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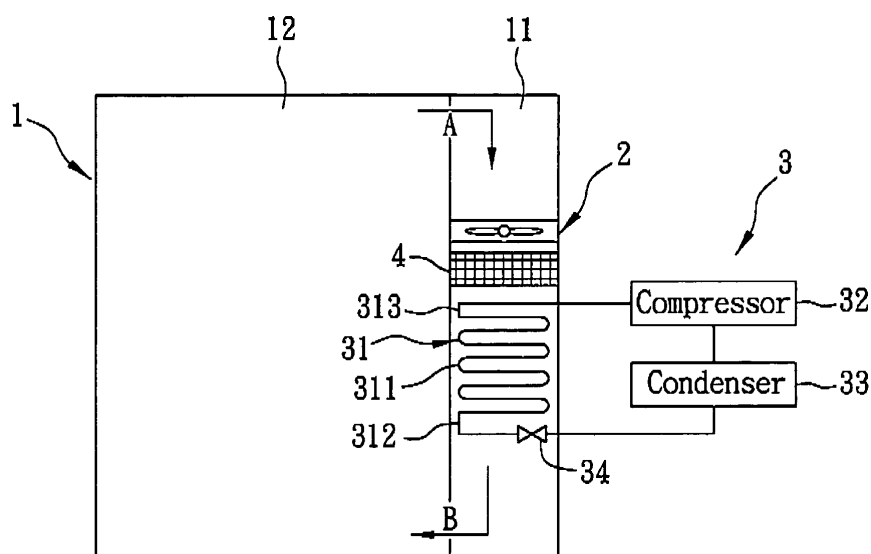
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(54) **Refrigerating apparatus**

(57) A refrigerating apparatus includes: a storage compartment (1), an air-circulating member (2), a refrigerating unit (3), and an electric field-generating unit (4). The storage compartment (1) has an evaporator-side region (11) and a cooling-side region (12). The air-circulating member (2) is disposed to establish an air circulation path in which a to-be-cooled air flows from the cooling-side region (12) to the evaporator-side region (11) along an onward flow route (A), and in which a cooled air flows

from the evaporator-side region (11) back to the cooling-side region (12) along a backward flow route (B). The refrigerating unit (3) includes an evaporator (31) disposed in the evaporator-side region (11), a compressor (32), and an expansion valve (34). The electric field-generating unit (4) is disposed to impose a DC voltage over the onward flow route (A) so as to minimize cohesion of water droplets in the evaporator-side region (11), thereby reducing phenomenon of frosting on the conduit body (311) of the evaporator (31).



**FIG. 1**

## Description

**[0001]** This application claims priority of Taiwanese application no. 096134035, filed on September 12, 2007.

**[0002]** The invention relates to a refrigerating apparatus with an electric field-generating unit.

**[0003]** A refrigerating apparatus includes a storage compartment, a fan, and a refrigerating unit. The storage compartment has an evaporator-side region and a cooling-side region that is used to store, for example, foods. The refrigerating unit includes an evaporator disposed in the evaporator-side region of the storage compartment, a compressor, a condenser, and an expansion valve. Generally, a thermodynamic cycle is performed in the refrigerating unit. In this cycle, a circulating refrigerant enters the compressor as a low-pressure vapor. The vapor is compressed and exits the compressor as a superheated high-pressure vapor. The superheated vapor travels through the condenser which removes the superheat and then condenses the vapor into a liquefied refrigerant. By passing through the expansion valve, the liquefied refrigerant expands from the high-pressure level in the condenser to the low-pressure level in the evaporator, thereby resulting in flash evaporation. The liquefied refrigerant is completely vaporized in the evaporator by cooling the warm air from the cooling-side region, such that the cooling-side region can be maintained at a low temperature. The resulting refrigerant vapor returns to the compressor to complete the cycle.

**[0004]** However, because the temperature of the evaporator is lower than the freezing point of water, ice builds up on a conduit body of the evaporator. The ice on the evaporator acts as an insulator and reduces heat transfer between the evaporator and the air passing there-through, thereby reducing the efficiency of the refrigerating apparatus.

**[0005]** There are several approaches to remove ice from the evaporator. Typically, a heating element providing heat to melt ice off the evaporator is connected to the evaporator or is disposed at a position adjacent thereto. Normally, the heating element is controlled through a timer or a sensor. However, the prior art approaches require the expenditure of heating and are time consuming. Since the temperature in the storage compartment is likely to be unstable using the heating approach for defrosting, most large chest freezers require manual defrosting.

**[0006]** Therefore, an object of this invention is to provide a refrigerating apparatus that can overcome the aforesaid drawbacks associated with the prior art.

**[0007]** Accordingly, a refrigerating apparatus of the present invention comprises: a storage compartment, an air-circulating member, a refrigerating unit, and an electric field-generating unit. The storage compartment includes an evaporator-side region and a cooling-side region. The air-circulating member is disposed to establish an air circulation path in which a to-be-cooled air flows from the cooling-side region to the evaporator-side region along an onward flow route, and in which a cooled air

flows from the evaporator-side region back to the cooling-side region along a backward flow route. The refrigerating unit includes: an evaporator having a conduit body disposed in the evaporator-side region for evaporation of a refrigerant, and inlet and outlet members which are disposed upstream and downstream of the conduit body respectively to lead the refrigerant in and out of the conduit body, respectively; a compressor which is disposed outwardly of the storage compartment, which is positioned downstream of the outlet member to compress the vapor of refrigerant led out thereof for supply of liquefied refrigerant, and which is upstream of the inlet member for delivering the liquefied refrigerant towards the inlet member; and an expansion valve which is disposed downstream of the compressor and upstream of the inlet member for flash evaporation of the liquefied refrigerant. The electric field-generating unit is disposed to impose a DC voltage over the onward flow route with a sufficient intensity such that water droplets entrained in the to-be-cooled air are charged so as to minimize cohesion of water droplets in the evaporator-side region, thereby reducing phenomenon of frosting on the conduit body of the evaporator.

**[0008]** Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

Fig. 1 is a schematic diagram of the first preferred embodiment of a refrigerating apparatus according to the present invention;

Fig. 2 is a schematic diagram of the second preferred embodiment of the refrigerating apparatus according to the present invention; and

Fig. 3 is a schematic diagram of an electric field-generating unit of the refrigerating apparatus according to the present invention.

**[0009]** Before the present invention is described in greater detail with reference to the accompanying preferred embodiments, it should be noted herein that like elements are denoted by the same reference numerals throughout the disclosure.

**[0010]** Referring to Fig. 1, in the first preferred embodiment, a refrigerating apparatus according to this invention is shown to include a storage compartment 1, an air-circulating member 2, a refrigerating unit 3, and an electric field-generating unit 4.

**[0011]** The storage compartment 1 has an evaporator-side region 11 and a cooling-side region 12.

**[0012]** The air-circulating member 2 is disposed in the evaporator-side region 11 to establish an air circulation path in which a to-be-cooled air flows from the cooling-side region 12 to the evaporator-side region 11 along an onward flow route (A), and in which a cooled air flows from the evaporator-side region 11 back to the cooling-side region 12 along a backward flow route (B).

**[0013]** The refrigerating unit 3 includes an evaporator

31, a compressor 32, a condenser 33, and an expansion valve 34.

**[0014]** The evaporator 31 has a conduit body 311, and inlet and outlet members 312, 313. The conduit body 311 is disposed in the evaporator-side region 11 for evaporation of a refrigerant. The inlet and outlet members 312, 313 are disposed upstream and downstream of the conduit body 311 respectively to lead the refrigerant in and out of the conduit body 311, respectively. The refrigerant evaporates in the conduit body 311 as the heat is transferred from the to-be-cooled air to the refrigerant through the conduit body 311 of the evaporator 31. The cooled air then flows back to the cooling-side region 12 so as to maintain the storage compartment 1 of the refrigerating apparatus at a relatively low temperature.

**[0015]** The compressor 32 is disposed outwardly of the storage compartment 1, and is positioned downstream of the outlet member 313 to compress the vapor of refrigerant as a superheated high-pressure vapor.

**[0016]** The condenser 33 is also disposed outwardly of the storage compartment 1, and is positioned downstream of the compressor 32 and upstream of the expansion valve 34 to condense the superheated high-pressure vapor into a liquefied refrigerant.

**[0017]** The liquefied refrigerant is delivered towards the expansion valve 34 disposed downstream of the condenser 33 and upstream of the inlet member 312 for flash evaporation of the liquefied refrigerant, followed by delivery of the refrigerant into the evaporator 31.

**[0018]** As shown in Fig. 3, in this preferred embodiment, the electric field-generating unit 4 includes a rectifier 43, a DC/DC converter 42, and a voltage grid 41 disposed upstream of the evaporator 31 in the onward flow route (A). The number of the voltage grid 41 is not limited. An external AC voltage is converted to a DC voltage using the rectifier 43, followed by amplification of the DC voltage to a desired high voltage using the DC/DC converter 42. The high voltage is applied to the voltage grid 41 such that water droplets entrained in the to-be-cooled air passing through the voltage grid 41 are charged so as to minimize cohesion of water droplets in the evaporator-side region 11, thereby reducing phenomenon of frosting on the conduit body 311 of the evaporator 31. Preferably, the high voltage ranges from 3000V to 5000V.

**[0019]** In this embodiment, as shown in Fig. 1, the air-circulating member 2 is disposed on the onward flow route (A) and upstream of the electric field-generating unit 4. The air-circulating member 2 is a ventilating fan.

**[0020]** Fig. 2 illustrates the second preferred embodiment of the refrigerating apparatus of this invention. The second preferred embodiment differs from the previous embodiment in that the air-circulating member 2 is disposed on the backward flow route (B) and downstream of the evaporator 31. The air-circulating member 2 is a ventilating fan.

**[0021]** With the inclusion of the electric field-generating unit 4 in the refrigerating apparatus of this invention,

cohesion of water droplets in the evaporator-side region 11 can be minimized, thereby reducing the phenomenon of frosting on the conduit body 311 of the evaporator 31. Thus, the aforesaid drawbacks associated with the prior art can be eliminated. Accordingly, high efficiency, less defrosting energy consumption, time saving, and steady cooling can be achieved by the present invention.

## 10 Claims

### 1. A refrigerating apparatus comprising:

a storage compartment (1) which includes an evaporator-side region (11) and a cooling-side region (12);  
an air-circulating member (2) disposed to establish an air circulation path in which a to-be-cooled air flows from said cooling-side region (12) to said evaporator-side region (11) along an onward flow route (A), and in which a cooled air flows from said evaporator-side region (11) back to said cooling-side region (12) along a backward flow route (B);  
a refrigerating unit (3) including:

an evaporator (31) having a conduit body (311) disposed in said evaporator-side region (11) for evaporation of a refrigerant, and inlet and outlet members (312, 313) which are disposed upstream and downstream of said conduit body (311) respectively to lead the refrigerant in and out of said conduit body (311), respectively;  
a compressor (32) which is disposed outwardly of said storage compartment (1), which is positioned downstream of said outlet member (313) to compress the vapor of refrigerant led out thereof for supply of liquefied refrigerant, and which is upstream of said inlet member (312) for delivering the liquefied refrigerant towards said inlet member (312); and  
an expansion valve (34) which is disposed downstream of said compressor (32) and upstream of said inlet member (312) for flash evaporation of the liquefied refrigerant; and

an electric field-generating unit (4) disposed to impose a DC voltage over the onward flow route (A) with a sufficient intensity such that water droplets entrained in the to-be-cooled air are charged so as to minimize cohesion of water droplets in said evaporator-side region (11), thereby reducing phenomenon of frosting on the conduit body (311) of the evaporator (31).

2. The refrigerating apparatus of claim 1, wherein said electric field-generating unit (4) includes a voltage grid (41) disposed upstream of said evaporator (31) to apply the DC voltage to the water droplets flowing therethrough on the onward flow route (A). 5
3. The refrigerating apparatus of claim 2, wherein the DC voltage is up to 5000V.
4. The refrigerating apparatus of claim 3, wherein the DC voltage ranges from 3000V to 5000V. 10
5. The refrigerating apparatus of claim 1, wherein said air-circulating member (2) includes a ventilating fan (21). 15
6. The refrigerating apparatus of claim 5, wherein said air-circulating member (2) is disposed on the onward flow route (A) and upstream of said electric field-generating unit (4). 20
7. The refrigerating apparatus of claim 5, wherein said air-circulating member (2) is disposed on the backward flow route (B) and downstream of said evaporator (31). 25

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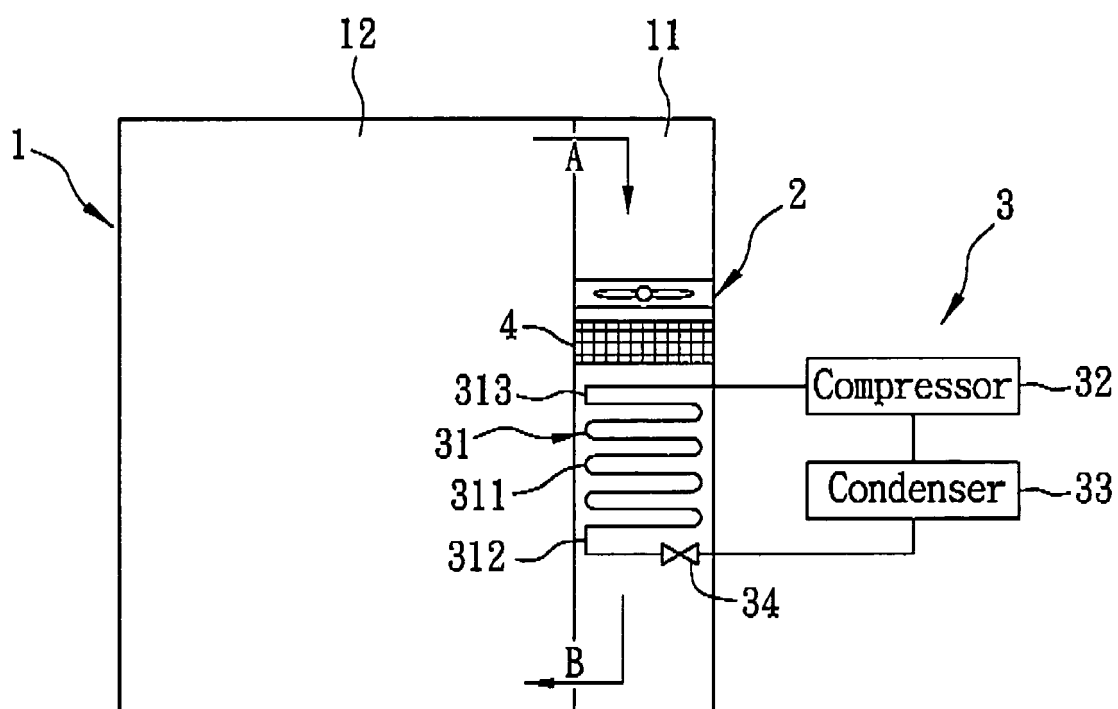


FIG. 1

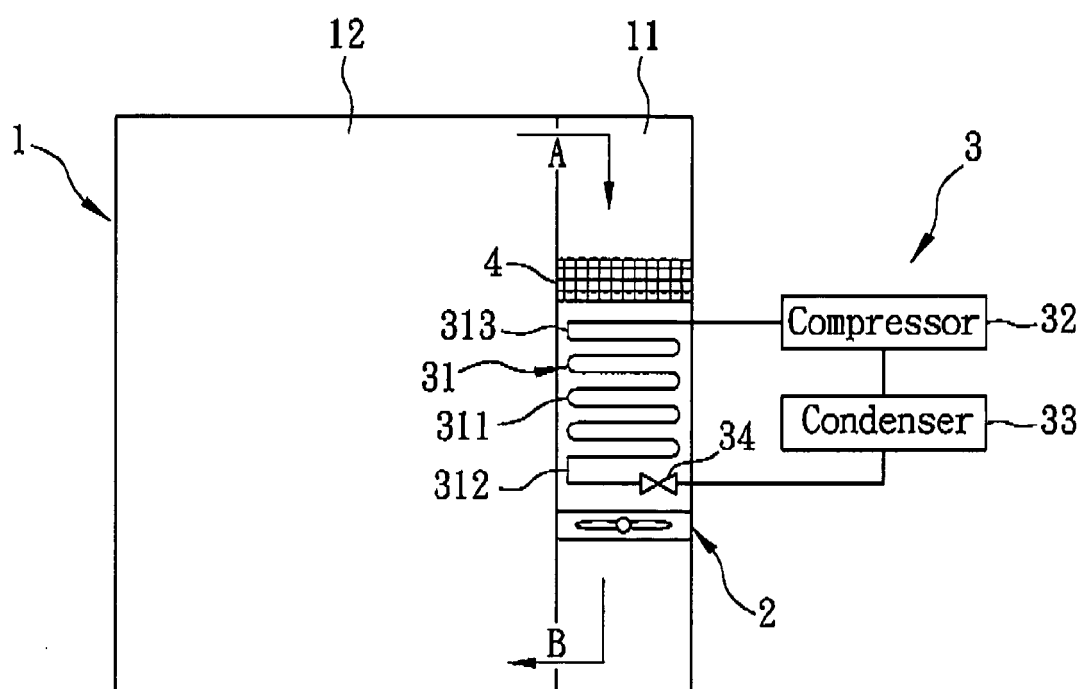


FIG. 2

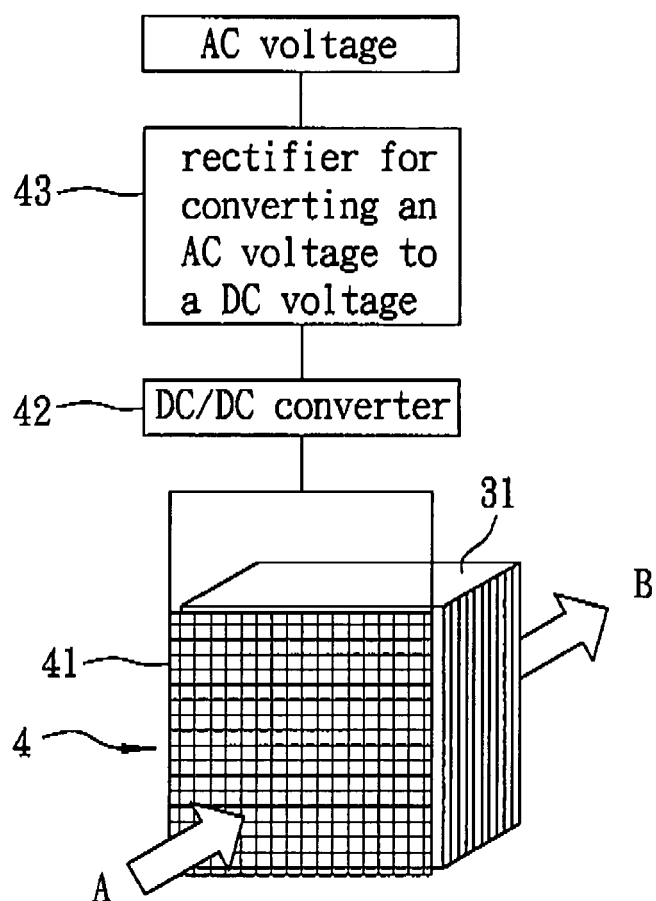


FIG. 3

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- TW 096134035 [0001]