30** temperature exceed the upper limits of each preset temperature range, the RF cycle operation is conducted so as to introduce refrigerant into the refrigerating chamber evaporator **4** and the freezing chamber evaporator **5**.

[**0066**] If only the freezing chamber **20** temperature exceeds the upper limit of its preset temperature range in the middle of an RF cycle operation, an F cycle operation is initiated so as to introduce the refrigerant into the freezing chamber evaporator **5**.

[**0067**] Though it is required to drop the refrigerator chamber **30** temperature when the refrigerating chamber **30** temperature exceeds the upper limit of its preset temperature range in the middle of the F cycle operation, the RF cycle operation allows refrigerant to flow through both the refrigerating chamber evaporator **4** and the freezing chamber evaporator **5** in order to maintain the refrigerating chamber

30 temperature within the preset temperature range. In contrast, the related art refrigerating cycle system permits a refrigerant flow to only the refrigerating chamber evaporator 4 and the freezing chamber evaporator 5 in succession.

[0068] In this instance, since no acceleration of heat exchange between air in the freezing chamber 20 and refrigerant of the freezing chamber evaporator 5 is necessarily required, as the freezing chamber 20 temperature is within its preset temperature range, operation of the freezing chamber evaporator fan 5*a* is stopped. On the other hand, since the refrigerating chamber 30 temperature exceeds the upper limit of its preset temperature range, the refrigerating chamber evaporator fan 4*a* is operated so as to accelerate heat exchange of the refrigerating chamber evaporator 4.

[0069] According to this, since the freezing chamber 20 temperature and the refrigerating chamber 30 temperature fall within their respective preset temperature ranges, effective cold/frozen food storage is made possible.

[0070] Second, as shown in **FIG. 6**, the step for continuous operation (S20) may selectively include an RF operation step for conducting the RF cycle operation if the freezing chamber 20 temperature and the refrigerating chamber 30 temperature exceed upper limits of respective preset temperature ranges, an F cycle operation step for conducting the F cycle operation if the refrigerating chamber 30 temperature is within its preset temperature range and the freezing chamber 20 temperature exceeds the upper limit of its preset temperature range, and a continuous F cycle operation step for continuous operation of the F cycle even if the freezing chamber 20 temperature is within its preset temperature range and the refrigerating chamber 30 temperature exceeds the upper limit of its preset temperature range.

[0071] In addition to this, it is preferable that the step for continuous operation (S20) further includes a step for operating the refrigerating chamber evaporator fan 4*a* at the refrigerating chamber evaporator 4, together with the F cycle operation.

[0072] Herein, referring to **FIG. 6**, another embodiment of the step for continuous operation (S20) will be explained in more detail.

[0073] Generally, when compressor 1 is initiated, the freezing chamber 20 temperature and the refrigerating chamber 30 temperature exceed the upper limits of respective preset temperature ranges. Accordingly, the RF cycle operation is conducted so as to introduce refrigerant into the refrigerating chamber evaporator 4 and the freezing chamber evaporator 5.

[0074] If at only the freezing chamber 20 temperature exceeds the upper limit of its preset temperature range in the middle of the RF cycle operation, the F cycle operation is conducted so as to introduce refrigerant only into the freezing chamber evaporator 5.

[0075] Thereafter, if the refrigerating chamber 30 temperature exceeds the upper limit of its preset temperature range in the middle of the F cycle operation, the F cycle operation is not switched over to the RF cycle operation, which consumes much of the compressor 1 power, but is continued. In this instance, since the refrigerating chamber 30 temperature must be dropped, the refrigerating chamber evaporator fan 4*a* is operated together with the F cycle operation.

[0076] When the compressor 1 is put into operation once again after the compressor 1 is stopped, the RF cycle operation or the F cycle operation is carried out, and if the refrigerating chamber 30 temperature exceeds the upper limit of its preset temperature range in the middle of the F cycle operation, the step for continuous operation of the F cycle is carried out.

[0077] Accordingly, since, not the step for continuous operation of the RF cycle, but the step for operation of the RF cycle, is carried out in case that the refrigerating chamber 30 temperature does falls within its preset temperature range, power consumption of the compressor 1 can be reduced. Moreover, since the freezing chamber 20 temperature and the refrigerating chamber 30 temperature meet respective preset temperature ranges, effective cold/frozen food storage is made possible.

[0078] In the meantime, in case that there are plural refrigerating chambers 30, as one embodiment of the step of stopping operation of the compressor (S30) in the method for controlling operation of a refrigerator shown in **FIG. 3**, it is preferable that the compressor 1 is stopped when all the refrigerating chamber 30 temperatures and the freezing chamber 20 are within respective preset temperature ranges.

[0079] Consequently, since the compressor 1 never stops in a state where even one of the refrigerating chamber temperatures and the freezing chamber temperature exceeds respective upper limits of the preset temperature ranges, perfect cold/frozen storage of food is made possible.

[0080] In the meantime, referring to **FIG. 7**, in order to make a multiple stage control of the refrigerating chamber 30 temperature which varies with external/internal loads when the continuous operation step (20) is carried out, it is preferable that the method for controlling operation of a refrigerator according to the present invention further includes a multiple stage load responding step, in which the refrigerating chamber 30 preset temperature range is set in multiple stages for operating the refrigerating chamber evaporator fan 4*a*, or the RF cycle operation is conducted again when the operation of the RF cycle is stopped by making a multiple stage temperature range setting for the refrigerating chamber 30.

[0081] It is preferable that the multiple stage load responding step includes a first stage load responding step for operating the refrigerating chamber evaporator fan 4*a* if the refrigerating chamber 30 temperature exceeds the upper limit (H2) of a first preset temperature range (A) due to internal/external loads applied after the RF cycle operation is stopped, and a second stage load responding step for initiating the RF cycle operation to introduce the refrigerant into the refrigerating chamber evaporator 4 if the refrigerating chamber 30 temperature exceeds the upper limit (H3) of a second preset temperature range (B) higher than that of the first preset temperature range (A) due to the internal/external loads after the RF cycle operation is stopped.

[0082] Herein, it is preferable that the first stage load responding step includes a step for operating the refrigerating chamber evaporator fan 4*a* from a time the refrigerating chamber 30 temperature exceeds the upper limit (H2) of the first preset temperature range (A) to a time the refrigerating chamber 30 temperature reaches to the upper limit (H3) of the second preset temperature range (B), and a step for stopping the refrigerating chamber evaporator fan **4***a* when the refrigerating chamber **30** temperature falls within the first preset temperature range (A).

[**0083**] Also, it is preferable that the second stage load responding step includes a step for conducting the RF cycle operation and operating the refrigerating chamber evaporator **4***a* when the refrigerating chamber **30** temperature exceeds the upper limit (H**3**) of the second preset temperature range (B), and a step for stopping both the RF cycle operation and the refrigerating chamber evaporator fan **4***a* when the refrigerating chamber **30** temperature falls within a first preset temperature range (A).

[**0084**] It is preferable that the upper limit (H**3**) of the second preset temperature range (B) is higher than the upper limit (H**2**) of the first preset temperature range (A), and the lower limit (H**1**) of the second preset temperature range (B) is equal to the lower limit (H**1**) of the first preset temperature range (A).

[**0085**] Referring to **FIG. 7**, the multiple stage load responding step will be explained in more detail.

[**0086**] First, in a case that the refrigerating chamber **30** temperature is between the upper limit (H**2**) of the first preset temperature range (A) and the upper limit (H**3**) of the second preset temperature range (B) due to internal/external loads applied after the RF cycle operation is stopped, the refrigerating chamber evaporator fan **4***a* is put into operation so as to drop the refrigerating chamber **30** temperature to be within the first preset temperature range (A), or to rise up slowly. The reason why only the refrigerating chamber evaporator fan **4***a* is put into operation, and that the RF cycle operation is not conducted at this point is to reduce a number of turn on/off times of the compressor **1** and provide a more effective response to the loads.

[**0087**] Second, when the refrigerating chamber **30** temperature exceeds the upper limit (H**3**) of the second preset temperature range (B), the RF cycle operation is initiated and the refrigerating chamber evaporator fan **4***a* is operated to drop the refrigerating chamber **30** temperature down to within first preset temperature range (A). In this instance, not only the refrigerating chamber evaporator fan **4***a* is operated, but also the RF cycle operation is initiated in order to provide an effective response to the load. More specifically, when the refrigerator chamber **30** temperature exceeds the upper limit (H**3**) of the second preset temperature range (B), it is beyond a point at which the temperature may be lowered and maintained within the preset temperature range simply through operation of the refrigerating chamber evaporator fan **4***a*.

[**0088**] Third, if the freezing chamber **20** temperature is within the preset temperature range when the refrigerating chamber **30** temperature reaches to the upper limit (H**3**) of the second preset temperature range (B) and starts the RF cycle operation, it is preferable that operation of the freezing chamber evaporator fan **5***a* is stopped so as to prevent unnecessary power consumption.

[**0089**] According to this, it is possible to provide an effective response to the internal/external loads applied to the refrigerating chamber **30**.

[**0090**] In the meantime, it is preferable that the method for controlling operation of a refrigerator according to the present invention further includes a fermenting control step for stopping the compressor **1** if the freezing chamber **20** temperature and the refrigerating chamber **30** temperature are lower than relevant preset fermenting temperatures, and for operating the compressor **1** if at least one of the temperatures of the chambers is higher than the preset fermenting temperature. This is done when the refrigerator is in a fermenting mode by a fermenting heater **40** provided with the refrigerating chamber **30** while the step for starting a compressor (S**10**), the step for continuous operation (S**20**), and the step for stopping operation (S**30**) are conducted repeatedly to form a series of cycles.

[**0091**] Moreover, there may be various fermenting control steps based on a number of the refrigerating chambers **30**.

[**0092**] That is, in a case that there are plural refrigerating chambers **30** in a refrigerator, it is preferable that if the freezing chamber **20** temperature and all the refrigerating chamber **30** temperatures are lower than respective preset fermenting temperatures, the compressor **1** is stopped, and if the temperature of at least one chamber is higher than the preset fermenting temperature, the compressor **1** is operated.

[**0093**] Referring to **FIG. 8**, the fermenting control step will be explained in more detail. It is assumed that the refrigerating chamber **30** is divided into an upper part **31** and a lower part **32**.

[**0094**] First, when both the fermenting heaters **41** and **42** for the upper refrigerating chamber **31** and the lower refrigerating chamber **32**, respectively, are turned on to start a fermenting operation, if the upper refrigerating chamber **31** temperature is lower than the fermenting temperature of the upper refrigerating chamber **31**, the lower refrigerating chamber **32** temperature is lower than the fermenting temperature of the lower refrigerating chamber **32**, and the freezing chamber **20** temperature is lower than the preset temperature of the freezing chamber, the compressor **1** is stopped.

[**0095**] Second, when both the fermenting heaters **41** and **42** for the upper refrigerating chamber **31** and the lower refrigerating chamber **32**, respectively, are turned on to start fermenting, if a temperature of at least any one of the upper refrigerating chamber **31**, the lower refrigerating chamber **32**, and the freezing chamber **20** is higher than a relevant preset fermenting temperature, the compressor **1** is put into operation.

[**0096**] The compressor **1** is put into operation in the above condition because operation of the compressor **1** is essential for dropping a temperature of the chamber in which the temperature is higher than the preset fermenting temperature through a cooling operation using the F cycle or the RF cycle. More specifically, if the freezing chamber **20** temperature is higher than its preset temperature, the F cycle operation is conducted, and if the upper refrigerating chamber **31** temperature or the lower refrigerating chamber **32** temperature is higher than a fermenting temperature, the RF cycle operation is conducted.

[**0097**] According to this, food requiring fermenting, particularly, Kimchi, can be fermented at an accurate fermenting temperature.

[**0098**] In the meantime, referring to **FIG. 9**, the method for controlling operation of a refrigerator may further include a first pre-cooling step for cooling the freezing chamber **20** in advance by conducting the F cycle operation for a preset time period (C**1**-C**2** period) before the fermenting mode (C**2**) ends, and a second pre-cooling step for conducting the RF cycle operation and cooling the refrigerating chamber **30** and the freezing chamber **20** at the same time when operation of the fermenting mode is finished (C**2**). According to this, a situation in which the freezing chamber **20** temperature goes up when the fermenting mode operation is finished can be prevented in advance.

[**0099**] In this instance, the preset time period (C**1**-C**2** period) of the first pre-cooling step is varied with capacities of refrigerators and calculated so that the freezing chamber **20** temperature is within the preset temperature range even if refrigerant in the freezing chamber evaporator **5** heat exchanges with air in the freezing chamber **20** under the RF cycle operation as the fermenting mode operation is finished (C**2**).

[**0100**] Along with this, it is preferable that the second pre-cooling step further includes a step for stopping an operation of the freezing chamber evaporator fan **5***a* for a fixed time period (C**2**-C**3** period) when the fermenting mode operation is finished (C**2**).

[**0101**] It is preferable that the fixed time period (C**2**-C**3** period) ranges from a time point when operation of the fermenting mode is finished (C**2**) to a time point when the refrigerating chamber **30** temperature falls within its preset temperature range in which the food can be stored properly (C**3**). The reason is that, if the freezing chamber evaporator fan **5***a* is operated when the refrigerating chamber **30** temperature exceeds the upper limit of the preset temperature range, though the freezing chamber **20** temperature rises sharply when refrigerant which has been heat-exchanged with air in the refrigerating chamber **30** is introduced into the freezing chamber evaporator **5**, the freezing chamber **20** temperature may still fall within its preset temperature range if the freezing chamber evaporator **5** is operated when the refrigerating chamber **30** temperature falls within its preset temperature range.

[**0102**] Referring to **FIG. 9**, the first and second pre-cooling steps will be explained in more detail.

[**0103**] When the RF cycle operation is carried out after the fermenting mode (C**2**) is finished, the refrigerating chamber **30** is in a state the refrigerating chamber **30** temperature exceeds the upper limit of the preset temperature range. Therefore, high temperature refrigerant in the refrigerating chamber evaporator **4** is introduced into the freezing chamber evaporator **5**, thereby making the freezing chamber **20** temperature rise. However, in the present invention, since the F cycle operation has already been carried out in the first pre-cooling step, the refrigerating chamber **20** temperature falls within its preset temperature range, and even though the high temperature refrigerant is introduced into the freezing chamber evaporator **5**, the freezing chamber **20** temperature may be maintained within its preset range.

[**0104**] In addition to this, since the heat exchange between the air in the freezing chamber **20** and the freezing chamber evaporator **5** slows down, effective frozen storage of food in the freezing chamber **20** is made possible even if the refrigerant heat exchanged with the high temperature air in the refrigerating chamber **30** is introduced into the freezing chamber evaporator **5**, because the freezing chamber evaporator fan **5***a* is stopped from a time when the fermenting mode is finished (C**2**) to a time when the refrigerating chamber **30** temperature reaches its preset temperature range proper for cold storage of food such as Kimchi (C**3**). Subsequently, if the refrigerating chamber **30** temperature reaches the preset temperature range proper for cold storage of food, a time when the temperature of refrigerant introduced into the freezing chamber evaporator **5** is dropped (C**2**), heat exchange between air in the freezing chamber **20** and the freezing chamber evaporator **5** is accelerated by the operation of the freezing chamber evaporator fan **5***a*, permitting effective frozen storage of food in the freezing chamber.

[**0105**] As has been explained, the present invention has the following advantages.

[**0106**] First, since the compressor is stopped when temperatures both of the refrigerating chamber and the freezing chamber meet the preset temperature ranges, effective cold/frozen storage of food is made possible.

[**0107**] Second, since the compressor starts when a temperature of either the refrigerating chamber or the freezing chamber does not meets the preset temperature range, effective cold/frozen storage of food is made possible from a moment when the compressor starts.

[**0108**] Third, the multiple stages of the preset temperature range of the refrigerating chamber permit to make an effective response to internal/external loads. The operation of the only refrigerating chamber evaporator within a preset temperature range permits to reduce a number of compressor turn on/off times, thereby reducing power consumption.

[**0109**] Fourth, since a proper temperature for fermenting is maintained by separate control turn on/off of the compressor in the fermenting, food requiring for fermenting can be fermented at fermenting temperatures that can be set differently.

[**0110**] Fifth, since the pre-cooling is carried out before the fermenting mode operation is finished, the temperature rise of the freezing chamber occurred at the time of starting the RF cycle operation is prevented in advance, effective frozen storage of food in the freezing chamber is made possible.

[**0111**] It will be apparent to those skilled in the art than various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A method for controlling operation of a refrigerator, in which a refrigerating chamber and a freezing chamber of the refrigerator are cooled by a Refrigerating-Freezing (RF) cycle, or by a Freezing (F) cycle, the method comprising:

starting a compressor;

carrying out an RF cycle or an F cycle depending on a temperature of the freezing chamber or the refrigerating chamber after the compressor is started; and

stopping operation of the compressor if a freezing chamber temperature and a refrigerating chamber temperature are within respective preset temperature ranges.

2. The method of claim 1, wherein starting a compressor comprises starting the compressor when either the freezing chamber temperature or the refrigerating chamber temperature exceeds an upper limit of a preset temperature range.

3. The method of claim 2, wherein if the refrigerating chamber comprises a plurality sections, the compressor is started if either a temperature of at least one of the plurality of sections of the refrigerating chamber or a temperature the freezing chamber exceeds an upper limit of a corresponding preset temperature range.

4. The method of claim 3, wherein the at least one of the plurality of sections of the refrigerating chamber comprises a designated section that has a greater temperature variation than the remaining plurality of sections.

5. The method of claim 1, further comprising:

stopping the compressor when the freezing chamber temperature and the refrigerating chamber temperature are lower than respective preset fermenting temperatures; and

operating the compressor when at least one of the refrigerating chamber and the freezing chamber is at a higher temperature than its respective preset fermenting temperature.

6. The method of claim 5, further comprising:

operating a fermenting heater provided in the refrigerating chamber when the refrigerator is in a fermenting mode.

7. The method as claimed in claim 5, wherein, if the freezing chamber temperature and the refrigerating chamber temperature are each lower than respective preset fermenting temperatures and the refrigerating chamber comprises a plurality of sections, the compressor is stopped.

8. The method of claim 7, wherein if a temperature of at least one of the plurality of sections of the refrigerating chamber is higher than a preset fermenting temperature, the compressor is driven.

9. The method of claim 5, further comprising:

operating an F cycle for a preset time period before a fermenting operation is stopped; and

operating an RF cycle when the fermenting operation is stopped.

10. The method of claim 9, wherein the F cycle is operated so as to pre-cool the freezing chamber.

11. The method of claim 9, wherein the RF cycle is operated so as to cool the refrigerating chamber and the freezing chamber at the same time.

12. The method of claim 9, wherein the preset time period during which the F cycle is operated is calculated so as to maintain the freezing chamber temperature within a preset temperature range even if a refrigerant in an evaporator of the freezing chamber is heat-exchanged with air in the freezing chamber when the RF cycle is operated after the fermenting operation is stopped.

13. The method of claim 12, wherein the preset time period is varied based on a capacity of the refrigerator.

14. The method of claim 9, further comprising:

stopping operation of a freezing chamber evaporator fan for a preset time period when the fermenting operation is stopped.

15. The method of claim 14, wherein the preset time period ranges from a time the fermenting operation is stopped to a time when the refrigerating chamber temperature falls within a preset temperature range.

16. The method of claim 15, wherein the preset temperature range is based on a range of temperatures appropriate for food storage.

17. The method of claim 1, wherein carrying out an RF cycle or an F cycle comprises carrying out an F cycle that comprises operating a refrigerating chamber evaporator and a freezing chamber evaporator in succession.

18. The method of claim 1, wherein carrying out an RF cycle or an F cycle comprises carrying out an F cycle that comprises operating only a freezing chamber evaporator.

19. The method of claim 1, further comprising carrying out the steps of claim 1 as a series of cycles.

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