(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 829 812 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.01.2015 Bulletin 2015/05

(51) Int Cl.:
F24F 11/00 *(2006.01)*

(21) Application number: **14176873.9**

(22) Date of filing: **14.07.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **25.07.2013 TR 201309039**

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(54) **A refrigeration device and method of operation**

(57) A refrigeration device (S) according to the present invention comprises one body (G) including one compartment; one compressor (K); one condenser (C); equipment allowing the transfer of the refrigerant leaving the condenser (C) to the units; one chamber (H) wherein the compressor (K) and condenser (C) are located; one air blowing unit (F) allowing air circulation through the compressor (K) and condenser (C); measurement member (M) which measures the humidity of the outside environment and one control unit (U) associated with this measurement member (M), and the method of operation comprises the steps of: measuring the humidity of the outside environment and transferring it to the control unit (U); calculating humidity values of the outside environment at which dew formation may occur, and calculating the operation status and periods of the air blowing unit (F) by evaluation of the measured data and the temperature and humidity values of the compartment; comparing the calculated value with the measured value; if the measured value is higher than the calculated value, stopping the air blowing unit (F), at the beginning of the refrigeration cycle, for a period of time calculated; at the end of this time period, operating the air blowing unit (F) at the highest speed (F1) for a second period of time; performing such processes of stopping - operating at the highest speed (F1) of the air blowing unit (F), during the refrigeration cycle, at certain intervals; when the refrigeration cycle is stopped, operating the air blowing unit (F) at the highest speed (F1).

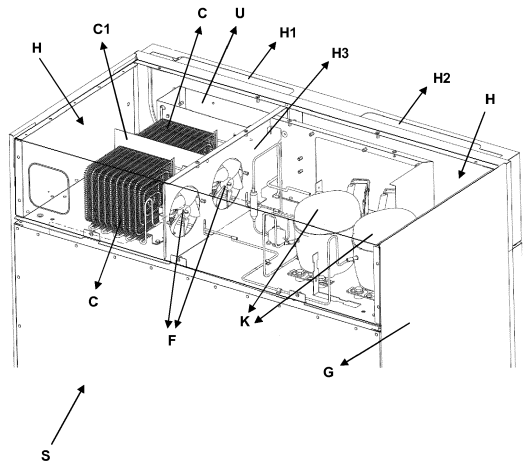

Figure 1

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Description

Field of the Invention

[0001] The present invention relates to refrigeration devices in which dew formation that may occur depending on the temperature and humidity of the outside environment is prevented, and methods of operation thereof.

Prior Art

[0002] As is known, refrigeration devices comprise such units as a compressor, a condenser, and an evaporator for refrigeration purposes. In a refrigeration system comprising such units, a refrigerant is passed through these units and circulated inside the system so that the refrigeration device is cooled down to the desired and/or required temperature values. During the circulation of the refrigerant, transfer of the refrigerant from one unit to the other (for example its transfer from the condenser to evaporator) can be carried out by various equipment (such as piping called hotgas). This equipment is generally in contact with different portions of the refrigeration device body (such as front panel of the body, outer frames of the door and/or drawer etc.). The temperature of the refrigerant passing through the equipment varies according to the operation status of the compressor provided in the refrigeration device; and as a result of such temperature changes, dew formation may occur on areas where this equipment is situated, depending on the temperature and humidity of the outside environment. In other words, the compressor of the refrigeration device provided for the refrigeration cycle is operated and stopped at certain intervals. When the compressor is about to stop, the temperature of the refrigerant leaving the compressor is lower than that when the compressor starts to operate. Therefore, the temperature of the refrigerant reaching to the said equipment is much lower. Due to the fact that the flow of the refrigerant would be stopped once the compressor stops, the temperature of the said equipment becomes quite low, which results in dew formation on areas where the equipment is situated, if the humidity of the outer environment is high.

[0003] The patent document no. US2007039339A1 of the state-of-art discloses an embodiment of a refrigerator designed to prevent dew from being formed on the front panel of the device. In the said embodiment, the temperature of the outside environment where the device is located and the front panel temperature are measured and compared. If the front panel temperature is lower than the outside temperature by a reference temperature difference or more, the condenser fan is operated with a delayed time set according to the temperature difference of the front panel-outside when the compressor is operated, and it is stopped when the compressor stops. However, due to the fact that the fan is completely stopped in this embodiment, heating may be seen on the body of the refrigeration device to the extent to affect refrigeration efficiency negatively, in which case the compressor must be operated more, possibly resulting in increased energy consumption.

Brief Description of the Invention

[0004] The inventive refrigeration device comprises at least one body including at least one compartment in which products to be cooled are placed; at least one compressor supplying a high-temperature refrigerant to the refrigeration cycle; at least one condenser to which the refrigerant leaving the compressor is transferred; equipment enabling the transfer of the refrigerant leaving the condenser to the relevant units for refrigeration cycle and in contact with several portions of the said body; at least one chamber wherein said compressor and condenser are located, which is isolated from the outside environment and which comprises at least one air inlet opening for passage of air from the outside environment thereto, and at least on air outlet opening for passage of air therefrom to the outside environment; at least one air blowing unit which is located inside the said chamber, and which regulates the temperature of the compressor and condenser by allowing air circulation through the compressor and condenser; at least one measurement member which measures the humidity of the outside environment, and at least one control unit associated with this measurement member and controlling operation of the air blowing unit in line with the data received from the said measurement member and the operation status of the compressor, and the operation method of the refrigeration device comprises the steps of: measuring the humidity of the outside environment, where the refrigeration device is located, by the measurement member and transferring it to the control unit; calculating possible humidity values of the outside environment at which dew formation may occur and calculating the operation status and operation-shutdown period of the air blowing unit by combined evaluation of the measured data and the temperature and humidity values of the compartment in the refrigeration device by the control unit; comparing the calculated humidity value with the measured humidity value; if the measured humidity value is higher than the calculated value, stopping the air blowing unit, at the beginning of the refrigeration cycle, for a period of time calculated by the control unit; at the end of this time period, operating the air blowing unit at the highest speed for a second period of time again calculated by the control unit; performing such processes of stopping - operating at the highest speed of the air blowing unit at certain intervals, during the refrigeration cycle, in line with the time periods calculated by the control unit; when the refrigeration cycle is stopped, operating the air blowing unit at the highest speed during the shutdown period.

[0005] With the method of operation according to the present invention, dew formation is effectively prevented on portions where the equipment contacts the body, which equipment allows passage of the refrigerant

through the refrigeration members in the refrigeration device provided for purposes of refrigeration and is, at the same time, in contact with the body of the refrigeration device. Furthermore, with an effective regulation of the operation conditions of the air blowing unit, refrigeration efficiency of the refrigeration device is also prevented from being affected negatively.

Object of the Invention

[0006] An object of the present invention is to provide a refrigeration device wherein dew formation that may occur on the outer surface depending on the temperature and humidity of the outside environment is prevented.

[0007] Another object of the present invention is to provide an operation method for a refrigeration device, wherein the compressor and condenser are located inside a chamber isolated from the outside environment, in which method dew formation that may occur on the outer surface depending on the temperature and humidity of the outside environment is prevented.

[0008] Another object of the present invention is to provide an operation method for a refrigeration device, wherein the compressor and condenser are cooled by a common air blowing unit, in which method dew formation that may occur depending on the temperature and humidity of the outside environment is prevented.

[0009] Still another object of the present invention is to provide an operation method for refrigeration devices, in which the compressor and condenser are cooled down effectively while dew formation is prevented.

Description of the Drawings

[0010] The exemplary embodiments of the refrigeration device and operation method thereof according to the present invention are illustrated in the enclosed drawings, in which:

Figure 1 is a rear sectional perspective view of the refrigeration device.
Figure 2 is a front sectional perspective view of the refrigeration device.
Figure 3 is another rear sectional perspective view of the refrigeration device.
Figure 4 is an operation diagram of the compressor and air blowing device of the refrigeration device.

[0011] All the parts illustrated in the figures are individually assigned a reference numeral and the corresponding terms of these numbers are listed as follows:

Refrigeration device	(S)
Body	(G)
Chamber	(H)
Air inlet opening	(H1)
Air outlet opening	(H2)

(continued)

Panel	(H3)
Compressor	(K)
Compressor operation period	(K1)
Compressor shutdown period	(K2)
Condenser	(C)
Separator	(C1)
Air blowing unit	(F)
Air blowing unit operation period	(F1)
Control unit	(U)
Measurement member	(M)
Control panel	(1)
Control member	(2)

Description of the Invention

[0012] The refrigeration devices comprise at least one body including compartments in which products to be cooled are placed. This body is, on one surface, in contact with the environment where the refrigeration device is situated and on the opposite surface, it is in contact with the inner volume of the compartment and various equipment (such as piping called hotgas through which refrigerant is transferred from the condenser to the evaporator) in which the refrigerant is circulated for cooling the compartment. The temperature of the refrigerant flowing through the equipment varies according to the operation status of the compressor in the refrigeration device; and as a result of such temperature changes, dew formation may occur on the outer surface of the body portions where this equipment is located depending on the temperature and humidity of the external environment. More specifically, the compressor in the refrigeration device provided for refrigeration cycle is operated and stopped at certain intervals. When the compressor is about to stop, the temperature of the refrigerant leaving the compressor is lower than that when the compressor starts to operate. Therefore, the temperature of the refrigerant reaching to the said equipment is much lower. Due to the fact that the flow of the refrigerant would be stopped once the compressor stops, the temperature of the said equipment becomes quite low, which results in dew formation on areas where the equipment is situated, if the humidity of the outer environment is high. Therefore, with the present invention, there is provided an operation method for refrigeration devices, wherein moisture formation that may occur depending on the temperature and humidity of the outside environment is prevented.

[0013] The inventive operation method, an illustrative diagram of which is shown in Figure 4 and illustrated in Figures 1-3, is suitable for use in a refrigeration device (S) comprising at least one body (G) including at least one compartment (which may a normal cooling compartment or freezing compartment) in which products to be cooled are placed; at least one compressor (K) supplying a high-temperature refrigerant to the refrigeration cycle;

at least one condenser (C) to which the refrigerant leaving the compressor (K) is transferred; equipment (i.e. a refrigerant transferring pipe called hotgas) allowing the transfer of the refrigerant leaving the condenser (C) to the relevant units for refrigeration cycle (i.e. evaporator) and in contact with the said body (G); at least one chamber (H) (which is preferably located at the top part of the refrigeration device (S)) wherein the said compressor (K) and condenser (C) are located, which is isolated from the outside environment and which comprises at least one air inlet opening (H1) for passage of air from the outside environment thereto, and at least one air outlet opening (H2) for passage of air therefrom to the outside environment; at least one air blowing unit (F) which is located inside the said chamber (H), and which regulates the temperature of the compressor (K) and condenser (C) by allowing air circulation through the compressor (K) and condenser (C); at least one measurement member (M) which is preferably located closed to the air inlet opening (H1) and which measures the humidity of the outside environment (preferably also the temperature of the outside environment) and at least one control unit (U) associated with this measurement member (M) and controlling the operation of the air blowing unit (F) in line with the data received from the said measurement member (M) and the operation status of the compressor (K) and which is preferably located inside the said chamber (H). The inventive operation method comprises the steps of: measuring the humidity (and preferably the temperature) of the outside environment where the refrigeration device (S) is situated by the measurement member (M) and transferring it to the control unit (U); calculating possible humidity values of the outside environment at which dew formation may occur, and calculating the operation status and operation-shutdown period of the air blowing unit (F) by combined evaluation of the measured data (humidity and preferably temperature data) and the temperature and humidity values of the compartment in the refrigeration device (S) by the control unit (U); comparing the calculated humidity value with the measured humidity value; if the measured humidity value is higher than the calculated value, stopping the air blowing unit (F), at the beginning of the refrigeration cycle (in other words, when the compressor (K) starts to operate (K1)), for a period of time calculated by the control unit (U); at the end of this time period, operating the air blowing unit (F) at the highest speed (F1) for a second period of time calculated again by the control unit (U); performing such processes of stopping - operating at the highest speed (F1) of the air blowing unit (F), during the refrigeration cycle (in other words, during the operation period (K1) of the compressor (K)), at certain intervals in line with the time periods calculated by the control unit (U); when the refrigeration cycle is stopped (in other words, when the compressor (K) is stopped to operate (K2)), operating the air blowing unit (F) at the highest speed (F1) during this shutdown period.

[0014] In the said operation method, the compressor (K) and condenser (C) quickly heats up during the shutdown period of the air blowing unit (F) while the compressor (K) is operating (K1), due to the fact that the compressor (K) and condenser (C) are located in the closed chamber (H). Therefore, the refrigerant is supplied to the equipment allowing the transfer of the refrigerant with a high temperature (i.e. superheated). Thus, body (G) portions (i.e. front panel of the body, outer frames of the door and/or compartment etc.) with a temperature level lower than the dew point, which are cooled down during the shutdown period of the refrigeration cycle (while the compressor (K) is stopped (K2)) and in contact with the said equipment, are brought to a temperature higher than the dew point by being heated in a quick manner due to non-operation of the air blowing unit (F) upon the start of the refrigeration cycle (K1). After the shutdown period of the said air blowing unit (F) is completed, it is operated at a high speed for a certain period of time (F1) by the control unit (U) so that the heat inside the chamber (H) is eliminated and the temperature of the compressor (K) and condenser (C) is reduced. Thus, the temperature of the refrigerant is also reduced and thus the temperature of the equipment to which the refrigerant is delivered and of the body (G) portions in contact with the equipment is reduced as well. Then, operation of the air blowing unit (F1) is stopped before the said body (G) portions reach to the dew point. During this shutdown period, the compressor (K) and condenser (C) heat up very quickly since they are located in the closed chamber (H), and accordingly the refrigerant is also heated up, as a result of which said equipment becomes warm quickly. Thus, dew formation on the body (G) portions in contact with the said equipment is prevented. However, with the operation of the air blowing unit (F) at the highest speed (F1) when the refrigeration cycle is stopped (K2), the chamber (H) and therefore the compressor (K) and condenser (C) are cooled down prior to the refrigeration cycle so that refrigeration efficiency of the refrigeration device (S) is prevented from being affected negatively by the stopping of the air blowing unit (F) at the beginning of the refrigeration cycle. Furthermore, with the operation of the air blowing unit (F) at the highest speed (F1) at certain intervals during the refrigeration cycle, any increase in the temperature that may occur in the compartment of the refrigeration device (S) is prevented so that refrigeration efficiency is kept stable. As an example of the operation of the invention, when the temperature of the compartment in the refrigeration device (S) is - 16°C and the humidity value of the outside environment where the device (S) is located is 85% Rh, no dew formation occurs whereas if the temperature of the compartment is - 24°C, dew formation occurs at humidity value of 85% Rh. Since these data are measured and calculated by the control unit (U), as described above, in the second case, the above-mentioned operation method is activated. Thus, the said operation method is used when necessary so that energy is saved, and effective refrigeration efficiency is obtained.

[0015] In a preferred embodiment of the invention, the

refrigeration device (S) comprises at least one control panel (1) and at least one control member (2) (which may be in the form of a button or key as well as a display screen or a touch screen with a button/key) located on this panel (1) and associated with the said control unit (U). In this embodiment, the temperature of the compartment in the refrigeration device (S) is inputted by the user through the control member (2) and the control unit (U) uses the value inputted by the control member as the temperature value of the compartment so as to make any calculation and comparison on the basis of this value. Thus, it is possible for the user to use the compartment as a refrigeration compartment or as a freezing compartment, when desired, and the inventive operation method can be used accordingly.

[0016] In another alternative embodiment of the invention, the chamber (H) in the refrigeration device (S) comprises at least one panel (H3) located so as to separate the compressor (K) and condenser (C) from each other. In this embodiment, the condenser (C) is located on that part of the chamber (H) where the air inlet opening (H1) is provided while the compressor (K) is located on that part where the air outlet opening (H2) is provided, and the said air blowing unit (F) is located on the panel (H3) such that it draws air from the air inlet opening (H1) during the operation period (F1) and leads it to the air outlet opening (H2). Thus, air drawn from the environment where the refrigeration device (S) is located is passed through the condenser (C) so as to allow the condenser (C) to cool down and consequently refrigeration efficiency is kept stable.

[0017] In another alternative embodiment of the invention, the refrigeration device (S) comprises at least two compartments, at least one of which is a refrigeration compartment and at least the other one thereof is a freezing compartment, and each of these compartments is cooled down with separate systems comprising at least one compressor (K), at least one condenser (C) and at least one air blowing unit (F). Therefore, the refrigeration device (S) comprises at least one compressor (K), at least one condenser (C), at least one air blowing unit (F) and at least one refrigeration compartment associated with each other for normal refrigeration process, and at least one further compressor (K), at least one further condenser (C), at least one air blowing unit (F) and at least one freezing compartment associated with each other for freezing process. In this embodiment, the air blowing unit (H) provided for purposes of normal refrigeration is operated constantly when the humidity value measured by the measurement device (M) is high whereas the air blowing unit (H) provided for freezing process is operated with the inventive operation method (wherein it is operated at the highest speed at certain intervals during the operation period (K1) of the compressor (K), and at the highest speed and constantly during the shutdown period (K2) of the compressor (K)). Thus, on one hand, body (G) portions in contact with the equipment enabling passage of the refrigerant between the condensers (C) and other refrigeration units such as evaporator are maintained at a temperature higher than that at which dew formation may occur, and at the same time the chamber (H) is ventilated efficiently.

[0018] With the method of operation according to the present invention, dew formation is effectively prevented on portions where the equipment contacts to the body (G), which equipment allows passage of the refrigerant through the refrigeration members of the refrigeration device (S) provided for purposes of refrigeration and is, at the same time, in contact with the body (G) of the refrigeration device (S). Furthermore, with an effective regulation of the operation conditions of the air blowing unit (H), refrigeration efficiency of the refrigeration device (S) is also prevented from being affected negatively.

Claims

1. A method of operation for a refrigeration device (S) comprising at least one body (G) including at least one compartment in which products to be cooled are placed; at least one compressor (K) supplying a high-temperature refrigerant to the refrigeration cycle; at least one condenser (C) to which the refrigerant leaving the compressor (K) is transferred; equipment allowing the transfer of the refrigerant leaving the condenser (C) to the relevant units for refrigeration cycle and in contact with various portions of the said body (G); at least one chamber (H) wherein the said compressor (K) and condenser (C) are located, which is isolated from the outside environment and which comprises at least one air inlet opening (H1) for passage of air from the outside environment thereto, and at least one air outlet opening (H2) for passage of air therefrom to the outside environment; at least one air blowing unit (F) which is located inside the said chamber (H), and which regulates the temperature of the compressor (K) and condenser (C) by allowing air circulation through the compressor (K) and condenser (C); at least one measurement member (M) which measures the humidity of the outside environment and at least one control unit (U) associated with this measurement member (M) and controlling the operation of the air blowing unit (F) in line with the data received from the said measurement member (M) and the operation status of the compressor (K), **characterized by** comprising the following steps:

   - measuring the humidity of the outside environment where the refrigeration device (S) is situated by the measurement member (M) and transferring it to the control unit (U);
   - calculating possible humidity values of the outside environment at which dew formation may occur, and calculating the operation status and operation-shutdown period of the air blowing unit (F) by combined evaluation of the measured

data and the temperature and humidity values of the compartment in the refrigeration device (S) by the control unit (U);

- comparing the calculated humidity value with the measured humidity value;
- if the measured humidity value is higher than the calculated value, stopping the air blowing unit (F), at the beginning of the refrigeration cycle, for a period of time calculated by the control unit (U);
- at the end of this time period, operating the air blowing unit (F) at the highest speed (F1) for a second period of time calculated again by the control unit (U);
- performing such processes of stopping - operating at the highest speed (F1) of the air blowing unit (F), during the refrigeration cycle, at certain intervals in line with the time periods calculated by the control unit (U);
- when the refrigeration cycle is stopped, operating the air blowing unit (F) at the highest speed (F1) during this shutdown period.

2. A method of operation according to claim 1, **characterized in that** the temperature of the compartment in the refrigeration device (S) is inputted by the user through the at least one control member (2) provided in the refrigeration device (S), and the control unit (U) uses the value inputted by the control member as the temperature value of the compartment so as to make any calculation and comparison on the basis of this value.

3. A method of operation according to claim 1, **characterized in that** the temperature of the outside environment where the refrigeration device (S) is situated is also measured by the said measurement member (M), and this measured temperature value is also considered in the step of calculating possible humidity values of the outside environment at which dew formation may occur as well as the operation conditions and periods of the air blowing unit (F).

4. A refrigeration device (S) comprising at least one body (G) including at least one compartment in which products to be cooled are placed; at least one compressor (K) supplying a high-temperature refrigerant to the refrigeration cycle; at least one condenser (C) to which the refrigerant leaving the compressor (K) is transferred; equipment allowing the transfer of the refrigerant leaving the condenser (C) to the relevant units for refrigeration cycle and in contact with various portions of the said body (G); at least one chamber (H) wherein the said compressor (K) and condenser (C) are located, which is isolated from the outside environment and which comprises at least one air inlet opening (H1) for passage of air from the outside environment thereto, and at least one air outlet opening (H2) for passage of air therefrom to the outside environment; at least one air blowing unit (F) which is located inside the said chamber (H), and which regulates the temperature of the compressor (K) and condenser (C) by allowing air circulation through the compressor (K) and condenser (C); at least one measurement member (M) which measures the humidity of the outside environment and at least one control unit (U) associated with this measurement member (M) and controlling the operation of the air blowing unit (F) in line with the data received from the said measurement member (M) and the operation status of the compressor (K), **characterized by** comprising:

- at least one panel (H3) which is located in the chamber (H) in such a way that it separates the compressor (K) and condenser (C) from each other, and that the condenser (C) is located on that part of the chamber (H) where the air inlet opening (H1) is provided while the compressor (K) is located on that part where the air outlet opening (H2) is provided, and on which the said air blowing unit (F) is located such that it draws air from the air inlet opening (H1) during the operation period (F1) and leads it to the air outlet opening (H2).

5. A refrigeration device (S) according to claim 4, **characterized in that** the said chamber (H) is located at the top part of the refrigeration device (S).

6. A refrigeration device (S) according to claim 4, **characterized in that** the said control unit (U) is located inside the chamber (H).

7. A refrigeration device (S) according to claim 4, **characterized by** comprising at least two compartments, at least one of which is a refrigeration compartment and at least the other one thereof is a freezing compartment.

8. A refrigeration device (S) according to claim 7, **characterized by** comprising at least one compressor (K), at least one condenser (C), at least one air blowing unit (F) associated with each other for cooling the said refrigeration compartment, and at least one refrigeration compartment for cooling the said freezing compartment and at least one further compressor (K), at least one further condenser (C), at least one air blowing unit (F) associated with each other for the freezing process.

9. A method of operation for a refrigeration device (S) according to claim 8, **characterized in that** when the humidity value measured by the measurement device (M) is high, the air blowing unit (H) allowing the refrigeration compartment to be cooled down is

operated constantly whereas the air blowing unit (H) cooling down the freezing compartment is operated according to the method of operation as claimed in claims 1-3.

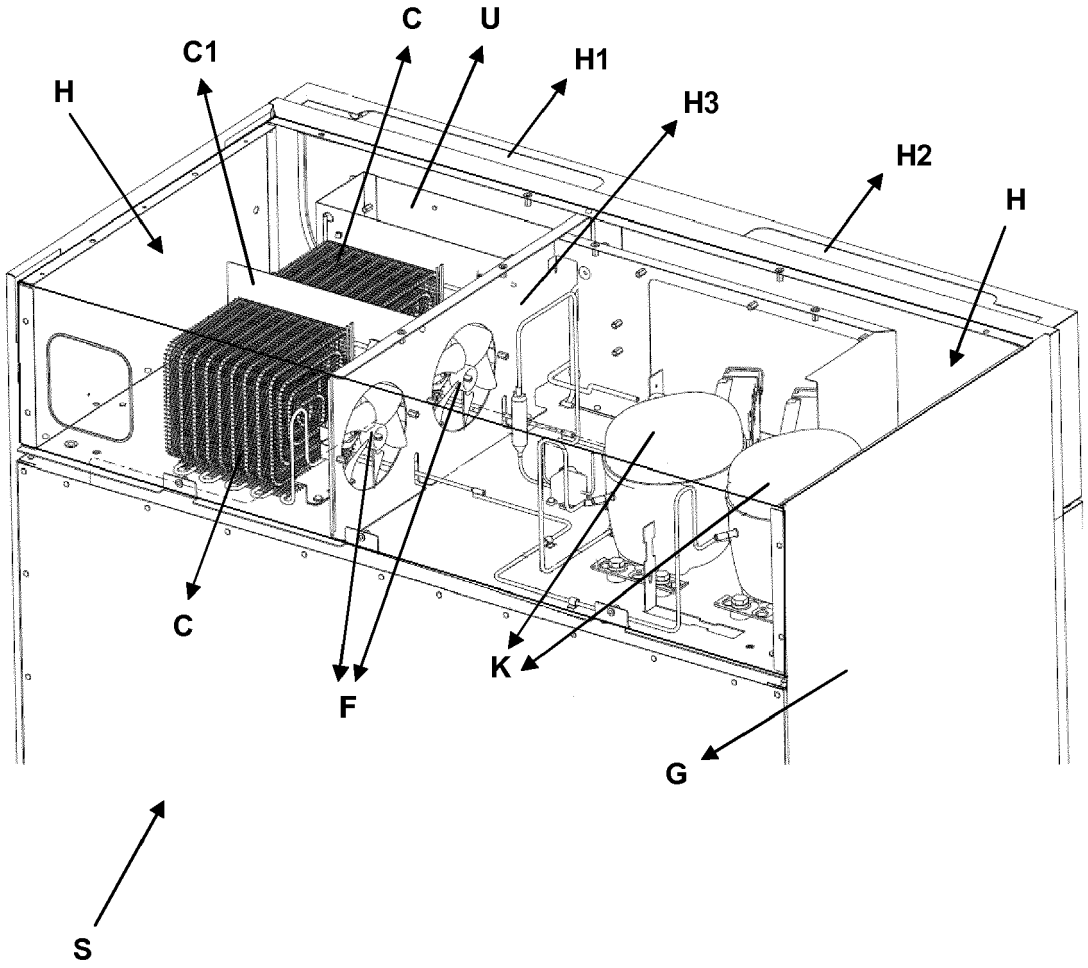

Figure 1

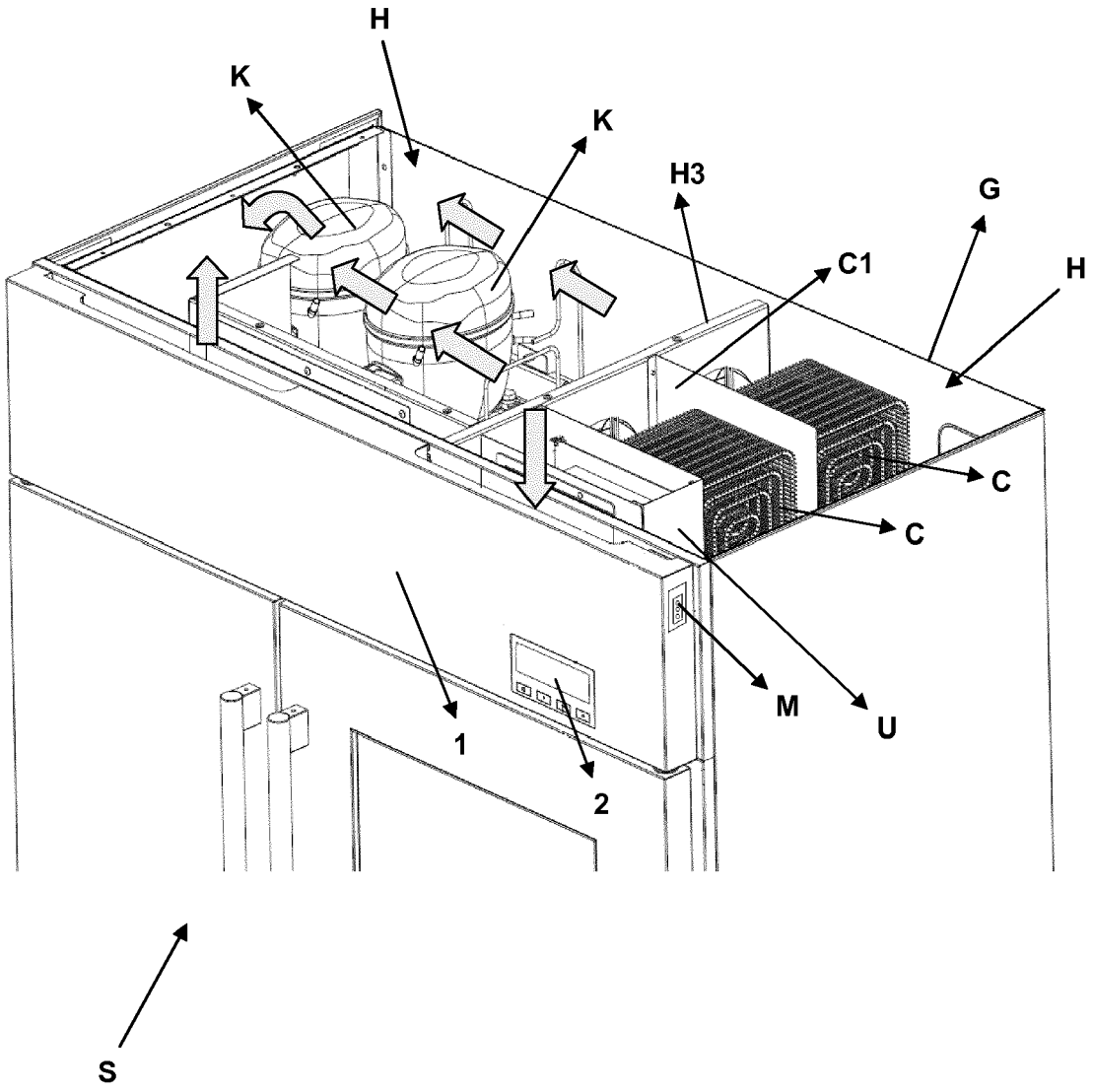

Figure 2

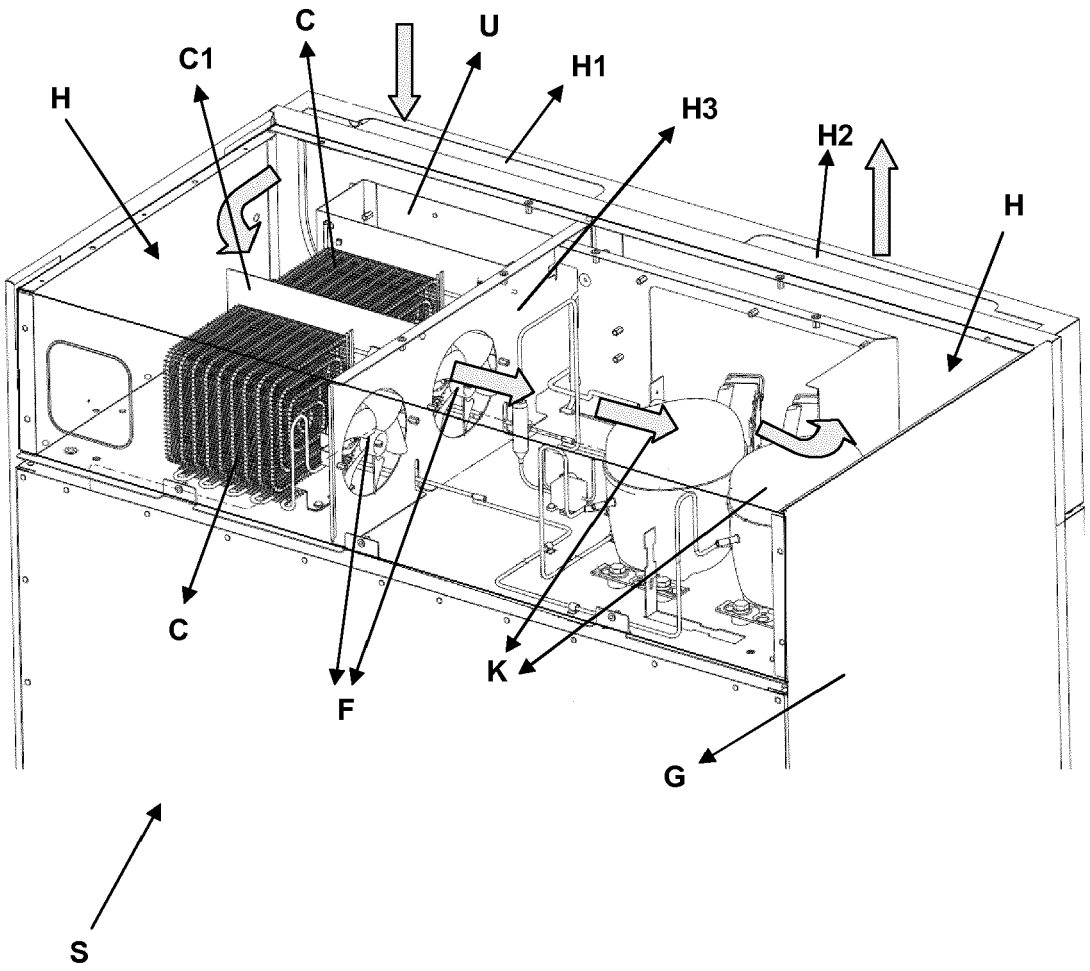

Figure 3

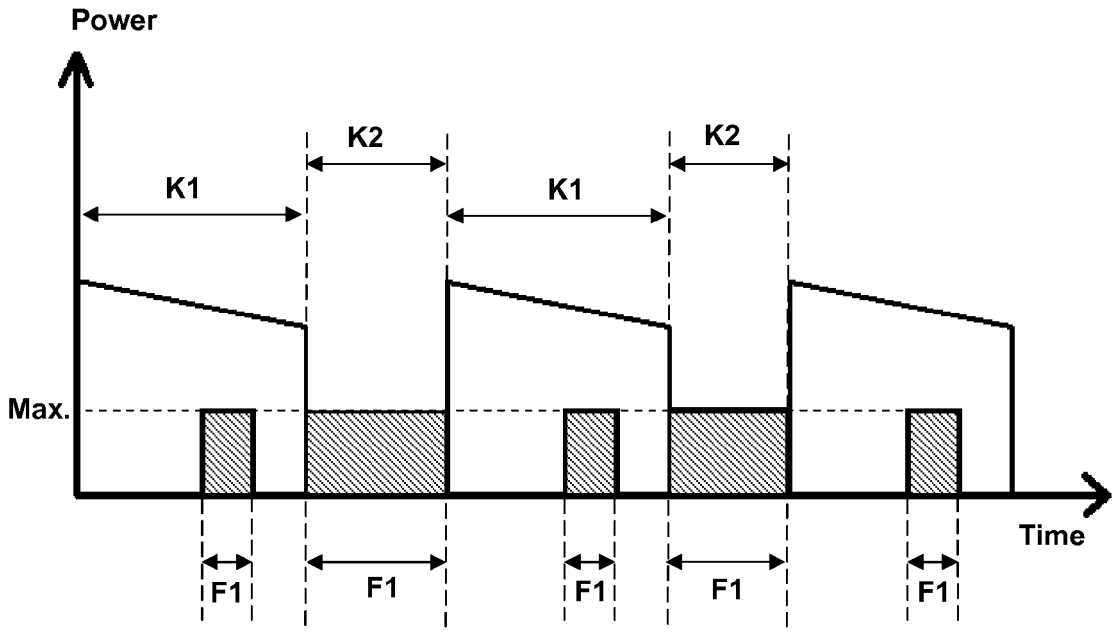

Figure 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2007039339 A1 **[0003]**