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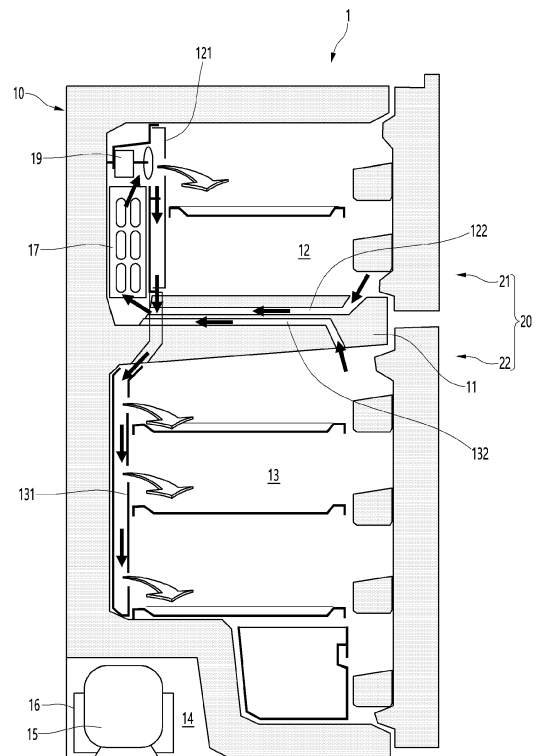
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(54) **REFRIGERATOR AND METHOD OF CONTROLLING A REFRIGERATOR**

(57) A method of controlling a refrigerator (1) including:

a cabinet (10) in which a refrigerating compartment (13) and a freezing compartment (12) are formed;
a refrigerating compartment temperature sensor (32) included in the refrigerating compartment (13);
an evaporator (17) included in the freezing compartment (12);
a freezing compartment fan (19) included in the freezing compartment (12) and configured to supply cold air to the freezing compartment (12) and the refrigerating compartment (13);
a compressor (15) operable with variable cooling power;
a condenser (16) connected to the compressor (15);
a condenser fan (18) configured to cool the condenser (16); and
a controller (30) configured to control the compressor (15), the freezing compartment fan (19), and the condenser fan (18) to maintain the refrigerating compartment (13) at a target control temperature depending on temperature detected by the refrigerating compartment temperature sensor (32), the method comprising:
detecting (S 120) outside temperature through an outside temperature sensor (31) configured to detect ambient temperature of the refrigerator (1);
performing a winter operation (200) when the outside temperature detected by the outside temperature sensor (31) is equal to or less than a set temperature; and
performing a normal operation (300) when the temperature detected by the outside temperature sensor (31) is higher than the set temperature.

Fig. 1



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Description

FIELD

[0001] The present disclosure relates to a method of controlling a refrigerator.

BACKGROUND

[0002] In general, a refrigerator is a home appliance for storing food at low temperature in an internal storage space that is shielded by a refrigerator door, and is configured to store the stored food in an optimal state by cooling the inside of the storage space using cold air generated through heat exchange with a refrigerant circulating through the refrigeration cycle.

[0003] Such a refrigerator is gradually being enlarged and multi-functional according to a trend of changes in dietary life and high-quality products, and a refrigerator for optimal performance in various use environments is being developed.

[0004] In particular, a refrigerator for ensuring storage performance and reducing power consumption in an environment at low temperature is being developed for a use environment with a large change in temperature depending on the season.

[0005] As a representative example, Korean Patent Publication No. 10-2004-0085324 discloses a refrigerator and a method of controlling the same for increasing or decreasing an on/off temperature of a compressor based on a reference temperature by user manipulation of a season selection button depending on outside temperature and increasing or decreasing a period of a defrost operation based on a reference value to adjust an operation of the refrigerator depending on the temperature and humidity characteristics according to the season.

[0006] However, in the prior art, an operation of a refrigerator is adjusted only by direct manipulation of a user, which not only causes inconvenience in use, but also has a problem in that there is no substantial driving change without user manipulation, and thus, it is impossible to achieve expected performance.

[0007] In addition, a refrigerator operated to control the temperature of a freezing compartment based on the temperature of a refrigerating compartment without a separate damper has a problem in that it is impossible to solve dissatisfaction with the temperature of the freezing compartment in a situation at low outside temperature such as winter even through such an operation.

SUMMARY

[0008] An object of an embodiment of the present disclosure is to provide a refrigerator and a method of controlling the same for ensuring cooling performance of a freezing compartment even when outside temperature is low.

[0009] An embodiment of the present disclosure provides a refrigerator and a method of controlling the same for achieving satisfactory temperatures of a refrigerating compartment and a freezing compartment by adjusting operations of a compressor, a freezing compartment fan, and a condenser fan depending on outside temperature.

[0010] An embodiment of the present disclosure provides a refrigerator and a method of controlling the same for effectively performing operations of a refrigerating compartment and a freezing compartment depending on outside temperature in a refrigerator including one evaporator and one fan without a damper.

[0011] The object is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims.

[0012] According to an embodiment of the present disclosure, a method of controlling a refrigerator including a cabinet in which a refrigerating compartment and a freezing compartment are formed; a refrigerating compartment temperature sensor included in the refrigerating compartment; an evaporator included in the freezing compartment; a freezing compartment fan included in the freezing compartment and configured to supply cold air to the freezing compartment and the refrigerating compartment; a compressor controlled with variable cooling power; a condenser connected to the compressor; a condenser fan configured to cool the condenser; and a controller configured to control the compressor, the freezing compartment fan, and the condenser fan to maintain the refrigerating compartment at a target control temperature depending on temperature detected by the refrigerating compartment temperature sensor includes detecting outside temperature through an outside temperature sensor configured to detect ambient temperature of the refrigerator, performing a winter operation when the outside temperature detected by the outside temperature sensor is equal to or less than a set temperature, and determining a normal operation to be performed when the temperature detected by the outside temperature sensor is higher than the set temperature, wherein, during the winter operation, the compressor is operated with higher cooling power than in the normal operation.

[0013] In another aspect, a refrigerator is provided. The refrigerator is operated according to the method as described above.

[0014] The refrigerator includes a cabinet in which a refrigerating compartment and a freezing compartment. The refrigerator includes a controller to operate the refrigerator in a winter operation or normal operation depending on a temperature sensed by a one or more temperature sensors.

[0015] The method for controlling a refrigerator or the refrigerator may be further combined with one or more of the following optional features.

[0016] The controller may determine whether to perform a winter operation or a normal operation depending on an outside temperature detected by the outside tem-

perature sensor.

[0017] The set temperature for determining the winter operation and the normal operation may be 18°C.

[0018] During the winter operation, the freezing compartment fan may be turned on when a set time elapses after the compressor is turned on.

[0019] The freezing compartment fan may be operated at lower speed than rotational speed of the freezing compartment fan during the normal operation.

[0020] Cold air may be simultaneously supplied to the freezing compartment and the refrigerating compartment by driving the freezing compartment fan.

[0021] The condenser fan may start being operated sequentially with the freezing compartment fan.

[0022] During the winter operation, the condenser fan may be turned on when a set time elapses after the compressor is turned on.

[0023] The condenser fan may be operated at lower speed than rotational speed of the condenser fan during the normal operation.

[0024] The set time may be a time taken until the compressor reaches the high cooling power after being driven.

[0025] The set time may be within 60 seconds after the compressor is driven.

[0026] During the winter operation, when temperature of the refrigerating compartment in the refrigerating compartment temperature sensor is satisfactory, the compressor, the freezing compartment fan, and the condenser fan may be turned off.

[0027] The compressor, the freezing compartment fan, and the condenser fan may be simultaneously turned off.

[0028] The compressor may be configured as an inverter compressor or a linear compressor and may be operated with a variable frequency depending on a load.

[0029] The compressor may be operated with a higher frequency during the winter operation than in the normal operation.

[0030] The compressor may be operated at a frequency of 50 Hz during the winter operation and may be operated at a frequency of 30 Hz during the normal operation.

[0031] The outside temperature sensor may be provided at one side of the cabinet and may measure an ambient temperature of outside of the refrigerator.

[0032] The outside temperature sensor may be installed on a hinge cover for shielding a hinge that rotatably connects the cabinet and a door.

[0033] During the normal operation, when temperature of the refrigerating compartment in the refrigerating compartment temperature sensor is satisfactory, the compressor and the condenser fan may be first turned off, and the freezing compartment fan may be turned off after being operated until a set time elapses.

[0034] The refrigerator may include an evaporator included in the freezing compartment, a freezing compartment fan included in the freezing compartment and configured to forcibly flowing air for cooling the refrigerating

compartment and the freezing compartment, a compressor included in the machine room and controlled with variable cooling power, a condenser included in the machine room, a condenser fan included in the machine room and dissipating heat of the condenser.

[0035] The one or more temperature sensors may include a refrigerating compartment temperature sensor configured to detect temperature of inside of the refrigerating compartment and/or an outside temperature sensor provided at one side of the cabinet and configured to detect ambient temperature at which the refrigerator is installed.

[0036] The controller is configured to control operations of at least one of the compressor, the freezing compartment fan, and the condenser fan to maintain the refrigerating compartment at control temperature depending on temperature detected by the one or more temperature sensors, in particular based on the refrigerating compartment temperature sensor.

[0037] The controller may perform a winter operation when temperature detected by the outside temperature sensor is equal to or less than a set temperature.

[0038] The controller may select and perform a normal operation when the detected temperature is higher than the set temperature.

[0039] The controller may operate the compressor with higher cooling power during the winter operation than cooling power of the compressor during the normal operation.

[0040] The controller may turn on the freezing compartment fan when the set time elapses after the compressor is turned on.

[0041] The refrigerator may include a machine room for accommodating the condenser and the compressor and the condenser fan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042]

FIG. 1 is a cross-sectional view of a refrigerator of an embodiment of the present disclosure.

FIG. 2 is a block diagram showing control signal flow of the refrigerator.

FIG. 3 is a flowchart sequentially showing a method of controlling the refrigerator.

DETAILED DESCRIPTION

[0043] Hereinafter, detailed embodiments will be described in detail with reference to the accompanying drawings. However, the present disclosure is limited to the embodiments in which the spirit of the present disclosure is proposed, and other degenerate idea or other embodiments included in the scope of the present disclosure may be easily proposed by addition, changes, deletions, etc. of other elements.

[0044] FIG. 1 is a cross-sectional view of a refrigerator

according to an embodiment of the present disclosure. FIG. 2 is a block diagram showing control signal flow of the refrigerator.

[0045] As shown in the drawings, an outer appearance of a refrigerator 1 according to an embodiment of the present disclosure may be formed by a cabinet 10 forming a storage space, and a door 20 for opening and closing an open front of the storage space.

[0046] The cabinet 10 may include a barrier 11. The barrier 11 may divide the storage space into upper and lower parts, an upper storage space 12 may be formed above the barrier 11, and a lower storage space 13 may be formed below the barrier 11.

[0047] The upper storage space 12 may maintain freezing temperature for storing frozen food, and thus may be referred to as a freezing compartment 12. The lower storage space 13 may maintain refrigeration temperature for storing chilled food, and thus may be referred to as a refrigerating compartment 13. Needless to say, depending on the form of the refrigerator 1, arrangements of the refrigerating compartment 13 and the freezing compartment 12 may also be changed. However, the invention is also applicable to a refrigerator having only one compartment or having the compartments arranged side by side or in any other way.

[0048] The door 20 may be rotatably mounted on the cabinet 10 and may include an upper door 21 for opening and closing the upper storage space 12 and a lower door 22 for opening and closing the lower storage space 13. The upper door 21 may also be referred to as a freezing compartment door 21 and the lower door 22 may also be referred to as a refrigerating compartment door 22. The one or more doors may be also realized as drawer.

[0049] A grille 121 may be provided at a rear side of the freezing compartment 12. The grille fan may be a plate having openings and may form a space for accommodating an evaporator 17 that configures a refrigeration cycle. The grille 121 may be formed like a plate and may form a rear surface of the freezing compartment 12. The grille 121 may include a freezing compartment outlet for ejecting cold air generated by the evaporator 17 to the freezing compartment 12.

[0050] The grille 121 may include or may be coupled to a freezing compartment fan 19. The freezing compartment fan 19 may be used to supply and circulate cold air to the freezing compartment 12 and/or the refrigerating compartment 13. The freezing compartment fan 19 may be provided above the evaporator 17. The freezing compartment fan 19 may be provided inside a space defined by the grille 121. Needless to say, it may be possible to circulate cold air to the refrigerating compartment 13 as well as the freezing compartment 12 by driving the freezing compartment fan 19.

[0051] In detail, a freezing compartment return duct 122 may be formed to connect a front side of a lower surface of the freezing compartment 12 to the space containing the evaporator 17. The freezing compartment return duct 122 may be provided inside the barrier 11 or

inside a side wall. Thus, air inside the freezing compartment 12 may be recovered and provided to the evaporator 17 via the freezing compartment return duct 122.

[0052] A refrigerating compartment supply duct 131 may be formed to connect a lower surface of the space containing the evaporator 17 to the refrigerating compartment 13. The refrigerating compartment supply duct 131 may extend downward along a rear wall of the refrigerating compartment 13.

[0053] The refrigerating compartment supply duct 131 may include a refrigerating compartment outlet formed to eject cold air to the refrigerating compartment 13. Thus, cold air generated by the evaporator 17 may be supplied to the refrigerating compartment 13 by the refrigerating compartment supply duct 131.

[0054] Furthermore, there might be a refrigerating compartment return duct 132. The refrigerating compartment return duct 132 may be formed to connect a front side of an upper surface of the refrigerating compartment 13 to the space containing the evaporator 17. The refrigerating compartment return duct 132 may be provided inside the barrier 11 or a side wall. Thus, air inside the refrigerating compartment 13 may be supplied back to the evaporator 17 and recovered by the evaporator 17 via the refrigerating compartment return duct 132.

[0055] A refrigerating compartment temperature sensor 32 may be provided inside the refrigerating compartment 13.

[0056] The freezing compartment fan 19 may be driven depending on temperature detected by the refrigerating compartment temperature sensor 32.

[0057] Cold air may be supplied to both of the refrigerating compartment 13 and the freezing compartment 12 by one freezing compartment fan 19. Thus, the cold air is only generated in the freezing compartment 12 and then provided to the freezing compartment 12 and to the refrigerating compartment 13.

[0058] In detail, when the temperature detected by the refrigerating compartment temperature sensor 32 is lower than a set target control temperature, the freezing compartment fan 19 may be driven.

[0059] By driving the freezing compartment fan 19, air of the freezing compartment 12 may be provided and/or introduced into the evaporator 17 through the freezing compartment return duct 122. Air cooled while passing through the evaporator 17 may be then ejected through the freezing compartment outlet to cool the freezing compartment 12.

[0060] When the freezing compartment fan 19 is driven, some of cold air passing through the evaporator 17 may be also supplied to the refrigerating compartment 13 through the refrigerating compartment supply duct 131. Air cooling the refrigerating compartment 13 may be recovered from the refrigerating compartment 13 through the refrigerating compartment return duct 132.

[0061] The freezing compartment fan 19 may be operated until the temperature detected by the refrigerating compartment temperature sensor 32 reaches a set target

control temperature or temperature range. While the refrigerating compartment 13 is cooled via circulation of cold air due to an operation of the freezing compartment fan 19, the freezing compartment 12 may also be cooled. That is, until the temperature of the refrigerating compartment 13 is lowered to the target control temperature, the refrigerating compartment 13 may also be continuously cooled.

[0062] The freezing compartment 12 is not only used less frequently than the refrigeration compartment 13, but is also maintained at a relatively low temperature by direct cooling by the evaporator, resulting in less food damage, and thus the refrigerating compartment 13 and the freezing compartment 12 may be driven to be maintained at predetermined temperatures using the refrigerating compartment temperature sensor 32 inside the refrigerating compartment 13.

[0063] Such a structure may be relatively simple and may have concise configuration in that both of the temperatures of the refrigerating compartment 13 and the freezing compartment 12 are adjusted using only one freezing compartment fan 19 and one refrigerating compartment temperature sensor 32 without a damper in one of the ducts 132, 131 or 122 for adjusting supply of cold.

[0064] A machine room 14 may be provided in the cabinet 10. The machine room 14 may be disposed in a corner between rear and lower surfaces of the cabinet 10, and an independent space separated from the machine room 14 may be formed therein.

[0065] The machine room 14 may include a compressor 15 and a condenser 16 that configure the refrigeration cycle. The machine room 14 may be at least partially connected to the outside, and thus the compressor 15 may be cooled by outside air and the condenser 16 may exchange heat. To this end, a condenser fan 18 may be further provided inside the machine room 14. By driving the condenser fan 18, air may be circulated smoothly between the inside and outside of the machine room 14, and heat dissipation of the condenser 16 and cooling of the compressor 15 may be more effectively performed.

[0066] The compressor 15 may be configured to control an operating rate differently depending on the load. For example, the compressor 15 may be configured as an inverter compressor or a linear compressor and may adjust cooling power by changing a frequency of a motor depending on the load.

[0067] The refrigerator 1 may include an outside temperature sensor 31 for detecting the outside temperature, that is, ambient temperature of the refrigerator 1. The outside temperature sensor 31 may be disposed to detect a high outside temperature. The outside temperature sensor 31 may be provided at one side of the cabinet 10. For example, the outside temperature sensor 31 may be installed on a cover for shielding a hinge that connects the cabinet 10 and the door 20. So, it may be provided close to the upper hinge or in or at an upper portion of the cabinet.

[0068] The outside temperature sensor 31 as well as

the refrigerating compartment temperature sensor 32 may be connected to a controller 30. The controller 30 may be connected to the compressor 15, the condenser fan 18, and the freezing compartment fan 19 and may control an operation of the refrigerator 1.

[0069] The outside temperature sensor 31 may detect the ambient temperature of the refrigerator. Based on the outside temperature measured by the outside temperature sensor 31 the controller may adjust the operation of the refrigerator 1.

[0070] In particular, when the ambient temperature of a place in which the refrigerator 1 is installed is equal to or less than a set temperature (e.g., 18°C), such as in winter, the temperature of the refrigerating compartment 13 may not be largely different from the ambient temperature, and thus may rapidly reach the target control temperature when the refrigerating compartment 13 is cooled. In detail, due to the low ambient temperature, the temperature of the refrigerating compartment 13 may reach the target control temperature compared with the freezing compartment 12, and thus the freezing compartment 12 may not be sufficiently cooled. That is, the temperature of the refrigerating compartment 13 may reach the target control temperature to stop driving of the compressor 15 before the freezing compartment 12 is sufficiently cooled, and thus there is a problem in that storage performance is degraded because the freezing compartment 12 is not sufficiently cooled. For example, when the freezing compartment 12 is not sufficiently cooled due to low ambient temperature and the temperature of the freezing compartment 12 is equal to or greater than -12°C, storage quality may be degraded in the case of dairy products such as ice cream stored in the freezing compartment 12.

[0071] In order to overcome the problem, the controller 30 may detect a temperature input by the outside temperature sensor 31 and may control the operation of the compressor 15. Needless to say, the controller 30 may control the refrigerating compartment 13 to thereby control the operation of the refrigerator 1 to maintain an optimum temperature of the freezing compartment 12.

[0072] Hereinafter, the operation of the refrigerator 1 as configured above will be described in detail with reference to the accompanying drawings.

[0073] FIG. 3 is a flowchart sequentially showing a method of controlling the refrigerator.

[0074] As shown in the drawing, power may be supplied to the refrigerator 1 for the operation of the refrigerator 1 [S110].

[0075] After power is supplied to the refrigerator 1, the controller 30 may determine whether to perform a winter operation 200 or a normal operation 300 depending on the outside temperature detected by the outside temperature sensor 31.

[0076] In detail, the controller 30 may first detect the ambient temperature of the refrigerator 1, that is, the outside temperature detected by the outside temperature sensor 31 in order to determine the winter operation 200

and the normal operation 300. The controller 30 may determine whether the ambient temperature detected by the outside temperature sensor 31 is equal to or less than a set temperature.

[0077] The set temperature may be a reference temperature for determining whether to perform the winter operation 200 and may be set to a low temperature or temperature range that affects the temperature of the refrigerating compartment 13.

[0078] The set temperature may be set to a temperature at which it is possible to recognize the current state as a winter state due to low ambient temperature and may be, for example, 18°C. The winter operation 200 may also be referred to as a low ambient-temperature operation.

[0079] That is, when the outside temperature detected by the outside temperature sensor 31 is equal to or less than 18°C as the set temperature, the controller 30 may determine the winter operation 200 to be performed, and otherwise, may determine the normal operation 300 to be performed [S120].

[0080] When detecting the ambient temperature of the refrigerator 1 and then determining the winter operation 200 to be performed, the controller 30 may first determine temperature of the inside of the refrigerating compartment 13 through the refrigerating compartment temperature sensor 32. That is, in order to cool the refrigerating compartment 13, the controller 30 may determine whether the temperature of the inside of the refrigerating compartment 13 is equal to or less than the set target control temperature.

[0081] When the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is lower than the target control temperature, the controller 30 may determine that it is not required to cool the refrigerating compartment 13 and operation S120 may be performed again.

[0082] In contrast, when the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is higher than the target control temperature, the controller 30 may determine that the refrigerating compartment 13 needs to be cooled [S210].

[0083] When the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is higher than the target control temperature and the controller 30 determines that the refrigerating compartment 13 needs to be cooled, the controller 30 may turn on the compressor 15.

[0084] In this case, the compressor 15 may be operated to generate higher cooling power than cooling power of the compressor 15, which is set by the normal operation 300. For example, when the compressor 15 is operated at a motor rotation frequency of 30 Hz during the normal operation 300, the compressor 15 may be operated at a higher frequency of 50 Hz to output higher output at the same temperature during the winter operation 200.

[0085] That is, when the controller 30 instructs the op-

eration of the compressor 15 for the winter operation, the compressor 15 may be driven at a higher frequency than the normal operation 300 to generate high cooling power [S220].

[0086] The controller 30 may not cause the freezing compartment fan 19 and/or the condenser fan 18 to be driven at the same time as the start of driving the compressor 15, but instead, may maintain the state in which the compressor 15 is operated alone at a set frequency for a set time. That is, until the set time elapses after the compressor 15 starts being driven, the controller 30 may delay driving of the freezing compartment fan 19 and/or the condenser fan 18.

[0087] In the state in which ambient temperature is low such as in winter, the refrigerating compartment 13 may rapidly reach the target control temperature, and in particular, in the state in which the compressor 15 is operated to generate high cooling power, the refrigerating compartment 13 may rapidly reach the target control temperature, and thus there may be a problem in that the freezing compartment 12 is not sufficiently cooled.

[0088] For example, the set time may be 60 seconds. The current state may become a state in which the compressor 15 is capable of generating target cooling power within about 60 seconds from driving of the compressor 15, and in this case, cold air may be simultaneously supplied to the refrigerating compartment 13 and the freezing compartment 12 [S230].

[0089] When determining that the set time elapses after the compressor 15 is turned on, the controller 30 may start driving the freezing compartment fan 19. Cold air may be supplied to the refrigerating compartment 13 and the freezing compartment 12 by driving the freezing compartment fan 19, and the refrigerating compartment 13 and the freezing compartment 12 may be simultaneously cooled.

[0090] In this case, the controller 30 may operate the freezing compartment fan 19 at lower speed than rotational speed of the freezing compartment fan 19 during the normal operation 300. When the freezing compartment fan 19 rotates rapidly in the state in which the compressor 15 is operated with high cooling power, cold air may be rapidly supplied to the refrigerating compartment 13 and the freezing compartment 12. In the state in which ambient temperature is low, a time period in which the freezing compartment 12 reaches the target control temperature may be longer than a time period in which the refrigerating compartment 13 reaches the target control temperature, and thus speed of the freezing compartment fan 19 may be lowered to generate high cooling power for a long time, and the refrigerating compartment 13 and the freezing compartment 12 may be operated at respective satisfactory temperatures [S240].

[0091] When determining that the set time elapses after the compressor 15 is turned on, the controller 30 may start driving the condenser fan 18. In this case, driving of the condenser fan 18 and the freezing compartment fan 19 may be performed simultaneously or sequentially.

[0092] The controller 30 may operate the condenser fan 18 at lower speed than rotational speed of the condenser fan 18 during the normal operation 300. In the state in which ambient temperature is low, the temperature of the inside of the machine room 14 may also be lowered to degrade refrigerant circulation performance of the condenser 16. Thus, in order to increase ambient temperature of the condenser 16, the controller 30 may start driving the condenser fan 18 when the set time elapses after the compressor 15 is turned on, and may operate the condenser fan 18 at low rotational speed [S250].

[0093] The refrigerating compartment temperature sensor 32 may continuously detect the temperature of the refrigerating compartment 13. When determining that the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, does not reach the target control temperature or the target control temperature range, the controller 30 may continuously operate the compressor 15, the freezing compartment fan 19, and the condenser fan 18 [S260].

[0094] When determining that the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, reaches the target control temperature or the target control temperature range, the compressor 15, the freezing compartment fan 19, and the condenser fan 18 may be turned off and may stop being operated.

[0095] The controller 30 may return to operation S120 and may compare the ambient temperature of the refrigerator 1 with the set temperature to determine whether to perform the winter operation 200 [S270].

[0096] In operation S120, when the temperature detected by the outside temperature sensor 31 is higher than 18°C as the set temperature, the controller 30 may sufficiently cool the refrigerating compartment 13 and the freezing compartment 12 without the winter operation 200 and may perform the normal operation 300.

[0097] In detail, when determining the normal operation to be performed, the controller 30 may determine the temperature of the inside of the refrigerating compartment 13 through the refrigerating compartment temperature sensor 32. That is, in order to cool the refrigerating compartment 13, the controller 30 may determine whether the temperature of the inside of the refrigerating compartment 13 is equal to or less than the set target control temperature.

[0098] When the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is lower than the target control temperature, the controller 30 may determine that it is not required to cool the refrigerating compartment 13 and may perform operation S120 again. In contrast, when the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is higher than the target control temperature, the controller 30 may determine that the refrigerating compart-

ment 13 needs to be cooled [S310].

[0099] When the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, is higher than the target control temperature and the controller 30 determines that the refrigerating compartment 13 needs to be cooled, the controller 30 may turn on the compressor 15.

[0100] In this case, the compressor 15 may be operated to generate smaller normal cooling power than cooling power of the compressor 15, set in the winter operation 200. For example, the compressor 15 may be operated at a motor rotation frequency of 30 Hz during the normal operation 300. Thus, compared with the winter operation 200, the compressor 15 may be operated with low cooling power [S320].

[0101] The controller 30 may start driving the freezing compartment fan 19. By driving the freezing compartment fan 19, cold air may be supplied to the refrigerating compartment 13 and the freezing compartment 12, and the refrigerating compartment 13 and the freezing compartment 12 may be simultaneously cooled.

[0102] In this case, the controller 30 may operate the freezing compartment fan 19 at higher normal speed than rotational speed of the freezing compartment fan 19 during the winter operation 200. Thus, the freezing compartment fan 19 may be operated at high speed [S330].

[0103] The controller 30 may start driving the condenser fan 18. In this case, driving of the condenser fan 18 and driving of the compressor 15 and the freezing compartment fan 19 may be simultaneously performed. The controller 30 may operate the condenser fan 18 at higher normal speed than rotational speed of the condenser fan 18 during the winter operation 200. Thus, the condenser fan 18 may be operated at high speed [S340].

[0104] A frequency of the compressor 15 and operations of the freezing compartment fan 19 and the condenser fan 18 may be set to an operation specification during a general operation of the refrigerator 1. The normal operation 300 may take a longer time than the winter operation to cool the refrigerating compartment 13 during an operation for cooling the refrigerator 1 when the ambient temperature is higher than the set temperature, and thus may provide a time for sufficiently cooling the freezing compartment 12 to -12°C or less.

[0105] Needless to say, based on the type of the compressor 15, the compressor 15 may be operated at a variable frequency depending on the load during the normal operation 300.

[0106] The refrigerating compartment temperature sensor 32 may continuously detect the temperature of the refrigerating compartment 13. When determining that the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, does not reach the target control temperature or a target control temperature range, the controller 30 may continuously operate the compressor 15, the freezing compartment fan 19, and the condenser fan 18 [S350].

[0107] When determining that the temperature of the refrigerating compartment 13, detected by the refrigerating compartment temperature sensor 32, reaches the target control temperature or the target control temperature range, the compressor 15 and the condenser fan 18 may be turned off and may stop being operated [S360].

[0108] In operation S360, in the state in which the compressor 15 and the condenser fan 18 are turned off, the evaporator 17 may provide latent heat for a set time. Thus, in the state in which the compressor 15 and the condenser fan 18 are turned off, the freezing compartment fan 19 may also be operated to further cool the freezing compartment 12 and the refrigerating compartment 13. The set time may be, for example, 60 seconds [S370].

[0109] In the state in which the compressor 15 and the condenser fan 18 stop being operated, the refrigerating compartment 13 and the freezing compartment 12 may also be further cooled while the freezing compartment fan 19 is operated for the set time, the freezing compartment fan 19 may be turned off after the set time elapses. Power consumption may be reduced by further driving the freezing compartment fan 19.

[0110] After the freezing compartment fan 19 is turned off, the controller 30 may return to operation S120 and may compare the ambient temperature of the refrigerator 1 with the set temperature to determine whether to perform the winter operation 200 [S380].

[0111] As such, the refrigerator 1 may determine the winter operation 200 and the normal operation 300 depending on the ambient temperature and may be continuously operated depending on the temperature of the refrigerating compartment 13.

[0112] The refrigerator and the method of controlling the same proposed according to embodiments may have the following effects.

[0113] According to an embodiment of the present disclosure, a winter operation and a normal operation may be determined by detecting ambient temperature through an outside temperature sensor, and cooling performance may be advantageously ensured in a situation with low ambient temperature by performing a winter operation for maintaining temperature suitable for food storage in a refrigerating compartment and a freezing compartment even in winter with low ambient temperature.

[0114] In particular, in a refrigerator in which cold air is supplied to both of the refrigerating compartment and the freezing compartment using one evaporator and one freezing compartment fan and driving of the compressor and the freezing compartment fan is controlled using a refrigerating compartment temperature sensor, the freezing compartment may be effectively cooled for a short time in which satisfactory temperature of the refrigerating compartment is achieved using high cooling power of the compressor during a winter operation while overcoming a problem in terms of unsatisfactory temperature of the freezing compartment due to low ambient temperature when the freezing compartment is cooled based

on the temperature of the refrigerating compartment.

[0115] Until a set time elapses after the compressor is driven during the winter operation, the evaporator and the freezing compartment fan adjacent thereto may be stopped, and the evaporator and the freezing compartment fan may be operated after the set time elapses, and accordingly, cold air may be supplied to the freezing compartment and the freezing compartment to more effectively cool the freezing compartment for a short time.

[0116] The freezing compartment fan may be rotated at low speed than in the normal operation, and accordingly, a time taken to achieve satisfactory temperature of the refrigerating compartment may be delayed by reducing a flow rate of cold air introduced into the compressor to further cool the freezing compartment.

[0117] The condenser fan may be operated when the set time elapses after the compressor is driven, and the condenser fan may be rotated at lower rotational speed than in the normal operation, and accordingly, a refrigerant may be effectively circulated even in an environment at low temperature by increasing temperature of the condenser.

[0118] Even in winter in which satisfactory temperature of the freezing compartment is not achieved due to a structure thereof, the freezing compartment may be maintained at appropriate temperature using a winter operation through detection of ambient temperature, thereby improving storage performance.

[0119] In particular, embodiments of the present disclosure may provide a refrigerator for ensuring excellent cooling performance of both of the refrigerating compartment and the freezing compartment using a minimum structure and for ensuring cooling performance of the freezing compartment even in winter.

Claims

1. A method of controlling a refrigerator (1) including:
 - a cabinet (10) in which a refrigerating compartment (13) and a freezing compartment (12) are formed;
 - a refrigerating compartment temperature sensor (32) included in the refrigerating compartment (13);
 - an evaporator (17) included in the freezing compartment (12);
 - a freezing compartment fan (19) included in the freezing compartment (12) and configured to supply cold air to the freezing compartment (12) and the refrigerating compartment (13);
 - a compressor (15) operable with variable cooling power;
 - a condenser (16) connected to the compressor (15);
 - a condenser fan (18) configured to cool the condenser (16); and

- a controller (30) configured to control the compressor (15), the freezing compartment fan (19), and the condenser fan (18) to maintain the refrigerating compartment (13) at a target control temperature depending on temperature detected by the refrigerating compartment temperature sensor (32), the method comprising:
- detecting (S120) outside temperature through an outside temperature sensor (31) configured to detect ambient temperature of the refrigerator (1);
- performing a winter operation (200) when the outside temperature detected by the outside temperature sensor (31) is equal to or less than a set temperature; and
- performing a normal operation (300) when the temperature detected by the outside temperature sensor (31) is higher than the set temperature.
2. The method of claim 1, wherein, during the winter operation (200), the compressor (15) is operated with higher cooling power than in the normal operation (300).
 3. The method of claim 1 or 2, wherein the set temperature for determining the winter operation (200) and the normal operation (300) is 18°C.
 4. The method of any one of claims 1, 2 or 3, wherein, during the winter operation (200), the freezing compartment fan (19) is turned on when a set time elapses after the compressor (15) is turned on.
 5. The method of any one of the preceding claims, wherein during the winter operation (200) the freezing compartment fan (19) is operated at lower speed than the rotational speed of the freezing compartment fan (19) during the normal operation (300).
 6. The method of any one of the preceding claims, wherein during the winter operation (200), the condenser fan (18) is turned on when a set time elapses after the compressor (15) is turned on, preferably the condenser fan (18) is operated at lower speed than rotational speed of the condenser fan (18) during the normal operation (300).
 7. The method of any one of the claims 3-6, wherein the set time may be a time taken until the compressor (15) reaches the high cooling power after being driven.
 8. The method of any one of the preceding claims, wherein, during the winter operation (200), when temperature of the refrigerating compartment (13) in the refrigerating compartment temperature sensor (32) is satisfactory, the compressor (15), the freezing compartment (12) fan, and the condenser fan (18) are turned off, preferably the compressor (15), the freezing compartment fan (19), and the condenser fan (18) are simultaneously turned off.
 9. The method of any one of the preceding claims, wherein the compressor (15) is configured as an inverter compressor or a linear compressor and/or is operated with a variable frequency depending on a load.
 10. The method of any one of the preceding claims, wherein the compressor (15) is operated with a higher frequency during the winter operation (200) than in the normal operation (300).
 11. The method of claim any one of the preceding claims, wherein the compressor (15) is operated at a frequency of 50 Hz during the winter operation (200) and is operated at a frequency of 30 Hz during the normal operation (300).
 12. The method of any one of the preceding claims, wherein the outside temperature sensor (31) is provided at one side of the cabinet (10), and configured to measure an ambient temperature of outside of the refrigerator (1).
 13. The method of claim 12, wherein the outside temperature sensor (31) is installed on a hinge cover for shielding a hinge that rotatably connects the cabinet (10) and a door (20).
 14. The method of any one of the preceding claims, wherein, during the normal operation (300), when temperature of the refrigerating compartment (13) in the refrigerating compartment temperature sensor (32) is satisfactory, the compressor (15) and the condenser fan (18) are first turned off, and the freezing compartment fan (19) is turned off after being operated until a set time elapses.
 15. A refrigerator (1) including:
 - a cabinet (10) having a refrigerating compartment (13) and a freezing compartment (12);
 - a refrigerating compartment temperature sensor (32) included in the refrigerating compartment (13);
 - outside temperature sensor (31) provided at the outside of the cabinet (10);
 - an evaporator (17) included in the freezing compartment (12);
 - a freezing compartment fan (19) included in the freezing compartment (12) and configured to supply cold air to the freezing compartment (12) and the refrigerating compartment (13);

a compressor (15) operable with variable cooling power;
a condenser (16) connected to the compressor (15);
a condenser fan (18) configured to cool the condenser (16); and
a controller (30) configured to control the compressor (15), the freezing compartment fan (19), and the condenser fan (18) in a winter operation or a normal operation to maintain the refrigerating compartment (13) at a target control temperature depending on temperatures detected by the refrigerating compartment temperature sensor (32) and outside temperature sensor (31).

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Fig. 1

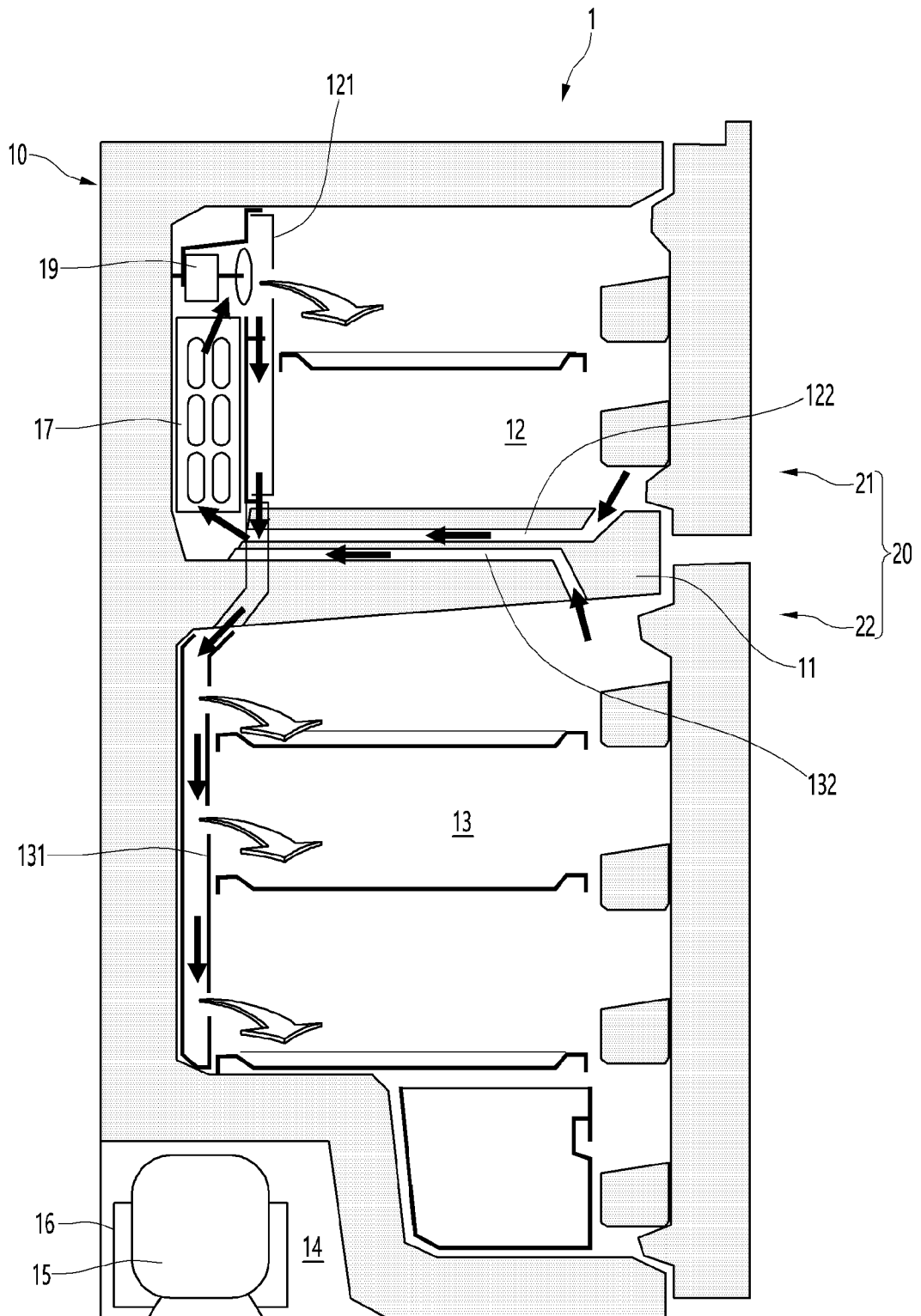


Fig. 2

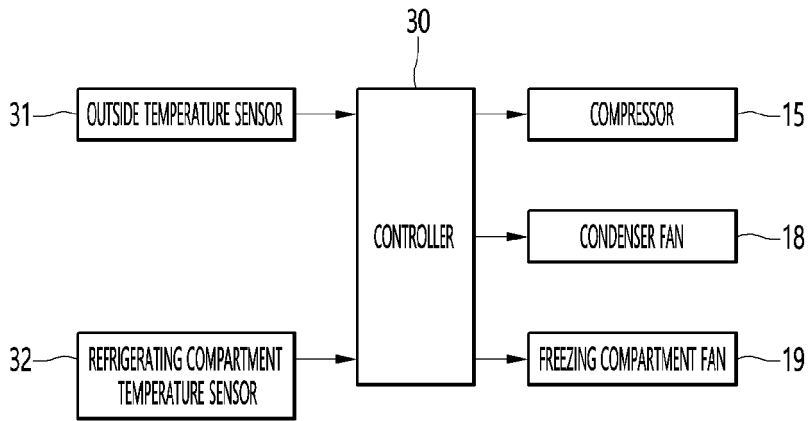
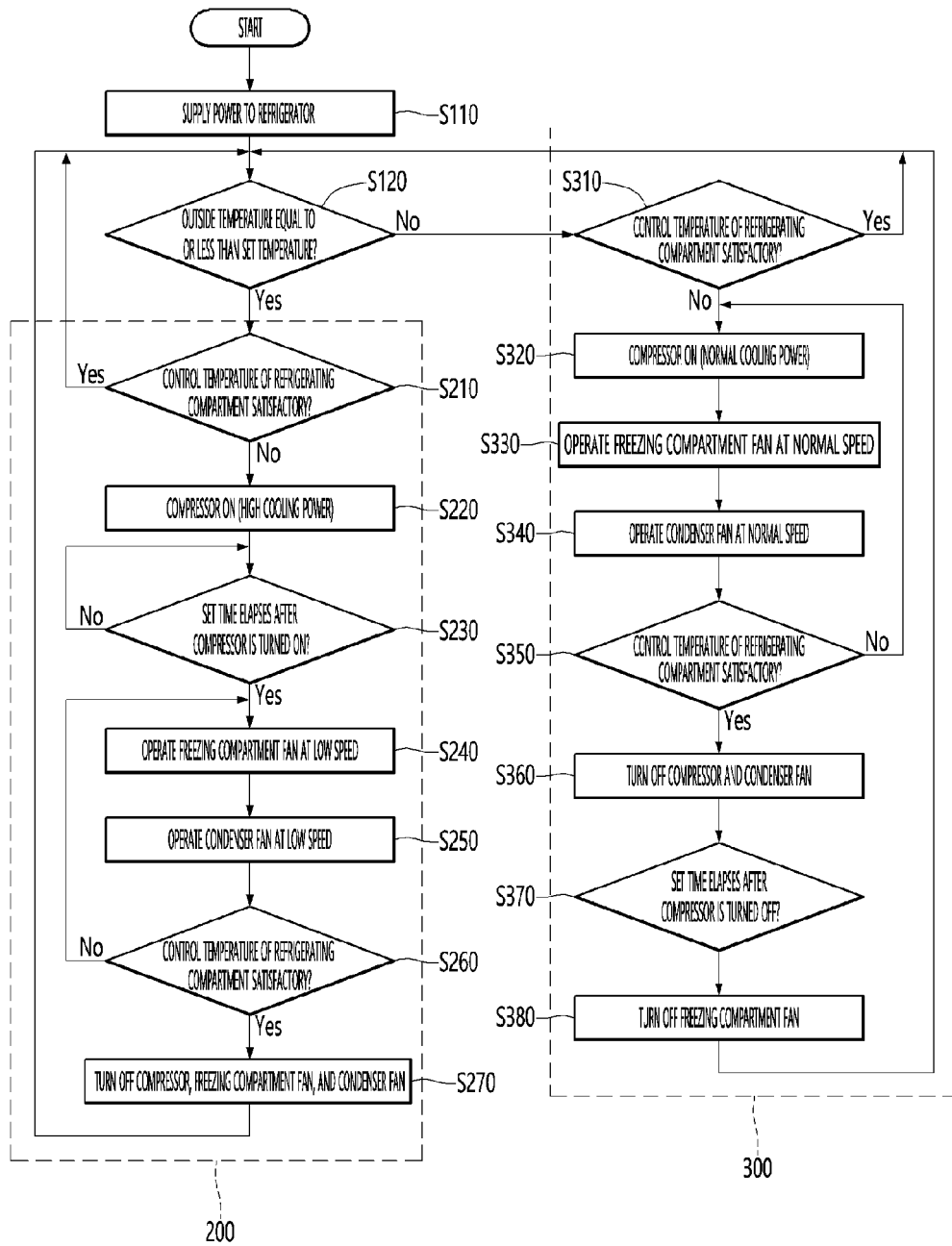


Fig. 3





EUROPEAN SEARCH REPORT

Application Number

EP 21 21 1064

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Place of search The Hague		Date of completion of the search 19 April 2022	Examiner Kolev, Ivelin
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