

DESCRIPTION

TITLE OF INVENTION: INSPECTION SYSTEM, AND INFORMATION PROCESSING MACHINE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001]

This application is based on Japanese Patent Application No. 2018-112105 filed on June 12, 2018, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002]

The present disclosure relates to an inspection system and an information processing machine for inspecting a vapor compression refrigeration cycle device included in a refrigerator on a vehicle.

BACKGROUND

[0003]

Conventionally, an information processing machine is known (see, for example, Patent Document 1), which is connected via a communication line to an information terminal used by a user of a refrigerating device. The information processing machine generates periodic inspection information of the refrigerating device from the operation status information of the refrigerating device, and sends the generated periodic inspection information to the user. The information processing machine described in Patent Document 1 generates periodic inspection information from the operating conditions at high load time in summer and sends the periodic inspection information to the user who inspects the refrigerating device when it is recommended to be inspected.

PRIOR ART LITERATURE

PATENT LITERATURE

[0004]

Patent Document 1: JP 2017-107466A

SUMMARY

[0005]

The information processing machine described in Patent Document 1 only extracts items required for inspection from the

operation status information of the refrigeration cycle device and transmits the extracted items to the user as periodic inspection information. The inspection itself is to be done by the user.

[0006]

5 If the information processing machine described in Patent Document 1 is a fixed refrigerator installed in a store or the like, it is often used in a stable environment with little disturbance. In this case, the user may be able to inspect the refrigeration cycle device.

[0007]

10 However, the refrigerator mounted on a mobile unit such as vehicle is used in an environment with a lot of disturbance. It is often difficult for the user to inspect the refrigeration cycle device, and the inspection tends to be a heavy burden for the user.

15 An object of the present disclosure is to provide an inspection system and an information processing machine capable of reducing the burden on the user due to the inspection of the refrigeration cycle device included in the refrigerator mounted on the vehicle for abnormalities.

[0008]

20 According to one aspect of the present disclosure, an inspection system that inspects a vapor compression refrigeration cycle device included in a refrigerator mounted on a vehicle, the inspection system including:

25 a cycle monitoring device to be mounted on the vehicle together with the refrigeration cycle device to acquire operation status information indicating an operation status of the refrigeration cycle device and transmit the operation status information to outside; and

30 an information processing machine arranged outside the vehicle to receive the operation status information transmitted from the cycle monitoring device and to inspect presence or absence of an abnormality in the refrigeration cycle device based on the operation status information.

[0009]

35 The information processing machine includes

 an information storage unit that stores the operation status information,

an information calculation unit configured to generate inspection data for inspecting the presence or absence of an abnormality in the refrigeration cycle device based on the operation status information stored in the information storage unit, to store the inspection data in the information storage unit and to inspect the presence or absence of an abnormality in the refrigeration cycle device by comparing the inspection data with a reference data indicating a normal state or an abnormal state of the refrigeration cycle device, and

an information communication unit that transmits an inspection result regarding the presence or absence of an abnormality in the refrigeration cycle device to a predetermined information terminal.
[0010]

In this way, since the information processing machine located outside the vehicle inspects for abnormalities in the refrigeration cycle device and the inspection result is transmitted to a predetermined information terminal, the inspection of the refrigeration cycle device can be omitted on the user side. Thus, the burden on the user side can be reduced. It should be noted that "mounted" does not only mean that it is permanently installed, but also includes that it is temporarily installed. In addition, the user means not only a vehicle owner and driver, but also persons in charge of managing the vehicle and the refrigerator, agents who manage the vehicle and the refrigerator, and shippers (such as clients) who want to check the delivery status of cargo.

[0011]

According to another aspect of the present disclosure, the information processing machine that communicates with the cycle monitoring device, which acquires the operation status information indicating the operation status of the vapor compression refrigeration cycle device included in the refrigerator mounted on the vehicle and sends it to the outside, located outside the vehicle, including

an information storage unit that stores the operation status information received from the cycle monitoring device,

an information calculation unit configured to generate inspection data for determining an abnormality in the refrigeration cycle device based on the operation status information stored in the information storage unit, to store the inspection data in the information storage unit

and to inspect the presence or absence of an abnormality in the refrigeration cycle device by comparing the inspection data with a reference data indicating a normal state or an abnormal state of the refrigeration cycle device, and

5 an information communication unit that transmits an inspection result regarding the presence or absence of an abnormality in the refrigeration cycle device to a predetermined information terminal.
[0012]

10 In this way, the information processing machine located outside the vehicle inspects for abnormalities in the refrigeration cycle device and the inspection result is transmitted to a predetermined information terminal. Since the inspection of the refrigeration cycle device can be omitted on the user side, the burden on the user can be reduced.

[0013]

15 The reference numerals in parentheses attached to the components and the like indicate an example of correspondence between the components and the like and specific components and the like in an embodiment to be described below.

BRIEF DESCRIPTION OF THE DRAWINGS

20 [0014]

FIG. 1 is a schematic configuration diagram of an inspection system according to a first embodiment.

FIG. 2 is a schematic view of a vehicle equipped with a freezer according to the first embodiment.

25 FIG. 3 is a schematic configuration diagram of a refrigerator according to the first embodiment.

FIG. 4 is a diagram showing operation status information.

FIG. 5 is a schematic configuration diagram of an information processing machine according to the first embodiment.

30 FIG. 6 is an explanatory diagram for explaining behavior of a refrigeration cycle device when the amount of refrigerant is insufficient.

FIG. 7 is a diagram showing a report created by the information processing machine of the first embodiment.

35 FIG. 8 is a schematic configuration diagram of an information terminal according to the first embodiment.

FIG. 9 is a flowchart showing a flow of control processing

executed by a cycle monitoring device of the first embodiment.

FIG. 10 is a flowchart showing a flow of control processing executed by the information processing machine of the first embodiment.

5 FIG. 11 is a flowchart showing a flow of inspection data generation processing executed by the information processing machine of the first embodiment.

10 FIG. 12 is a flowchart showing a flow of abnormality inspection processing executed by the information processing machine of the first embodiment.

FIG. 13 is a flowchart showing a flow of inspection data generation processing executed by an information processing machine of a second embodiment.

15 FIG. 14 is a schematic configuration diagram of a refrigerator according to a third embodiment.

FIG. 15 is a flowchart showing a flow of control processing executed by a cycle monitoring device of the third embodiment.

20 FIG. 16 is a flowchart showing a flow of inspection data generation processing executed by an information processing machine of the third embodiment.

FIG. 17 is a schematic view showing an operation panel of a refrigerator according to another embodiment.

FIG. 18 is a schematic view of a vehicle equipped with a freezer according to another embodiment.

25 FIG. 19 is a schematic view of a vehicle equipped with a freezer according to another embodiment.

FIG. 20 is a schematic view of a vehicle equipped with a freezer according to another embodiment.

30 FIG. 21 is a schematic view of a vehicle equipped with a freezer according to another embodiment.

DESCRIPTION OF EMBODIMENT

[0015]

35 Hereinafter, embodiments of the present disclosure will be described with reference to the drawings. In the following embodiments, portions that are the same as or equivalent to those described in the preceding embodiments are denoted by the same reference numerals,

and a description of the same or equivalent portions may be omitted. In addition, when only a part of the components is described in the embodiment, the components described in the preceding embodiment can be applied to other parts of the components. The following
5 embodiments may be partially combined with each other even if such a combination is not explicitly described as long as there is no disadvantage with respect to such a combination.

[0016]

(First embodiment)

10 The present embodiment will be described with reference to FIGS. 1 to 12. In the present embodiment, an inspection system 1 of the present disclosure is applied to a system for inspecting the presence or absence of abnormality of a refrigeration cycle device 26
15 included in a refrigerator 25 mounted on a vehicle 2A, 2B equipped with a freezer.

[0017]

As shown in FIG. 1, the inspection system 1 includes a cycle monitoring device 28 arranged on the vehicle 2A, 2B together with the refrigeration cycle device 26, and an information processing machine
20 50 disposed outside of the vehicle 2A, 2B to communicate with the cycle monitoring device 28 via a communication line CN.

[0018]

As shown in FIG. 2, the vehicle 2A, 2B has a cabin 21 for the driver and a loading platform 22 having a heat insulating structure
25 connected behind the cabin 21. The vehicle 2A, 2B includes an engine 23 which is a drive source for traveling the vehicle. The rotation of the engine 23 is transmitted to the drive wheels 24 via an automatic transmission or the like (not shown). The vehicle 2A, 2B may have an electric motor in addition to the engine 23 (for example, a hybrid
30 vehicle) or in place of the engine 23 (for example, an electric vehicle or fuel cell vehicle) as a drive source for traveling the vehicle. The vehicle 2A, 2B are not limited to have exactly the same configuration, and at least a part thereof may be different.

[0019]

35 The vehicle 2A, 2B has the refrigerator 25 for adjusting the temperature of the internal space 22a inside the loading platform 22.

The refrigerator 25 is configured to adjust the temperature of the internal space 22a inside the loading platform 22 by a single refrigeration cycle device 26. In the present embodiment, the interior space 22a is a target space for the temperature control by the refrigerator 25.

[0020]

As shown in FIG. 3, the refrigerator 25 includes the vapor compression refrigeration cycle device 26, the cycle control device 27 that controls the operation of the refrigeration cycle device 26, and the cycle monitoring device 28 that monitors the refrigeration cycle device 26.

[0021]

The refrigeration cycle device 26 includes a circulation circuit 260 in which a compressor 261, a radiator 262, a decompression device 263, and an evaporator 264 are sequentially connected. The compressor 261 is arranged adjacent to the cabin 21 in which the engine 23 is housed. The radiator 262, the decompression device 263, the evaporator 264 and the like are arranged inside the storage case 220 mounted on the vehicle 2A, 2B shown in FIG. 1. The radiator 262 and the evaporator 264 of the refrigeration cycle device 26 are not limited to the configuration (so-called package type) arranged inside the storage case 220. The refrigeration cycle device 26 may have a configuration in which the radiator 262 and the evaporator 264 are separately installed (so-called separate type). The refrigeration cycle device 26 may be configured such that, for example, the radiator 262 is arranged inside the storage case 220 and the evaporator 264 is arranged in the internal space 22a.

[0022]

The compressor 261 includes a compression mechanism unit 261a that compresses the refrigerant, and a power transmission unit 261b that transmits a rotational driving force to the compression mechanism unit 261a. The compression mechanism unit 261a is composed of, for example, a variable capacitance type refrigerant compression mechanism such as a swash plate type, or a fixed capacitance type refrigerant compression mechanism such as a scroll type or a vane type. The power transmission unit 261b has a driven

pulley 261c. The driven pulley 261c is connected to a drive-side pulley 231 that rotates together with the drive shaft of the engine 23 via a belt 232.

[0023]

5 As a result, the rotation of the drive shaft of the engine 23 is transmitted to the power transmission unit 261b via the belt 232. When the driven pulley 261c of the power transmission unit 261b rotates in conjunction with the engine 23, the compression mechanism unit 261a of the compressor 261 compresses the refrigerant sucked from the
10 refrigerant suction port and discharges it from the refrigerant discharge port.

[0024]

As described above, the compressor 261 of the present embodiment is configured to operate in conjunction with the output from
15 the engine 23, which is a drive source for traveling the vehicle. The power transmission unit 261b of the present embodiment is provided with an electromagnetic clutch mechanism 261d.

[0025]

20 The radiator 262 is connected to the refrigerant discharge port side of the compressor 261. The radiator 262 is a heat exchanger that dissipates heat by exchanging heat between the refrigerant discharged from the compressor 261 and air outside the vehicle interior (that is, the outside air) blown from the outdoor fan 262a.

[0026]

25 The decompression device 263 is connected to the refrigerant outlet side of the radiator 262. The decompression device 263 is an expansion valve that reduces and expands the refrigerant flowing out of the radiator 262, that is, the refrigerant radiated by the radiator 262 to a predetermined pressure.

30 [0027]

The evaporator 264 is connected to the refrigerant outlet side of the decompression device 263. The evaporator 264 is a heat exchanger that evaporates the refrigerant decompressed by the decompression device 263 and cools the internal space 22a, which is the space to be
35 cooled, by the endothermic action due to the evaporation of the refrigerant. The evaporator 264 of the present embodiment cools the

air circulating in the internal space 22a by exchanging heat between the refrigerant decompressed by the decompression device 263 and the air circulating in the internal space 22a by the indoor fan 264a. A refrigerant suction port of the compressor 261 is connected to the refrigerant outlet side of the evaporator 264 via an accumulator or the like (not shown).

[0028]

Further, the refrigeration cycle device 26 is provided with a bypass pipe 265 that guides the refrigerant discharged from the compressor 261 to the evaporator 264 by bypassing the radiator 262 and the decompression device 263. One end of the bypass pipe 265 is connected to a position between the compressor 261 and the radiator 262, and the other end of the bypass pipe 265 is connected to a position between the decompression device 263 and the evaporator 264.

[0029]

The bypass pipe 265 is provided with an on-off valve 266 that switches between a closed state in which the flow of the refrigerant to the bypass pipe 265 is blocked and an open state in which the flow of the refrigerant to the bypass pipe 265 is allowed. The on-off valve 266 is controlled by the cycle control device 27 to be closed in the normal operation mode in which the refrigerant is evaporated by the evaporator 264. The on-off valve 266 is controlled to the open state the defrost mode for removing the frost adhering to the evaporator 264 or in the heating mode to heat the internal space 22a.

[0030]

The cycle control device 27 includes a microcomputer including a processor for performing control processing and arithmetic processing and a storage unit, such as a ROM and a RAM, for storing a program and data, as well as peripheral circuits thereof. The storage unit of the cycle control device 27 is composed of a non-transitory tangible storage medium.

[0031]

The clutch mechanism 261d, the outdoor fan 262a, the indoor fan 264a, the on-off valve 266, and the like are connected to the output side of the cycle control device 27. The cycle control device 27 controls the operation of the device connected to the output side by calculating

and processing various input information by a program stored in the storage unit.

[0032]

A high-pressure-side pressure sensor 270a, a high-pressure-side temperature sensor 270b, a low-pressure-side pressure sensor 270c, and a low-pressure-side temperature sensor 270d are connected to the input side of the cycle control device 27 for detecting a refrigerant state amount indicating the state of the refrigerant. The high-pressure-side pressure sensor 270a is a pressure sensor that detects the high-pressure-side pressure P_d , which is the pressure of the high-pressure refrigerant discharged from the compressor 261. The high-pressure-side temperature sensor 270b is a temperature sensor that detects the high-pressure temperature T_d , which is the refrigerant temperature on the refrigerant outlet side of the radiator 262. The low-pressure-side pressure sensor 270c is a pressure sensor that detects the low-pressure-side pressure P_s , which is the refrigerant pressure on the refrigerant outlet side of the evaporator 264. The low-pressure-side temperature sensor 270d is a temperature sensor that detects the low-pressure temperature T_e , which is the air temperature on the air outlet side of the evaporator 264. The low-pressure-side temperature sensor 270d may be configured to detect the refrigerant temperature on the refrigerant outlet side of the evaporator 264 instead of the air temperature on the air outlet side of the evaporator 264. A sensor other than the above-mentioned sensor may be connected to the input side of the cycle control device 27.

[0033]

An information display panel 29 for displaying the state of the refrigeration cycle device 26 and the like is connected to the cycle control device 27. The information display panel 29 notifies the user A, B of the operating status of the refrigeration cycle device 26 and the like. The information display panel 29 is connected to the cycle control device 27 or the like by serial communication such as CAN. The information display panel 29 may be connected to the cycle control device 27 or the like by wireless communication such as "Wifi" or "BLUETOOTH (registered trademark)".

[0034]

The information display panel 29 is provided with an A/C display 29a, an abnormality display 29b, and the like. The A/C display 29a is, for example, an LED for notifying that the refrigeration cycle device 26 is operating, and is configured to switch on and off according to a control signal from the cycle control device 27. The abnormality display 29b is, for example, an LED for notifying an abnormality in the amount of refrigerant, and is configured to be turned on and off according to a control signal from the cycle control device 27.

[0035]

The cycle monitoring device 28 is composed of a microcomputer that includes a processor that performs control processing and arithmetic processing, a storage unit such as a ROM and a RAM that stores programs and data, and peripheral circuits thereof. The storage unit of the cycle monitoring device 28 is composed of a non-transitory tangible storage medium.

[0036]

The cycle monitoring device 28 monitors the state of the refrigeration cycle device 26, and is mounted on the vehicle 2A, 2B together with the refrigeration cycle device 26. The cycle monitoring device 28 is not limited to the one permanently installed in the vehicle 2A, 2B, and may be temporarily installed. That is, the cycle monitoring device 28 is not limited to the one fixed to the vehicle 2A, 2B, and may be one that can be taken out from the vehicle 2A, 2B like a mobile communication device.

[0037]

The cycle monitoring device 28 includes an information acquisition unit 281 for acquiring various information, and an external communication device 282 for communicating with the outside of the vehicle 2A, 2B.

[0038]

The information acquisition unit 281 acquires information from the cycle control device 27 and the like at a predetermined cycle (for example, 60 seconds) in a state where the refrigeration cycle device 26 is operating. Specifically, the information acquisition unit 281 acquires the operation status information indicating the operation status of the refrigeration cycle device 26 from the cycle control device 27, the state

quantity detection unit 271, the travel information detection unit 272, and the environmental information detection unit 273 connected by serial communication such as CAN. The information acquisition unit 281 may be connected to the cycle control device 27 or the like by wireless communication such as "Wifi" or "BLUETOOTH (registered trademark)".

[0039]

The state quantity detection unit 271 detects the control state information indicating the control state of the refrigeration cycle device 26. The state quantity detection unit 271 detects the rotation speed N_c of the compressor 261, the rotation speed N_{fc} of the outdoor fan 262a, and the rotation speed N_{fe} of the indoor fan 264a as control state information. The compressor 261 of the present embodiment operates in conjunction with the output from the engine 23. Therefore, the rotation speed N_c of the compressor 261 can be calculated from the rotation speed N_e of the engine 23 and the pulley ratios of the pulleys 261c, 231.

[0040]

The travel information detection unit 272 detects the travel information of the vehicle 2A, 2B. The travel information detection unit 272 detects the vehicle speed SPD, the rotation speed N_e of the engine 23, the position information LP of the vehicle 2A, 2B, and the like as travel information from an engine control device, a navigation device, and the like (not shown).

[0041]

The environmental information detection unit 273 detects the environmental information around the vehicle 2A, 2B. The environmental information detection unit 273 detects the outside air temperature T_{am} , the inside temperature T_r , the amount of solar radiation T_s , etc. from the outside air temperature sensor, the inside temperature sensor, the solar radiation sensor, etc., which are not shown as environmental information. The internal temperature T_r may be estimated from the detected value of the low-pressure-side temperature sensor 270d.

[0042]

The information acquisition unit 281 of the present embodiment

acquires various information including the operation state, the refrigerant state amount, and the control state information of the refrigeration cycle device 26 as the operation status information. Examples of the operating state of the refrigeration cycle device 26 include the operating mode of the refrigeration cycle device 26, the operating time from the start of the refrigeration cycle device 26, and the total operating time from the time when the refrigeration cycle device 26 is installed in the vehicle 2A, 2B to the present. In the present embodiment, the data indicating the refrigerant state amount in the operation status information constitutes the refrigerant state data.

[0043]

The external communication device 282 communicates with the outside of the vehicle 2A, 2B via the telecommunication line CN. The external communication device 282 is configured to be able to transmit various information including the operation status information acquired by the information acquisition unit 281 to the outside. The external communication device 282 also has a function as a receiving unit for receiving information from the outside.

[0044]

Specifically, as shown in FIG. 4, the external communication device 282 sends the operation status information such as ID number, an acquisition date and time when the information was acquired, information on the refrigerator 25, an operating state of the refrigeration cycle device 26, a refrigerant state amount, control state information, vehicle driving information and environmental information to the outside. The ID number, model, machine number, type of refrigerant, etc. are information for identifying the refrigerator 25, and are set in advance in the external communication device 282. The ID number is a unique number assigned to the refrigerator 25 in advance to identify the refrigerator 25.

[0045]

Subsequently, the information processing machine 50 will be described with reference to FIGS. 1 and 5. The information processing machine 50 is arranged at a remote location outside the vehicle 2A, 2B and inspects whether or not there is an abnormality in the refrigeration cycle device 26 included in the refrigerator 25 mounted on the vehicle

2A, 2B.

[0046]

As shown in FIG. 1, the information processing machine 50 is configured to be able to communicate with the plural vehicles 2A, 2B and the information terminals 60 for the plural users A and B via a communication line CN. In the present embodiment, the user A uses the vehicle 2A, and the user B uses the vehicle 2B. The number of users A, B is not limited to two, and may be three or more. Further, the number of vehicles 2A, 2B used by the user A, B is not limited to one, and may be two or more. Further, the refrigerators 25 mounted on the vehicles 2A, 2B are not limited to the same model, but may be different models.

[0047]

The information processing machine 50 is realized by at least one workstation. The information processing machine 50 may be realized as a separate personal computer or workstation capable of communicating with each other.

[0048]

The information processing machine 50 includes an information communication unit 51 that communicates with the outside, an information storage unit 52 that stores information acquired from the outside, and an information calculation unit 53 that inspects the refrigeration cycle device 26 for abnormalities.

[0049]

The information communication unit 51 is configured to be able to communicate with the cycle monitoring device 28 mounted on the vehicle 2A, 2B and the information terminals 60 for the users A and B via the communication line CN. The information communication unit 51 is configured to be able to receive the operation status information transmitted from the cycle monitoring device 28.

[0050]

Further, the information communication unit 51 is configured to be able to transmit inspection result information or the like indicating the inspection result of the refrigeration cycle device 26 to the information terminals 60 for the user A, B who uses the vehicle 2A, 2B. The information communication unit 51 of the present embodiment is

basically configured to transmit inspection result information or the like indicating an inspection result to the information terminal 60 in response to a request from the information terminal 60.

[0051]

5 However, the information communication unit 51 is configured to transmit the inspection result information or the like to the information terminal 60 regardless of the request from the information terminal 60 when there is an abnormality in the refrigeration cycle device 26. Further, when there is an abnormality in the refrigeration cycle device
10 26, the information communication unit 51 is configured to be able to transmit a signal indicating the abnormality to the cycle control device 27 via the cycle monitoring device 28.

[0052]

15 The information storage unit 52 is composed of a large-capacity storage medium that stores various information including operation status information transmitted from the cycle monitoring device 28. The information storage unit 52 is composed of a non-transitory tangible storage medium.

[0053]

20 The information calculation unit 53 includes a data generation unit 531 that generates inspection data for inspecting the presence or absence of abnormality in the refrigeration cycle device 26, and an inspection unit 532 that inspects the presence or absence of abnormality in the refrigeration cycle device 26 using the generated
25 inspection data.

[0054]

 The data generation unit 531 generates inspection data based on the operation status information stored in the information storage unit 52. The data generation unit 531 stores the generated inspection
30 data in the information storage unit 52 in a state of being associated with the operation status information used for generating the inspection data.

[0055]

35 The inspection unit 532 collates the inspection data generated by the data generation unit 531 with the reference data stored in the information storage unit 52 in advance, and inspects the refrigeration

cycle device 26 for the presence or absence of abnormality. The reference data indicates a normal state or an abnormal state of the refrigeration cycle device 26. The reference data is not limited to the data stored in the information storage unit 52 in advance, and may be data calculated by the arithmetic processing in the inspection unit 532. For example, the reference data may be defined by correcting data stored in the information storage unit 52 in advance by the total operating time of the refrigeration cycle device 26.

[0056]

After the inspection for the presence or absence of abnormality in the refrigeration cycle device 26, the inspection unit 532 stores the inspection result information indicating the inspection result in the information storage unit 52 in a state of being associated with the inspection data and the reference data used for the inspection.

[0057]

If a fluorocarbon-based refrigerant is adopted as the refrigerant of the refrigeration cycle device 26, it is not preferable from a viewpoint of environmental pollution, since the refrigerant may leak to the outside of the circulation circuit 260. Even when a natural refrigerant such as carbon dioxide is adopted, if the refrigerant leaks in excess of the permissible amount, it leads to malfunction of the refrigerator 25, which is not preferable. For this reason, the inspection of the presence or absence of an abnormality in the amount of the refrigerant is particularly important in the refrigeration cycle device 26.

[0058]

Since many refrigerants are colorless, transparent and difficult to see, it is difficult to judge the suitability of the amount of refrigerant by a simple inspection such as a visual inspection. Then, it needs inspection using a dedicated device for measuring the amount of refrigerant. For this reason, the implementation of the inspection regarding the suitability of the amount of the refrigerant is a factor that greatly increases the burden on the users A and B.

[0059]

In view of these, the information processing machine 50 of the present embodiment generates a physical quantity having a correlation with the amount of refrigerant as inspection data, collates the physical

quantity with the reference data, and inspects the suitability of the amount of refrigerant in the circulation circuit 260.

[0060]

In the refrigeration cycle device 26, when the amount of the refrigerant in the circulation circuit 260 decreases, the state shown by the solid line in FIG. 6 changes to the state shown by the broken line in FIG. 6. That is, in the refrigeration cycle device 26, when the amount of the refrigerant in the circulation circuit 260 decreases, the high-pressure-side pressure P_d decreases from the A1 point to the B1 point in FIG. 6, and the low-pressure-side pressure P_s decreases from the A3 point to the B3 point in FIG. 6. Further, when the amount of the refrigerant in the circulation circuit 260 decreases, the superheat degree SH of the refrigerant on the refrigerant outlet side of the evaporator 264 increases as shown at points A4 and B4 in FIG. 6, and the supercooling degree SC of the refrigerant on the refrigerant outlet side of the radiator 262 becomes small at the points A2 and B2 in FIG. 6. As described above, the amount of the refrigerant in the circulation circuit 260 has a strong correlation with the temperature and pressure of the refrigerant in the circulation circuit 260.

[0061]

Therefore, the information calculation unit 53 uses at least the refrigerant state data of the operation status information to generate a physical quantity having a correlation with the amount of the refrigerant in the circulation circuit 260 as inspection data. Specifically, the information calculation unit 53 calculates the estimated amount M_e of the refrigerant by substituting the high-pressure-side pressure P_d , the low-pressure-side pressure P_s , the high pressure temperature T_d , and the low pressure temperature T_e into a predetermined calculation formula. The formula for calculating the estimated amount of refrigerant M_e is, for example, a regression equation obtained by regression analysis using the amount of refrigerant as an objective variable and using the high-pressure-side pressure P_d , the low-pressure-side pressure P_s , the high pressure temperature T_d , and the low pressure temperature T_e as explanatory variables.

[0062]

As described above, the amount of refrigerant has a strong

correlation with the supercooling degree SC on the refrigerant outlet side of the radiator 262. Therefore, it is desirable to adopt a regression equation in which the supercooling degree SC is added as an explanatory variable for the calculation formula of the estimated amount Me of the refrigerant. The supercooling degree SC can be calculated from the vapor pressure curve of the refrigerant, the high-pressure-side pressure Pd, and the high pressure temperature Td.
[0063]

The high-pressure-side pressure Pd, the low-pressure-side pressure Ps, the high pressure temperature Td, and the low pressure temperature Te change depending on not only the amount of the refrigerant in the circulation circuit 260, but also the control state of the refrigeration cycle device 26, the driving state of the vehicle 2A, 2B, and the environmental conditions around the vehicle 2A, 2B.

[0064]

Therefore, it is desirable to adopt a regression equation in which at least a part of the control state information, the travel information, and the environmental information is added as an explanatory variable for the calculation formula of the estimated amount Me of the refrigerant. That is, the information calculation unit 53 is configured to calculate the estimated amount Me of the refrigerant in consideration of the control state of the refrigeration cycle device 26, the running state of the vehicle 2A, 2B, and the environmental conditions around the vehicle 2A, 2B. According to this, it is possible to improve the calculation accuracy of the amount of the refrigerant in the information calculation unit 53. In addition, when the operation status information includes the running information and the environmental information of the vehicle 2A, 2B, it is possible to investigate whether or not the abnormality of the refrigeration cycle device 26 is related to the running information and the environmental information. For example, if the refrigeration cycle devices 26 of the vehicles 2A, 2B, which often travel in a specific area, have abnormalities, it is possible to apply measures such as encouraging maintenance of the vehicles 2A, 2B traveling in the specific area. In addition, if the refrigeration cycle devices 26 of the vehicles 2A, 2B, which often travel under specific environmental conditions, have abnormalities, it is possible to promote measures such

as maintenance of the vehicle 2A, 2B traveling under specific environmental conditions.

[0065]

5 The information calculation unit 53 uses the estimated amount Me of refrigerant calculated by the above method as inspection data, and compares the inspection data with the reference data in which the required amount of refrigerant Mth required by the refrigeration cycle device 26 is defined, to inspect whether there is an abnormality in the amount of refrigerant. Specifically, the information calculation unit 53
10 determines that the refrigerant amount is in a normal state when the estimated amount Me of the refrigerant used as the inspection data is larger than the required refrigerant amount Mth used as the reference data. When the estimated amount Me of the refrigerant is more than the required refrigerant amount Mth, the amount of refrigerant is
15 abnormal.

[0066]

If the refrigeration cycle device 26 is required to be inspected regularly or irregularly by law, etc., it may be required to submit a report containing necessary items such as inspection results to government
20 offices and the like. The creation of such a report is a factor that increases the burden on the user A, B.

[0067]

The information processing machine 50 has a report creation unit 54 that creates report data in a predetermined format
25 corresponding to each of the vehicles 2A, 2B. The report creation unit 54 creates report data in a predetermined format used for reporting the inspection result of the refrigeration cycle device 26 based on the inspection result information indicating the inspection result of the presence or absence of abnormality of the refrigeration cycle device 26.
30 Then, the report creation unit 54 stores the created report data in the information storage unit 52.

[0068]

The report creation unit 54 prepares report data in a format conforming to the provisions of laws and the like. For example, in the
35 file data in the format shown in FIG. 7, the report creation unit 54 reflects the inspection result information and the like in the portion

indicated by five dots such as "....." as the report data.

[0069]

Subsequently, the information terminals 60 for the users A and B will be described with reference to FIG. 8. The information terminal 60 is configured to be able to acquire information about the refrigerator 25 of the vehicle 2A, 2B used by the user A, B from the information processing machine 50.

[0070]

The information terminal 60 is used by the user A, B, and is composed of a smartphone or a personal computer, which is one of the mobile communication terminals. As shown in FIG. 8, the information terminal 60 includes a communication unit 61 that communicates with the outside via a communication line CN, a processor 62, a display unit 63 that displays information, and a terminal-side storage unit 64 that stores various data.

[0071]

The information terminal 60 is configured to be able to request the information processing machine 50 to transmit information about the refrigerator 25 via a dedicated application, an E-mail, a Web browser, or the like. Further, the information terminal 60 is configured to be able to receive information about the refrigerator 25 via a dedicated application, E-mail, or the like.

[0072]

Next, the operation of the inspection system 1 of the present embodiment will be described with reference to FIGS. 9 to 12. The cycle monitoring device 28 executes the control process shown in FIG. 9 in a predetermined cycle (for example, 60 seconds) while the refrigeration cycle device 26 is operating.

[0073]

Specifically, in step S100, the cycle monitoring device 28 obtains the operation status information of the refrigeration cycle device 26 from the cycle control device 27, the state quantity detection unit 271, the travel information detection unit 272, and the environmental information detection unit 273. Then, in step S110, the cycle monitoring device 28 transmits the operation status information to the information processing machine 50 via the telecommunication

line CN.

[0074]

When the information processing machine 50 receives the operation status information from the cycle monitoring device 28 via the telecommunication line CN, the information processing machine 50 executes the control process shown in FIG. 10. That is, in step S200, the information processing machine 50 stores the operation status information in the information storage unit 52.

[0075]

Subsequently, in step S210, the information processing machine 50 executes an inspection data generation process for generating inspection data for inspecting the presence or absence of abnormality in the refrigeration cycle device 26. Specifically, as shown in FIG. 11, the information processing machine 50 calculates the estimated amount Me of the refrigerant based on the operation status information in step S210a. Then, in step S210b, the information processing machine 50 stores the estimated amount Me of the refrigerant in the information storage unit 52 in a state associated with the operation status information.

[0076]

As shown in FIG. 10, the information processing machine 50 executes an abnormality inspection process for inspecting the presence or absence of an abnormality in the refrigeration cycle device 26 in step S220. Specifically, as shown in FIG. 12, the information processing machine 50 determines in step S220a whether or not the estimated amount Me of refrigerant is smaller than the required amount Mth of refrigerant. As a result of this determination, when the estimated amount Me of refrigerant is smaller than the required amount Mth of refrigerant, the information processing machine 50 turns on the abnormality flag indicating that the amount of refrigerant is in an abnormal state in step S220b. When the estimated amount Me of refrigerant is equal to or greater than the required amount Mth of refrigerant, the information processing machine 50 turns off the abnormality flag in step S220c.

[0077]

As shown in FIG. 10, the information processing machine 50

executes the report creation process in step S230. In this report creation process, report data in a predetermined format used for reporting the inspection result of the refrigeration cycle device 26 is created based on the inspection result information indicating the inspection result of the presence or absence of abnormality in the refrigeration cycle device 26.

[0078]

Subsequently, the information processing machine 50 determines in step S240 whether or not there is an abnormality in the refrigeration cycle device 26. Specifically, the information processing machine 50 determines whether or not there is an abnormality in the refrigeration cycle device 26 based on the on/off of the abnormality flag.

[0079]

If there is no abnormality as a result of this determination, the information processing machine 50 determines in step S250 whether or not the request signal of the inspection result is received from the information terminal 60. Then, when the information processing machine 50 receives the request signal, in step S260, at least one of the inspection result information and the report data, which are the inspection results, is transmitted to the information terminal 60 requesting the inspection result.

[0080]

When there is an abnormality in the refrigeration cycle device 26, the information processing machine 50 skips the determination process in step S250 and transmits at least one of the inspection result information and the report data which are the inspection results to the information terminal 60 for the user A, B of the refrigeration cycle device 26.

[0081]

The information processing machine 50 is configured to transmit a control signal for lighting the abnormality display 29b to the cycle control device 27 via the cycle monitoring device 28 when there is an abnormality in the refrigeration cycle device 26. According to this, even if the driver does not have the information terminal 60, the driver can be urged to carry out maintenance of the refrigeration cycle device 26.

[0082]

The inspection system 1 described above inspects the refrigeration cycle device 26 for abnormalities by the information processing machine 50 arranged outside the vehicle 2A, 2B, and transmits the inspection result to a predetermined information terminal 60. According to this, the inspection of the refrigeration cycle device 26 can be omitted on the user A, B side, so that the burden on the user A, B can be reduced.

[0083]

Since the vehicle 2A, 2B is a movable unit and the installation space of the equipment is greatly limited as compared with stores and the like, it is often difficult to install a dedicated equipment in the vehicle 2A, 2B for inspecting abnormalities in the refrigeration cycle device 26.

[0084]

When the information processing machine 50 arranged outside the vehicle inspects the refrigeration cycle device 26, there is no need to install a dedicated device for inspecting the presence or absence of abnormalities in the refrigeration cycle device 26 to the vehicle 2A, 2B, since the cycle monitoring device 28 is sufficient. In addition, the information processing machine 50 stores the estimated amount M_e of the refrigerant in the information storage unit 52 at any time in a state associated with the operation status information. That is, the information storage unit 52 stores information on the amount of refrigerant. According to this, since the information processing machine 50 can grasp the change over time in the amount of refrigerant and the reasons, for example, the abnormality in the amount of refrigerant is due to the time-dependent factor such as deterioration or due to a sudden factor such as damage in the piping. Further, since the vehicle 2A, 2B travels in various places nationwide, for example, it is possible to improve the accuracy of the environmental information and the like by referring to the information in the vehicle 2A, 2B traveling in the vicinity so as to improve the accuracy of the inspection data. Further, it is possible to provide the driver with information (for example, weather information of the destination) to assist the driver by using the environmental information.

[0085]

Further, the inspection system 1 has the report creation unit 54

that creates report data in a predetermined format used by the information processing machine 50 to report the inspection result of the refrigeration cycle device 26, and the information terminal 60 is configured so that report data can be acquired from the information processing machine 50.

[0086]

According to this, the user A, B can obtain not only the inspection result of the refrigeration cycle device 26 but also the report data created in a predetermined format based on the inspection result through the information terminal 60. For example, if the inspection of the refrigeration cycle device 26 is required regularly or irregularly by law or the like, it can be expected that the report data will be effectively used as evidence that the inspection is properly carried out. If the report data can be used as evidence that the inspection is being carried out appropriately, the burden on the user A, B can be significantly reduced.

[0087]

If a large amount of information is unilaterally transmitted from the information processing machine 50 to the information terminal 60, the information processing on the user A, B side becomes complicated, and the burden on the user A, B may increase.

[0088]

Therefore, the information processing machine 50 is configured to transmit inspection result information or report data to the information terminal 60 in response to a request from the information terminal 60. According to this, the user A, B can obtain information from the information processing machine 50 when necessary, so that the above-mentioned situation can be avoided.

[0089]

Further, the information processing machine 50 is configured to transmit inspection result information or report data to the information terminal 60 regardless of the request from the information terminal 60 when an abnormality of the refrigeration cycle device 26 is detected. According to this, the user A, B can know the abnormality of the refrigeration cycle device 26 at an early stage, and it becomes easy to take measures against the abnormality of the refrigeration cycle device 26.

[0090]

The information processing machine 50 of the present embodiment is configured to inspect the suitability of the amount of refrigerant in the circulation circuit 260 of the refrigeration cycle device 26. According to this, it is possible to omit the inspection on the suitability of the amount of the refrigerant on the user A, B, so that the burden on the user A, B can be significantly reduced.

[0091]

(Modification of First embodiment)

In the first embodiment, the information processing machine 50 is configured to always execute the abnormality inspection process and the report creation process regardless of the request from the information terminal 60, but is not limited to this. The information processing machine 50 may be configured to execute an abnormality inspection process and a report creation process when, for example, a request is received from the information terminal 60. The same also applies to the following embodiments.

[0092]

In the first embodiment, the compressor 261 of the refrigeration cycle device 26 is driven by the engine 23, which is a drive source for traveling the vehicle, but is not limited to this. The compressor 261 may be driven by, for example, a sub-engine dedicated to the refrigerator 25, which is mounted separately from the engine 23 for traveling the vehicle.

[0093]

(Second embodiment)

A second embodiment will be described with reference to FIG 13. In the present embodiment different from the first embodiment, the information processing machine 50 specifies the operation status information to be inspected this time with reference to the control state information used in the previous inspection, and generates inspection data using the specified operation status information. In the present embodiment, a difference part different from the first embodiment will be mainly described, and description for a part similar to the first embodiment will be omitted.

[0094]

The information processing machine 50 executes the control process shown in FIG. 10 at a predetermined cycle (for example, 1 hour). The cycle in which the information processing machine 50 executes the control process shown in FIG. 10 is longer than the cycle in which the cycle monitoring device 28 executes the control process shown in FIG. 9.

[0095]

In the inspection data generation process shown in step S210 of FIG. 10, the information processing machine 50 specifies the operation status information to be inspected this time with reference to the control state information in which the previous inspection was performed, and generates inspection data using the specified operation status information.

[0096]

Specifically, as shown in FIG. 13, in step S210c, the information processing machine 50 specifies the operation status information including the control state information that is the basis of the previous inspection data from the plurality of operation status information stored in the information storage unit 52. When this inspection is the first inspection, the information storage unit 52 stores the control status information suitable for the inspection in advance as the initial information, and specifies the initial information as the control status information used in the previous inspection.

[0097]

Subsequently, in step S210d, the information processing machine 50 specifies the control state information having a high degree of similarity as the control state information the used in the previous inspection among the plurality of control state information stored in the information storage unit 52 after the previous inspection. In this similarity determination, for example, the control state information having the smallest difference from the control state information used in the previous inspection is specified as the control state information having a high degree of similarity among a plurality of control state information stored in the information storage unit 52 after the previous inspection.

[0098]

Subsequently, in step S210e, the information processing machine 50 calculates the estimated amount Me of the refrigerant, which is the inspection data, based on the operation status information including the control status information having a high degree of similarity to the control status information used in the previous inspection. Then, in step S210f, the information processing machine 50 stores the estimated amount Me of the refrigerant in the information storage unit 52. The information processing machine 50 may be configured to skip the process of steps S210e and S210f, when the plurality of control state information stored in the information storage unit 52 after the previous inspection has a low degree of similarity to the control state information used in the previous inspection.

[0099]

The other configurations are the same as those of the first embodiment. The inspection system 1 and the information processing machine 50 of the present embodiment can obtain the effects obtained from the same configuration as that of the first embodiment as in the first embodiment.

[0100]

In the present embodiment, the information processing machine 50 is configured specify the operation status information to be inspected this time by referring to the control state information used in the previous inspection, and to generate the inspection data using the specified operation status information. According to this, the inspection data can be generated under the condition that the control state is similar to that at the time of the previous inspection. Therefore, the inspection data with high accuracy can be obtained without affecting the operating state of the refrigeration cycle device 26. This greatly contributes to improving the accuracy of inspection results.

[0101]

(Third embodiment)

A third embodiment will be described with reference to FIGS. 14 to 16. The present embodiment is different from the first embodiment in that the cycle monitoring device 28 is provided with a mode switching unit 284 for switching the operation mode of the refrigeration cycle device 26. In the present embodiment, a difference part different from

the first embodiment will be mainly described, and description for a part similar to the first embodiment will be omitted.

[0102]

As shown in FIG. 13, in the refrigeration cycle device 26 of the present embodiment, the compressor 261 is composed of an electric compressor. That is, the compressor 261 has a configuration in which the compression mechanism unit 261a is driven by the electric motor 261e. The rotation speed of the electric motor 261e of the compressor 261 is controlled according to a control signal from the cycle control device 27. Therefore, in the compressor 261 of the present embodiment, the discharge capacity of the refrigerant can be adjusted by the cycle control device 27. The electric motor 261e of the present embodiment is driven by using a battery mounted on the vehicle 2A, 2B as a power source. The power source of the electric motor 261e is not limited to the battery mounted on the vehicle, and may be configured to use, for example, an in-vehicle generator or an in-vehicle solar cell as a power source.

[0103]

Further, the cycle monitoring device 28 of the present embodiment has a mode switching unit 284 that switches the operation mode of the refrigeration cycle device 26 to an inspection mode for controlling the control state of the control device included in the refrigeration cycle device 26 so as to be in a predetermined state. The inspection mode is an operation mode in which the refrigerant discharge capacity of the compressor 261, the ventilation capacity of the outdoor fan 262a, and the ventilation capacity of the indoor fan 264a are fixed to predetermined capacities, as the control device of the refrigeration cycle device 26. The mode switching unit 284 is configured to output a request signal requesting the cycle control device 27 to shift to the inspection mode when a predetermined inspection condition is satisfied.

[0104]

The predetermined inspection condition can be, for example, condition which is satisfied when the internal temperature T_r reaches the target temperature when the vehicle 2A, 2B is started. The predetermined inspection condition may be a condition that is satisfied

when, for example, a request signal for switching the operation mode to the inspection mode is received from the information processing machine 50.

[0105]

5 Next, the mode switching process of the operation mode executed by the cycle monitoring device 28 of the present embodiment and the inspection data generation process executed by the information processing machine 50 will be described. In the present embodiment, the mode switching process executed by the cycle monitoring device
10 28 will be described, and then the inspection data generation process executed by the information processing machine 50 will be described.

[0106]

 The cycle monitoring device 28 executes the control routine shown in the flowchart of FIG. 15 at a predetermined cycle (for example,
15 60 seconds). That is, as shown in FIG. 15, the cycle monitoring device 28 determines in step S300 whether or not the inspection condition is satisfied. If the inspection condition is not satisfied as a result of this determination process, the cycle monitoring device 28 shifts to step S310 and continues the normal operation mode. That is, the cycle
20 monitoring device 28 does not output a request signal requesting the cycle control device 27 to shift to the inspection mode. When the inspection condition is satisfied, the cycle monitoring device 28 shifts to step S320 and switches the operation mode to the inspection mode. That is, the cycle monitoring device 28 outputs a request signal
25 requesting the cycle control device 27 to shift to the inspection mode.

[0107]

 As a result, the operation mode of the refrigeration cycle device 26 shifts to the inspection mode. Then, the information acquisition unit 281 of the cycle monitoring device 28 acquires the operation
30 information indicating that the operation mode of the refrigeration cycle device 26 is the inspection mode from the cycle control device 27.

[0108]

 Subsequently, the information processing machine 50 executes the control process shown in FIG. 10 at a predetermined cycle (for
35 example, 1 hour). The cycle in which the information processing machine 50 executes the control process shown in FIG. 10 is longer

than the cycle in which the cycle monitoring device 28 executes the control process shown in FIG. 15.

[0109]

The information processing machine 50 specifies the operation status information at the inspection mode in the inspection data generation process shown in step S210 of FIG. 10, and generates inspection data using the specified operation status information.

[0110]

Specifically, as shown in FIG. 16, in step S210g, the information processing machine 50 specifies the operation status information acquired in the inspection mode among a plurality of operation status information stored in the information storage unit 52 after the previous inspection was performed. Since each of the plurality of operation status information includes information regarding the operating mode of the refrigeration cycle device 26, it is possible to specify the operation status information in the inspection mode based on the operation status information.

[0111]

Subsequently, in step S210h, the information processing machine 50 calculates the estimated amount Me of the refrigerant, which is the inspection data, based on the operation status information in the inspection mode. Then, in step S210i, the information processing machine 50 stores the estimated amount Me of the refrigerant in the information storage unit 52. When the operation status information in the inspection mode is not included in the plurality of operation status information stored in the information storage unit 52 after the previous inspection, the information processing machine 50 is configured to skip each process of step S210h and step S210i.

[0112]

The other configurations are the same as those of the first embodiment. The inspection system 1 and the information processing machine 50 of the present embodiment can obtain the effects obtained from the same configuration as that of the first embodiment as in the first embodiment.

[0113]

In the present embodiment, the information processing machine

50 is configured to specify the operation status information when the operation mode of the refrigeration cycle device 26 is the inspection mode and to generate inspection data using the specified operation status information. According to this, since the inspection data can be generated under the condition that the control state is the same as that at the time of the previous inspection, it is possible to improve the inspection accuracy for the presence or absence of abnormality in the refrigeration cycle device 26.

[0114]

(Other embodiments)

The representative embodiments of the present disclosure have been described above. However, the present disclosure is not limited to the above-described embodiments, and may be be variously modified as follows.

[0115]

As in the above embodiments, it is desirable that the information processing machine 50 is provided with the report creation unit 54, but is not limited to this. The information processing machine 50 may not include the report creation unit 54.

[0116]

In the embodiments, the information processing machine 50 transmits at least one of the inspection result information and the report data to the information terminal 60 in accordance with the request from the information terminal 60, but is not limited to this. The information processing machine 50 may be configured to transmit at least one of the inspection result information and the report data to the information terminal 60, for example, periodically or when the total operating time of the refrigeration cycle device 26 exceeds a reference time.

[0117]

In the embodiments, the information processing machine 50 inspects the presence or absence of an abnormality in the amount of refrigerant by comparing the estimated amount Me of refrigerant with the required amount Mth of refrigerant, but is not limited to this. The information processing machine 50 may be configured to inspect whether or not there is an abnormality in the amount of refrigerant by collating the estimated amount Me of refrigerant calculated in this

inspection with the estimated amount M_e of refrigerant calculated in the previous inspection.

[0118]

In the embodiments, the estimated amount M_e of the refrigerant is calculated by using the regression equation obtained by the regression analysis, but is not limited to this. The estimated amount M_e of refrigerant may be calculated by preparing and referring to, for example, a control map in which the estimated amount M_e of refrigerant, the high-pressure-side pressure P_d , the low-pressure-side pressure P_s , the high pressure temperature T_d , and the low pressure temperature T_e are associated with each other.

[0119]

In the embodiments, the information processing machine 50 calculates the amount of the refrigerant in the circulation circuit 260 as inspection data, but is not limited to this. The information processing machine 50 may be configured to calculate the amount of leakage of the refrigerant leaked from the circulation circuit 260 as inspection data. In this case, the amount of leaked refrigerant is a physical quantity that correlates with the amount of refrigerant in the circulation circuit 260. The amount of leaked refrigerant has a correlation with the amount of refrigerant in the circulation circuit 260 since the amount of the refrigerant in the circulation circuit 260 is reduced as the leaked amount is increased.

[0120]

In the embodiments, the information processing machine 50 inspects the suitability of the amount of refrigerant in the refrigeration cycle device 26 based on the operation status information, but is not limited to this. For example, frost adhering to the evaporator 264 affects the heat exchange between the air from the indoor fan 264a and the refrigerant, so that the low-pressure-side pressure P_s and the low pressure temperature T_e tend to decrease. Therefore, the information processing machine 50 may be configured to inspect whether or not frost is attached to the evaporator 264 based on the refrigerant state amount included in the operation status information.

[0121]

When the operation status information includes image data that

captures the appearance of the compressor 261 and the piping through which the refrigerant flows, the information processing machine 50 may be configured to inspect an abnormality such as dirt or oil leakage based on the image data. When the operation status information includes voice data recorded by recording the operating sounds of the compressor 261, the outdoor fan 262a and the indoor fan 264a, the information processing machine 50 may be configured to inspect whether or not there is an abnormal noise of the control device based on the voice data.

[0122]

In the embodiments, when the operation status information is received from the cycle monitoring device 28, the information processing machine 50 executes a control process for inspecting the refrigeration cycle device 26 for an abnormality, but is not limited to this. That is, the timing at which the information processing machine 50 executes the control process can be freely set. For example, the information processing machine 50 may be configured to execute the control process at a predetermined operation time during the operation of the refrigeration cycle device 26.

[0123]

In the embodiments, the cycle control device 27 and the cycle monitoring device 28 are used as independent devices, but is not limited to this. Some functions of the cycle monitoring device 28 may be performed by the cycle control device 27. That is, the cycle monitoring device 28 may be configured as a device including the cycle control device 27.

[0124]

In the embodiments, the information acquisition unit 281 of the cycle monitoring device 28 acquires the operation status information of the refrigeration cycle device 26 from the cycle control device 27, the state quantity detection unit 271, the travel information detection unit 272, and the environmental information detection unit 273, but is not limited to this. For example, when a data logger or an in-vehicle communication module is mounted on the vehicle 2A, 2A, the information acquisition unit 281 may be configured to acquire a part of the operation status information from the data logger or the in-vehicle

communication module. The data logger is a device that stores various information collected from sensors and the like. The in-vehicle communication module is a device that connects the vehicle to the outside via a communication line CN or the like.

5 [0125]

In the embodiments, the information display panel 29 connected to the cycle control device 27 has the A/C display 29a and the abnormality display 29b for notifying the operating status of the refrigeration cycle device 26, but is not limited to this. As shown in FIG. 10 17, the cycle control device 27 is connected to an operation panel 30 for the user to operate the refrigeration cycle device 26. The operation panel 30 has an operation switch 31 of the refrigeration cycle device 26, a temperature adjustment switch 32, a display unit 33 for displaying various information, an operation mode changeover switch 34, and the 15 like. Therefore, the refrigerator 25 may be configured to notify the operating status of the refrigeration cycle device 26 by using the display unit 33 of the operation panel 30 instead of the information display panel 29. The mode of notifying the operating status of the refrigeration cycle device 26 is not limited to the one displayed on the display unit 20 33, and may be voiced or the like.

[0126]

In the embodiments, the interior space 22a, which is the temperature control target space, is formed as a single space with respect to the loading platform 22, but is not limited to this. In the 25 vehicle 2A, 2B, the internal space 22a of the loading platform 22 may be divided into plural spaces.

[0127]

For example, in the vehicle 2A, 2B, as shown in FIG. 18, the internal space 22a of the loading platform 22 may be divided into a 30 refrigerating chamber 22c and a freezing chamber 22d by a partition wall portion 22b. In this case, the refrigerating chamber 22c and the freezing chamber 22d can be adjusted to different temperatures by arranging the evaporators 264A and 264B whose temperatures can be adjusted independently for each of the refrigerating chamber 22c and 35 the freezing chamber 22d.

[0128]

Further, in the vehicle 2A, 2B, for example, as shown in FIG. 19, the internal space 22a of the loading platform 22 may be divided into a refrigerating chamber 22c and a warm chamber 22e by a partition wall portion 22b. In this case, it is possible to adjust the refrigerating chamber 22c and the warm chamber 22e to appropriate temperatures by arranging the evaporator 264 in the refrigerating chamber 22c and arranging the radiator 262 in the warm chamber 22e.

[0129]

Further, when the internal space 22a of the loading platform 22 is divided into plural spaces 22f and 22g, for example, as shown in FIGS. 20 and 21, the vehicle 2A, 2B may have the refrigeration cycle devices 26A and 26B corresponding to the spaces 22f and 22g respectively. In this case, the cycle monitoring device 28 transmits the operation status information of each of the two refrigeration cycle devices 26A and 26B to the information processing machine 50.

[0130]

In the embodiments, the compressor 261 is arranged on the cabin 21 side together with the engine 23, but is not limited to this. For example, when two refrigeration cycle devices 26A and 26B are mounted, as shown in FIG. 20, one compressor 261A is arranged inside the storage case 220 together with the radiator 262, the evaporator 264 and the like, and the other compressor 261B may be arranged below the loading platform 22. Further, the refrigeration cycle devices 26A and 26B may have a configuration in which one radiator 262A is arranged inside the storage case 220 and the other radiator 262B is arranged below the cabin 21. Further, the refrigeration cycle devices 26A and 26B may be configured such that one evaporator 264A is arranged inside the storage case 220 and the other evaporator 264B is arranged inside. As shown in FIG. 21, the refrigeration cycle devices 26A and 26B may be configured such that the evaporators 264A and 264B are arranged inside, respectively.

[0131]

In the embodiments, the inspection system 1 of the present disclosure is applied to a system for inspecting the presence or absence of abnormality of the refrigeration cycle device 26 included in the refrigerator 25 mounted on the vehicle 2A, 2B, but is not limited to.

The inspection system 1 of the present disclosure can also be applied to a system for inspecting the presence or absence of abnormality of the refrigeration cycle device 26 included in the refrigerator 25 mounted on a vehicle other than the vehicle 2A, 2B with the freezer.

5 [0132]

In the embodiments described above, it is needless to say that the elements configuring the embodiments are not necessarily essential except in the case where those elements are clearly indicated to be essential in particular, the case where those elements are considered to be obviously essential in principle, and the like.

10 [0133]

In the embodiments described above, the present disclosure is not limited to the specific number of components of the embodiments, except when numerical values such as the number, numerical values, quantities, ranges, and the like are referred to, particularly when it is expressly indispensable, and when it is obviously limited to the specific number in principle, and the like.

15 [0134]

In the embodiments described above, when referring to the shape, positional relationship, and the like of a component and the like, it is not limited to the shape, positional relationship, and the like, except for the case where it is specifically specified, the case where it is fundamentally limited to a specific shape, positional relationship, and the like, and the like.

20 [0135]

In the embodiments, when the external environmental information of the vehicle (for example, outside air temperature, position information) is acquired by using the sensor, the sensor is abolished and the external environmental information can be received from the server or the cloud outside the vehicle. Alternatively, it is possible to abolish the sensor, acquire related information related to the external environmental information from a server or cloud outside the vehicle, and estimate the external environmental information from the acquired related information.

25 [0136]

The controller and the method described in the present

disclosure may be implemented by a special purpose computer which is configured with a memory and a processor programmed to execute one or more particular functions embodied in computer programs of the memory. Alternatively, the controller and the method described in the present disclosure may be implemented by a special purpose computer configured as a processor with one or more special purpose hardware logic circuits. Alternatively, the controller and the method described in the present disclosure may be implemented by one or more special purpose computer, which is configured as a combination of a processor and a memory, which are programmed to perform one or more functions, and a processor which is configured with one or more hardware logic circuits. The computer programs may be stored, as instructions to be executed by a computer, in a tangible non-transitory computer-readable medium.

[0137]

(Overview)

According to the first aspect shown in part or all of the embodiments, an inspection system includes a cycle monitoring device to be mounted on the vehicle together with the refrigeration cycle device to acquire operation status information indicating an operation status of the refrigeration cycle device and transmit the operation status information to outside. The inspection system further includes an information processing machine arranged outside the vehicle to receive the operation status information from the cycle monitoring device and to inspect presence or absence of an abnormality in the refrigeration cycle device based on the operation status information. The information processing machine generates inspection data for inspecting the presence or absence of an abnormality in the refrigeration cycle device based on the operation status information received from the cycle monitoring device and inspects the presence or absence of an abnormality in the refrigeration cycle device based on the inspection data. The information processing machine transmits an inspection result regarding the presence or absence of an abnormality in the refrigeration cycle device to a predetermined information terminal.

[0138]

According to the second aspect, the information processing

machine of the inspection system has a report creation unit that creates a report data used for reporting the inspection result based on an inspection result information indicating the inspection result of the presence or absence of abnormality in the refrigeration cycle device, and stores the created report data in the information storage unit. The information terminal is configured so that report data can be acquired from the information processing machine via the information communication unit.

[0139]

Accordingly, the user can obtain not only the inspection result of the refrigeration cycle apparatus but also the report data created in a predetermined format based on the inspection result through the information terminal. For example, if a regular or irregular inspection of refrigeration cycle device is required due to the law, it is expected that the report data will be effectively used as evidence that the inspection of the refrigeration cycle device is carried out appropriately. If the report data can be used as evidence that the inspection is carried out properly, the burden on the user can be significantly reduced.

[0140]

According to the third aspect, the inspection system is configured such that the information communication unit of the information processing machine transmits at least one of the inspection result information and the report data to the information terminal in response to the request from the information terminal.

[0141]

If a large amount of information is unilaterally transmitted from the information processing machine to the information terminal, the information processing on the user side may become complicated and the burden on the user may increase. In contrast, the information processing machine is configured to transmit the inspection result information or the report data to the information terminal in response to the request from the information terminal. In this case, the user can obtain the information from the information processing machine when necessary. Therefore, the above-mentioned situation can be avoided.

[0142]

According to the fourth aspect, the inspection system is

configured such that the information communication unit of the information processing machine transmits at least one of the inspection result information and the report data to the information terminal regardless of the request from the information terminal when the information calculation unit detects an abnormality in the refrigeration cycle device. According to this, the user can know the abnormality of the refrigeration cycle device at an early stage, and it becomes easy to take measures against the abnormality of the refrigeration cycle device. [0143]

According to the fifth aspect, in the inspection system, the operation status information includes a control state information indicating a control status of a control device included in the refrigeration cycle device. The information storage unit stores a plurality of control state information after a previous inspection, and the information calculation unit specifies the control state information having a high degree of similarity with the control state information that is a basis of the inspection data used in the previous inspection. The information calculation unit carries out a present inspection using the inspection data generated based on the operation status information including the specified control state information. [0144]

According to this, the presence or absence of abnormality in the refrigeration cycle device is inspected using the inspection data generated under the condition of the control state similar to that of the previous inspection. In this case, highly accurate inspection data can be obtained without affecting the operation state of the refrigeration cycle device. This greatly contributes to improving the accuracy of inspection results. [0145]

According to the sixth aspect, the cycle monitoring device has a mode switching unit to switch an operation mode of the refrigeration cycle device, when a predetermined inspection condition is satisfied, to an inspection mode so that the control state of the control device included in the refrigeration cycle device becomes a predetermined state. [0146]

The information calculation unit identifies the operation status information when the refrigeration cycle device is in the inspection mode, from the plurality of operation status information stored in the information storage unit after the previous inspection. The information calculation unit inspects the presence or absence of an abnormality in the refrigeration cycle device using the inspection data generated based on the identified operation status information.

[0147]

In this way, highly accurate inspection data can be obtained by inspecting the presence or absence of abnormalities in the refrigeration cycle device using the inspection data generated from the operation status information in the inspection mode. Thus, the accuracy of the inspection results can be improved.

[0148]

According to the seventh aspect, the refrigeration cycle device includes a circulation circuit in which the refrigerant circulates. In addition, the operation status information includes refrigerant status data indicating a refrigerant status amount including temperature and pressure of the refrigerant circulating in the circulation circuit. The information calculation unit generates a physical quantity having a correlation with the amount of refrigerant in the circulation circuit as the inspection data by using at least the refrigerant state data, and the information calculation unit inspects a suitability of the amount of refrigerant in the circulation circuit by comparing the physical quantity with the reference data.

[0149]

The leak of the refrigerant causing environmental pollution is not preferable when, for example, a fluorocarbon-based refrigerant is used as the refrigerant of the refrigeration cycle device. Further, even when a natural refrigerant such as carbon dioxide is adopted, if the refrigerant leaks in excess of the permissible amount, it leads to malfunction of the refrigerator, which is not preferable. Therefore, the inspection of the presence or absence of an abnormality in the amount of refrigerant is important in the refrigeration cycle device.

[0150]

Since the refrigerant is invisible, it is difficult to judge the

suitability of the refrigerant amount by a simple inspection such as a visual inspection. Then, an inspection using a dedicated device for measuring the refrigerant amount is required. The implementation of the inspection regarding the suitability of the amount of the refrigerant is a factor that greatly increases the burden on the user.

[0151]

When the information processing machine is configured to inspect the suitability of the amount of refrigerant, it is possible to omit the inspection on the suitability of the amount of refrigerant on the user side, which greatly reduces the burden on the user.

[0152]

According to the eighth aspect, an information processing machine is arranged outside a vehicle to communicate with a cycle monitoring device that obtains operation status information indicating an operation status of a vapor compression refrigeration cycle device included in a refrigerator on a vehicle to transmit the operation status information to outside. The information processing machine generates inspection data for inspecting the presence or absence of abnormality in the refrigeration cycle device based on the operation status information received from the cycle monitoring device, and determines the presence or absence of abnormality in the refrigeration cycle device based on the generated inspection data. Then, the information processing machine transmits the inspection result of the presence or absence of abnormality in the refrigeration cycle device to a predetermined information terminal.

CLAIMS

1. An inspection system that inspects a vapor compression refrigeration cycle device (26) included in a refrigerator (25) on a vehicle (2A, 2B), the inspection system comprising:

5 a cycle monitoring device (28) to be mounted on the vehicle together with the refrigeration cycle device to acquire operation status information indicating an operation status of the refrigeration cycle device and transmit the operation status information to outside; and

10 an information processing machine (50) arranged outside the vehicle to receive the operation status information from the cycle monitoring device and to inspect presence or absence of an abnormality in the refrigeration cycle device based on the operation status information, wherein

 the information processing machine includes

15 an information storage unit (52) that stores the operation status information,

20 an information calculation unit (53) configured to generate inspection data for inspecting the presence or absence of an abnormality in the refrigeration cycle device based on the operation status information stored in the information storage unit, to store the inspection data in the information storage unit and to inspect the presence or absence of an abnormality in the refrigeration cycle device by comparing the inspection data with a reference data indicating a normal state or an abnormal state of the refrigeration cycle device, and

25 an information communication unit (51) that transmits an inspection result regarding the presence or absence of an abnormality in the refrigeration cycle device to a predetermined information terminal (60).

30 2. The inspection system according to claim 1, wherein

 the information processing machine has a report creation unit (54) configured to create a report data in a predetermined format for reporting the inspection result of the refrigeration cycle device based on inspection result information indicating the inspection result of the presence or absence of an abnormality of the refrigeration cycle device in the information calculation unit, and to store the report data in the

information storage unit, and

the information terminal is configured to acquire the report data from the information processing machine via the information communication unit.

5

3. The inspection system according to claim 2, wherein the information communication unit transmits at least one of the inspection result information and the report data to the information terminal in response to a request from the information terminal.

10

4. The inspection system according to claim 3, wherein

the information communication unit transmits at least one of the inspection result information and the report data to the information terminal regardless of the request from the information terminal when the information calculation unit detects an abnormality in the refrigeration cycle device.

15

5. The inspection system according to any one of claims 1 to 4, wherein the operation status information includes a control state information indicating a control status of a control device included in the refrigeration cycle device,

20

the information storage unit stores a plurality of control state information after a previous inspection,

the information calculation unit specifies the control state information having a high degree of similarity with the control state information that is a basis of the inspection data used in the previous inspection, and

25

the information calculation unit carries out a present inspection using the inspection data generated based on the operation status information including the specified control state information.

30

6. The inspection system according to any one of claims 1 to 4, wherein the cycle monitoring device has a mode switching unit (284) to switch an operation mode of the refrigeration cycle device, when a predetermined inspection condition is satisfied, to an inspection mode so that the control state of the control device included in the

35

refrigeration cycle device becomes a predetermined state,

the information calculation unit identifies the operation status information when the refrigeration cycle device is in the inspection mode, from the plurality of operation status information stored in the information storage unit after the previous inspection, and

the information calculation unit inspects the presence or absence of an abnormality in the refrigeration cycle device using the inspection data generated based on the identified operation status information.

7. The inspection system according to any one of claims 1 to 6, wherein the refrigeration cycle device includes a circulation circuit (260) in which refrigerant circulates,

the operation status information includes refrigerant state data indicating a refrigerant state amount including temperature and pressure of the refrigerant circulating in the circulation circuit,

the information calculation unit generates a physical quantity having a correlation with the amount of refrigerant in the circulation circuit as the inspection data by using at least the refrigerant state data, and

the information calculation unit inspects a suitability of the amount of refrigerant in the circulation circuit by comparing the physical quantity with the reference data.

8. An information processing machine arranged outside a vehicle (2A, 2B) to communicate with a cycle monitoring device (28) configured to obtain operation status information indicating an operation status of a vapor compression refrigeration cycle device (26) included in a refrigerator (25) on the vehicle (25) and to transmit the operation status information to outside, the information processing machine comprising:

an information storage unit (52) that stores the operation status information received from the cycle monitoring device,

an information calculation unit (53) configured to generate inspection data for determining an abnormality of the refrigeration cycle device based on the operation status information stored in the information storage unit, to store the inspection data in the information

storage unit and to inspect the presence or absence of an abnormality in the refrigeration cycle device by comparing the inspection data with a reference data indicating a normal state or an abnormal state of the refrigeration cycle device, and

- 5 an information communication unit (51) that transmits an inspection result regarding the presence or absence of abnormality in the refrigeration cycle device to a predetermined information terminal (60).