

DESCRIPTION

Title of Invention

TURBO REFRIGERATOR

[Technical Field]

[0001]

The present disclosure relates to a centrifugal chiller.

[Background Art]

[0002]

In recent years, as a response to global warming, a refrigerant filled in a chiller has been replaced with a low GWP refrigerant. As the low GWP refrigerant, R1234ze (E), R1234yf, and the like are known, and these low GWP refrigerants are classified as mildly flammable (A2L) in ISO. In a case of using a mildly flammable refrigerant in Japan, it is preferable to install a refrigerant leakage detector.

[0003]

As the refrigerant in the related art, for example, R134a is known, but since this R134a is nonflammable, a technique of installing a refrigerant leakage detector from the viewpoint of environmental pollution and economic loss at the time of refrigerant leakage is disclosed (Patent

Document 1).

[Citation List]

[Patent Document]

[0004]

[Patent Document 1] Japanese Unexamined Patent
Application Publication No. 2013-113555

[Summary of Invention]

[Technical Subject]

[0005]

However, in Patent Document 1, the use of a mildly flammable refrigerant is not premised, and in particular, a case where the mildly flammable refrigerant leaks is not disclosed.

[0006]

The present disclosure has been made in view of such circumstances, and an object of the present disclosure is to provide a centrifugal chiller capable of determining leakage of a mildly flammable refrigerant early and efficiently.

[Subject to be solved]

[0007]

In order to solve the above subject, a centrifugal chiller of the present disclosure adopts the following means.

That is, a centrifugal chiller according to an aspect of the present disclosure includes a refrigerating cycle in

which a compressor, a condenser, an expander, and an evaporator are connected by a refrigerant pipe, and a mildly flammable refrigerant is filled; and a refrigerant detector which has a sensor unit that detects a refrigerant, and a main body portion that determines a leakage of a refrigerant on the basis of information from the sensor unit, in which auxiliary equipments in which the refrigerant flows and which are attached to the compressor, and joints of the refrigerant pipe are centralized in a predetermined location, and the sensor unit is installed below the predetermined location.

[0008]

With the centrifugal chiller according to the aspect, the auxiliary equipments (for example, an oil filter, an oil cooler, and the like) in which a mildly flammable refrigerant flows and which are attached to the compressor, and joints (for example, joint portions and screwed portions) of the pipe are centralized in the predetermined location, and the sensor unit that detects the refrigerant is installed below the centralized location.

Since the refrigerant usually has a higher specific gravity than air, in a case where the refrigerant leaks from the auxiliary equipments centralized in the predetermined location, the connecting portions between these auxiliary equipments and the compressor, and/or the joints of the

pipes centralized in the predetermined location, the refrigerant can be detected early and efficiently by the sensor unit by installing the sensor unit below the predetermined location. In this case, the main body portion determines the leakage of the refrigerant on the basis of the detection signal from the sensor unit. That is, the leakage of the refrigerant can be determined early and efficiently. Moreover, by determining the leakage of the refrigerant early, it is possible to suppress the economic loss by suppressing the large-scale leakage of the expensive mildly flammable refrigerant.

Further, since only the sensor unit of the separate sensor unit and main body portion is installed in a space below the predetermined location, even in a case where the space below the predetermined location is narrow, the installation can be performed in the space as long as only the sensor unit is installed.

[0009]

Further, in the centrifugal chiller according to the aspect of the present disclosure, the predetermined location is in the vicinity of the compressor.

[0010]

With the centrifugal chiller according to the aspect, the predetermined location is in the vicinity of the compressor. Thus, access to the auxiliary equipments and

the joints of the refrigerant pipe can be easily performed simply by removing the compressor, and it is possible to take immediate action in a case where the refrigerant leaks.

[0011]

In the centrifugal chiller according to the aspect of the present disclosure, the compressor is arranged such that a bottom surface of a housing is positioned above a top surface of a shell of the evaporator, the predetermined location is a region in the vicinity of the compressor, and the sensor unit is arranged at a height substantially the same as a bottom surface of the shell of the evaporator.

[0012]

With the centrifugal chiller according to the aspect, the compressor is arranged such that a bottom surface of a housing is positioned above a top surface of a shell of the evaporator, the predetermined location is a region in the vicinity of the compressor, and the sensor unit is arranged at a height substantially the same as a bottom surface of the shell of the evaporator. As a result, in a case where the refrigerant leaks, the refrigerant can be more easily guided to the sensor unit.

[Advantageous Effects of Invention]

[0013]

With the centrifugal chiller according to the present disclosure, it is possible to determine the leakage of the

mildly flammable refrigerant early and efficiently.

[Brief Description of Drawings]

[0014]

Fig. 1 is a front view of a centrifugal chiller according to an embodiment of the present disclosure.

Fig. 2 is a right side view of the centrifugal chiller illustrated in Fig. 1.

Fig. 3 is a plan view of the centrifugal chiller illustrated in Fig. 1.

Fig. 4 is a rear view of the centrifugal chiller illustrated in Fig. 1.

Fig. 5 is a right side view of another example of the centrifugal chiller according to the embodiment of the present disclosure.

Fig. 6 is a front view of the centrifugal chiller illustrated in Fig. 5.

[Description of Embodiments]

[0015]

Hereinafter, the centrifugal chiller according to an embodiment of the present disclosure will be described with reference to the drawings.

[0016]

Fig. 1 illustrates a front view of a centrifugal chiller 1 in a state where some devices are omitted. Fig. 2 illustrates a right side view of the same centrifugal

chiller 1. Fig. 3 illustrates a plan view of the same centrifugal chiller 1. Fig. 4 illustrates a rear view of the same centrifugal chiller 1.

[0017]

As illustrated in Figs. 1 to 4, the centrifugal chiller 1 includes a compressor 10, a condenser 12, a first (high stage) expansion valve 14 (expander), an economizer 16, a second (low stage) expansion valve 18 (expander), and an evaporator 20, and these devices are connected by a refrigerant pipe to form a refrigerating cycle.

[0018]

This refrigerating cycle is filled with a low GWP refrigerant. Examples of the low GWP refrigerant include R1234ze(E) and R1234yf. In addition, these low GWP refrigerants are classified as mildly flammable (A2L) in ISO. Hereinafter, the low GWP refrigerant is simply referred to as a "refrigerant".

[0019]

The compressor 10 is a closed type compressor in which an electric motor 11 and a housing are integrally coupled to each other. The compressor 10 is a device that compresses the refrigerant filled in the refrigerating cycle. The compressor 10 is a multi-stage (for example, two-stage) centrifugal compressor.

[0020]

The condenser 12 is a shell-and-tube heat exchanger having a cylindrical outer shape that extends in a predetermined direction. The condenser 12 is a device that condenses the refrigerant by exchanging heat between the cooling water cooled by a cooling tower (not illustrated) and the high-temperature and high-pressure refrigerant guided from the compressor 10.

[0021]

The first (high stage) expansion valve 14 is provided in the refrigerant pipe that connects the condenser 12 and the economizer 16. The first (high stage) expansion valve 14 is a device that reduces the pressure to an intermediate pressure by expanding the refrigerant condensed by the condenser 12.

[0022]

The economizer 16 is a device that separates the refrigerant decompressed by the first (high stage) expansion valve 14, into gas and liquid. The gas refrigerant of the separated refrigerants is injected between the first stage and the second stage of the compressor 10 via a suction pipe 50.

Further, the liquid refrigerant is guided toward the second (low stage) expansion valve 18 provided in the refrigerant pipe connected to the downstream side of the economizer 16.

[0023]

The second (low stage) expansion valve 18 is provided in the refrigerant pipe connecting the economizer 16 and the evaporator 20. The second (low stage) expansion valve 18 is a device that expands the refrigerant guided from the economizer 16 to reduce the pressure to a low pressure.

[0024]

The evaporator 20 is a shell-and-tube heat exchanger having a cylindrical outer shape that extends in a predetermined direction. The evaporator 20 is a device that evaporates the refrigerant by exchanging heat between the return water from the load side and the refrigerant decompressed by the second (low stage) expansion valve 18.

Further, the refrigerant flowing out of the evaporator 20 is guided to the compressor 10 again. Thus, a refrigerating cycle that is a closed cycle is obtained.

[0025]

In the centrifugal chiller 1 provided with each of the above-described devices, the compressor 10 is installed above the evaporator 20. Specifically, the bottom surface of the housing of the compressor 10 is positioned above the top surface of the shell of the evaporator 20.

Further, in Fig. 2, the condenser 12 is positioned on the side of the compressor 10 and the evaporator 20 (on the right side in the figure), and substantially in the middle

between the compressor 10 and the evaporator 20 in the height direction.

[0026]

As illustrated in Figs. 1 to 4, auxiliary equipments attached to the compressor 10, such as a plurality of oil filters 30 and an oil cooler 32 are provided in the vicinity of the compressor 10. In detail, the auxiliary equipments are provided on a side (on the left side in Fig. 2) opposite to the side where the condenser 12 is arranged.

[0027]

Further, in addition to the auxiliary equipments attached to the compressor 10, joints (for example, joint portions and screwed portions) of the refrigerant pipe are centrally arranged in the vicinity of the compressor 10, and a pipe joint group 40 formed by a large number of joints is present at a plurality of locations in the vicinity of the compressor 10.

[0028]

That is, the auxiliary equipments such as the oil filters 30 and the oil cooler 32, and the pipe joint group 40 at a plurality of locations are centrally arranged in the vicinity of the compressor 10, and the location is referred to as a centralized location S (predetermined location).

[0029]

Further, along with the above arrangement, the joints of the pipes connected to the auxiliary equipments and the joints of the pipes connecting the auxiliary equipments and the compressor 10 are also centrally arranged at the centralized location S.

[0030]

Among a large number of the auxiliary equipments and the joints of the refrigerant pipes, not all the auxiliary equipments and joints need to be centrally arranged at the centralized location S, and at least a plurality of auxiliary equipments and joints may be centrally arranged at the centralized location S.

[0031]

In addition to the above configuration, the centrifugal chiller 1 includes a refrigerant detector which has a sensor unit 72 that detects the refrigerant, and a main body portion 74 that determines the leakage of the refrigerant on the basis of information from the sensor unit 72.

[0032]

The sensor unit 72 is installed below the centralized location S. In detail, the sensor unit 72 is installed at a height substantially the same as the bottom surface of the shell of the evaporator 20, which is substantially a lower portion on a vertical line passing through the

centralized location S when viewed from the right side (refer to Fig. 2), and substantially at the center in the extending direction (right-left direction in Fig. 4) of the evaporator 20 when viewed from the rear (refer to Fig. 4).

This is because the refrigerant can be easily detected by installing the sensor unit 72 below the centralized location S since in a case where the refrigerant leaks from the centralized location S, the refrigerant having a large specific gravity with respect to the air tends to flow downward from the leakage location thereby staying below the leakage location.

[0033]

The main body portion 74 is installed below the condenser 12. The position of the main body portion 74 is not limited to the position illustrated in the figure, and the main body portion 74 can be installed at any position based on the specifications of the centrifugal chiller 1.

[0034]

The sensor unit 72 can detect the refrigerant, and can detect the refrigerant in a case where the refrigerant leaks from a location where the refrigerant flows, such as devices constituting the centrifugal chiller 1 or refrigerant pipes.

The sensor unit 72 that has detected the refrigerant transmits the information (detection signal) to the main body portion 74 to be described later.

[0035]

The main body portion 74 can receive the detection signal transmitted from the sensor unit 72, and determines the leakage of the refrigerant on the basis of the detection signal.

For example, the main body portion 74 calculates the concentration of the refrigerant on the basis of the detection signal from the sensor unit 72, and determines that the refrigerant is leaking in a case where the calculated value exceeds a predetermined value.

[0036]

The communication method between the sensor unit 72 and the main body portion 74 may be a wired system or a wireless system.

[0037]

According to the embodiment, the following effects are obtained.

In a case where the refrigerant leaks from the auxiliary equipments (the oil filter 30, the oil cooler 32, and the like) centralized in the centralized location S, the connecting portions between these auxiliary equipments and the compressor 10, and/or the pipe joint group 40 centralized in the centralized location S, the refrigerant can be detected early and efficiently by the sensor unit 72 by installing the sensor unit 72 below the centralized

location S. In this case, the main body portion 74 determines the leakage of the refrigerant on the basis of the detection signal from the sensor unit 72. That is, the leakage of the refrigerant can be determined early and efficiently. Moreover, by determining the leakage of the refrigerant early, it is possible to suppress the economic loss by suppressing the large-scale leakage of the expensive refrigerant.

[0038]

Further, since only the sensor unit 72 of the separate sensor unit 72 and main body portion 74 is installed in a space below the centralized location S, even in a case where the space below the centralized location S is narrow, the installation can be performed in the space as long as only the sensor unit 72 is installed.

[0039]

Further, since the centralized location S is located in the vicinity of the compressor 10, access to the auxiliary equipments and the pipe joint group 40 can be easily performed simply by removing the compressor 10, and it is possible to take immediate action in a case where the refrigerant leaks.

[0040]

As illustrated in Figs. 5 and 6, the sensor unit 72 may be installed at a height substantially the same as the

bottom surface of the shell of the evaporator 20, which is substantially a lower portion on a vertical line passing through the centralized location S when viewed from the right side (refer to Fig. 5), and in the vicinity of the second (low stage) expansion valve 18 in the extending direction (right-left direction in Fig. 6) of the evaporator 20 when viewed from the front (refer to Fig. 6). Even with this arrangement, the sensor unit 72 is installed below the centralized location S, so that the refrigerant can be detected early and efficiently.

[Reference Signs List]

[0041]

- 1: centrifugal chiller
- 10: compressor
- 11: electric motor
- 12: condenser
- 14: first (high stage) expansion valve
- 16: economizer
- 18: second (low stage) expansion valve
- 20: evaporator
- 30: oil filter (auxiliary equipment)
- 32: oil cooler (auxiliary equipment)
- 40: pipe joint group
- 50: suction pipe
- 72: sensor unit (refrigerant detector)

74: main body portion (refrigerant detector)

S: centralized location (predetermined location)

Claims

[Claim 1]

A centrifugal chiller comprising:

a refrigerating cycle in which a compressor, a condenser, an expander, and an evaporator are connected by a refrigerant pipe, and a mildly flammable refrigerant is filled; and

a refrigerant detector which has a sensor unit that detects a refrigerant, and a main body portion that determines a leakage of a refrigerant on the basis of information from the sensor unit,

wherein auxiliary equipments in which the refrigerant flows and which are attached to the compressor, and joints of the refrigerant pipe are centralized in a predetermined location, and

the sensor unit is installed below the predetermined location.

[Claim 2]

The centrifugal chiller according to claim 1,

wherein the predetermined location is in the vicinity of the compressor.

[Claim 3]

The centrifugal chiller according to claim 2,
wherein the compressor is arranged such that a bottom surface of a housing is positioned above a top surface of a shell of the evaporator,
the predetermined location is a region in the vicinity of the compressor, and
the sensor unit is arranged at a height substantially the same as a bottom surface of the shell of the evaporator.