REFRIGERANT LEAKAGE SENSING SYSTEM AND METHOD

The present invention relates to refrigerant leakage sensing system and method, and more particularly, to refrigerant leakage sensing system and method for sensing the occurrence or not of refrigerant leakage. In the present invention, temperature sensors are mounted at inlet and outlet sides of an evaporator, respectively. When a difference between the temperatures sensed by the temperature sensors becomes above a predetermined value, a control unit determines that the refrigerant leaks. Then, the refrigerant leakage is displayed to a user. Accordingly, the present invention makes it possible to cope with the problem caused from the occurrence of the refrigerant leakage and to exchange parts such as refrigerant pipes with new ones at an early stage by automatically sensing the refrigerant leakage with low cost.

Start

Supply Power

200

Sanee Refrigerant Temperature at Evaporator Inlet

210

Sanee Refrigerant Temperature at Evaporator Outlet

220

Calculate Difference between Refrigerant Temperatures at Evaporator Inlet and Outlet

230

Is Calculated Temperature Greater Than Reference Temperature?

Yes

No

240

Display Refrigerant Leakage

250

End
FIG. 1

Semi-Closed System

Refrigerant Leakage

FIG. 2

Generation of soap Bubbles Due to Refrigerant Leakage
FIG. 3

First Temperature Sensor 20
Second Temperature Sensor 20

Microcontroller 20
Display 210

Power Supply 220

FIG. 4

Start 200
Supply Power 210

Sense Refrigerant Temperature at Evaporator Inlet 220

Sense Refrigerant Temperature at Evaporator Outlet 230

Calculate Difference between Refrigerant Temperatures at Evaporator Inlet and Outlet 240

Is Calculated Temperature Greater Than Reference Temperature? 240

Yes

Display Refrigerant Leakage 250

No

End
Temperature:

- First Temperature Sensor: Small Difference in Temperature
- Second Temperature Sensor:

FIG. 5

FIG. 6a

FIG. 7a

FIG. 6b
FIG. 7b

Temperature

First Temperature Sensor

Occurrence of Difference in Temperature

Second Temperature Sensor

Time
REFRIGERANT LEAKAGE SENSING SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

The present invention relates to refrigerant leakage sensing system and method, and more particularly, to refrigerant leakage sensing system and method for sensing the occurrence or not of refrigerant leakage.

[0002] 2. Description of the Prior Art

Hydrocarbon-based and hybrid refrigerant and the like has been employed as the alternative to a general refrigerant applied to a cooling cycle. The refrigerant has explosiveness and toxicity. Therefore, leakage of the refrigerant in a refrigerant pipe not only deteriorates the performance of the cooling cycle but also affects the human body adversely. Accordingly, a refrigerant leakage sensing system is essential for sensing whether or not the refrigerant leaks from the refrigerant pipe.

Hereinafter, a refrigerant leakage sensing system according to a prior art will be described.

[0006] FIG. 1 shows a first embodiment for sensing refrigerant leakage according to the prior art.

[0007] In prior art, a gas concentration sensor 20 is separately provided in a semi-closed system as shown in the figure. The gas concentration sensor 20 is connected to a controller 30. The gas concentration sensor 20, as a sensor for sensing gas concentration, senses that the concentration of toxic gas in the room increases above the dangerous level when refrigerant in a refrigerant pipe 10 leaks into a space where a refrigerator or air conditioner is installed.

[0008] However, it was difficult for such a conventional refrigerant leakage sensing system to immediately sense the refrigerant leakage caused from the occurrence of fine cracks in the refrigerant pipe 10.

[0009] In addition, the refrigerant leakage sensing system including such a gas concentration sensor 20 is very expensive. Accordingly, the expensive sensing system increases cost and makes it hard to apply such a system to electric home appliances such as general refrigerators.

[0010] Furthermore, in such a conventional first embodiment, there is a cumbersome in that algorithm for sensing the gas concentration according to the capacity of the refrigerant pipe.

[0011] FIG. 2 shows a second embodiment for sensing refrigerant leakage according to the prior art.

[0012] FIG. 2 illustrates a manual method for sensing the refrigerant leakage. Referring to FIG. 2, when the refrigerant is gradually discharged through cracks or bad welds occurring in the refrigerant pipe 10, soap water or refrigerant reaction solution is sprayed at a portion where it is expected for the crack to occur. Then, at a portion where the crack occurs, bubbles of the soap water solution are generated or the refrigerant reaction solution indicates the existence of the crack.

[0013] However, if the crack of the refrigerant pipe is too fine or the refrigerant is completely exhausted, the refrigerant leakage cannot be sensed by such a manual sensing method. Further, an inspector should manually and periodically sense the refrigerant leakage, which is cumbersome.

SUMMARY OF THE INVENTION

[0014] Accordingly, an object of the present invention is to provide refrigerant leakage sensing system and method for automatically sensing the occurrence or not of refrigerant leakage with low cost.

[0015] According to an aspect of the present invention for achieving the objects, there is provided a refrigerant leakage sensing system in a cooling cycle comprising a compressor, a condenser, and an evaporator. The refrigerant leakage sensing system comprises a first temperature sensor for sensing a temperature of the refrigerant flowing into the evaporator; a second temperature sensor for sensing a temperature of the refrigerant discharging from the evaporator; a control means for calculating a difference between the temperatures sensed by the first and second temperature sensors and determining the occurrence or not of refrigerant leakage; and a display unit for displaying the refrigerant leakage when the refrigerant leakage occurs under control of the control unit.

[0016] According to another aspect of the present invention for achieving the objects, there is provided a refrigerant leakage sensing method, comprising: a first sensing step of sensing a temperature of refrigerant at an inlet side of an evaporator; a second sensing step of sensing a temperature of the refrigerant at an outlet side of the evaporator; a calculating step of calculating a difference between the temperatures sensed in the first and second sensing steps; and a refrigerant leakage displaying step of displaying refrigerant leakage when the temperature difference calculated in the calculating step is above a predetermined value.

[0017] Preferably, in the refrigerant leakage displaying step, an alarm sound is outputted when the refrigerant leakage occurs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objects, features and advantages of the present invention will become apparent from the following description of a preferred embodiment given in conjunction with the accompanying drawings, in which:

[0019] FIG. 1 is a view of a first embodiment for sensing refrigerant leakage according to a prior art;

[0020] FIG. 2 is a view of a second embodiment for sensing the refrigerant leakage according to the prior art;

[0021] FIG. 3 is a control block diagram for sensing the refrigerant leakage according to the present invention;

[0022] FIG. 4 is a control flow chart of the operation for sensing the refrigerant leakage according to the present invention;

[0023] FIG. 5 is a view of an embodiment for sensing the refrigerant leakage according to the present invention;

[0024] FIG. 6a is a view showing a normal state of inflow and outflow of the refrigerant;

[0025] FIG. 6b is a view showing a difference between temperatures at inlet and outlet of an evaporator according to the normal state of the inflow and outflow of the refrigerant;
FIG. 7a is a view showing a state of the inflow and outflow of the refrigerant when the refrigerant leaks; and

FIG. 7b is a view showing a difference between temperatures at the inlet and outlet of an evaporator according to the state of the inflow and outflow of the refrigerant when the refrigerant leaks.

Detailed Description of the Preferred Embodiment

Hereinafter, refrigerant leakage sensing system and method according to the present invention will be described in detail.

FIG. 3 is a control block diagram for sensing refrigerant leakage according to the present invention.

A refrigerant leakage sensing system of the present invention comprises a power supply 220 for supplying a refrigerant main body with power, a first temperature sensor 120 for measuring a refrigerant temperature at an inlet side of an evaporator, a second temperature sensor 130 for measuring a refrigerant temperature at an outlet side of the evaporator, a microcontroller 200 for controlling the operation of the evaporator, calculating a difference between the temperatures measured by the first and second temperature sensors 120 and 130, comparing the difference with a reference value, and determining the occurrence or not of the refrigerant leakage, and a display 210 for displaying the refrigerant leakage.

Referring to FIGS. 4 and 5, the operation of the refrigerant leakage sensing system will be described as follows.

FIG. 4 is a control flow chart of the operation for sensing the refrigerant leakage according to the present invention. FIG. 5 is a view of an embodiment for sensing the refrigerant leakage according to the present invention.

As shown in FIG. 5, the evaporator of the refrigerant is provided in a freezing chamber. Cold air supplied to the freezing chamber circulates in the freezing chamber and is then sucked through a return duct 150. The freezing chamber is provided with a fan motor 110 for controlling a fan to be driven so that the heat exchanged cold air can be fast blown into the freezing chamber.

In the meantime, the cold air which is subjected to heat exchange through the evaporator in the freezing chamber is supplied into a refrigerating chamber. That is, the cold air generated from the evaporator of the freezing chamber is supplied to the refrigerating chamber through a duct 140 for cold air flow formed from the freezing chamber to the refrigerating chamber. The cold air supplied to the refrigerating chamber circulates in the refrigerating chamber, and then, is sucked through return the duct 150.

The inlet side of the refrigerant pipe of the evaporator 100 attached to a rear face of the freezing chamber is mounted with the first temperature sensor 120. The outlet side of the refrigerant pipe of the evaporator 100 is mounted with the second temperature sensor 130. The first and second temperature sensors 120 and 130 mounted as mentioned above sense the temperatures at the inlet and outlet sides of the refrigerant pipe (steps 210 and 220). The temperatures sensed through the first and second temperature sensors 120 and 130 are transmitted to the microcontroller 200. Accordingly, the microcontroller 200 calculates the difference between the transmitted temperatures (step 230).

In the meantime, a reference value for determining the occurrence or not of the refrigerant leakage of the refrigerant pipe according to the difference between the temperatures sensed by the first and second temperature sensors 120 and 130 is set in the microcontroller 200.

Accordingly, if the difference between the temperatures sensed by the first and second temperature sensors 120 and 130 is below the reference value, the microcontroller 200 determines that the refrigerant pipe of the evaporator 100 is in normal state.

However, if the difference between the temperatures sensed by the first and second temperature sensors 120 and 130 is above the reference value (step 240), the microcontroller 200 determines that the refrigerant leakage occurs from the refrigerant pipe of the evaporator 100.

Accordingly, the occurrence or not of the refrigerant leakage is displayed through the display (step 250), which is confirmed by a user such that the user can immediately cope with the refrigerant leakage (e.g., exchange parts such as the refrigerant pipes with new ones).

When the refrigerant leakage occurs, although the occurrence of the refrigerant leakage is displayed through the display 210 in the embodiment of the present invention, an alarm sound may be outputted according to the refrigerant leakage by providing an alarm (not shown) as another example of the present invention.

FIG. 6a is a view showing a normal state of the inflow and outflow of the refrigerant. FIG. 6b is a view showing a difference between the temperatures at the inlet and outlet of the evaporator according to the normal state of the inflow and outflow of the refrigerant.

FIG. 6a shows an evaporation state of the refrigerant when the inflow and outflow of the refrigerant normally progress without the refrigerant leakage. The first temperature sensor 120 provided at the inlet side of the evaporator 100 and the second temperature sensor 130 provided at the outlet side of the evaporator 100 sense the temperatures, respectively. In the state without the refrigerant leakage, the temperatures at the inlet and outlet sides of the evaporator 100 are expressed as shown in FIG. 6b. That is, the difference between the temperatures of the refrigerant flowing into the evaporator 100 and the refrigerant discharged from the evaporator 100 hardly exists and is constantly maintained.

FIG. 7a is a view showing a state of the inflow and outflow of the refrigerant when the refrigerant leaks. FIG. 7b is a view showing a difference between the temperatures at the inlet and outlet of the evaporator according to the state of the inflow and outflow of the refrigerant when the refrigerant leaks.

As shown in FIG. 7a, if the refrigerant leakage occurs, an amount of the refrigerant in the evaporator 100 is reduced. Therefore, an evaporation point of the refrigerant of the evaporator 100 becomes relatively early as compared with the normal state. That is, the refrigerant is completely evaporated at a point B before a point A where the refrigerant is evaporated in the normal state (FIG. 6a) as shown in the FIG. 7a. Accordingly, the refrigerant temperature at
the outlet side of the evaporator 100 becomes too high, and finally, the difference between the temperatures at the inlet and outlet sides of the evaporator 100 becomes large.

[0045] That is, as shown in FIG. 7b, the difference between the temperatures sensed through the first temperature sensor 120 provided at the inlet side of the evaporator 100 and the second temperature sensor 130 provided at the outlet side of the evaporator 100 is greater than a certain value (for example, about 5° C. in the embodiment of the present invention) when the refrigerant leaks.

[0046] The first and second temperature sensors 120 and 130 employed in the present invention also function as defrosting temperature sensors.

[0047] According to the refrigerant leakage sensing system and method of the present invention, the following advantages can be expected.

[0048] According to the present invention, it is possible to determine the occurrence or not of the refrigerant leakage according to the difference between the temperatures sensed through the temperature sensors provided at the inlet and outlet sides of the evaporator, without sensing the occurrence or not of the refrigerant leakage by using an additional expensive apparatus or by manual inspection as in the prior art.

[0049] That is, according to the present invention, the evaporation point of the refrigerant in the evaporator becomes early when the refrigerant leaks, and thus, the temperature at the outlet side of evaporator is increased. Then, since the difference between the temperatures at the inlet and outlet sides of the evaporator becomes large, the occurrence or not of the refrigerant leakage can be determined. Accordingly, the present invention makes it possible to automatically sense the refrigerant leakage with low cost.

[0050] As described above, in the present invention, the respective temperature sensors are provided at the inlet and outlet sides of the evaporator in order to sense the refrigerant leakage in the refrigerant. Then, there is a fundamental feature of the present invention in that whether or not the refrigerant leakage progresses is determined according to the difference between the temperatures sensed through the temperature sensors.

[0051] The scope of the present invention is not limited to the embodiment described and illustrated above but is defined by the appended claims. It will be apparent that those skilled in the art can make various modifications and changes thereto within the scope of the invention defined by the claims. Therefore, the true scope of the present invention should be defined by the technical spirit of the appended claims.

What is claimed is:

1. A refrigerant leakage sensing system for use in a cooling cycle including a compressor, a condenser and an evaporator, comprising:

   a first temperature sensor for sensing a temperature of the refrigerant flowing into the evaporator;

   a second temperature sensor for sensing a temperature of the refrigerant discharging from the evaporator;

   a control unit for calculating a difference between the temperatures sensed by the first and second temperature sensors and determining whether the refrigerant leakage has occurred or not; and

   a display unit for displaying the refrigerant leakage when the refrigerant leakage occurs under control of the control unit.

2. A refrigerant leakage sensing method, comprising:

   a first sensing step of sensing a temperature of refrigerant at an inlet side of an evaporator;

   a second sensing step of sensing a temperature of the refrigerant at an outlet side of the evaporator;

   a calculating step of calculating a difference between the temperatures sensed in the first and second sensing steps; and

   a refrigerant leakage displaying step of displaying refrigerant leakage when the temperature difference calculated in the calculating step is greater than or equal to a predetermined value.

3. The method as claimed in claim 2, wherein in the refrigerant leakage displaying step, an alarm sound is outputted according to the refrigerant leakage.