

REFRIGERATING APPARATUS

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to a refrigerating apparatus having a defrosting capability for use in a container.

Description of the Prior Art:

A refrigerant circuit diagram of a refrigerating apparatus in the prior art is shown in Fig. 3. In this figure, reference numeral 1 designates a compressor, numeral 2 designates a condensor, numeral 3 designates a throttle, numeral 4 designates an evaporator, numeral 5 designates a hot gas modulating valve, numeral 6 designates a condensor fan, numeral 7 designates an evaporator fan, numeral 8 designates an electric heater, numeral 9 designates a return air temperature detector, numeral 10 designates an overheat preventing temperature detector, numeral 11 designates an evaporator outlet refrigerant temperature detector, and numeral 20 designates a controller.

A cross-section view of a container equipped with the above-described refrigerating apparatus is shown in Fig. 4. In this figure, reference numeral 12 designates a container, and a dash-line arrow therein indicates a flow of air. In this figure are shown the locations of the evaporator 4, the evaporator fan 7, the electric heater 8,

the return air temperature detector 9 and the overheat preventing temperature detector 10.

In the above-described apparatus, a high-temperature high-pressure gas refrigerant compressed by the compressor 1 enters the condensor 2. Here, the refrigerant is cooled by air blown by the condensor fan 6 and becomes a liquid refrigerant, then it is reduced in pressure by the throttle 3 and enters the evaporator 4, wherein it is heated by air blown by the evaporator fan 7, and it evaporates and returns to the compressor 1. At this time, the blown air is refrigerated in the evaporator 4 and is further blown out into the container to refrigerate the inside of the container.

The controller 20 compares a temperature detected by the return air temperature detector 9 with a set value of a predetermined temperature in the container, performs adjustment of a degree of opening of the throttle 3 and the hot gas modulating valve 5, adjusts a capability, and carries out control for maintaining the temperature in the container 12 constant.

As the temperature in the container lowers, frost begins to adhere to the surface of the evaporator 4, and a capability also lowers. In order to recover this lowering of a capability, the compressor 1, the evaporator fan 7 and the condensor 6 are stopped, and defrosting of

the evaporator 4 is effected by feeding an electric current to the electric heater 8. The timing for entering a defrosting phase, is T_1 minutes after the start of operation of the refrigerating apparatus or after finish-
5 ment of the last defrosting, and also in the event that a temperature TE detected by the evaporator outlet refrigerant temperature detector 11 has become lower than its set value STE1. Also, the timing for finishing defrosting operation is the case where a temperature TE detected by
10 the evaporator outlet refrigerant temperature detector 11 has become higher than its set value STE2 or T_2 minutes have elapsed after commencement of defrosting operation.

When anomalies should happen in the evaporator outlet refrigerant temperature detector 11, in the event
15 that, for instance, defrosting is effected and even though a temperature has risen the detection temperature TE of the aforementioned detector 11 should not indicate temperature rise higher than the set value STE2, naturally the defrosting is forcibly finished according to the set value
20 T_2 of the timer, but in the event that adhesion of frost should be a little, the timer set value T_2 is too long and the temperature in the container would excessively rise, sometimes resulting in damage of the cargoes. Also, on the contrary to the above-described case, in some cases
25 the apparatus does not enter a defrosting phase even though

frost has adhered, hence frost would adhere excessively, and inconvenience such that a capability becomes short, would arise.

SUMMARY OF THE INVENTION:

5 It is therefore one object of the present invention to provide refrigerating apparatus, in which even if anomalies should occur in an evaporator outlet refrigerant temperature detector, defrosting is effected normally.

10 According to the present invention, there is provided refrigerating apparatus including an electric heater adapted to be fed with an electric current to effect heating for a defrosting operation, defrosting control means having a defrosting timer and an
15 evaporator outlet refrigerant temperature detector for controlling electric current feed to said electric heater, and an overheat preventing temperature detector for preventing abnormal overheat caused by said electric heater; characterized in that said overheat preventing
20 temperature detector is connected to said defrosting control means and is additionally able, if required, to control a defrosting operation, whereby a detection temperature signal from either said evaporator outlet refrigerant temperature detector, or said overheat
25 preventing temperature detector, is used for commencing and finishing a defrosting operation.

 In accordance with the present invention, due to the above-defined structural feature, in order to

utilize the temperature detecting function possessed by the overheat preventing temperature detector, this detector is connected to the defrosting control means to be used in cooperation with the evaporator outlet refrigerant temperature detector so that they both can detect the temperatures for commencement and finishing of defrosting, and thereby the overheat preventing temperature detector can be operated for backup purpose upon failure of the evaporator outlet refrigerant temperature detector.

The above-mentioned and other objects, features and advantages of the present invention will become more apparent by reference to the following description of one preferred embodiment of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Fig. 1 is a functional block diagram of one preferred embodiment of the present invention;

Fig. 2 is a control flow chart of the same preferred embodiment;

Fig. 3 is a refrigerant circuit diagram of a refrigerating apparatus in the prior art; and

Fig. 4 is a cross-section view of a container equipped with a refrigerating apparatus in the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Now the present invention will be described in greater detail in connection to one preferred embodiment thereof with reference to Figs. 1 and 2 respectively showing a functional block diagram and a control flow chart of the embodiment. It is to be noted that a refrigerant circuit of the refrigerating apparatus according to the illustrated embodiment and an arrangement of the refrigerating apparatus within a container are identical to those in the prior art as shown in Figs. 3 and 4, respectively.

In Fig. 1, component parts designated by reference numerals 1, 8 - 11 and 20 are identical to those described previously in connection to the prior art. Additionally, reference numeral 101 designates temperature control means, numeral 102 designates defrosting control means, numeral 103 designates control temperature setting means, numeral 104 designates timer means A, numeral 105 designates timer means B, numeral 106 designates compressor drive means, and numeral 107 designates heater current feed means.

In the above-described apparatus, the temperature control means 101 compares a set temperature preset by the control temperature setting means 103 with an air temperature within a container detected by a return air

temperature detector 9, and switches on and off a compressor 1 by the compressor drive means 106 so as to maintain the temperature within the container at the aforementioned set temperature. Upon heating operation, the temperature control means 101 sends a signal to the defrosting control means 102 and commands the heater current feed means 107 to switch on a heater 8, and thereby heating is effected. Furthermore, it compares an air temperature within the container detected by the return air temperature detector 9 with the set temperature, and if the air temperature within the container has become higher than the set temperature, it sends a signal to the defrosting control means 102 and commands the heater current feed means 107 to switch off the heater 8.

However, upon defrosting, in the event that the defrosting control means 102 has sensed that the timer means A 104 indicates that a set time T_1 has elapsed and also that either the temperature TE detected by the evaporator outlet refrigerant temperature detector 11 or the temperature THK detected by the overheat preventing temperature detector 10 has become lower than the corresponding defrosting commencement set temperature STE1 or STHK1, the defrosting control means 102 causes the timer means B 105 to start counting and drives the heater current feed means 107 to feed an electric current to the heater 8.

Regarding finishing of defrosting, in the event that the defrosting control means 102 has sensed either that either the temperature TE detected by the evaporator outlet refrigerant temperature detector 11 or the temperature THK detected by the overheat preventing temperature detector 10 has reached the corresponding set defrosting finishing temperature STE2 or STHK2, or that the timer means B 105 which started counting from the commencement of defrosting indicates that a set time T_2 has elapsed, the defrosting control means 102 commands the heater current feed means 107 to interrupt current feed to the heater 8.

The overheat preventing temperature detector 10 per se is existing one, and an inherent purpose of provision thereof is to prevent a risk of generation of fire when a heater 8 for heating or defrosting purpose has abnormally overheated, and it is provided in order to interrupt electric current feed to the heater via the controller when the temperature in the proximity of the same temperature detector 10 has reached a designated value. Accordingly, the operating temperature of such temperature detector in the prior art is only one temperature level, and for instance, it is adapted to operate at 65°C. The inventors of this invention have marked the fact that this overheat preventing temperature detector

10 is continuously detecting a temperature, and modification has been made such that the temperature detector 10 may operate further at a lower temperature also, a capability of detecting defrosting commencement and finishing
5 temperatures is given to the temperature detector 10 to be used in cooperation with the evaporator outlet refrigerant temperature detector 11, and thus the overheating preventing temperature detector 10 is utilized for a backup purpose upon failure of the evaporator outlet re-
10 frigerant temperature detector 11. In other words, double-detection of the defrosting commencement and finishing temperatures has been made possible, and thereby a reliability of the apparatus has been improved.

As will be obvious from the detailed description
15 above, according to the present invention, owing to the fact that in a refrigerating apparatus, an overheating preventing temperature detector is connected to defrosting control means and a detection temperature signal of either an evaporator outlet refrigerant temperature detector or
20 the overheating preventing temperature detector is used as a signal of defrosting commencement and defrosting finishment, even if anomalies should arise in the evaporator outlet refrigerant temperature detector, defrosting can be achieved normally.

25 While the present invention has been described

above in connection to one preferred embodiment of the present invention, it will be appreciated that modifications can be carried out within the scope of the appended claims.

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CLAIMS

1. Refrigerating apparatus including an electric heater adapted to be fed with an electric current to effect heating for a defrosting operation, defrosting control means having a defrosting timer and an evaporator outlet refrigerant temperature detector for controlling electric current feed to said electric heater, and an overhear preventing temperature detector for preventing abnormal overhear caused by said electric heater; characterized in that said overhear preventing temperature detector is connected to said defrosting control means and is additionally able, if required, to control a defrosting operation, whereby a detection temperature signal from either said evaporator outlet refrigerant temperature detector, or said overhear preventing temperature detector, is used for commencing and finishing a defrosting operation.

2. Refrigerating apparatus as claimed in Claim 1, further characterized in that when the detection temperature of either the evaporator outlet refrigerant temperature detector or the overhear preventing temperature detector reaches a corresponding set temperature for commencing a defrosting operation, or lower, electric current feed to the electric heater is effected by the defrosting control means.

3. Refrigerating apparatus as claimed in



Claim 2, further characterized in that when the detection temperature of either the evaporator outlet refrigerant temperature detector or the overheat preventing temperature detector reaches a corresponding set temperture for finishing a defrosting operation, electric current feed to the electric heater is interrupted by the defrosting control means.

4. Refrigerating apparatus constructed, substantially as hereinbefore described with reference to Figures 1 and 2 of the accompanying drawings.



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